

TENDER

for

MAIN CONTRACT

of

FITTING-OUT WORKS

at

5/F (PHASE I), HEUNG TO MIDDLE SCHOOL

APRIL 2026

HEUNG TO MIDDLE SCHOOL

Employer

I ARCHITECTS LIMITED

Architect / Designer

CONDITIONS OF TENDERING

CONDITIONS OF TENDERING

1. The Tender Documents issued consist of:-
 - (a) A Tender Booklet comprises:-
 - (i) Conditions of Tendering
 - (ii) Form of Tender
 - (iii) General Conditions of Contract
 - (iv) Special Conditions of Contract
 - (v) Specification Preliminaries
 - (vi) General Specification
 - (vii) Particular Specification
 - (viii) Schedule of Rates
 - (ix) Summary of Tender
 - (x) Schedule of Drawings
 - (b) One set of Tender Drawings as listed in the Schedule of Drawings of the Tender Booklet in A3 size and in electronic copy (in compact disc).
2. The Tender to be submitted in one (1) set of hard copy and electronic copy in one (1) compact disc (i.e. CD) in a sealed envelope clearly marked with the Tender title and the words 'Tender Submission' by the Tenderer shall comprise:-
 - (a) One copy of the Tender Booklet referred to in Clause 1(a) above.
 - (b) One duplicate copy of the Form of Tender completed, signed, witnessed and dated. The total of the Summary of Tender must agree with the amount entered into the Form of Tender. In case of discrepancies, the sum given in words in the Form of Tender shall take precedence over that given in numeric.
 - (c) One copy of the following submissions required with the Tender:-
 - (i) A construction method statement and outline programme of the Works according to Clause 23 of Conditions of Tendering.
 - (ii) Project specific Quality Control and Safety Plan.
 - (iii) Details and organization chart of the proposed management and site organization including the curriculum vitae of the Tenderer's key personnel.
 - (iv) Methodology to minimize noisy works and vibration nuisance.
 - (v) The proposals for items contained in the Equipment & Delivery Schedule required under Clause 24 of Conditions of Tendering and tender information as required under Technical Specification for Building Services Works, especially a preliminary proposal of MVAC system, etc.
 - (vi) A letter of Anti-collusion Undertaking required under Clause 25 of Conditions of Tendering (Appendix COT.A).
 - (vii) Proposed List of Selected Specialist Sub-contractors (Appendix COT.C).
 - (viii) The form of Declaration of Interest as appendix to the Form of Tender duly completed and signed (Appendix FOT.A).
 - (ix) Any other details and information required by the Tender Documents.
 - (x) Company Profile.

The documents which constitute the Tender are to be enclosed in a sealed envelope labeled "**The Main Contract of Fitting-out Works at 5/F (Phase I), Heung To Middle School, 33 To Yuen Street, Kowloon**" and deposited at the time and place set out in the Invitation to Tender. In the event of part or any section of a Tender not being returned or being returned unpriced or incomplete and not in accordance with the above then such Tenders may not be considered.

3. The Tenderer shall submit a Schedule of Rates (the "Schedule") on which his Tender is based and submit this Schedule together with his Tender for the Architect's / Engineer's / Quantity Surveyor's

examination. The Tenderer is required to prepare all rates and extensions. The Tenderer shall be responsible to ensure that his Schedule is complete and cover all works called for as per the Tender requirements. The total of the Schedule must agree with the amount carried to the Summary of Tender. Any items which are not included to the Schedule but are required as per the Tender Documents for the completion of the Works shall be deemed to have been included in the tendered sum. The rates in the Schedule shall be used for the valuation of variations ordered by the Architect.

4. The Summary of Tender is to be fully priced in ink, extended, cast and totaled and the Form of Tender completed, signed, witnessed and dated. The sum shown in the Form of Tender must agree with the total of the Summary of Tender. Any items which the Tenderer considers have no value shall have dashes or other suitable marks placed against them in the cash columns. The value of any items not priced shall be deemed to be included in the tendered sum.
5. The Tendered sum will not be amended for errors found in the evaluation of tenders. The following errors should they occur in the tendered priced Schedule of Rates will be rectified and altered in red ink:-
 - (a) The rate amended to agree with the quantity and the extension in the cash column or the extension to agree with the quantity and the rate.
 - (b) Errors in casting of cash columns.
 - (c) Errors in carrying forward totals to collections or summaries.

Where a Provisional Sum or a Contingency Sum or a Prime Cost Sum has been stated in the Schedule of Rates and the Tenderer has not included it in the Tendered Sum, then the missing sum (or sums) shall be added to the Tendered Sum. In addition, allowance shall be made for profit and attendance on any missing Prime Cost Sum, at the minimum rate which has been quoted in respect of other Prime Cost sums (if any) included in the Tendered Sum. Allowance for profit and attendance shall not be made if these items are unpriced elsewhere in the Tender or if no other Prime Cost Sum is included in the Schedule of Rates.

The total error will be calculated as a plus or minus percentage of the corrected tendered sum minus the correct totals of the Preliminary items and Prime Cost and Provisional Sums (but not profit and attendance thereon), dayworks and prime cost elements within the tendered rates based on prime cost rates and will be applied to the tendered rates for the purposes of preparing Interim Payment Valuation and pricing variations. If the percentage error is less than 0.50% no adjustment will be made.

6. In the event of a Tenderer discovering a genuine error in his Tender after it has been deposited, attention in writing may be drawn to the error and an amendment submitted which, provided that the amendment shall have been deposited on or before the time fixed for receipt of Tender, may be accepted.
7. Should examination of a Tender reveal errors of such magnitude as in the opinion of the Architect / Quantity Surveyor would involve the Tenderer in serious loss then the nature and amount of such errors will be communicated to the Tenderer and he will be asked to confirm in writing that he is prepared to abide by his Tender.
8. No liability will be admitted, nor claim allowed, in respect of errors in the Contractor's Tender due to mistakes in or misinterpretation of the Tender Documents which should have been rectified in the manner described above.
9. The Tenderer shall be required to check the numbers of the pages of the Tender Documents against the page numbers given in the Contents, and should he find any missing, in duplicate, or indistinct, he must inform the Architect / Quantity Surveyor at once and have the same rectified.

10. The Tenderer shall be deemed to have made allowance in his prices generally to cover items of Specification Preliminaries and Particular Specification, any expense in connection with Provisional Sums and other items if these have not been priced against the respective items.
11. Should the Tenderer for any reason whatsoever be in doubt the precise meaning of any item or figure, he must inform the Architect / Quantity Surveyor in writing at least seven (7) days before the date for submission of Tender. Only answers in writing addressed to all Tenderers by the Architect / Quantity Surveyor shall be deemed to affect the Tender Documents. Such letters will be bound in with and shall become part of the Contract Documents.

Tenderers may send tender queries in writing via fax and post to the following parties for clarity at least seven (7) days prior to the Tender closing date:-

Architect	:	I Architects Limited
Address	:	Rm 01, 18/F, Comweb Plaza, 12 Cheung Yue Street, Kowloon
Tel	:	852-2115 8123
Fax	:	852-2115 8125
e-mail	:	info@iarchitects.com.hk
Attn	:	Mr. F. Tim CHAN

12. No unauthorized alteration or erasure to the text of the Tender Documents will be permitted. Any Tender containing such alteration or erasure may not be considered.
13. Any qualification of the Tender may cause the Tender to be disqualified.
14. Tenderers are advised to visit the Site and to make themselves thoroughly acquainted with location, general site conditions, accessibility, restrictions for loading and unloading materials, storage, working space, etc. and other conditions which may affect their Tender.
15. The Employer shall not be responsible for nor shall pay for any loss or expense incurred by the Tenderer in the preparation or submission of this Tender.
16. All Tenders shall be in Hong Kong dollars and no adjustment will be made for fluctuations in exchange rates of currencies.
17. The Tenderer shall be deemed to be in possession of a valid business registration certificate and, if necessary, be registered with the relevant Government Departments / Authorities authorizing him to carry out the works described in the Tender Documents.
18. The Employer is not bound to accept the lowest or any Tender he may receive.
19. Late Tenders will not be considered.
20. The Tenderer shall treat all documents or information passed to him by the Employer / Architect / Quantity Surveyor for the purpose of submitting this Tender as private and confidential.
21. Prevention of Bribery Ordinance

Tenderers are warned that offering or giving any gratuity, bonus, discount, bribe, loan or any other gift or consideration as an inducement or reward to any employee of Heung To Middle School in relation to this or any Heung To Middle School contracts could constitute an offence contrary to the Prevention of Bribery Ordinance Cap. 201, and that if the Tenderer was found to have made such an offer, Heung To Middle School shall be at liberty to cancel the contract and shall hold the Contractor liable for any losses or damages which Heung To Middle School may thereby sustain and in any event such action will result in the rejection of the Tender.

22. Tenderers shall inspect the Site and the existing Buildings and make all necessary investigations in order to thoroughly acquaint themselves with the location, levels, general site conditions, nature and types of renovation / redecoration works to be carried out, the locations and routing of the existing Public Utility Services, accessibility, storage and working space, restrictions for off loading debris and all other aspects which may affect the carrying out of the Works. Tenderers shall make due and proper allowance when pricing the Tenders for the information obtained or which ought to have been obtained during the site inspection and / or other investigations.

23. Construction Method Statement and Preliminary Programme of the Works

The Tenderer shall submit with his Tender a brief construction method statement and preliminary programme showing his intended method, sequence, phase and order of proceeding with the works together with the period of time for each and every phase based on the tentative site possession and commencement date for the Works for the consideration of acceptance of Tender.

The programme should clearly indicate the tentative submission and approval of sample, shop drawings etc. including for all long-term delivery items and any other related items.

24. Equipment & Delivery Schedule

- 24.1 (i) The Tenderer shall include in his Tender a Tender Equipment Schedule completed with detailed information submitted by the Specialist Sub-contractor on all items indicated in the Equipment & Delivery Schedule as attached to Technical Specification for Building Services Works for respective Building Services works and ensure that the Specialist Sub-contractor has offered the items indicated in the Tender Equipment Schedule all of which shall comply with the Specification and the Drawings and other requirements of the Contract.
- (ii) The submission of the Tender Equipment Schedule is to demonstrate the Tenderer's technical capability in selecting suitable equipment items in compliance with the contract requirements. The Tenderer shall ensure that only equipment of the correct model number, appropriate materials of construction, suitable protection against corrosion, performance quality, size, rating, etc. which are in compliance with the Specification and the Drawings and other requirements of the Contract are selected by the Specialist Sub-contractor. The proposals may be standard products of known makes, specially made or custom-built products.
- (iii) Before the acceptance of the Tender, the Employer may advise the Tenderer of any of the proposals that are unacceptable.
- 24.2 The Tenderer shall ensure that the obligations and responsibilities of the Specialist Sub-contractor under Clause 24.1 of this Conditions of Tendering are duly incorporated into the Specialist Sub-contract.
- 24.3 The Tenderer shall procure the attendance of the Specialist Sub-contractor at meetings with the Employer in respect of proposals for items offered in the Tender Equipment Schedule under Clause 24.1 of this Conditions of Tendering and allow the Specialist Sub-contractor to discuss such proposals with the Employer in his presence.

25. Anti-collusion

- 25.1 The Tenderer shall not communication to any person other than the Employer the amount of any Tender, adjust the amount of any Tender by arrangement with any other person about whether or not be or that other person should or should not tender or otherwise collude with any other person in any manner whatsoever in the tendering process until the Tenderer is notified by the Employer of the outcome of the tender exercise. Any breach of or non-compliance with this Sub-clause by the Tenderer shall without affecting the Tenderer's liability for such breach or non-compliance, invalidate his Tender.

- 25.2 Sub-clause 25.1 of this Clause shall have no application to the tender's communications in strict confidence with his own insurers or brokers to obtain an insurance quotation for computation of tender price and communications in strict confidence with his consultants or Sub-contractor's to solicit their assistance in preparation of Tender submission.
- 25.3 The Tenderer shall submit a duly signed letter in the form set out in Appendix COT.A to these Conditions of Tendering. The letter shall be signed by a person authorized to sign contracts on the Tenderer's behalf.

26. Submission of Statement

- 26.1 If the Tenderer is a partnership or an unincorporated or incorporated joint venture, each participant of the partnership or unincorporated joint venture or shareholder of the incorporated joint venture shall submit such a statement separately for each of the Statement of Convictions as required in the Tender Documents.
- 26.2 For the purpose of these Conditions of Tender, "unincorporated" and "incorporated" joint venture shall be as that defined in the Environment, Transport and Works Bureau Technical Circular No. 27/2001 (or the latest version that is effect on the Date of Invitation to Tender).

27. All quantities marked as Provisional and all Provisional Sums in the Schedule of Rates or the Summary of Tender will be adjusted in accordance with the expressed provisions of the terms of the Contract. No alteration, omission or addition to such provisional quantities, Provisional Sums and their related item descriptions shall be allowed.

28. Tender Cost

The Employer shall not in any circumstances be liable for any costs, expenses and damages incurred or suffered by the tenderers in connection with the preparation and submission of their tenders, in the event that this tender exercise is cancelled on any ground.

29. Copyright

The documents, plans, drawings or other materials forming part of the tender documents shall only be used by a tenderer or any person authorized or licensed by the tenderer for the purpose of preparing his tender. All other rights in the aforesaid materials are reserved by the relevant copyright owners. The tenderer shall be liable to the Employer for breach of the foregoing by any such person as if the breach were committed by the tenderer.

30. The Competition Ordinance

With effective form 14 December 2015, the Tenderer's attention is drawn to his obligations under the Competition Ordinance (Cap. 619) and all anti-competitive practices are strictly prohibited.

Appendix COT.A

Date:

To: Heung To Middle School

Dear Sir / Madam,

Tender for The Main Contract of Fitting-out Works
at 5/F (Phase I), Heung To Middle School, 33 To Yuen Street, Kowloon

Confirmation Letter for Compliance with Anti-collusion Clause in Tender

[I / We]¹, [*name of the tenderer*]² _____ of

[*address of the tenderer*]² _____

refer to [my / our]¹ tender for the above Contract.

[I / We]¹ confirm that as at the time of submission of this letter and other than the Excepted Communications referred to in the last paragraph of this letter [I / We]¹ had not communicated to any person other than Heung To Middle School (hereinafter referred to as the Employer) the amount of any tender, adjusted that amount of any tender by arrangement with any other person, made any arrangement with any other person about whether or not [I / We]¹ or that other person should tender or otherwise colluded with any other person in any manner whatsoever and undertake that at any time thereafter in the tendering process for the above Contract and other than the Excepted Communications referred to in the last paragraph of this letter [I / We]¹ will not communicate to any person other than the Employer the amount of any tender, adjust the amount of any tender by arrangement with any other person, make any arrangement with any other person about whether or not [I / We]¹ or that other person should tender or otherwise collude with any other person in any manner whatsoever.

In this letter, the expression "Excepted Communications" means [my / our]¹ communications in strict confidence with [my / our]¹ own insurers or brokers to obtain an insurance quotation for computation of tender price and communications in strict confidence with [my / our]¹ consultants or sub-contractors to solicit their assistance in preparation of tender submission.

(signed for and on behalf of the tenderer)

Note:

- 1. Delete as appropriate.*
- 2. Where the tenderer comprises two or more persons or companies acting in partnership, joint venture or otherwise, this part in square brackets should be expanded to include the respective names and addresses of such persons or as the case may be companies.*
- 3. Where the tenderer comprises two or more persons or companies acting in partnership, joint venture or otherwise, all such persons or as the case may be companies must sign. The signatory for each of such persons or companies shall be a person authorized to sign the contract on behalf of that person or as the case may be company.*

PROPOSED LIST OF DOMESTIC SUB-CONTRACTORS

The Main Contract of Fitting-out Works
at 5/F (Phase I), Heung To Middle School, 33 To Yuen Street, Kowloon

1. The works as stated in the Clause shall be constructed by one of the Domestic Sub-contractors hereafter lists. The Tenderer / Contractor shall hold a tender exercise inviting tenders only from these Domestic Sub-contractors.

2. Proposed List of Domestic Sub-contractors:-

The following part of the Works shall be carried out by Domestic Sub-contractors who shall be selected by the Contractor from the respective list of Approved Supplier of Materials and Specialist Contractors for Public Works (the Specialist List) of the Hong Kong SAR and / or the respective list which are subject to approval by the Architect, Building Services Engineer and Employer's Representative:-

- 2.1 Mechanical Ventilation and Air-conditioning (MVAC) Installation
- 2.2 Plumbing & Drainage (P & D) Installation
- 2.3 Aluminium Window
- 2.4 Towngas Installation
- 2.5 Electrical & ELV Installation
- 2.6 Laboratory Furniture
- 2.7 Movable Partition
- 2.8 Aluminium Ceiling
- 2.9 Fire Services System
- 2.10 Others

LIST OF DOMESTIC SUB-CONTRACTORS

The Main Contract of Fitting-out Works
at 5/F (Phase I), Heung To Middle School, 33 To Yuen Street, Kowloon

Name of Main Contractor: _____

We confirm that we will engage the following Domestic Sub-contractors selected from the approval list:-

Domestic Sub-contract

▲ Domestic Sub-contractor

Mechanical Ventilation and Air-conditioning (MVAC)
Installation

Plumbing & Drainage (P & D) Installation

Aluminium Window

Towngas Installation

Electrical & ELV Installation

Laboratory Furniture

Movable Partition

Aluminium Ceiling

Fire Services System

Others

Signed : _____
Authorized Signature

Date : _____

▲ *Note:*

- ▲ *Only one name of Domestic Sub-contractor shall be inserted for each Domestic Sub-contract.*
- ▲ *Delete the items if not applicable, or insert items if found applicable.*

FORM OF TENDER

FORM OF TENDER
FOR
THE MAIN CONTRACT OF FITTING-OUT WORKS
AT 5/F (PHASE I), HEUNG TO MIDDLE SCHOOL

Tenderer: _____

- Notes:
- (i) If a Tender is being made by a partnership or an unincorporated body, the names and residential addresses of all partners should be given in the spaces provided on page FOT/3.
 - (ii) In all cases, the Tenderer must give the number and date of the business registration certificate here:-

Business Registration

Certificate no. _____ Valid until _____

Telephone no. _____ Fax no. _____

- (iii) In all cases, the Tenderer must give the number and date of the Registered General Building Contractor or / and Class 1 Minor Works Registered Contractor under Buildings Department here:-

Buildings Department

Registration no. _____ Valid until _____

Date of Registration _____

To: Heung To Middle School

1. Having inspected the Site and surroundings, examined the Drawings, Conditions of Contract and Special Conditions of Contract, Specification and Schedules for the execution of the above-named Works, I / We offer to design (to the extent required by the Contract), execute, complete and maintain the whole of the said Works in conformity with the said Drawings, Conditions of Contract and Special Conditions of Contract, Articles of Agreement, Specification and Schedules for the sum of Hong Kong Dollars _____

(HK\$ _____) or such sum as may be ascertained in accordance with the Conditions and Special Conditions of Contract (hereinafter referred to as "the said Conditions").

2. I / We undertake if my / our Tender is accepted, to complete and deliver the whole of the Works in this Contract within the period specified in the Appendix to the Conditions of Contract or within any extended time which may be authorized under the Conditions of Contract.
3. I / We agree to abide by this Tender for a period of 90 calendar days from the date fixed for receiving the same and it shall remain binding upon me / us and may be accepted at any time before the expiration of that period.

4. Unless and until a formal Agreement is signed and executed, this Tender together with the written acceptance thereof by the Architect on behalf of the Employer, subject to the provisions of Clause 3 hereof, shall constitute a binding Contract between me / us and the Employer.
5. I / We are aware of any accept the amendment to the General Conditions of Contract as described in the Special Conditions of Contract hereinafter following.
6. I / We understand that the Employer is not bound to accept the lowest or any Tender which he may be received.

Signature (with company chop) _____

Name _____

in the capacity of _____

duly authorized to sign tenders for and on behalf of* _____

Registered address of firm _____

Witness _____

Address _____

Occupation _____

Date _____

Name of Partners+

Residential Address of Partners

* In the case of Limited Company, insert the name of the Company.

+ In the case of a partnership or unincorporated body, the names and residential addresses of all partners must be inserted.

FORM OF TENDER

DECLARATION OF INTEREST

1. *(A) I / We certify that I / member of our Directors in the company have no interest or relation with any of Heung To Middle School (HTMS) staff or through members of his family either director or indirectly.

OR

- * (B) I / We certify that I / member of our Directors in the company have interest or relation with any of Heung To Middle School (HTMS) staff or through members of his family either director or indirectly.

Name of HTMS's Staff: _____

Department of HTMS's staff: _____

Relationship (next to kin / close relatives / business associated):

Financial / Share-holding interest: _____

*** Tenderer is to delete Clause (A) or (B).**

2. I / We undertake to inform Heung To Middle School in writing immediately if any staff employed under Heung To Middle School have a conflict of interest in handling this tender and contract from my / our company.

Signature _____

in the capacity of _____

duly authorized to sign tenders for and on behalf of** _____

Registered address of firm _____

** In case of Limited Company, insert the name of the Company.

GENERAL CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT

The Conditions of Contract shall be the "Agreement and Schedule of Conditions of Building Contract for use in the Hong Kong Special Administrative Region, Private Edition – Without Quantities, 2006 Edition" published by The Hong Kong Institute of Architect, The Hong Kong Institute of Construction Managers and The Hong Kong Institute of Surveyors (hereinafter "the General Conditions").

Wherever the term "General Conditions of Contract (GCC)" is used, it refers to the "General Conditions of Building Contract" annexed to the Articles of Agreement" as described above.

Although a copy of the General Conditions of Contract is not issued with these Tender Documents, the Tenderer is advised to arrange for themselves a copy of such contract for their reference and use.

The General Conditions of Contract may be purchased from The Hong Kong Institute of Architects of 19/F, One Hysan Avenue, Causeway Bay, Hong Kong.

SPECIAL CONDITIONS OF CONTRACT

SPECIAL CONDITIONS OF CONTRACT

-	General
SCC-1	Interpretation and definitions
SCC-2	Contractor's obligations
SCC-3	Master programme
SCC-4	Not used
SCC-5	Documents forming the Contract and other documents
SCC-6	Statutory obligations
SCC-7	Not used
SCC-8	Materials, goods, workmanship and work
SCC-9	Not used
SCC-10	Not used
SCC-11	Not used
SCC-12	Architect's representative
SCC-13	Variations, Provisional Quantities, Provisional Items and Provisional Sums
SCC-14	Not used
SCC-15	Not used
SCC-16	Not used
SCC-17	Substantial Completion and defects liability
SCC-18	Partial possession by Employer
SCC-19	Assignment and sub-letting
SCC-20	Not used
SCC-21	Insurance against injury to persons or property
SCC-22	Insurance of the Works
SCC-23	Not used
SCC-24	Damages for non-completion
SCC-25	Extension of time
SCC-26	Not used
SCC-27	Direct loss and / or expense

SPECIAL CONDITIONS OF CONTRACT

SCC-28	Not used
SCC-29	Nominated Sub-contractors and Nominated Suppliers
SCC-30	Not used
SCC-31	Not used
SCC-32	Certificates and payments
SCC-33	Not used
SCC-34	Not used
SCC-35	Determination by Employer
SCC-36	Not used
SCC-37	Not used
SCC-38	Fluctuations
SCC-39	Notices, certificates and other communications
SCC-40	Not used
SCC-41	Settlement of disputes
SCC-42	Domestic Sub-contract's Warranty
SCC-43	Protection of existing services
SCC-44	Specialist Sub-contractor
SCC-45	Stop work instruction
SCC-46	Contractor's design responsibility
SCC-47	Urgent work by person other than the Contractor
SCC-48	Contracts (Rights of Third Parties) Ordinance

SPECIAL CONDITIONS OF CONTRACT

Context

General

These Special Conditions of Contract are to be read in conjunction with the Conditions of Contract which shall be the General Conditions contained in the "Agreement and Schedule of Conditions of Building Contract for use in the Hong Kong Special Administrative Region, Private Edition – Without Quantities, 2006 Edition" published by The Hong Kong Institute of Architects, The Hong Kong Institute of Construction Managers and The Hong Kong Institute of Surveyors (hereinafter "the General Conditions"). Wherever these Special Conditions vary from the General Conditions the terms of the Special Conditions shall take precedence.

Typographical Errors

The following typographical errors in the Conditions shall be corrected:-

- (a) Clause 13.4(1)(a), add the work "or" at the end of the Clause.
- (b) Clause 35.4(8) first line, the comma after the word "equipment" shall be deleted.
- (c) Clause 40(2)second line "40.1(1)" shall be changed to "40(1)".

Clause Numbering

Each SCC Clause number matches the clause number of the General Conditions clause to be amended.

SCC-1
Interpretation and
definitions

Delete Sub-clause (vii) and Clause 1.6 under the "Variation" sub-heading at Page 14 and replace with the following Sub-clause:-

"(vii) The sequence or timing of carrying out or completion work;"

SCC-2
Contractor's
obligations

Delete lines 1 and 2 of Clause 2.4(1) at Page 17 and replace with the following:-

"(1) The Contractor shall as soon as practicable but in any event within 14 days after his receipt of any of the following documents carefully check and inform the Architects if the Contractor finds any ambiguity or discrepancy in or divergence between the following documents:"

Add the following as new Clause 2.4(3):-

"(3) If in the opinion of the Architect (which shall not be exercised unreasonably) any discrepancy or divergence is one which should have been apparent to a reasonably competent contractor and notified by the Contractor in compliance with Clause 2.4(1) and if such discrepancy or divergence was not in fact notified by the Contractor; then, in determining the entitlement of the Contractor to any extension of time or any direct loss and / or expense to which the Contractor would otherwise be entitled in consequence of an instruction issued by the Architect under this Clause, the Architect shall exclude from such extension or direct loss and / or expense (as applicable) any delay or direct loss and / or expense which could reasonably have been avoided had the discrepancy or divergence been notified in accordance with Clause 2.4(1) and the Contractor's entitlements shall be limited

accordingly.

Add the following as new Clause 2.4(4):-

- "(4)(a) The Contractor shall in the course of carrying out the Works take full responsibility for the adequate stability and safety of all operations on the Site other than those of persons for whom the Employer is responsible under Clause 30.1 and have full regard for the safety of all persons on the Site.
- (b) The Contractor shall comply with the Building Ordinance, the Construction Site (Safety) Regulations, all Labour Department Regulations, all Electrical and Mechanical Services Department Regulations, the Factories and Industrial Undertaking (Safety Officers and Safety Supervisors) Regulations and all other statutory requirements regarding safety on construction sites.
- (c) The Contractor shall employ at least the number of safety officers and safety supervisors prescribed by the Factories and Industrial Undertaking (Safety Officers and Safety Supervisors) Regulations for the time being in force as at the date of the Contract. The Safety Officers shall be registered by the Commissioner for Labour under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations and any additional duties as specified in the Contract.

None of the requirements of this Clause shall in any way relieve the Contractor of his obligations under Clause 6 of the Conditions. In particular, the Contractor shall not be relieved of his obligations to employ Safety Supervisors, any additional Safety Officers and / or any other safety personnel in excess of the number required by this Clause as may be separately required by any Act or Ordinance of Government, instrument, rule, order, regulation or by-law as may be in force at any time during the progress and continuance of the Works."

SCC-3
Mater programme

At page 19 renumber existing Clause 3.3 as Clause 3.4 and insert the following new Clause 3.3:-

- "3.3 If the Contractor does not comply with the provisions of Clauses 3.1 or 3.2 to the satisfaction of the Architect, the Employer may employ and pay others to carry out such programming activities as, in the Architect's opinion, are sufficient for the Architect to monitor, update and forecast the Contractor's progress on site. All costs incurred in connection therewith shall be recoverable from the Contractor by the Employer as a debt or may be deducted by the Employer from any monies due or to become due to the Contractor under the Contract."

SCC-4

Note used.

SCC-5
Documents forming
the Contract and other
documents

Delete Clause 5.12(1) at Page 23 and replace with the following:-

- "(1) The Contractor shall submit to the Architect 2 copies of the as-built drawings which are required by the Contract, Nominated Sub-contracts or Nominated Supply Contracts within 1 month of the date when, in the Architect's opinion, substantial completion of any particular trade or portion of the Works occurred."

SCC-6 Statutory obligations	Delete Clause 6.1 at Page 24 and replace with the followings:- “6.1 The Contractor shall comply with and give the notices required by any Ordinance, regulation, rule, order or by-law applicable to the Works and any changes thereto upto and including the Date of Substantial Completion of the Works (“the Statutory Requirements”)” Delete Clause 6.3(1) and replace with the following:- “(1) The Contractor shall pay and indemnify the Employer against liability in respect of all fees or charged legally demandable or which shall become legally demandable during the course of the Works under the Statutory Requirements.” Delete Clause 6.3(2). On the sixth line of Clause 6.4(1) after “legally demandable” insert “or which shall become legally demandable”.
SCC-7	Not used.
SCC-8 Materials, goods, workmanship and work	Add the following as new Clause 8.1(7) to Clause 8.1:- “(7) Without prejudice to the generally of the foregoing, the Contractor shall carry out the Works: (a) using materials which are new, free of defects and of good quality; and (b) using methods of construction which are in accordance with sound practice and which are not likely to endanger any existing structures or finishes, adjacent property or the safety of the public.” Add the following as new Clause 8.2(4) to Clause 8.2:- “(4) Where the Specification requires any item of work to be inspected prior to being covered up, then the Contractor shall notify the Architect in writing before work is covered up and give them at least 2 full working days’ notice to inspect. Should any work be covered up without the required notice being given then, whether or not the work in accordance with the Contract, the Contractor will be responsible for all costs of the testing, opening up for inspection, and any consequential making good and the Contractor shall not entitled to any extensions of time or to any adjustment of the Contract Sum or other additional monetary compensation in respect of any delay or disruption caused thereby and such entitlement being hereby irrevocably waived.”
SCC-9	Not used.
SCC-10	Not used.
SCC-11	Not used.
SCC-12 Architect’s representative	Delete the words “to be resident on the Site” in the second line of the first paragraph of Clause 12.1 at Page 29 and replace with the following:-

"who may or may not be resident on the Site".

Add the following as new Clause 12.4 to Clause 12:-

"12.4 Not act or omission by the Architect's representative in the performance of any of his duties or exercise of any of his powers under the Contract shall in any way operate to relieve the Contractor of any of the duties, responsibilities, obligations or liabilities imposed upon him by any of the provisions of the Contract".

SCC-13
Variations, Provisional
Quantities, Provisional
Items and Provisional
Sums

Delete Clause 13.1(1) and replace with the following:-

"(1) The Architect may issue an instruction requiring a Variation."

Add the following Clause 13.4(1)(v) at Page 31:-

"(v) For work which it to be the subject of a fair valuation under Clause 13.4(1)(iii), the Contractor shall obtain, if so requested by the Architect / Quantity Surveyor, three competitive tenders, and the fair valuation shall be based upon the most competitive tender so received by the Contractor together with an adjustment of the Contractor's profit and overheads as may be agreed with the Architect / Quantity Surveyor."

Add the following to the end of Clause 13.4(3)(b) at Page 32:-

"Provided that no such adjustments shall be made if the omission of work is due to omission of work which is included in or covered by the Provisional Quantities, Provisional Items or Provisional Sums."

Add the following new Clause at the end of Clause 13.4:-

"(10) If required by the Architect, the Contractor shall within seven(7) days of the Architect's written request submit a detailed estimate of the value of any variation."

SCC-14

Not used.

SCC-15

Not used.

SCC-16

Not used.

SCC-17
Substantial Completion
and defects liability

Delete Clause 17.1 at Page 34 and replace with the following:-

"17.1 The Architect shall issue the Substantial Completion Certificate for the Works when he is satisfied that the Works have been substantially completed and have passed the inspections and tests that are required by the Contract to be carried out and completed before Substantial Completion and that any approvals, permits or temporary permits required by the Contract have been issued by the relevant authorities or, if any such approval, permit or temporary permit, remains unissued it is not as a consequence of any default if the Contractor and the (subject to any written undertaking the Architect may require) all unfinished items of work shall be completed as soon as practicable after the issue of the Substantial Completion Certificate, or as instructed by the Architect, and in any case before the expiry of the Defects Liability Period."

Replace the whole of Clause 17.3(3) by the following:-

- “(3) The Contractor shall rectify the defects specified in the schedules of defects to the Architect’s satisfaction within a reasonable time, but in any case within 60 days, after issuance of those schedules by the Architect.”

Replace the words “within a reasonable time” in Clause 17.3(4) with “within 60 days”. Add the following to the end of Clause 17.3(4):-

“If the Employer engages other persons to rectify the defects under Clause 4.3(3), the Employer shall be entitled to recover from the Contractor all costs incurred in connection herewith. The defects shall be considered as having been rectified by the Contractor and the Contractor’s liabilities under the Contract for the defective works shall not be relieved by the operation of this Clause.

Delete Clause 17.3(5) at Page 35 and replace with the following:-

- “(5) The Architect may instruct the Contractor not to rectify some or all of the defects specified in the schedules of defects in which case the Quantity Surveyor shall assess a fair value for defects not rectified and reduce the Contract Sum accordingly.”

Add the following new Clause 17.3(6) after Clause 17.3(5):-

- “(6) If in the opinion of the Architect it is more suitable and beneficial that unfinished items of work or remedial work in rectifying defects remaining after the issuance of the Substantial Completion Certificate is carried out by others, the Contractor shall undertake to reimburse the Employer the cost of carrying out such outstanding or remedial work by others or the Employer has the right to deduct such cost from payments due to the Contractor.”

Delete the word “and” at the end of Clause 17.4(b) at page 35.

Delete “.” At the end of Clause 17.4(c) and add “; and” at the end of Clause 17.4(c).

Add the following Sub-clause to the end of Clause 17.4:-

- “(d) the Contractor (or the relevant Nominated Sub-contractors / suppliers) has submitted all specified guarantees and warranties as required by the Contract and all such guarantees and warranties have been approved by the Architect.”

Add the following new clauses 17.8, 17.9 and 17.10 to Clause 17:-

- “17.8 The Works are scheduled for completion in Sections. Substantial Completion Certificates for respective sections shall be issued.
- 17.9 For the purpose of this Contract, the Defects Liability Period for all sections of the works shall be expired upon the end of twelve calendar months commencing from and including the Date of Substantial Completion of the whole of the Works, notwithstanding that earlier completed section may have been certified by the Architect as substantially completed and handed over to the Employer. The payment of one-half of the Retention shall also be released only upon the issuance of Substantial Completion Certificate for the whole of the

Works.

17.10 For the avoidance of doubt, the Contract shall always be read and construed as if all necessary amendments had been made to the documents to allow for completion of the Works in Sections."

SCC-18
Partial possession by
Employer

Delete Clause 18.1(1) and replace with the following:-

"(1) The Employer may take possession of a part of the Works or where sectional completion is provided for in the Contract a part of a Section before Substantial Completion if the Architect considers such part of the Works or part of a Section is capable of occupation or use by the Employer and that part of the Works or part of a Section shall be referred to as a Relevant Part."

SCC-19
Assignment and
sub-letting

Add the following as new Clause 19.2(g) to Clause 19.2:-

"(g) it shall be a condition in any sub-letting which may occur that the employment of the Sub-contractor under the Sub-contract shall determine immediately upon the determination (for any reason) of the Contractor's employment under this Contract."

SCC-20

Not used.

SCC-21
Insurance against
injury to persons or
property

Insert the words "the Employer", after the words "names of" in the third line of Clause 21.1(1) at Page 38.

Add the following new Sub-clause at the end of Clause 21.1:-

"(4) The Contractor shall be responsible to ensure that the persons, who are not covered in Clause 21.1(1) such as self-employed persons working in connection with the Contract, shall effect and maintain employees' compensation insurance in compliance with the provisions of the Employees Compensation Ordinance by themselves."

Add the following new Sub-clause at the end of Clause 21.2:-

"(4) The Contractor's attention is drawn to Clause 20 which sets out his contractual obligations to indemnify the Employer against certain damage, expense, liability or loss in respect of claim or proceedings. If the Contractor considers the limit of indemnity referred to in Clause 21.2(3)(c) for any one occurrence or series of occurrence of loss or damage to be inadequate to cover these contractual obligations he is at liberty to take out a policy with an increased limit of indemnity but any additional premium or differential in premium shall be at his own expense."

SCC-22
Insurance of the Works

Add the following words at the beginning of the second sentence of Clause 22.4(a) at Page 42:

"Subject to Clause 22.4(4),"

and the following word "The" shall be replaced by the word "the".

Add the following as new Sub-clause 22.4(4) to Clause 22.4:-

"(4) The Contractors' All Risks Insurance Policy shall be extended beyond the period of 14 days after the issue of the Substantial Completion Certificate required under Clause 22.4(1) above to extend the period of

cover to include the carrying out of unfinished items of works and works of repair or maintenance etc. by the Contractor, his sub-contractors and their sub-contractors of all tiers during the Defects Liability Period”.

Add the words “(less only any amount included for the professional fee as stated in Clause 22.2(b))” after the words “of the Works” in the third line of Clause 22.6.

SCC-23

Not used.

SCC-24
Damages for
non-completion

In Clause 24.2(1) at Page 45 delete the words “between the Completion Date and the Date of Substantial Completion” in the last line and replace with the words “commencing from the date by which the Architect certified the Works or Section ought to have been completed under Clause 24.1(1) upto and including the date by which they were ultimately completed as certified under the Substantial Completion Certificate”.

SCC-25
Extension of time
SCC-26

Delete Clauses 25.1(3)(m) and 25.1(3)(n) at Pages 46, 47 and 48.

Not used.

SCC-27
Direct loss and / or
expense

Delete Clause 27.1(2)(d) and 27.1(2)(h) at Pages 53 and 54.

SCC-28

Not used.

SCC-29
Nominated
Sub-contractors and
Nominated Suppliers

Delete Clause 29.2(1)(c) at Page 57.

Delete Clause 29.2(7) at Page 58.

SCC-30

Not used.

SCC-31

Not used.

SCC-32

Insert the following words at the beginning of Clauses 32.1(1) and at 32.1(5) at Pages 64 and 65:-

“Provided the Contractor complies with the requirements of Clause 32.1(4) then”

Insert the words “with copies to the Architect and the Engineer as appropriate” after the words “Quantity Surveyor” in the first line of Clause 32.1(4) at Page 64.

Add the following words to the end of Clause 32.1(5) at Page 65:-

“or such other time as may be agreed between the Architect and the Quantity Surveyor provided always that the Quantity Surveyor shall submit the valuation prior to the Architect’s due date under Clause 32.1(1).”

Delete Clause 32.3 and replace with the following:-

“32.3 For the avoidance of doubt it is confirmed that Clause 32.3 shall not be applicable to this Contract.”

Delete the words “14 days after Substantial Completion” in the third line of Clause 32.5(2) at Page 67 and replace with the words “within 14 days after the issue of the Substantial Completion Certificate”.

	At Page 68 in Clause 32.6(5) at line 1 insert the words "the Architect," before the words "the Quantity Surveyor".
	Delete Clause 32.7(3)(h)(i) at Page 70.
	Insert the word "within" before the words "28 days" in the third line of Clause 32.8(4) at Page 71.
SCC-33	Not used
SCC-34	Not used.
SCC-35 Determination by Employer	Add the following as new Sub-clause 35.1(f) to Clause 35.1:- "(f) persistently or significantly breaching his obligations under this Contract to the material detriment of the Employer." Delete the word "or" from Clause 35.1(d) and at the end of Clause 35.1(e) "." Shall be deleted and replaced by "; or". Renumber Clause 35.8 as Clause 35.9 and the following shall be inserted as new Sub-clause 35.8:- "35.8 In addition to the grounds for determination given in Clause 35 of the Conditions, the Employer shall be entitled to immediately, determine the employment of the Contractor under this Contract and the Contractor shall be liable to pay to the Employer the amount of any loss to the Employer resulting from such determination, if the Contractor has offered, given or agreed to give to any person any bribe, gift, loan or advantage of any kind as defined in the Prevention of Bribery Ordinance, Cap 201 as an inducement or reward for doing or forbearing to do or for having done or forborne to do any action in relation to the obtaining or execution of this Contract or any other contract with the Employer, or for showing or ay forbearing to show favour or disfavour to any person in relation to this Contract or other contract with the Employer, or if the like acts shall have been done by any person employed by the Contractor or acting on his behalf whether with or without the knowledge of the Contactor." In the first line of the renumbered Clause 35.9 delete the Clause reference "35.7" and replace with the Clause reference 35.8".
SCC-36	Not used.
SCC-37	Not used.
SCC-38 Fluctuations	For the avoidance of doubt it is confirmed that Clause 38 shall not be applicable to this Contract. No adjustment to the Contract Sum shall be made for any rises or falls in the cost of labour or materials, fluctuations in exchange rates, freight charges, insurance premium or for any other reasons whatsoever.
SCC-39 Notices, certificates and other communications	Delete Clause 39(3) and replace with the following:- "(3) Any notice, certificate or other communication to be given or made under the Contract shall be deemed to have been delivered: - in the case of delivery by electronic mail immediately following transmission (provided that the correct response is received by

	the sender); or,
	- in the case of delivery by facsimile machine immediately following transmission; or,
	- in the case of a document sent by post two days after the document has been posted in the case of a recipient in Hong Kong (irrespective of whether ordinary or registered post or recorded delivery is used) or seven days after the document has been posted in the case of an overseas recipient (irrespective of whether standard airmail, speedpost or any other form of airmail is used); or,
	- in the case of a document delivered by hand or courier, at the time of delivery (provided receipt is obtained noting the time of delivery)."
SCC-40	Not used.
SCC-41 Settlement of disputes	In Clause 41.3(2) and 41.4(2) at Page delete the words:- "the Hong Kong Institute of Architects co-jointly with the". Delete Clause 41.4(3) at Page 86 and replace with the following:- "The President or Vice-president referred to in Clause 41.4(2) may, at his discretion, request the Hong Kong International Arbitration Centre to appoint the arbitrator, by letter to the Chairman of that organization." Delete Clause 41.4(4).
SCC-42 Domestic Sub-contractor's Warranty	The Contractor shall, within 21 days of the date of entering into a Sub-contract with a Domestic Sub-contractor, submit a Domestic Sub-contractor's warranty executed by the Domestic Sub-contractor in the format acceptable by the Architect as required in Technical Specification and Drawings.
SCC-43 Protection of existing services	It is agreed that the Contractor shall have full responsibility for the protection of existing works, in particular the building services within the site area or locations in connection with this Contract. For any isolating, disconnecting or making inoperative in any way, any part of the utilities or the building services, the Contractor must seek for prior written approval from the Architect.
SCC-44 Specialist Sub-contractor	(1) "Specialist Sub-contractor" means and includes all specialists, merchants tradesmen and the like executing any part of the Works and / or carrying out any part of the design of the Works or supplying materials or services for the Works who shall have been or shall be selected in accordance with the provisions of the Contractor and employed by the Contractor. (2)(a) Within 28 days after the date of acceptance of the Tender, the Contractor shall resubmit for the Architect's approval the Tender Equipment Schedule. The Tender Equipment Schedule submitted under this Sub-clause shall include, in respect of each of the items indicated in the Tender equipment Schedule, either one proposal selected from the proposals made for each of the items in the Tender Equipment Schedule submitted with the Tender and which are not found to be unacceptable by the Employer pursuant to Clause 24 of the Conditions of Tendering,

or a new proposal if the proposals made for the item in the Tender Equipment Schedule submitted with the Tender are all found to be unacceptable by the Employer pursuant to Clause 24 of the Conditions of Tendering. The Architect shall give his approval provided always that the items proposed are fully in compliance with the Specification and the Drawings and the other requirements of the Contract and that such approval shall not impose any additional contractual and / or financial liabilities whatsoever on the Employer.

- (b) The list so approved by the Architect in accordance with Sub-clause (2)(1) of this Clause shall become the Agreed Equipment Schedule and shall not be amended by the Contractor without prior approval of the Architect.
- (c) If the Contractor, on the request of the Specialist Sub-contractor, wishes to amend the Agreed Equipment Schedule or to propose substituting an item with one of the other items not found to be unacceptable by the Employer pursuant to Clause 24 of the Conditions of Tendering, then the Contractor shall ensure that the Specialist Sub-contractor will provide the Architect with a detailed explanation justifying the proposed change. Provided the proposed items fully comply with the Specification and the Drawings and other requirements of the Contract and that no additional cost whatsoever is imposed on the Employer by reason of such change and that no delay to the progress of the Works or any Section thereof will be caused then the Architect shall not unreasonably withhold his approval of the change which approval should be given within 21 days of the Contractor submitting his proposal to change.
- (d) The Contractor shall indicate in the programme submitted to the Architect pursuant to Clause 3 of the General Conditions of Contract the timing and sequence of submission of his proposals for the equipment and materials as required in the equipment schedules included in the particular specifications for the Specialist Sub-contract works. The Contractor shall then, in accordance with the programme, submit for the approval of the Architect in writing the manufacturer, brand name, model number and detailed technical information for such items of equipment and materials to be offered by the Specialist Sub-contractors. Such equipment and materials shall not be delivered to site without the prior approval of the Architect.
- (e) Notwithstanding any direct dealing with and / or submissions made by the Specialist Sub-contractor to the Architect under this Clause, the Contractor shall not in any way be relieved of his obligations and responsibilities under the Contract.
- (f) Approval or order by the Architect under this Clause shall not in any way relieve the Specialist Sub-contractor of his obligations and responsibilities under the Specialist Sub-contract nor the obligations and responsibilities of the Contractor under the Contract.

SCC-45
Stop work instruction

The Architect may issue instructions suspending or stopping the Works or any part of the works for such time or times and in such manner as the Architect may consider necessary.

- (i) by reason of weather conditions affecting the safety or quality of the Works or any part thereof, or

- (ii) by reason of default on the part of the Contractor for not complying with the Architect's Specifications, Drawings and Instructions, and / or Statutory or relevant Government Authorities' requirement, or
- (iii) by reason of the noise level / nuisance produced during the course of work as complained by the Employer.

The Contractor shall upon the written instruction of the Architect suspend and stop the progress of the Works or any part thereof for such time and in the manner as contained in such instruction, and shall during such suspension or stop work properly protect and secure the Works to the Architect's reasonable satisfaction.

All costs incurred in connection with the suspension or stop work instruction shall be borne by the Contractor and no extension of time will be granted in this respect. No claim for loss and / or expenses will be entertained in connection with such stop work instruction.

SCC-46
Contractor's design
responsibility

Further to Clauses 2.1(2), any design work for which the Contractor is responsible shall be submitted to the Architect prior to execution of such work for his written confirmation that the requirements of the Employer appear to have been met, and after the Architect's confirmation the Contractor shall not vary such design without the written consent of the Architect.

All the Contractor's structural design submissions including all temporary works design shall be carried out and endorsed by a qualified engineer with the qualification of Registered Structural Engineer under the Building Ordinance.

Should the Architect make any variation of the Works, the Contract shall amend, if necessary, any design for which he is responsible, and shall obtain the Architect's written confirmation prior to execution of the varied work that such amendment appears to meet the Employer's requirements.

Without prejudice to the generality of the foregoing, the Contractor warrants that the design of the Works and the resultant work including the solution of any specification any kind or standard of materials or workmanship shall exercised with all reasonable skill and care.

The submission to the Architect of such design or amendment and the confirmation from the Architect shall not relieve the Contractor of any duty or responsibility under the Contract.

SCC-47
Urgent work by person
other than the
Contractor

If by reasons of any accident or failure or other event occurring to, in or in connection with the Works or any part thereof either during the course of the Works or during the Defects Liability Period any remedial or repair or other work shall in the opinion of the Architect be urgently necessary and the Contractor is unable or unwilling at one to do such remedial or repair or other work, the Architect may authorize the carrying out of such remedial ore repair or other work by a person other than the Contractor. If the remedial or repair or other work so authorized by the Architect's work which in the Architect's opinion the Contractor was liable to under the Contract, all expenses properly incurred in carrying out the same shall be recoverable from the Contractor by the Employer as a debt or may be deducted by him from any monies due or to become due to the Contractor under this Contract. Provided that the Architect shall as soon after the occurrence of any such emergency as may be reasonably practicable notify the Contractor thereof in writing.

Notwithstanding the requirements of Sub-clause (1) of this Clause, the Contractor shall not be relieved of his liabilities and obligations under the Contract.

SCC-48
Contracts (Rights of
Third Parties
Ordinance)

Nothing in this Contract confers or purports to confer on any third party any benefit or any right pursuant to the Contracts (Rights of Third Parties) Ordinance (Cap. 623) to enforce any term of the Contract.

Appendix SCC.A

FORM OF WARRANTY

To : Heung To Middle School
(hereinafter called "the Employer")

From : _____ (Main Contractor)
(hereinafter called "the Guarantors")

: _____ (Sub-contractor / supplier)
(hereinafter called "The Guarantors")

Project : The Main Contract of Fitting-out Works
at 5/F (Phase I), Heung To Middle School, 33 To Yuen Street, Yau Yat
Cheun, Kowloon
(hereinafter called "the Contract")

Commencement Date of the Warranty : Date of Substantial Completion of the Contract

Expiry Date of the Warranty : 1 Year(s) after Date of Substantial Completion of the Contract for
each section as stated in the Appendix of General of Conditions of Contract
(hereinafter called "the Warranty Period")

We, the undersigned parties, hereby severally and irrevocably and unconditionally warrant to the Employer, its successors and assignees the due performance of the Renovation Works installed under the Project. We warrant that the Renovation Works shall:-

"comply with & satisfy any Tender Drawings, Specifications, design & performance requirements and remain free from defects insofar as included or referred to in the Tender Drawings and Tender Documents".

during the whole Warranty Period.

We shall at our own expense rectify, make good and / or replace to the satisfaction of the Employer in accordance with the Contract all and any defects found during the Warranty Period and notified to us.

We shall rectify, make good and / or replace such defects notified to us within a reasonable time of notification, subject to reasonable access being provided to enable rectification work to be execute.

We shall indemnify the Employer against any expense, liability, loss, claim and / or proceedings whatsoever in the event of any defects occurring during the warranty period and reimburse the Employer for the reasonable and proper cost remedial works together with necessary associated expenses.

Subject to the above conditions, if we fail to rectify the defective works with due diligence, the Employer is empowered to assign other specialist to complete the remedial works of which the cost incurred will be borne by us.

The benefit of this Warranty may be assigned by the Employer to any third party at the Employer's sole discretion upon prior notice to the Guarantors.

The Guarantors shall not be release from liability under this Agreement by reason of the unenforceability, invalidity, assignment or termination of the Contract for any reason whatsoever.

This Warranty does not cover defects due to misuse, vandalism, improper maintenance, Acts of God, fair wear and tear and other causes beyond the guarantors' reasonable control / and or not forming part of the Contract which affects the integrity of the waterproofing work.

This Deed of Warranty shall be construed and governed in accordance with the Laws of Hong Kong Special Administrative Region and the Guarantors hereby agreed to submit to the non-exclusive jurisdiction of the Courts of Hong Kong Special Administrative Region.

The Common Seal of
the above named Main Contractor
was hereunto affixed in the presence of

(Date: _____)

(Main Contractor)

The Common Seal of
the above named Sub-contractor
was hereunto affixed in the presence of

(Date: _____)

(Sub-contractor)

SPECIFICATION PRELIMINARIES

INDEX

Contents

1.0 Generally

2.0 Definitions

3.0 Description of Works

- 3.1 · Scope of the Works
- 3.2 · Works to be Carried Out by Specialist / Direct Contractors Employed by the Employer
- 3.3 · Specialist Sub-contractors Employed by the Main Contractor
- 3.4 · Relationship with Specialist / Direct Contractors and Public Authorities
- 3.5 · Design Responsibility and Requirement
- 3.6 · Subsoil Conditions and Investigation Reports
- 3.7 · Initial Site Checking
- 3.8 · Existing Services
- 3.9 · Guarantee

4.0 Site of the Works

- 4.1 · Location
- 4.2 · Site Visit
- 4.3 · Access to the Site
- 4.4 · Accept Site as Found
- 4.5 · Working Area
- 4.6 · Control of Site
- 4.7 · Work outside the Site / Working Areas
- 4.8 · Weather and Underground Water Conditions

5.0 Possession, Commencement and Completion

- 5.1 · Site Handover and Possession
- 5.2 · Completion of the Works
- 5.3 · Notices for Preliminary Inspections
- 5.4 · Joint Inspections
- 5.5 · Listed Snagging and Remedial Work to be Completed before the Issue of Substantial Completion Certificate
- 5.6 · Substantial Completion

6.0 Conditions of Contract

- 6.1 · Form of Contract
- 6.2 · Appendix to the General Conditions of Contract
- 6.3 · Special Conditions of Contract amending the Standard Conditions of Contract

7.0 Tender, Drawings and Specification

- 7.1 · Tender
- 7.2 · No Adjustment for Rises or Falls in Cost of Labour and Materials
- 7.3 · Drawings used for Preparation of Tender Documents
- 7.4 · Schedule of Rates and Summary of Tender
- 7.5 · Provisional Quantities
- 7.6 · Provisional Sums
- 7.7 · Drawings, etc. at the Site
- 7.8 · Specification
- 7.9 · Shop / Installation Drawings
- 7.10 · As-built Drawings

INDEX

Contents

7.0 Tender, Drawings and Specification (Cont'd)

- 7.11 · Operating & Maintenance Manuals
- 7.12 · Dimensions
- 7.13 · Drawings, Information Required, etc.
- 7.14 · Combined and Co-ordinated Services Drawings and Combined and Co-ordinated Service Builders Works Drawings

8.0 Labour, Materials and Workmanship

- 8.1 · Labour
- 8.2 · Compliance with Regulations
- 8.3 · Samples
- 8.4 · Testing of Materials
- 8.5 · Proprietary Articles and Brand Names
- 8.6 · Quality of Materials and Workmanship
- 8.7 · Origin of Materials
- 8.8 · Safe Custody of Materials and Plant
- 8.9 · Delivery and Storage
- 8.10 · Packing, Storage and Protection
- 8.11 · Loading and Unloading of Materials
- 8.12 · Off-site Storage
- 8.13 · Ordering Materials
- 8.14 · Testing and Commissioning
- 8.15 · Rejection of Unsuitable Materials, etc.
- 8.16 · Spares Parts and Materials
- 8.17 · Warranty / Guarantee

9.0 Instruction, Variations, Method of Measurement and Valuation

- 9.1 · Site Instructions
- 9.2 · Stop Work Instructions
- 9.3 · Main Contractor's Claims for Extras
- 9.4 · Main Contractor's Expenses in Connection with Variation and Settlement of Accounts
- 9.5 · Measurement of Variations
- 9.6 · Invoices, Receipts, etc.
- 9.7 · Supportive Documentation for a Fair Valuation
- 9.8 · Daywork Claims

10.0 Programme and Reports

- 10.1 · Programme for Works
- 10.2 · Approval of Programme
- 10.3 · Daily Reports
- 10.4 · Weekly Reports
- 10.5 · Progress Photographs
- 10.6 · Site Meetings and Project Co-ordination Meeting
- 10.7 · Construction Method Statements

11.0 Statutory Obligations

- 11.1 · Regulations
- 11.2 · Working Hours, Rates of Wages, etc.
- 11.3 · Notices, Fees and Charges
- 11.4 · Site Safety Inspections
- 11.5 · Industrial Training and Pneumoconiosis Levies

INDEX

Contents

11.0 Statutory Obligations (Cont'd)

- 11.6 ▪ Illegal Immigrants
- 11.7 ▪ Restriction of Nuisance of Dust and Noise
- 11.8 ▪ Construction Waste Disposal Charging Scheme
- 11.9 ▪ Construction Workers Registration Ordinance

12.0 Safety, Health and Environment

- 12.1 ▪ Safety of Personnel Engaged
- 12.2 ▪ Compliance with Safety Regulations and Procedures
- 12.3 ▪ Safety Management
- 12.4 ▪ Provision of Safety Precautionary Measures
- 12.5 ▪ Removal of Person from Site
- 12.6 ▪ Wearing Safety Equipment
- 12.7 ▪ Emergency Procedures
- 12.8 ▪ Responsibility of Sub-contractors
- 12.9 ▪ Compliance with Ordinances and Regulations
- 12.10 ▪ Report of Accident
- 12.11 ▪ Responsibility of Main Contractor
- 12.12 ▪ Precautionary Work in Case of Fire
- 12.13 ▪ Precautionary Work in Case of Typhoon or Heavy Rain
- 12.14 ▪ Protection of Public
- 12.15 ▪ Ingredient of Materials
- 12.16 ▪ Site Health and Safety Management Committee
- 12.17 ▪ Monthly Health and Safety Report
- 12.18 ▪ Health and Safety Staff

13.0 Protection of Public Property, etc.

- 13.1 ▪ Protection of Public
- 13.2 ▪ Protection of Public Property
- 13.3 ▪ Protection of Existing Property and Adjoining Property
- 13.4 ▪ Protection of Persons and to Existing Buildings, Adjoining Property, Roads, Utilities, etc.
- 13.5 ▪ Maintenance of Existing Roads, Footpaths, Steps, etc.
- 13.6 ▪ Maintenance of Existing Services
- 13.7 ▪ Dust Suppression Measures
- 13.8 ▪ Construction Works close to Buildings, Roads and Other Structures

14.0 Insurance and Surety Bond

- 14.1 ▪ Employees' Compensation Insurance
- 14.2 ▪ Contractor's All Risks and Third Part Liability
- 14.3 ▪ Other Insurances
- 14.4 ▪ Approval of Insurance Company
- 14.5 ▪ Period of Insurance Cover
- 14.6 ▪ Main Contractor to give Notice of Injury
- 14.7 ▪ Surety Bond

15.0 Attendance and Overall Co-ordination Responsibility of Main Contractor

- 15.1 ▪ General Attendances on Nominated Sub-contractors, Nominated Suppliers, Direct Contractors and Utility Undertakers

INDEX

Contents

16.0 General Obligations

- 16.1 ▪ Overtime
- 16.2 ▪ Foreman-in-Charge
- 16.3 ▪ Detailed Safety Supervision Plan
- 16.4 ▪ Full Time Site Supervisor
- 16.5 ▪ Workmen Living on the Site
- 16.6 ▪ Watching
- 16.7 ▪ Protection and Cleaning of the Works
- 16.8 ▪ Removal of Debris during the Course of the Works and upon Completion
- 16.9 ▪ Protection of Works
- 16.10 ▪ Property belonging to the Government and Public Utility Companies
- 16.11 ▪ Preparation for Substantial Completion
- 16.12 ▪ Defects after Completion
- 16.13 ▪ Working / Access Permits
- 16.14 ▪ Workmen
- 16.15 ▪ Setting Out
- 16.16 ▪ Removal of Water
- 16.17 ▪ Effective Diversion of Storm Water
- 16.18 ▪ Removal of Underground Obstructions
- 16.19 ▪ Prevention of Mosquito Breeding
- 16.20 ▪ Bench Marks, Survey Check Points, etc.
- 16.21 ▪ Damage by Erosion
- 16.22 ▪ Protection and Cleaning upon Completion
- 16.23 ▪ Clearance of Site on Completion
- 16.24 ▪ Liability
- 16.25 ▪ Fire Protection
- 16.26 ▪ Treasure trove, coins, etc.
- 16.27 ▪ Visitors

17.0 Temporary Works

- 17.1 ▪ Plant, Tools, Scaffolding, Screens, Sheds, etc.
- 17.2 ▪ Hoardings, Screens, etc.
- 17.3 ▪ Temporary Water Supply
- 17.4 ▪ Temporary Lighting and Power
- 17.5 ▪ Main Contractor's Storage Sheds, Workshops and Offices
- 17.6 ▪ Temporary Latrines
- 17.7 ▪ Telephones for his Own Use
- 17.8 ▪ Temporary Facilities
- 17.9 ▪ Positions and all Site Offices, Temporary Latrines, Sheds, Hoists and the like
- 17.10 ▪ Restriction of Advertising
- 17.11 ▪ Notice Boards
- 17.12 ▪ Other Temporary Works
- 17.13 ▪ Electronic Submittal

Note: The Specification Preliminaries are to be read in conjunction with the Particular Specification. Whenever there is any discrepancy between the Particular Specification and the Specification Preliminaries, the more stringent requirements shall take precedence.

1.0 Generally

The Preliminaries items included herein apply to the whole of the Works and the Tender Sum shall be deemed to include for all costs in connection with such Preliminaries items, overheads, supervision and other expenses. These Preliminaries shall be deemed to apply to the whole of the Works carried out under this Contract including all variations to the Contract.

All costs in connection with such Preliminaries items, etc. included in the Tender Sum shall be at the risk of the Main Contractor and no adjustment will be made at the settlement of accounts.

The documents forming the Contract are to be taken as mutually explanatory and the Tender Sum shall be deemed to cover the complete requirements of the Conditions of Contract, Special Conditions of Contract, Contract Drawings, Schedule of Rates and Specification. In the event of any contradiction between the Specification and the Drawings, and the Specification and the Preliminaries, the Main Contractor should immediately bring same to the attention of the Architect in writing who shall decide which shall be followed.

In the event of a lump sum only being inserted in respect of this Specification Preliminaries, the Main Contractor will be required to provide an itemized breakdown of the amount so included.

In the event of the amount allowed against an item in this Specification Preliminaries for which whole payment or substantially whole payment would normally be made at the outset of the contract (e.g. insurances) being higher than the amount which the Main Contractor can substantiate, payment for the excess amount will be effected over the period of the Contract. Payment for all other lump sums included will be similarly appointed but in any event such payments will be subject to the progress of the Works being in accordance with the programme.

The Main Contractor shall be deemed to have allowed in his tender for all costs in respect of all items described in this Specification Preliminaries. In the event of no amounts being inserted by the Main Contractor in respect of any item or items in this Specification Preliminaries or the Schedule, the value thereof will be deemed to have been included in the unit rates for the Works contained in the Schedule of Rates hereinafter.

Interim payments for amounts allowed for all items in Preliminaries shall be effected over the period of the Contract in the same proportion as the value of Main Contractor's work carried out is the total value of Main Contractor's work (excluding Preliminaries) except:-

- (i) Payment of each item will not commence until the obligation arises and is being discharged.
- (ii) Payment for materials on Site shall be restricted to those materials which are to be incorporated into the permanent works. No amounts shall be included in interim certificates for hose material on Site that will be used for temporary works.

In the event of no amounts being inserted by the Main Contractor in respect of this Specification Preliminaries, no relative payment whatsoever will be included in interim payments.

2.0 Definitions

2.1 Employer

Heung To Middle School

2.2 Employer's Representative

The person appointed from time to time by the Employer to act as the Employer's Representative for the purposes of the Contract

2.3 Consultants

- a. Architect / Designer
I Architects Limited
Rm 01, 18/F, Comweb Plaza, 12 Cheung Yue Street, Kowloon, Hong Kong

2.4 Main Contractor

Whenever the term "Main Contractor" or "Contractor" appears, it shall be deemed to refer to the person or company so named in the Articles of Agreement including any of his representatives who is appointed by the Employer to design (to the extent required by the Contract), execute and complete the Works.

2.5 Nominated Sub-contractor

Whenever the term "Nominated Sub-contractor" appears, it shall be deemed to refer to the person or company so nominated by the Architect and accepted by the Main Contractor for the execution of any portion of the work as described in these documents.

2.6 Domestic Sub-contractor / Sub-contractor

Whenever the term "Domestic Sub-contractor" or "Sub-contractor" appears, it shall be deemed to refer to the person or company so employed by the Main Contractor to carry part(s) of the Main Contract Works as sub-contracted by the Main Contractor.

2.7 Specialist Contractor / Direct Contractor

Whenever the term "Specialist Contractor" or "Direct Contractor" appears, it shall be deemed to refer to the person or company so directly employed by the Employer to carry those parts of the works as described in these documents.

2.8 Specialist Sub-contractor

"Specialist Sub-contractor" means and includes all specialists, merchants, tradesmen and the like executing any part of the Works and / or carrying out any part of the design of the Works or supplying materials or services for the Works who shall have been or shall be selected in accordance with the provisions of the Contract and employed by the Main Contractor as a Domestic Sub-contractor.

2.9 Named Sub-contractor

Whenever the term "Named Sub-contractor" appears, it shall be deemed to refer to the person or company specified by the Architect, and so employed by the Main Contractor to carry part(s) of the Main Contractor Works as sub-contained by the Main Contractor.

2.10 Clerk of Works / Resident Engineer

Such members of the staff of the Employer as may be appointed.

2.11 Buildings Department / Building Authority

Whenever the term "BD" or "BA" appears, it shall be deemed to refer to Buildings

Department or Building Authority.

2.12 Making Good

The term “making good” shall be understood as including all labours and materials necessary to bring the disturbed area to the same face, colour, texture, etc., in the same materials as the surrounding work, and shall include for painting, colouring and / or varnishing any new work to match the surrounding existing work to the entire satisfaction of the Architect.

2.13 Month

The term “month” shall be regarded as meaning a calendar month.

2.14 Day

The term “day” shall be regarded as meaning a calendar day.

2.15 Approved

Terms such as “approved by”, “to approval”, “as directed” and the like, refer to approval or directions given by the Architect who will consider alternative materials and methods that the Main Contractor may propose. No such alternatives shall be adopted without the prior approval of the Architect. Any increase in cost to the Contract due to the use of any alternative materials or methods will not be entertained. Appropriate adjustment shall be made to the final Contract Sum for any cost saving in adopting the Main Contractor’s proposed alternative materials and methods. Under no circumstances shall approval relieve the Main Contractor of his responsibilities as set out in the Conditions of Contract. No approval will be binding until given in writing.

2.16 British Standard (B.S.)

Current British Standard Specification including amendments and revisions published up to the date of tender.

2.17 Code of Practice (C.P.)

Current British Standard Code of Practice including amendments and revisions published up to the date of tender.

2.18 The Authority / Authorities

The Authority shall mean the Building Authority or any Government Department or Public Utility or Statutory Undertaking or Independent Checker having jurisdiction with regard to the Works or with whose systems the same are or will be connected.

2.19 Hong Kong Government / Government

Except when the content otherwise requires, reference in the Contract and in this document to “government”, “Government”, “the Hong Kong Government” or “the Government of Hong Kong” shall be deemed to be reference to ‘the Government of the Hong Kong Special Administrative Region’.

2.20 Existing Building / Existing Properties

Wherever the term “Existing Building” or “Existing Properties” appears it refers to the existing Heung To Middle School, 33 To Yuen Street, Yau Yat Chuen, Kowloon (BD

approval plan, approved on 1994; A & A approved on 2015).

2.21 General Holidays

Wherever the term "General Holidays" is used, it refers to every Sunday and other day which is a general holiday by virtue of the Government Holidays Ordinance (Cap. 149).

2.22 Site

The land and other places on, under, in or through which the Work is to be executed and any other areas designated as storage or work areas.

2.23 Works

The term "Works" shall include both permanent and temporary works as described herein and / or shown on the Drawings and the performance of any services in connection herewith, as may be called for.

2.24 Specification

The Specification Preliminaries, Particular Specification attached hereto, General Specification referred to and any further specifications furnished to the Main Contractor as the Works proceed.

2.25 Drawings

The drawings as listed in the Schedule of Drawings, together with any modifications of such drawings and any such other drawings as may from time to time be furnished by or approved in writing by the Architect.

2.26 Utility Undertaking

Utility undertaking shall mean any person, undertaking, company, organization or government department and includes any office, division, sub-division, section, sub-section, unit or group within a government department which engages in or is so engaged in supplying or providing utilities (including electricity, lighting, traffic control, telecommunications, cable television, gas, water, drainage, sewerage and tramway) and any associated work and the supply or provision of which does not form part of the Works under the Contract, including the Contractors and Sub-contractors of any tier of such person, undertaking, company, organization or government department.

3.0 Description of the Works

3.1 Scope of the Works

The description of the scope of the Works and description of the works given hereunder must not be considered as being complete.

The Main Contractor is deemed to have studied the Particular Specification and other Sections of the Tender Documents including the Tender Drawings, etc., and visited the Site to be fully aware of the full extent of the Works.

The Works to be carried out under this Contract consist of interior fitting-out works for Integrated Science (IS) Laboratory, Biology Laboratory at 5/F (Phase I) and 2 nos. of Preparation Rooms, Heung To Middle School all in accordance with Tender Drawings and Specifications, comprising the provision of all materials, labour, plants, tackle, tools, implements, supervision and other items required for the carry out of, timely and

satisfactory completion of the Works include, but not limited to the following works:-

- a. Perform the role of Main Contractor for all Fitting-out Works and Registered Minor Works (MW) Contractor (Class 1) / RGBC, if applicable.
- b. Prepare and submit all necessary drawings and calculation under Buildings Authority's Minor Works System includes all fees for Registered Consultants, if applicable.
- c. Provide preliminaries and carry out all necessary precautionary, temporary and protective measure.
- d. Removal of existing partition walls, floor finishes, loose furniture, etc. and disconnect all wirings and drains.
- e. Erection block wall for Preparation Rooms with plaster, cement sand and paint finish.
- f. Supply and install floor finishes (vinyl) with plaster and cement sand.
- g. Supply and install wall finishes (plastic laminate and pain finish).
- h. Supply and install metal ceiling finishes (wood texture finish) including all fixing and support.
- i. Supply and install aluminium window (dark grey) with double glazed (clear glass), frame, angle lock (max. 100mm clear) and all necessary fixings.
- j. Supply and install semi-automatic movable partition with all necessary fixings and coloured finishes (red & brown) (plastic laminated finishes).
- k. Supply and install laboratories furniture with all necessary fixings.
- l. Supply and install all electrical works (track system) include but not limited to wiring ducting. Supply and install all switches and sockets.
- m. Lighting (LED) lux level required min. 600 lux in lighting provision, the contractor to demonstrate the required lux level as built.
- n. Supply and install low voltage system, such as WiFi system, telephone direct connection system, etc.
- o. To prepare and provide shop drawings such as double glazed window, electrical roller blind, electrical track system, metal ceiling / grille, semi-automatic movable partition, loudspeakers w/. microphone, and as when requires, for Architect's approval and comment.
- p. Supply and install gas system with piping and necessary support and fittings.
- q. Supply and install drainage system with piping and necessary support and fittings.
- r. Design, supply and install "intelligent system" via tablet (removable w/. permanent charging on table) to control lighting (downlight & LED strip light), electrical roller blind, fan, A/C, exhaust fan, electrical track, TV, etc. Shop drawing and information to be submitted to the Architect for approval. Only labs to apply intelligent system.
- s. Modify the fire services system to suit new layout carried out registered Fire Services Contractor. The Main Contractor to submit the name and information for the

Architect's approval and comment.

- t. Submission to and obtaining from Government Authorities approvals / consents in relation to the Works, if necessary.
- u. All other works necessary for completion of the Works, whether expressed or implied, in a proper and workmanlike manner in accordance with the Drawings and Specification.
- v. Provision of protection to existing building to ensure the safety and stability of the building.

The Named Sub-contractors are as below:

- Fire Services System
 - Company Name : Yee Fung Fire Services Engineering & Consultant Limited
 - Tel : 5616 2852
 - e-mail : raywu.yeefung@gmail.com
 - Address : Unit 16, 15/F, Block B, Tak Lee Industrial Centre,
8 Tsing Yeung Circuit, Tuen Mun, New Territories

Where to extent that design, materials, products and workmanship are not fully specified they are to be:

- I. suitable for the normal use of the Works stated in or reasonably to be inferred from the Contract, and
- II. in accordance with the General Specifications for Building, 1993 edition and all current amendment thereto, the Drawings and good building practice.

All Minor Works shall be exercised. Construction of work is clarified as Minor Works.

Exaction of the Construction Works

- I. The Contractor is required to complete all the Works. The Contractor shall indemnify and keep indemnified the Employer against all losses, claims, liabilities, and cost for violating or incomplete the above mentioned works which may arise out of or in consequence of the execution of the Works and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.
- II. For all the Construction Works, free and safe passages for people and traffic should be maintained throughout the contract period. The Works for all lobbies should be carried out in sections to allow people and traffic to pass and use at any times. Phase planning and all necessary protection measures should be submitted together with the tender for consideration and approval.

Overall construction programme taking into the above-mentioned consideration should be submitted together with this tender.

3.2 Works to be carried out by Specialist / Direct Contractors employed by the Employer

The following works shall be carried out by separate Specialist Contractors directly employed by the Employer except those specifically described on the drawings and the Tender Documents.

The aforesaid separate Specialist Contractors will carry out their works concurrently on site with this Contract. The Main Contractor shall provide attendance and facilities to the

separate Specialist Contractors for carrying out of their works.

The Main Contractor shall make due consideration in programming of his works and no claim for extra expenses or time extension in this connection will be entertained.

The Main Contractor shall allow for attendance on the Specialist / Direct Contractors in the tender.

The Main Contractor shall liaise closely from time to time with the Architect and the separate Specialist Contractors to define in detail the boundaries, working spaces, accesses, sequence of work, etc. No Claim whatsoever will be entertained if, in the opinion of the Architect, prior and more adequate liaison and planning would have prevented any disruption, damage, delay and / or additional cost to the Works. The Main Contractor shall indemnify the Employer against any valid claim by the separate Specialist Contractors against the Employer due to disruption, damage, delay and / or additional cost caused to the Specialist / Direct Contractor's works by the Main Contractor.

The Contractor shall resolve all problems with, and settle all claims against or from, the Specialist / Direct Contractors. The Employer may, but without obligation, assist in the settlement.

3.3 Specialist Sub-contractors employed by the Main Contractor

The following part of the Works shall be carried out by Domestic Specialist Sub-contractors who shall be selected by the Main Contractor and approved by the Architect.

The Main Contractor will be free to choose his own Domestic Sub-contractors for the Works, in a quality of sense will be submitted to the Architect's approval.

Once approval is given by the Architect of any Specialist Sub-contractors, the Main Contractor shall not be permitted to substitute or change the Specialist Sub-contractors without the approval of the Architect.

The Specialist Sub-contractors and any subsequently approved substitutes thereof shall be employed by the Main Contractor at his own expense and act as the Main Contractor's own Domestic Sub-contractors. The term "the Main Contractor" referred to in this Contract shall include also the Specialist Sub-contractors unless the context otherwise required. The employment of the Specialist Sub-contractors including any subsequent substitutes thereof, and the Architect's approval therefor shall not relieve or reduce in any way the Main Contractor's absolute responsibility and liability under this Contract for the care of and timely completion of the whole of the Works.

The Main Contractor shall enter into a formal Domestic Sub-contract agreement with the approved Specialist Sub-contractors for the execution of the respective part of the Works and be responsible for all works, acts, defaults and breaches by duty of any Specialist Sub-contractor or its employees or agents as fully as if they were the works, acts or defaults or breaches of duty of the Main Contractor, and he is required to co-operate fully with the Specialist Sub-contractors.

3.4 Relationship with Specialist / Direct Contractors and Public Authorities

The Main Contractor shall liaise closely from time to time with the Architect and Public authorities to define in detail the delineated working spaces, access, sequence of work, etc. No claim whatsoever will be entertained where, in the opinion of the Architect, prior and more adequate liaison and planning would have prevented any disruption, damage,

delay and / or additional cost to the Works.

The Main Contractor shall indemnify the Employer against any valid claim by Public Authorities against the Employer due to disruption, damage, delay and / or additional cost caused to Specialist / Direct Contractors or Public Authorities' works by the Main Contractor.

The Employer will not be responsible for the acts or omissions of Public Authorities or third parties carrying out work not forming part of this Contract and outside the delineated Site Area, not matter whether they are employed by the Employer or not.

The Main Contractor shall resolve all problems with, and settle all claims against or from, Public Authorities directly. The Employer may, but without obligation, assist in the settlement.

3.5 Design Responsibility and Requirement

The Main Contractor shall prepare all necessary designs (to the extent specifically required by the Contract and including that required of Specialist Sub-contractor's works), calculations, drawings, details, specifications, schedules and other documents required to satisfy the requirements of the Architect as indicated on the Contract Drawings and described by or referred to in the Specification and the requirements of the Building Authority and for the proper carrying out of the Works (including any variation thereof) to the Architect's approval and under the general direction of the Architect, but no such approval given by the Architect shall relieve the Main Contractor of his responsibility for the adequacy, safety and suitability of his designs (including any variations thereof), calculations, drawings, details, specifications, schedules and other documents.

In respect of any Main Contractor designed works, whether temporary or permanent, include in the Works, the Main Contractor shall design and construct the same to conform to the Design Intent Criteria and Performance Requirements shown on the Contract Drawing and / or described in the Specification and to fit for their intended purposes. The Main Contractor designed works shall include, but not limited to, those items of work described in the Schedule of Rates as including the design element. The Main Contractor shall prepare and submit all necessary design drawings, working drawings, calculations, method statements, product catalogues, test certificates, etc. to substantiate his design and for approval by the Architect. Any test as may be required by the Architect and / or relevant Authorities for verification of the Main Contractor's design shall also be carried out by the Main Contractor or independent bodies as directed at no extra cost and time to the Contract.

The Main Contractor shall note that the relevant drawings and specifications only define the design intent and performance requirements. The Main Contractor shall be responsible for the final design which shall comply with all requirements including but not limited to statutory submissions, approvals and consents, technical performance, physical appearance, selection of material and finishes etc.

The Architect's approval for the Main Contractor's design shall not relieve the Main Contractor of his responsibility of delivering the relevant works in compliance with the Design Intent Criteria and Performance Requirements and fir for purposes intended.

The Main Contractor shall be responsible for the design of interior fitting-out works including obtaining the approvals and respective consents from the Building Authority.

Notwithstanding Clause 4(1) of the Standard Conditions of Contract, the Main Contractor shall accept the risk of any impending legislation, new provisions, amendments to current regulations and requirements and all other conditions which may alter his obligations as

no extension of time or monetary claim whatsoever will be allowed in this respect.

The Main Contractor shall submit to the shopdrawings, calculations, etc. detailing the Contractor-designed elements to be carried out and the method to carry out these works. The Architect may approve, reject or amend such proposals, drawings, calculations, etc. If the proposal and drawings are rejected, the Main Contractor shall revise them as necessary and resubmit the revised proposals, drawings, calculations, etc. for the Architect's approval.

3.6 Subsoil Conditions and Investigation Reports

N/A

3.7 Initial Site Checking

Upon possession of the Site, the Main Contractor shall carry out a survey check of site corners and boundaries and photographic study and record a check level grid of the Site which shall be agreed between the Main Contractor and the Architect or his representative. A survey drawing and photographic record of the state of the Site shall be prepared by the Main Contractor and submitted to the Architect and Quantity Surveyor, if any, for record purposes. All costs in connection with carrying out the check survey and photographic study / record shall be borne by the Main Contractor. The site boundary survey must be prepared and endorsed by a Chartered Land Surveyor.

The Contractor is to check and satisfy himself as to the correctness of the setting out, levels, etc. of the works already carried out on Site. He shall immediately and prior to the commencement of the Works inform the Architect of any discrepancies or faults otherwise no claim will be considered for costs incurred or extension of time granted in respect of such discrepancies or faults.

3.8 Existing Services

The Main Contractor shall liaise and co-ordinate with the relevant Authorities and Utility Companies and shall ascertain from them all particulars relating to existing and proposed services work with regard to the programme and order of the execution of their work, etc. No claims for any additional work, delays and / or expense arising out of lack of liaison and co-ordination with others will be considered.

The information shown on the drawings, which should be viewed at the Architect's office by prior appointment, with regard to the layout of the existing services and proposed routes of services, are given in good faith for the Main Contractor's reference only. No monetary claim or claim for extension of time will be entertained if the actual layouts of existing / proposed services are different from that shown on the drawings and additional diversions are required.

The Main Contractor shall exercise extreme care in carrying out the works, to ensure that no damage whatsoever is caused to pipes, drains and supply cables and shall take all necessary precautions and liaise with relevant Authorities and Utility Companies in respect of programming operations, sequencing operations and in particular excavation operations. Special care should be taken in respect of excavation operation, water draw-down, site transport, storage of materials and the like. Any damage to the existing services by the Main Contractor shall be made good by the relevant Authorities and Utilities Companies all at the Main Contractor's costs.

3.9 Guarantee

In offering to execute and complete the Works comprised in this Contract based on the

Contractor's design, the Contractor is required to guarantee the design and construction of the load bearing piles, the design of the pile caps, tie and strap beams and that such design shall be adequate for the purposes as defined in the Contract. He shall undertake to make good any defects or damage to the substructure or superstructure erected thereon at his own cost. He shall also indemnify the Employer against any liability, loss, expense, claim or proceedings whatsoever arise as a result of defects or settlement of the building during or after its construction or settlement of the surrounding properties during the process of construction if such settlements are due to the failure or defects in the Contractor's design foundation system.

4.0 Site of the Works

4.1 Location

The Site of the Works is at 5/F, Heung To Middle School, 33 To Yuen Street, Yau Yat Chuen, Kowloon.

The Main Contractor's attention is drawn to the proximity of the adjacent properties, building, roadways, footpaths, lanes, etc. The Works shall not obstruct access, cause damage or cause any hazard to pedestrian, vehicular traffic, or adjacent properties, roadways, footpaths, etc.

The Main Contractor's attention is drawn to the requirement for maintaining smooth pedestrian and vehicular traffic flow along To Yuen Street at all times throughout the Contract Period. The Main Contractor shall programme his works accordingly, including the provision of safety barriers, lights, signals, signs, etc. in compliance with current requirements of appropriate authorities.

The Main Contractor shall not be permitted to utilize as works areas any areas adjacent to our outside the boundary of the Site and he shall keep his workpeople strictly within these limits. Fabrication on site of steel must be kept to a minimum and will as far as possible be carried out away from the building area.

The storage, movement or lifting of equipment, materials and plant shall at all times be confined within the prescribed boundary of the Site. Should the Main Contractor require off-site areas for storage etc., he should allow for all additional costs, including rent, in connection therewith.

Such off-site areas shall be covered by the insurance policy for the works in respect of materials for the works which are stored in them.

4.2 Site Visit

Tenderers are deemed to have visited the Site of the Works and make themselves thoroughly acquainted with the location, general site conditions, type of soil to be excavated, accessibility, existing building structure, storage space, restrictions for loading and off-loading materials, requirements, in protection of adjoining buildings and public, safe movement of traffic as required by relevant authorities, etc. and any other conditions which may affect their Tender.

The tenderer should not base solely on the drawing to establish the quantities of works under this Contract. The tenderer is advised to visit the Site to ascertain the exact quantities of works to be carried out.

No claim for extra payment or extension of the Contract Period will be allowed on the grounds of ignorance of the conditions under which the work is to be carried out.

Permission to visit the site may be obtained by prior arrangement with the Architect prior to the date fixed for return of the Tender.

4.3 Access of the Site

Access to the Site shall be by the Right of Way passing through the parking area of the adjoining building as indicated on the Drawings.

The Main Contractor should be aware that no guarantee can be given that the above access provisions are definite and fixed. However, the Main Contractor will always be provided with one access point for the full Contract Period.

The Main Contractor shall be responsible for gaining all approvals for access points from the relevant Authorities including complying with the Authorities' requirements in all respects. This shall include all necessary traffic signaling and control.

No additional expense and / or extension of time shall be granted to the Main Contractor as a result of changes in the mode of access to the Site.

The Main Contractor shall note that all existing roads whether private or public are common access roads and shall be shared with the public. The Main Contractor shall be responsible for ensuring that the roads leading to and around the Site are kept free from obstruction brought about by the Works and in no way shall cause any damage, hindrance or obstruction to traffic or ancillary works either by his own vehicles, or by his workpeople, materials, etc.

The restriction to site access imposed by the Authorities are expected to be, but may not be limited to the following:-

- a. The access is to be maintained in good condition at all times. Pavement to be kept free of irregularities, pot-holes, etc., and hollows are to be removed so that water ponding does not occur.
- b. Where a raised walking surface is provided, the change in level, if by steps, to have risers not more than 140mm and tread not less than 255mm and as approved or, if by ramping, at a gradient to be approved.
- c. Where a raised decking is to be used as a temporary walking surface for pedestrians, there is to be no stop, in the line of flow of traffic, between the beginning and end of such decking. If a change in level is required within such length, it is to be by means of a ramp suitably installed and at a gradient to be approved.
- d. Vehicles entering / leaving the Site must do so front on. Vehicles must turn around only within the Site. No backing in or out will be permitted.
- e. Crossings over footpaths are to be suitably and clearly marked and illuminated such as not only to show up the area but also to provide when required, satisfactory warning to pedestrians and users of roads that the pedestrian walkway is to be breached either by incoming or outgoing traffic and as previously agreed.

The Main Contractor shall be responsible for ensuring that he is properly authorized to cross pavements and areas and he shall give all notices, pay all fees and reinstate at his own cost all damage caused by him howsoever occurring.

- f. The access gates are to be located at the position shown on the drawing and due care must be taken to ensure the safety of pedestrians and / or vehicles using the streets. An attendant must be present when trucks are entering / leaving the Site to safeguard pedestrian traffic.
- g. Neither vehicles, equipment nor materials, which may be required for use on the Site, are to be parked, stored or left in or over the streets.
- h. No 'banking-up' of vehicles is permitted in the street.
- i. Neither water nor mud nor other offensive material is to be allowed from the Site on to the street. Where it is necessary to remove water from the Site to a stormwater gully it is to be conveyed directly to same in enclosed conduit positioned so as not to interfere with the normal traffic surface. Where it is required for such liquids to be removed from Site they must first pass through sedimentation tanks, to be operational throughout the whole period of construction.
- j. Vehicles conveying materials to or from the Site are to be properly laden and suitably equipped as to prevent spillage of materials on to the streets and / or dust into the atmosphere.

It is a specific requirement of this Contract that hoses and a water supply be provided at the Site exit point and that all mud and debris is washed from the wheels and under-sections of vehicles, before they exit the Site onto public roadways. Water from this washing operation must be properly drained from the Site.

- k. Where pollution could result from site works, suitable dampening or other effective measures are to be taken to prevent the spread of same to outside the Site.
- l. Apart from the permitted Run-in / Run-out, the line of hoarding is to be unbroken over such frontages, from end to end and from top to bottom. The exposed surface of the hoarding is to be even throughout with no rough or protruding materials which could injure pedestrians or cause damage to their clothing. It is understood that such vertical surfaces will be regularly and properly cleaned of dust / debris, etc., deposited thereon and caused as a result of the construction works or other cause.

Further, welding works are to be completely screened from pedestrians, where they are likely to otherwise cause harm / damage due to glare or falling sparks.

- m. No materials or equipment are to be placed or allowed in such a way as to intrude above the walking surface or covered walkway nor within the interior alignment of walls / framing on both sides of same.
- n. Covered walkways are to be well illuminated and to approval.
- o. The adjustments in positioning of hoarding and other works related to covered Run-in / Run-out and covered walkway are to take place after 7:00p.m. and before 8:00a.m.
- p. No lifting in to or out of the Site is to take place where loads would at any time be above a public area. Where such lifting may be required prior approval / arrangement must be made with the Hong Kong Police and other applicable authorities

- q. The Main Contractor's attention is drawn to the need for the safe arrangement of equipment such as cranes which should be suitable restrained by effective guy ropes, etc., to avoid possibility of collapse of same onto public streets and / or other areas outside the site.
- r. Every precaution is to be taken to prevent objects and / or materials in any form falling outside the Site.

Upon completion of the Works, the Main Contractor shall remove all cross-overs, scaffolding and temporary access roads formed by him including making good all works disturbed.

The Main Contractor shall be responsible for all claims, damages and costs arising from or caused by his failure to comply with the above requirements.

4.4 Accept Site as Found

The Main Contractor shall accept the Site AS FOUND on the Date for Possession of the Site and at his own expense clear the Site of any materials / items confirmed as debris by the Employer which may have been left by the Employer or previous occupants and / or contractors; and to form / level the Site where necessary to a condition suitable for the proper execution of the Works.

4.5 Working Area

The area that the Main Contractor will have for the Works will be within the area as delineated on the drawings and as designated by the Architect and the Employer. The Main Contractor must keep his workpeople, plant, material, etc. strictly within the working areas unless otherwise approved by the Architect.

Proper hoardings, fencings, etc. to the approval of the Architect must be erected around the working and / or storage areas to avoid any protrusion or other hazards to the pedestrians, occupants and properties in the existing buildings. The hoarding shall be removed at the end of the Contract Period and the working and / or storage areas cleaned and made good to the satisfaction of the Architect.

4.6 Control of Site

The Main Contractor shall be responsible for the care and control of the Site including keeping it clear of illegal occupation and illegal dumping.

The Site shall not be used for any purpose other than for executing the Works.

4.7 Work outside the Site / Working Areas

The Main Contractor shall note that there may have some works outside the Site / Working Area. For the purpose of this Contract, the areas in which these works (if any) are to be carried out shall be considered to be part of the Site / Working Area.

If any of the Main Contractor's works required in this Contract is found located outside the Site / Working Area, the Main Contractor shall make necessary arrangement to obtain the approval from the relevant Authorities concerned and the Employer for permission to work in the public area particularly. He shall conform in strict compliance with all statutory requirements and those of the relevant Authorities and shall pay all fees and charges in connection therewith (if any). The Main Contractor shall be responsible for making good and reinstating all work disturbed to match existing standard of finish at his own expense on completion of the aforesaid works.

4.8 Weather and Underground Water Conditions

The Main Contractor shall be deemed to have taken all possible weather, tides and underground water tables and conditions into account when preparing his Tender and he shall not be entitled to extra payment by reason of the occurrence or effect of change in water tables, tides, excessive rainfall, temperature or humidity, high winds, typhoons or any other meteorological phenomena.

Without limiting his liabilities under the Contract, the Main Contractor shall make suitable arrangements to protect the Works and temporary works against the effects of weather and underground water conditions.

No work shall be performed when in the opinion of the Architect such work is liable to injuriously affected by the weather. The Main Contractor shall not be entitled to extra payment on account of loss alleged to have been sustained directly or indirectly by reason of the Architect declining to permit such work to start or continue or ordering any work damaged by the weather to be made good or removed and re-executed.

5.0 Possession, Commencement and Completion

5.1 Site Handover and Possession

Tentatively the Site will be handed over to the Main Contractor within seven days of the written notice of such by the Architect which should be around May 2026.

For the purposes of this Contract the Date for Possession of the Site shall be the Date of Site Handover and the contract period shall commence accordingly.

The Main Contractor should be aware that no guarantee can be given that the above anticipated date is definite and fixed, and that a certain amount of slippage may occur. Under no circumstances will the Main Contractor be entitled to any monetary claim as a result of possession of the Site being delayed beyond the anticipated date stated above. The Date for Possession of the Site shall depend upon the obtaining of approval from the Building Authority to the Contractor-designed elements and no monetary claims shall be considered for any delay in obtaining the approval from the Building Authority to the Contractor-designed elements.

5.2 Completion of the Works

The Main Contractor's attention is drawn to the fact that the timely completion of this Contract is very critical and the whole of the Works must be completed within the time for completion stated in the Tender Documents.

The Works shall be completed within the number of calendar days stated in the Tender Documents, including Sundays and Public Holidays from and including the Date of Award of the Contract.

The Tenderer should study the drawings and specifications carefully and should clarify with the Architect any questions he may have with regard to the timely completion. The Main Contractor shall be deemed to be aware of and accept all "risks" arising out of any unfavourable or obstructions whether foreseeable or unforeseeable and the Main Contractor shall not entitle to any extension of time, extra payment of compensation in respect thereof.

The Main Contractor is fully responsible for all Nominated / Specialist / Named Sub-Contractors' works and all Suppliers' timely delivery of the contract goods for incorporating in the Works; and the completion of the Works shall also include the

completion of all Nominated Sub-Contractors' works except otherwise specified.

The Main Contractor should allow in his tender for all extra costs for overtime, provision of extra labour, protective covers and all other provisions considered necessary for the timely completion of the Works.

The time for completion of the Works is inclusive of the following:-

- a. The whole of the Works has been practically completed.
- b. Submission of Guarantees / Warranties for waterproofing, etc. as required in the Specification.

If it becomes apparent that there is any likelihood of the completion date not being met, the Main Contractor may be instructed to give precedence to the completion of part or parts of the Works. The Main Contractor shall comply with such instructions at no extra cost.

5.3 Notices for Preliminary Inspections

The Main Contractor shall notify the Architect in writing 14 days before he expects the Works as parts thereof, to be completed. On receipt of each notice the Architect shall carry out preliminary inspections to satisfy himself as to the state of completion of the Works or parts thereof.

5.4 Joint Inspections

If the Architect is satisfy with the state of completion of the Works or parts thereof, he shall arrange joint inspections to be undertaken by the Architect, Main Contractor, Sub-contractor and representative of the Employer, as appropriate. Any snagging or remedial works which have to be carried out or made good to achieve the status of Substantial Completion and which are discovered during the inspections shall be listed by the Architect.

5.5 Listed Snagging and Remedial Work to be Completed before the Issue of Substantial Completion Certificate

The Architect's list of snagging or remedial works referred to in Clause 5.6 herein shall be issued to the Main Contractor who shall complete such works to the satisfaction of the Architect before the Architect will issued the Certificate of Substantial Completion for the Works or parts thereof.

5.6 Substantial Completion

For the purposes of this Contract, the Date of Substantial Completion of each Section of the Works shall be deemed to be the date on which all the Works have been completed in accordance with the Contract and to the satisfaction of the Architect with all testing and commissioning and site clearance done and the Site ready for handover to the Employer. The Main Contractor shall be deemed to have made due allowance in his work programme for all measures, procedure and arrangements necessary for the completion of the Works on time. The Main Contractor shall carry out all necessary preparatory work well in advance of the expected Date of Substantial Completion so that inspection and handover can be achieved by the expected date.

The Main Contractor's particular attention is drawn to the following submission requirement prior to the issue of the Certificate of Substantial Completion by the Architect.

- a. All data required as evidence of satisfactory completion of all tests required on plant and equipment including a schedule of equipment to be handed over;
- b. Servicing arrangements for maintenance works during the Defects Liability Period as required;
- c. Required as-built documents and O & M manual, as-built material schedule and test reports / certificates as specified in the Specification.

6.0 Conditions of Contract

6.1 Form of Contract

The Articles of Agreement and General Conditions of Contract will be the "Agreement and Schedule of Conditions of Building Contract for use in the Hong Kong Special Administrative Region, Private Edition – Without Quantities, 2006 Edition", copies of which may be purchased from The Hong Kong Institute of Architects, together with its Appendix attached hereto the Special Conditions of Contract set out elsewhere in the documents forming the Contract.

The General Conditions of Contract may be purchased from The Hong Kong Institute of Architects, 19/F, One Hysan Avenue, Causeway Bay, Hong Kong.

"The Conditions of Contract" means the General Conditions of Contract as completed by Section 6.2 of this Preliminaries Section and as amended by the Special Conditions of Contract set out elsewhere in the Contract Documents notwithstanding that General Conditions of Contract may be / have been signed by the parties in an incomplete and / or unamended form.

The Main Contractor should study and acquaint himself with the General Conditions of Contract in conjunction with the particulars inserted in Section 6.2 of this Specification Preliminaries and the amendments made pursuant to Special Conditions of Contract as neglect or failure on his part to do so will not relieve him from complying with the said Conditions or any part thereof.

The following is a list of clause headings and the Main Contractor should allow for complying with any of the Conditions of Contract which are not described more fully elsewhere in this Preliminaries Section:-

Clause No.

1. Interpretation and definitions (amended)
2. Contractor's obligations (amended)
3. Master programme (amended)
4. Architect's instructions
5. Documents forming the Contract and other documents (amended)
6. Statutory obligations (amended)
7. Setting out the Works
8. Materials, goods, workmanship and work (amended)
9. Intellectual property rights
10. Contractor's site management team
11. Assess for the Architect to the Works
12. Architect's representative (amended)
13. Variations, Provisional Quantities, Provisional Items and Provisional Sums (amended)
14. (Not used)
15. Contract Sum
16. Materials and good on or off-site
17. Substantial Completion and defects liability (amended)
18. Partial possession by Employer (amended)
19. Assignment and sub-lettering (amended)

20. Injury to persons and property and indemnify to Employer
21. Insurance against injury to persons or property (amended)
22. Insurance of the Works (amended)
- 22A. Insurance of the Works by the Contractor
- 22B. Insurance of the Works by the Employer (amended)
- 22C. Insurance of existing building and insurance of the Works by the Employer (amended)
23. Possession, commencement and completion
24. Damages for non-completion (amended)
25. Extension of time (amended)
26. Delay recovery measures
27. Direct loss and / or expense (amended)
28. Notice of claims for additional payment
29. Nominated Sub-contractors and Nominated Suppliers (amended)
30. Persons engaged by Employer
31. Facilities for statutory undertakers and utility companies
32. Certificate and payments (amended)
33. Surety bond (amended)
34. Antiquities
35. Determination by Employer (amended)
36. Determination by Contractor
37. Determination by Employer or Contractor
38. Fluctuations (amended)
39. Notices, certificates and other communications (amended)
40. Recovery of money due to the Employer
41. Settlement of disputes (amended)

6.2 The General Conditions of Contract, refer to SPP – Appendix A.

6.3 Special Conditions of Contract amending the Standard Conditions of Contract

The following is a list of Clause headings of the Special Conditions of Contract. The Contractor shall allow here or in his rates for complying with any of these Special Conditions which are not described more fully elsewhere in these Specification Preliminaries.

SCC Clause No.

SCC-1	Interpretation and definitions
SCC-2	Contractor's obligations
SCC-3	Master programme
SCC-4	Not used
SCC-5	Documents forming the Contract and other documents
SCC-6	Statutory obligations
SCC-7	Not used
SCC-8	Materials, goods, workmanship and work
SCC-9	Not used
SCC-10	Not used
SCC-11	Not used
SCC-12	Architect's representative
SCC-13	Variations, Provisional Quantities, Provisional Items and Provisional Sums
SCC-14	Not used
SCC-15	Not used
SCC-16	Not used
SCC-17	Substantial Completion and defects liability
SCC-18	Partial possession by Employer
SCC-19	Assignment and sub-lettering
SCC-20	Not used

SCC-21	Insurance against injury to persons or property
SCC-22	Insurance of the Works
SCC-23	Not used
SCC-24	Damages for non-completion
SCC-25	Extension of time
SCC-26	Not used
SCC-27	Direct loss and / or expense
SCC-28	Not used
SCC-29	Nominated Sub-contractors and Nominated Suppliers
SCC-30	Not used
SCC-31	Not used
SCC-32	Certificates and payments
SCC-33	Not used
SCC-34	Not used
SCC-35	Determination by Employer
SCC-36	Not used
SCC-37	Not used
SCC-38	Fluctuations
SCC-39	Notices, certificates and other communications
SCC-40	Not used
SCC-41	Settlement of disputes
SCC-42	Domestic Sub-contractor's guarantee
SCC-43	Protection of existing services
SCC-44	Specialist Sub-contractor
SCC-45	Stop work instruction
SCC-46	Contractor's design responsibility
SCC-47	Urgent work by person other than the Contractor
SCC-48	Contracts (Rights of Third Parties) Ordinance

7.0 Tender, Drawings and Specification

7.1 Tender

The tender shall be "Lump Sum Fixed Price Tender" for the carrying out of the whole of the Works in conformity with the Drawings, Conditions of Contract, Specification Preliminaries, Particular Specification and the Summary of Tender.

The Tenderer must also submit together with his tender, a Schedule of Rates on which the Tender has been based, showing the quantities and rates for the works including labour charges, overheads, etc.

The Contract Sum shall be deemed to be inclusive of the cost of all ancillary and other work and expenditure, whether specifically or separately mentioned or described in the Contract or not, which are either indispensably necessary to carry out and bring to completion the relevant items of work, or which may contingently become necessary to overcome difficulties before completion.

All the work described in this Specification is to be taken as new and as including all labour, material, all cutting and waste, duties, royalties, packing freight, shipping, insurance, godown, or other storage costs, delivery to site, hoisting and fixing in the required position, plant, supervision, profit and all things and matters necessary for the carrying out of all the Works and the timely and satisfactory completion of the entire Works.

Where provisional items and provisional sums are allowed in the Schedule, these items may be omitted from the Contract if the works are not required and the sums will be expended as directed by the Architect and deducted wholly or in part if not required.

7.2 No Adjustment for Rises or Falls in Cost of Labour and Materials

There will be no adjustment to the Contract Sum for rises or falls in the cost of labour, materials or exchange rates of currencies, insurance, premiums, import and export duties, taxes and levies or any other items occurring after the date of tendering.

7.3 Drawings used for Preparation of Tender Documents

The drawings listed in the Schedule of Drawings herein have been used for the preparation of the Tender Documents.

7.4 Schedule of Rates and Summary of Tender

The Schedule of Rates prepared for the Main Contractor are for reference only and do not form part of this Contract except the unit rates therein shall form the Schedule of Rates under the Contract. The Main Contractor shall take full responsibility for the accuracy and sufficiency of the quantities and descriptions.

The quantities (except provisional quantities) in the Schedule of Rates and Summary of Tender and any statements as to quantities of work submitted by the Tenderer are at his sole risk and shall not form part of the Contract.

Should the Main Contractor wish to add more items to the Schedule of Rates, he can do so by adding appropriate items in the space provided at the end of each section. In the absence of any item in the Schedule of Rates and Quantities for the Works shown on the drawings or described in Specification, any monetary cost attributable thereto shall be deemed to have been included elsewhere in the Tender Sum.

The unit rates and / or prices inserted by the Tenderer for various items in the Schedule of Rates shall be deemed to include the costs of all incidentals of plant, labour, material, packing, cartage, moving, hoisting, lowering and fixing in the required positions, supervision, risks, overheads, profits and all other things and matters necessary for the timely and satisfactory completion of the Works.

The Tender Sum shall be deemed to have included all costs for the carrying out and completing the Works in accordance with the Conditions of Contract, Drawings and Specification.

Any works forming part of the Contract which has not been measured or allowed for in the Schedule of Rates shall not be recoverable by the Main Contractor as a variation nor as an extension of time.

The unit rates and prices in the Schedules of Rates submitted by the Tenderer shall be used for the purpose of ascertaining the prices of variations and calculation the amounts of interim payments. The pricing of variations will be strictly based on the unit rates or prices submitted and accepted.

The Main Contractor shall submit further breakdown of the Schedule of Rates if so required by the Architect or the Quantity Surveyor.

In the event that an error is made by the Main Contractor when measuring the quantities of the Works, no claim of variations and extension of times will be allowed.

Upon award of the Contract, the Schedule of Rates will be regarded as firm and will not be subject to remeasurement or adjustment whatsoever including any errors or omissions that may be detected at a later stage, otherwise than in accordance with the express provisions of the Conditions of Contract.

7.5 Provisional Quantities

The Tendered Sum shall be deemed to include for those items with quantities and marked as 'Provisional' in the Pro-form Schedule of Rates or the Summary of Tender shall be expended in whole or in part as directed by the Architect or shall be deducted from the Contract if the "Provisional" item(s) is / area not required.

Should the "Provisional" item(s) be expended in part as directed by the Architect, the Contract Sum shall be adjusted proportionally by the Quantity Surveyor in the settlement of the account.

The Works which are the subject of the provisional quantities will be re-measured upon completion of the Works and paid for at the rates contained in Schedule of Rates.

For the avoidance of doubt, the items without quantities when the unit is "ITEM" and marked as "provisional" will not be remeasured as aforesaid. The sums inserted against these "Items" will be deducted from the Contract Sum should the work described in an Item is not instructed in Architect's Instructions.

The provisional quantities are estimates only and no responsibility can be taken for their accuracy. No adjustment will be made to the Contract rates used for pricing the remeasurement bills nor extension allowed to the time for completion should the final quantities differ from the original provisional quantities. Furthermore, no claim for loss and / or expenses will be entertained in the event that the final quantities differ substantially from the original provisional quantities.

7.6 Provisional Sums

Where "Provisional Sums" appear in the Pro-forma Schedule of Rates or Summary of Tender, all amounts against such items will be deducted in full from the Contract Sum and all works carried out under such items, if any, will be valued in accordance with Clause 13.2 of the Conditions of Contract and will be added to the Contract Sum.

These provisional sums are for work to be carried out by the Main Contractor which has not been specified in detail at the time of tendering and shall be expended as directed by the Architect. These sums shall be deducted from the Contract and the works carried out as directed by the Architect shall be measured and valued in accordance with the Conditions of Contract and the value added to the Contract Sum.

7.7 Drawings, etc. at the Site

A complete set of drawings and documents approved by the relevant Authorities together with copies of all Variation Orders and any additional drawings issued after the award of the Contract shall be available on the Site at all times for reference by the Architect.

The Main Contractor shall be responsible for checking through the construction drawings to ensure that they contain sufficient information and details for the execution and completion of the Works. Should the Main Contractor discover in the course of construction that additional information or detailed drawings are necessary, except those drawings to be furnished by himself, he is to inform the Architect in writing at least two (2) weeks before such information or detailed drawings are required as no claims for delay or whatsoever will be permitted due to the non-availability of such information or detailed drawings in time for the execution of the Works on account of the Main Contractor's failure so to inform the Architect in writing.

The drawings and documents shall be stored in a neat and orderly manner.

7.8 Specification

The Specification for the Works comprises the following:-

- a. This Specification Preliminaries Section including Appendices as listed in the Contents of the Tender Documents;
- b. Particular Specification including Appendices and schedules as listed in the Contents of the Tender Documents;
- c. General Specification issued by the Architectural Services Department (ASD) and all current amendments:-
 - i. The General Specification for Building 2012 Edition (or the latest Edition);
 - ii. The General Specification for Air-condition, Refrigeration, Ventilation and Central Monitoring and Control System Installation in Government Buildings for the Hong Kong SAR (2012 Edition) (or the latest Edition);
 - iii. The General Specification for Electrical Installation in Government Buildings of the Hong Kong SAR (2012 Edition) (or the latest Edition);
 - iv. The General Specification for Plumbing and Drainage Installation in Government Buildings of the Hong Kong SAR (2012 Edition) (or the latest Edition);
 - v. The General Specification for Fire Service Installation in Government Buildings of the Hong Kong SAR (2012 Edition) (or the latest Edition);
 - vi. Testing and Commissioning Procedure for Air-conditioning, Refrigeration, Ventilation and Central Monitoring and Control System Installation in Government Buildings of the Hong Kong SAR (2012 Edition) (or the latest Edition);
 - vii. Testing and Commissioning Procedure for Electrical Installation in Government Buildings of the Hong Kong SAR (2012 Edition) (or the latest Edition);
 - viii. Testing and Commissioning Procedure for Fire Services Installation in Government Buildings of the Hong Kong SAR (2012 Edition) (or the latest Edition);
 - ix. Testing and Commissioning Procedure for Plumbing and Drainage Installation in Government Buildings of the Hong Kong SAR (2012 Edition) (or the latest Edition);
- d. Other requirements, specification and proforma specification as directed by the Employer or the Architect.

In case of any discrepancy between the General Specifications and the Particular Specifications, the Particular Specifications shall take precedence unless otherwise instructed by the Architect.

In case of any discrepancy between the Particular Specifications and the Specification Preliminaries, the most onerous one shall take precedence unless otherwise instructed by the Architect.

Unless otherwise stated in the Specification, all clauses specifying materials, fittings, etc. are to be read as implying that such materials, fittings, etc. are to be supplied and fixed by the Main Contractor.

The Main Contractor shall allow in his rates for complying with the requirements of the Specification.

The Specifications and the Drawings are to be used jointly and anything not specifically

mentioned in either but necessary for the fulfillment of the guarantees and requirements called for in the Main Contract, or necessary for the proper working of the systems to the satisfaction of the Architect is to be provided under the Main Contract.

In case of any discrepancy between the Drawings and Specifications, this shall be referred to the Architect whose decision as to which shall be followed shall be final.

The Main Contractor shall be deemed to have carefully examined the Specification attached to these documents which is the Specification referred to in the Articles of Agreement and Conditions of Contract. For the purpose of this Contract, the Specification, including the Specification Preliminaries, included in this document should be deemed to be the Specification.

The Main Contractor shall note that any references to British Standard Specification in this Contract shall be in respect of the latest version published in Metric Units.

The Main Contractor shall allow here or in the rates for any expense which may be incurred in complying with any Specification Clauses not hereinbefore / hereinafter specifically mentioned and which the Main Contractor deems to impose a financial obligation.

7.9 Shop / Installation Drawings

The Main Contractor shall submit detailed shop drawings, such as double glazed window, electrical roller curtain, electrical track system, metal ceiling / grille, semi-automatic movable partition, and as when requires, showing manufacturing or fabrication details of major components, fittings and equipment for design & built works, builder's works and M&E services to the Architect for approval.

The Main Contractor shall also submit detailed installation drawings for builder's works to show his intended fixing or interface details which have not been sufficiently detailed on the Tender Drawings to the Architect for approval.

The general schematic drawings for M&E services and plumbing and drainage works supplied as part of the Tender Documents were provided for the Main Contractor's guidance and information when tendering. Should be arrangement and dimensions shown be inadequate for the Main Contractor to properly install the system as specified, he shall have drawn the Architect's attention to the face at the time of submitting his Tender, together with details of amendments required. The final detailed dimensions will be subject to confirmation by the Architect. Any claim as a result of failure by the Main Contractor to implement this Clause will not be entertained.

The Main Contractor shall submit the details of the pipe run, duct run, conduit run, cable route, location of trunking, riser and samples proposed to be used with technical data to the Architect for approval. The Main Contractor shall as soon as possible and before the relevant work proceeds, prepare and submit for approval detailed INSTALLATION DRAWINGS, taking into account any modifications either to the building or the installation which may have take place and correctly related to the details of the actual items of plant and equipment to be installed. The Main Contractor shall similarly prepare all necessary schedules of equipment etc. and also all necessary wiring diagrams, both internal wiring diagrams for items of electrical equipment and diagrams showing the interconnections between different items. All installation drawings shall be prepared to a scale of 1:100 for all services in the building and of 1:20 for all plant rooms and similar spaces.

The Main Contractor shall carry out site survey of the existing services, installation and building and incorporate them into the shop or installation drawings.

All shop or installation drawings shall be well coordinated amongst the various trades of builder's works and M&E services.

The Main Contractor shall propose details of the openings for services penetration and installation. These information shall be shown on the shop or installation drawings and submitted for approval.

Three sets of all such shop or installation drawings, schedule, diagrams, etc. shall be submitted within seven days of the award of the Contract or before the relevant work is put in hand to the Architect for approval in writing. After approval, up to six of all such approved drawings or schedules shall be supplied by the Main Contractor to the Architect for his own use and distribution.

The Architect may reject, approved or amend such shop drawings. No claim will be accepted for disapprovals or amendment required by the Architect.

The approval by the Architect of any such drawings shall not relieve the Contractor of his duties and responsibilities under this Contract.

7.10 As-built Drawings

Upon the completion of the Works, the Main Contractor shall prepare and submit final record plans, as-built drawings, working records, etc. and to provide other factual information regarding all aspects of the Works as constructed including any variations to and / or departures from the Contract Documents.

Such record drawings, as-built drawings, working records, etc. shall include the necessary information as required by the Architect and shall be in a format in compliance with the approved by the Architect.

The Main Contractor shall note that the submission of as-built drawings to the satisfaction of the Architect is pre-requisite for the issue of the Certificate of Substantial Completion of the Works.

7.11 Operating & Maintenance Manuals

Within 1 month from the Contract completion date / extended contract completion date, the Main Contractor shall submit both soft copy and hard copies (4 sets A4 size) of the approved operating & maintenance manuals of the whole M&E services, plumbing and drawing works and other fittings or equipment having operable parts for the Architect's retention.

7.12 Dimensions

Figured dimensions are to be taken in preference to scaled in all cases. Before commencing any work or ordering any materials the Main Contractor must verify all measurements. If any discrepancies are found, they must be brought to the notice of the Architect immediately who shall give instructions to the Main Contractor to resolve the matter.

7.13 Drawings, Information Required, etc.

The Main Contractor shall be responsible for the proper working of the M&E services and plumbing and drainage works to produce the specified design conditions to the complete satisfaction of the Architect and shall be responsible for compliance with all tests called for in the Specification or required by the Architect.

Although the Tender Drawings show considerable detail and dimensions, no warranty or representation is given by the Architect as to the accuracy of such dimensions or the adequacy or build ability of such details.

The Tenderer shall carefully examine the Tender Drawings and Specification, and allow for developing the Tender Drawings into shop or installation drawings and for carrying out the Works to meet the requirements set out in this Specification and all other relevant criteria. Should the Main Contractor find that the fitting or equipment specified in any way varies from what he can economically supply, or that the headrooms, clearances, etc. shown on the Tender Drawings, cannot fulfil the requirements set out in the Specification, he shall raise queries with the Architect 7 days before submitting the tender and shall include a list of such items in his tender, clearly stating the Tenderer's opinion that such a difference exists, otherwise the Main Contractor will be held responsible for the complete development of the design of the work covered by this Contract.

Any instructions, drawings, levels or other information relating to the Works which are requested by the Architect must be provided in due time so as not to cause any disruption or delay to the Works or other works for the same Project.

The Main Contractor must ensure that his work is not undertaken as to cause the minimum disturbance, delay or disruption to other contractors on site.

7.14 Combined and Co-ordinated Services Drawings and Combined and Co-ordinated Service Builders Works Drawings

The Main Contractor may be provided by the Architect with one set of Co-ordination Drawings for all areas prepared by the Building Services Engineer. The Drawings, if issued will not be comprehensive and shall be regarded as being for reference only to indicate design intent or specific design limitation and shall be issued at the discretion of the Architect.

The Main Contractor shall be responsible for the preparation, co-ordination and submission of Combined Services Drawings, and Combined and Co-ordinated Services Builder's Works Drawings as required under the Contract.

The minimum scale of the Working and Shop Drawing shall be as follows:-

Floor Plans	: 1:50
Sections	: 1:30
Details	: 1:10

The minimum scale for Combined and Co-ordinated Services Drawings shall be as follows:-

Floor Plans	: 1:100
Sections	: 1:50
Details	: 1:20

Based on the drawings and issued by the Architect, the Co-ordination Drawings for all areas prepared by the Building Services Engineer and information pertaining to installation details, the Main Contractor shall check and incorporate all the services together and prepare the combined and Co-ordinated Services Drawings and the Combined and Co-ordinated Services Builders Works Drawings which shall cover all areas of the Works. Location and routing of all services shall be properly dimensioned to avoid conflicts and to ensure compliance with appearance, installation, maintenance and access requirements.

The Main Contractors shall be responsible for ensuring that the co-ordination between the existing building services system and the works by Main Contractor so that the

interfacing works are carried out correctly and efficiency. In the event that any conflicts exist between various services having been built and notwithstanding the Architect's approval of the working and shop drawings, any cost incurred in dismantling, re-positioning or re-routing as a result of poor co-ordination by the Main Contractor, will be borne by the Main Contractor. No extension of time will be entertained due to the Main Contractor's failure in co-ordination.

Checking of the building services working drawings or co-ordinated drawings by the Architect shall not relieve the Main Contractor of his responsibility for the technical, dimensional and co-ordinated content of these drawings, all in accordance with the Architect's design drawings and specification and in observation of all relevant standards, codes and ordinances.

When complete adequate sets of the Combined and Co-ordinated Services Drawings shall also be submitted to the Architect for review and when found acceptable, a corresponding set of drawings shall be submitted for endorsement.

Upon endorsement by the Architect the set of drawings shall be returned to the Main Contractor. The Main Contractor shall then distribute one set of prints of each Building Services Sub-contractor and adequate sets of prints to the Architect. The Sub-contractors shall be required by the Main Contractor to execute the works in accordance with these drawings.

Should any changes in services layout be required by the Architect, the Combined Services Drawings shall be amended by the Main Contractor in accordance with the procedure as set out above with no extra payment for drawing and production as required.

8.0 Labours, Materials and Workmanship

8.1 Labour

The Main Contractor and, for the avoidance of doubt, all his Sub-contractors of any tier shall provide and employ on the Site in connection with the execution and maintenance of the Works:

- a. only such technical assistants as are skilled and experienced in their respective callings and such sub-agents, foremen and leading hands as are competent to give proper supervision to the work they are required to supervise; and
- b. such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely execution and maintenance of the Works.

The Architect shall be at liberty to reject and require the Main Contractor and any Sub-contractor to remove forthwith from the Site any person employed by the Main Contractor or by a Sub-contractor who in the opinion of the Architect misconducts himself or is incompetent or negligent in the proper performance of his duties or whose employment is otherwise considered by the Architect to be undesirable and such person shall not be again employed upon the Works without the written permission of the Architect.

Any person so removed from the Site shall be replaced as soon as possible by a competent substitute approved by the Architect.

8.2 Compliance with Regulations

The Main Contractor shall comply with all regulations and requirements including those of

the Government of Hong Kong Special Administrative Region, the Hong Kong Fire Services Department, the Buildings Department and all other relevant Government Departments, Utility Companies and shall be responsible for giving notifications to the appropriate Authorities and for paying all fees levied.

The Main Contractor shall accept the risk of any impending legislation, new provisions, amendments to existing regulations and requirements and all other conditions which may alter his obligations as no claims or compensation whatsoever will be allowed in this respect.

Wherever possible, without conflict with the above, the works shall also comply with the relevant "British Standard Specifications" and the "British Standard Codes of Practice" together with any amendments made thereto.

8.3 Samples

The quality of materials and articles supplied for any purpose are to be approved by the Architect prior to their use in the Works. Wherever practicable samples are to be submitted for approval before bulk supplies are delivered to the Site. Approved samples are to be kept on Site to serve as standards for the materials or goods represented by the samples. Samples, and any packing for same, are to be provided free of charge by the Main Contractor.

The Main Contractor shall submit or provide for approval sample panels / specimens of floor, wall and ceiling finishes, doors and ironmongery, joinery work, painting, tiling, metal works, etc. before processing with ordering of materials or commencement of the work.

The Main Contractor shall submit all samples, etc. in sufficient time to allow the Architect to make the necessary decisions / approvals. The Main Contractor shall also make due allowances in his submissions programme for manufacturing periods, delivery schedules, etc.

Should any materials or article be rejected it shall be removed from the Site at the Main Contractors' expense.

The Main Contractor shall provide samples / prototype of workmanship for all trades and obtain the Architect's approval prior to commencement of each trade.

All subsequent workmanship shall be to the standard of the approved samples.

The approval of the Architect of any samples shall not relieve the Main Contractor of his duties and responsibilities under this Contract.

8.4 Testing of Materials

The Main Contractor shall carry out all tests on all materials and works required by the Contract at the Main Contractor's own expense and shall pay all charges in connection with tests and the test certificates ordered by the Architect to be carried out by others. The Main Contractor must make due allowances in his programme for testing of materials and submission of test reports / certificates.

All cost and expenses in connection with such test including testing equipment and apparatus, addition material and labour, transportation to laboratories, laboratory charges and preparation of reports, etc. shall be deemed to be included in the Tendered Sum.

The Main Contractor shall submit to the Architect the necessary record plans, certificates, testing reports and duly signed forms as required by the local regulations and / or instructed by the Architect, for record purposes and for onward submission to the Building Authority and other relevant Government departments.

The record plans, certificates, testing reports and duly signed forms submitted by the Main Contractor to the Architect shall be with sufficient details and format of acceptable standard and shall be immediately presentable to the Building Authority and other relevant Government departments after checking by the Architect. Should any of the reports submitted by the Main Contractor be rejected by the Architect or subsequently by the Building Authority or relevant Government departments, the Main Contractor shall resubmit the rejected items to the satisfaction of the Architect, Building Authority and / or relevant Government departments. No extension of time or cost compensation shall be granted to the main Contractor for such resubmission work and any delay to the works as a result of the resubmission. The Main Contractor shall also be responsible to take remedial action as required by the Architect and / or the Building Authority as a result of unsuccessful tests and / or defective works. No extension of time and / or extra cost will be granted under such circumstances.

8.5 Proprietary Articles and Brand Names

Where phrases such as "or approved equal" or "other approved" or "other equal and approved" or "or approved equivalent" or similar phrases follow proprietary articles or brand names in the Specification, such phrases are deemed to be included in the relevant descriptions in the pro-forma Schedule of Rates and the Summary of Tender.

Should the Main Contractor wish to propose alternative materials to those proprietary articles specified in the Tender Documents, he shall ensure that the class or quality of the materials, goods and workmanship for the alternative materials should be of equal quality to be specified proprietary articles. The Main Contractor shall state the manufacturer's and supplier's name, the article reference and model numbers for such alternatives together with the unit prices and the cost effect to the tender sum in a covering lettering accompanying his tender. The Main Contractor shall also submit with his tender catalogues and other detailed documentary evidence – physical property or technical data or samples to the approval and satisfaction of the Architect showing that the alternatives offered comply with the Specification and Drawings and to be of equivalent standard as the tender specified product.

Approval of the use of these proposed alternative materials is at the sole discretion of the Architect.

During the course of the Contract, the Main Contractor shall only be allowed to use further alternative materials to those specified in the Contract Documents or to those approved at the tender submission stage if it can be proved to the satisfaction of the Architect that the specified or approved materials have gone out of production during the post-Contract Period. The alternative materials proposed will be subject to the approved in the post contract stage are lower in cost, corresponding reductions to the Contract Sum shall be made by the Architect / the Quantity Surveyor to reflect the saving made. Should the alternative materials approved in the post contract stage be more expensive, no adjustment will be made to the Contract Sum.

The Architect's decision as to whether the alternative materials and workmanship are equal to those originally specified or approved at the tender submission stage shall be final.

Notwithstanding the above, it is the Main Contractor's responsibility to ensure that all the materials offered by him and approved by the Architect can be delivered to Site in

accordance with his programme work. Any delay in the delivery will not be considered as a ground for extension of time or for the Employer to accept alternative materials offered by the Main Contractor.

8.6 Quality of Materials and Workmanship

The whole of the materials, goods and workmanship, shall be consistent with good building practice in Hong Kong and shall be fit for the intended purpose.

8.7 Origin of Materials

All materials incorporated in the permanent work are to be new and of the best quality obtainable. The Main Contractor should ensure the quality and property of which must suit for their intended purpose. The origin of all materials shall be approved by the Architect. The Architect shall be sole judge as to what materials are of the specified quality and suitable for use in the work.

8.8 Safe Custody of Materials and Plant

The Main Contractor shall be responsible for the safe custody of all materials delivered on to the Site. He will be required to reinstate at his own expense any such materials that may be lost or stolen.

The Main Contractor will also be required to reinstate at his own expense any materials or article damaged by careless handling or storage or inferior workmanship by his workmen either in the original fixing or in the subsequent taking down and refixing thereof.

8.9 Delivery and Storage

The Main Contractor shall deliver the goods to the Site at the times and in the quantities in accordance with the approved programmes. The Main Contractor shall provide justification that the storage activities was capable by the existing structure if heavy storage was anticipate or on request of the Architect. Every necessary precaution shall be taken to avoid premature or late delivery of the goods and excess loading to the existing building.

Should the goods be delivered to Hong Kong prior to the schedules time and no storage space on Site is available, the Main Contractor shall arrange for proper storage of the goods and shall pay for all costs incurred including transportation costs, storage charges and insurance premiums, etc.

The Architect shall have the right to make all necessary adjustment to the approve programmes and time schedules at no extra costs to the Employer so far as reasonable.

8.10 Packing, Storage and Protection

All plant, equipment, apparatus, materials and parts be delivered to the Site in a good / new condition, properly packed and protected against damage due to handling, adverse weather or other circumstances and, as far as is practical, they shall be kept in the packing cases or under protective coverings until required for use.

Any items suffering damage in transit or on the Site shall be rejected and replaced without extra cost to the Employer. No item so rejected will be considered as a reason for failure to meet the Contract date for completion.

In the case of items of materials and goods which originate outside Hong Kong:-

- a. All materials and plant shall be adequately and securely packed for safe transportation with due regard to the climatic conditions encountered in transit and on arrival.
- b. British Standard 1133 and Supplements, or other comparable and acceptable code, shall be used as a guide for the standard of packing and package required. All bright, polished or plated parts shall be treated with suitable rust preventative.

8.11 Loading and Unloading of Materials

The Main Contractor's attention is drawn to the questing of loading and unloading of materials and plant to and away from the Site by lorries or other vehicles in case any special regulations are imposed or special arrangements required by the Local Authority or Police or the Employer or any question of payment for making good damage to roads, or driveway and paths is raised by them or for any work necessary, as no responsibility will be accepted in this matter by the Employer.

The Main Contractor shall take every care in the loading and unloading of materials and plant for the Works, ensure that the streets, roads, driveway and footpaths in the adjacent roads and the public are not obstructed or the traffic impeded and confirm with the police regulations therewith. He shall also arrange where specified to take delivery ex-ship or godown of any imported materials for the fixing of which he is responsible and shall pay all godown storage and transport charges.

The Main Contractor is to take full responsibility for all discussion, etc. with the various authorities concerned in respect of restrictions for loading and off-loading of materials and plant for the Works.

8.12 Off-site Storage

Site storage space is very restricted and the Main Contractor will be required to provide for himself off-site storage, if necessary, in order to ensure continuity of material supplies to the site and to allow sorting and any necessary field fabrication or alteration.

8.13 Ordering Materials

The Main Contractor should note that he should not order materials or commence work based only on quantities or sizes stated in the Schedule of Rates or the Summary of Tender without reference to the drawings and / or site measurements nor based only on quantities or sizes stated in the Drawings or Specification without reference to site measurements, and there shall be no liability for any expense incurred by the Main Contractor in connection with wrong items or abortive work which would have been apparent had the drawings and / or site measurements been checked.

The Main Contractor shall be responsible for the correct ordering of materials and goods including those supplied by Nominated Suppliers, if any.

Immediately on his appointment, the Main Contractor shall obtain approval of all particulars and details necessary for the placing of orders and thereafter shall, as soon as possible, place orders for all equipment and materials. In placing such orders, it shall be the Main Contractor's responsibility to ensure that his suppliers are fully acquainted with, and work strictly to, the requirements and time limits of this Contract.

The Main Contractor shall forward, within 3 days of receiving the formal approval of shop drawings, copies of all orders placed for major items of equipment which are required to be imported from overseas.

8.14 Testing and Commissioning

The Main Contractor shall carry out testing and commissioning on M&E services and plumbing and drainage works upon completion of installation.

If the results show that the installations are functioning in a satisfactory manner, the Main Contractor shall carry out such alteration, replacement, adjustment, re-testing and commissioning again as required.

The Main Contractor having set to work, adjusted and himself tested the installations or any part thereof, shall then demonstrate to the satisfaction of the Employer and the Architect that the installation which have been set to work comply with the requirements of the Specification.

8.15 Rejection of Unsuitable Materials, etc.

The Architect shall be at liberty to reject any materials, plants, etc. and workmanship not complying with the Specification or which are in any way unsuitable and to order the removal and replacement, without extra cost to the Employer, of any faulty materials or inferior work. The above shall apply notwithstanding that the Architect may have previously nominated a particular make or type of plant or material. The Architect's decision as to what constitutes compliance with requirements and suitability shall be final and binding the true intent and meaning of Contract being that the whole of the Contract Work shall completed to the satisfaction of the Architect so as to be perfect in all their parts. No rejected item shall be considered as a reason for failure to meet the Contract Completion Fate or Date or entitlement to time extension.

8.16 Spared Parts and Materials

The Main Contractor shall provide the spare materials and spare parts as specified in the Specifications.

8.17 Warranty / Guarantee

The Main Contractor shall be required to submit to the Architect the following, but not limited to, Guarantees in accordance with the requirement of the Specification.

It should be noted that the Main Contractor is responsible for rectification of defects at his own cost during the warranty period for various elements / components of the Works.

Should the Specifications and Drawings shown be inadequate for the Main Contractor to properly carry out the works as required, he shall draw the Architect's attention to this fact at the time of submitting the tender. To avoid any misunderstanding or misinterpretation, the Main Contractor is hereby advised that the responsibility for the whole of the said works are totally his, including the specification, drawings, shop drawings, material installation and related documentation and certifications as required. No claim arising as a result of failure by the Main Contractor to comply with this clause will be entertained.

The Main Contractor is required to note that the provision of the warranties is an essential part of compliance with the Contract and therefore these written warranties must be submitted and approved by the Architect before the end of Defect Liability Period.

9.0 Instructions, Variations, Methods or Measurement and Valuation

9.1 Site Instructions

The Main Contractor shall maintain an efficient organization so that all instructions issued by the Architect are communicated immediately to the Site and he shall take instructions only from the Architect or persons authorized by the Architect in writing.

The Main Contractor shall enter all site instructions given to him or his foreman by the Architect or such other persons as are authorized as noted above in a Special Diary recording a description of such work ordered and shall obtain against each entry the initials of the Architect or such other authorized person on the day that such instructions are given.

The Main Contractor shall allow such diary to be inspected at all reasonable times when required by the Architect, the Quantity Surveyor and the Clerk of Works.

9.2 Stop Work Instructions (See also SCC-45 of the Special Conditions of Contract)

The Architect, Clerk of Works or other authorized Employer's representative is empowered to stop all work or any part of the Works and advise the Employer / Architect immediately if such work is not in accordance with the Specifications, Drawings, Architect's instructions and any impeding Ordinances and Regulations etc. of the relevant Authorities.

9.3 Main Contractor's Claims for Extra

The Main Contractor shall submit to the Architect / Quantity Surveyor any claims for direct loss and / or additional expense (giving full and detailed particulars of the amount claimed) to which the Main Contractor may consider himself entitled or of any extra and additional work contained in Architect's verbal instructions within three days after the event and no claim for such additional expense or extra work will be considered if submitted later than required herein.

9.4 Main Contractor's Expenses in Connection with Variations and Settlement of Accounts

The Main Contractor shall be responsible for making or procuring at his own expense such additional copies of Architect's instructions and any specifications, schedules, drawings and details issued herewith as are necessary for distribution within his own organization.

The Employer will not be liable for any expense incurred by the Main Contractor in connection with the measurement of variations or the adjustment and settlement of accounts.

9.5 Measurement of Variations

Notwithstanding the requirements of the Standard Method of Measurement General Principles Clause 6(d), the units of billing measured omission and additions for variations where the unit is either m³ or m², the quantities shall be billed to the nearest 0.10 of a whole unit and where the unit is either m or kg, the quantities shall be billed to the nearest whole unit.

9.6 Invoices, Receipts, etc.

The Main Contractor shall produce all original invoices, vouchers or receipted accounts for any materials or Sub-contract labour charges when called upon to do so by the

Architect or the Quantity Surveyor. Upon making photo-copies of the invoices, receipts, etc., the originals shall be returned to the Main Contractor.

9.7 Supportive Documentation for a Fair Valuation

Where it becomes necessary for a fair valuation to be made, as required under Sub-clause 13(4) of the Conditions of Contract, the Main Contractor shall provide all supportive documentation as may reasonably be required by the Architect / Quantity Surveyor to make such fair valuation. They shall be provided by the Main Contractor within one of the Architect / Quantity Surveyor's formal request.

If required by the Architect, the Main Contractor shall within 7 days of the Architect's written request submit a detailed estimate of the cost and time effects of any proposed variation or work which is covered by a provisional sum. The issue of a subsequent instruction by the Architect requiring the execution of the proposed variation or work shall not be construed as acceptance of the estimate. The acceptance of such estimate shall not be prerequisite to the execution of the proposed variation or work by the Main Contractor.

9.8 Daywork Claims

No work shall be carried on a daywork basis without the prior written approval of the Architect.

When the Main Contractor intends to make a claim for daywork under Clause 13(7) of the Conditions of Contract, he shall give the Architect and the Quantity Surveyor at least three days notice of this intention. However, the giving of this notice shall not bind the Architect to value the work on such basis.

The Main Contractor shall furnish to the Architect such receipts or other vouchers as may be necessary to prove the amounts paid and before ordering materials shall submit to the Architect quotations for the same for his approval.

In respect of all work executed on a daywork basis the Main Contractor shall during the continuance of such work deliver each day to the Architect's Representative an exact list in duplicate of the names, occupation and time of all workmen employed on such work and a statement, also in duplicate, showing the description and quantity of all materials and plant used thereon or therefore. One copy of each list and statement will, if correct or when agreed, be signed by the Architect's Representative and returned to the Main Contractor.

At the end of each month the Main Contractor shall delivered to the Architect a priced statement of the labour, material and plant used and the Main Contractor shall not be entitled to any payment unless such lists and statements have been fully and punctually rendered.

The Main Contractor shall afford to the Architect and to the Architect's Representative every facility for checking on the ground all time and materials for which he proposes to charge.

10.0 Programme and Reports

10.1 Programme for Works

Within 7 calendar days after the award of the Contract, the Main Contractor will be required to submit to the Architect a detailed bar chart programme showing all aspects of the carrying out of the project, dates for receipt of information, the submittal and

approval of samples of materials and shop drawings, the procurement of critical materials, if any and equipment, fabrication of special material, if any and equipment and their installation and testing.

The Main Contractor's programme shall clearly define the critical path and depict and describe the sequences and interdependence of all of the activities in sufficient detail to satisfy the Architect that the work is thoroughly planned and meets all the requirements of the Contract.

All significant activities shall be identified in bar chart form or other approved format and the critical activities and critical path shall be clearly indicated, including all other dependent activities. The programme shall include the key activities, key dates and milestones of activities including with the following:-

In order that the programme may be maintained or amended where necessary it is incumbent upon the Main Contractor to notify the Architect whenever there is the likelihood of a delay occurring in his own work or material supplies. Failure of the Main Contractor to take such action will be prejudicial to consideration being given to requests for extension of time.

- a. Work to be carried out, including testing and commissioning.
- b. Fabrication, delivery and installation of materials to be fabricated off the Site, and import of fill material.
- c. Resources deployment plan and productivity projection should be presented in a form and format agreeable to the Architect. Labour, material and plant utilization should be accounted for and justified by past experience and the best of judgement.
- d. Activities for which the Employer or Architect is responsible.

The Architect reserves the right to examine, enquire and check the practical feasibility of the Programme and, if necessary, make suggestions and require alterations to it.

Approval by the Architect of the Main Contractor's critical path schedule and revisions where applicable shall not be deemed to relieve the Main Contractor of any of his duties and responsibilities under the terms of the Contract.

The Main Contractor's programme once approved by the Architect shall become the accepted basis of the Main Contractor's work. At this stage, the Main Contractor will be required to provide schedule data, in a form approved by the Architect, which indicates how he proposes to take advantage of various float conditions that exist in his network. The final delegation of total float in the project schedule will be the subject of mutual agreement.

The programme shall be updated regularly to reflect the existing status of the work. Approval by the Architect of the Main Contractor's critical path schedule and revisions where applicable shall not be deemed to relieve the Main Contractor of any of his duties and responsibilities of diligently pursuing the work in optimum progress and other undertakings under the terms of the Contract.

The Main Contractor's programme one approved by the Architect shall become the accepted basis of the Main Contractor's work. At this stage, the Main Contractor will be required to provide schedule data, in a form approved by the Architect, which indicates how he proposes to take advantage of various float conditions that exist in his network. The final delegation of total float in the project schedule will be the subject of mutual agreement.

The programme shall be updated regularly to reflect the existing status of the work.

On alternate weeks coinciding with review of the programme the report is to list any deviation from programme and provide reasons for actual or expected delays together with details of proposed action to overcome the delay.

The format and content of weekly report shall be submitted to the Architect for approval prior to commencement of the Works on the Site.

The Main Contractor shall furnish to the Architect monthly statement and short term programme, listing those parts of the Works the execution of which is behind the scheduled programme together with the reasons. Where appropriate the Main Contractor shall indicate the steps, which shall be taken in order to recover any time lost.

Notice to the Architect or his representatives, for inspection of the Works should be 24 hours in advance during weekdays or 48 hours in advance during weekend and public holidays.

At monthly intervals (or at such shorter periods as may be agreed), the complete programme shall be revised to take into account the latest available information and the Architect notified of any changes.

Six copies of all programmes and supporting documents shall be submitted to the Architect. A further copy, updated monthly, shall be displayed in the Main Contractor's site office and retained for reference until completion of the Works.

If and when it is found that the works are not keeping abreast with the Critical Programme, the Main Contractor must with the utmost diligence endeavour to catch up on time.

Should any of the Main Contractor's activities become supercritical, the Main Contractor will be required to submit a report to the Architect within seven days detailing the proposed remedial action to be taken to alleviate the unacceptable float conditions.

10.2 Approval of Programme

The submission to and approval by the Architect of such programme (and revisions if applicable) shall not relieve the Main Contractor of any of his duties or responsibilities under the Contract.

10.3 Daily Reports

The Main Contractor shall submit to the Architect at his office and the Clerk of Works on site each day throughout the Contract Period a report showing a record of the labour employed on Site under each trade, materials delivered to Site, plant and equipment on site and the weather throughout the day and the activities carried out / works completed.

The format of the daily report shall be submitted to the Architect for approval before commencement of work on Site.

In all cases where a Clerk of Works or a Resident Engineer of the Employer is employed upon the Works the daily reports shall be submitted for checking and signing by the Clerk of Works or the Resident Engineer of the Employer.

10.4 Weekly Reports

The Main Contractor shall submit to the Architect at weekly intervals reports in

quadruplicate on the general progress of the Works and detailing any information required, extension of Contract Period claimed, etc.

10.5 Progress Photographs

The Main Contractor shall provide at weekly intervals or as and when directed by the Architect for duration of the Contract colour photographs showing progress of the works with brief descriptions taken from locations as directed by Architect. The photographs shall be submitted in electronic format, uploaded to web server set up by the Main Contractor for access and viewing by the Architect and any other concerned parties designated by the Architect. Printed copy of the photographs shall be submitted bi-weekly.

The Main Contractor shall also provide a comprehensive photographic record, aided by sketches and notes where essential, and eventually submitted as part of owner's manual, to document all underground or behind / below concrete works such as water proofing treatment, conduits and junction boxes, sleeves, drain pipe joints and any other covered up works as directed by the Architect.

The Main Contractor shall ensure that no use is made of any negative or print without permission from the Employer to whom all copyrights shall be transferred. The Main Contractor shall also ensure that no unauthorized photography is allowed on the Site.

10.6 Site Meetings and Project Co-ordination Meetings

The Main Contractor shall designate representatives (including but not limited to the Project Manager, Site Agent and Building Services Co-ordinator) approved by the Architect to attend all meetings. Such person must be empowered to make decisions and take instructions from the Architect on behalf of the Main Contractor.

The Main Contractor shall submit to the Architect, 3 days prior to the meeting, an agenda listing and site problems, variations and extra works instructed by the Architect, the programme of work and any other matters relating to the Contract for discussion during the meeting.

10.7 Construction Method Statements

The Main Contractor shall within 7 days after the award of the Contract or such other period agreed by the Architect formally submit to the Architect for approval a detailed method statement submission programme showing the types and timing of the method statements that he intend to submit in the future.

The method statements eventually submitted shall contain a detailed risk assessment, showing the potential risk hazards associated with the relevant work and recommended precautionary measures to be taken.

Each method statement shall be signed by the Main Contractor's project manager or site agent and by his senior health & safety practitioner, such as health and safety manager, in charge of the relevant work.

Method statements shall be submitted at such time that sufficient time is allowed for the review by the Architect. Before the review and subsequent consent given by the Architect, no relevant work shall be commenced.

11.0 Statutory Obligations

11.1 Regulations

The Main Contractor shall comply with current Ordinances, Regulations and requirements of the Government of Hong Kong Special Administrative Region or Statutory Undertakings applicable to the Works, subject to Clause 4 of the Conditions of Contract. The Main Contractor shall also comply with and accept the risk of any impending Ordinances, Regulations, requirements and legislation or other conditions including any amendments enforced during the currency of the Contract which alter any obligations or impose new obligations.

The attention of the Main Contractor is particularly drawn to his obligations in respect of the Employees' Compensation Ordinance (Cap. 282) which requires that he insures against his liability to pay compensation to employees injured in the course of or caused by the carrying out of the Works. The Employees' liability to employees of the Contractor and all Sub-contractors under the Employees Compensation Ordinance and at common law as principal.

Materials, workmanship and the works as a whole shall conform to or be of a higher standard than the minima required by the latest edition of the Buildings Ordinance, Chapter 123 of the Laws of the Hong Kong Special Administrative Region.

The Main Contractor shall submit such method statements, forms, certificates and information in whatever format, etc. as may be required by the Architect for submission to the Building Authority.

Whenever it is the duty of the Main Contractor to make application to a competent authority or any Government Departments or Utility Companies, no extension of time will be granted for any delay in obtaining the relevant permits, consents, etc. which is the subject of the Main Contractor's application. Therefore the Main Contractor is advised to make such application at an early stage and to process such application in good time.

The Main Contractor shall also comply with all the Practice Notes issued by the Buildings Department to Authorized Persons and Registered Structural Engineers and all Codes of Practice which are applicable to the Works:-

- APP-21 - Demolition Works – Measures for Public Safety
- APP-52 - Supply of Plans to Registered General Building Contractors, Registered Specialist Contractors and Registered Minor Works Contractors - Regulation 36 of the Building (Administration) Regulations and Section 55 of the Building (Minor Works) Regulation
- ADV-4 - Control of Environmental Nuisance from Construction Sites
- PNAP 147 - Minor Works Control System
- PNAP 184 - Code of Practice for Scaffolding Safety
- ADV-11 - Suspended Working Platform
- ADM-13 - Monitoring for Site Safety
- PNRC-85 - Fire Retardant Performance of Protective Nets, Screens, Tarpaulins and Plastic Sheeting Installed on Scaffolding of External Walls

11.2 Working Hours, Rates of Wages etc.

The Main Contractor shall comply with any current legislation or regulations regarding working conditions, working hours, or rates of payment to employees and accept the risk of any impending legislation or other conditions which alters any obligations or imposes new obligations.

The Main Contractor shall always comply with and observe all rules of the Police and the

Labour Department, the Employer's standing requirements and any regulations or other orders which may be issued by the Hong Kong Government, on any day of the week. The Main Contractor shall at his own expense supply all necessary and additional labour for his overtime and night work, including all artificial light for his Sub-contractors' workpeople as may be required to complete the Works within the Contract time. No concreting work will be permitted at night without the permission of the Architect. The Main Contractor's attention is drawn to the Summary Offence Ordinance and he shall apply formally to the relevant Government Department for permit if overtime and night work is required.

Should the Main Contractor fail to complete all the noisy works according to the statutory requirements, subject to prior approval by the Architect, the Main Contractor may arrange night works at no extra cost.

11.3 Notices, Fees and Charges (See also Clause 4 of Conditions of Contract)

The Main Contractor shall comply with and give all notices required by any Ordinance of Government of Hong Kong Special Administrative Region, any instrument, rule or order made under any Ordinance of Government of Hong Kong Special Administrative Region, any regulation or byelaw of any Authority or of any Statutory Undertaking which has any jurisdiction with regard to the Works or with whose systems the same are or will be connected.

The Main Contractor shall bear the cost of any fees or charges (including any rates or taxes) legally demandable under any Ordinance of Government of Hong Kong Special Administrative Region, any instrument, rule or order made under any Ordinance of Government of Hong Kong Special Administrative Region, or any regulation or byelaw of any Authority or of any Statutory Undertaking in respect of the Works.

11.4 Site Safety Inspections

The Main Contractor shall maintain records on the number of site visits carried out by the Labour Department inspectors at monthly intervals. Records shall be submitted to Works Branch of the Government Secretariat on a regular basis after verification by the Labour Department.

The Main Contractor shall allow for all time and cost implications for complying with instructions given by the Labour Department / Works Branch with respect to site safety measures.

11.5 Industrial Training and Pneumoconiosis Levies

The Main Contractor's attention is drawn to his obligations under the Industrial Training (Construction Industry) Ordinance and the Pneumoconiosis (Compensation) Ordinance and the Contract Sum shall include the amounts payable in respect of these levies with regard to the Main Contractor's own work.

11.6 Illegal Immigrants

The Main Contractor shall comply with the current Immigration Ordinance. No employment of illegal immigrants by the Main Contractor or any of his Sub-contractors is permitted. The Main Contractor shall take all precautions against illegal immigrants being on the Site.

The Main Contractor's attention is drawn to the Immigration (Amendment) Ordinance and shall, on behalf of the Employer, effect the following practical requirements:-

- a. Report any suspected illegal immigrants immediately to the police.
- b. Offer a reward to any employee who reports the presence of an illegal immigrant; this could be publicized on posters.
- c. Contract the local police divisional commander and ask for a visit from the crime prevention officer who can advise on site security.
- d. Make it known to all his Sub-contractors that if they employ illegal immigrants, they will receive no further work from the Main Contractor or the Employer.
- e. Make it a breach of contract for any Sub-contractor to employ any illegal immigrant.
- f. Put up signs or posters in appropriate position on site stating that illegal immigrants will not be employed on the site and any found will be reported to the police.
- g. Post signs in appropriate positions on site that state no one will be allowed to remain on the Site if they refuse to produce their Hong Kong Identity Cards when requested by a supervisor.
- h. Tell Sub-contractors they must keep a full list of workers' names and identity card numbers which must be produced to the site office daily.
- i. Secure the Site at night and impress upon the security guard that no one is allowed to sleep on the Site.
- j. Fully brief all supervisory staff on the procedures and have a record of this in the company code of practice.

The Main Contractor shall take all practicable steps to determine that all persons present on the Site are not illegal immigrants and all persons employed on the Site or in connection with the Works are lawfully employable and are not illegal immigrants. The Main Contractor shall maintain and keep continually up-to-date a list of his employees and those of his Sub-contractors, and a record of each employee's Hong Kong Identity Card.

The Main Contractor shall immediately remove from the Site any person who is unable to produce for inspection a valid Hong Kong Identity Card.

The Main Contractor shall indemnify and keep indemnified the Employer against any loss or damage which may be incurred by the Employer as a result of the presence or employment of illegal immigrants.

11.7 Restriction of Nuisance of Dust and Noise

The Main Contractor's particular attention is drawn to the proximity of the existing neighbouring properties and he shall so arrange his works programme as to cause the minimum construction nuisance, noise, dust, air pollution, vibration or any other disturbance and inconvenience to these properties or to the occupants thereto.

The Main Contractor is to take all necessary steps to restrict the nuisance of dust and noise. Pneumatic drills shall be fitted with silencers. Compressors shall be in good order to run as quietly as possible and shall be placed in position as far away as possible from adjoining premises. The Main Contractor shall take care to abate the nuisance caused by dust and shall sprinkle dusty areas with water frequently.

All mechanical plant shall be fitted with radio and T.V. interference suppressers.

The Main Contractor's attention is drawn to the restrictions on construction activities as set out in the Noise Control Ordinance and subsequent amendments thereto.

The Main Contractor shall apply as soon as possible for a Construction Noise Permit in accordance with the Noise Control (General) Regulations and the Noise Control (Appeal Board) Regulations 1989, display the Permit as required and copy to the Architect.

The Main Contractor shall not allow any wastewater to flow for the Site or allow any waste to be deposited within the Site. The Main Contractor shall not discharge any waste into any public sewer, drainage or watercourse without the written consent of the Director of Environmental Protection.

11.8 Construction Waste Disposal Charging Scheme

The Main Contractor's attention is drawn to the Construction Waste Disposal Charging Scheme as required by the Waste Disposal Regulation (CAP 354N). all construction waste producer must open a billing account for contracts of value HK\$1 Million and above with the Environmental Protection Department in advance for construction waste disposal. Charges for disposing of construction waste and other costs arising from this shall be solely borne by the Main Contractor.

The Regulation also specifies (under Section 7) criteria for Main Contractors to apply for exemption accounts, whereby no prescribed charge is payable by the account holder of that exemption account in respect of construction waste generated from construction work undertaken under the Contract included in the exemption accounts. The Main Contractor shall check if this Contract is applicable for such exemption account.

The Main Contractor shall keep the Architect informed, from time to time or as requested, on the status of compliance with the Regulation. The Main Contractor is reminded that all costs and expenses incurred by the Employer arising from incidents where the Main Contractor have failed to comply with the above Regulation shall be recovered by the Employer from the Main Contractor.

11.9 Construction Workers Registration Ordinance

The Construction Workers Registration Authority (CWRA) has already commenced conducting registration for all construction workers as required by the "Construction Workers Registration Ordinance". Construction workers holding a valid "Green Card" – a certificate issued upon completion of safety training courses related to construction work required by the "Factories and Industrial Undertakings Ordinance" (Cap 59), may apply for registration based on their particular trades and skill. The registration categories include: registered skilled workers, registered skilled workers (provisional), registered semi-skilled worker, registered semi-skilled worker (provisional) for designated trades, and registered general worker.

The Contractor shall note that construction workers can be registered as registered skilled worker (provisional) if they do not hold a trade test certificate or other qualifications as specified by the Ordinance but can prove having not less than six years of experience in personally carrying out relevant construction work. Applicants who only have not less than two years of such experience can be registered as registered semi-skilled (provisional). Starting from 1 September 2007, all construction workers carrying out construction work on construction site must be registered; any unregistered construction workers are prohibited from carrying out construction work on construction site.

The Contractor is required to make sure that all their workers for this contract are

registered with CWRA. Besides, the Contractor is required to apply and install the SAM card and SATM from CWRA when entering the Site, construction workers should produce their registered smart cards for verification. The Construction shall submit the Daily Attendance Report to CWRA and comply with all the requirements of CWRA.

12.0 Safety, Health and Environment

12.1 Safety of Personnel Engaged

The Main Contractor shall be responsible for the safety of all persons engaged in the execution of the Works and for all authorized visitors to the Site.

12.2 Compliance with Safety Regulations and Procedures

The Main Contractor, his Sub-contractors and all persons employed by him on the Site are to comply in every respect with the provisions of any relevant statutory requirements as may be considered applicable to the Works or any temporary works being executed.

In particular, when working on drains and sewers the Main Contractor is to observe adequate safe working procedures.

12.3 Safety Management

The Main Contractor shall provide to the Architect for approval details of all aspects of safety precautions in connection with demolition, disposal of debris, lifting of material and fire hazard. He shall maintain such approved health and safety programme throughout the Contract.

The Main Contractor is also required to provide details of his safety management system including, but not limited to, the following:

- a. A health and safety plan of the work to be submitted for the Architect's approval.
- b. Inclusion of the essential elements of the Factories & Industrial Undertakings (Safety Management) Regulation.
- c. Appointment of site safety personnel and identification of their duties.

The health and safety plan shall be site specific and shall address the major risks arising out from the project work, materials and equipment. The Main Contractor should note that a model copy of health and safety plan template without containing site specific information related to this project will not be accepted by the Architect and the Employer. The Main Contractor should also note that work will not be allowed to commence on Site without the health and safety plan submitted and to the satisfaction of the Architect and the Employer.

Health and Safety Plan means the health and safety plan, including any supplement or any amended or varied version, submitted by the Main Contractor in accordance with the following and consented to by the Architect in writing.

Within 3 days after the award of the Contract, the Main Contractor shall submit to the Architect a detailed and comprehensive draft Health and Safety Plan (Plan) which shall include the policies and detailed procedures and requirements which, when implemented, will achieve compliance with the Main Contractor's safety and health obligations and responsibilities under the Contract.

The Main Contractor shall, from time to time as necessary, or as required by the Architect,

revise and update the Plan so that it is at all times a comprehensive and contemporary statement of the Main Contractor's safety and health obligations and responsibilities and the policies, procedures and requirements to achieve them. Any submission to the Architect of a revision to and / or update of the Safety Plan shall be made in accordance with the Contract.

The Main Contractor shall comply with the Plan in carrying out the obligations and responsibilities of the Contract and shall ensure that all Sub-contractors and other contractors working on the Site shall have a copy of the Safety Plan and shall comply with it.

The Main Contractor shall provide all facilities, access and assistance to the Architect to verify that the Plan is being properly and fully implemented. If in the opinion of the Architect, the Main Contractor fails to implement properly and fully the Plan which does or may adversely affect the safety of the Works and / or the health and safety of any person or property on or adjacent to the Site, the Architect may suspend the Works, or any part of it, until such time as the Main Contractor shall have rectified to the satisfaction of the Architect. The Main Contractor shall not be entitled to any claim whatsoever due to such suspension.

If at any time the Architect is of the opinion that the Plan is insufficient or requires revision or modification in the interest of the health and safety of the Works and / or the health and safety and health of persons on or adjacent to the Site, the Architect may, by notice in writing requirement the Main Contractor to revise and / or update the Plan and the Main Contractor shall comply within a reasonable time.

The Architect's consent to or rejection of the Plan and of any proposed revision or updates shall not relieve the Main Contractor of any obligation or responsibility under the Contract. The implementation of the Plan by the Main Contractor is entirely without prejudice to and does not derogate from the Main Contractor's responsibilities under the Contract or any statutory regulation with respect to health and safety or impose any new obligation or responsibility on the Employer or the Architect.

12.4 Provision of Safety Precautionary Measures

The Main Contractor shall comply with the Labour Department's regulations for safety on Work Sites. Obtain, display prominently upon all structures or temporary huts on the Site throughout the construction period and remove on completion, posters, in both English and Chinese, drawing attention to safety on site. These posters are obtainable free of charge from the Labour Department of the Hong Kong Government.

The Main Contractor shall provide sufficient safety helmets for the exclusive use of the Employer, Architect, Engineer, Quantity Surveyor, the Clerk-of Works and other authorized persons visiting the Site.

The Main Contractor shall display during the hours of daylight, such flags, signals and markings and during the hours of darkness such lights as the Government of Hong Kong or other competent authority may require for the safety of aircraft of the Public.

The Main Contractor shall object in writing to any instruction issued by the Architect which he considers unsafe stating the grounds for his objection.

The Main Contractor shall give appropriate warning and protection measures to any areas which may be dangerous or cause danger to the workmen, consultants and site staff. The Main Contractor shall provide adequate lighting throughout the construction site for safety reasons and for construction / inspection purposes.

12.5 Removal of Person from Site

The Architect or the Employer's Representative may require the immediate removal from Site of any person who, in the opinion of the Architect or the Employer's Representative, fails to properly observe the provisions of the Factories and Industrial Undertakings Regulations or the Construction Sites (Safety) Regulations as appropriate and such other statutory regulations which from time to time may be in force. Such person shall under no circumstances be employed again on the Site without the prior written agreement of the Architect.

12.6 Wearing Safety Equipment

The Main Contractor is to provide and enforce the wearing of efficient safety helmets, and where necessary, face masks, eye goggles, ear protectors, protective boots, protective and waterproof clothing, safety harness and other personal protection equipment for all personnel. If required by the Architect, the Main Contractor is to submit for approval detailed proposals for emergency procedures and safety regulations. Typhoon emergency procedure shall be compatible with the procedures described in the Building Development Department's "Emergency and Storm Damage Regulations".

12.7 Emergency Procedures

Emergency procedures and safety regulations are to be produced by the Main Contractor, approved by the Architect and distributed and displayed by the Main Contractor at each place of work and as directed by the Architect. In addition, any other documents, posters, notice boards or other items of a like nature which the Architect may direct or are required by law shall be displayed. The Main Contractor is to revise, replace, maintain or remove the notices, regulations and the like as required by the Architect.

12.8 Responsibility of Sub-contractors

The provisions listed herein regarding safety shall apply to and be binding upon any Sub-contractor employed by the Main Contractor for any part of the Works on the Site and the persons employed by such Sub-contractor. The Main Contractor shall ensure that proper and adequate provisions to this end are included in Sub-contracts placed by him.

12.9 Compliance with Ordinances and Regulations

The Main Contractor shall comply with all legislations relating to safety and health including but not limited to:-

- a. The Factories and Industrial Undertakings Ordinance (Sections 6A and 6B);
- b. The Construction Sites (Safety) Regulations;
- c. The Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations;
- d. The Factories and Industrial Undertakings (Confined Spaces) Regulations;
- e. The Dangerous Goods Ordinance (Section 6);
- f. The Electricity Ordinance (Part VII);
- g. The Electricity (Wiring) Regulations;
- h. "Safety Guide to Working in Confined Space" published by Government and the Institute of Electrical Engineers Wiring Regulations (16th Edition 1991) Section "Construction Site Installation".

The Main Contractor shall display during the hours of daylight, such flags, signals and markings and during the hours of darkness such lights as the Government of Hong Kong or other competent authority may require for the safety of aircraft or the public.

The Main Contractor is also required to comply with the Factories and Industrial

Undertakings (First Aid in Registerable Workplaces) Regulations, in the provisions of first aid equipment and personnel. A copy of "A Brief Guide" to these regulations can be obtained from the Labour Department.

12.10 Report of Accident

The Main Contractor shall forthwith report to the Architect any accident occurrence on site; such report shall be in writing and shall reach the Architect within 48 hours of the accident occurrence. The Main Contractor shall also copy the written accident report to the Employer. Throughout the Contract Period, the Main Contractor shall submit written site accident summary report on a monthly basis to the Architect copied to the Employer regardless of whether there is any site accident within the period covered by the monthly site accident summary report.

12.11 Responsibility of Main Contractor

The safety requirements stated above are by no means an exhaustive list of safety precautions required from the Main Contractor. The Main Contractor still obliged to follow the current regulations, codes of practice, etc., issued in respect of safety in construction works.

The Main Contractor shall take full responsibility for the Site and construction safety including public utilities contractors, Specialist / Direct Contractors engaged direct by the Employer.

12.12 Precautionary Work in Case of Fire

The Main Contractor shall provide fire extinguishers, sand buckets and all other adequate and efficient fire fighting equipment as necessary during the Contract Period. Width of required exit routes should not be reduced by the carrying out of works including but not exclusive, the hoarding erection. Fire rated provision, if damage or temporary suspended due to the site works. Should be maintained by relevant precautionary measures such as fire rated separation or hoarding.

In addition, the Main Contractor shall observe the following:-

- a. All flammable materials to be kept to a minimum.
- b. All flammable liquids to be kept in a fire resisting cabinet.
- c. All flammable debris is to be removed daily.
- d. No welding or hot work to be done on Site unless all flammable materials have been removed.
- e. Any other fire precaution measures as necessary.

Fire Services Regulations (Cap. 95) and any other requirements which may be lay down from time to time by the Architect shall be observed at all times. In particular, the Main Contractor must ensure that there shall be no obstruction to any fire escape routes, whether such routes are temporary within the Site or permanent within the Site.

12.13 Precautionary Work in Case of Typhoon or Heavy Rain

The Main Contractor shall allow for the provision of earth bunds or sandbag barriers and / or other temporary measures together with all necessary temporary drainage to protect the Works and / or adjoining property from being washed out during typhoon or heavy rain and also the provision of an emergency working unit standing by to clear away earth, mud and / or debris that may be washed down. A procedure for use during typhoons and heavy rain is to be proposed by the Main Contractor and approved by the Architect.

12.14 Protection of Public

The Main Contractor is to take every precaution necessary to protect the public from any injury or death during the course of the Works.

12.15 Ingredient of Materials

All materials, including equipment, products articles used in the Works shall not contain hazardous ingredient and shall not emit hazardous or irritation-causing substance into the environment.

12.16 Site Health and Safety Management Committee

The Main Contractor should establish an on-site Health and Safety Management Committee within 3 days after the award of the Contract for monitoring implementation of the health and safety plan.

The Architect or his representative would be the Chairman of the Committee and members should include the Main Contractor's project manager, site agent and safety officer. The Committee should organize regular monthly meeting and undertake a health and safety inspection to the site immediately before each meeting.

Major health and safety irregularities should be raised for discussion in the Site Management Health and Safety Committee and the Main Contractor should report progress of each remedial action until its completion. This includes reviews and assessment of contractor's submissions such as monthly health and safety reports, accident reports, training record, inspection reports, accident statistic, statutory warning notices / execution record, statutory tests / examination certificates, safety officer and supervisors' reports etc.

The Main Contractor should act without delay upon the decisions or recommendations made by the committee on all health and safety issues. The above arrangements are entirely without prejudice to and do not relieve the Main Contractor from any contractual or legal obligation with respect to health and safety.

The Main Contractor should also set up a site Health and Safety Sub-committee for reviewing all aspects of health and safety issues on site. The Main Contractor should chair the Sub-committee and members should include site supervisory staff, management staff of Sub-contractors and all the on-site health and safety personnel such as health and safety manager / officer and supervisors.

The Sub-committee should organize monthly meeting and minutes of meeting should be taken and signed by the Sub-committee Chairman and submitted to the Site Health and Safety Management Committee within 3 days of the meeting.

12.17 Monthly Health and Safety Report

The Main Contractor should submit a site health and safety report within the first week of each month to the Architect. The Report should comprehensively address all relevant aspects of occupational health and safety and be endorsed by the Main Contractor's project manager and health and safety manager / officer.

The contents of the report should at least cover the following items:-

- a. Details of accidents, incidents and dangerous occurrences;
- b. Summary of health and safety training;
- c. Outcome of health and safety committee meetings;
- d. Records of health and safety inspections, audits; and

- e. Accident statistics.

12.18 Health and Safety Staff

Within 3 days after the award of the Contract, the Main Contractor shall employ at least one full time project health and safety officer and one health and safety supervisor or such additional number as may be required by the statutory regulations on Site throughout the Contract Period.

Health and safety officers and health and safety supervisors shall respectively satisfy the definitions of "safety officer" and "safety supervisor" as prescribed by the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. They shall be registered with the Commissioner of Labour under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. They shall be employed on a full-time basis to undertake all duties entailed by the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations and any additional duties as specified in the Contract. In addition, health and safety supervisor should have not less than 3 years experience on construction works and should have attended appropriate health and safety training course.

The Main Contractor shall empower the health and safety staff to instruct employees of the Main Contractor or of any Sub-contractors to cease operations and take urgent and appropriate action to make safe the Site and the works and prevent unsafe working practices or other infringements of the Health and Safety Plan or other contractual health and safety requirements.

If for any reason (e.g. injury, resignation) the health and safety officer and / or the health and safety supervisor cannot perform the duties, the health and safety officer and / or the health and safety supervisor shall be replaced within a reasonable time, but in any case within 7 days. Do not replace the health and safety staff without the express consent of the Architect.

The Architect may give notice in writing to the Main Contractor for the removal and replacement of the health and safety staff should there be repeated breaches of the Health and Safety Plan or any other contractual safety requirements.

The CV's of the health and safety staff shall be submitted to the Architect for review and approval prior to the applications taking up the posts.

13.0 Protection of Public

13.1 Protection of Public

The Main Contractor is to take every precaution necessary to protect the public from injury or death during the course of the Works.

13.2 Protection of Public Property

The Main Contractor shall maintain and protect all public property including roads, pavements, steps, retaining walls, drains, utility services or other property or things within the proximity of the Site and bear all costs incurred in making good any damage caused thereto.

13.3 Protection of Existing Property and Adjoining Property

The Main Contractor shall take every precaution necessary to protect adjoining property from damage and shall bear all costs incurred in remedying damage caused through lack of proper care on his part. The Main Contractor shall prepare photographic survey record

for the adjoining buildings at the beginning of the Contract and submit to the Architect for record.

Allow for taking adequate precautions against excavated materials getting into Government properties or adjoining properties, shoring up, protecting and in all ways supporting and restoring all lands, buildings, roads, fences, parapets and retaining walls, cables, water mains, sewers, live drains or other properties or things which may be disturbed or damaged during the execution of the Works.

The Main Contractor shall be required to make good at his own expense, or reimburse to Government and surrounding properties all costs in connection with any damage whatsoever by water pollution due to any act or negligence of the Main Contractor.

Provide all necessary additional planking, strutting and shoring to the sides of excavations adjacent to existing buildings, public roads and other structures and take special care to prevent subsidence or other damage.

The Main Contractor should carry out defect survey for adjacent buildings and other structures prior to commencement of the Works and submit the survey record to the Architect.

The Main Contractor shall provide suitable temporary protection to buildings and other structures affected by the Works as defined by the Architect. The Architect's approval will not relieve the Contractor of the responsibility for any damage caused to the buildings or injury to their occupants.

13.4 Protection of Persons and to Existing Buildings, Adjoining Property, Roads, Utilities, etc.

The Main Contractor shall note that the existing buildings will be open for the continuous use by the occupants, staff, visitors, other contractors, etc. for the duration of this Contract, and the Main Contractor shall take every precaution to ensure that the users of the building are protected from injury.

The Main Contractor shall protect and in all ways support and maintain or restore all parts of the existing buildings or other property or things which may be disturbed or damaged during the execution of the Works. In addition, the Main Contractor shall keep the existing plumbing and drainage system free from any damage and blockage and is strongly advised to keep his workmen from throwing or dumping rubbish and debris into sanitary fitments.

In the event of any damage or injury to the existing buildings or any adjacent and nearby properties, ground, roads, services, passages and persons in consequence of such negligence of taking the above precautionary measures, the Architect shall be notified immediately, the Main Contractor shall be entirely responsible for the entire cost of reinstatements and shall indemnify the Employer against all claims which may be made against him in respect of any such damage or injury caused by any negligence or default on the part of the Main Contractor, his Sub-contractor or their respective employees.

The Main Contractor shall also note that where the making good and equipment replacement are carried out by the Employer, the cost of such as charged by the Employer and including all costs and expenses incurred therefore, shall be deducted from any monies due or to become due to the Main Contractor, or may be recovered as a debt from the Main Contractor.

An experienced and competent person shall therefore be employed by the Main Contractor full time on Site during the construction period to supervise the execution of the Work and watch the stability of the existing building or any adjacent and nearby

buildings, ground, roadways and underground services, etc. and shall immediately report to the Architect of any sign or likelihood of collapse or danger.

The Main Contractor shall locate, shore up, protect and in all ways support and maintain or restore all buildings, roads, fences parapets, cables, sewers, live drains or other properly or things which may be disturbed or damaged during the execution of the Works. Where appropriate, the Main Contractor shall open up the ground in advance of the main work by hand digging if necessary to locate precisely the position and details of services which are likely to affect his operations.

The Main Contractor shall be entirely responsible for ensuring that no damage is caused by his workpeople including Sub-contractors to the existing buildings or any of the surrounding properties including public or private roads, pavements, steps, staircases, footpaths, drains, services pipes or cables, etc. If any such damage is caused, he shall be entirely responsible for the entire cost of reinstatements whether carried out by himself or others, as well as for all other consequences resulting therefrom.

The Main Contractor shall check with the appropriate utility companies or relevant Authorities the positions of public utility and communications services lines and shall take steps to ensure that these services are not damaged in any way by the Works and shall arrange for diversion if such utility lines are affected by the Works.

Plans which purport to show lines and positions of Public Utilities and Communications services may be inspected in the Office of the Architect.

These information are given in good faith and are believed to be accurate. However, no guarantee on the drawings accuracy can be given and no claims whatsoever from the Main Contractor in respect of the information given in these drawings will be entertained.

13.5 Maintenance of Existing Roads, Footpaths, Steps, etc.

The Main Contractor shall maintain all existing roads, footpaths, steps, etc. and reinstate any damage caused by any reason whatsoever during the progress of the Works.

The Main Contractor shall provide and employ on the Site, such labour and washing facilities as is necessary to clean the wheels and undersides of lorries free of earth prior of leaving the Site.

The Main Contractor shall be responsible for ensuring that the accesses, roads, etc. leading to and around the Site are kept free from obstruction brought about by the work on this Site and in no way shall he cause any hindrance to traffic or ancillary works either by his own vehicles, or by his workpeople, materials etc.

The Main Contractor shall be responsible for maintaining all existing surface water channels and drainage works within and around the site in proper working order and shall reinstate any damage caused by any reason whatsoever during the progress of the works at his own expense.

The Main Contractor shall keep all roads, footpaths, drains, channels, etc. completely free from all mud, water, sand debris, slurry, etc. at all times and to the entire satisfaction of the Architect.

13.6 Maintenance of Existing Services

The Main Contractor shall ensure that any existing services such as electric power, telephone, water, gas or drainage to adjacent areas and properties and or which pass through or adjacent to the site of the Works are safe-guarded from any damage or

contamination whatsoever and fully maintained during the course of the Works.

The Main Contractor shall ensure that existing services which are not intended to be removed or diverted are not disturbed or damaged during the course of the Works. The Main Contractor is advised to check the position of all existing services prior to the commencement of any work and shall be deemed to have allowed in the tender.

The Main Contractor shall co-ordinate and arrange with the Authority or the Public Utility companies, the Architect and the Employer for any necessary disconnection or diversion of drains or other services.

The Main Contractor shall comply with all the requirements from those bodies in this connection and make sure that all preparatory works have been carried out as required prior to any diversion, dismantling or removal.

Any services that the Main Contractor required to be diverted to suit his method of construction shall be diverted by the relevant Authority and / or adjacent owners and the Main Contractor shall bear all costs and charges in respect thereof.

Where alterations to services are necessitated by the Works, no adjacent work shall commence until the alterations have been made.

Easy access by the staff of Public Utility Companies and Government Authorities to all existing services including joint boxes, manholes, etc. shall be provided and maintained at all time.

If, in the Architect's opinion, damage may be caused by the operation of mechanical plant over or adjacent to services, the Main Contractor shall be required to excavate by hand in their vicinity. The Main Contractor shall be responsible for any damage, accidental or otherwise, and shall make good such damage as required at his own expense.

Before excavations are carried out near utility services by means of mechanical plant, the Main Contractor shall carry out full and adequate preliminary investigations to locate utility services by means of hand-dug trial holes. The Main Contractor shall allow for making such enquiries and investigations as are necessary to check and confirm the positions of all utility services before commencing work.

The Main Contractor is to shore up, protect and in all ways support and maintain or restore all lands, buildings, roads, fences, parapets and retaining walls, sewers, live drains, gas mains, telephone lines, electric cables, or other properties or public utility installation which may be disturbed or damaged during the execution of the Works.

The Main Contractor shall be entirely responsible for ensuring that no damage is caused by his workpeople including Sub-contractors, and if any such damage is caused he shall notify the Architect and the concerned authorities or utility companies immediately and he shall be responsible for the entire cost of reinstatements whether carried out by himself or others.

When the Main Contractor is working in the vicinity of underground water pipes, the Main Contractor shall exercise great care and take all necessary precautions to protect the watermains. The Main Contractor shall follow the 'Conditions of Working in Vicinity of Waterworks Installations' as stipulated by Water Supplies Department (WSD) and take all necessary steps to avoid any damages to WSD's watermains / waterworks installations, for which they will be held responsible.

When the Main Contractor is working in the vicinity of underground electric cables, the Main Contractor shall exercise great care and take all necessary precautions to protect

the cables. The Main Contractor shall follow the 'General Practice on the Execution of Road Work Near Cables' as stipulated by Hong Kong Electric Co. Ltd. and take all necessary steps to avoid any damages to electric installations, for which they will be held responsible.

Should any services be damaged during the execution of the Works, the Main Contractor shall immediately notify the Architect, the Employer and the Utility Undertakings concerned and bear all costs of making good the damage.

It is the responsibility of the Main Contractor to search for the details of any existing services during tendering and during the course of the Works and plan the Works to suit at no extra cost and time to the Employer.

13.7 Dust Suppression Measures

The Main Contractor shall undertake at all times to prevent dust nuisance as a result of his activities.

In the process of material loading, any material which has the potential to create dust shall be treated with water or wetting agent sprays prior to being loaded into a vehicle.

Any vehicle with an open load carrying area used for moving materials which have the potential to create dust shall have properly fitting side and tail boards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300mm over the edges of the side and tail boards.

Stockpiles of sand and aggregate greater than 20m³ shall be enclosed on three sides, which walls extending above the pile and 2 meters beyond the front of the pile. In addition, water sprays shall be provided and used both to dampen stored materials and when receiving new materials.

Where in the opinion of the Architect that the emission of dust from the Site has created hardship to the public, in spite of the above measures taken by the Main Contractor, the Main Contractor shall take other action immediately to rectify the situation to the satisfaction of the Architect.

13.8 Construction Works close to Buildings, Roads and Other Structures

Care must be taken in carrying out the construction works close to buildings, roads and other structures and the Main Contractor shall bear all costs incurred in remedying any damage caused through lack of proper care on his part.

14.0 Insurance and Surety Bond

14.1 Employees' Compensation Insurance

The Main Contractor is solely responsible and shall bear full liability for accidents or injuries to work people.

The Employer shall not be liable for or in respect of any damages or compensation payable at law in respect of or in consequence of any accident or injury to any workman or other person in the employment of the Main Contractor, and the Main Contractor shall indemnify and keep indemnified the Employer against all such damages or compensation and against all claims, demands, proceedings, costs, charges and expense whatsoever in respect thereof or in relation thereto.

The Main Contractor shall take out and maintain on behalf of himself and his Sub-contractors (including Nominated Sub-contractors) such insurances as necessary to cover all liability of the Main Contractor arising under any statute and any revision and amendment thereof during the course of the Contract or at Common Law in respect of personal injury to or the death of any employee and other person who may be employed on the Works or anywhere in Hong Kong whilst engaged in business connected with the Works.

The policies shall be issued on a 'Joint named' basis, i.e. in the name of the Main Contractor and of all his Sub-contractors whilst engaged about the business.

The policies shall be endorsed to cover the Employer's liability under the Employees' Compensation Ordinance as Principal.

The insurances are to be taken out through an insurance agent approved of in writing by the Architect and the policies are to be deposited with the Architect prior to commencement of the Work.

The policy shall include Endorsements W204, W338 and W348 and the Extraordinary Weather Clause.

The Employees' Compensation insurance is to be extended to cover the Defects Liability Period and until the completion of any further work including the making good of defects.

14.2 Contractor's All Risks and Third Part Liability Insurance

See Clause SCC-22 of the Special Conditions of Contract.

14.3 Other Insurances

The Main Contractor shall take out his own insurance to cover damage or loss to temporary buildings, plant, tools and equipment owned or hired by him.

14.4 Approval of Insurance Company

All insurances are to be taken out with a company to be approved in writing by the Architect and the policies are to be deposited with the Architect prior to commencement of the Works on Site.

The Main Contractor shall furnish a letter from the Insurance Company confirming that the policies comply fully with the Contract Conditions and these "Preliminaries" clauses.

14.5 Period of Insurance Cover

The Third Part Liability and Employees' Compensation Insurance are to be extended to cover the Defects Liability Period and until the completion of any further work including the making good of defects.

14.6 Main Contractor to give Notice of Injury

In the event of any workman or other person employed on the Works or in connection with the Contract whether in the employment of the Main Contractor, suffering any personal injury and whether there be a claim for compensation or not, the Main Contractor shall without delay give notice in writing of such personal injury to the Employer and to the Commissioner of Labour in such form as the Commissioner of Labour may require.

15.0 Attendance and Overall Co-ordination Responsibility of Main Contractor

The Main Contractors shall provide attendance on all Authorities, Utility Companies and separate contractors to extent required to permit them to expeditiously carry out and complete their works.

This shall include but not be limited to, the co-ordination, administration, etc. in respect of the ascertainment of their requirements and programming with relevant bodies; provision of all accesses, facilities, temporary works, plant, equipment, materials, labour etc.; maintenance of traffic flows, etc.; setting out, taking of record, preparation and submission of drawings / records; carrying out of all works required by them or not done by them but necessary to complete the Works in the opinion of the Architect; all reinstatement, etc.

The Main Contractor shall also provide security to all storage areas of Separate Contractors, Government Departments and Utility Companies and illuminate all surrounding areas of all storage sheds erected.

The Main Contractor shall allow for the provision of the working area or areas for storage to each of Separate Contractors.

Note: The Main Contractor shall allow for relocation of such working and storage areas as may be necessary to suit progress of the Works and for subsequently clearing away on completion of the Works and making good all works disturbed.

The Main Contractor shall be responsible for the complete co-ordination of the Works including works executed by Separate Contractors, Government Departments and Public Utility Companies. This responsibility shall include but not be limited to:-

- a. co-ordination of all trade sections or components one with the other for the compatible integration of the work;
- b. establishment of detailed logical sequence of work or erection schedules;
- c. ensuring that Public Utility Companies are allocated their required amount of time to complete their works;
- d. provision of suitable and sufficient staff to ensure that the co-ordination procedures are followed to enable the expeditious completion of the Works within the time scale of the construction programme;
- e. carrying out any alteration work and indemnification of the Employer against all costs, charges, expenses and the like resulting from any failure to co-ordinate the Works;
- f. liaison with Sub-contractors undertaking installations of air-conditioning, electrical wiring and conducting and specialist installation to ensure that all trunking, ducts, piping, conducting and related equipment are "built-in" in a logical sequence.

The Main Contractor shall be responsible for any damage caused owing to lack of liaison with Sub-contractors and Public Utility Companies and shall make good such damage and / or requirement for adjustment that might be necessary to the satisfaction of the Architect at the Main Contractor's expense.

The aim of co-ordination the building services is to enable the service to be properly installed within the spaces designed to house the services without conflict of one service with another or with the building structure, architectural works or finishing and within the time scale of the construction programme.

"Building Services" in this context includes services and plumbing systems installed by Nominated Sub-contractors, Separate Contractors or Public Utility Companies together with drainage installation carried out by the Main Contractor or his Sub-contractors.

"Properly Installed" in addition to normal technical requirements, is the requirements for building services to be installed in such positions and sequence that a neat, logical and tidy appearance of

all services is achieved and that adequate space for future maintenance of all services is provided.

The aforesaid term "co-ordinate" shall be deemed to include the acquisition and checking of all design drawings from the Architect and those to be provided under any Nominated Sub-contracts, Separate Contracts or by Public Utility Companies for the compatible integration of all the work, including devising and recommending to the Architect for approval design solutions to eliminate any conflict between the positioning of any work, and to provide adequate space for the routing of all such work and for subsequent maintenance for the various installations in accordance with good practice together with technical checking of the compatibility of adjacent services.

The Main Contractor shall bear the cost of carrying out any alteration work and shall indemnify the Employer against all costs, charges, expenses and the like resulting from any failure on the part of the Main Contractor to co-ordinate the design and installation of all services installations, as determined by the Architect.

The process of co-ordination will require the accurate location of services and their brackets etc. in the spaces designed to house the services and the establishment of a detailed sequence of installation. In the event of conflicts arising between the requirements of different parties the Main Contractor will be required to negotiate satisfactory arrangement and to see that they are resolved. Conflicts of this nature shall be the sole responsibility of the Main Contractor and do not fall within the area of responsibility of the Architect who will not be excepted to be involved in such matters.

15.1 General Attendances on Nominated Sub-contractors, Nominated Suppliers, Direct Contractors and Utility Undertakers

The Main Contractor is to provide the attendances detailed below, free of charge, to Nominated Sub-contractors, Nominated Supplier, Direct Contractors and Utility Undertakers, to enable them to properly carry out and complete their respective works.

General Attendances

- a. Spaces on Site or in the building under construction, as designed by the Main Contractor, for the erection of offices, amenities or stores.
- b. Use of access roads on the Site, working space for and clear access to the places where works are to be carried out.
- c. Use of such plant and operators thereof as may have been provided by the Main Contractor for the Works, subject to the prior agreement and at the convenience of the Main Contractor, and provided that there is no obligation to retain any such plant operators thereof longer than is necessary for the Main Contractor's own use.
- d. Use of such scaffolding, staging or ladders as may have been erected by the Main Contractor for the Works, subject to the prior agreement and at the convenience of the Main Contractor, and provided that there is no obligation to retain any such scaffolding, staging or ladders longer than is necessary for Main Contractor's own use.
- e. Use of telephones and facsimile machines for local calls and transmission.
- f. Use of the usual conveniences and established facilities of a building site such as messrooms, latrines and first aid facilities.
- g. Fencing, hoardings, or screens and the like erected for Site Safety.

- h. Watchmen and security guards for the Site.
- i. An adequate electricity supply with sufficient terminal points (MCB's) at convenient positions throughout the Works under construction with at least one MCB at each level and to work and storage areas within the Site. The electricity supply shall be for lighting, operation of power tools and testing and commissioning up to and including final acceptance of the installations by the Architect.
- j. An adequate water supply with sufficient stop taps at convenient position throughout the Works under construction with at least one stop tap at each level and to work and storage areas within the Site.
- k. Protecting the Works under construction against tropical cyclones, fire, flooding and the like but only to an extent reasonable to the progress of construction.
- l. Provision of supervision, plant, equipment and operators thereof for assisting in the unloading and hoisting of permanent works, plant, goods and materials to various locations.
- m. Clearing away rubbish as it is deposited in designated locations which shall be at every level of the Works.
- n. Making good to completed works disturbed by the removal of the preceding attendance items.
- o. Final cleaning of the Sub-contract Works.
- p. Cutting or forming chases, holes and openings etc. of all sizes, building in sleeves, puddle flanges, brackets, anchorages, or any other insets provided by others, filling in and making good the structure around sleeves, supplying cement mortar for fixing brackets and floor trunking, bedding and grouting behind frames, making good work disturbed and all other necessary work of a like nature (sealing between pipe sleeves and pipes etc., and painting of exposed pipes etc., to be done by the Nominated Sub-contractors, Direct Contractors and Utility Undertakers). The Main Contractor shall ascertain all particulars with regard to the positions and which chases, holes and openings etc., will be required to ensure that the party responsible for the work is present on site when required.

16.0 General Obligations

16.1 Overtime

Should the Main Contractor consider that it may become necessary to cause overtime to be worked in order to complete the Works by the Date for Completion, he must allow for such a contingency in his Tender price. No claim for any extra in this connection will be considered.

Working after normal office hours is deemed to be included in the Contract and would generally be required to suit the normal operation and administration of the Employer.

The Main Contractor shall apply to the relevant Government Departments for approval permit including noise control permit and also give the Architect written notice of his intention to work overtime.

16.2 Foreman-in-charge

The Main Contractor shall keep a competent Foreman-in-charge, literate and fluent in English, constantly on the Works.

The Main Contractor's Foreman-in-charge is to be approved by the Architect. The Architect shall require details of his experience and qualifications, and may require his replacement if considered unsuitable.

The Main Contractor shall provide a contact person with emergency contact telephone number for the Architect to contact in case of emergency.

The Main Contractor shall provide an experienced engineer to act as a co-ordinator for the carrying out of the installation of building services by the Main Contractor or his Domestic Sub-contractors, Nominated Sub-contractors and / or Separate Contractors.

Qualification and experience of the Building Services Co-ordinator are to be subject to approval by the Architect and full time on site.

The aforesaid term "co-ordinate" shall, in this context, be deemed to include:-

- a. The acquisition and checking of all design drawings from the Architect and those to be provide under any Domestic Sub-contracts, Nominated Sub-contracts or contract for Specialist work for the compatible integration of all the work, including recommending to the Architect for approval design solutions to eliminate any conflict between the positioning of any work, and to provide adequate space for the routing of all the various installations in accordance with good practice.
- b. In conjunction with the Domestic Sub-contractors and Nominated Sub-contractors, the production and provision of finalized master co-ordination drawings incorporating all design solutions approved by the Architect and showing the integration of all services to be executed by himself, his Domestic Su-contractors and Nominated Sub-contractors.
- c. The establishment of a detailed sequence of work to enable the expeditious completion of the Works and all Specialist Works.
- d. The Main Contractor shall bear the cost of carrying out any alteration work and shall indemnify against all cost, charges, expenses and the like resulting from any failure on the part of the Main Contractor to co-ordinate for the carrying out of all services installations.
- e. To co-ordinate all building services Sub-contractors, whether Domestic or Nominated, for the timely completion of all testing / commissioning works, submission of O&M manual and as-fitted drawings, combined and co-ordinated services drawings including the completion of all outstanding works and rectification of defects during the Defects Liability Period.
- f. To co-ordinate with utility companies for the timely completion of all installation, connection and inspection / testing works to be carried out by utility companies.

16.3 Detailed Safety Supervision Plan

The Main Contractor shall, if not already previously submitted, immediately upon award of Contract complete and submit to the Architect (as appropriate) of the Detailed Safety Supervision Plan for the Works in accordance with the requirements under the Technical

Memorandum for Supervision Plans issued by the Secretary for Planning, Environment and Lands under Section 19A of the Building Ordinance (Cap. 123) for approval by the Building Authority and shall comply with such throughout the Contract Period.

The Main Contractor shall note that the Supervision Plan is pre-requisite document for application for consent to the commencement of Works. If the issue of consent is delayed (notwithstanding sole or partly) due to fault by the Main Contractor in the preparation of the Supervision Plan, no extension of time shall be granted and the Main Contractor shall be responsible for the consequences of the full delay. The preview and approval by the Architect of the Main Contractor's Supervision Plan shall not release the Main Contractor's liability as specified above.

16.4 Full Time Site Supervisor

The Main Contractor shall designate a full time site supervisor for the period when construction works execute on Site.

16.5 Workmen Living on the Site

No workmen will be allowed to live on the site at any time throughout the Contract apart from the necessary number of watchmen.

16.6 Watching

The Main Contractor shall keep sufficient efficient watchmen / security guards on the Works day and night and provide all necessary lighting, guards, barriers and all safeguards for the prevention of fire, accidents and losses.

The Main Contractor shall be solely responsible for the safety from damage or theft of all materials, plant, machinery, tools and scaffolding and also for all Separate Specialists Contractor's fixed and unfixed materials, etc. delivered to site.

Under no circumstances will the Employer be responsible for any loss suffered by the Main Contractor through theft, etc. However, the Main Contractor shall immediately report to the Architect and the Employer any discovery of suspected theft / burglary of burglary of personal and / or the Employer's properties.

16.7 Protection and Cleaning of the Works

The Main Contractor shall suitably protect from inclement weather and all other causes all his work during the progress of the Works until completion and shall hand over the works in a completely clean and finished state. Any damage arising in this context shall be made good at his own expense.

Clear away from the Site all plant, surplus materials, earth and rubbish and leave the Site clean to the entire satisfaction of the Architect.

16.8 Removal of Debris during the Course of the Works and upon Completion

Burning of rubbish and waste materials on site shall not be permitted.

All materials shall be stored on site in a neat and orderly manner, such as to minimize risks due to fire, inclement weather, etc.

The Main Contractor shall comply with any order from the Architect or Employer's Representative in connection with the removal of rubbish or clearing the Site.

All rubbish, crates, surplus materials etc. are to be removed from the Site as soon as possible, at frequent intervals during the progress of the Works and at close of the work day so as to maintain safe environment and unhindered access to the Site. Such rubbish etc. shall be removed away from the Site directly. No debris accumulation shall be allowed. If the Main Contractor fails to remove any rubbish etc. in accordance with the Architect's instruction, the Employer shall be entitled to have such rubbish etc. removed by his own workmen or by other contractors, and to recover from the Main Contractor, or the cost incurred in connection therewith plus the associated administration costs, whichever is the greater amount.

On completion of the work and before handing over, all the floor, glass, tiling, ironmongery, paintwork, etc. are to be thoroughly washed and / or cleaned down using proper detergents, scrapers, scrubbed bushes, etc. Before handing over the Site, all gutters and channels are to be cleaned and left tidy all to the satisfaction of the Employer.

On completion of the Works, and before handing over the Site, all channels, drains catch pits, manholes, sand traps shall be cleaned out.

All plant, rubbish, crates, containers, surplus materials, etc. are to be removed. The Site and adjacent areas thereto shall be left clean and tidy.

Labeled keys, maintenance instruction and guarantees (if any) shall be handed to the Employer on or before the Date for Substantial Completion.

16.9 Protection of Works

The Main Contractor is to amply protect all finished Works and will be responsible for any damage caused by carelessness and negligence in this respect. Any damage arising in this context shall be made good at the Main Contractor's expenses.

The Main Contractor shall provide full and adequate protection for all finished surfaces and for all materials subject to injury or staining and shall be responsible for making good all damage done to such finishes surfaces and materials until the Works are handed over complete.

This protection must be applied or provided as soon as a surface is finished and / or materials arrive on the Site or as may be otherwise desirable and such protection shall be maintained in effective condition throughout the course of the Works.

16.10 Property belonging to the Government and Public Utility Companies

The Main Contractor shall not remove any of the property on Site belonging to the Government and Public Utility Companies except with the written approval from the relevant authorities.

16.11 Preparation for Substantial Completion

The Main Contractor shall carry out all necessary preparatory works well in advance of the Date of Substantial Completion stated in the Appendix to the Conditions of Contract.

16.12 Defects after Completion (See also Conditions of Contract Clause 17)

The Main Contractor shall make good any defects, shrinkages or other faults which shall appear with the Defect Liability Period in accordance with the Conditions of Contract.

16.13 Working / Access Permits

The Main Contractor shall provide his employees with working / access permits with their names and photos on and a copy of the names together with the ID number of all staff employees should give to the Employer before the Works commence.

16.14 Workmen

All workers working on Site shall wear proper uniform and identity badge prominently with the names of the worker and Main Contractor clearly displayed. The worker may be requested to leave the Site immediately if found not wearing the uniform and the identity badge.

The Main Contractor shall not allow the workpeople to live on the Site at any time throughout the Contract nor to trespass beyond the limits of the Site. The Main Contractor will be held responsible for any acts of trespassing by the workpeople.

16.15 Setting Out

The Main Contractor shall set out the work and provide all instruments etc. and labour required by the Architect for checking this work.

The Main Contractor shall verify all dimensions and ground levels shown on drawings before commencing work.

Any discrepancy which occurs between the measurement on site and any dimensions shown on drawings shall be immediately brought to the attention of the Architect.

16.16 Removal of Water

The Main Contractor shall use pumping to keep the Site and the Works including all excavations, if any, free from water at any time during the execution of the Contract, and this shall be deemed to include rain, storm, percolating, spring, running water, or any other sources. All pumping must be done by means of electric pumps. No accumulation of water will be permitted at any time during the execution of the Contract.

The Main Contractor shall obtain any consent which may be required from the Government Departments to carry out pumping operations and shall allow for any delay to the Works which may be caused by delay in obtaining such permission.

The Main Contractor shall ensure that water is not allowed to accumulate anywhere on the Site in excavations, formwork, temporary or permanent tanks, cans, pots, etc., where such standing water is liable to be a breeding area for mosquitoes, and comply at all times with the Government Authorities' regulations for the prevention of breeding of mosquitoes.

The Main Contractor shall provide all things necessary including all additional temporary and permanent works and temporary drainage system to ensure that adequate measures are taken at all times and especially during typhoons, monsoons, rainstorms, etc. to properly and safely remove all surface and ground water in and around the Site including run-off from adjoining roads, sites / properties, etc. so as to protect the works and / or adjoining property from being washed out.

All such measures shall however be subject to the approval of the Architect.

16.17 Effective Diversion of Storm Water

If will be the Main Contractor's responsibility to see to the effective diversion of storm water from the existing surface water channels or other surface drainage of adjoining properties, etc. during the construction period.

16.18 Removal of Underground Obstructions

The Main Contractor shall be solely responsible for the removal of all underground obstructions of whatever nature, including breaking up existing reinforced concrete pile caps, piles, foundations, slabs, etc. and boulders and solid rock, net with during the Works.

Rates are deemed to include for removing all underground obstructions and excavating in whatever material is encountered.

The Main Contractor shall allow in his time for completion for removing any underground obstructions.

Any existing piling plan or other information which may be available are given in good faith as a guide only to tenderers, but no responsibility can be taken for their accuracy or applicability over the whole Site.

16.19 Prevention of Mosquito Breeding

The Main Contractor is required to ensure that water is not allowed to accumulate anywhere on the Site. If standing water is liable to be a breeding area for mosquitoes, the Main Contractor must at all times clear and clean the Site to prevent breeding of mosquitoes.

16.20 Bench Marks, Survey Check Points, etc.

The Main Contractor shall protect all bench marks, survey check points, etc. found within the Site.

16.21 Damage by Erosion

The Main Contractor shall be responsible for the containment of the Site including temporary access roads. In the event of any erosion, washout or collapse, he shall reinstate the Site at his own expense. Should any spoil or debris from the Site or from other areas affected by the Works be eroded and washed down or collapse onto public and or private property, the Main Contractor shall at his own expense comply with any Government instructions or Architect's instruction as to the removal of such spoil and debris and the carrying out of any remedial works and he shall indemnify the Employer against any expense, liability, loss, claim or proceeding arising out of any damage or nuisance caused by such erosion, washing down or collapse.

16.22 Protection and Cleaning upon Completion

The Main Contractor shall amply protect all new and existing finished Works including electrical and sanitary fittings, built-in fixtures, metal work, glass, tiles, terrazzo and other wall and floor finishing, and shall be responsible for any damage caused by carelessness and negligence in this respect.

At the completion of the Works, the Main Contractor shall clean up after all trades and remove all marks, stains, finger prints and other soil or dirt from all finished surfaces, ease and adjust all doors, windows, drawers, etc., check and oil all hardware, cut out

cracks in plastering and make good, clean all wall linings, floor and glass inside and out, touch up all painted and polished work and clean out all gutters and channels.

16.23 Clearance of Site on Completion

Upon completion of the Works, the Main Contractor shall clear away from the Site all tools, plant, surplus building materials, earth apparatus, temporary latrines, rubbish and temporary works of every kind (except shoring which the Architect has given instruction not to remove), and leave the Site and Works clean and in a workmanlike condition to the entire satisfaction of the Architect and shall inform the Architect for inspection before the Works are handed over to the Employer.

16.24 Liability

It is expressly provided and agreed that to final or other certificate shall under any circumstances cover or relieve the Main Contractor from liability for any fraud, default, or willful deviation from the Contract or the Work shown on the drawings, or as described in the Specifications, but he shall remain responsible for such fraud, default, or wilful deviation and the consequences thereof, whether the same be discovered or not, prior to the granting of such final or other certificates.

16.25 Fire Protection

The Main Contractor shall keep the Site and the Works thereon safe from fire hazard and shall take all possible precautions and provide all necessary fire fighting equipment and properly trained staff.

The Main Contractor shall comply with FSD's requirements e.g. provision of temporary fire pump in respect of construction site safety.

16.26 Treasure Trove, Coins, etc.

Any treasure trove, coins or objects of antiquity shall become the property of the Employer and shall be carefully removed by the Main Contractor and handed to the Architect.

16.27 Visitors

The Main Contractor shall not allow any unauthorized visitors on the Site. He shall keep a visitors book with clear warning that the Employer and Main Contractor shall be indemnified against any claim for death or injury to persons authorized to visit the Site and the Main Contractor shall provide safety helmets for such visitors.

17.0 Temporary Works

17.1 Plant, Tools, Scaffolding, Screens, Sheds, etc.

The Main Contractor shall provide, erect and maintain in good working order and remove on completion all proper scaffoldings, platforms, shoring, strutting, cranes, hoists, all other mechanical equipment, tools, implements, ladders, tarpaulins etc. together with all other tackle and plant necessary for the proper execution of the Works.

The amount of noise made on the Works is to be kept to a minimum. Generators, compressors and other noisy plant are to be muffled at all times by means of silencers, screens and the like.

The maintenance of all plant shall be undertaken outside normal working hours, however

the Main Contractor shall comply with the restrictions on working hours as stated herein. The Main Contractor shall provide sufficient reserve plant of all kinds to ensure that the work is not interrupted by breakdown of any single unit.

The Main Contractor shall erect and maintain suitable and safe ladders and gangways for the Employer / Architect to inspect thoroughly any portion of the Works with complete safety.

17.2 Hoardings, Screens, etc.

The Main Contractor shall taking over from the previous contractor, addition, alteration and maintenance of all hoardings, screens, gates, covered walkways, footways, gangways, fences, gantries, temporary enclosures, barriers, etc. to the satisfaction of the Architect and as detailed on the Drawings.

The Main Contractor shall also said, alter and maintain the hoardings, covered walkways, gates, fences, etc., as required to suit his Works and hand over the same in good condition on completion of the Works.

The Main Contractor shall provide all lighting to hoardings, covered walkways, fencing, etc. as may be required by the Architect and the Authorities.

Hoarding, fence or other shown in the Drawings shall be completed before proceeding with the Works on the Site unless prior written approval is obtained from the Architect. Where applicable, the Main Contractor shall apply for consent from the relevant Government Departments for the erection of the proposed hoardings.

Subject to the prior approval of the Architect, hoarding may be constructed using proprietary products made of re-cycled materials or materials that can be repeatedly re-used under exposed site conditions. The appearance, strength and durability of the proposed products shall be similar to those shown on the Drawings. The materials to be used or re-used shall not show any sign of deterioration or damage at the time of installation and shall be maintained in good condition throughout the construction period to the satisfaction of the Architect. If the materials are found to have deteriorated and do not meet the requirements of the Specifications. The Main Contractor shall replace those defective materials with acceptable ones at his own cost.

Hoarding, fences, gates and the like made of hardwood or containing hardwood shall not be permitted.

The permission of the Architect shall be obtained before hoarding, fences, gates or name-boards are removed.

The steel frames to name-boards and hoarding shall be painted in accordance with painting system and colour as specified by the Architect.

The hoardings, covered walkways, fencing, etc. are to be removed on completion of the Works and all works disturbed are to be made good.

17.3 Temporary Water Supply

The Main Contractor is required to make arrangements for the connection to the water supply of the Employer under the direction of the Architect. The water for the carrying out of the Works will be provided free of charge by the Employer but the Main Contractor is obliged to keep wastage to minimum. If the Main Contractor waste the water with negligence, he shall be liable to reimburse the Employer all the water consumed according to the tariff of the Hong Kong Water Authority. The Main Contractor shall pay

all fees and charges and supply temporary storages tanks, pipe lines and plumber's work, remove the temporary installation and make good all disturbed areas on completion of the Works.

17.4 Temporary Lighting and Power

The Main Contractor shall provide all necessary electric lighting and power at the Site for the carrying out of the Works.

Temporary electricity source will be provided by the Employer. The Main Contractor shall however make his own arrangement for making a metered connection from the source designated by the Architect, distribute to his work locations with temporary electrical installation, remove the temporary electrical installation after use and make good all work disturbed etc. upon completion of the Works. The Main Contractor shall pay for the electricity consumption charge.

The Main Contractor shall be responsible for all site work in distributing electricity including, but not limited to, provision, installation and subsequent removal of temporary main switch board, distribution boards, cables, wiring, junction boxes, transformers, lights and all other accessories.

The whole installation is to comply with the latest edition of the Institute of Electrical Engineers Regulations for Electrical Installations in Buildings, and all requirements of the Electricity Supply Company.

Should the Main Contractor intend to use electricity from the mains he shall apply for a temporary electricity supply at an early stage of the mobilization period. No extension of time will be granted for any delay in obtaining a temporary electricity supply.

17.5 Main Contractor's Storage Sheds, Workshops and Offices

The Main Contractor shall provide and erect all necessary workshops, messrooms, offices and sheds of suitable construction for the storage of materials, maintain them in good order to the satisfaction of the Architect, remove on completion of the Works and make good the sites.

As part of his offices the Main Contractor, shall also provide a meeting room fitted with conference table, chairs and fully furnished with reverse cycle air conditioning to seat 15 persons.

Materials may be stored in completed sections of the Works provided that no section of the structure is loaded in excess of the design loading and no hindrance is caused to the progress of the Works or access thereto or to partial completion of Works where this is required.

Separate inflammable goods storage sheds, if required, must be provided in an approved location. No inflammable goods such as oil based paints, kerosene, thinners, cellulose lacquers, bitumen or bitumen based products, etc. will be permitted to be stored in the Site during construction.

17.6 Temporary Latrines

The Main Contractor shall provide and maintain efficient and sanitary latrine accommodation for the use of male and female labour employed on the Works and keep the whole of the Site in a clean and sanitary condition to the satisfaction of the Architect and of the Director of Food and Environmental Hygiene and remove on completion.

The latrines must be emptied twice daily if not connected to foul disposal pipes and cleared away on completion. The attention of the Main Contractor is specially drawn to the fact that he must instruct his workpeople and those of the Sub-contractors to use the temporary latrines which must be provided by the Main Contractor for this purpose. The Main Contractor is responsible for arranging the necessary temporary connections to the sewers. The Main Contractor shall remove from site all such temporary accommodation and make good all work disturbed including properly disconnecting all services.

17.7 Telephones for his Own Use

The Main Contractor shall provide mobile phones for his own key personnel for liaison at any time including paying all charges.

17.8 Temporary Facilities

The Main Contractor shall provide all necessary temporary supports including, inter alia, shoring, propping, strutting, planking and strutting, sheet piling, etc. whether for the support of excavation, new work under construction or of existing buildings. All such temporary supports shall be designed by the Main Contractor to the satisfaction of the Architect and the Building Authority as required, and its construction and maintenance supervised by him. The Main Contractor shall be responsible for its safety throughout the period of the Works and no indication of approval or disapproval of such temporary supports by the Architect shall be interpreted as in any way reducing the Main Contractor's responsibility. Should the Architect in lieu of the Main Contractor subsequently undertake to provide drawings detailing the requirements for temporary supports detailing the requirements for temporary supports and should the Architect obtain the approval of the Building Authority to these proposals, then the Main Contractor shall construct the temporary supports in accordance with such drawings at no extra cost, as if they were his own design.

In the event that the Architect subsequently provided additional drawings detailing such further requirements, the Main Contractor shall construct the shoring, propping, strutting, etc. in accordance with such drawings at no extra cost and time to the Contract.

The Main Contractor's attention is drawn to the fact that hardwood is not allowed to be used for the following temporary works:-

- a. site hoarding;
- b. false work;
- c. shoring of trenches and pits.

The Main Contractor shall alter, adapt and maintain all such temporary works as may be necessary and remove on completion and make good all works disturbed.

17.9 Positions of all Site Offices, Temporary Latrines, Sheds, Hoists and the like

The Main Contractor shall submit to the Architect for approval proposals for the positions of all site offices, temporary latrines, sheds, hoists and the like. After receiving approval from the Architect, submit the proposals with the required Form to the Building Authority for approval.

17.10 Restriction of Advertising

No advertising, other than that given by the nameboards specified will be permitted on Site, except with permission in writing from the Architect. The Architect may instruct the Main Contractor to remove advertisements, etc., from the Works, whether erected by the Main Contractor or not.

Publicity releases relating to this project should be first submitted to the Employer and the Architect for approval.

17.11 Notice Boards

The Main Contractor shall be responsible to erect notice board to the satisfaction and approval of the Architect. The Main Contractor shall also be responsible for erection, relocation, extension and adaption from time to time as necessary for the completion of the Works and maintain them in good conditions during the whole Contract Period all to the satisfaction of the Architect. On completion of the Works, the notice board is to be removed and any works disturbed are made good.

17.12 Other Temporary Works

The Main Contractor shall provide all other necessary temporary works not specifically mentioned herein which may be necessary for the carrying out of the Works.

17.13 Electronic Submittal

All correspondence, shop drawings and other submittals, etc. by the Main Contractor and Nominated Sub-contractors submitted to the Architect shall be made in both hard copy and electronic format. The electronic format shall be uploaded to a web server set up by the Main Contractor for access and viewing by the Architect and other parties concerned designated by the Architect.

The following particulars will be inserted in the Appendix to the Conditions of Contract:-
Clause No.

3.1	Time for submission of master programme	- Within seven (7) calendar days of acceptance of the Contractor's tender
17.3	Defects Liability Period	- Six (6) calendar months commencing from and including the Date of Substantial Completion of the Works.
21.2	Limit of indemnity to third party liability insurance against injury or death to any person	- HK\$20,000,000.00
21.2	Limit of indemnity to third party liability insurance against injury or damage to real or personal property	- HK\$10,000,000.00
22.1	Insurance of the Works	- Clause 22A applied
22.2	Percent to cover professional fees	- Not Applicable
23.1	Date for Possession of the Site	- Within seven (7) calendar days from the Date of the Architect's written instruction
23.2	Commencement Date	- Within seven (7) calendar days from the Date of the Architect's written instruction, tentatively in December 2025
23.2	Completion Date	- 75 calendar days calculated from and including the Commencement Date (All works as shown on Drawings and Specification unless otherwise stated)
24.2	Liquidated and ascertained damages (HK\$ per day)	- At the rate of HK\$5,000.00 per calendar day for the Works
32.1	Period of Interim Certificates	- As following terms of payment
32.1	Period for payment of certificates	- Within thirty (30) calendar days upon the Contractor's presentation of the Certificate
32.4	Retention Percentage	- Not Applicable
32.4	Limit of Retention	- Not Applicable
32.6	Period for completion of the final account	- Within twelve (12) calendar months from Substantial Completion of the Works
33.1	Amount of Surety Bond	- Not Applicable
38	Fluctuation	- Not Applicable

- A. Terms of Payment
- 20% upon confirmation
 - 15% upon completion of removal works
 - 20% upon 50% completion of site works
 - 25% upon completion of site works
 - 15% upon completion of all contract works
 - 5% upon completion of DLP

GENERAL SPECIFICATION

DEMOLITION

A2 DEMOLITION

- A2.1 Scope of Works
- A2.2 Statutory Requirements
- A2.3 General Requirements
- A2.4 Salvage of Demolished Materials
- A2.5 Government Property
- A2.6 Survey
- A2.7 Notice to Government Departments and Public Utility Companies
- A2.8 Materials to be Carted Away
- A2.9 Loading and Off-Loadin15g Materials
- A2.10 Avoidance of Nuisance
- A2.11 Protection of Adjoining Buildings
- A2.12 Protection of Existing Structures
- A2.13 Hoardings and Walkways
- A2.14 Shoring
- A2.15 Scaffolding, Protective fans and Screens
- A2.16 Protection of Public Services and Diversion of Services
- A2.17 Protection of Existing Trees
- A2.18 Cutting of Trees
- A2.19 Safety of Works
- A2.20 Control of Debris
- A2.21 Method of Demolition
- A2.22 Blasting
- A2.23 Supervision
- A2.24 General Procedure of Demolition
- A2.25 Demolition of Floors, Beams, Columns, etc.
- A2.26 General Site Clearance
- A2.27 Filling Disused Underground Structures and Chambers
- A2.28 Removal of Old Foundations, etc.
- A2.29 Underpinning
- A2.30 Protection of Existing Site Monitoring Equipment

A2 DEMOLITION

A2.1 Scope of Works

A2.1.1 The Contractor shall:

- a) indemnify the Employer against claims for damages by owners or users of adjoining properties and / or structures as a result of executing the works under this Section.
- b) provide temporary easement and / or any other encroachment to owners or users of adjoining properties and / or structures.
- c) provide butterfly-shaped glass telltales set in 1:3 cement mortar applied on both sides of all structural cracks at maximum 3-metre centres, and fix these to structural elements and not to finishes. The date of installation shall be marked on the mortar.
- d) demolish all existing structures as indicated on drawings.
- e) notify all public utility companies and provide facilities for the disconnection and removal of such services. Where the services are to be abandoned but not removed by the public utility companies, the same shall be removed by the Contractor at his own expense.
- f) provide minimum 20mm thick waterproof cement sand rendering to any walls exposed due to the carrying out of the demolition work. The Contractor shall be responsible for further making good the rendering if rainwater leaks through the walls in question.
- g) provide all precautionary safety measures, screens, scaffoldings, hoardings, covered walkways and the like for the carrying out of the demolition work.
- h) provide underpinning to existing and adjoining properties where necessary.
- i) provide timbering, shuttering and shoring where necessary.
- j) perform as a Registered Specialist Contractor under Building Ordinance.
- k) clean up, remove and legally dispose of all surplus materials and debris as a result of the works under this Section before handing over the site to the Employer.
- l) any alteration to existing structures as indicated on the drawings.

A2.1.2 All alteration works shall include:

- a) wedging and pinning up,
- b) cutting to line of the remaining portions,
- c) making good any walling which collapses or is pulled down in excess of the specified requirements,
- d) preparing surfaces of floor slabs under, ceiling over, and abutting surfaces of columns or side walls to receive new finishes,
- e) facing up or flushing up of the existing surfaces after cutting to match the surrounding work,
- f) cutting back old plaster and pavings, etc. for jointing with the new finishes, and
- g) all other incidental works.

A2.1.3 The Contractor shall not, unless with the prior written consent of the Architect, or with expressed indication on drawings:

- a) carry out any permanent structural work on site.
- b) sink any well for any purposes.

A2.2 Statutory Requirements

- A2.2.1 The demolition and alteration works are to be carried out in accordance with Building (Demolition Works) Regulations including any amendments in respect of the use of mechanical equipment and any subsequent amendments made therein, and / or in any such order or manner as directed by the Architect.
- A2.2.2 Unless expressly approved by the Architect, the use of crane and hammer for demolition works in urban areas is strictly forbidden.
- A2.2.3 The Contractor shall strictly comply with the Factories and Industrial Undertakings Ordinance No. 34 of 1955 (1985 edition), Noise Control Ordinance and Noise Control (General) Regulation, and subsequent amendments made therein.
- A2.2.4 The Contractor shall comply with all currently in force requirements from
 - a) Public Health,
 - b) Labour Department, and
 - c) Environmental Protection Department.

A2.3 General Requirements

- A2.3.1 The Contractor shall demolish buildings and structures down to the required levels and those parts which are scheduled for removal as specified in the drawings, or other parts of the Specification, or as directed by the Architect.
- A2.3.2 The Contractor shall at his own expense make good damage to adjoining properties to the satisfaction of the adjoining owners.
- A2.3.3 The Contractor shall at his own expense make good any damage to any remaining part of the buildings or structures associated with the works in excess of the specified requirements.
- A2.3.4 The Contractor shall be solely responsible for the entire safety of the works. No indication of approval or disapproval of any demolition methods and sequence, shoring, screening, protection works, etc. by the Architect shall be interpreted as in any way reducing the Contractor's responsibility for the same.
- A2.3.5 The Contractor shall submit a method statement with his tender for the consideration of the Architect. The method statement shall state his:
 - a) intended method and sequence of demolition;
 - b) labour force;
 - c) use of mechanical plant, if any, and tools;
 - d) method of sealing services;
 - e) treatment of all features to be retained on site;
 - f) daily rate of removal of surplus materials; and
 - g) location of dump site;
 - h) method of protecting and preserving existing trees within the site.

- A2.3.6 If the above method statement is absent, either
- a) the Contractor is deemed to be willing to comply at his own expense with all requirements and instructions given by the Architect with regard to the method of demolition; or
 - b) the Contractor's tender will not be considered.

A2.4 Salvage of Demolished Materials

- A2.4.1 All materials, debris and other items arising from the demolition works shall become the property of the Contractor unless specifically stated otherwise in the Appendix, and due allowance for the credit value (if any) of such materials, items, etc. shall be made in the Tender.
- A2.4.2 Before the building or structure is handed over to the Contractor for demolition the Employer reserves the right to remove any fittings and fixtures if he desires to do so.
- A2.4.3 Any fittings and fixtures in the existing building or structure which are to be handed over to the Employer shall be carefully dismantled and removed by the Contractor and stored away in places as directed by the Employer.

A2.5 Government Property

- A2.5.1 The Contractor shall not remove any items from the site which are the property of the Government except with the written approval from the Architect.
- A2.5.2 The Contractor shall preserve the street name, signs, etc. on the building or structure to be demolished and hand them to the Architect as soon as possible.
- A2.5.3 The Contractor shall preserve or, with the permission from Government, relocate any road and street signs, hydrants and street fixtures all at his own cost.

A2.6 Survey

- A2.6.1 Before the commencement of the works the Contractor shall:
- a) carry out a thorough survey and examine all available drawings of the building or structure to be demolished;
 - b) locate and mark the positions of services which may be affected by the demolition.
- A2.6.2 During the execution of the works, the Contractor shall report to the Architect the details of any underground tanks, wells, etc. discovered.
- A2.6.3 On the completion of the works, the Contractor shall submit record drawings of all the treatments of services carried out by him.

A2.7 Notice to Government Departments and Public Utility Companies

The Contractor shall give due notice of the demolition works to the electric, gas, water,

telephone and any other public utility companies or government departments if their installations will be affected, and arrange for the disconnection of all existing services before the commencement of the works.

A2.8 Materials to be Carted Away

- A2.8.1 The Contractor shall remove off the site all salvaged materials, debris arising from demolition and discard all rubbish left on site by the previous occupants to a legal dump area specified in this tender submission.
- A2.8.2 The Contractor shall remove debris and rubbish in such a manner as to cause as little inconvenience as possible to the adjoining occupants and the public.
- A2.8.3 The Contractor shall not burn debris, rubbish or salvaged materials on site.
- A2.8.4 The Contractor shall not allow demolished materials to accumulate on site exerting excessive loading on the floors, ground, walls, hoardings, etc. The Contractor may be instructed to remove such materials on a daily basis at his own expense.

A2.9 Loading and Off-Loading Materials

- A2.9.1 The Contractor shall ensure that the adjoining streets, roads and paths are not obstructed, and that the traffic is not impeded due to the loading and off-loading materials for the work.
- A2.9.2 The Contractor shall conform to police regulations for the carting, loading and off-loading of all materials, plant, earth and debris, etc. to and from the works.

A2.10 Avoidance of Nuisance

- A2.10.1 The Contractor shall execute the works in such a way that the safety of the adjoining properties and occupants, the public, the passing vehicles and the workmen is ensured, and that inconvenience caused is minimised.
- A2.10.2 The Contractor shall prevent dust from arising during the works by keeping the debris well sprinkled with water.

A2.11 Protection of Adjoining Buildings

- A2.11.1 The Contractor shall execute work to protect the adjoining buildings and properties against damage which may occur from falling debris, etc.
- A2.11.2 The Contractor shall not interfere with the use of the adjoining buildings and shall maintain free, safe passage to and from the same.
- A2.11.3 The Contractor shall take precautions to safeguard the adjoining buildings against any movement, settlement or collapse, and provide all necessary bracing, shoring in connection therewith.

- A2.11.4 The Contractor shall also take precautions to safeguard the adjoining buildings against any movement, settlement or collapse of any existing retaining wall, side-walks, street, passages, adjoining footings, etc.
- A2.11.5 The Contractor shall provide safe support to the adjoining buildings and shall be liable for any movement, settlement or collapse and any damage or injury of person or property caused thereby or resulting therefrom.
- A2.11.6 If at any time the safety of any adjoining buildings appears to be endangered, the Contractor shall cease all operations on site and take necessary precautions to support such buildings and notify the Architect immediately. No work shall be resumed without the Architect's written permission.
- A2.11.7 If the Architect considers that additional bracings or shorings are necessary to safeguard against or prevent such movement, settlement or collapse of the adjoining buildings, the Contractor shall install such bracings or shorings as per the Architect's instructions, which work shall be evaluated according to the conditions of Contract.
- A2.11.8 If the Contractor fails to comply promptly with such instructions, the Architect shall have the power to order any other person to place such bracings and shorings; and the Contractor shall be responsible for any claim due to his failure to comply.

A2.12 Protection of Existing Structures

- A2.12.1 The Contractor shall provide all temporary shoring, needling, strutting or other supports necessary for the protection and safety of and upholding all portions of the existing structures during cutting of openings, replacement or demolition of structural elements, and remove the same when no longer required, including all necessary cutting away and making good.
- A2.12.2 In order to prevent water accumulation in basements which are to be retained after the completion of the works, the Contractor shall construct the following works at ground floor of the remaining building all to the satisfaction of the Architect:
 - a) concrete curb around all openings;
 - b) waterproof covers;
 - c) all necessary stormwater drainage system.

A2.13 Hoardings and Walkways

- A2.13.1 Prior to the commencement of the works, the Contractor shall erect hoardings and walkways in positions shown on the drawings, and in accordance with the required details, for the safety and convenience of passersby, occupiers of adjoining premises and workmen employed upon the works etc. The Contractor shall note that these hoardings and walkways may be phased to suit the Architect's requirements.
- A2.13.2 The hoardings and walkways shall be maintained, altered, extended, repaired and adopted if necessary at the Contractor's expense during the whole contract period in

the sequence and manner to the satisfaction of the Architect. The cover of the walkways shall be applied with approved waterproof membrane or sheets which shall be protected and laid in a manner approved by the Architect beforehand.

- A2.13.3 The hoardings and walkways shall not obstruct any drainage, surface water channel, traffic signs, signals or lights.
- A2.13.4 The whole hoardings and walkways including the underside of the cover shall be painted with two coats of approved synthetic paint of colour to be specified by the Architect. Any logo, lettering and graphics shown on drawings / details shall be provided by competent graphics painters and calligraphers.
- A2.13.5 All steel frames, bracings for the hoardings and walkways shall be primed with rustproof primer and painted with two coats of approved synthetic paint of colour specified.
- A2.13.6 Unless otherwise specified, the covered walkways shall be adequately lit to the satisfaction of the Architect and the Building Authority. All metal conduit wiring and lighting fittings shall be waterproof and vandal proof to the satisfaction of the Architect. All systems of wiring shall be carried out by a Registered Electrician in strict accordance with the I.E.E. regulations and supply rules of the power company currently in force.
- A2.13.7 On completion of demolition works the hoardings and walkways shall be left in position and handed back to the Employer in good condition, or otherwise as directed by the Architect.

A2.14 Shoring

- A2.14.1 The Contractor shall provide and erect all necessary shoring and strutting at positions shown on the drawings, including obtaining licenses from government departments where necessary.
- A2.14.2 The Contractor shall be solely responsible for the construction and adequacy of the said shoring and strutting for the purpose for which they are erected. The shoring shall be the property of the Employer upon the completion of demolition works.
- A2.14.3 The maintenance period of the said shoring and strutting shall be three (3) months from the completion of the demolition works. However, the Contractor's responsibility shall be released upon the commencement of any subsequent piling or building works on site.

A2.15 Scaffolding, Protective Fans and Screens

- A2.15.1 Scaffolding shall be provided on the outside of the building and should be reinforced to withstand strong wind. Calculations shall be submitted as and when required by the Architect.

- A2.15.2 Protective screens constructed of flame-retardant material as approved by Architect shall be erected to cover all external or walls or walls abutting open areas accessible to the public. The Contractor shall submit his proposed material for the Architect's approval, as and when required.
- A2.15.3 Temporary protective screens constructed of flame-retardant material as approved by Architect shall also be erected to protect the adjoining buildings during the works. The Contractor shall submit his proposed material for the Architect's approval, as and when required.
- A2.15.4 Steel catch fans shall be erected at the level of the first floor of the existing building or below cantilever structures above street.
- A2.15.5 Catch fans shall also be erected at the level of such other floors of the existing building or structure at vertical intervals of not more than 10 metres, with the uppermost fan not more than 10 metres below the working level.
- A2.15.6 All necessary scaffolding, screens and other temporary protections shall be provided and maintained to the satisfaction of the Architect and Government Authorities concerned, and be removed upon the completion of the works, or when no longer required.

A2.16 Protection of Public Services and Diversion of Services

- A2.16.1 The Contractor shall ensure that all the existing services within the site have been disconnected or diverted by the public utility companies and government departments concerned before the commencement of the demolition works.
- A2.16.2 The Contractor shall take every precaution to prevent damage to, and exercise extreme care during the execution of the works in the vicinity of electrical cables, as these may have been dislocated from their positions indicated on existing plans.
- A2.16.3 Any services layout drawings are given in good faith only as a guide to the Contractor. The Architect takes no responsibility for their accuracy.
- A2.16.4 The Contractor shall report to the Architect immediately of any live water, electric and gas supply, telephone and rediffusion connections which have not been removed or disconnected by the respective government department or utility company, so that the Architect can serve notice to them accordingly.
- A2.16.5 The Contractor shall disconnect and seal all stormwater drains or sewers from the last manhole of the specified premises leading to the government stormwater drains or sewers in accordance with the rules, requirements and regulations of the relevant authorities.
- A2.16.6 All costs chargeable by the utility companies or government departments in connection with the disconnection or diversion of services shall be reimbursed to the

Contractor by the Employer.

- A2.16.7 Unless otherwise indicated, all manholes within the site shall be removed together with any connecting drains or sewers, and the pipes shall be blocked up at the site boundary. Where manholes are to be retained as directed, they shall be blocked up at the inlets to the satisfaction of the Architect. The Contractor shall obtain the Architect's written approval of the removal of any manhole, and submit record drawings of any blocked utilities of this kind.
- A2.16.8 The Contractor shall ensure that no public roads, drains, sewers, electric cables, overhead wires, gas mains, telephone lines or other public utility installations are damaged by the works under this Section. The Contractor shall indemnify the Employer against all claims, charges or expenses for making good any damage to the above installations caused by the works.

A2.17 Protection of Existing Trees

- A2.17.1 The Contractor shall not cut any tree of diameter exceeding 150 mm measured at 1 m from the ground level without the prior written permission of the District Lands Office.
- A2.17.2 The Contractor shall preserve all existing trees on site by providing daily and competent attendance.
- A2.17.3 If any existing tree is damaged, destroyed or felled within the contract period, the Contractor shall at his own expense make good the resultant tree deficiency the satisfaction of the Architect.

A2.18 Cutting of Trees

- A2.18.1 The Contractor shall uproot the whole tree where shown on the drawings, unless he is otherwise instructed to cut down the tree as near to the ground level as possible.
- A2.18.2 All felled trees shall be removed from the site.
- A2.18.3 Stumps and tree roots shall, unless otherwise directed by the Architect, be grubbed up and removed from the site.
- A2.18.4 Holes left by stumps and roots shall be filled with suitable materials and well compacted.

A2.19 Safety of Works

- A2.19.1 The Contractor shall erect all necessary temporary supports to prevent any unexpected collapse of any part of the building or structure during demolition.
- A2.19.2 The Contractor shall provide all necessary measures to secure the site against unauthorised entry.

- A2.19.3 The Contractor shall ensure that there will be no unstable free-standing structure left after work each day.
- A2.19.4 No electric cables or other apparatus, other than such cables or apparatus used during the works, shall at any time remain electrically charged.
- A2.19.5 The Contractor shall take all necessary precautions to prevent danger from the risk of fire or explosion through the leakage or accumulation of gas or vapour, especially when removing tanks or pipes which may contain flammable liquid, gas or particles.
- A2.19.6 The Contractor shall take all necessary precautions to prevent danger from the risk of flooding from water mains, sewers or culverts.

A2.20 Control of Debris

- A2.20.1 Debris shall only be allowed to fall freely through lift shafts or chutes specially provided for the purpose.
- A2.20.2 Precautions shall be taken against flying or falling debris by sealing off all openings in walls adjacent to the area of fall.
- A2.20.3 Care shall be taken to prevent excessive lateral pressure being built up due to the stacking of debris against walls, structures and timber hoardings adjoining the public footpaths or carriageways.
- A2.20.4 In order to prevent overloading the floor slabs and to spread the loading of the debris, timber platforms supported on the floor beams shall be provided at the floor below.
- A2.20.5 The existing lift pits shall be slabbed over at the ground floor level to prevent the accumulation of debris.

A2.21 Method of Demolition

- A2.21.1 All plant and equipment employed in the carrying out of the demolition work shall be subject to the approval of the Architect and the Building Authority.
- A2.21.2 The use of mechanical equipment, such as a vehicle operating a pneumatic chisel or a crane and hammer, on a portion of the building close to adjoining buildings, streets, lanes or areas accessible to the public, is considered as having unacceptable risks and shall not be used.
- A2.21.3 Demolition using hand-held tools shall be adopted.
- A2.21.4 No use of air compressors with breakers shall be allowed unless approved by the Architect.
- A2.21.5 Lifting appliances may be used for lifting and lowering demolished members once

they are released.

A2.22 Blasting

A2.22.1 Blasting for demolition purpose shall not be permitted.

A2.23 Supervision

A2.23.1 The demolition and all works incidental thereto shall be specifically placed under the supervision of a person experienced in the carrying out of demolition works and appointed for the purpose.

A2.23.2 A notice in the prescribed form specifying the name of the person so appointed shall be posted up in a prominent position on the site of the works.

A2.23.3 The following operations shall be carried out only under the immediate supervision of a competent foreman with adequate experience of demolition works, or by workmen experienced in the kind of works under the direction of a competent foreman with adequate experience of the particular kind of work:

- a) the actual demolition of the framework of a building or of any floors, walls, roofs or staircases, save where there is no risk of collapse of any parts of a building, in the course of, or as a result of, the demolition works, so as to endanger any persons employed in the demolition works, other than a risk which cannot reasonably have been foreseen;
- b) the actual demolition of any parts of a building where there is a special risk of collapse, whether of the whole of the building or of any parts of a building, in the course of, or as a result of, the demolition works, so as to endanger any persons employed in the demolition works;
- c) the cutting or breaking up or dismantling of reinforced concrete, steelwork or ironwork forming part of the structure of a building.

A2.24 General Procedure of Demolition

A2.24.1 All internal glazed sashes and doors shall be removed from the building prior to demolition.

A2.24.2 Demolition shall be commenced by removing partitions and external non-bearing cladding and architectural features.

A2.24.3 Work shall be carried out from the top down and from the outside in to preserve stability.

A2.24.4 As demolition proceeds, temporary supports and guards shall be provided to control the fall of cut members and to support any unrestrained remaining members.

A2.24.5 All demolition works shall be executed in such a manner as not to weaken or cause collapse of any structures hence endangering the workmen on site.

A2.25 Demolition of Floors, Beams, Columns; etc.

- A2.25.1 Floors shall be demolished in strips parallel to the main reinforcement.
- A2.25.2 Beams shall be demolished by first exposing the reinforcement at both ends, and the reinforcement shall then be cut in such a way as to allow the beams to be lowered under control to the floor.
- A2.25.3 Columns shall be demolished by first exposing the reinforcement at the base, and the reinforcement shall then be cut in such a way as to allow the columns to be pulled down to the floor under control.

A2.26 General Site Clearance

- A2.26.1 The Contractor shall demolish, break up and remove walls and superficial obstructions down to the ground level on the site in the way of or otherwise affected by the Works.
- A2.26.2 The Contractor shall clear each part of the site at times and to the extent as required, directed or approved by the Architect.

A2.27 Filling Disused Underground Structures and Chambers

Disused underground structures and chambers shall be filled and compacted with approved hard dry materials to levels as directed by the Architect.

A2.28 Removal of Old Foundations, etc.

- A2.28.1 The Contractor shall break up and remove:
 - a) ground slabs;
 - b) ground beams;
 - c) reinforced concrete foundations;
 - d) piles
 - e) old concrete;
 - f) disused manholes, drains, gullies, culverts, cable trenches and the like;
 - g) old sea walls
 - h) any other artificial obstructions.
- A2.28.2 The Contractor shall fill up all voids with approved hard dry materials and well compact the materials to levels as directed by the Architect.

A2.29. Underpinning

- A2.29.1 Where the foundations of a new building are below the level of an adjoining building, underpinning shall be carried out from the level of the bottom of the new foundation to the underside of the foundation of the adjoining buildings with brickwork or

reinforced concrete as shown on drawings.

A2.29.2 Unless otherwise directed by the Architect, no underpinning shall be carried out simultaneously at any two locations with a clear distance of:

- a) less than 1.5 metres apart;
- b) Not more than 1.5 metres in length.

A2.29.3 The Contractor shall wedge and pin up on top of the new underpinning to the underside of the old underpinning with cement sand mortar.

A2.29.4 The cement sand mortar shall be in the proportions specified in the drawings, mixed fairly dry and well rammed in.

A2.30 Protection of Existing Site Monitoring Equipment

A2.30.1 Where site monitoring equipment such as inclinometers or piezometers have been installed on site at locations shown on the drawings. The exact locations shall be verified on site by the Contractor.

A2.30.2 All existing site monitoring equipment shall be protected against any disturbance from the demolition works. Should there be any damage to the equipment which affects its operation or function, the Contractor should rectify the damage and if necessary install replacement equipment at his own expenses at locations to be approved by the Architect.

A2.30.3 A free access to all existing site monitoring equipment shall be allowed by the Contractor at all times.

A2.30.4 Upon the completion of the demolition works, all debris around the monitoring equipment shall be removed.

A2.30.5 The alignment of the hoarding shall be locally adjusted so that access to the monitoring equipment is not obstructed at any time.

GENERAL SPECIFICATION

ARCHITECTURAL CONCRETE WORK

A4 ARCHITCTURAL CONCRETE WORK

- A4.1 Scope of this Section

- A4.2 Materials
 - A4.2.1 Cement
 - A4.2.2 Sand
 - A4.2.3 Admixtures
 - A4.2.4 Water

- A4.3 Workmanship
 - A4.3.1 Generally
 - A4.3.2 Mixing, Testing and Placing of Concrete
 - A4.3.3 Mix Schedule
 - A4.3.4 Concrete with Waterproof Compound
 - A4.3.5 Concrete with Hardener
 - A4.3.6 Lightweight Concrete
 - A4.3.7 Foamed Concrete
 - A4.3.8 Raw Concrete Surfaces
 - A4.3.9 Fair-Face (F.F.) Concrete

- A4.4 Sundry Works
 - A4.4.1 Holes and Openings
 - A4.4.2 Concrete Pads for Pipes
 - A4.4.3 Concrete Plinths for Pumps
 - A4.4.4 Concrete Plinths under Fittings
 - A4.4.5 Concrete Posts for Fence and Gate
 - A4.4.6 Surface Channels
 - A4.4.7 Flat Channels
 - A4.4.8 Lintols
 - A4.4.9 Other Concrete Works

Appendix I – Specimen Form of Guarantee (Waterproof Concrete System)

A4 ARCHITECTURAL CONCRETE WORK

A4.1 Scope of this Section

- a) All concrete works not indicated on structural drawings.
- b) Installation of pipe sleeves, anchors, bolts, inserts and holdfasts.
- c) Waterproof compound for ordinary waterproof concrete works.
- d) Cement hardener for concrete pavings.
- e) Lightweight concrete including foamed concrete.
- f) All types of fair face concrete finish.
- g) Special formwork for fair face concrete works.
- h) Concrete pads or plinths for mechanical equipment and / or pipe works.
- i) Sundry concrete including precast concrete posts, cooking slabs, architectural fins, duct heads, etc.

A4.2 Materials

A4.2.1 Cement

- a) Cement shall be Ordinary Portland Cement (O.P.C.) in conformity with the requirements of B.S. 12.
- b) The Contractor shall obtain a manufacturer's test certificate in accordance with the appropriate standard for each consignment of cement delivered to site and shall forward a duplicate of the same to the Architect immediately.
- c) Notwithstanding the manufacturer's test certificate, the Architect may require that any cement delivered to site, or elsewhere for use in the Works, shall be sampled and tested. Any batch of cement so tested which fails to comply with the appropriate B.S. specifications will be rejected.
- d) All cement shall be delivered in original sealed bags of the manufacturer or in approved bulk containers.
- e) All cement shall at all times be protected from deterioration. Bagged cement shall be stored in a weatherproof shed, the floor of which shall be raised at least 150 mm above the ground to allow free air circulation. Cement delivered in bulk shall be stored in a weatherproof silo.
- f) Each consignment of cement shall be clearly identified, stored separately and used in order of delivery. Different types of cement shall not be used in combination.
- g) Any cement which, upon inspection, is considered by the Architect to have deteriorated in any way will be rejected, and immediately removed from site.

A4.2.2 Sand

- a) Sand shall mean naturally occurring sand, crushed stone or a combination of both. In any case, sand shall be clean and free from salt.
- b) Grading of sand shall be:

<u>B.S. Sieve</u>	<u>% by weight passing B.S. Sieve</u>
5.00mm	100
2.36mm	90 – 100
1.18mm	70 – 100
600µm	40 – 100
300µm	40 – 70
150µm	0 – 15
- c) Sand shall contain no greater than 5% (10% if crushed stone) of fine clay, silt or fine dust by weight.
- d) The Architect may require at any time that sand delivered to site be tested to ascertain its sulphate soundness, alkali reaction, chloride ion content and grading, and to check for presence of adherent coatings, clay, or other harmful substance which may adversely affect the hardening, strength or durability of the mortar, screed or plaster.
- e) Well before the commencement of any works, the Contractor shall forward to the Architect for approval details of his proposed source of supply of sand giving the aggregate group

- classification and typical physical and chemical properties as required by B.S 882 and this Specification.
- f) Any sand which, in the opinion of the Architect, does not conform with the above requirements or has become contaminated may be rejected by the Architect, and immediately removed from site.

A4.2.3 Admixtures

- a) Admixtures shall comply with B.S. 1014 or B.S. 5075.
- b) Admixtures and additives shall not be used without the written approval of the Architect. To obtain this approval the following information shall be submitted at least seven (7) days before it is intended to be used in the work:
- 1) manufacturer's printed literature and test certificates;
 - 2) the proposed dosage and detrimental effects, if any, of underdosage and overdosage;
 - 3) details of the chloride content;
 - 4) method of application.
- c) When the use of admixtures or cement containing additives is approved or specified, they shall be used strictly in accordance with the manufacturer's instructions and at dosage levels approved by the Architect.
- d) Admixtures shall be stored in watertight and weatherproof containers clearly labeled to show the contents.
- e) Every time of use of admixtures and additives shall be entered in Contractor's daily reports and submitted to Architect for record purpose.

A4.2.4 Water

- a) Water for use in mixing with cement or for wetting bricks or blocks shall be potable water from an approved source, be clean, fresh and free from organic and other deleterious matter.
- b) The Architect may require that any water be sampled and tested by the method given in B.S. 3148. Water failing the criteria given in the appendix to B.S. 3148 will be rejected.
- c) Temperature of water for use in mixing with cement shall be within the range of 5°C to 25°C.

A4.3 Workmanship

A4.3.1 Generally

Architectural concrete work shall conform to B.S. 5628.

A4.3.2 Mixing, Testing and Placing of Concrete

Mixing, testing and placing of concrete shall be as specified for structural concrete.

A4.3.3 Mix Schedule

- a) Unless otherwise specified, architectural concrete shall be mixed in accordance with Table 1 or Table 2.
- b) The actual mix proportion for each item of concrete work shall be approved by the Architect before concreting.

TABLE 1 Ordinary Grade for use with granite fines and 45kg bags of cement

Materials	Cement/kg	Granite m ³				Water/liter
		30mm	20mm	10mm	Fines	
Mix A (1:2:4)	45	0.10	-	0.05	0.05	18 to 22
Mix B (1:2:4)	45	-	0.06	0.07	0.06	18 to 22
Mix C (1:3:6)	45	0.12	-	0.09	0.08	25 to 30

TABLE 2 Ordinary Grade for use with sand aggregates and 45kg bags of cement

Materials	Cement/kg	Granite m ³				Water/liter
		30mm	20mm	10mm	Coarse sand	
Mix F (1:2:4)	45	0.04	0.07	-	0.07	18 to 22
Mix G (1:2:4)	45	-	0.07	0.04	0.07	18 to 22
Mix H (1:3:6)	45	0.08	0.08	0.04	0.08	25 to 30

- A4.3.4 Concrete with Waterproof Compound
- a) The following brands of waterproof compounds will be considered by the Architect for use in producing waterproof concrete:
Manol, Pudlo, Cement Aids or approved equivalent.
- b) All waterproof compound shall be used strictly in accordance with the manufacturer's instructions and under the direct supervision of the supplier, if there is any.
- c) Upon completion of waterproofing system concrete works and acceptance by Architect, the Contractor shall furnish a written guarantee that the works shall remain watertight and free from defects for a period of ten (10) years and the guarantee shall be in a form all as per the Specimen Guarantee appended with this specification.
- A4.3.5 Concrete with Hardener
- a) The following brands of hardeners will be considered by the Architect for use in producing concrete with hardener:
Manol, Pudlo, Cement Aid, Tricosal or approved equivalent.
- b) All hardeners shall be used strictly in accordance with the manufacturer's instructions and under the supervision of the supplier, if there is any.
- A4.3.6 Lightweight Concrete
- Shall be concrete of 1:3:6 mix with approved lightweight aggregates such as foamed slag, expanded vermiculite or perlite but the weight of concrete shall not exceed 800kg/m³ in general and 650kg/m³ some particular cases as shown on drawings.
- A4.3.7 Foamed Concrete
- a) All foamed concrete shall be batched with one of the following foaming agents:
Manol, Cement Aids, Aircon or approved equivalent.
- b) Foaming agents shall be executed strictly in accordance with the manufacturer's instructions.
- A4.3.8 Raw Concrete Surfaces
- a) Where concrete is specified to have a rendering finish, such finish shall be applied whilst the concrete is still "green".
- b) Where, in the opinion of the Architect, the concrete finish including rendering, terrazzo and granolithic cannot be applied whilst the concrete is still 'green', the hardened concrete shall be thoroughly cleaned, well wetted and washed with cement grout before the finish is laid.
- A4.3.9 Fair-Face (F.F.) Concrete
- a) Unless otherwise specified, all fair face concrete shall be finished as one of following treatments described below:
- Steel Trowelled F.F. Concrete
- 1) Floor surfaces required to be self-finished shall be trowelled smooth with a steel trowel, using additional cement for surfacing if necessary.
 - 2) Surface finishing of concrete shall be carried out only by experienced and skillful craftsmen.

Wood Floated F.F. Concrete shall be applied to floors and pavings where specified. The surface shall be worked over with a rubber faced timber float to ensure a smooth, even and textured surface.

Rammed F.F. Concrete

- 1) When applied to yard and footpath, etc. where specified:
 - i) Additional cement shall be thrown on top to absorb surface water before trowelling with wood float to an even surface.
 - ii) Mark the surface with a "V" edge board while the concrete is still 'green' in the direction as shown on the drawings to produce an even texture throughout.
- 2) When applied to access road, ramps, etc. where specified:
 - i) Following completion of the final compaction by the vibration, the final line and level will be obtained by a tamping board with three passes.
 - ii) The board shall extend the full width of the slab as cast and be operated by two men.
 - iii) For the first pass, the board shall be dropped 300mm to 450mm following which the minor irregularities shall be made up by hand-placing using a drop of 150mm to 225mm. A final pass using a drop of 25mm to 50mm shall be made rapidly to even out any ridges.
 - iv) When an initial set has occurred and usually about 30 minutes after the placing, a stiff-bristled English pattern broom shall be drawn lightly across the surface of slab in one motion, reserving all evidence of corrugation and leaving a rough but uniformly lined surface, the lines being perpendicular to the direction of traffic flow.

Timber Formed F.F. Concrete

- 1) Formwork shall be of 100mm uniform width sawn timber boards unless otherwise specified.
- 2) Each face of timber board shall only be used once for walls and columns.
- 3) Pattern of timber formwork and location of recess lines shall be strictly in accordance with drawings.
- 4) Joints shall be perfectly butted and no watertight strip of any kind shall be used.
- 5) Additional vibration shall be allowed at the end of each pour to ensure that no honey-comb is formed at the joint.

Batten Formed F.F. Concrete

- 1) Formwork shall be of 50mm x 25mm timber battens shown on drawings unless otherwise specified.
- 2) Batten formwork shall only be used once.
- 3) Recess line on fairface concrete work shall be formed by the insertion of hardwood sections of the required sizes as shown on drawings.
- 4) Concrete of walls and columns shall only be allowed to stop at top of the recess line.

Plywood Formed F.F. Concrete

- 1) Formwork shall be of waterproof plywood in sheets of adequate thickness and banded with marine type phenolic resins.
- 2) All F.F. concrete finishes shall be properly protected when finished. No retouching shall be permitted to off-form concrete surfaces.
- 3) Two coats of transparent waterproof silicon paint shall be applied to all exterior walls of fair face concrete.
- 4) Unsatisfactory work due to honey-combing, stains, damages and other defects shall be cut and reworked as directed by the Architect at the Contractor's own expense. The Architect, at his absolute discretion may order the entire unsatisfactory work to be demolished and re-executed at the Contractor's own expense.

A4.4 Sundry Works

A4.4.1 Holes and Openings

- a) Provision shall be made for forming holes and openings for service pipes, conduits, and ducts as indicated on drawings. The Contractor shall coordinate with all sub-contractors or suppliers to supply in time the necessary pipe sleeves to be inserted before concreting, where such pipe sleeves are clearly stated as outside the scope of work of the main contract.
- b) Holes and openings shall be formed in such a way that they do not interfere with any reinforcement.
- c) All pipe sleeves shall be accurately installed and secured.

A4.4.2 Concrete Pads for Pipes

Form concrete pads with 1:2:4 ordinary mix, shaped to support pipes without deflection, at least 75 mm clear of roof surface and finished smooth.

A4.4.3 Concrete Plinths for Pumps

Form concrete plinths to required size for pumps and other mechanical equipment with 1:2:4 mix, unless otherwise specified.

A4.4.4 Concrete Plinths under Fittings

Shall be 1:3:6 mix under cupboard fittings, around squatting type W.C. pans, etc. as shown on drawings.

A4.4.5 Concrete Posts for Fence and Gate

- a) Concrete fence and gate posts are to be precast or cast in-situ of 1:2:4 mix unless otherwise specified and are to conform to details shown on drawings.
- b) Steel reinforcement shall be in accordance with those specified in Structural Concrete Work.

A4.4.6 Surface Channels

- a) Surface water channels shall be constructed to sizes as shown on drawings with concrete of 1:2:4 mix in a minimum thickness of 75mm at sides and 100mm at base and formed with semi-circular water ways of the diameter, depths and falls as shown on drawing.
- b) The exposed surfaces where required shall be rendered with 12mm thick cement and sand (1:3) rendering and steel trowelled smooth.

A4.4.7 Flat Channels

- a) Construct 225mm or other sizes flat channels in 1:2:4 mix concrete laid to proper fall on 100mm hardcore.
- b) The flat channel shall be rendered smooth with 12mm thick cement and sand (1:3) rendering and steel trowelled smooth.

A4.4.8 Lintols

- a) Lintols shall be provided over any opening wider than 200 mm in brickwork and blockwork, except for openings to underside of structural beam and those in structural wall.
- b) Lintols shall be precast or cast-in-situ concrete, mix B or G and to be constructed as follows:

Clear span not Exceeding	Minimum Depth required	No. of bars at bottom with 25 mm cover		
		≤115 mm wide	125 to 225 mm	≥225 mm
1200 mm	150 mm	1 x 12 mm dia.	2 x 12 mm dia.	3 x 12 mm dia.
2100 mm	225 mm	1 x 16 mm dia.	2 x 16 mm dia.	3 x 16 mm dia.
3000 mm	300 mm	1 x 20 mm dia.	2 x 20 mm dia.	3 x 20 mm dia.

- c) A minimum of 150mm bearing at each end of lintol shall be provided for all masonry work.
- d) Lintols abutting R.C. column or wall shall be cast-in-situ and supported by 20mm diameter x 450mm long mild steel dowel bar with 225mm embedded in the R.C. column

- e) or wall during concreting.
No. of dowel bars shall be allowed as follows:
1 No. for lintols up to 125mm wide
2 Nos. for lintols from 125mm up to 225 mm wide
3 Nos. for lintols over 225mm wide
- f) If the Contractor fails to reserve the aforesaid dowel bars, he shall at his own expense provide a 75mm x 75mm x 12mm thick mild steel angle bracket at each end of lintol with same width to suit the thickness of lintol and to be secured by 2 No. of 12mm diameter red head anchor bolts.
- A4.4.9 Other Concrete Works
Other concrete works not particularly specified such as architectural features, fins, eaves, etc. shall be of the same mix of the attached structure and of mix B or mix G if precast and shall be constructed according to drawings with necessary steel reinforcement as provided for non-structural concrete (i.e. 48 kg/m³) unless otherwise indicated on the drawings.

SPECIMEN FORM OF GUARANTEE

(Waterproof Concrete System)

TO: _____ (Employer)

1. We, _____ (Contractor)

of _____ (Address)

are the Contractor of the Waterproofing System for the concrete structures

including _____ (Works)

of _____ (Project)

and these works were completed on _____ (Date of Practical Completion)

2. We shall assume responsibility for the visible migration of water through the waterproof concrete structures described above, for a period of **ten (10)** years from the Date of Practical Completion of the Contract, subject to the conditions herebelow.
3. Our responsibility includes the penetration of water through cracks caused by structural failure or other causes, or through expansion joints, and includes water entry through honeycombing and / or voids as a result of poor compaction of the waterproof concrete, or of leaking formwork, or for concrete which has been disturbed or tampered with.
4. This Warranty does not include or cover the liability for damage or failure of the waterproofing system caused by fire, explosion, vibration, structural movement, lightning, thunderbolt, earthquake, riot, civil commotion, strikes or labour disturbances.
5. Our liability for any non-performance of the waterproofing system includes the direct costs of repairs or rectification of the waterproof concrete through which visible water is migrating and the cost for any consequential loss or damage suffered by the Employer.
6. We shall be notified in writing of any non-performance of the waterproofing system and the area of non-performance as soon as practicable after such non-performance shall have come to the knowledge of the Employer or his representative.
7. We shall respond within 48 hours to fault calls. Remedial work, if necessary, shall be carried out at our expense in a manner as may be directed by us or our nominee.

Authorized Signature
(With Company Seal)

Date: _____

GENERAL SPECIFICATION

BRICKWORK & BLOCKWORK

A5 BRICKWORK & BLOCKWORK

A5.1	<u>Generally</u>
A5.1.1	British Standards and Codes of Practice
A5.1.2	Work included in this Section
A5.1.3	Samples
A5.2	<u>Materials</u>
A5.2.1	Cement
A5.2.2	Sand
A5.2.3	Lime
A5.2.4	Water
A5.2.5	Bricks
A5.2.6	Solid Concrete Block
A5.2.7	Hollow Concrete Block
A5.2.8	Hollow Glass Block
A5.2.9	Brickwork Reinforcement
A5.2.10	Damp Proof Courses
A5.2.11	Wall Ties
A5.2.12	Movement Joint
A5.2.13	Mastic for Pointing Around Windows, Louvres, etc.
A5.3	<u>Workmanship</u>
A5.3.1	Mortar
A5.3.2	Laying of Bricks
A5.3.3	Laying of Concrete Block
A5.3.4	Laying of Glass Block
A5.3.5	Thickness of Non Load-bearing Walls
A5.3.6	Uniformity
A5.3.7	Tolerances
A5.3.8	Bonding of Walls and Partitions
A5.3.9	Ties to Concrete
A5.3.10	Damp Proof Course
A5.3.11	Chases, Reveals, Recesses, etc.
A5.3.12	Sleeve Openings
A5.3.13	Pinning up to Underside of Beams, etc.
A5.3.14	Bedding and Pointing Frames
A5.3.15	Rake Out for and Point Flashing, etc.
A5.3.16	Expansion Joints
A5.3.17	Fixing of Metal Windows and Louvres

A5 BRICKWORK & BLOCKWORK

A5.1 Generally

- A5.1.1 British Standards and Codes of Practice
Brickwork and blockwork shall conform to B.S.5628.
- A5.1.2 Work included in this Section
- a) 100mm or 75mm thick brickwork or blockwork for internal partitions, pipe ducts and supports to benches.
- b) Supply and installation of mild steel angles, holdfasts, dowels, anchors, metal inserts, etc. for brickwork and blockwork.
- A5.1.3 Samples
- a) Samples of bricks and blocks, glass blocks, etc. shall be submitted for approval before placing bulk order.
- b) Sample of finished work of facing bricks (in panels not exceeding 3m x 3m) shall be provided on site as instructed by Architect.

A5.2 Materials

- A5.2.1 Cement
- a) Cement shall be Ordinary Portland Cement (O.P.C.) in conformity with the requirements of B.S.12.
- b) The Contractor shall obtain a manufacturer's test certificate in accordance with the appropriate standard for each consignment of cement delivered to site and shall forward a duplicate of the same to the Architect immediately.
- c) Notwithstanding the manufacturer's test certificate, the Architect may require that any cement delivered to site, or elsewhere for use in the Works, shall be sampled and tested. Any batch of cement so tested which fails to comply with the appropriate B.S. specifications will be rejected.
- d) All cement shall be delivered in original sealed bags of the manufacturer or in approved bulk containers.
- e) All cement shall at all times be protected from deterioration. Bagged cement shall be stored in a weatherproof shed, the floor of which shall be raised at least 150mm above the ground to allow free air circulation. Cement delivered in bulk shall be stored in a weatherproof silo.
- f) Each consignment of cement shall be clearly identified, stored separately and used in order of delivery. Different types of cement shall not be used in combination.
- g) Any cement which, upon inspection, is considered by the Architect to have deteriorated in any way will be rejected, and immediately removed from site.
- A5.2.2 Sand
- a) Sand shall mean naturally occurring sand, crushed stone or a combination of both. In any case, sand shall be clean and free from salt.
- b) Grading of sand shall be:
- | <u>B.S. Sieve</u> | <u>% by weight passing B.S. Sieve</u> |
|-------------------|---------------------------------------|
| 5.00 mm | 100 |
| 2.36 mm | 90 – 100 |
| 1.18 mm | 70 – 100 |
| 600 µm | 40 – 100 |
| 300 µm | 40 – 70 |
| 150 µm | 0 – 15 |
- c) Sand shall contain no greater than 5% (10% if crushed stone) of fine clay, silt or fine dust by weight.
- d) The Architect may require at any time that sand delivered to site be tested to ascertain its sulphate soundness, alkali reaction, chloride ion content and grading, and to check for

- presence of adherent coatings, clay, or other harmful substance which may adversely affect the hardening, strength or durability of the mortar, screed or plaster.
- e) Well before the commencement of any works, the Contractor shall forward to the Architect for approval details of his proposed source of supply of sand giving the aggregate group classification and typical physical and chemical properties as required by B.S. 882 and this Specification.
- f) Any sand which, in the opinion of the Architect, does not conform with the above requirements or has become contaminated may be rejected by the Architect, and immediately removed from site.
- A5.2.3 Lime
- a) Stone lime shall consist of quicklime formed by burning a natural rock or other suitable material at such a temperature that it will slake when brought into contact with water.
- b) Stone lime may also be dry hydrated lime in the form of a fine dry powder produced by treating quicklime so as to produce a dry sound product.
- c) The calcium and magnesium compounds present in the lime as oxides shall be not less than 70% by weight.
- d) Lime may be well burnt stone or chalk lime which has been run into a putty and sieved through a 3mm sieve into a maturing tank a minimum of one month before use.
- e) Alternatively it shall be hydrated lime (Class A) complying with B.S. 890 which has run into a putty 24 hours before use.
- f) Lime shall be delivered to site in sealed bags carrying manufacturer's name or brand.
- g) Shell lime shall NOT be use.
- A5.2.4 Water
- a) Water for use in mixing with cement or for wetting bricks or blocks shall be potable water from an approved source, be clean, fresh and free from organic and other deleterious matter.
- b) The Architect may require that any water be sampled and tested by the method given in B.S. 3148. Water failing the criteria given in the appendix to B.S. 3148 will be rejected.
- c) Temperature of water for use in mixing with cement shall be within the range of 5°C to 25°C.
- A5.2.5 Bricks
- a) Clay bricks:
- 1) Shall be well burnt, hard, sound, square, clean and free from cracks or other defects.
 - 2) Nominal dimension of bricks shall be 225 x 105 x 70 mm.
 - 3) The average crushing strength of a random selected sample of 10 bricks shall be not less than 3.5 MPa or as specified.
- b) Bricks for fair faced work shall be "selected", being picked for texture, sharpness of arrises and uniformity of shape and colour.
- c) Facing bricks shall be provided as per drawings.
- d) Engineering or loadbearing bricks:
- 1) shall be to B.S. 3921 and obtained from an approved manufacturer.
 - 2) the average crushing strength of a random selected sample of 10 bricks shall be not less than 10.5 MPa or as specified.
- e) Fire bricks:
- 1) shall be imported fireclay refractory bricks of the best quality, light in colour, uniform in texture and of standard sizes to B.S. 3056.
 - 2) testing, if specified, shall be to B.S. 1902.
- A5.2.6 Solid Concrete Block
- a) Solid concrete blocks shall be to B.S. 6073 : Part 1 and obtained from an approved manufacturer.
- b) The average crushing strength of a random selected sample of 10 blocks shall be not less than 7.0 MPa or as specified.
- c) Sizes shall be 300 x 100 x 200mm, 300 x 200 x 200mm or as specified in drawings with 25mmΦ semi-circular groove formed on all edges.

- A5.2.7 Hollow Concrete Block
- a) Hollow concrete blocks shall be obtained from an approved manufacturer.
 - b) The average crushing strength of a random selected sample of 10 blocks shall be not less than 5.0 MPa or as specified.
 - c) Sizes shall be 300 x 75 x 200mm, 300 x 150 x 200mm or as specified in drawings with 25mm Φ semi-circular groove formed on all edges.
- A5.2.8 Hollow Glass Block
- Hollow glass blocks shall be 150 x 150 or 200 x 200 x 95mm or other standard sizes by 'Pittsburgh Corning Corporation' or other approved manufacturer of face pattern specified in drawings or Particular Specification.
- A5.2.9 Brickwork Reinforcement
- Shall be expanded metal or mild steel rods of specified size, galvanized or painted with 2 coats of bituminous paint.
- A5.2.10 Damp Proof Courses
- Shall be 2 layers of 2-ply bituminous paper or of other types to B.S.743. Do not use hessian based types of bitumen damp proof courses.
- A5.2.11 Wall Ties
- a) Ties between ends of walls and concrete to be one of the following:
 - 1) 350mm x 6mm Φ galvanised mild steel round bar,
 - 2) 350 x 20 x 3mm galvanised mild steel flat bar flanged at both ends, or
 - 3) Strips of approved brickwork reinforcement 350mm long of the following widths:
 - For 100 – 105mm walls 60mm.
 - For 200 – 225mm walls 110mm.
 - b) Where strips are to be fixed by shot firing the length may be reduced subject to approval.
 - c) Ties for walls built against face of concrete to be formed from 150 x 20 x 3mm galvanised mild steel flat bar fanged at both ends.
- A5.2.12 Movement Joint
- Materials used in movement joint for brick or block walls shall be :
- 1) Primer – Expandite primer to manufacturer's recommendations,
 - 2) Joint filler – Expandite Flexcell 12.5mm,
 - 3) Backing strip – Polyethylene,
 - 4) Sealant – Expandite Thioflex 600,
- or other approved equivalent.
- A5.2.13 Mastic for Pointing Around Windows, Louvres, etc.
- The mastic for pointing around windows, louvres, etc. shall be Expandite "Thioflex 600" or W.R. Grace Ltd.'s "Paraseal" sealant used in accordance with the manufacturer's instructions.

A5.3 Workmanship

- A5.3.1 Mortar
- a) Mix proportion of mortar for laying brickwork or blockwork shall generally be one part of cement to three parts of sand (1:3 cement sand).
 - b) Mix proportion of mortar may be one part of cement, one part of lime and six parts of sand (1:1:6 cement lime sand) with Architect's written approval.
 - c) Cement mortar shall be used for brickwork below general damp-proof course, brickwork above roof level, half brick walling, brick on edge walling, concrete block walling up to 150mm thickness and load bearing walls. Cement / lime mortar shall be used for brickwork and blockwork generally, except in those positions and thicknesses as specified above.
 - d) Firebrick mortar shall be an approved proprietary brand of fire cement, used neat, or high

- e) alumina cement to B.S.915 and fine crushed firebrick 1:2.
All ingredients shall be measured in boxes to control mix proportions, mixed dry on clean boards, water added in small quantities and thoroughly mixed in until the required workability is achieved.
- f) The proportions of materials used with proper mixing shall have a mean compressive strength as the table below:

<u>Strength of Mortar</u>	
<u>Type of Mortar</u>	<u>Mean compressive strength at 28 day</u>
(cement : lime : sand)	(site test)
1:0 to 1/4:3	11 MPa
1:1:5 to 6	2.5 MPa
1:2:8 to 9	1.0 MPa

- g) The quantity of mortar mixed at one time shall be that which is required for use within one hour. Mortar that has begun to set shall NOT be used.

A5.3.2 Laying of Bricks

- a) Clay bricks shall be well wetted before laying. Block surfaces in contact with mortar shall be wetted before laying.
- b) Bonds shall be as follows:
English bond - for one brickwall (225mm thick) and over,
Stretcher bond – for half brickwall (102.5mm thick) and brick on edge (75mm thick) walls.
- c) Works shall be carried up evenly in truly horizontal courses, with no portion being raised more than 900mm above another at any time, racking back between levels.
- d) Bricks shall be laid on a full bed of mortar with the joints filled solid to a consistent thickness of 10mm.
- e) Gauge brick courses with four courses to 320mm including joints. Strike off joints not visible in the finished work as the work proceeds. Rake out joints to a depth of 10mm in the works to provide key for plaster or other similar applications.

A5.3.3 Laying of Concrete Block

- a) Shall be laid dry in cement mortar.
- b) Walls and partitions shall be laid in stretcher bond.
- c) The bond shall be formed with purpose made half blocks and closers.
- d) All perpends and quoins shall be truly kept.
- e) All joints shall be flushed up as the work proceeds.

A5.3.4 Laying of Glass Block

- a) Steel bar reinforcement shall be provided for all external glass block walls / panels and all internal panels exceeding 4.0 metre high.
- b) Hollow glass blocks shall be laid in strict accordance with manufacturer's instruction and as generally described below:
- Paint all sides of structural opening to receive glass block panels with two coats of bituminous paint.
 - Lay blocks in cement / lime mortar and point both sides.
 - Provide 12 mm clearance at jambs and head of panels. Fill gap with movement joint filler and seal both sides with approved sealant.
 - Build in strips of brickwork steel reinforcement 64 mm wide at every fourth course. Carry ends of strips across the clearance gap and build into or secure to jambs of opening in an approved manner.

A5.3.5 Thickness of Non Load-bearing Walls

- a) All non load-bearing partition walls shall be adequately restrained laterally on all 4 edges and of thickness such that when 3 times its height is added to its length to total does not exceed 200 times its thickness.
- b) In the event that any non load-bearing wall falls outside this rule, the Contractor shall bring this to the attention of the Architect and shall provide all necessary reinforcement for the erection of the wall and for maintaining its stability to the Architect's satisfaction.

- A5.3.6 Uniformity
Carry up work with no portion more than 0.9m above another at any time, racking back between levels.
- A5.3.7 Tolerances
Brickwork and blockwork shall be built within the permissible tolerances listed herebelow:
- | | |
|-------------------------------------|--------|
| Position on plan..... | ±15 mm |
| Length | ±15 mm |
| Height | ±15 mm |
| Level of bed joint (in any 5m)..... | ±15 mm |
| Straightness (in any 5m)..... | ±15 mm |
| Verticality (in any 5m)..... | ±15 mm |
- A5.3.8 Bonding of Walls and Partitions
- a) Division walls and partitions shall be properly bonded to main walls.
- b) All perpends shall be strictly true and square and shall not be less than a quarter of a brick from those in the course below. No closers or bats shall be used except where necessary for bonding purpose.
- c) All corners or wall intersections shall be bonded by staggering the block joints. The vertical joints in each course must not be coincident.
- A5.3.9 Ties to Concrete
- a) At junctions of walls with concrete structure cast in, cut and pin or shot fire ties to concrete at 320mm centres vertically to project 250mm into brick or block walls.
- b) For brickwork or blockwork built against face of concrete structure cast in or cut and pin ties to concrete at 900mm centres horizontally, 320mm centres vertically and staggered, to project 75mm into brick or block walls.
- A5.3.10 Damp Proof Course
- a) Flush up brickwork to form a level and even bed with / mortar used in the general brickwork to receive the horizontal damp proof course.
- b) Lay damp proof course in continuous strip with 150mm laps at end of length and at returns and complete mortar joint to normal thickness.
- A5.3.11 Chases, Reveals, Recesses, etc.
Leave, form or cut chases, holes, recesses, and reveals in walls to receive frames, rainwater pipes or other pipes, conduits for electric cables or the like and as shown on drawings.
- A5.3.12 Sleeve Openings
- a) The Contractor shall leave square openings as shown on drawings or as marked on site for the provision of services by others. Openings that are wider than 200mm shall require lintels to be installed as specified.
- b) Pipe sleeves are to be supplied and installed by others, but unless otherwise specified, shall be grouted with approved unshrinkable cement grouts by the Contractor.
- A5.3.13 Pinning up to Underside of Beams, etc.
The tops of all walls where built to the underside of beams, slabs, etc., to be solidly pinned up with cement mortar, provided always that when the depth of such pinning exceeds 25mm the pinning up shall be carried out with purpose-made precast cement tiles of approved pattern and of the required thickness bedded solidly in cement mortar.
- A5.3.14 Bedding and Pointing Frames
Timber door frames, etc., are to be built in as the work proceeds and bedded solid on the backs and pointed in cement mortar one or both sides as required including building in holdfasts as described in "Section A9".

- A5.3.15 Rake Out for and Point Flashing, etc.
The Contractor shall rake out joints of brickwork and blockwork and cut or form rebates in concrete for and wedge with teak wedges and point flashings, and skirtings, etc., in cement mortar.
- A5.3.16 Expansion Joints
Expansion joints in brickwork and blockwork, when and where clearly shown on drawings, shall be constructed by building up to a joint filler and facing the joints as indicated on drawings.
- A5.3.17 Fixing of Metal Windows and Louvres
- a) The Contractor shall cut or form holes in the jambs, heads and cills of window and louvre openings to receive fixing lugs.
- b) The Contractor shall build in the louvres, fix the lugs in cement mortar, plumb the frames and screw up to lugs, bed and pack solidly behind frames with waterproof cement mortar and point all round externally in mastic.

GENERAL SPECIFICATION

IRONMONGENRY

A8 IRONMONGERY (FINISHED HARDWARE AND FITTINGS)

A8.1	<u>General</u>
A8.1.1	Scope of Section
A8.1.2	General Requirements
A8.1.3	Plugging
A8.2	<u>Fittings</u>
A8.2.1	Steel Butt Hinge
A8.2.2	Stainless Steel Butt Hinge
A8.2.3	Aluminium Butt Hinge
A8.2.4	Aluminium Rising Hinge
A8.2.5	Aluminium Falling Hinge
A8.2.6	Steel Spring Hinge
A8.2.7	Brass Invisible Hinge
A8.2.8	Floor Spring (Floor Check)
A8.2.9	Door Closer (Surface Mount)
A8.2.10	Semi-concealed Door Closer
A8.2.11	Fully Concealed Door Closer
A8.2.12	Barrel Bolt
A8.2.13	Flush Bolt
A8.2.14	Indication Bolt
A8.2.15	Panic Bolt
A8.2.16	Push Plate
A8.2.17	Pull Handle
A8.2.18	Door Stop
A8.2.19	Magnetic Door Catch
A8.2.20	Cupboard Catch
A8.2.21	Cabinet Handle
A8.2.22	Security Viewer
A8.3	<u>Locks and Locksets</u>
A8.3.1	General Requirements
A8.3.2	Lock for Flat Entrance Door
A8.3.3	Lock for Rear Entrance Door
A8.3.4	Lock for Bedroom Door
A8.3.5	Lock for Bathroom Door
A8.3.6	Lock for Kitchen Door
A8.3.7	Lock for Exit Door
A8.3.8	Lock for Classroom Door and Lavatory Door
A8.3.9	Lock for Hotel Guestroom Door
A8.3.10	Other Locks

A8 IRONMONGERY (FINISHED HARDWARE AND FITTINGS)

A8.1 General

- A8.1.1 Scope of this Section
- a) All finished hardware to wooden doors and furniture such as door chain, security viewer, drawer tracks, etc.
 - b) All locks and locksets to wooden doors and furniture.
 - c) Floor spring (floor check / hinge).
 - d) Concealed, semi-concealed and surface-mount door closer.
 - e) Panic bolt.
 - f) All track and pulley for straight sliding, sliding and folding local-made doors and partitions, etc.
 - g) Toilet hardwares such as medicine cabinets, tower rails, shower curtain rails, shower screens, soap and paper holders and grab bars etc.
 - h) Steel, aluminium or proprietary exit signs.
 - i) Aluminium hose reel cabinet.
 - j) Hardwares and locksets for steel or aluminium windows / doors shall refer to 'Metalwork' Section.
- A8.1.2 General Requirements
- a) All hardwares and locksets shall be supplied with matching wood screws.
 - b) The Contractor shall supply and install all finished hardwares, unless a 'Provisional Sum' is allowed for any specific item to be supplied by the Employer or any Nominated Supplier.
 - c) The Contractor shall be responsible for the installation of all hardwares and fittings, either supplied by himself or others with the exception of those under other sections.
 - d) The Contractor shall take possession of the delivered articles at ground floor level and shall be responsible for conveyance, storage and providing labour for proper installation in a workman like manner.
 - e) The colour and finish of the hardware, where not specified, shall be provided to match the door fixtures such as door locks and locksets.
 - f) Where a particular manufacturer or make is specified, the items or articles as specified shall be provided.
 - g) The Contractor shall place his order well in advance for all specified items and articles and NO substitution shall be allowed whatsoever or on the ground that the brand specified is not available in the local market.
 - h) All finished hardwares and locksets shall be of approved European or equivalent Japanese origin.
 - i) All locksets shall be standard pattern of either Union, Yale, Miwa or as specified.
- A8.1.3 Plugging
- When fittings are to be secured with plugs, rawlplugs or other approved and similar plugs shall be used. The use of wooden plugs will not be permitted.

A8.2 Fittings

- A8.2.1 Steel Butt Hinge
- a) Steel butt hinge shall be classified as:
 - 1) Type 1 – square butt hinge for wooden doors;
 - 2) Type 2 – narrow butt hinge for cupboard doors.
 - b) Type 1 hinge shall be of approved origin, and
 - 1) standard duty with five (5) nylon friction rings, nylon bushes, flat button tips and loose non-rising pins;
 - 2) finished as specified;
 - 3) provided as follows:
- | Type of Door | Required Quantity and Size |
|------------------|----------------------------|
| 50mm solid door | 1½pairs – 100 x 100mm |
| 45mm hollow door | 1½pairs – 100 x 75mm |
| 38mm hollow door | 1 pair – 100 x 75mm |

- c) Type 2 hinge shall be of approved origin, and
- 1) flat button tips, loose non-rising pins;
 - 2) finished as specified;
 - 3) provided as follows:

<u>Type of Door</u>	<u>Required Quantity and Size</u>
30mm hollow door	1 pairs – 88 x 55mm
25mm hollow door	1 pairs – 75 x 50mm
19mm solid door	1 pair – 63 x 43mm

A8.2.2 Stainless Steel Butt Hinge

- a) Square butt hinge shall be of approved origin, and
- 1) standard duty with five (5) nylon friction rings, nylon bushes, flat button tips and loose non-rising pins;
 - 2) of dull satin finish;
 - 3) provided as follows:

<u>Type of Door</u>	<u>Required Quantity and Size</u>
50mm solid door	1½pairs – 100 x 100mm
45mm hollow door	1½pairs – 100 x 75mm

- b) Narrow hinge shall be of approved origin, and
- 1) four (4) nylon friction rings, nylon bushes, flat button tips; and
 - 2) of dull satin finish;
 - 3) provided as follows:

<u>Type of Door</u>	<u>Required Quantity and Size</u>
30mm hollow door	1 pair – 88 x55mm
25mm hollow door	1 pair – 75 x50mm
19mm solid door	1 pair – 63 x43mm

A8.2.3 Aluminium Butt Hinge

Aluminium butt hinge shall be:

- 1) of approved origin;
- 2) solid drawn aluminium with four (4) double nylon friction rings, nylon bushes, aluminium alloy or stainless steel pins;
- 3) of silver anodized finish;
- 4) provided as follows:

<u>Type of Door</u>	<u>Required Quantity and Size</u>
50mm solid door	1½ pairs – 100 x75mm
45mm hollow door	1½ pairs – 100 x75mm
38mm hollow door	1 pair – 88 x60mm
25mm hollow door	1 pair – 75 x50mm

A8.2.4 Aluminium Rising Hinge

Aluminium rising hinge shall be:

- 1) of approved origin;
- 2) solid drawn aluminium with black nylon cams, nylon bushes and stainless steel pins;
- 3) of silver anodized;
- 4) provided as follows:

A8.2.5 Aluminium Falling Hinge

Aluminium falling hinge shall be:

- 1) approved origin;
- 2) solid drawn aluminium with black nylon cams, nylon bushes and stainless steel pins; and
- 3) of silver anodized;
- 4) provided as follows:

<u>Type of Door</u>	<u>Required Quantity and Size</u>
45mm hollow door	1½ pairs – 100 x 75mm
20mm cubicle door	1 pair – 75 x 70mm

- A8.2.6 Steel Spring Hinge
- a) Steel spring hinge shall be:
- 1) of approved European or Japanese origin; and
 - 2) made of cold rolled steel;
 - 3) of rust-proof bake finish; and
 - 4) with adjustable pins;
 - 5) classified as: Type D – double action spring hinge; and
Type S – single action spring hinge.
- b) Type D spring hinge shall be of quality and design equivalent to the following:
'Dorma – No.121' – steel, japanned,
'Dorma – No.124' – steel, bronze galvanized,
'Dorma – No.126C' – steel, chrome galvanized.
- c) Type S spring hinge shall be of quality and design equivalent to the following:
'Dorma – No.131' – steel japanned,
'Dorma – No.134' – steel, bronze galvanized,
'Dorma – No.136C' – steel, chrome galvanized.
- d) Spring hinge shall be provided as follows:
- | <u>Type of Door</u> | <u>Required Quantity and Size</u> |
|--------------------------------------|-----------------------------------|
| 50mm solid door
(over 900mm wide) | 1½ pairs – 150mm hinges |
| 50mm solid door | 1 pair – 150mm hinges |
| 45mm hollow door | 1 pair – 125mm hinges |

- A8.2.7 Brass Invisible Hinge
- Brass invisible hinge shall be:
- 1) of approved European origin or equivalent;
 - 2) made of solid drawn brass;
 - 3) with brass plated finish; and
 - 4) extruded and to open to 180°;
 - 5) provided as follows:
- | <u>Type of Door</u> | <u>Required Quantity and Size</u> |
|---|-----------------------------------|
| 50mm solid door
(over 825mm wide) | 1½ pairs – 115mm hinge |
| 50mm solid door
(under 825mm wide) | 1½ pairs – 115mm hinge |
| 38 or 44mm hollow door | 1½ pairs – 95mm hinge |
| 30mm cupboard door | 1 pair – 70mm hinge |
| 25mm cupboard door | 1 pair – 60mm hinge |
| 25mm cupboard door
(under 900 mm H x 450 mm W) | 1 pair -45mm hinge |

- A8.2.8 Floor Spring (Floor Check)
- a) Floor spring shall be:
- 1) of approved European or Japanese origin;
 - 2) equivalent to 'showell' standard weight of 22.7 to 68kg;
 - 3) maximum 53mm thick, unless otherwise specified;
 - 4) of stainless steel, aluminium alloy or bronze plated finish;
- b) Single action floor spring shall be:
- 1) offset hung;
 - 2) with maximum opening 180°;
 - 3) with stand open at 90°; and
 - 4) completed with single action cranked shoe or strip shoe, single action cranked top centre and iron loose base box.
- c) Double action floor spring shall be:
- 1) centre hung;
 - 2) with maximum opening of 135°; and
 - 3) completed with double action adjustable shoe or strip shoe and double action adjustable top centre.

- A8.2.9 Door Closer (Surface Mount)
Surface mount overhead door closer shall be:
1) of approved European or Japanese origin;
2) silver colour bake coated or gold colour bake coated as specified;
3) completed with two (2) closing speed and adjustable valve.
- A8.2.10 Semi-concealed Door Closer
Semi-concealed door closer shall be:
1) of approved European or Japanese origin;
2) silver colour bake coated or gold colour bake coated as specified;
3) completed with two (2) closing speed, 90° hold open and adjustable valve and,
4) applied only to internal doors with minimum thickness of 44mm and to operate a maximum door weight of 45kg.
- A8.2.11 Fully Concealed Door Closer
Fully concealed door closer shall be:
1) of approved European or Japanese origin;
2) completed with two (2) closing speed, 90° hold open and adjustable valve;
3) applied only to internal doors with minimum thickness of 50mm and to operate a maximum door weight of 65kg.
- A8.2.12 Barrel Bolt
Barrel bolt and end socket shall be:
1) unless otherwise specified, of extruded brass;
2) design and quality shall be equivalent to 'showell-310 series';
3) Whether or not shown on drawings, provided as follows:
- | <u>Use</u> | <u>Barrel Bolts Required</u> |
|----------------------------|------------------------------|
| Each pair of closet doors | — |
| - top | 1 No. – 150 x 25mm |
| - bottom | 1 No. – 100 x 25mm |
| Each pair of cupboard door | — |
| - bottom only | 1 No. – 75 x 25mm |
- A8.2.13 Flush Bolt
- a) Lever action flush bolt shall be:
1) hot pressed brass of satin chromium plated finish or,
2) stainless steel of sandy finish.
- b) Whether or not shown on drawings, flush bolts shall be provided to each pair of double-leaf door with lockset as follows:
- | <u>Use</u> | <u>Flush Bolts Required</u> |
|------------|-----------------------------|
| Top | 1 No. – 250mm |
| Bottom | 1 No. – 150 mm |
- A8.2.14 Indication Bolt
- a) Unless otherwise specified, indication bolt shall be of brass of satin chromium plated finish.
- b) Whether or not shown on drawings, each lavatory compartment door shall be provided with one (1) no. indication bolt.
- A8.2.15 Panic Bolt
- a) Panic bolt shall be of brass of satin chromium plated or bronze as specified.
- b) Design and quality shall be equivalent to those manufactured by Edwin Showell & Son Ltd.
- c) Panic bolt shall be:
1) provided with cylinder panic lock,
2) completed with easy clean socket for the top bolt shoot and,
3) completed with dirt excluding socket for the bottom bolt shoot.
- d) The end of top and bottom shoot shall each be fitted with a screw down round cap.
- e) Whether or not shown on drawings, panic bolts shall be provided to each exit door open

to street or lane.

A8.2.16

Push Plate

a)

Push plate shall be:

- 1) stainless steel of sandy finish or,
- 2) aluminium alloy of silver anodized finish.

b)

Push plate shall be 75 x 100 x 1.5mm thick.

c)

Stainless steel push plate shall comply with B.S.970 and be anti-magnetic.

d)

Whether or not shown on drawings, push plate shall be provided as follows:

<u>Use</u>	<u>Push Plates Required</u>
Each leaf of single action self-closing swing door	1 No. push plate
Each leaf of double action self-closing door	2 No. push plate

A8.2.17

Pull Handle

a)

Pull handle shall be of:

- i) stainless steel or,
- ii) aluminium of silver anodized finish.

b)

Whether or not shown on drawings, pull handle shall be provided as follows:

<u>Use</u>	<u>Push Plates Required</u>
Each leaf of single action main entrance door without lockset	1 No. – 300mm long pull handle
Each leaf of single action main entrance door with deadlock	1 No. – 300mm long pull handle
Each leaf of single action door without lockset	1 No. – 250mm long pull handle
Each leaf of single action door with deadlock	1 No. – 250mm long pull handle
Each leaf of single action rear entrance or store door with dead lock	1 No. – 150mm long pull handle

A8.2.18

Door Stop

a)

Door stop shall be:

- 1) wall mount cast aluminium with rubber buffer and,
- 2) of 65mm projection.

b)

Whether or not shown on drawings, one (1) no. wall mount door stop shall be provided for each leaf of door except:

- 1) closet or pipe duct doors,
- 2) doors fitted with floor springs or bumper coat hooks.

A8.2.19

Magnetic Door Catch

Magnetic door catch shall be floor mount type.

A8.2.20

Cupboard Catch

a)

Cupboard catch shall be brass with double steel balls.

b)

Whether or not shown on drawings, one (1) no. cupboard catch shall be provided to each pair of double-leaf cupboard door and closet door.

A8.2.21

Cabinet Handle

a)

Cabinet handle shall be aluminium alloy of silver anodized finish.

b)

Whether or not shown on drawings, one (1) no. cabinet handle shall be provided to each leaf of lavatory compartment door.

A8.2.22

Security Viewer

a)

Security viewer shall be:

- 1) of brass of chrome plated finish,
- 2) of wide-angle lens of 200° and,
- 3) suitable for doors with thickness ranging from 35 to 58mm,
- 4) fitted at 1,350mm above finished floor level.

b)

Whether or not shown on drawings, one (1) no. security viewer shall be provided to each of the entrance door (both entrance and rear) to an apartment, tenement or house.

A8.3 Locks and Locksets

A8.3.1 General Requirements

- a) All locks and locksets shall be:
 - 1) approved European and Japanese origin or,
 - 2) approved equivalent.
- b) Unless otherwise specified, all locksets and latches shall be equivalent in design, finishes and quality to those specified here-in-after.
- c) All locksets shall be:
 - 1) 5-pin tumbler and,
 - 2) with unlimited key changes.
- d) All locks, locksets and latches shall be completed with:
 - 1) striking plates and,
 - 2) 31 to 38mm long wood screws of finishes to match the locksets.
- e) For full rebated door, rebated components set shall be applied instead of the standard striking plates.
- f) Unless otherwise specified, all cylinder locksets shall have standard backset of 69 to 88mm.
- g) Each lockset shall be provided with two (2) keys, each key shall be fitted with an approved circular chromium plated brass plate:
 - 1) size 25mm diameter x 2mm thick and,
 - 2) stamped for identification.
- h) The Contractor shall stamp the face plate of each lock with number of name of the room or for which it is to be used.
- i) The Contractor shall check the positions / directions of swing of each door and provide left or right handed locksets and closers where appropriate.
- j) The Contractor shall check the thicknesses and details of all doors and provide appropriate locksets to fit the thicknesses. The backset of each lock shall in no case be less than 70mm.

A8.3.2 Lock for Flat Entrance Door

- a) Lock for flat entrance door shall be cylinder night latch set with antithrust latch and satin chrome finish.
- b) Cylinder night latch set shall be completed with:
 - 1) 125mm backset adaptor and,
 - 2) 125mm diameter decorative with matching finish.
- c) Operation:
 - 1) latch bolt of the cylinder night latch set shall be withdrawn by key from outside,
 - 2) outside knob is always locked and,
 - 3) inside knob is always free.

A8.3.3 Lock for Rear Entrance Door

- a) Lock for rear entrance door shall be cylinder rim drawback lock with silver enamel finish.
- b) Operation:
 - 1) dead bolt shall be withdrawn by key both from outside and inside,
 - 2) spring bolt shall be withdrawn by key from outside and by hand from inside and the spring bolt can be held by turn of the handle and,
 - 3) dead bolt may be double thrown by key from either side.

A8.3.4 Lock for Bedroom Door

- a) Lock for bedroom door shall be cylinder key and push button set with antithrust latch and satin chrome finish.
- b) Operation:
 - 1) latch set shall be withdrawn by either knob, except when outside knob is locked by push button in inside knob, then withdrawn by key from outside or knob inside and,
 - 2) outside knob remains locked, unit push button is released either by turning key, rotating inside knob or when door swing into close position, except when push button is rotated to the locked position, inside knob always free.

- A8.3.5 Lock for Bathroom
- a) Lock for bathroom door shall be bathroom push button set with satin chrome finish.
 - b) Operation:
 - 1) latch bolt withdrawn by either knob, except when outside knob is locked by push button in the inside knob,
 - 2) push button is released by either turning inside knob, by operating emergency release through small hole in the outside knob or when door swings into closed position.
- A8.3.6 Lock for Kitchen Door
- a) Lock for kitchen door shall be plain latch set with satin chrome finish.
 - b) Latch bolt shall be withdrawn by knob from either side at all times.
- A8.3.7 Lock for Exit door
- a) Lock for exit door shall be single cylinder mortice deadlock.
 - b) Single cylinder locks by key from outside and turn from inside.
- A8.3.8 Lock for Classroom Door and Lavatory Door
- a) Lock for classroom door and lavatory door shall be single cylinder lockset with anti-thrust latch and satin chrome finish.
 - b) Operation:
 - 1) inside knob always free and,
 - 2) outside knob only locked and unlocked by key in outside cylinder.
- A8.3.9 Lock for Hotel Guestroom Door
- a) Master key system shall be employed for hotel guestroom doors. Details of the system shall be as per drawings.
 - b) Lock for hotel guestroom door shall be push button set with satin chrome finish.
 - c) Operation:
 - 1) latch bolt withdrawn by either knob, except when outside knob is locked by push button in the inside knob.
 - 2) push button is released by either turning inside knob, by operating emergency release through small hole in the outside knob or when door swings into closed position.
- A8.3.10 Other Locks
- a) Single cylinder key and turn button lockset with anti-thrust latch and satin chrome finish and operation as follows:
 - 1) latch bolt withdrawn by either knob, except when outside knob is locked by turn button in inside knob,
 - 2) latch bolt is withdrawn by turning inside knob or by key from outside and,
 - 3) outside knob remains locked until turn button is manually released.
 - b) Double cylinder lockset with anti-thrust latch and satin chrome finish and operation as follows:
 - 1) latch bolt withdrawn by either knob, except when knobs are locked in either cylinder and,
 - 2) either cylinder locks and un-locks both knobs.
 - c) Cupboard door lockset with anti-thrust latch and satin chrome finish and operation as follows:
 - 1) latch bolt withdrawn by either knob or turn,
 - 2) inside knob always free and,
 - 3) outside knob only locked and un-locked by key in outside cylinder.
 - d) Wardrobe door lockset with satin chrome finish and operation is that latch bolt withdrawn by knob outside or turn inside at all times.
 - e) Hotel bathroom door lockset with anti-thrust latch and satin chrome finish and operation as follows:
 - 1) latch bolt withdrawn by inside knob at all times,
 - 2) outside knob is always locked,

- 3) latch bolt withdrawn by key in outside knob except when push button in inside knob is depressed, thus shutting out all keys except emergency key and,
- 4) turning inside knob or operating emergency key release indicator and shut out features.

GENERAL SPECIFICATION

METAL WORK

A9 METALWORK

- A9.1 Generally
- A9.1.1 Scope of Specification
- A9.1.2 Samples
- A9.1.3 Testing

- A9.2 Materials
- A9.2.1 General Requirements
- A9.2.2 Mild Steel Plates, Rods, Bars and Sections
- A9.2.3 Slotted Steel Angle
- A9.2.4 Stainless Steel
- A9.2.5 Copper Alloy
- A9.2.6 Aluminium alloy
- A9.2.7 Cast Iron
- A9.2.8 Galvanized Steel Tubing
- A9.2.9 Galvanized Steel Strip, Sheet and Coil
- A9.2.10 Welded Steel Mesh
- A9.2.11 Expanded Metal (Steel)
- A9.2.12 Metal Lathing for Plastering
- A9.2.13 Durasteel for Fireproof Use
- A9.2.14 Fixing Bolts
- A9.2.15 Bolts, Screws, Nuts and Washers
- A9.2.16 Metal Insert Channels for Concrete
- A9.2.17 Adhesive for Metal

- A9.3 Workmanship
- A9.3.1 Metal Worker's Work
- A9.3.2 Galvanizing
- A9.3.3 Chromium Plating
- A9.3.4 Cutting, Drilling and Sawing
- A9.3.5 Welding
- A9.3.6 On Completion

- A9.4 Metal Fixtures
- A9.4.1 Sink Brackets
- A9.4.2 Shelf Brackets
- A9.4.3 Dowels
- A9.4.4 Holdfasts
- A9.4.5 Galvanised Steel Tube Handrails
- A9.4.6 Water Bars
- A9.4.7 Water Tank Covers
- A9.4.8 Access Ladders
- A9.4.9 Letter Plates
- A9.4.10 Rat Guard and Insect Screen
- A9.4.11 Fire Damper

A9.5	<u>Steel Windows and Doors</u>
A9.5.1	Scope of Works
A9.5.2	General Requirements
A9.5.3	Materials
A9.5.4	Construction
A9.5.5	Finish
A9.5.6	Mullion and Transom Couplings
A9.5.7	Fittings
A9.5.8	Fixing Lugs and Screws
A9.5.9	Schedule of Hardware
A9.5.10	Glazing Beads
A9.5.11	Louvres
A9.5.12	Flyscreen
A9.5.13	Guarantee
A9.6	<u>Aluminium Windows, doors and Louvres</u>
A9.6.1	General Requirements
A9.6.2	Shop Drawings and Samples
A9.6.3	Guarantee
A9.6.4	Aluminium Sections
A9.6.5	Aluminium Finishes
A9.6.6	Glazing
A9.6.7	Putty, mastic Compound and Glazing Sealants
A9.6.8	Gaskets and Weatherstrips
A9.6.9	Construction
A9.6.10	Schedule of Hardware
A9.6.11	Lightning Protection
A9.6.12	Protection and Cleaning

Appendix I – Specimen Form of Guarantee (Aluminium Windows, Doors, Louvres Installation)

A9 **METALWORK**

A9.1 Generally

A9.1.1 Scope of Specification

The specification shall apply to all metalwork including:

- 1) Metal doors, windows and louvers;
- 2) Metal gates and collapsible gates;
- 3) Metal subframes and inserts;
- 4) Metal fixtures;
- 5) Metal railing and handrails;
- 6) Metal staircase.

A9.1.2 Samples

- a) Samples of materials shall be submitted, free of charge, in two (2) sets for approval if required by the Architect.
- b) Test certificates, where applicable at Architect's own discretion, shall be submitted together with the samples.

A9.1.3 Testing

- a) Testing for composition and tensile strength shall be carried out as required by the Architect.
- b) Manufacturer's certificates shall be submitted whenever required by the Architect.

A9.2 Materials

A9.2.1 General Requirements

- a) Materials shall be of top quality obtainable in local market, unless their origin or make is expressly specified.
- b) Fixing accessories shall be of the same material and finish as the material to be fixed.
- c) Materials shall be cleanly finished, straight, free from twist or other defects that may impair the strength, functioning or appearance of the finished work or its adjacent structure or finishes.
- d) All material delivered to site shall be reasonably free from scale, properly stacked, protected from weather and stored in dry condition.
- e) If expressly required, all mild steel sections shall be protected from rust on site with a coat of approved rust inhibiting primer.

A9.2.2 Mild Steel Plates, Rods, Bars and Sections

- a) Plates, rods and bars shall comply with B.S.1449 and be of low carbon type (i.e. 0.2% maximum), perfectly straight, free from winding except where otherwise shown and in one length.
- b) Cold rolled steel sections shall comply with B.S.2994.
- c) Plates, rods, bars and sections shall be bent to exact forms as shown on drawings and the ends filled to form true joints.

A9.2.3 Slotted Steel Angle

- a) Slotted steel angle shall be self-finished angle to B.S.4345. Fittings shall be cadmium plated steel.
- b) Use of slotted angles for ordinary steel angles shall not be allowed unless submitted for Architect's approval beforehand.

A9.2.4 Stainless Steel

- a) Stainless steel shall be of the 18/9 chromium nickel group, Type 304S15 (or AISI Type 304) and above for internal work, of the 17/12 chromium nickel group Type 316S13 (or AISI Type 316L) and above for external work and of the type stabilized for welding. Except where specifically shown to be polished, stainless steel shall be hairline finished, minimum thickness of 1.27mm.

- b) Plate, sheet and strip shall be to B.S.1449 : Part 2, of
 - 1) finish No.2B for mill finish;
 - 2) finish No.8 for polished finish;
 - 3) or otherwise specified;
 - 4) hairline finish in accordance to sample approved.
- c) Stainless steel tubes for structural and general engineering purposes shall be to B.S.6323 : Part 1 & Part 8. Composition and finish shall be as above.
- d) All exposed screws, fastenings shall be of appropriate matching materials to the approval of the Architect.
- e) Work shall be built by a manufacturer regularly engaged in production of architectural metal whose workmen shall be skilled at fabricating high grade ornamental metal work.
- f) The work shall be fabricated and assembled in the shop in as large sections as consistent with shipping and field requirements.
- g) All mitres and joints shall form flush, hairline joints and all joints between sections and all field splices shall produce strength to resist deformation and misalignment.
- h) The work shall be fabricated and installed with concealed fastenings insofar as practicable.
- i) Welding of non-ferrous metals and stainless steel shall be on concealed sides to minimise pitting, discolouration, weld halo, or other surface imperfections after finishing. Welds shall thoroughly penetrate the material and produce a complete fusion work shall be made of non-corrosive wire. Dissimilar metals shall be insulated against electrolysis or galvanic action.
- j) Components shall be delivered, stored and handled to prevent damage of whatever nature. Factory-finished metal shall be protected in an approved manner during transportation and installation and such protection shall be removed when directed.
- k) Finished surfaces of work shall be cleaned to leave free of stains, markings and defects of any kind. Burrs and sharp corners shall be removed from exposed work.

A9.2.5 Copper Alloy

- a) Copper sheet, strip and foil shall comply with B.S.2870;
- b) Copper tubes shall comply with B.S.2871 : Part 2 – for general purposes;
- c) Copper rods and sections shall comply with B.S.2874;
- d) Brass rods and sections shall comply with B.S.2874 Designation CZ 106 condition M.
- e) Copper plates shall comply with B.S.2875.
- f) Copper shall never be used in contact with aluminium. If such is shown on drawings, an approved rubber separator shall be provided between the two metal.

A9.2.6 Aluminium alloy

- a) Aluminium sections shall be mechanical extruded sections of required profile, size and design.
- b) Aluminium alloy plate, sheet and strip shall be to B.S.1470, of the required alloy designation.
- c) Aluminium alloy bars, extruded tube sections and hollow sections shall be to B.S.1474 alloy designation 6063.
- d) Aluminium alloy drawn tubes shall be to B.S.1471 alloy designation 6063.
- e) Aluminium sections for structural purposed shall be to B.S.1161.
- f) All aluminium sections and fittings shall be anodized, of a minimum thickness 0.02mm (20 microns), of natural or any specified colour.
- g) All bolts and screws for aluminium alloy shall be stainless steel or other approved alloy and countersunk flush whenever practicable.

A9.2.7 Cast Iron

Cast iron shall be grey iron to B.S.1452, Grade 150 minimum.

A9.2.8 Galvanized Steel Tubing

- a) Galvanized steel tubing for non-structural use shall be medium duty grade complying with B.S.1387.
- b) All galvanized steel tubing shall be capped at open ends.

- A9.2.9 Galvanised Steel Strip, Sheet and Coil
- a) Hot dip galvanised steel strip, sheet and coil shall comply with B.S.2989,
 - b) Unless otherwise specified, galvanised steel shall be of grade 22 (bending and profiling quality) and normal spangle finish.
- A9.2.10 Welded Steel Mesh
- a) Welded steel mesh shall be steel wire of the specified diameter welded to form a square or oblong mesh of the specified sizes.
 - b) Welded steel mesh shall be hot-dip galvanized after manufacture unless otherwise specified.
- A9.2.11 Expanded Metal (Steel)
- a) Expanded metal (steel) mesh for general purposes shall comply with B.S.405.
 - b) The finished mesh shall be free from flaws, joins, broken strands and all other defects.
 - c) Decorative coated expanded metal wire mesh is to be in strict accordance with the mock-up sample as approved.
- A9.2.12 Metal Lathing for Plastering
- a) Metal lathing for plastering shall be ribbed expanded type complying with B.S.1369, of 10mm mesh (measured the short way), No.22 gauge weighing about 2.5kg/m² and dipped in bitumastic paint during manufacturing.
 - b) Metal lathing for plastering shall be 'Expamet' or approved equivalent.
 - c) Metal lathing shall be secured at 150mm centres to timber members with 1.8 x 37mm galvanized staples or to steel members with 2mm galvanized tying wire.
 - d) Edges of adjacent lathing sheets shall be securely wired together at 75mm centres maximum.
- A9.2.13 Durasteel for Fireproof Use
- a) Fireproof (minimum 2 hours) panels shall be of specified Durasteel (by Cape Durasteel Ltd.) panel or approved equivalent of sufficient thickness to meet the fire requirements. Where cutting of panel is unavoidable, the edge shall be cut in such a manner that its profile shall match perfectly to the adjacent panel or structure to form only hairline butt joint.
 - b) Access panels shall be provided to locations as shown on drawings or as required by the Architect. Access panels shall be easily fixed to and removed from the ceiling by using M8 bolts with its nuts welded in the inside steel angle member unless otherwise shown on drawings. Edges of access panels and the openings should form hairline joints only when being fixed.
 - c) Where the durasteel enclosure is penetrated by single piping, the penetration shall be sealed by applying a flange of Durasteel, or 3 mm thick steel plate profiles to form a tight fit. In complex penetration, 'Durastop' fire resisting seals shall be applied by bolting a light gauge steel angle to either side of the durasteel skin and acts as a forwork for the Durastop compound. The thickness and installation of durastop shall be strictly according to the manufacturer's instruction.
 - d) Durasteel constructed ducts and cableways shall be provided according to the drawings. The ducts shall have its own suspension system and shall consist of suspension rod, mild steel channel bracket and angle support bolt anchorage.
- A9.2.14 Fixing Bolts
- a) Stud anchors shall be minimum 6mm diameter, of suitable length and approved proprietary brand, and shall be used in accordance with the manufacturer's recommendations. Stud anchors shall be of HILTI HSA series or approved equivalent.
 - b) Fixing bolts shall be minimum 8mm diameter, of suitable length and approved proprietary expansion bolts, and shall be used in accordance with the manufacturer's recommendations. Expansion bolts shall be of HILTI HSL series or approved equivalent.
 - c) Any other types of stud anchors and fixing bolts shall be submitted for approval beforehand.

- A9.2.15 Bolts, Screws, Nuts and Washers
- a) Hexagon bolts, screws, nuts and washers are to be to B.S.4190.
 - b) Fixings ceiling shall generally be matt black finish or to match the background.
 - c) Washers to be single coil square or rectangular section steel to B.S.4320 unless otherwise specified. Provide tapered washers to give the bolt heads and nuts a satisfactory bearing where so required.
 - d) Length of bolts shall be such that the threaded portion of each bolt projects through double nuts by at least two (2) threads.
- A9.2.16 Metal Insert Channels for Concrete
- a) Concrete insert channel shall be an approved galvanised steel channel, with expanded polystyrene temporary filler. Provide matching sliding fixing devices.
 - b) Steel dowels and tie-bars shall be dovetailed and protected with a coat of butimastic paint before casting in concrete.
- A9.2.17 Adhesive for Metal
- a) Use of adhesive in lieu of other fixing accessories shown on drawings shall not be allowed.
 - b) Adhesive for bonding metal to wood or metal to metal shall be an approved proprietary brand.

A9.3 Workmanship

- A9.3.1 Metal Worker's Work
- a) The whole work shall generally conform to B.S.449, Part2.
 - b) Straightening, bending and flattening shall be done in a manner that will not damage the material.
 - c) All metal worker's work shall be forged clean from the anvil with flatters, swages or rounding tools and shall be neatly chamfered at the edges or diminished as required.
 - d) All welds, tenons and setts shall be soundly made and all superfluous metal removed.
- A9.3.2 Galvanizing
- a) Components shall be hot-dip galvanised to B.S.729, and shall be galvanised after fabrication as far as it is practicable.
 - b) If approved, zinc sprayed galvanising shall be to B.S.2569, Part 1 – nominal thickness 0.2mm unless otherwise specified.
 - c) Components or articles shall be galvanised thoroughly and evenly, free from stains, bare spots and other defects.
 - d) Minimum amount of zinc deposited by galvanising shall be 0.14mm thick or 1.0kg/m² of metal surface which is to be subsequently painted with finishing paints.
 - e) Minimum amount of zinc deposited by galvanising shall be 0.20mm thick or 1.43kg/m² or metal surface which is to be exposed to weather.
 - f) Any cutting, drilling or welding after galvanising shall be avoided; if unavoidable, they shall be treated with two coats of metallic zinc-rich priming paint to B.S.4652, Type 2.
- A9.3.3 Chromium Plating
- a) Chromium plating shall be to B.S.1224, Service condition no. 3, with
 - 1) 'bright' or 'satin' finish for exposed work, and
 - 2) 'dull' finish for concealed work.
 - b) Satin chrome shall mean a semi-gloss polished finish.
 - c) Chromium plating shall be free from visible defects, such as blisters, pits, unplated areas, cloudy patches, cracks or stains.
 - d) Chromium plating shall be provided to pre-formed, pre-drilled metal assemblies to avoid non-protected surfaces.
- A9.3.4 Cutting, Drilling and Sawing
- a) Should site cutting be necessary it shall be by machine flame cutting.
 - b) Cut edges shall be finished by removing burrs, sharp arrisses and slag from edges of the

cut members and by dressing machine sheared or cropped edges to a neat finish free from distortion.

- c) Grind stiffeners, plates and the like to fit the profile of the parent member with diagonal cuts to clear the root radius.
- d) Form holes for rivets and bolts by drilling, except holes in plate less than 15mm thick which may be formed by punching. Punch holes to a size 2mm less than the required diameter and finish the holes by reaming. Finished holes shall be 2mm larger than the nominal size of rivets and bolts up to 24mm diameter and 3mm larger where over 24mm diameter.

A9.3.5 Welding

- a) Welding shall be manual metal-arc welding unless otherwise approved.
- b) Welding procedures are to be proposed by the Contractor for approval before execution. The procedures shall include the following:
 - 1) preparation of fusion faces
 - 2) preheating temperature where required
 - 3) type of electrodes
 - 4) number and sequence of runs to build-up the weld head
 - 5) post-heating treatment if required
- c) Approval testing of welding procedures shall be carried out in accordance with BS EN 288 : Part 3 when required by Architect.
- d) Grease, dirt, moisture, oxide and scale shall be cleared from the surfaces before welding.
- e) Accuracy may be maintained by using clamps and wedges; welds for temporary attachment are not allowed.
- f) Joints to be fully fused throughout with no holes, pores or cracks.
- g) Butt welds or fillet welds, where visible, shall be ground smooth and flush.
- h) Welding shall be executed in a flat or horizontal position. Welding overhead is strictly prohibited unless prior approval is obtained from the Architect.
- i) Weld tests shall be carried out by methods proposed by the Contractor in accordance with relevant British Standards when required by the Architect.
- j) Welding shall be supervised by an experienced and competent operative. All welders shall be certified to British Standards with valid certificates.
- k) Welding records shall be kept up-to-date on site to identify welders responsible for major welds.

A9.3.6 On Completion

- a) Lubricate and adjust all moving components, and leave in perfect working order on completion.
- b) Date of completion may not be recognised if all necessary test certificates have not been submitted to the satisfaction of the Architect after the works are completed.

A9.4 Metal Fixtures

A9.4.1 Sink Brackets

- a) Supply and fix two (2) nos. of brackets for the support of each stainless steel sink unit, unless otherwise shown on drawings.
- b) Brackets shall be 40 x 40 x 6mm thick mild steel angle of suitable length, built into the wall at minimum 75mm deep and countersunk drilled to receive fixing screws.

A9.4.2 Shelf Brackets

- a) Supply and fix brackets at 1m centres as the support of each shelf, unless otherwise shown on drawings.
- b) Brackets shall be constructed of 25 x 25 x 4mm mild steel angles, pretreated with galvanising or with approved rust inhibiting primer.
- c) Flange size of mild steel angle section shall be not less than the thickness of the shelf and the length of shelf brackets shall extend to the full depth of the shelf.

- A9.4.3 Dowels
Dowels shall be 16mm diameter x 75mm long galvanised steel bar, mortised for a depth of 40mm into the feet of the jambs with a tight push fit and bedded into concrete floor in cement sand (1:3) mortar.
- A9.4.4 Holdfasts
- a) Supply and install six (6) nos. of 40mm x 3mm x 200mm girth galvanised steel flat cramps as holdfasts for fixing each door frame to masonry work (three (3) nos. for each jamb) as shown on standard detail.
 - b) Cramps shall be turned up at one end and twice drilled countersunk for 2.6mm screws at the back of door frame and dovetailed at the other end for building-in.
 - c) Supply and install six (6) nos. of 12mm diameter x 100mm long expansion bolts with nuts and washers as holdfasts for fixing each door frame to concrete work (three (3) nos. for each jamb), unless otherwise shown on drawings.
 - d) Holdfasts for other fixtures and fittings shall be provided in accordance with drawings.
 - e) Holdfasts to concealed cupboards and the like:
 - 1) Provide and fix four (4) nos. of holdfasts for each built-in concealed cupboard (two (2) nos. at a side).
 - 2) Holdfasts for box frames to masonry wall shall be of mild steel bar size 150 x 38 x4mm with 50mm turned up at one end, drilled countersunk for screws at the back of frame and the other end split and dovetailed for connection to the wall.
 - 3) Holdfasts for fixing frames to reinforced concrete shall be four (4) Nos. 13mm mild steel bolts and nuts, two (2) Nos. of each joint or as shown on drawings.
- A9.4.5 Galvanised Steel Tube Handrails
- a) Unless otherwise specified, galvanised steel tube handrails for internal stairs shall be 38mm internal diameter galvanised steel tubes cut to length and capped at both ends.
 - b) Brackets for handrail shall be 15mm diameter galvanised steel rod welded to the tube rail and fixed to concrete or masonry walls at 900mm centres with 50mm diameter flush galvanised steel plate at ends, unless otherwise shown on drawings.
- A9.4.6 Water Bars
Provide and fix to cills 25 x 3mm galvanised mild steel or plastic water bar bedded in white lead or butyl mastic bedding compound leaving no gaps.
- A9.4.7 Water Tank Covers
- a) Tank covers and supporting frames shall be of single seal type for fire services water tanks and flushing water tank, and of double seal type for city water tank.
 - b) All components shall be of galvanised steel complete with hinges, "Eye Bar" for opening, provision for padlock for double seal cover and other details as shown, all complete to comply with relevant codes and regulations.
 - c) Each tank cover shall have the name of the water tank stenciled in large letter with appropriate paint.
- A9.4.8 Access Ladders
- a) Access ladders, unless otherwise specified or shown on the drawings, shall be fabricated with 50mm diameter galvanised steel tube stringers with 38mm diameter galvanised steel tube rungs 400mm long and at 300mm centres; the top and bottom of the stringers shall be bent at right angles and dovetailed for building in.
 - b) Where the length of the stringers exceeds 1.8m, 38mm diameter galvanised steel tube brackets shall be welded to the stringers at centres not greater than 1.8m. The ends shall be dovetailed for building in, or brackets shall be of 38 x 6mm thick mild steel flat bar, welded to the catladder, and built into the concrete or masonry walls at 900mm centres or as shown on Drawings.
- A9.4.9 Letter Plates
Letter plates shall comply with B.S.2911 or equivalent as approved by the Architect.

- A9.4.10 Rat Guard and Insect Screen
- a) Metal rat guard for external louvres, door and fire dampers shall be constructed of 12mm galvanised steel wire mesh sandwiched in galvanised 25 x 5mm thick mild steel flat bar as shown on drawings. Intermediate flat bars shall be allowed if any length of rat guard exceeds 1,200mm.
 - b) Fixing accessories shall be as shown on drawings.
 - c) Metal insect screen for external louvres and doors shall be of 6 x 6 mesh per 10mm² woven aluminum wire mesh which shall be weather-resistant and shape-retentive.
 - d) If fixing detail of insect screen is not shown, the Contractor shall provide standard finish roll-formed aluminum lineals of 0.45mm gauge, stove-enamelled on both sides, complete with splines and all necessary components and accessories for proper installation to the satisfaction of the Architect.
- A9.4.11 Fire Damper
- Fire dampers shall be provided according to drawings with appropriate certificates to the effect that the fire dampers are acceptable to the Fire Services Department and relevant utility companies and to the satisfaction of the Architect.

A9.5 Steel Windows and Door

- A9.5.1 Scope of Works
- a) Steel windows and doors as specified on drawings.
 - b) Fittings, hinges, fixing screws and lugs, steel beadings etc.
 - c) Louvres in steel frames
 - d) Flyscreens
 - e) Mastic compound for filling transom and mullion couplings.
 - f) Installation of all windows and doors and fittings.
 - g) Red lead primer or chromate primer to all steel windows and doors before delivery.
- A9.5.2 General Requirements
- a) Steel windows and doors shall comply with B.S.6510 and in accordance with specification hereinafter provided.
 - b) For industrial buildings, steel windows and doors shall comply generally with B.S.6510 if expressly required in particular specification.
 - c) Steel windows and doors may be supplied and delivered to site by a Nominated Supplier.
 - d) Sample of steel windows and fittings shall be submitted to the Architect for approval.
 - e) Unless otherwise specified or shown on drawings, all windows and doors shall open outwards and shall be prepared for outside glazing as specified.
- A9.5.3 Materials
- a) Steel windows shall be either medium-duty (32mm) section or heavy-duty (38mm) section as specified or shown on the detail drawings.
 - b) Steel windows shall be manufactured of universal steel rolled sections, and dovetail grooved for a weatherstrip if shown on drawings. All sections shall be hot rolled, cold straightened and free from rolling defects.
 - c) All manufacturer's fabrication holes shall be sealed by welding prior to delivery to site.
- A9.5.4 Construction
- a) Frames shall be square and flat with mitred, welded corners, with glazing bars machine tendoned or welded to frames, and shop-drilled to receive hinges, glazing clips, fixing lugs and other fittings as required.
 - b) Provide all slotted adjustable lugs and screws necessary for building in the windows and doors and ensure that lugs project at least 60mm beyond the metal frames.
- A9.5.5 Finish
- a) The finish of steel windows shall be spray zinc galvanised to B.S.2569 and shall be free from stains, bare spots and other defects.
 - b) The thickness of the zinc coating shall be at least 0.065mm. Unless otherwise specified,

- hot-dip galvanising to B.S.729 or electroplated galvanising to B.S.1706 will not be accepted in lieu of zinc sprayed galvanising unless this has been clearly indicated in the tender and Architect's attention has been drawn to it.
- c) Any cutting, drilling or welding after galvanising must be made good with two coats of approved metallic zinc-rich priming paint on completion, (Galvakote or other equivalent paints to Architect's approval).
 - d) All zinc galvanised steel window frames shall be primed with two coats of red lead primers before delivery to site.
 - e) The final finishing paint shall be three coats of polyurethane paint of approved manufacturer and colour.
- A9.5.6 Mullion and Transom Couplings
- Mullion and transom couplings shall be provided as shown on drawings, properly cut to length with 75mm extension at both ends for building-in, and completed with all necessary coupling screws and nuts at 450mm centres, and shall be bedded in mastic with all interstices completely filled.
- A9.5.7 Fittings
- a) Unless otherwise specified or shown on drawings, all fittings shall be imported bronze-plated manganese brass of British manufacture.
 - b) Steel hinges shall be with brass pins and welded or riveted to frames.
 - c) Other fittings including friction grip pivots, casement fasteners spring catches, brackets, slide arms, shoes, slip bolts, cabin hooks and eyes and handles shall retain the opening parts rigidly in both the open and close positions.
 - d) Handle plates, round-headed stay brackets shall be welded to the fixed frames with interchangeable handles and stays.
- A9.5.8 Fixing Lugs and Screws
- a) All steel windows and doors shall be provided with steel fixing lugs with brass countersunk screws at 450mm centres on all outer frames. Fixing lugs shall be 13 x 3mm and extended at least 75mm built into the structure.
 - b) Holes for fixing lugs or screws shall be driven at the centre of the webs.
- A9.5.9 Schedule of Hardware
- a) Top Hung Fanlight (Ventilator) (each leaf)
 - 2 Nos. steel butt hinge (under 1.5m wide)
 - 2 Nos. 63mm long brass bolt and socket (if required)
 - 1 No. brass stay 225mm centres – with holes
 - 1 No. brass fixing bracket
 - 1 No. brass top hung pin
 - 1 No. brass top hung rest or proprietary remote control system as specified.
 - b) Side Hung Window (each leaf under 1.05m high)
 - 2 Nos. steel projection hinge
 - 1 No. brass handle
 - 1 No. brass wedge
 - 1 No. brass slide stay
 - c) Side Hung Window (each leaf over 1.05m high)
 - 3 Nos. steel projection hinge (under 1.5m high)
 - 1 No. brass duplex handle set
 - 1 No. brass wedge
 - 1 No. brass slide stay
 - d) Side Hung Door (single leaf)
 - 3 Nos. steel projection hinges
 - 1 No. "Union" mortice lockset PS 692-24-95 FB
 - 1 No. door clip
 - e) Side Hung Doors (double leaves)
 - 3 Nos. steel projection hinges (each leaf)
 - 1 No. "Union" mortice lockset PS 692-24-95 FB

- 1 No. brass bow handle
 - 2 Nos. 150mm brass bolts and wedge
 - 2 Nos. 150mm brass bolts and sockets
 - 2 Nos. door clips
- f) Horizontally centre Hung Ventilator (each leaf)
 - 2 Nos. brass friction pivot
 - 1 No. brass spring catch with brass catch plate
 - 2 Nos. 63mm brass bolts and sockets (if over 1.2m in width)
 - Brass pole hook(s)
- g) Vertically Pivoted Hung Windows (each leaf)
 - 2 Nos. brass friction pivot
 - 1 No. brass handle (only 1.05m high or under) or
 - 1 No. brass duplex handle set with bronze connecting rod (if over 1.05m high)
- h) Slide Projected Ventilator (each leaf)
 - 2 Nos. side arm
 - 2 Nos. shoe and channel and body
 - 1 No. brass handle or
 - 1 No. brass handle with ring (for pole operations)
 - 1 No. brass spring catch with brass wedge Brass pole hook(s)
 - Brass link arm
- A9.5.10 Glazing Beads
 - a) Unless otherwise specified or shown on drawings, steel windows and doors shall be manufactured for external glazing with beads.
 - b) The glazing beads shall be rolled steel heavy channel section, size 13 x 10mm for 32mm windows and 20 x 10mm for 38mm windows or doors, mitred at corners and fixed with galvanised steel flat-headed countersunk screws at 225mm centres and frames tapped to receive same.
- A9.5.11 Louvres
 - a) Frames and clips shall be 1.2mm and 0.9mm steel sheet respectively and galvanised before assembly.
 - b) Clips (or blade holders) shall be fitted with spring clips suitable for receiving 100, 150 or 230mm wide and 6mm thick glass blades as shown on drawings, and pivoted vertically at the side members at the centre of the blade.
 - c) Each section of louvre shall be fitted with a single lever locking operating handle.
 - d) Weatherstrip shall be shaped metal strips of an approved design and thickness.
 - e) Provide matching rustless screws, bolts and spacers etc. for coupling adjacent frames to form mullions, where specified.
- A9.5.12 Flyscreen
 - a) When specified, provide extruded aluminium flyscreens having plastic covered fibre-glass mosquito gauze with 7 x 7 mesh per 10mm square.
 - b) Where flyscreens are provided, side hung casements shall have a locking handle and an opening and closing mechanism consisting of a bronze cam handle and bronze roto operator, and top hung casements shall have bronze "through the frame" type stays.
- A9.5.13 Guarantee

The Contractor shall, in joint name with the manufacturer, submit a one-year guarantee certificate to commence after the date of Completion Certificate against faulty workmanship, structural failure and distortion of the installation, water penetration and corrosion of the steel window and door installation.

A9.6 Aluminium Windows, Doors and Louvres

- A9.6.1 General Requirements
 - a) The drawings only indicate design of unit in outline, size of structural openings and relationship of various sections to the interior and exterior building works.

- b) Sizes and thickness of glass and aluminium members shown on drawings are the minimum requirements only. The Contractors shall, as part to his responsibility, check and verify their adequacy and propose alternative sizes and thicknesses to Architect for approval at no extra cost to the Contract.
- c) Unless otherwise specified, the Contractor shall verify all dimensions of windows on site prior to manufacture of the windows.
- d) The design of window, doors and louvres inclusive of glazing shall comply with all government codes of practice and regulations. Attention is drawn to the Hong Kong Building Ordinance, Building (Construction) Regulation 1990 and Code of Practice on Wind Effects, in reference to standards adopted for calculation of horizontal faces and wind pressure on buildings.
- e) The whole windows, doors and louvres installation shall comply with:
 - 1) all the wind load requirements,
 - 2) weather resistance,
 - 3) anti-corrosion standard and,
 - 4) water tightness as described in the current specifications published by the Architectural Aluminium Manufacturer's Association(AAMA) and of adequate strength to resist bending and distortion during fixing, normal use and typhoon conditions.
- f) The Contractor shall allow thermal and structural movement in the installation of windows, doors and louvres in relation to building structure under normal temperature range and structure safety standard accepted by the Architect.
- g) Any windows, doors, louvres and fittings subsequently delivered to site that are below the standard of the approved samples shall be rejected.

A9.6.2 Shop Drawing and Samples

- a) Before commencing the work and within two weeks from award of contract, the Contractor shall submit to the Architect for approval shop drawings, suitable for reproduction, showing working details, scale elevations, overall dimensions, fixing positions, method of anchorage, full size sections and work to be done by other trades.
- b) Particular regard shall be given to the method of locking the windows and the design of handles and bolts.
- c) Approval given by the Architect shall not be considered relieving the Contractor from his responsibility for the adequacy, safety and suitability of his design, drawings and details.
- d) The shop drawings shall show the following information:
 - 1) The position, size and type of all opening light;
 - 2) The type and thickness of glass to be used;
 - 3) Relationship of the various sections to the interior and exterior building works;
 - 4) The Contractor's calculation supporting his design in type/thickness of glass;
 - 5) Fixing details of aluminium panels, louvers, turnbuckles and angles frames etc.
- e) The Contractor shall submit samples of windows, doors, louvres and fittings within one (1) month after approval of shop drawings.

A9.6.3 Guarantee

- a) The Contractor shall submit upon completion of the work a five year guarantee certificate in the form all as per the Specimen Guarantee appended with this specification against:
 - 1) Faulty workmanship and material.
 - 2) Structural failure and distortion of the installation.
 - 3) Non-uniformity of surface finish.
 - 4) Water-penetration.
 - 5) Corrosion.
- b) The Contractor shall submit in the joint name with the window manufacturer a certificate verifying the thickness of all glasses, aluminium sections and any metal reinforcement used in the Contract.
- c) All guarantee shall include for the cost of removal and replacement of all defective work at no extra cost to the Employer at such times designated by the Employer.

A9.6.4 Aluminium Sections

- a) All aluminium extrusion shall be tempered aluminium alloy with minimum tensile strength – 151.68 MPa (22,000psi).
b) Window section shall not be less than the following section and weight:

<u>Sash Size</u>	<u>Section</u>	<u>Min. Weight kg/m (1 b/ft)</u>
under 600W x 1200H	Z section (Welded Joints)	0.626 (0.42)
under 600W x 1200H	Z section (Mechanical Joints)	0.830 (0.557)
600 – 840W x 1200H – 1500H	Hollow section (Welded Joints)	0.868 (0.582)
840 – 1350W x 1500H – 1650H	Box section	1.433 (0.961)

- c) The maximum deflection under 3.8KPa minimum must not exceed 1/180 the length of the particular member. Where necessary, use mild steel cores, anchors, brackets, etc. as stiffeners.
d) The window sashes and door leaves shall be constructed of extruded aluminium alloy sections of U.S.A. origin to B.S. 1470 and B.S. 1474 British alloy designation 6063 with a minimum wall thickness 1.6 mm and dovetailed grooved for weatherstrip and mitred and flash welded.

A9.6.5 Aluminium Finishes

- a) All aluminium surfaces and hardwares exposed to view and / or to the exterior shall be finished with:
1) Fluoropolymer resin. The fluorocarbon coating colour is a factory over cured min. 3 coat system and applied in strict accordance with the manufacturers requirement.
2) Clear anodized to B.S. 1615 AA/20.
3) Colour anodized to B.S. 3987 average 25 um thick.
b) The anodic coating shall be Kal-colour process which is equivalent to Kaiser Aluminium and Chemical Corporation of U.S.A. standard. The Contractor shall submit a certificate of guarantee from the manufacturer verifying the depth of Kal-colour anodic coat.
c) Prior to the anodic coating process all material shall receive a caustic etch treatment, in which a minimum of 1 micron surface material shall be removed from all visible surface. Anodic coating thickness shall be a minimum of 20 microns.
d) A certificate of guarantee shall be submitted by the Contractor verifying the depth of the anodized coating. The finished surface of all aluminium shall be of uniform colour, clean and free from defects and surface blemishes.
e) The Contractor shall provide for Architect's selection a series of samples and several finish variations.
f) Repair of damage to finished surfaces by mechanical means (other than those specified). Painting is strictly forbidden unless authorized in writing by the Architect.
g) Finished surfaces shall be free from mechanical imperfections such as scratches, scrapes, dents, spots, stains and streaks.

A9.6.6 Glazing

Refer to 'Glazing' Section.

A9.6.7 Putty, Mastic Compound and Glazing Sealants

- a) Refer to 'Glazing' Section.
b) Sealant back-up material shall be polyethylene foam, sponge neoprene conforming to ASTM C-509, or Denver Foam as recommended by sealant manufacturer.
c) Colour for sealants to be selected by Architect.
d) Edge cover provided by sealant to be as follows:

<u>Glass Area (m²)</u>	<u>Edge Cover (mm)</u>
up to 0.5	5
0.5 – 1.5	9
1.5 – 4.0	15
over 4.0	as recommended by sealant manufacturer

- A9.6.8 Gaskets and Weatherstrips
- a) Sponge gaskets and weatherstrips shall be extruded black neoprene with a hardness of 40 + 5 durometer Shore A and conforming to ASTM C-509, JIS A-5756. Design sponge gaskets to provide 20% to 35% compression.
 - b) Dense gaskets and weatherstrips shall be extruded black neoprene with a hardness of 70 + 5 durometer Shore A for hollow profile and 60 + 5 for solid profiles (NAAMM SG-1-70).
 - c) Vulcanize all corners of gaskets both sponge and dense as far as practical.
 - d) Interior and exterior gasket profiles shall be designed to produce a glass edge pressure of between 1.8kg/25mm and 4.5kg/25mm.
 - e) Silicone gaskets shall be ASTM standard.
 - f) All gaskets in contact with structural silicone sealant must be made of silicone.
- A9.6.9 Construction
- a) Where sections of window sashes or door leaves are mechanically fastened, they shall be caulked and fastened to a watertight hair-line joint.
 - b) The windows and doors shall be manufactured for inside glazing with glazing beads of snap interlocking design and synthetic rubber dry glazing gaskets.
 - c) All parts supplied shall be:
 - 1) Pre-drilled and pre-fabricated where possible and,
 - 2) Well wrapped and protected against scratching or damage during delivery and fixing.
 - d) The windows and doors shall be:
 - 1) Erected plumb and true and,
 - 2) Securely fixed to structural openings with lugs, red head bolts, anchors or other approved method at a minimum of 300mm (maximum) interval.
 - e) Allow a clearance of 100mm between window and frame when the window sash is in open position.
 - f) Frames to be mechanically jointed of mortice and tenon construction to provide rigid and secure connection. Mechanically joint or mitre and flush butt weld sash members to develop the full strength of members and provide a neat weather-tight joint. Do not use excessive heat during welding. Provide adequate drainage in bottom members.
 - g) Mullions, transoms and corner posts in composite units to have additional 75mm at each end for building in. Reinforce mullions and transoms over 1.5m in length with galvanized steel with ends extended for building in.
 - h) Assemble all composite units at Site including provision of all necessary bolts, screws etc. and sealing all joints with an approved one pack polysulphide sealant to B.S.5215.
 - i) Unless otherwise specified, provide an approved chloroprene rubber, polyvinyl chloride or woolpile weather strip securely fixed into dovetailed groove in the window or door sections to provide a continuous contact between each opening part and its fixed frame.
 - j) Windows and doors to be suitable for internal glazing unless otherwise specified. Provide an approved glazing system and aluminium beads. Securely clip beads to the frame or use beads which are an integral part of the frame.
 - k) Use aluminium alloy, stainless steel, nylon or other corrosion resistant material for all exposed fixings including screws, nuts, bolts, washers and rivets and match up with finish where possible. Use hot-dipped galvanized or cadmium-plated steel for all concealed fastening devices.
 - l) Prime with zinc chromate primer and paint two coats of bituminous paint on all steel framework, cores, anchors and brackets.
 - m) Paint one coat of bituminous paint on concealed aluminium or stainless steel surfaces which may come into contact with wet mortar, cement, plaster or similar materials.
 - n) For fixing hinges:
 - 1) minimum of 3 Nos. 5mm round head stainless steel machine screws shall be used per attachment point,
 - 2) with aluminium back plate minimum 5mm thick threaded at the same time with the window section and,
 - 3) each screw tightened with 2 Nos. stainless steel nuts in accessible locations and 1 no. spring washer in concealed locations.
 - o) For fixing handles, stays, bolts or wedges, one of the following may be used:
 - 1) stainless steel screws or,

- 2) stainless steel rivets or,
 - 3) aluminium rivets.
- p) Rake out joint around external edge of aluminium window and door frames and point with an approved one pack gun type polysulphide sealant to B.S.5215 or silicone sealant as specified, to form a smooth, flat joint. Remove excess sealant from adjoining surfaces and leave clean. Mask adjoining surfaces which would be impossible to clean if smeared with sealant.
- A9.6.10 Schedule of Hardware
 - a) All locks, rotor operator, strikers, keepers and concealed hardware to be cast aluminium or stainless steel. Hardware for aluminium windows and doors shall be designed to adequately perform the function for which it is intended and shall be securely attached to the window, doors and/or adjacent window. Submit sample of all hardware to be used on windows and doors with tender.
 - b) Locking devices shall be cast aluminium cam handle type used on all ventilating window. Sashes exceeding 800mm in height and 500mm in width shall be fixed with 2 points locking system. Locking contact points shall be located at bottom rails or jambs opposite hinges and so spaced to assure even compression of weather-stripping over entire length and height of sash.
 - c) Horizontal slide projecting (side hung) window (each leaf):
 - 1) 2 Nos. non-magnetic stainless steel concealed 4 bar parallel link arm hinges, U.S.A. origin, minimum plate thickness 2.5 mm, width 20 mm and length minimum 60 percent of the sash height.
 - 2) 1 No. aluminium handle,
 - 3) 1 No. stainless steel or aluminium die-cast dual action locking handle with solid stainless pivot pins.
 - d) Vertical slide projecting (top hung) window (each leaf):
 - 1) 2 Nos. non-magnetic stainless steel concealed 4 bar parallel link arm hinges, U.S.A. origin, minimum plate thickness 2.5 mm, width 20mm and length minimum 60 percent of sash height.
 - 2) 1 Nos. aluminium handle,
 - 3) (For sashes under 800mm wide):
 - 1 No. stainless steel or aluminium die-cast locking handle with solid stainless pivot pins.
 - 4) (For sashes over 800mm wide):
 - 2 Nos. of the same pivot as above.
 - e) Vertical slide projecting (top hung fan light) window under 1,200mm wide x 400mm high (each leaf)
 - 1) 2 Nos. non-magnetic stainless steel concealed 4 bar parallel link arm hinges, U.S.A. origin, minimum plate thickness 2.5mm, width 20mm and length minimum 200mm,
 - 2) 1 No. aluminium handle,
 - 3) 2 Nos. stainless steel typhoon bolts.
 - f) Horizontal and Vertical Centre Pivot Window (each half)
 - 1) 2 Nos. stainless steel heavy duty friction pivot hinges.
 - 2) 1 No. aluminium handle.
 - 3) 1 No. stainless steel or aluminium die-cast dual action locking handle with solid stainless pivot pins.
 - g) Side hung door (single leaf)
 - 1) 2 sets floor spring pivot hinge, single or double action as specified,
 - 2) 4 Nos. aluminium push handles,
 - 3) 1 No. single or double cylinder mortice dead lock as specified.
 - h) Sliding Doors
 - 1) Each pair of sliding doors shall be provided with continuous bottom track and sheaves to suit the weight of door. Sheaves to be silent running and permanently lubricated.
 - 2) Track to be provided with the necessary drainage holes required to release any water that may enter under door leaves.
 - 3) Doors to be provided with stiles wide to accept selected door lock.

- 4) Each sliding door to be provided with 1 no. 450mm C.P. on brass flush bolts to the approval of the Architect. External leaf to be provided with "Reliance" or equal approval narrow stile sliding door lock completed with recess pull handle and with snib fitted to internal face only. Top of track to be provided stop to prevent snib hitting internal leaf.
 - 5) Meeting stiles of sliding doors to be provided with removable supporting section to be secured by means of thumb screws or similar to internal face of internal leaf for additional strength under typhoon conditions.
 - i) Key operated stainless steel or aluminium die-cast lockable handles with two (2) keys shall be provided for all openable windows.
 - j) Stainless steel concealed friction restrictor stays with solid stainless steel pivot pins shall be provided to restrict window aperture to sizes as specified.
 - k) All openable windows will be sealed with vinyl weather strip or neoprene weather strip.
 - l) All openable doors shall be sealed with vinyl backed. Silicone treated wool pile or approved equivalent.
- A9.6.11 Lightning Protection
- a) The construction of the windows, doors and louvers shall incorporate lightning protection device. The Contractor shall install all necessary conductors, wiring connection etc. for the windows and doors in accordance with the latest edition of IEE Regulation. The Electrical Contractor shall connect his lightning provision to the earthing system.
 - b) Proposals on the lightning protection system shall be submitted with the tender.
- A9.6.12 Protection and Cleaning
- a) Apply a strippable coating or masking tape to all exposed aluminium or stainless steel surface. (Note: The anodised surface may be permanently damaged by contact with wet cement and plaster) Wrap all window and door units and other associated materials in stout waterproof paper or polythene to protect against damp and scratching and do not make premature delivery to site.
 - b) On completion of building work, carefully remove protective coating and leave clean.
 - c) All glass and glazing shall be thoroughly washed with approved detergent on both sides and left clean on completion.

**SPECIMEN FORM OF GUARANTEE
(Aluminium Windows, Doors, Louvres Installation)**

To _____(Employer)

Re: Aluminium Windows, Doors, Louvres Installation

at _____(Works)

In accordance with the Specification requirements we, _____
_____ (Contractor of the captioned Works), hereby
guarantee the satisfactory performance of our products including the glass and accessories for the respective
portion of our works which was completed on _____
_____ at the captioned site for a period of five (5) years after the completion of the Works against
the following:

- i) Faulty workmanship and material
- ii) Structural failure and distortion of the installation;
- iii) Non-uniformity of surface finishes
- iv) Water-penetration; and
- v) Corrosion.

During the guarantee period, we shall be responsible for the removal and replacement of all defective works
at no extra cost to the Employer and at such times as designated by the Employer.

Repairs or replacement during the guarantee period due to alterations, abuse of work, vandalism, failure of
the supporting structure, acts of God, and other causes beyond our control are not covered under this
guarantee, and may be carried out by us at the discretion of the Architect or Employer and paid for by the
Employer/Owner/Occupant at prevailing rates.

Moreover, we warrant that the thickness of all glass, aluminium sections and any metal reinforcements used
in the Works are carried out with the contractual Specification and/or Drawings. We shall be responsible for
the costs of removal and replacement of all works which do not comply with the Specification and/or
Drawings.

Authorised Signature
(with Company Seal)

Date : _____

GENERAL SPECIFICATION

PLASTERING, PAVING, TILING, STONework AND SUSPENDED CEILING

A10 PLASTERING, PAVING, TILING, STONework AND SUSPENDED CEILING

- A10.1 General
- A10.1.1 Scope of Works
- A10.1.2 General requirements
- A10.1.3 Accuracy of Wall and Ceiling Finishes
- A10.1.4 Surface Finish
- A10.1.5 Curing of Floor Finishes
- A10.1.6 Protection

- A10.2 Materials
- A10.2.1 Cement
- A10.2.2 Sand
- A10.2.3 Granite Fines
- A10.2.4 Water
- A10.2.5 Lime Putty
- A10.2.6 Marble/granite Chippings
- A10.2.7 Metal Lathing
- A10.2.8 Other Fixing Accessories
- A10.2.9 Dividing Strips
- A10.2.10 Non-slip Strips

- A10.3 Plastering
- A10.3.1 Keying for Plaster
- A10.3.2 Spatterdash
- A10.3.3 Internal Plaster
- A10.3.4 Skim Coat Plaster
- A10.3.5 External Plaster
- A10.3.6 Rough Cast External Plaster
- A10.3.7 Cement Sand Render
- A10.3.8 Rough Cast Cement Sand Render
- A10.3.9 Waterproof Cement Sand Render (other than Specialist Waterproofing)
- A10.3.10 Gypsum Plaster
- A10.3.11 Gypsum Plaster on Concrete
- A10.3.12 Gypsum Plaster on Plasterboard
- A10.3.13 Gypsum Plaster on Wood Wool Slab
- A10.3.14 Gypsum Plaster on Metal Lathing
- A10.3.15 Shanghai Plaster
- A10.3.16 Acoustic Plaster

- A10.4 Paving
- A10.4.1 Finished Floor Level
- A10.4.2 Screed
- A10.4.3 Waterproof Screed (other than Specialist Waterproofing)
- A10.4.4 Lightweight Screed on Roof
- A10.4.5 Cement Sand Pavings
- A10.4.6 Hardener for Cement Sand Pavings
- A10.4.7 Hacking, Cleaning and Slurrying
- A10.4.8 Granolithic
- A10.4.9 Rubbed Granolithic
- A10.4.10 Washed Granolithic
- A10.4.11 Dressed Granolithic
- A10.4.12 Terrazzo
- A10.4.13 Light Colour Terrazzo
- A10.4.14 Dark Colour Terrazzo

A10.5	<u>Tiling</u>
A10.5.1	Floor Screed to Receive Various Tiles
A10.5.2	Wall Screed to Receive Various Tiles
A10.5.3	Tiling in General
A10.5.4	Precast Terrazzo Tiles
A10.5.5	Ceramic Mosaic Tiles
A10.5.6	Vitreous Mosaic Tiles
A10.5.7	Glass Mosaic Tiles
A10.5.8	Glazed Wall Tiles
A10.5.9	Colour Cement Tiles
A10.5.10	Concrete Tiles and Insulating Tiles
A10.5.11	Quarry Tiles
A10.5.12	Ceramic Tiles
A10.5.13	Rubber Tiles and sheet
A10.5.14	'Canton' Tiles
A10.5.15	Non-Slip Nosing Tiles
A10.5.16	Vertical Junction of Different Wall Finishes
A10.5.17	Expansion Joints
A10.5.18	Adhesive for Tile Installation
A10.6	<u>Internal Marble, Granite and Artificial Stone Work</u>
A10.6.1	Internal Marble, Granite and Artificial Stone Work in General
A10.6.2	Samples for Approval
A10.6.3	Quality of Material and Testing
A10.6.4	Shop Drawing
A10.6.5	Mock-up Samples
A10.6.6	Marble and Granite Materials
A10.6.7	Artificial Stone Materials
A10.6.8	Cement Mortar
A10.6.9	Sealant
A10.6.10	Plaster of Paris
A10.6.11	Marble, Granite and Artificial Stone Workmanship
A10.6.12	Laying Marble, Granite and Artificial Stone to Floor
A10.6.13	Mounting Marble, Granite and Artificial Stone to Suspended Ceiling / Interior Wall and Column
A10.6.14	Curved Granite / Marble / Artificial Stone Slabs, Mouldings
A10.6.15	Expansion Joint
A10.6.16	Fixing Marble/Granite/Artificial Stone to Counters
A10.6.17	Accuracy of Installation
A10.6.18	Protection and Cleaning Down

A10.7	<u>Suspended Ceiling</u>
A10.7.1	Suspended Ceilings Work in General
A10.7.2	Samples for Tendering
A10.7.3	Installation Instruction
A10.7.4	Shop Drawings
A10.7.5	Samples of Approval
A10.7.6	Mock-up Samples
A10.7.7	Open Grid Metal Ceiling
A10.7.8	Fire-Resisting Ceiling
A10.7.9	Gypsum Suspension Ceiling System
A10.7.10	Lay-in Tile Ceiling System
A10.7.11	Extruded Aluminium Strip Ceiling
A10.7.12	Expanded Metal Lath Ceiling
A10.7.13	Metal Panel Ceiling
A10.7.14	Installation Work in General
A10.7.15	Openings
A10.7.16	Jointing and Connections
A10.7.17	Access Panels
A10.7.18	Installation
A10.7.19	Built-in Works
A10.7.20	Attachment
A10.7.21	Painting
A10.7.22	Tolerances
A10.7.23	Protection and Cleaning

A10 PLASTERING, PAVING, TILING, STONEMWORK AND SUSPENDED CEILING

A10.1 General

A10.1.1 Scope of Works

- a) Carry out all the base and finishes application as shown on drawings.
- b) Wallpaper and anti-mould treatment to wall are excluded from this section.

A10.1.2 General Requirements

- a) Surfaces to be screeded, rendered and plastered shall be well wetted beforehand.
- b) Base (undercoat) coat shall be laid evenly to fall as required, straightened with a rule and scratched to form key.
- c) Finish coat shall be trowelled with a steel trowel to a smooth and even surface with sharp straight corners.
- d) Thicknesses of base and finish coats specified here-in-after are the minimum requirement only. The Contractor shall follow the thickness shown in drawings wherever such applies.
- e) Each coat shall be allowed to cure thoroughly before any succeeding coat is applied.
- f) Mixing of plasters and mortars, except for small quantities or otherwise approved in writing by the Architect, shall be carried out with suitable type of machine driven roller-pan mixer.
- g) Samples of fixing accessories, tiles and other permanently fixed material shall be submitted for approval before placing order.

A10.1.3 Accuracy of Wall and Ceiling Finishes

Wall and ceiling finishes shall be brought to a true plane and to correct line and level. Angles and corners shall be right angles unless otherwise required, with walls and reveals plumb and square.

A10.1.4 Surface Finish

- a) Smooth finish shall be that achieved with a steel trowel or power float, shall be free from blemishes and untextured.
- b) Wood float finish shall be that achieved with a dry wood float to give an even textured surface.
- c) Stiff brush finish shall be that achieved with a stiff brush to give a slightly roughened textured finish surface.

A10.1.5 Curing of Floor Finishes

- a) Immediately after laying, protect surface of floor screeds or in-situ finished from wind and sunlight to prevent rapid or localised drying out of wall and ceiling finishes.
- b) Cover surface, as soon as it is sufficiently hardened, with canvas, waterproof sheeting, mats, or a 50mm layer of damp sand. Keep covered for a minimum period of seven (7) days.

A10.1.6 Protection

Protect all finished works from discolouration or physical damage until completion.

A10.2 MATERIALS

A10.2.1 Cement

Refer to 'Brickwork and Blockwork' Section.

A10.2.2 Sand

Refer to 'Brickwork and Blockwork' Section.

A10.2.3 Granite Fines

Special approval for use of granite fines as substitute for sands is required from the Architect.

- A10.2.4 Water
Refer to 'Brickwork and Blockwork' Section.
- A10.2.5 Lime Putty
- a) Lime putty shall be well burnt stone or chalk lime which has been run into a putty and sieved through a 3mm sieve into a maturing tank for a minimum of one month before use.
 - b) Alternatively, it shall be hydrated lime (Class A) complying with B.S.890 which has run to a putty twenty-four (24) hours before use.
 - c) Use of shell lime is not allowed.
- A10.2.6 Marble / Granite Chippings
- a) Marble / granite chippings shall be graded from 3mm to 5mm, free from dust and mixed with cement in proportions as specified hereinunder for various finishings.
 - b) Colour of marble / granite chippings shall be uniform in the adjacent areas and shall be submitted for Architect's approval beforehand.
- A10.2.7 Metal Lathing
- a) Metal lathing shall comply with B.S.1369, supplied from an approved manufacturer and shall be either:
 - 1) plain expanded type of 6mm short way mesh coated with tight coat galvanising and weighing not less than 1.6kg/m² or
 - 2) ribbed expanded type similarly coated and weighing not less than 2.25kg/m² as shown on drawings.
 - b) Metal lathing shall be provided:
 - 1) at junction between two dissimilar backgrounds which are to receive same plaster backing or finish, and
 - 2) on wooden or steel frames which are to receive plaster backing or finish, and
 - 3) when there is a combination of the above.
 - c) Plain lathing should be applied at the back side of pipe or conduit work which runs continuously with 2 nos. or more at brick walls of 100mm thick or less.
 - d) Metal lathing shall be tightly fixed with the largest dimension of mesh running perpendicular to direction of support, at 100mm centres to wood with staples, to steelwork with tying wire, to brickwork or concrete with 40mm nails.
 - e) Metal lathing shall be lapped 25mm generally and 50mm where end laps occur between supports. Laps shall be secured with tying wire at 75mm centres. Cut ends shall be coated with bituminous paint.
- A10.2.8 Other Fixing Accessories
- a) Galvanised steel corner beads, plaster stops and movement joint beads shall have expanded metal wings, be supplied from an approved manufacturer, "Expamet" or equivalent, and be provided wherever applicable and as indicated on drawings.
 - b) Wire netting shall be to B.S.1485, of 0.9mm galvanised wire and 50mm mesh and provided as indicated on drawings.
 - c) Staples shall be galvanised steel wire staples.
 - d) Tying wire shall be 1.25mm annealed steel wire, galvanised to B.S.443.
- A10.2.9 Dividing Strips
- a) Unless otherwise specified, 3mm thick approved stainless steel, brass, aluminium or plastic strips by the full depth of the paving, render or screed shall be set in cement mortar between junctions of various type of finishes.
 - b) Metal dividing strips shall be provided for all terrazzo works and rubbed granolithic finishes, whether shown on drawings or not. Dividing strips shall be placed at maximum 600mm apart in one direction and 1,200mm apart in the other direction in floor finishes with a strip around the perimeter of the paving to form a border, and at maximum 600mm apart vertically in wall lining.

- A10.2.10 Non-Slip Strips
Non-slip strip insert shall be 25 x 15mm, slightly curved on top, consisting of a compound of cement and carborundum dust 1:1 or a proprietary black insert strip.

A10.3 PLASTERING

- A10.3.1 Keying for Plaster
a) Joints of brickwork, masonry etc. shall be thoroughly raked out to form keying for plaster.
b) Concrete surfaces shall be applied with spatterdash to form keying for subsequent finishes.

- A10.3.2 Spatterdash
a) All vertical surfaces and soffits of concrete to be plastered, screeded and etc. shall be applied with a coat of spatterdash.
b) Immediately after removing the formwork, the Contractor shall hack off projections and fins, remove efflorescence, laitance and any loose material by thoroughly dry brushing, and wash to remove form oil before applying spatterdash.
c) Spatterdash shall be composed of one part cement and two parts coarse sand or granite fines (1:2 by volume) and shall be mixed to the consistency of a thick slurry.
d) Spatterdash shall be evenly thrown on the concrete soffits and vertical surfaces to form key for plastering, etc. Thickness of spatterdash shall not exceed 6mm.
e) Spatterdash shall be kept wet for at least one hour after application and allowed to cure and harden before applying base coats.

- A10.3.3 Internal Plaster
a) Internal wall lime plaster shall be a two-coat work, with an average thickness of 15mm and not exceeding 18mm.
b) Base coat shall be minimum 10mm thick composed of one part cement, two parts lime putty and six parts sand (1:2:6 by volume).
c) Finish coat shall be minimum 5mm thick composed of one part cement, twelve parts lime putty and twenty-four parts sand (1:12:24 by volume).
d) For ceiling application, 16kg of paper-pulp to every m³ of mixture shall be added to the finish coat only with Architect's written instruction.

- A10.3.4 Skim Coat Plaster
Skim coat plaster shall be 6mm thick throughout composed of one part cement, twelve parts lime putty and twenty-four parts sand (1:12:24 by volume), or at a special mix approved by Architect.

- A10.3.5 External Plaster
a) External wall lime plaster shall be a two-coat work, with an average thickness of 18mm.
b) Base coat shall be 12mm thick composed of one part cement, two parts lime putty and six parts sand (1:2:6 by volume).
c) Finish coat shall be 6mm thick composed of one part cement, two parts lime putty and three parts sand (1:2:3 by volume).

- A10.3.6 Rough Cast External Plaster
Rough Cast External Plaster shall be the same as ordinary external plaster except that fine gravel or granite chippings shall be added to the finish coat to produce a rough texture.

- A10.3.7 Cement Sand Render
a) Cement sand render shall be a two-coat work, with an average thickness of 18mm.
b) Base coat shall be 12mm thick composed of one part cement and three parts sand (1:3 by volume).
c) Finish coat shall be 6mm thick composed of one part cement and three parts finely sieved sand (1:3 by volume).
d) Cement sand render for unexposed surfaces shall be composed of one part cement and

four parts sand (1:4 by volume), and floated to the thickness of the ground or as otherwise required to fill in voids behind skirtings, dubbing out to uneven surfaces, etc. to a maximum thickness of 20mm.

- A10.3.8 Rough Cast Cement Sand Render
Rough cast cement sand render shall be the same as cement sand render except that fine gravel or granite chippings shall be added to the finish coat to produce a rough texture.
- A10.3.9 Waterproof Cement Sand Render (other than Specialist Waterproofing)
- a) Waterproof cement sand render shall be one-coat work, 20mm thick composed of 45kg cement, 135kg sand and 4.5kg waterproof agent (10:30:1 by weight).
 - b) The waterproof agent shall be either 'Pudlo' (manufactured by Kerenr-Greenwood & Co., Ltd.) 'Impermo' (manufactured by Green Island Cement Co., Ltd) or approved equivalent.
 - c) Unless otherwise specified, waterproof cement sand render shall be used as wall finish in:
 - 1) Dado up to soffit of ceiling in kitchen, bathroom, toilet, balcony and open staircase,
 - 2) Rendering to roof water tank internally and externally, unless otherwise specified or instructed,
 - 3) Rendering to top and sides of coping, parapet and boundary wall as well as cover of staircase and pipe duct head,
 - 4) Internal wall of closets and pipe ducts.
- A10.3.10 Gypsum Plaster
- a) Gypsum plaster shall be of following types complying with B.S.1191: Part 1.
 - 1) Undercoat plaster (Browning plaster) – retarded hemihydrate gypsum plaster of Class B, Type a,
 - 2) Finish plaster – retarded hemihydrate gypsum plaster of Class B, Type b,
 - 3) Keene's plaster – dual purpose plaster of Class D, Type c;
 - 4) Plaster of Paris – Class A.
 - b) Generally the average thickness of gypsum plaster shall not exceed 13mm.
- A10.3.11 Gypsum Plaster on Concrete
- a) Base coat shall be 6mm thick composed of one part Browning plaster and two parts sand (1:2 by volume).
 - b) Finish coat shall be 4mm thick composed of four parts finish plaster and one part lime putty (4:1 by volume).
- A10.3.12 Gypsum Plaster on Plasterboard
- a) Apply only finish plaster to a maximum thickness of 5mm using as little water as possible and trowelled to a smooth surface.
 - b) All joints between plasterboards shall be scrimmed with jute scrim cloth not less than 90mm wide before plastering.
- A10.3.13 Gypsum Plaster on Wood Wool Slab
- a) Base coat shall be 6mm thick composed of one part Browning plaster and two parts sand (1:2 by volume) and with good quality ox or goat hairs incorporated in the proportion of 5.50kg to each m³ of the mix.
 - b) Finish coat shall be 4mm thick composed of four part Browning plaster and one part lime putty (4:1 by volume).
 - c) Where wood wool slabs are to be plastered on one side only, the use of scrim cloth may not be required.
 - d) Surfaces of the slabs shall be covered with twenty-two standard wire gauge (s.w.g.) galvanized wire netting of 50mm mesh, loosely stapled over the entire surface.
- A10.3.14 Gypsum Plaster on Metal Lathing
- a) Base coat shall be 6mm thick composed of one part cement, two parts lime putty and six parts sand (1:2:6 by volume) with good quality ox or goat hairs incorporated in the proportion of 5.50kg to each m³ of the mix.
 - b) Second coat shall be 6mm thick with composition same as base coat.

- c) Finish coat shall be 3mm thick composed of one part of Browning plaster and two parts lime putty (1:2 by volume).
- d) Each coat shall be allowed to dry thoroughly before application of succeeding coats.

A10.3.15 Shanghai Plaster

- a) Base coat shall be 10mm thick composed of one part cement and three parts sand (1:3 by volume).
- b) Finish coat for light colour shanghai plaster shall be 10mm thick composed of one part cement (93% white cement and 7% Ordinary Portland Cement) and one part white marble chippings (1:1 by volume).
- c) Finish coat for dark colour shanghai plaster shall be 10mm thick composed of one part cement with appropriate amount of colouring and one part black marble chippings (1:1 by volume).
- d) Finish coat shall be well washed and scrubbed down just prior to setting in order to remove superfluous cement.

A10.3.16 Acoustic Plaster

- a) Acoustic plaster shall be 'Vermiculite Plaster' (manufactured by Duro Industries Ltd. Hong Kong) or approved equivalent.
- b) Acoustic plaster shall be applied by an approved subcontractor in strict accordance with manufacturer's printed instructions.

A10.4 PAVING

A10.4.1 Finished Floor Level

- a) Unless otherwise specified, finished floor level shall generally be 40mm above structural floor level. The Contractor shall verify that this requirement is applicable throughout the whole work and inform the Architect immediately if any area may require a different finished floor level.
- b) The Contractor shall provide screed to the required levels for various types of floor finishes.

A10.4.2 Screed

- a) Floor and wall screeds shall generally be in accordance with C.P.204, Part 2 and B.S.5385, Parts 1 & 2 respectively.
- b) In bathroom, kitchen, balcony, etc., which are designed with sunken structural slab, the sunken bay shall be filled up with lightweight screed composed of one part cement, three parts sand and six parts cinder (1:3:6 by volume) to make up to the structural level of the adjacent floor.

A10.4.3 Waterproof Screed (other than Specialist Waterproofing)

- a) Waterproof cement sand screed shall be one-coat work, 20mm thick composed of 45kg cement, 135kg sand and 4.5kg waterproof agent (10:30:1 by weight).
- b) The waterproof agent shall be either 'Pudlo' (manufactured by Kerner -Greenwood & Co., Ltd.), 'Impermo' (manufactured by Green Island Cement Co., Ltd) or approved equivalent.
- c) Unless otherwise specified, waterproof cement sand screed shall be used for wall and floor finishes in:
 - 1) Floor and dado up to soffit of ceiling in kitchen, bathroom, toilet, balcony, open staircase, and exterior wall.
 - 2) Roof water tank internally and externally, unless otherwise specified or instructed.

A10.4.4 Lightweight Screed on Roof

- a) The lightweight screed shall be of 'Cheecolite Superlight 500' or approved equivalent with a resultant density of between 520+40 kg/m² and a compressive strength at 28 days of 12.3kg/m².
- b) The lightweight screed shall be mixed and laid in accordance with the manufacturer's printed instructions.

- c) The lightweight screed shall be finished with a cement and sand (1:4 by volume) topping screed 20mm thick to receive the covering materials. The topping shall be laid whilst the base screed is still green. 40 x 40mm triangular fillets at all upstands shall be formed.
- d) Channels, where shown on the drawings, shall be formed in the screeds to fall evenly to rainwater outlets.

- A10.4.5 Cement Sand Pavings
 - a) Cement sand paving shall be composed of one part cement and three parts sand (1:3 by volume). Generally, the surface shall be trowelled smooth for internal dry areas, floated for internal wet areas, or combed / brushed for exterior areas.
 - b) Paving shall be laid in panels not exceeding 3.3m x 3.3m.

- A10.4.6 Hardener for Cement Sand Pavings
 - a) Hardener for cement sand pavings shall be "Dynagrip" (Manufacturer: Fosroc Construction Chemicals Ltd. / Local Agent: Fairlite Industries Ltd.), or "Setcrete S.B." (Manufactured: Don Construction Chemicals Ltd. / Local Agent: World Wide Bldg. Material Co., Ltd.), or approved equivalent and shall be applied strictly in accordance with the manufacturer's instructions.
 - b) The coverage of the Dynagrip / cement mixture shall be minimum 5kg/m².

- A10.4.7 Hacking, Cleaning and Slurrying
 - a) The laitance of the concrete base to receive screed shall be thoroughly removed and the surface slightly hacked to provide a suitable key for its topping.
 - b) The surface of the concrete base shall be thoroughly cleaned and well watered just before the laying of topping. After the surplus water has been removed, a coat of cement slurry shall be well brushed onto the surface and topping laid immediately.
 - c) For repair and renovation work, the existing floor finishes shall be completely removed and coarse aggregates of concrete slab fully exposed before applying cement slurry.

- A10.4.8 Granolithic
 - a) Granolithic shall be one-coat work, 20mm thick to floors and stair treads and 13mm thick to stair risers, and brought to an even surface with a steel trowel or wooden float and allowed to set undisturbed.
 - b) Lay granolithic in bays not exceeding 15m² each with the length not more than 1.5 times the width. Provide 6 x 6mm wood inlays to the paving and remove them after the paving has cured.

- A10.4.9 Rubbed Granolithic
 - a) Rubbed granolithic shall be composed of two parts cement, one part granite fines and four parts white or light grey granite chippings (2:1:4 by volume).
 - b) After setting, the surface shall be rubbed with carborandum stone to produce a smooth, dense finish exposing the aggregates.
 - c) Care shall be taken during trowelling so as to form as little as possible laitance on the surface.

- A10.4.10 Washed Granolithic
 - a) Washed granolithic shall be composed of one part cement and two parts white or grey granite chippings (1:2 by volume).
 - b) Just prior to setting, the surface shall be well wetted, brushed with stiff brush to remove superfluous cement and to expose the aggregates to form a textured surface.

- A10.4.11 Dressed Granolithic
 - a) Dressed granolithic shall be composed of one part cement and two parts white or grey granite chippings (1:2 by volume).
 - b) After setting, the surface shall be dressed with a sharp steel chisel to produce a rough but even surface and to expose the aggregates.

A10.4.12 Terrazzo

- a) Terrazzo shall be floated onto a cement sand backing before initial set takes place.
- b) Non-slip grains of carborundum or aluminium oxide shall be incorporated at the rate of 14kg per 100kg of cement in all pavings.
- c) All surfaces shall be rubbed down, highly polished and treated with a protective coat of wax.
- d) Any void in the surface shall be filled with cement grout of matching colour.
- e) Any work showing wavy or uneven surfaces shall be unacceptable and shall be redone.
- f) Terrazzo and its screed shall be divided into panels maximum 1m², with dividing strips as specified.

A10.4.13 Light Colour Terrazzo

- a) Base coat shall be minimum 10mm thick for walls, 12mm thick for floors and consists of one part cement and three parts sand (1:3 by volume).
- b) Finish coat shall be minimum 10mm thick for walls, 12mm thick for floors and consists of one part cement (90% white cement and 10% ordinary cement) and two parts white marble chippings (1:2 by volume).

A10.4.14 Dark Colour Terrazzo

- a) Base coat shall be minimum 10mm thick for walls, 12mm thick for floors and consists of one part cement and three parts sand (1:2 by volume).
- b) Finish coat shall be minimum 10mm thick for walls, 12mm thick for floors and consists of one part cement with appropriate amount of colouring and two parts black marble chippings (1:2 by volume).

A10.5 TILING

A10.5.1 Floor Screed to Receive Various Tiles

- a) Floor screed shall consist of one part cement and three parts sand (1:3 by volume).
- b) All floor screeds shall be minimum 13mm thick, floated to required thickness to true level or to falls as shown on drawings.
- c) Before laying, the Contractor shall prepare all level lines and wooden / metal level marks at 1,500mm intervals at both directions for quality control purpose.
- d) After the screed is laid, the surface shall be trowelled with a teak level rod (1,800mm long by 50mm wide with continuous surface) and finally finished with a wooden float to receive vinyl tiles, carpet and the like or scratched as key for tile bedding.

A10.5.2 Wall Screed to Receive Various Tiles

- a) Wall screed shall consist of one part cement and three parts sand (1:3 by volume).
- b) Wall screed shall be minimum 10mm thick and floated to required thickness.
- c) Before applying, the Contractor shall prepare all vertical line and wooden / metal studs at 1,500mm intervals at both directions for quality control purpose.
- d) After the wall screed is applied, the surface shall be trowelled with a teak rod (1,800mm long by 50mm wide with continuous surface) and scratched as key for tile bedding.

A10.5.3 Tiling in General

- a) All tiles shall be true to shape, flat as required, free from flaws or other defects and smooth in texture throughout.
- b) Areas to be finished with tiles shall be set out with tiles before laying to avoid unnecessary cutting. Unless otherwise shown on drawings, wall tiles shall be laid in such a manner and pattern so as to minimize cutting.
- c) The base shall be cleaned and well wetted to prevent water in tile bedding being absorbed.
- d) Tiles shall be soaked in clean water, brushed on the underside with a cement (ordinary or coloured) slurry of creamy consistency, and bedded and jointed in cement mortar on prepared screeds and pointed in coloured or white cement mortar as specified.
- e) Width of floor tile joint shall normally be 3mm wide. Wall tiles shall normally be tightly laid leaving no visible joints.

- f) Grout for pointing tile joints shall be mixed with ordinary or coloured cement of following proportions and use:
Floor tiling – cement and sand (1:1 by volume) mixed to a paste with the minimum of water.
Mosaic / glazed wall tiling – cement and powdered limestone (1:3 by volume).
External facing tiling – cement and granite fines (1:1 by volume).
For tiling work where water penetration is possible, approved waterproof colour grout shall be used.
- g) Where light colour or white tiles are specified, they shall be pointed with white pointing, that is, both bedding slurry and pointing slurry shall be of white cement.
- h) Tiling work shall be cleaned with water and protected immediately after laying.
- i) Where there is heavy traffic during construction period, the Contractor shall provide plywood cover to finished tile surfaces to the satisfaction of the Architect.

- A10.5.4 Precast Terrazzo Tiles
 - a) Precast terrazzo tiles shall be of size, thickness and colour as shown on drawings and laid on 20mm (minimum) thick screed.
 - b) Size and thickness shall be:
 - 225 x 225 x 20mm
 - 300 x 300 x 25mm
 - 450 x 450 x 40mm
 - 500 x 600 x 50mm
 - c) Precast terrazzo tiles shall be laid on a screed of cement, lime and sand (1:1:5 by volume).
 - d) The setting coat shall be applied with a steel trowel immediately before the tile are placed.
 - e) Joints shall be pointed with coloured cement or approved waterproof grout.

- A10.5.5 Ceramic Mosaic Tiles
 - a) Glazed ceramic mosaic tiles shall be size 18 x 18mm or 25 x 25mm and 5mm thick with square edges. Tiles should be graded as Fine Quality from the standard colour range, and in accordance with samples approved by Architect.
 - b) Mosaic tiles to be laid direct on concrete or other base shall be laid by the semi-dry mix method as follows:
 - 1) Lay cement and sand (1:4 by volume) semi-dry mix bed thoroughly compacted to the required thickness (20mm minimum) and draw off to the required levels, falls or currents;
 - 2) Pour cement and sand (1:1 by volume) slurry over the bed and spread and trowel to about 3mm thick;
 - 3) Coat back of sheets of mosaic tiles with cement slurry immediately before fixing. Slurry shall be of same colour as the final grout;
 - 4) Fix sheets of mosaic tiles and tamp firmly into bed maintaining straight and regular joints;
 - 5) Allow sufficient time for bed to set, remove backing paper and complete final straightening;
 - 6) Point the joints with approved coloured cement grout;
 - 7) Clean surplus grout from face of tile and wash the finished tilework as work proceeds.
 - c) Mosaic tiles to be applied on wall screed shall be laid by the thick bed method as follows:
 - 1) Damp the wall screed with sufficient clean water to prevent it absorbing water from the mortar bed;
 - 2) Apply bedding coat of mortar 10mm (maximum) thick composing of cement and granite fines (1:3 by volume);
 - 3) Coat surface of wall screed and back of sheets of mosaic tiles with cement slurry immediately before fixing. Slurry shall be of same colour as the final grout;
 - 4) Fix sheets of mosaic tiles and tamp firmly into position maintaining straight and regular joints;
 - 5) Allow sufficient time for bed to set, remove backing paper and complete final

- straightening;
- 6) Point the joints with approved coloured cement grout;
- 7) Clean surplus grout from face of tile and wash the finished tile work as work proceeds.
- d) If approved, thin bed method may be applied as follow:
 - 1) Fix mosaic tiles using a bed of adhesive in accordance with the manufacturer's recommendations;
 - 2) Point the joints with a proprietary grout unless otherwise instructed.
- A10.5.6 Vitreous Mosaic Tiles
 - a) Unglazed vitreous mosaic tiles shall be size 18 x 18mm, 18 x 38mm or 38 x 38mm and 4 or 5mm thick of either Japanese, European or Taiwan origin and to be chosen from the colour range specified to form a combination of colour, as specified, and supplied complete with coved tiles for internal and external angles if expressly specified or shown on details.
 - b) Laying of tile shall be as described in that of ceramic mosaic tiles.
- A10.5.7 Glass Mosaic Tiles
 - a) Glass mosaic tiles shall be fully vitrified glass tile size 20 x 20 x 4mm thick of European, Japanese or Taiwanese origin, as specified, shall be regular in shape, free from cracks or sharp edges and uniform in colour and texture.
 - b) Whited glass mosaic tiles shall be either translucent or opaque or of a mixture of both.
 - c) When light/dark colour glass mosaic tiles are specified, this shall mean a mixture of both in specified proportions to produce a jumble effect.
 - d) Laying of tile shall be as described in that of ceramic mosaic tiles.
- A10.5.8 Glazed Wall Tiles
 - a) White glazed wall tiles shall be size 100 x 100mm or 150 x 150mm, 5mm thick as described, of Japanese origin or approved equivalent.
 - b) Colour glazed wall tiles or porcelain cushion edged tiles (matt finish) shall be 108 x 108 x 5mm, "A" grade of Japanese manufacture "Inas" brand or approved equivalent, guaranteed non-crazing and of colours to be selected by the Architect from the standard range.
 - c) All tiles and fittings shall comply with B.S.6431.
 - d) Rounded edge tiles shall be provided to horizontal and vertical external angles, top of dado and as indicated on drawings.
 - e) The tiles shall be soaked in clean water for at least thirty minutes, stacked to drain and fixed as soon as surface water has drained off.
 - f) Back of each tile shall be buttered with cement and sand (1:3 by volume) and tapped firmly onto the prepared screed so that the bed is solid throughout. No adjustment to the tiles shall be allowed after ten minutes of fixing.
 - g) All joints shall be 2mm wide throughout and pointed with white or colour cement to match the tiles and as instructed by the Architect. Surplus mortar shall be removed before set.
 - h) Tiles shall be neatly cut and fitted around other works such as plumbing fixtures and fittings.
 - i) The total thickness of screed, bedding and tile shall match the adjacent finishes and generally be at least 22mm.
 - j) If so specified in the Particular Specification or on the drawings, glazed wall tiles may be fixed by 'thin-bed' method, using a bed of approved adhesive in accordance with the manufacturer's recommendations. The entire back of each dry tile shall be evenly butter to give finished bed thickness of not more than 3mm and tapped firmly in position onto the prepared cement and sand wall screed. Grout up joints using a proprietary grout if recommended.
- A10.5.9 Colour Cement Tiles
 - a) Colour cement tiles shall be size 150 x 150mm or 200 x 200mm, 20mm thick or as described. Unless otherwise specified, colour cement tiles of Chinese origin shall be

- allowed.
- b) Smooth surface tiles shall be used for interior and the surface shall be coated with white cement with colour pigment.
 - c) Non-slip surface tiles with uniform spot or rib texture shall be used on roof or exterior floor areas.
- A10.5.10 Concrete Tiles and Insulation Tiles
- a) Concrete flat tiles shall be of precast vibrated concrete of one part cement, two parts sand and four parts aggregates graded from 5mm to 10mm (1:2:4 by volume). Size of concrete tile shall be 300 x 300 x 30mm or 400 x 400 x 35mm as shown on drawings.
 - b) Concrete insulation (flat) tiles shall be made of lightweight concrete with a density of 1250+120kg/m³. Size of insulating tile shall be 300 x 300 or 400 x 400 x 40mm. The surface of the insulating tile shall be protected by steel mesh reinforced screed (20mm thick) as specified.
 - c) Concrete five-legged tiles shall not be used in any case.
 - d) Precast concrete paving slabs shall comply with B.S.7263, 50mm thick and of the size, colour and surface texture specified.
- A10.5.11 Quarry Tiles
- a) Quarry tiles shall comply with B.S.6431 with water absorption not exceeding 10% and shall be 100 x 100 x 9mm for ordinary duty or 150 x 150 x 13mm for heavy duty use, and of the required colour, surface finish and origin.
 - b) Tiles shall be laid direct on concrete or other base by the semi-dry mix method as follows:
 - 1) Soak tiles in clean water and allow to drain;
 - 2) Lay cement and sand (1:4 by volume) semi-dry mix bedding thoroughly compacted to the required thickness (13mm minimum) and draw off to the required levels, falls or currents;
 - 3) Pour cement and sand (1:1 by volume) slurry over bedding and spread and trowel to about 3mm thick;
 - 4) Beat tiles firmly into the bedding;
 - 5) Joints shall be even and 3mm (minimum) wide;
 - 6) Allow bedding to set before grouting;
 - 7) Point the joints with approved coloured cement grout and clean surplus from face of tiles;
 - 8) Lay tiles to fall as shown on drawings.
- A10.5.12 Ceramic Tiles
- a) Ceramic tiles shall be vitrified complying with B.S.6431 with water absorption not exceeding 3%, and of size, colour, surface finish and origin as described on drawings or in schedule of finishes.
 - b) Floor tiles shall be laid as described for quarry tiles.
 - c) Wall tiles shall be laid as described for glazed wall tiles.
 - d) All external facing tiles shall be fixed by 'thin-bed' method as described in A10.5.8.
- A10.5.13 Rubber Tiles and Sheet
- a) Rubber tiles or sheet shall comply with B.S.1711 and shall be minimum 4mm thick solid tiles or sheet either smooth or with a raised or studded pattern as shown on drawings.
 - b) The rubber forming the tile or sheet shall be satisfactorily vulcanized and free from sulphur bloom. The material shall be free from porosity and grit; the wearing surface shall be the most durable type to manufacturer's specification.
 - c) The colour of the flooring shall be within the standard range provided from the manufacturer and be submitted for approval.
 - d) Dimension of tiles, if not specified, shall be square with side length 225mm or 300mm to match the surrounding.
 - e) Workmanship and fixing method shall generally comply with B.S.8203, unless otherwise specified.

- A10.5.14 'Canton' Tiles
- a) 'Canton' tiles shall be hard, sound, square, well burnt, free from twist, cracks or other defects. Size of tile shall be either 300 x 300 or 400 x 400 mm and thickness varies from 30 to 35mm.
 - b) Where 'Canton' tiles are to be laid on roofs, they shall be bedded solid, flushed up, pointed with a neat flush joint in 1:3 cement mortar and, protected with sawdust as soon as laid.
- A10.5.15 Non-Slip Nosing Tiles
- a) Unless otherwise specified, non-slip nosing tiles of Chinese or Japanese origin shall be allowed for steps and treads stairs to match the adjoining tile paving.
 - b) Non-slip nosing tiles for steps shall generally be 150 x 75 x 13mm thick ceramic nosing tiles of approved manufacture with rounded nosing and non-slip grooves.
- A10.5.16 Vertical Junction of Different Wall Finishes
- Vertical junction of different wall finishes shall be provided with a recessed groove 3 x 6mm deep, or with 3mm thick approved plastic, brass, stainless steel or aluminium dividing strips as shown on drawings.
- A10.5.17 Expansion Joints
- a) All external tiles shall be laid with base screed in panels not exceeding 30m² each, separated by 15mm wide expansion joints.
 - b) Mortar shall be thoroughly raked out from expansion joints so that the joints are entirely open from the surface of the tiles.
 - c) Unless otherwise shown on drawings, the joints shall then be filled with a foam plastic or neoprene filler, stripped to a depth of 12mm minimum below the surface of the tiles, and neatly pointed flush with "Expandite Secomastic" of approved colour to match that of the tiles, or with other approved equal mastic pointing material.
- A10.5.18 Adhesive For Tile Installation
- a) Adhesive shall be employed in the fixing of all the facing tiles to external walls and of any homogeneous tiles to internal walls.
 - b) The Main Contractor is required to submit the catalogue of the proposed adhesive to be used in the works for the Architect's agreement before commencing the tiling works on site.
 - c) The method of fixing the tiles with adhesive shall be in strict accordance with the adhesive manufacturer's recommendations.
 - d) The Main Contractor shall submit copies of these manufacturer's recommendations for the Architect's agreement prior to carrying out the works.
 - e) The Main Contractor, in selecting a specific type of adhesive, shall be deemed to warrant its satisfactory performance and compatibility with the tiles to be fixed with the adhesive under all working conditions which may be encountered.
 - f) Unless otherwise stated in this Specification, the Main Contractor shall submit a guarantee, as per the specimen form of guarantee appended with this Specification for the works under this section for a period of five year from the Date of Practical Completion of the Contract.
 - g) The Main Contractor shall be responsible for obtaining the adhesive and tile manufacturers' guarantees on all the adhesives used and the tiling works.
 - h) All guarantees which extend beyond the expiry of the Defects Liability Period shall be vested in the name of the Employer.
 - i) The Main Contractor shall, without additional charge to the Employer, rectify any defective works under guarantee during the guarantee period, and arrange that the repaired works be guaranteed for another period of time equal to the guarantee period of the original installation.
 - j) In the event of anything described in the Specification or shown in the Drawings being, in the Main Contractor's opinion, unsuitable to or inconsistent with his guarantees or responsibilities, the Main Contractor shall draw the Architect's attention thereto at the time of tendering.

- k) Neither the time limit imposed on the Main Contractor's guarantees, nor the Practical Completion Certificate issued by the Architect, nor the acceptance of the installation by the Employer, nor the agreement or approval by the Architect of any materials or methods shall in any way relieve the Main Contractor from his responsibility for any latent defects in the Contract works which may become apparent in the future and which are, in the opinion of the Architect, due to the Main Contractor's failure to correctly use materials and methods which comply with this Specification and Drawings.

A10.6 **INTERNAL MARBLE, GRANITE AND ARTIFICIAL STONE WORK**

- A10.6.1 Internal Marble, Granite and Artificial Stone Work in General
- a) Unless otherwise shown on drawings or described by the Specification, the whole of this sub-section shall apply for internal marble and / or granite and / or artificial stone works. For external stone cladding, Section A16 of General Specification will apply.
- b) Contractor shall provide all labour, material, tools, equipment and services necessary for and reasonably incidental to the furnishing and complete installation of all interior coverings and finishes as shown on the drawings and as specified herein.
- c) The finished surface shall generally be smooth (unless otherwise specified as flamed finish, etc.), clean and free from damage and defects.
- d) All materials shall be of the best quality of the types selected.
- e) Type, size and finishes of granite / marble / artificial slabs / tiles to be selected by the Architect.
- A10.6.2 Samples for Approval
- a) Contractor shall submit 2 sets of samples and performance data of materials and articles to be used for Architect's approval.
- b) The order for bulk supplies of materials and articles shall not be confirmed until formal approval is obtained from Architect and one set of approved samples is required for Architect's record.
- c) Irrespective of the materials and articles offered in the tender, all materials and articles for use of the work shall be in full compliance with the specification unless otherwise agreed or approved by Architect.
- A10.6.3 Quality of Material and Testing
- a) The tenderer shall submit copies of laboratory test reports to indicate that the compressive and tensile strengths, hardness, water absorption, imperviousness, resistance to abrasion and resistance to chemicals and pollutants of the granite / marble / artificial stone are satisfactory for the purpose intended and for use in the site as specified.
- A10.6.4 Shop Drawing
- a) The Contractor shall submit shop drawings for Architect's approval prior to the fabrication of the bulk.
- b) The shop drawings shall indicate clearly:
- 1) the stone layout in relation to adjoining structure and other related works
 - 2) arrangement of the vein pattern for marble slabs or tiles
 - 3) fixing details
 - 4) full size details for joints and edges
 - 5) dimension and thickness
 - 6) materials and finishes
 - 7) location and spacing of hangers, anchorage and other accessories
 - 8) all other pertinent information
- c) Review of any data, approval of shop drawings shall not mitigate the Contractor's responsibility for the performance of the works nor relieve the Contractor of his responsibility to verify for himself that the work conforms to the Contract Requirements.
- d) Six (6) copies and one (1) reproducible print for each of the final approved shop drawings shall be submitted to Architect.
- e) Should the Contractor consider it necessary to fabricate or order any work before

Architect's approval is granted in order to meet the completion date, it is entirely at his own risk and no compensation in time or expense will be considered if the work is eventually considered unacceptable and rejected.

- A10.6.5 Mock-up Samples
- a) When the shop drawings are approved, the Contractor shall fabricate, deliver to and install on site mock-up samples for Architect to review on construction and design details, at location as selected by the Architect.
 - b) The samples should each show the full construction of each type of stone work.
 - c) Fabrication of bulk shall not commence until the mock-up samples have been approved.
- A10.6.6 Marble and Granite Materials
- a) Unless otherwise specified, marble / granite slabs or tiles shall be:
 - 1) of the type and origin approved by Architect.
 - 2) from the same quarry for each type specified.
 - 3) of thicknesses as required by the Architect.
 - 4) free from defects, stain and blemishes.
 - b) The surfaces of the granite / marble offered must be resistant to any discolouration or staining due to the atmospheric conditions in the site as specified other than normal weathering.
 - c) All stone slabs shall be neatly cut to specified size, free from flaws, defects, stains and blemishes throughout.
 - d) Any material that is damaged during delivery, storage, or installation is to be replaced at Contractor's own expense.
- A10.6.7 Artificial Stone Materials
- a) Unless otherwise specified, artificial stone slabs or tiles shall be:
 - 1) of the type, size and finish specified by the Architect
 - 2) of thickness as required by the Architect
 - 3) free from defects, stain and blemishes
 - b) All surfaces of the artificial stone must be covered by removable coating for protection against weather or damage and staining.
 - c) All artificial stone slabs / tiles shall be machine-cut to provide shape and square edges, unless otherwise specified.
 - d) Any material that is damaged during delivery, storage or installation is to be replaced at Contractor's own expense.
- A10.6.8 Cement Mortar
- a) Cement mortar shall be non-staining type and composed of one (1) part of cement and three (3) parts clean wash sand.
 - b) A polymer fortifield medium bed mortar, "Marble and Granite Mortar Mixed White", or approved equivalent shall be added for the installation of the light colour stone.
- A10.6.9 Sealant
- a) Sealant material for cladding shall be silicone sealant equivalent to "GE Silicones" Silpruf silicone sealant, "Dow Corning" 790 Building Sealant, or approved equivalent.
 - b) Sealant backing shall be of the close-cell butyl, neoprene or polyethylene sponge rubber rod type, compatible with the sealant and as recommended by the sealant manufacturer.
 - c) Sealant material for caulking around joints of lavatory basin, trimming, etc. shall be silicone sealant equivalent to "GE Silicones" Sanitary 1700 Sealant, "Dow Cornig" Silicone Rubber Bath Tub Caulk, or approved equivalent.
 - d) Colour of sealant shall be selected from standard product range by Architect.
- A10.6.10 Plaster to Paris
- Plaster of Paris shall be of Grade "A" in accordance with B.S.1191.
- A10.6.11 Marble, Granite and Artificial Stone Workmanship
- a) All fixing for the granite / marble / artificial stone shall be in accordance with the

- recommendations of C.P.298, by metal anchorage of a suitable, approved, non-ferrous material such as copper, phosphor-bronze or gunmetal and shall be of such shape and dimensions that they are adequate to carry the loads to be imposed on them.
- b) Cramp holes and mortices shall be carefully drilled or cut to avoid stunning or fracture of the material adjacent to the hole or mortice.
 - c) All granite / marble / artificial stone slabs or tiles shall be neatly cut and laid in patterns as required by the Architect. All joints between panels shall not be more than 1.5mm wide, unless otherwise specified and approved by the Architect.
 - d) All cutting and drilling in the slab or tile for outlet boxes or any other fixtures shall be neatly done to Architect's satisfaction.
 - e) All works and materials shall be free from any defect that may impair the strength, functioning, or appearance of the works or the adjoining construction.
 - f) All granite and artificial stone shall be selected in such a way that no vein can be observed after installation. Granite and artificial slabs or tiles with vein can only be considered when a continuous surface can be arranged to give an acceptable matching continuous veining pattern and produce a homogenous effect to Architect's approval. Surface of slabs or tiles shall be polished where specified.
 - g) Slabs or tiles abutting at an external angle are to be mitred to within 1.5mm of the angle unless otherwise specified on drawings. Where edges of slabs are exposed, the edges are to be finished to match the surface.
 - h) Slabs or tiles shall not cover up any expansion joint of the building structure.
- A10.6.12 Laying Marble, Granite and Artificial Stone to Floor
- a) All granite / marble / artificial stone floor slabs / tiles shall be bedded solid in screeds of non-staining cement mortar composed of one (1) part cement, three (3) parts clean washed sand (or selected granite fines) a minimum thickness of 40mm for polished and honed finish and minimum 50mm for flamed finish (including thickness of the slab) to form the required and even level, or installed by special method as required by the manufactory.
 - b) Marble / granite / artificial stone floor joints shall not greater than 1.5mm wide.
 - c) Floor slabs or tiles joints to be pointed with cement mortar of approved colour.
- A10.6.13 Mounting Marble, Granite and Artificial Stone to Suspended Ceiling/Interior Wall and Column
- a) The stone slab / tile shall be installed by a dry mount method and all components shall be assembled, secured, anchored, reinforced, sealed and made watertight in a manner not restricting thermal movement.
 - b) The stone wall slabs / tiles to be fixed minimum of 20mm from the structural surface.
 - c) Each slab / tile is to be dowelled for and fitted with 3mm thick stainless steel expansion bolt/brackets / cramps and "S" hooks / pins formed of 5mm diameter wire at 350mm centres. The cramp and pin thickness shall be determined by engineering calculation to Architect's approval. The cramps must be solidly bonded to the structure and "S" hooks to back of slabs.
 - d) Voids behind the granite / marble / artificial stone shall be filled up with cleaned dry sand specified as above up to 2 metres high from finished floor level.
 - e) Granite / marble / artificial stone slabs / tiles shall be laid in butt joints not greater than 1.5mm wide (unless otherwise specified on drawing).
 - f) All wall joints shall be slightly recessed as per detail drawings and pointed with sealant or silicone of approved colour.
 - g) Contractor shall submit detailed design of the dry mount construction to Architect for approval.
 - h) All grid struts, brackets, fasteners, etc. for the mounting of the stone slabs shall be treated with an approved anti-corrosive treatment.
 - i) The stone slabs/tiles shall be installed in such a manner that they will produce a visual flatness when viewed from any angle.
- A10.6.14 Curved Granite / Marble / Artificial Stone Slabs, Mouldings
- a) The curved surface should be perfectly circular and the vertical surface plumbed lined, to

- look as a monolithic piece.
 - b) Moulding could be divided into segments with Architect's approval.
 - c) Slabs shall be neatly moulded to exact profile to the adjacent piece and shall be butt jointed and plumbed lined.

- A10.6.15 Expansion Joint
 - a) Contractor shall indicate every expansion joint in the shop drawings and draw Architect's attention to it.
 - b) For marble / granite slabs / tiles, expansion joints of 2mm wide of approved sealant and joint filler are to be provided at every 20 metres continuous straight length of a bay of slabs.
 - c) For artificial stone, expansion joints of 1.5mm wide shall space at intervals of 50 x 50 metres, unless otherwise specified with manufacturer's recommendation.

- A10.6.16 Fixing Marble / Granite / Artificial Stone to Counters
 - a) Contractor shall submit detailed design of the fixing of marble / granite / artificial stone to counters for Architect's approval.
 - b) All cutting and forming of holes for other fixtures shall be neatly done.
 - c) All joints between walls and counter tops, around openings, trimmings, etc. shall be sealed with approved sealant materials.

- A10.6.17 Accuracy of Installation
 - a) All works shall be installed with finished surfaces to a true plane, with walls plumb and square unless otherwise specified.
 - b) The surface plane for wall claddings shall be accurate across any one or more joints to a tolerance of +/-1.5mm as measured under a 2.000m straight-edge or appropriate curve-edge template. Tolerance for planar leveling for wall panels shall be totally 5.0mm maximum between any two building gridlines.
 - c) Tolerance for floor levels shall be within +/-0.5mm vertically under a 2.000m straight-edge laid across any one or more joints. The maximum total rise or fall for a level floor (not ramped) between any two building gridlines shall be 3mm maximum, but maintaining the level to within +/-0.5mm vertically at the junction to any other adjacent finished floor surface.
 - d) Column and wall cladding shall be installed with finished surfaces to correct horizontal and vertical lines to all angles.
 - e) Tolerance for floor and wall installations setting-out relative to the horizontal building gridlines shall be within +/-1.5mm between adjacent panels and within 5.0mm maximum between any two building gridlines.
 - f) Tolerance for vertical setting-out of wall installations as measured from any adjacent building gridline shall be within +/-1.5mm maximum.

- A10.6.18 Protection and Cleaning Down
 - a) Contractor shall be responsible for protection against weather or damage and staining by other trades on the marble / granite / artificial stone works after installation:
 - 1) Floor slabs shall be covered with sufficient thickness of fine ash with plywood on top to give protection.
 - 2) For wall slabs, building paper and plywood protection layer is acceptable. All edges and external angles shall also be cased to Architect's satisfaction.
 - b) Contractor shall cover up all installed marble / granite / artificial stone work that may be affected by other operations, with plywood or other approved method for protection against mechanical damages such as abrasion, and chemical damages such as staining from timber, oil, wet straw, washings, steelworks or scaffolding and other injurious substances.
 - c) The intention of such precautionary measures is to avoid any replacement after installation of the marble / granite / artificial stone work.
 - d) On completion of the building operations, Contractor shall thoroughly clean down and wax the complete marble / granite / artificial stone work, and attend to any defects in the pointing and polishing.

- e) Any defective works or materials shall be replaced at Contractor's expense immediately.

A10.7 SUSPENDED CEILINGS

A10.7.1 Suspended Ceilings Work in General

- a) The work in this sub-section includes but are not limited to:
- 1) Marble and granite ceiling (Specification should refer to marble and granite installation).
 - 2) Open grid metal ceiling.
 - 3) Gypsum board suspended ceiling system.
 - 4) Acoustic Tile Ceiling System.
 - 5) Extruded Aluminium Strip Ceiling.
 - 6) Metal Lath Ceiling.
 - 7) Metal Panel Ceiling.
 - 8) Fire-resisting ceiling or equivalent E/M services at protected lobby, fire escape staircases and escape route.
 - 9) All suspension system including hangers, hanging wires, supporting steel angles, ceiling grids, trims, runners, etc.
 - 10) All ceiling bulkheads and fascia works.
 - 11) Co-ordination and forming of all openings for sprinkler heads, smoke detectors, loudspeakers, downlights, lighting fixtures, diffusers and air grilles etc. which are to be installed by others.
 - 12) Access panels or universally demountable grids.
 - 13) All necessary protective and decorative painting to the suspended ceiling works.
 - 14) Any other associated works which are required for the completion of the suspended ceiling installations.
- b) The Contractor shall supply, deliver and install the various types of suspended ceiling works at various locations as indicated on drawings, or otherwise specified.
- c) Installation of all suspended ceiling works shall be generally in accordance with C.P.290 and in strict accordance with the manufacturer's specification. The completed works shall be smooth, clean and free from damage and defects.
- d) The Contractor shall provide all labour and material, equipment and services necessary for and reasonably incidental to the furnishing and complete installation of all suspended ceiling works as shown on drawings and / or specified herein.
- e) The Contractor shall also prepare, submit, provide and be responsible for the following:
- 1) Shop drawings.
 - 2) Samples of material and finishes.
 - 3) Mock-up samples.
 - 4) Co-ordination with works of other trades.
 - 5) Protection of installation.
 - 6) All hoisting and temporary site services.
- f) Samples, colour and finish of all materials shall be submitted for Architect's approval before ordering.
- g) All combustible ceiling linings, fabric materials woodwork, etc. must be given flame retardant treatment with an approved flame retardant product. This work shall be carried out by a Registered Fire Services Installation Contractor and a certificate to this effect from the Contractor is to be forwarded to the Fire Services Department with duplicates to the Architect.
- h) Where ceiling linings are of Class 1 or 2 "Rating of Surface Spread of Flame" as per B.S.476: Part 7; then flame retardant treatment may not be necessary providing that documentary proof of compliance is submitted and accepted by the Architect.
- i) Tender drawings are diagrammatic only and do not purport to identify or solve completely the problems of construction details, fixings and anchorage, flatness and stability of the work.
- j) Tender drawings indicate profile and configuration required together with relationship to structural frame and interior building elements.

- A10.7.2 Samples for Tendering
The tenderer shall submit samples together with the tender to illustrate construction and finishes including:
1) Ceiling materials
2) Ceiling grids
3) Framing system
- A10.7.3 Installation Instruction
The Contractor shall submit the Manufacturer's Literature and Installation Instructions which specify all items of work including:
1) Performance standards.
2) Suspension system and calculation showing structural adequacy.
3) Arrangement of components.
4) Details of connection and anchorage.
5) Details of access panels, or other openings for E/M fittings.
6) All other pertinent information.
- A10.7.4 Shop Drawing
a) The Contractor shall submit shop drawing for Architect' approval prior to the fabrication of the bulk.
b) The shop drawing shall indicate clearly:
1) the ceiling layout and sections in relation to adjoining installations, structure, mechanical and electrical systems and other related works.
2) setting out and arrangement of components.
3) sequence and details of fabrication, assembly and erection.
4) typical details of fixing and openings.
5) dimension and thickness.
6) materials and finishes.
7) location and spacing of fixings, hangers, anchorage and other accessories.
8) access panels as required by other contractors and as specified on drawings.
9) openings for fire services, light fittings, HVAC diffusers, speakers, CCTV cameras, etc.
10) all other pertinent information as required by the Architect.
c) Review of any data, approval of shop drawings shall not mitigate the Contractor's responsibility for the performance of the works nor relieve the Contractor of his responsibility to verify for himself that the work conforms to the Contract Requirements.
d) Six (6) copies and one (1) reproducible print for each of the final approved shop drawings shall be submitted to Architect.
e) Should the Contractor consider it necessary to fabricate or order any work before Architect's approval is granted in order to meet the completion date, it is entirely at his own risk and no compensation in time or expense will be considered if the work is eventually considered unacceptable and rejected. Due allowance in programme shall be made by the Contractor to prepare and submit the shop drawings well in advance.
- A10.7.5 Samples for Approval
a) The Contractor shall submit 2 sets of samples and performance data of materials to be used in the Contract for Architect's approval.
b) The order for bulk supplies of materials and articles shall not be confirmed until Architect's written approval is obtained.
c) Irrespective of the materials offered in the tender, all materials for use of the work shall be in full compliance with the Specification unless otherwise approved by Architect.
- A10.7.6 Mock-Up Samples
a) When the shop drawings are approved, the Contractor shall fabricate, deliver to and install mock-up samples for Architect to review on construction and design details, at location as selected by the Architect.
b) The mock-up samples should each show the full construction of each type of ceiling system to an extent as required by the Architect. Access panel should be included.

- c) Fabrication of bulk shall not commence until the sample mock-ups have been approved. No claim for time or expense compensation would be acceptable due to disapproved mock-up samples and due allowance in programme shall be made by the Contractor to prepare the mock-up and associated shop drawings well in advance.
- A10.7.7 Open Grid Metal Ceiling
- a) The grid ceiling shall be constructed of specified metal in the grid pattern as per Drawings.
- b) The open grid ceiling shall be fully demountable for easy access to ceiling services.
- c) Acoustical treatment shall be provided as 25mm thick 42 kg/m³ minimum mineral wool batts and faced with an acoustically transparent matt black colour material which shall not significantly reduced the ground absorptive performance of the base material. The acoustic batts shall be laid loosely above the open grid ceiling panels.
- d) Openings shall be let into the acoustic treatment in conjunction with above-ceiling alarm belts, speakers, air diffuser, etc.
- e) Any exposed perimeter trim shall consist of factory-made folded continuous GMS steel angles, clean, square edges shall be produced.
- f) Detailing is subject to shop drawing approvals and mock-up installations.
- A10.7.8 Fire-Resisting Ceiling
- a) Fire resisting ceiling shall be "Promat" ceiling system or approved equivalent which shall be in accordance with BS 476 : Part 22.
- b) The Contractor shall ensure the fire protection and fire insulation system which shall be satisfied the most recent fire test standards and B.D. requirements.
- c) Ceiling panel
- 1) Ceiling panels shall be of "Promatect Boards", 9mm thick or approved equivalent which shall be in accordance with BS 476:Part 22.
- 2) When cutting of panel is required, the edge shall be cut in the manner that its profile shall match perfectly to the adjacent panel or structure to form only hairline butt joint.
- d) Suspension system
- The ceilings shall have its own supporting system and shall consist of a framing system of galvanized mild steel angles, anchorages and any other sections as required and approved by the Architect to support the panel, bolts, nuts as specified in drawings.
- e) Access panel
- 1) Access panels shall be provided to locations as shown on drawings or as required by Architect.
- 2) Access panels shall be easily fixed to and removed from the ceiling by using bolts with its nuts welded in the inside steel angle member as shaown on drawings.
- 3) Edges of access panels and the openings shall be formed hairline joints when being fixed.
- f) Bulkhead
- When the fire-resisting ceiling stop at the location where the ceiling forms vertical partition or bulkhead, the construction described in this section shall also apply.
- g) Pipe penetration
- Where the fire-resisting ceiling or enclosure is penetrated by single piping, the penetration shall be properly sealed by method or detail approved by Architect to form a tight fit.
- h) Fire resisting duct
- 1) Ducts and cableways constructed with fire-resisting enclosures shall be provided as required by the Architect.
- 2) The ducts shall have its own suspension system and shall consist of suspension rod, galvanised mild steel channel bracket and angle support expansion bolt anchorage.
- i) Integrity of fire compartment
- 1) The Contractor shall ensure that the construction of the fire-resisting ceiling and enclosures are in full compliance with the manufacture's specification.
- 2) Any deviation from specification and bad workmanship of the ceiling and enclosures will be rejected by Architect and the Contractor shall make good the work at his own

expense.

- A10.7.9 Gypsum Suspension Ceiling System
- a) Suspension system for gypsum board shall be Kirii ceiling suspension system, or approved equivalent. The same shall apply to curved ceiling board.
 - b) Gypsum board used shall be "James Hardie Gypsum, Hardirock, Regular Type size 4' x 8' x 1/2" thick, or otherwise approved by the Architect.
 - c) Tapered edge gypsum board shall be used where junctions are required.
 - d) Curved ceiling board used shall be "Asano F.G. Board" of 6mm thickness minimum or otherwise approved by the Architect.
 - e) Fixing procedures
 - 1) The ceiling system to be suspended from the underside of structural slab soffit.
 - 2) The suspension system, supporting channels, steel bar, clips, fixing, screws shall be installed in accordance with manufacturer's recommendations.
 - 3) Corner bead/trim shall be used at gypsum board edge to provide accurate, neat and sharp line, in conform with the adjacent wall surfaces and specified detail.
 - 4) Co-ordinate and form openings for air diffusers, light fittings, all required building services and access panels as required by Architect.
 - 5) Having fixed the gypsum boards to the suspension system, the joints shall be taped by jute scrim cloth not less than 90mm wide or other reinforcing means as approved by Architect. Both the joints and exposed screw heads will be primed and touched with gypsum joint compound.
 - f) Finished
 - 1) Apply gypsum plaster as one finishing coat 5mm (maximum) thick on gypsum board trowelled to a smooth surface using as little water as possible.
 - 2) Surfaces shall be thoroughly cleaned down before finishing with two (2) coats of emulsion paint as specified in small surface finishes such as emulsion paints.
 - 3) Emulsion Paint shall be I.C.I., 'Pentalite' or equivalent approved by the Architect.
 - 4) All edges of recesses shall be painted to match nearby surfaces unless otherwise indicated.
- A10.7.10 Lay-in Tile Ceiling System
- a) Installation of Lay-in Tile Ceiling System shall be generally in accordance with the manufacturer's specification, and in compliance with C.P.200 of the British Standards, or C.635-78 of the American Society of Testing and Materials, or any other standards to be proposed by the Contractor, which may be acceptable to the Architect.
 - b) The ceiling system shall be planned on a specified grid pattern as indicated in drawings.
 - c) Each of the modules shall be demountable for easy access of ceiling services.
 - d) Openings shall be let into the acoustic treatment in conjunction with above-ceiling alarm belts, speakers, air diffuser, etc.
 - e) Any exposed perimeter trim shall consist of factory-made folded continuous GMS angles, clean, square edges shall be produced.
 - f) The completed works shall be stable, level, smooth, clean, and free of any damage or defects.
 - g) Ceiling tiles
 - 1) Ceiling tiles shall be mineral fibre lay-in panel type and factory applied washable matt white vinyl latex paint or similar protective coating, unless otherwise specified.
 - 2) Tiles shall be moisture and mould resistant, and shall be free of any asbestos content.
 - 3) Tiles shall have a minimum thickness of 15mm and a minimum density of 350kg/m³ unless otherwise specified.
 - 4) If the ceiling void is to be used as a return air plenum of the air-conditioning system, tiles shall be incombustible and shall conform to Class 1 or 2 of B.S.476:Part 1 regarding the rate of surface flame spread, and shall also conform to the FSD(Ventilation) Code.
 - 5) If acoustical tile is to be used, tiles shall have the following acoustical properties:
 - i) Sound absorption coefficients:
125Hz 0.30

250Hz 0.35

500Hz 0.60

1000Hz 0.70

2000Hz 0.75

4000Hz 0.85

ii) Average NRC of 0.50 to 0.60.

iii) Average STC of 40 to 44.

6) Tiles shall have a light reflectance of 75% or over.

h) Ceiling grids

- 1) Ceiling grids shall be a semi-concealed type with galvanised mild steel main runners, or otherwise specified.
- 2) The runners shall be of a double web design with a rectangular top bulb. The exposed tee shall be capped with a 24mm wide aluminium flange.
- 3) The exposed aluminium flanges shall be polyester powder coated in matt white colour which shall match the colour of the ceiling tiles.
- 4) The concealed cross tee up-lines shall be electro-galvanised steel sections spanning the main runners, concealed and placed to support the ceiling panels.
- 5) The ceiling grid system shall provide an uniformly level and rigid framework for holding each tile, lighting fixture and air conditioning diffuser in place and in the same plane at any time. The completed system shall allow for the removal of individual tiles, lighting fixtures or diffusers, and sections of the tee-members without upsetting the stability of the system.

i) Suspension system

- 1) The ceiling shall have its own supporting system and shall consist of prestretched steel suspension wires not less than 12 SWG or steel hanger rods, anchorages, leveling devices, runners, couplings, clips, wall mouldings, joint trimmings, and other accessories. All mild steel components shall be galvanized.
- 2) The suspension system shall be capable of carrying the total load of the ceiling system, and fittings and fixtures of other contractors, with a deflection not greater than 1:360 of the span.
- 3) The suspension system shall be anchored only to the structure of the building. No anchorage shall be allowed to any other building elements.
- 4) All components shall be formed from hot dipped galvanised steel of commercial quality.

j) Bulkheads and wall perimeter trim

- 1) Bulkheads shall be according to approved shop drawings; painted in colour to match the ceiling unless specified otherwise; and completed with angle trim to all four edges with the same material and finish as the adjacent ceiling's exposed runner.
- 2) Wall mouldings shall be to the section as shown on the shop drawings and finished as specified.

k) Pelmet

Pelmets are to be constructed as shown on shop drawings including all necessary fixings, supports and anchorages.

A10.7.11 Extruded Aluminium Strip Ceiling

a) Slat

- 1) Ceiling strips shall be of baked enamelled aluminium extruded C-section with recess groove on one edge and flange on the other for interlocking fitting with adjacent ceiling strip.
- 2) The ceiling strip shall be 84mm wide, 16mm deep and 0.6mm thick.
- 3) There shall be a recess gap of 16mm in between the ceiling strip and filled by recessed infill piece.
- 4) All cut edges shall have the same colour of baked enamel finish.
- 5) Wherever possible, panels shall be ordered in maximum lengths up to 9m or as required to eliminate joining.
- 6) Laps shall be 50mm long and shall not be further than 100mm from the nearest stringer.

- b) Carriers
 - 1) The ceiling shall have aluminium strip carriers with prongs to hold the strips in position.
 - 2) Clips shall not be visible after the panels are installed.
 - c) Access panels
 - 1) Access panels shall be provided at locations as shown on drawings.
 - 2) All access panels shall be designed to suit ceiling design and complete with all necessary hardware including locking device to ensure secure fixing and ease of opening.
 - 3) To maintain rigidity of the ceiling system, edges of panel openings should be properly framed up.
 - d) Suspension system
 - 1) The ceilings shall have its own supporting system and shall consist of suspension wire in galvanised steel or hangers, anchorages and leveling devices, runners, runners, couplings and clips, wall mouldings, joint trimmings and other accessories necessary for suspending from the structural ceiling, making leveling adjustment, and the proper assembling of the ceiling system.
 - 2) The suspension system shall be designed to carry the total load of the ceiling without deflection.
- A10.7.12 Expanded Metal Lath Ceiling
- a) Expanded metal lath ceiling shall be 'Expamet' suspended ceiling system, or equivalent.
 - b) Installation method shall be in strict accordance with manufacturer's recommendation.
 - c) Expamet suspended ceiling
 - 1) Hanger anchors, support system and metal lath shall be constructed as per Expamet suspended ceiling system.
 - 2) The system shall be suitable for heavy weight plaster or renders.
 - 3) Plaster stop shall be provided at all junctions with suspended ceiling and access panels and wall junctions.
 - 4) Ceiling or bulkheads shall be plastered and finished with two coats of anti-mould emulsion paint.
 - 5) Co-ordination and forming openings for light fittings, air diffusers, all required building services and access panels.
 - d) Access panels
 - 1) Expamet access panel shall be provided at bathroom ceilings where A/C refrigerant and condensation pipes passes through, size and location shall be as required by the Architect.
 - 2) Expamet access panels shall be provided at all other bathroom ceilings, size and location shall be as required by the Architect.
 - 3) The access panels shall be recessed type and be able to receive plaster finish.
 - 4) The access panels shall be painted with anti-mould emulsion paint.
 - e) Suspension system
 - 1) The ceilings shall have its own supporting system and shall consist of galvanised steel or hangers, channels anchorages and leveling devices, wire ties, couplings and clips, and other accessories necessary for suspending from the structural ceiling, making leveling adjustment, and the proper assembling of the ceiling system.
 - 2) The suspension system shall be designed to sustain the total load of the ceiling without deflection, creeping and / or any structural defects.
- A10.7.13 Metal Panel Ceiling
- a) Material
 - 1) Ceiling panels shall be flat aluminium tray sections with profiled edges for interlocking fitting with adjacent runners of the suspension system.
 - 2) Ceiling panels shall consist of the modules as shown in Drawings and finishes schedules.
 - 3) A diffusion membrane of black polyethylene foil shall be inlaid above the perforated panels.
 - 4) The aluminium panels shall be factory-finished after preparation with chromatin

- treatment by proprietary store enamelling with polyester material in specified colour.
- 5) All cut edges shall have the same colour of finish as the panel surface.
- b) Suspension system
- 1) The ceiling shall have its own supporting system which shall consist of suspension wire in galvanised mild steel or hangers, anchorages and leveling devices, runners, coupling, joint trimmings and other accessories necessary for
 - i) the proper assembling of the ceiling
 - ii) suspending from the lift car, and
 - iii) making leveling adjustment
 - 2) The suspension system shall be designed to carry the total load of the ceiling together with any imposed live load including building movement wind and external environmental loads.
 - 3) The suspension system shall allow for thermal expansion and the deflection of the building structure.
 - 4) No clips and fixings shall be visible after the installation of the panels.
- c) Access panel
- 1) The ceiling system shall be designed for ready removal and subsequent replacement of individual panel at any location without any visual or structural effect on the completed ceiling.
 - 2) Edges of access panel shall be formed hairline joints when being fixed.
- A10.7.14 Installation Work in General
- a) Materials, fabricating methods, fittings, assembling, suspension, framing, supporting, fastening, jointing and execution shall conform to drawings and specification, approved shop drawings, manufacturer's recommendation, and shall be of the best quality practice of the industry.
 - b) Use new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected to.
 - c) All work shall be accurately and neatly fabricated, assembled and erected. Ensure that ceiling tiles and grids are properly set out and that all cutting is done at the perimeter. Fix all cover strips, edge trims and the like as required.
- A10.7.15 Openings
- a) Drill or cleanly punch openings, so that these openings will be accurate, clean, neat and sharp, without deforming adjacent surfaces.
 - b) Openings for services shall be the minimum necessary radius to enable concealment by the cover plates or flanges supplied with the service's components. Actual samples of the specified lighting fittings, recessed lighting tracks, diffuser grill, etc. shall be measured by the Contractor for the provision of the ceiling openings. Supply of samples can be obtained from specified trades.
- A10.7.16 Jointing and Connections
- a) All fastening, jointing and splicing shall be by concealed fasteners with joint accurately fitted, flush, and rigidly secured with metal to metal contacts.
 - b) Fasteners shall not be exposed after installation unless expressly approved by the Architect.
 - c) Where bolts or screws are permitted in work exposed to view they shall have a finish matching adjacent surfaces.
- A10.7.17 Access Panels
- Access panels shall:
- a) be provided to locations as shown on Drawings or as required by Architect. The Contractor shall co-ordinate with all related trades to confirm the location and size of access panels on site.
 - b) be designed to suit ceiling design and be of concealed design with mock-up installation for Architect's approval.
 - c) be completed with all necessary hardware including locking devices to ensure secure

- fixing and ease of opening.
- d) level with the ceiling plane unless otherwise specified on drawings.
- e) to maintain rigidity of the ceiling system, edges of panel openings shall be properly trimmed and framed up in the inside of the ceiling.

- A10.7.18 Installation
 - a) Install all work square, plumb, straight, to line, accurately fitted and located, with flush tight hairline joints (except otherwise indicated), with attachment devices as required for secure and rigid installation.
 - b) It is the responsibility of the Contractor that shop fabricated items shall properly fit the site conditions. If the shop fabricated items do not fit the site conditions, they shall be modified to the satisfaction of the Architect at Contractor's expense.

- A10.7.19 Built-in Works
 - a) Unless otherwise indicated, work to be built into concrete or masonry shall be anchored with shop-welded-on galvanised steel strap anchors or galvanized steel hanger bolts.
 - b) Provide all supplementary parts necessary to complete each item of work or this section.

- A10.7.20 Attachment
 - a) All attachment devices shall be of the type, size and spacing to suit site conditions to Architect's approval.
 - b) Provide adjustment hangers, shims, slotted holes, or other means necessary for leveling, plumbing and other required adjustments.
 - c) All attachment devices shall be concealed, unless otherwise indicated.
 - d) Where bolts or screws are permitted to expose to view they shall have finish match to adjacent surfaces.
 - e) Do all necessary drilling, tapping, cutting, shimming, or other preparations of surrounding construction on site accurately, neatly and as necessary for the attachment and support of all work, but obtain Architect's approval prior to such preparatory work to other Contractor's work.
 - f) Attachment to ducts, pipes, etc. shall not be allowed where such obstructions prevent installation of hangers as herein before specified, the Contractor shall bridge under the obstruction with grid of 38mm cold rolled channels, or by a method to Architect's approval, from which the ceiling grid may be suspended.

- A10.7.21 Painting
 - a) Scope of works
 - 1) Painting to ceilings
 - 2) Painting to metalwork
 - 3) Continued painting to above-ceiling level walls and structural soffit whenever visible above open-grid ceilings and through grills or uncovered openings.
 - b) All paints and materials shall be submitted to Architect for approval of:
 - 1) Brand,
 - 2) Type (including technical specification and fire safety compliance), and
 - 3) Colour, before delivery to site
 - c) No exposed painting shall be carried out under:
 - 1) Adverse weather conditions such as extremes of temperatures, etc. or
 - 2) Rain, fog conditions, etc. or
 - 3) Excessive dust or particles in the air
 - d) Unexposed surface of woodwork shall be treated with one coat of approved wood preservative before fixing.
 - e) New unprimed woodwork shall be cleaned from dirt, grease, etc., rubbed down or scraped smooth and dusted off. A thin coat of knotting primer as ICI Dulux A260-1 or equal shall be applied to all knots and allowed to harden. The surface shall then be primed with white leak wood primer as ICI Dulux A500-2 or equal when the primer is hard. All cracks, nail holes, open joints and other imperfections shall be made good with hard stopping of the appropriate type.
 - f) Prepare, prime with zinc chromate primer before fixing and paint three coats of synthetic

- g) paint (or red lead primer and oil paints if so required) on all iron and steel work.
This section shall be read in conjunction with Painting Section General Specification.
- A10.7.22 Tolerances
All work shall be plumb, square, level, and correctly aligned within the following limitations:
 - a) Offset from true horizontal, vertical, and design location shall not exceed 1:1000 of any component, not cumulative.
 - b) Maximum offset from true alignment between abutting components shall not exceed 1mm.
- A10.7.23 Protection and Cleaning
 - a) Protect all work from damage during transportation, storage at job site, erection, and subsequent construction activities.
 - b) After installation, provide additional temporary protection as required to protect all work from damage by subsequent site activities.
 - c) After installation is completed, suspension system and ceiling panels shall be cleaned where soiled and touched up where scratched or scuffed with appropriate paint supplied by manufacturer.
 - d) Upon completion of the various portions of the installations, all rubbish accumulated from the work shall be removed to Architect's satisfaction.
 - e) Any defective, soiled or improperly installed components which cannot be satisfactory corrected shall be replaced with new material at Contractor's expense.
 - f) The Contractor shall carry out and complete all remedial works at such time as designated by the Employer.

**SPECIMEN FORM OF GUARANTEE
(TILING WORKS)**

To: _____(the Employer")

_____(the "Project")

I / We, _____(the "Main Contractor") hereby

unconditionally warrant the due performance of the entire * external facing / internal homogeneous wall tiling installation for the captioned project including fixing systems, grouting and sealants against faulty workmanship and material, structural failure, non-uniformity of surfaces, cracking, peeling, spalling, discolouration and general disintegration and that they shall remain free from any defects for a five (5) year period commencing from the practical completion of the Works; and I / we shall indemnify the Employer against any expense, liability, loss, claim or proceedings whatsoever in the event of any defects being occurred during the five (5) year period provided always that the same is attributable to any negligence, omission or default of the Main Contractor.

Authorised Signature
(With Company Seal)

The Main Contractor

Date: _____

(* delete as appropriate)

GENERAL SPECIFICATION

GLAZING

A11

GLAZING

- A11.1 Generally
- A11.1.1 Scope of Works
- A11.1.2 General Requirements

- A11.2 Materials
- A11.2.1 Clear/Obscure Sheet Glass
- A11.2.2 Clear Polished Plate and Float Glass
- A11.2.3 Georgian Wired Glass
- A11.2.4 Wired Glass
- A11.2.5 Heat Strengthened (HS) and Fully Tempered (FT) Glass
- A11.2.6 Laminated Glass
- A11.2.7 Mirrors
- A11.2.8 Putty
- A11.2.9 Mastic Compound
- A11.2.10 Glazing Sealants
- A11.2.11 Guarantee
- A11.2.12 Polycarbonate Sheet

- A11.3 Workmanship
- A11.3.1 Preparation
- A11.3.2 Glass Louvres
- A11.3.3 Sealant
- A11.3.4 Cleaning

A11 GLAZING

A11.1 Generally

A11.1.1 Scope of Works

- a) Supply and installation of all glazing works as specified or as shown on drawings.
- b) Putty, glazing sealant, matching screws, spring clips and other accessories.
- c) Mirror.
- d) Glass louvers.

A11.1.2 General Requirements

- a) All materials shall be of the best quality of the types specified and conform to B.S.952.
- b) All glass shall be free from bubbles, smoke wanes, air holes, scratches or other defects, and shall be cut to the required size with clear undamaged edges to fit the rebates with due allowance for thermal expansion, etc.
- c) Unless otherwise specified, clear float glass in accordance with Table 1 of B.S.952 shall be used for window glazing.
- d) The glass type used for window glazing shall be as per window schedule. The thickness of glass shall be designed by the Contractor and meet with the design wind pressure or suction as required.
- e) Thermal Stress – All external glazing glass shall not develop any substantial thermal stress that may cause breakage of the glass when subject to the local climate conditions.

A11.2 Materials

A11.2.1 Clear/Obscure Sheet Glass

- a) Shall be of ordinary glazing quality.
- b) Shall be of the following approximate thickness and weight:

TYPE	THICKNESS	MAX AREA	MAX WIDTH	REMARKS
32 oz.	4.0+0.2 mm	0.90 m ²	610 mm	for upper panel of door and glass louvre
48 oz.	6.0 mm	1.85 m ²	1,215 mm	for partition and glass door, used only as instructed
- c) Obscure sheet glass shall generally be used for windows to bath, lavatory/toilet or storeroom. Obscure glass shall be "Arctic" or other figured, rolled or reeded pattern glass weighing not less than 9.50 kt/m+2.

A11.2.2 Clear Polished Plate and Float Glass

- a) Clear plate/float glass shall be of "Glazing Glass" (G.G.) quality with both surfaces flat and parallel to provide clear, undistorted vision.
- b) Float/plate glass shall conform to Federal Specification DD-G-451d or Japan Industrial Standard JIS R3202.
- c) Clear plate/float glass shall be of the following approximate thickness and weight:

THICKNESS	WEIGHT	MAX. AREA	REMARK
4 mm	10.0 kg/m+2	0.6 m ²	for windows and aluminium glass panel doors
5 mm	12.5 kg/m+2	1.0 m ²	
6 mm	15.0 kg/m+2	1.5 m ²	
10 mm	25.0 kg/m+2	4.0 m ²	for shop front panels and aluminium glass doors
12 mm	30.0 kg/m+2	exceeding 4.0 m ²	to be indicated on drawings

A11.2.3 Georgian Wired Glass

- a) Georgian wired glass shall be reinforced with wire in the form of a 13 mm square mesh

- b) with the wire electrically welded at intersections.
Georgian wired cast glass shall be of standard quality, 6mm nominal thickness and weighing approx. 17 kg/m².
- c) Georgian polished wired glass shall be completely transparent with both faces ground and polished and of 6 mm nominal thickness and weighing approx. 17 kg/m².

A11.2.4 Wired Glass

- a) Shall be provided as following:

<u>TYPE</u>	<u>ORIGIN</u>	<u>USE</u>
Rough Cast wired glass	European, U.S. or Japanese origin or as specified and glass	for metal windows facing light-well, specified staircase louvres
Clear wired Glass	European, U.S., Japanese origin or as specified	for smoke lobby doors, entrance and internal doors

A11.2.5 Heat Strengthened (HS) and Fully Tempered (FT) Glass

- a) Heat strengthened and fully tempered glass shall conform to B.S.952, Federal Specification (FS) DD-G-1403C or Japanese Industrial Specification (JIS) R3206.
- b) Tempered glass shall have structural integrity and shall not have any harmful scratches, pinholes or uneven, sharp angled or filed edges. All tempered glass shall be "heat soak" tested at a temperature of 240+°C for 3 hours and a manufacturer's certificate shall be submitted on delivery.

A11.2.6 Laminated Glass

- a) Laminated glass shall conform to B.S.952 and B.S.6262. Top & bottom glass lights shall be bonded together with interlayer of 1.5 mm thick clear vinyl interlayer film. Glass edges shall be neatly and cleanly factory cut, corners seamed.
- b) Laminated glass shall be used in all skylights, unless otherwise specified.

A11.2.7 Mirrors

- a) shall be 6 mm thick plate glass of 'silvering' quality.
- b) Shall be with edges bevelled, unless otherwise specified.
- c) Shall be backed with an even coating of silver and two (2) coats of shellac varnish or other approved treatment to resist moisture.

A11.2.8 Putty

- a) shall conform to B.S.544.
- b) shall be prepared from best washed whiting and boiled linseed oil, well kneaded together.
- c) with a proportion of not less than 10% of white lead ground in oil worked into it during preparation.

A11.2.9 Mastic Compound

- a) Compound for glazing to metalworks shall be an approved special compound manufactured for the purpose and of a brand and quality equal to Expandite "Safeseal" metal casement putty or "Arbo" glazing compound.

- b) Shall be provided in following:

<u>COMPOUND</u>	<u>USE</u>
100% mastic compound	for exterior and interior glazing with beadings
70% mastic compound 30% whiting putty	for exterior glazing without beadings

A11.2.10 Glazing Sealants

- a) Shall be one of the following:
- 1) G.E. Silicone Sealants – 1200 series, U.S.A.,
 - 2) DAP Polysulphide Polymer Sealant, U.S.A.,
 - 3) Bonseal Polysulphide Sealant, Japan,

4) Approved equivalent.

A11.2.11 Guarantee

- a) The Contractor shall obtain guarantee from glass manufacturer with a cover period of 5 years from date of final acceptance of the work for:
- 1) Replacement including delivery without charges for any unit of glass which has broken due to inclusion of nickel sulphide impurities.
 - 2) All replacement units installed for the final balance of the guarantee period applicable to the original unit which include the cost for removal plus replacement of the unit.

A11.2.12 Polycarbonate Sheet

Polycarbonate sheet shall be LEXAN GLAZING GRADE (9034) sheet manufactured by General Electric or equivalent. Polycarbonate Sheet shall be high-impact-resistant.

A11.3 Workmanship

A11.3.1 Preparation

All metalwork or woodwork shall be primed with one coat of approved primer before glazing.

A11.3.2 Glass Louvres

- a) Glass blades to fixed and adjustable louvres shall be 6 mm thick with exact widths and lengths as specified in drawings.
- b) Glass blades shall be provided with edges truly parallel and ground to remove sharp arise.

A11.3.3 Sealant

- a) Locate and identify all sealants by product name on shop drawings.
- b) In providing specified sealants or approved alternatives, strictly observe the printed instructions of the sealant manufacturer regarding joint size limitation. Where printed instructions are indefinite on the use of a primer, a primer shall be used.
- c) Sealant back-up material shall be polyethylene foam, sponge neoprene conforming to ASTM C-509, or Denver Foam as recommended by sealant manufacturer.
- d) Colour for sealants to be selected by Architect.
- i) Shop Sealants – all joints which are sealed in the manufacturer's plant as part of the assembly procedure shall be sealed with GE Silpruf, Dow Corning 790 or approved equal.
 - ii) Field Sealant:
For Glazing – Acceptable sealants are G.E. Silglaze 2400, G.E. Silpruf, G.E. 1200 Silicone, Dow Corning 732 or similar products approved by Architect.
For other joints – Select an appropriate sealant for joint size, movement, and substrates. Acceptable materials are Tremco Dymeric, G.E. 1200, Dow Corning 732 or 790, G.E. Silpruf.
- e) Alternative sealant materials may be considered if technical data sheets and cured and uncured sample are submitted. However, acrylics, Polybutane, oleoresinous, asphaltic, butyl, and polyisobutylene sealant are not acceptable for shop use; and polybutane, oleoresinous, asphaltic, and other oil base sealants are not acceptable for field use.

A11.3.4 Cleaning

Glazing work shall be thoroughly washed on both sides and left clean on completion.

GENERAL SPECIFICATION

PAINTING

A12 PAINTING

A12.1	<u>Generally</u>
A12.1.1	Scope of Work
A12.1.2	General Requirements
A12.1.3	Samples for Approval
A12.1.4	Guarantee
A12.2	<u>Materials</u>
A12.2.1	General Requirements
A12.2.2	Primers Sealers and Fungicidal Solution Generally
A12.2.3	Wood Primers
A12.2.4	Zinc Chromate Primer
A12.2.5	Etch Primer
A12.2.6	Metallic Zinc-rich Primer
A12.2.7	Alkali Resisting Primer
A12.2.8	Clearcolle
A12.2.9	Finishing Paints Generally
A12.2.10	Cement Paint
A12.2.11	Synthetic (Enamel) Paint
A12.2.12	Polyurethane Paint
A12.2.13	Emulsion (Latex) Paint
A12.2.14	Distemper (Washable)
A12.2.15	Limewash
A12.2.16	Oil Paints
A12.2.17	Bituminous Paints
A12.2.18	Wood Preservatives
A12.2.19	Wax Polish
A12.2.20	Varnish
A12.2.21	Marking Paint
A12.2.22	Acid-resisting Paint
A12.2.23	Synthetic Resin Based Wall Coating Generally
A12.2.24	Epoxy Based and Polyurethane Finished Coating
A12.2.25	Acrylic Based and Polyurethane Finished Coating
A12.2.26	Epoxy Based and Acrylic Finished Coating
A12.2.27	Acrylic Based and Acrylic Finished Coating
A12.2.28	Synthetic Resin Based and Inorganic Finished Coating
A12.3	<u>Workmanship</u>
A12.3.1	General Requirements
A12.3.2	Surfaces Preparation Generally
A12.3.3	Mordant
A12.3.4	Distemper Surfaces
A12.3.5	Water Paint Surfaces
A12.3.6	Cement Paint Surfaces
A12.3.7	Limewash Surfaces
A12.3.8	Woodwork
A12.3.9	Unexposed Surfaces of Woodwork
A12.3.10	Iron and Steel Work
A12.3.11	Wax Polish
A12.3.12	Letter Writing
A12.3.13	Line Marking, etc.
A12.3.14	Completion and Handover
A12.3.15	Identification Colour Code for Pipes and Plant

A12 PAINTING

A12.1 Generally

A12.1.1 Scope of Work

- a) painting to internal and external plastered or concrete surfaces.
- b) painting to internal and external woodwork such as doors, door frames, architraves, skirtings, handrails.
- c) painting to internal and external metalwork, such as steel windows, doors, gates and louvres, exposed and concealed pipeworks for plumbing, LP gas, fire services and electrical conduits, etc.
- d) line marking for carpark, playground, etc.
- e) letter-writings.

A12.1.2 General Requirements

- a) All priming, undercoating and finishing paints shall be either:
 - 1) from the same manufacturer for using together on the same work, or
 - 2) certified by one paint manufacturer to be compatible to supra and subsequent layers from another manufacturer.
- b) The Contractor shall place order for all specified or approved materials in due time and no substitution shall be allowed on the ground that the same is not available in current market.
- c) The Contractor shall submit documents to prove that materials have been ordered for Architect's verification within two (2) weeks after the approval of samples.
- d) The Contractor shall produce receipted invoices of the paint materials upon Architect's request.

A12.1.3 Samples for Approval

- a) Sample panels of all wood preservatives, primers, paints, coatings, wood stains and wax polish to be used in the work shall be submitted to Architect together with manufacturer's specifications, printed instructions in English and colour charts prior to bulk ordering.
- b) Sample panels shall be not less than 300 x 600 mm in size for each colour and type of paint.
- c) Approved sample panels shall be cut in halves by the Contractor and one half kept on site for quality control purpose.

A12.1.4 Guarantee

The Contractor together with the manufacturer, or his agent, shall submit a guarantee, in the form approved by Architect, stating that the external wall painting supplied and carried out by them shall be free from defects under local climatic conditions for a period of five(5) years, and that the joint guarantor will make good all defects at their own expenses including labour and material to remove the defective paint and carry out repainting to match existing adjoining work.

A12.2 Materials

A12.2.1 General Requirements

- a) All paints and materials shall be submitted to Architect for approval of brand, type and colour before delivery to site.
- b) If a brandname or a manufacturer is specified, materials of that manufacture shall be used, unless otherwise specified.
- c) Materials delivered to site shall be in manufacturer's sealed containers and packages, shall be properly stored in cool, ventilated space and protected from extreme temperatures.
- d) Unless otherwise specified, only those products from the following manufacturers will be considered by Architect:
 - I.C.I. Service Paints Ltd (hereinafter referred to as ICI)
 - Y.Cee Company Ltd.(hereinafter referred to as YC)

Fosroc Expandite Ltd – Permoglaze (hereinafter referred to as BP)

- A12.2.2 Primers, Sealers and Fungicidal Solution Genrally
- a) Primers shall be of the following types:
- 1) White lead wood primer for internal and external woodwork to receive synthetic finishing paints; aluminium wood primer for resinous woodwork only;
 - 2) Zinc chromate primer for internal and external metalwork to receive synthetic finishing paints;
 - 3) Zinc chromate based etch primer for all galvanised metal surfaces to receive synthetic finishing paints;
 - 4) Metallic zinc-rich primer for all cut or welded galvanised metalwork;
 - 5) Alkali resisting primer for internal plaster work to receive emulsion finishing paint.
- b) Sealers shall be used as recommended by primer manufacturer for plaster and masonry surfaces but shall be clearcolle for internal plaster work to receive distemper.
- c) Fungicidal solution (also known as anti-mould liquid) shall be from the same manufacturer of paints.
- A12.2.3 Wood Primers
- a) White lead wood primer shall be 'ICI A500-2 Delux white lead wood primer'.
- b) Aluminium wood primer shall be to B.S.4756, Type 1 as:
'ICI Aluminium Wood Primer Sealer A519-3697'
on new and unpainted resinous wood.
- A12.2.4 Zinc Chromate Primer
- Zinc chromate primer shall be to B.S.4652, Type 2 as:
ICI Delux Grey Green Chromate Primer A500-388 or
YC Zinc Chromate Primer PP3,
on iron and mild steel surfaces and suitably prepared non-ferrous metalwork.
- A12.2.5 Etch Primer
- Etch primer shall be two-pack type as:
'ICI Long Life Etch Primer AR565-10045' or
'YC Etch Primer PP1'
- A12.2.6 Metallic Zinc-rich Primer
- Metallic zinc-rich primer shall be to B.S 4652, Type 2 with minimum 80% zinc content as:
'ICI Zinc Rich Epoxy Primer AR580-2020' or
'YC Dufaysil 'E' PP240'
- A12.2.7 Alkali Resisting Primer
- Alkali resisting primer shall be as:
'ICI Acrylic Alkali Resisting Primer Sealer A931-PJ-1050'
or approved equivalent fungus resistant acrylic primer.
- A12.2.8 Clearcolle
- a) Clearcolle shall be composed of :
- 1) 0.25 kg. 'double size' dissolved in 4.5 litres hot water and,
 - 2) 0.5 kg. whiting previously soaked in 0.5 litre water added to the above.
- b) The above mixture shall be stirred to a creamy consistency and applied hot as a base for distemper to prevent suction by the plaster.
- A12.2.9 Finishing Paints Generally
- a) Finishing paints shall be the best quality product of the following types:
- 1) cement paint for external walls and soffits of balconies or canopies,
 - 2) synthetic paint for metalwork and woodwork,
 - 3) polyurethane paint for metalwork and woodwork,
 - 4) emulsion paint,
 - 5) washable and non-washable distempers and,

- 6) limewash.
 - b) Colour of paint shall be to B.S.4800 and shall be selected by Architect. Where the colour chosen by Architect is out of the manufacturer's range, the Contractor shall provide labour and samples for mixing to produce a stable and consistent resultant colour to Architect's satisfaction.
 - c) The following paints shall not be used unless expressly instructed by Architect:
 - 1) Whitening
 - 2) Non-washable or Chinese distemper
 - A12.2.10 Cement Paint
 - a) Cement paint shall be of waterproof type as 'Super Snowcem' manufactured by Cement Marketing Co., Ltd. (Local Agent: Green Island Cement Co.) or approved equivalent.
 - b) Cement paint shall be delivered to site in drums.
 - A12.2.11 Synthetic (Enamel) Paint

Synthetic paint shall be of 'alkyd' resin based type, combined with drying oils and pigments and mixed ready for use, as:

 - 'ICI Dulux Gloss Finish A365',
 - 'YC H.B. Alkyd Gloss Finish SP60 or SEA4' or
 - 'BP Permolaze Gloss'.
 - A12.2.12 Polyurethane Paint

Polyurethane paint shall be of the two pack type and part of an approved system.
- A12.2.13 Emulsion (Latex) Paint
 - a) Emulsion (or latex) paint shall be of internally plasticized polyvinyl acetate (P.V.A.) copolymer type of formulation such as ICI Pentalite' or approved equivalent.
 - b) P.V.A. type emulsion paint shall contain anti-mould agent which inhibits the development of all types of mould and fungus as certified by a recognised laboratory.
 - A12.2.14 Distemper (Washable)
 - a) Washable (oil-free) distemper shall be an approved manufacture.
 - b) The material shall be delivered to site in paste form, thinned with petrifying liquid, continually stirred, and allowed to stand for one (1) hour before use, so as to allow air bubbles to escape and to ensure a smooth coat.
 - A12.2.15 Limewash
 - a) Limewash shall be applied to ceilings only and shall be composed of tallow and quick-lime in the proportion of 16 kg. of tallow to 1 m³ of lime.
 - b) Mixing of limewash:
 - 1) The lime shall be broken into small lumps and the tallow shredded and placed on the top of the heap,
 - 2) Sufficient cold water shall be added so that heat developed in slaking is sufficient to melt and disperse the mass without becoming charred and,
 - 3) When slaking has completed, water shall be added to enable the mass to be worked into a stiff cream and screened to receive lumps if necessary.
 - A12.2.16 Oil Paints
 - a) Oil paint shall be white lead based of approved proprietary brand complying with B.S.2523.
 - b) Mixed ready for use, supplied in and used from the manufacturer's tins, labeled for:
 - 1) 'External' and 'Internal' use and,
 - 2) 'Undercoating' and 'Finishing' respectively.
 - c) The base and the required pigments shall be:
 - 1) grounded in linseed oil and,
 - 2) mixed with such proportions of thinners, driers and colouring pigments as necessary to produce a perfectly smooth, even coating of the required colour within a drying period of sixteen (16) hours.

- d) Where a 'Gloss' finish is required, the undercoats shall be finished 'Flat'.
- A12.2.17 Bituminous Paints
- a) Bituminous paints shall comply with B.S.1070.
- b) Bituminous paints shall only be used as concrete isolator or rust inhibitor for metal in contact with concrete. Other uses shall only be carried out under Architect's instruction.
- A12.2.18 Wood Preservatives
- Wood preservative shall be "Solignum" of U.K. manufacture or approved equivalent.
- A12.2.19 Wax Polish
- Wax polish for use on floors or furniture and joinery shall be an approved proprietary brand such as 'Johnsons', 'Ronuk' or approved equivalent.
- A12.2.20 Varnish
- a) Varnish shall be one of the following types:
- 1) Copal varnish to be of No.1 Extra Pale quality for internal use only.
 - 2) Synthetic varnish to be of the long linseed oil alkyd type for internal or external use.
 - 3) Polyurethane varnish for internal or external use to be either:
Moisture cure oil modified one pack type, or
Isocyanate cure two pack type.
- A12.2.21 Marking Paint
- Marking paint shall be an approved purpose made synthetic non-skid marking paint, with a drying time not exceeding 30 minutes.
- A12.2.22 Acid-resisting Paint
- Acid-resisting paint and thinner to be of an approved brand resistant to attack by all commonly used commercial acids and alkalis.
- A12.2.23 Synthetic Resin Based Wall Coating Generally
- a) All synthetic resin based wall coatings shall be of best quality and of the following type:
- 1) Epoxy based and Polyurethane finished coating,
 - 2) Acrylic based and Polyurethane finished coating,
 - 3) Epoxy based and Acrylic finished coating,
 - 4) Acrylic based and Acrylic finished coating and,
 - 5) Synthetic Resin based and Inorganic finished coating.
- b) The wall coating shall consist of three (3) layers, namely, sealer coat, textured coat and finishing coat, and the number of coats in each layer shall comply with manufacturer's printed instructions and up to the guarantee to be provided by the Contractor.
- c) Colour, texture and type of finishing of the wall coating shall be selected by Architect. Application shall be in compliance with manufacturer's printed instructions.
- d) Where the wall coating is to be applied on off-form concrete, the concrete surface shall be free from oil, wax and dust, and any defects, marks, holes, honeycombs and the holes leveled, smoothened and touched up with cement sand mortar to the satisfaction of Architect.
- e) Where the wall coating is to be applied on cement rendered surface, defective surfaces shall be mended and all corners mortared straight to the satisfaction of Architect.
- A12.2.24 Epoxy Based and Polyurethane Finished Coating
- a) This coating shall consist of three (3) layers, namely epoxy resin sealer coat, epoxy resin texture coat and polyurethane finishing coat.
- b) 'Bonntile', 'Multitile' or approved equivalent shall be as follows:
- 1) Where light texture is specified, it refers to texture similar to that of 'Bonntile B/E-L',
 - 2) Where rolled on cast pattern is specified, it refers to texture similar to that of 'Bonntile B/E',
 - 3) Where smooth texture is specified, it refers to texture similar to that of 'Multitile Sahara'.

- A12.2.25 Acrylic Based and Polyurethane Finished Coating
- a) This coating shall consist of first layer of acrylic resin sealer coat, second layer of acrylic resin textured coat and final layer of polyurethane finishing coat.
- b) 'Bonntile', 'Pyrok', 'Jaca' or approved equivalent shall be as follows:
- 1) Where light texture is specified, it refers to texture similar to that of 'Bonntile Pen (B/F-F)' or 'Pyrok Ceramitex Fine',
 - 2) Where rolled on cast patten is specified, it refers to texture similar to that of 'Bonntile Pen (B/P-R)' or 'Pyrok Ceramitex Semi-smooth',
 - 3) Where smooth texture is specified, it refers to texture similar to that of 'Bonn Coat (B/C)' or 'Pyrok Ceramiccoat'.
- A12.2.26 Epoxy Based and Acrylic Finished Coating
- a) This coating shall consist of first layer of epoxy resin based sealer coat, second layer of epoxy resin textured coat and final layer of acrylic finishing coats.
- b) 'Bonntile' or approved equivalent shall be as follows:
- 1) Where light texture is specified, it refers to texture similar to that of 'Bonntile B/E-L' and,
 - 2) Where rolled on cast pattern is specified, it refers to texture similar to that of 'Bonntile B/F'.
- A12.2.27 Acrylic Based and Acrylic Finished Coating
- a) This coating shall consist of first layer of acrylic resin sealer Coat, second layer of acrylic resin textured coat and final layer of acrylic finishing coats.
- b) 'Jaca' or approved equivalent shall be as follows:
- 1) Where light texture is specified, it refers to texture similar to that of 'Jaca Coat',
 - 2) Where rolled on cast pattern is specified, it refers to the texture similar to that of 'Jaca Tex-shade' and ,
 - 3) Where smooth texture is specified, it refers to the texture similar to that of 'Jaca'Coat(Spcial).
- A12.2.28 Synthetic Resin Based and Inorganic Finished Coating shall be as per the particular specification.

A12.3 Workmanship

- A12.3.1 General Requirements
- a) Painting shall be carried out in accordance with B.S.6150 and executed by skilled workmen only. Smoking and naked light shall be strictly prohibited at work or storage space.
- b) The Contractor shall replace any incompetent workmen to minimize wastage of paint materials and time.
- c) No painting work shall be carried out in adverse weather conditions such as extremely cold, raining, foggy, high humidity and where there is excessive dust in the air.
- d) All surfaces shall be made good and thoroughly dry and free from dirt, etc. before application of paint.
- e) All primers shall be brush-applied and subsequently topcoated within a reasonable period for maximum protection. Subsequent coats may be applied by spray, brush or roller of suitable size, unless otherwise directed.
- f) All brushed, tools, pots, etc. used in carrying out the work shall be clean and free from foreign matters, and shall be thoroughly cleaned before being used with a different type or quality of material. Distemper brushes shall be not less than 150mm wide. Cotton waste for painting is forbidden to use.
- g) For consecutive coats of paint of slightly different tint except white, each coat shall be allowed to harden before the next is applied to prevent colour variation occurs.
- h) Rubbing down between coats shall be done with fine abrasive paper.
- i) Thinning of paints, where necessary, shall be carried out with the type of thinner and proportions in strict compliance with manufacturer's printed instructions.
- j) Paints, when being applied, shall be free from all skin and extraneous substances and

- thoroughly mixed in clean container.
 - k) Each coat of paint shall be well brushed onto the surface to cover all areas including joints, junctions and angles; but the Contractor shall avoid excessive or uneven paint film thickness occur particularly at edges, junctions and angles.
 - l) The Contractor shall never paint over weatherstrip of windows and doors or painting into the joints at movable parts of hardwares and fittings.
 - m) All finished surface shall be free from brush marks, sags, runs and other imperfections.
- A12.3.2 Surfaces Preparation Generally
- a) All preparatory work specified here-in-after or elsewhere shall be part of the painting work.
 - b) All surfaces shall be cleaned thoroughly to remove dust, dirt, stains, grease, loose materials and plaster splashed, etc. Cracks and other imperfections shall be made good and allowed to dry out thoroughly.
 - c) Efflorescence:
 - 1) Any efflorescence shall be removed by wiping first with a dry coarse cloth and then with a damp cloth.
 - 2) The surface shall then be left for forty-eight (48) hours to see if further efflorescence occurs.
 - 3) Painting shall not be applied until efflorescence has definitely ceased.
 - d) Definitions: "Wash down" shall mean either:
 - 1) removal with clean water of all dirt, etc. not absorbed into the surface of a material not previously decorated, or
 - 2) removal with clean water of existing limewash, non-washable distemper or similar materials not absorbed into the decorated surfaces, or
 - 3) removal of dirt, etc. from cleaning down of existing washable distempered, cement painted, synthetic painted and similarly decorated applications of clean water.
 - e) Stopping and filling shall be included for all metal, wood and plastered surfaces with suitable material to produce smooth surfaces ready for priming and painting.
 - f) Knotting shall be included for all woodworks to be painted or otherwise treated. Knotting shall be carried out with shellac dissolved in spirit or approved ready mixed compound.
- A12.3.3 Mordant
- a) Mordant shall be applied to all surfaces which do not readily take paint.
 - b) Mordant shall be brushed on and allowed to dry for forty-eight (48) hours before painting to ensure proper adhesion of paint.
- A12.3.4 Distemper Surfaces
- a) Surface to be distempered shall be prepared as specified and treated with one (1) coat of clearcolle before application.
 - b) Unless otherwise specified, washable distemper shall be applied in two (2) coats to wall and ceiling surfaces.
- A12.3.5 Water Paint Surfaces
- a) Internal surfaces to be finished with oil-bound water paints shall be prepared as specified and treated with specified alkali resisting primer before applying:
 - 1) one coat of water paint thinned with petrifying liquid and,
 - 2) two coats of water paint thinned with water.
 - b) External surfaces shall be similarly treated, but with the last two (2) coats tinned with petrifying liquid in lieu of water.
- A12.3.6 Cement Paint Surfaces
- a) External surfaces shall be prepared as specified, washed down and treated with two (2) coats of cement paint mixed with clean water to a creamy consistency.
 - b) The cement paint shall be used within one (1) hour after mixing.
 - c) A minimum of twelve (12) hours shall be elapsed before application of the first and second coat.

- A12.3.7 Limewash Surfaces
Surfaces shall be thoroughly cleaned down before finished with two (2) coats of limewash only by brush or spray.
- A12.3.8 Woodwork
- a) Exterior woodwork shall be prepared as specified and painted with one (1) priming coat, two (2) undercoats and one (1) finishing coat in synthetic paint, or other finishing paints as specified.
 - b) Interior woodwork shall be prepared as specified and painted with one (1) priming coat, one (1) undercoat and one (1) finishing coat in synthetic paint, or other finishing paints as specified.
 - c) Before painting, new unprimed woodwork shall be cleaned from dirt, grease etc., rubbed down or scraped smooth and dusted off.
 - d) A thin coat of best patent knotting 'A260-1' by ICI Service Paints Ltd (I.C.I.) or approved equivalent shall be applied to all knots and allowed to harden.
 - e) The surface shall then be primed with white lead wood primer as 'A500-2 Delux white lead wood primer' or ICI Service Paints Ltd (I.C.I.) or approved equivalent.
 - f) After the primer has been hardened, all cracks, nail holes, open joints and other imperfections shall be made good with hard stopping of the appropriate type.
- A12.3.9 Unexposed Surfaces of Woodwork
All unexposed timber surfaces in contact with concrete or brickwork including grounds, backs of frame, skirtings and plywood wall lining, etc. shall be applied with minimum one (1) coat of wood preservative and inspected by Architect before fixing.
- A12.3.10 Iron and Steel Work
- a) All internal and external iron and steel work including metal windows and doors, balustrades, eave gutters and rainwater, soil, waste and vent pipes, etc. shall be primed with zinc chromate primer before fixing painted with three (3) coats of synthetic paint (or red lead primer plus oil paint if so required).
 - b) Eave gutters and rainwater heads shall be painted both sides.
 - c) Coated pipes shall have one (1) coat of knotting or aluminium primer before painting.
 - d) All cast iron pipes, holdfasts and other iron work enclosed in ducts shall be painted with one (1) coat of approved bituminous paint before fixing and one (1) coat after.
- A12.3.11 Wax Polish
- a) Floor surfaces shall be thoroughly cleaned, stopped and finished with two (2) coats of wax by and electric polisher.
 - b) Unless otherwise specified, wax polish on furniture and joinery shall be applied with a soft cloth and allowed a minimum drying time of four (4) hours between coats. Surfaces shall be brushed with a soft brush to obtain an eggshell finish.
- A12.3.12 Letter Writing
Unless otherwise specified, paint letters, characters, figures, etc. to the required sizes and styles in one (1) thick coat (not less than 0.3mm) synthetic paint free from brush marks.
- A12.3.13 Line Marking, etc.
Line marking used to delineate carpark spacing, playground, sport court, etc. on "tarmac" or other paved surfaces, shall be painted in the required colour and widths with two (2) coats of approved hardwearing marking paint.
- A12.3.14 Completion and Handover
- a) All completed works, fittings and furniture, etc. shall be properly protected during the execution.
 - b) Splashed on floors, walls etc. shall be removed during the progress of work and the whole left clean and perfect on completion.

GENERAL SPECIFICATION
PAINTING

- A12.3.15 Identification Colour Code for Pipes and Plant
- All pipes exposed to view shall be painted in primary colours with central band of specified colours as tabulated below.
 - Three (3) colour bands (two other bands and one central band) at three (3) metre intervals shall be used for identifying of pipes in false ceilings and unpainted P.V.C.pipes. The width of each band shall be equal to the diameter of the pipe.
 - Arrows showing the flow direction shall be painted in black and provided at three (3) metre intervals on all main distribution pipes.
 - All plants shall be painted in standard colours as tabulated below (colour numbers are those of B.S.381C for ready mixed paints):

DESCRIPTION OF SERVICES		PRIMARY COLOURS OR OTHER BANDS		CENTRAL BAND	
		COLOUR	NO.	COLOUR	NO.
(A)					
PIPEWORK:					
WATER:					
	Mains supply	Light French	175	White	-
	- potable	Light French	175	Light Orange	557
	- hot	Grass Green	218	Light French Blue	175
	- flushing	Grass Green	218	Canary Blue	309
	Well or Nullah	Grass Green	218	White	-
	Seawater	Light French	175	Canary Yellow	309
	Chilled water	Light French	175	-	-
	Supply to swimming pool				
STEAM:					
	Steam supply	Aluminium	-	White	-
	Condensate & boiler feed	Light French	175	Aluminium	-
MEDICAL:					
	Vaccum	White	-	Canary Yellow	309
	Oxygen	White	-	Black	-
	Nitrous Oxide	White	-	Light French Blue	-
FIRE FIGHTING WATER:					
		Signal Red	537	-	-
OIL:					
		Golden Brown	414	Black	-
TOWN GAS					
		Canary Yellow	309	Black	-
REFRIGERANT:					
		Light Orange	557	Code No. of refrigerant	
COMPRESSED AIR:					
		Light Buff	358	White	-
CHEMICALS:					
		Light Grey	637	Signal Red	537
DRAINS & VENT:					
		Black	-	Black	-
(B)					
EQUIPMENT					
	Plant	Opaline Green	275	-	-
	Elect. conduits	Aluminium	-	Light Orange	557
	Air Ducts	White	-	-	-
	Fire Fighting	Signal Red	537	-	-

GENERAL SPECIFICATION

PLUMBING INSTALLATION

A13

PLUMBING INSTALLATION

- A13.1 General Requirements
- A13.1.1 Scope of Works
- A13.1.2 Connection to Government Main Supply
- A13.1.3 Definitions
- A13.1.4 Specialist Contractor
- A13.1.5 Qualified Plumbers

- A13.2 Submittals
- A13.2.1 Samples and Shop Drawings
- A13.2.2 As-fitted Drawings
- A13.2.3 Instructions and Manuals

- A13.3 Materials and Workmanship
- A13.3.1 Patterns
- A13.3.2 Sheet Lead
- A13.3.3 Galvanised Mild Steel Pipes
- A13.3.4 Unplasticised PVC Pipes
- A13.3.5 Copper Pipes
- A13.3.6 Ductile Iron Pipes
- A13.3.7 Installation of Pipework
- A13.3.8 Pipe Supports
- A13.3.9 Pipe Sleeves
- A13.3.10 Pipe Anchors and Guides
- A13.3.11 Cutting of Holes
- A13.3.12 Pipe Passing through Roof Slab
- A13.3.13 Thrust and Anchor Blocks
- A13.3.14 Valves
- A13.3.15 Water Pumps
- A13.3.16 Pump Fittings
- A13.3.17 Pump Valves
- A13.3.18 Pump Bases
- A13.3.19 Pump Control
- A13.3.20 Hydropneumatic Booster Pump Sets
- A13.3.21 Non-concrete Water Tanks
- A13.3.22 Connections for Water Tanks
- A13.3.23 Stamping of Valves and Taps
- A13.3.24 Insulations
- A13.3.25 Water Meters
- A13.3.26 Water Heaters
- A13.3.27 Stainless Steel Enclosures to Plumbing Pipes inside Electrical Rooms
- A13.3.28 Co-ordination
- A13.3.29 Labelling
- A13.3.30 Cleaning after Installation
- A13.3.31 Painting
- A13.3.32 Incidental Works

A13.4	<u>Electrical Works</u>
A13.4.1	General Requirements
A13.4.2	Pump Control Panels
A13.4.3	Electric Motors
A13.4.4	Direct-on-line Starters
A13.4.5	Star-Delta Starters
A13.4.6	Contactors
A13.4.7	Ammeters
A13.4.8	Switchgear
A13.4.9	Connections to Motors
A13.4.10	Cables and Conduits
A13.4.11	Emergency Stop
A13.4.13	Remote Alarms and Indicators
A13.5	<u>Sanitary Fitments and Fittings</u>
A13.5.1	General Requirements
A13.5.2	Chromium-plated Brass Fittings to Water Taps and Valves
A13.5.3	Chromium-plated Gunmetal Fittings to Water Cisterns
A13.5.4	Jointing between Water Closets and Concrete Floors
A13.5.5	Materials of Sanitary Fittings for Salt Water Use
A13.5.6	Cleaning and Protection
A13.6	<u>Testing and Commissioning</u>
A13.6.1	Requirements of Testing and Commissioning
A13.6.2	Operating Tests
A13.6.3	Hydraulic Tests
A13.6.4	Electrical Tests
A13.6.5	Sterilization of Potable Pipework
A13.6.6	Instructing Employer's Staff
A13.6.7	Maintenance and Servicing

A13 PLUMBING INSTALLATION

A13.1 General Requirements

A13.1.1 Scope of Works

The works to be carried out by the Contractor comprise the provision of all materials, labour, plant, tools and other necessary items required for the supply, delivery, installation, testing, commissioning and maintenance of the entire plumbing system, as shown on the drawings and as specified herebelow:

- a) Cold water supply system
- b) Hot water supply system
- c) Flushing water supply system
- d) Sanitary and waste appliances

A13.1.2 Connection to Government Main Supply

The Contractor shall inform the Water Authority in good time for all the connection works, including all water meters, to be completed without delay to the programme of works.

A13.1.3 Definitions

- a) The Contractor as appeared hereinafter in this Specification and related specifications shall mean the specialist contractor appointed to carry out the plumbing and related works under this Specification.
- b) The Building Contractor as appeared hereinafter in this Specification and related specifications shall mean the Main Contractor appointed to carry out the construction of the superstructure of the development.

A13.1.4 Specialist Contractor

- a) The whole of the plumbing works included in this specification shall be installed complete at the Contractor's own expenses.
- b) All plumbing works shall be carried out by licensed plumbers employed by the Contractor, and all works shall be in compliance with the requirements of the Water Authority and Building Authority.
- c) Notwithstanding that the plumbing system has been approved in principle by the Water Authority, the Contractor shall be responsible for ensuring that the final installations are fully in compliance with the requirements of the relevant government authorities.

A13.1.5 Qualified Plumbers

At least 10% of qualified plumbers shall be employed by the Contractor or his Sub-contractors on site at any one time. Copper pipeworks must be carried out by qualified plumbers. A list for qualified plumbers shall be submitted to the Architect for approval before the commencement of works.

A13.2 Submittals

A13.2.1 Samples and Shop Drawings

- a) Before the preparation of shop drawings and the commencement of installation, the Contractor shall acquaint himself with the latest information, layouts and details of other services, and the latest architectural and structural details, so that well-coordinated working drawings and installations are accomplished for the checking and inspection by the Architect. The Contractor shall at the same time cooperate and coordinate with the Building Contractor and other contractors to ensure that all installations are completed in a neat and satisfactory manner.
- b) The Contractor shall bear all the costs of any dismantling, modification, etc. of any works installed due to failure of implementing sub-clause(a).
- c) Within two weeks after the award of this Contract, the Contractor shall submit schedules showing clearly the expected submission dates of proposed materials, samples, etc. for the Architect's approval. These schedules shall be prepared to match the building construction programme, and be reviewed regularly.

- d) Shop drawings shall be submitted by the Contractor for the Architect's approval, showing installation details based on actual dimensions of materials/equipment used. These shall be submitted at least one (1) month before the commencement of the installation works, and shall include the following:
- 1) Plumbing floor plans and vertical line diagrams
 - 2) Bathroom and kitchen details with sections (scale 1:50)
 - 3) Penetration drawings
 - 4) The lowest invert level of plumbing pipes for each floor
 - 5) Pipe installation details for critical areas
 - 6) Pipe support details
 - 7) Details of pump rooms with sections (scale 1:50)
 - 8) Details of pipe anchors and guides
 - 9) His own proposed electrical control wiring diagrams, and 1:25 scale control panel details with elevations
- e) The Contractor shall also submit for the Architect's approval samples of piping materials, valves, etc. and detailed catalogues and data of all equipment.

A13.2.2 As-fitted Drawings
Upon completion of the installations, the Contractor shall provide six (6) sets (2 sets in colour) of as-fitted drawings showing the details of piping, conduit run, etc. for record and maintenance purposes. These drawings shall be submitted to the Architect for approval within 60 days from the Date for Practical Completion.

A13.2.3 Instructions and Manuals

- a) Prior to Practical Completion the Contractor shall supply in hard-backed binders two (2) sets of record drawings and four (4) completed sets of instructions for the operation and maintenance of the services.
- b) The instructions for the operation and maintenance of the services shall be detailed to include:
- 1) A description of the installed services
 - 2) Safety and control features
 - 3) A description of the operation of the services
 - 4) Instructions for normal starting and stopping
 - 5) A schedule for maintenance and lubrication.
 - 6) An inventory of installed equipment listing the type, size, serial number, rpm, motor size, etc
 - 7) Spare parts lists and manufacturer's sectionalised diagrams for parts identification
 - 8) Manufacturer's maintenance manuals for each item of equipment
 - 9) As-installed drawings, photographically reduced to binder size, of the plant and equipment rooms; control and functional diagrams showing the instruments and equipment items
- c) A draft copy of the instructions for the operation and maintenance of the services shall be submitted for the Architect's inspection before final binding.

A13.3 Materials and Workmanship

A13.3.1 Patterns

All patterns, templates etc. which may be required for the proper execution of the works shall be provided free-of-charge by the Contractor.

A13.3.2 Sheet Lead

- a) The lead shall be new pig lead in accordance with BS 1178, milled to an even thickness and texture, well and evenly dressed without injury to the surface, and free from sand cracks and other defects.
- b) The lead shall be of the specified thickness in all cases, and be measured when required at the Contractor's own expenses. Unless otherwise required by the specification or drawings, 1.8mm thick sheet lead shall be used.

A13.3.3 Galvanised Mild Steel Pipes

- a) Galvanised mild steel pipes and fittings for use in the potable water system shall be of an approved make with screwed and socketed joints, tested by hydraulic test to withstand a pressure of 5 N/mm², and identified by a painted blue band in accordance with the medium thickness tubing as specified in BS 1387, or medium grade of Japanese origin. All underground galvanised mild steel pipes for potable water shall comply with BS 1387 heavy grade of Japanese origin.
- b) All screwed joints for galvanised mild steel pipes and fittings shall be cleaned, properly threaded, put together with an approved jointing compound and fine stranded hemp, and pulled up tightly in accordance with BS 21.
- c) All galvanised steel pipes and fittings which are chased in concrete or masonry, or buried underground, shall be wrapped with 'Densol' tape or equal and approved, or alternatively (55% overlap) and painted with two coats of 'ICI Dulux F432-LINE' coat tar epoxy or equivalent.
- d) Bolts, nuts and washers for piping connections shall be made of corrosion-resistant material.

A13.3.4 Unplasticised PVC Pipes

- a) Unplasticised polyvinyl chloride pipes for use in the flushing water pipe system shall comply with BS 3505 Class E.
- b) Fittings shall be supplied by the pipe manufacturer and be of the same standard colour and quality as the pipes.
- c) Bends in pipes shall be formed by filling the pipe with sand and gently heating over the entire surface to approximately 130°C, then cooling with water.
- d) All unplasticised PVC pipes and fittings shall be jointed with sockets and with jointing compound as recommended by the pipe manufacturer.
- e) Tapered gunmetal union joints shall be used for all joints which may be subject to disconnection.
- f) All unplasticised PVC pipes and fittings embedded in concrete or masonry, or buried underground, shall be wrapped with hessian or other approved material.
- g) Expansion joints should be provided at intervals as recommended by the pipe manufacturer.
- h) Bolts, nuts and washers for piping connections shall be made of corrosion-resistant material.

A13.3.5 Copper Pipes

- a) Light gauge solid drawn seamless copper tubes for use in the cold and hot water supply systems shall comply with BS 2871: Part 1: Table 'X'. All underground copper tubes shall comply with BS 2871: Part 1: Table 'Y'.
- b) Unless expressly authorized by the Architect, interchangeability will not be allowed between products from different copper pipe and fitting manufacturers.
- c) All copper pipes and fittings for use in the cold water system which are embedded in slab, wall or buried underground, shall be coated with 0.08mm thick polyethylene wrapping (55% overlap), or covered with plastic. The plastic shall comply with BS 3412. After the joint of the plastic-coated copper tube is completed, the plastic coat is folded back, and the joint and the exposed copper tube must be carefully wrapped with an adhesive polythene or PVC tape to give a continuity of protection. No wire (except copper wire) or steel is allowed to be in direct contact with copper tube. If two copper tubes cross each other inside the slab or wall, a minimum spacing of 3mm shall be provided between them.
- d) Jointing of plastic cover for concealed cold and hot water copper pipes shall be properly wrapped as per the manufacturer's recommendation. A sample shall be submitted to the Architect for approval prior to the commencement of the installation works.
- e) Adequate but not excessive flux shall be applied to the copper pipes. The flux shall be free of ammonia. The type and brand of the flux shall be recommended by the copper pipe manufacturer and approved by the Architect.
- f) All copper pipes and fittings for use in the hot water system shall be insulated. The insulation material shall be submitted to and approved by the Architect prior to

- installation.
- g) The Contractor shall arrange for the concealed copper pipes for the conveyance of water to be tested and inspected by a representative of the Water Authority before concrete is poured, as per the current 'Hong Kong Waterworks Standard Requirements'.
 - h) Copper or brass fittings up to and including 40mm internal diameter for use with copper pipes shall be of the capillary joint type of an approved make in accordance with BS 864 Part 2 Table 6, with solder suitable for the pipes under a hot water condition.
 - i) At a higher temperature, inhibited aluminium brass or gunmetal shall be made. Integral hard solder ring is of cadmium-free silver brazing alloy complying with the compositional requirements of BS 1845. Its higher creep strength provides a joint capable of withstanding the highest combination of temperature and pressure for which the appropriate BS copper tubes may be used. The jointing temperature is approximately 720°C and is lower than that required to make a brass brazed joint, so reducing the risk of overheating the tube and fitting.
 - j) Bronze or bronze welding with flanged joints shall be used for 50mm internal diameter or above copper pipes and fittings.
 - k) Bends up to and including 25mm internal diameter may be formed by cold bending, provided that the bend so formed shall be entirely free from buckling and excessive thinning of the pipe wall.
 - l) Expansion joints shall be provided in and straight run of hot water pipes, hot water recirculating pipes and hot water vent pipes exceeding 12m in length, unless otherwise specified. The Contractor shall submit the quantities and locations of expansion joints for the Architect's approval prior to installation.
 - m) Bolts, nuts and washers for piping connections shall be made of corrosion-resistant material.
- A13.3.6 Ductile Iron Pipes
- a) Ductile iron pipes and fittings for use in the flushing water supply, main down feeder and pump discharge pipe systems shall be of an approved make in accordance with BS 4772 Class K12 with flanged joints, and coated externally with an approved bitumastic solution, and internally with cement lining suitable for use with sea water duty.
 - b) All ductile iron flanged joint pipework shall be jointed with gasket rings suitable for use with sea water duty.
 - c) Where unplasticised PVC pipes connect to ductile iron pipes, special uPVC flanged fittings shall be used.
 - d) Bolts, nuts and washers for piping connections shall be made of corrosion-resistant material.
- A13.3.7 Installation of Pipework
- a) All pipework inside or outside the building shall be run in parallel lines and in a neat and workmanlike manner. Horizontal pipes shall run parallel with walls. All pipes which will eventually be concealed shall be tested and approved by the Architect and the relevant authorities before being covered. Failure to comply with the above requirements shall be a cause for the works to be rejected.
 - b) All pipe runs, where not underground or in duct or light well, shall be concealed as far as possible by careful positioning in concrete or block wall, or shall be chased into walls as directed by the Architect.
 - c) Pipe runs, where exposed, shall be positioned at least 25mm from the finished wall surfaces, so as to enable subsequent cleaning and painting of all surfaces. Where such pipe runs are installed in angle, they shall be positioned 40mm from the finished surfaces.
 - d) All pipework shall be free from blurs, rust and scale, and shall be thoroughly cleaned before installation. Open ends during the progress of work shall be blanked-off with purpose-made metal or plastic caps.
 - e) The Contractor shall note the restricted space available in certain pipe ducts, and care shall be taken to ensure that all pipework is installed in the correct sequence, manner and position so that operation of all valves and maintenance will be possible.
 - f) Suspended pipework shall be positioned as close to slab soffits as possible.

- g) On all systems, long radius bends and pitcher tees shall be used. All fittings shall be suitable for working a test pressure not lower than that specified for the pipework system concerned.
- h) Where reducers or reducing fittings are used in water supply systems, reductions in the bore of pipes shall be made eccentric for horizontal pipes (to prevent air locking) and concentric for vertical pipes.
- i) No bends or curves in any pipes shall be made so as to diminish the waterway or alter the internal diameter of the pipes in any way.
- j) For dissimilar metal joints in the water supply systems, special flanged connections with insulating gaskets, plus insulation sleeves for flange bolts, shall be provided and installed.
- k) All pipework within the pump room shall be jointed with flanged joints.
- l) Unions or flanged joints shall be used to join adjoining lengths of pipe where it is not possible to rotate either length. They shall be used for joints for equipment and apparatus items, also additionally at 15m intervals to permit the ease of installation, dismantling and re-fixing.
- m) All pump suction and discharge pipes shall be installed without contact with the concrete structure and masonry works. Sleeves and caulking shall be provided around the piping.
- n) Water delivery pump discharge pipework shall be fitted with approved 'silent' check valves.

A13.3.8 Pipe Supports

- a) All pipework, fittings, valves, connections etc. shall be sufficiently supported and bracketed. All pipework shall be supported at intervals not greater than the following distances on straight runs; additional supports shall be provided at bends, valves, etc.:

Normal Bore of Pipe Diameter(mm)	Galvanised steel and ductile iron pipes		uPVC pipes and copper pipes	
	Interval (metres)		Interval (metres)	
	Vertical	Horizontal	Vertical	Horizontal
15	1.5	1.2	1.0	0.7
20	1.5	1.2	1.0	0.7
25	1.8	1.5	1.5	1.0
32	1.8	1.5	1.5	1.0
40	2.1	1.8	1.8	1.2
50	2.1	1.8	1.8	1.2
65	2.4	2.1	2.1	1.5
80	2.7	2.4	2.1	1.5
100	2.7	2.4	2.4	1.8

- b) No less than two supports shall be used on all pipes having a length less than the minimum interval indicated.
- c) All supports for galvanised steel pipes and uPVC pipes shall be of galvanised steel. For uPVC pipes, rubber plates shall be inserted between the pipes and supports. Supports for copper pipes shall be made of brass.
- d) The Contractor shall be responsible for building in all supports etc., and shall allow for Philips Redhead bolt fixings for concrete, and cutting away and building in bracket fixings for concrete, and cutting away and building in brackets in brickwork etc. The Contractor shall particularly note that it may not be possible to fix the bolt fixings directly above the pipes to be supported, and cantilever angles shall be used where required.
- e) All pipework connected to vibration-isolated equipment and pump discharge pipes shall be mounted on spring hangers or supports. Samples and details of these supports shall be submitted for the Architect's approval prior to installation.

A13.3.9 Pipe Sleeves

- a) Cast iron or galvanised puddle flange sleeves shall be provided where pipes pass through walls, floors, beams etc. Where sleeves are fitted through floors, they shall extend at least 40mm clear of the finished floor. Sleeves shall be of a sufficient size to allow the free movement of pipes.
- b) The gap between pipes and sleeves shall be packed with a fibre-glass blanket material.

- However, for pipe sleeves through fire barriers, the gaps shall be firmly sealed with soft packings having a period of fire resistance equal to that of the fire barriers, which shall be approved by the Fire Services Department. The ends of sleeves shall be caulked with non-hardening mastic to the Architect's approval.
- c) All sleeves in walls, floors, beams etc. shall be set in the formwork and shuttering before concrete is poured.
- A13.3.10 Pipe Anchors and Guides
- a) All pipes shall be anchored as required to control their movement due to thermal changes. Generally anchors shall also be fitted at the lower end of vertical pipes.
- b) The anchors shall securely hold the pipes in a rigid position to resist the attempted movement due to expansion, and the weight of pipes and contents.
- c) Pipe guides shall be fitted on each side of each joint to keep the joints and pipes in true alignment. The metal guides for uPVC pipes shall be lined internally with a PVC material slightly oversized to allow axial movement of the pipes.
- A13.3.11 Cutting of Holes
- Holes shall be arranged to be left in concrete or masonry works wherever possible to reduce the cutting of slabs and walls to a minimum. No cutting of reinforced concrete shall be allowed without the prior approval of the Architect.
- A13.3.12 Pipes Passing through Roof Slab
- Each pipe passing through the roof slab shall be fitted with a luting flange not less than 150mm above the finished roofing material. A sheet lead collar not less than 150mm high shall be dressed around the pipe and into the luting flange. A sheet lead slate of size 300mm wider than the diameter of the pipe shall be soldered on the end of the collar and dressed between layers of roofing.
- A13.3.13 Thrust and Anchor Blocks
- a) Thrust blocks shall be constructed at all bends and branches of underground pipes of 50mm diameter and larger. In addition to the normal operating pressure of the system these thrust blocks shall resist internal pressure caused by the closing of valves etc.
- b) In addition to the thrust blocks specified above, anchor blocks shall be positioned at intervals on straight lengths of pipework so that the distance between any consecutive thrust blocks or anchor blocks shall not exceed 15 metres.
- A13.3.14 Valves
- a) Valves for potable water supply system
- 1) Isolating valves up to and including 50mm diameter shall be of gunmetal construction fullway split disc wedge pattern to BS 5154. All valves shall have inside screw gate, high tensile bronze spindle and screw bonnet. Valves shall have screwed female ends for taper thread to BS 21.
 - 2) All isolating valves exceeding 50mm diameter shall be flanged cast iron fullway sluice with inside screw solid wedge and high tensile bronze spindle to BS 5150, bolted bonnet. Valves shall have flanged connection to BS 4504. Bolts, nuts and washers for piping connections shall be of corrosion-resistant material.
 - 3) Valves shall be suitable for a test pressure of not less than 1,495 kN/m².
 - 4) Loose jumper valves shall be of BS 1010 rough finish with easy clean cover brass stop-cocks provided at the position before the water meters, as shown on the drawings. Only the Water Authority approved type of valves shall be used.
 - 5) All isolating valves shall be of a type approved by Water Authority.
- b) Valves for flushing water supply pipe system
- 1) Valves shall be fullway valves with external rising screw, flanged or screwed to suit the piping, and shall be of cast iron construction with nickel alloy faces and grade 316 stainless steel spindle to BS 5150. Ends shall be flanged to BS 4504 and suitable for sea water duty. Valves shall be of makes fully suitable and approved for the use with sea water duty, and suitable for a test pressure of not less than 1,495 kN/m². Bolts, nuts and washers for piping connections shall be

- of corrosion-resistant material.
 - 2) uPVC stop-cocks etc. shall be installed as shown on the drawings to isolate single fittings or groups of fittings to JIS-82212. The stop-cocks shall be suitable for a working pressure of 900 kN/m² and shall be suitable for the use with sea water duty.
- c) Check Valves
 - 1) Check valves shall be bronze with square nut head conforming to BS 5153 for the potable water supply system, and zinc-free bronze for the flushing water supply pipe system.
 - 2) For check valves on the discharge side of the potable and flushing water pumps with a delivery head exceeding 18 metres and a discharge outlet over 50mm diameter, the check valves shall be of cast iron spring-return quick-closing type to eliminate water hammer on closing, and to provide for quiet operation (working pressure 16.33 kg/cm²) or grade 316 stainless steel swing type with nitrile rubber seat and of U.K. origin.
 - 3) Bolts, nuts and washer for piping connections shall be of corrosion-resistant material.
- d) Pressure-reducing Valves
 - 1) Pressure-reducing valves shall be of approved adjustable pilot operated design capable of pressure reduction/adjustment to provide suitable pressure at each draw-off point.
 - 2) Pressure-reducing valves in the potable water supply system shall have brass body and stainless steel pistons or plungers. The valves shall have flanged ends for connection to pipework, and flanges shall be to BS 4540.
 - 3) Pressure-reducing valves in the flushing water supply system shall be suitable for use with sea water duty. In general, the valve body shall be in cast iron and all other parts in grade 316 stainless steel.
 - 4) Gate valves and pressure gauges shall be installed on the suction and discharge sides of pressure-reducing valves.
 - 5) Bolts, nuts and washers for piping connections shall be of corrosion-resistant material.
- e) Ball Valves
 - 1) All ball valves shall have bronze or cast iron valve bodies. The valves for flushing water supply systems shall have a construction suitable for the use with sea water duty, and floats shall be copper with neoprene coating or equal, and approved to BS 1212. Foam polystyrene float will not be accepted.
 - 2) Ball valves shall be of the slow closing or equilibrium type as specified above.
 - 3) Bolts, nuts and washers for piping connections shall be of corrosion-resistant material.
- f) Strainers
 - 1) Strainers for the potable and flushing water supply systems shall be of an angle type cast iron construction with 1.6mm perforated stainless steel screen (s.s. 316) and total available filtering area of at least three times the sectional area of the pipe inlet to the strainers.
 - 2) Bolts, nuts and washers for piping connections shall be of corrosion-resistant material.
- g) Flexible Pump Connectors
 - 1) Flexible pump connectors shall be installed on the suction and discharge sides of pumps and shall be of grade 316 stainless steel construction, externally braided, double flanged, with flexible hoses, one for each pump, full line size, rated 1,725 kN/m² minimum working pressure, fully suitable for sea water duty when used on flushing water pumps. The minimum length between flanges shall be 300mm. All connectors shall have flanged connection to BS 4504 and suitable for connection to the appropriate pipework and equipment.
 - 2) Bolts, nuts and washers for piping connections shall be of corrosion-resistant material.
- h) Automatic Air Vents
 - 1) Whether shown on drawings or not, automatic air vents shall be provided at the

- top of all hot water risers and all other high points of all water pipes to prevent air locks.
- 2) Automatic air vents shall be 15mm brass and of the vertical ball float type to allow air to enter and leave the system as required.
 - 3) Each automatic air vent shall be preceded by a lock shield valve. The waste line shall be taken to an approved drain point.
- i) Water Hammer Arresters
Water hammer arresters shall be:
- 1) Constructed entirely of non-corrosive stainless steel for use in the potable water supply system.
 - 2) Constructed entirely of grade 316 stainless steel for use in the flushing water supply system.
 - 3) Of built-in expansion bellow type and pre-charged with nitrogen and factory sealed.
- j) Pressure Gauges
Pressure gauges shall conform to BS 1780 and have brass cased with dials not less than 100mm diameter. They shall be calibrated in kPa to a maximum of not less than 1-1/3 times and not more than 2 times the operation pressure. Divisions of the scale shall not exceed 20 kPa for a maximum scale value of 1,000 kPa, 50 kPa for a maximum scale value of 1,600 kPa, and 100 KPa for maximum values in excess of 1,600 kPa. An isolating cock shall be provided for each pressure gauge.
- k) Pressure Relief Valves
- 1) Pressure relief valves shall be of an approved adjustable design and shall have a brass body and be bronze trimmed. Size shall comply with British Standards.
 - 2) Pump pressure relief valves shall be line pressure pilot operated.
- A13.3.15 Water Pumps
- a) Water pumps shall be started and stopped automatically under the command of electrode level controllers fixed in the water tank. No pump shall be started when the water in the tank is below a certain level. The duty and stand-by pumps shall be of the auto-changeover type.
 - b) The pumps shall be the vertical or horizontal type of close-grained cast iron accurately machined and assembled with metal-to-metal joints.
 - c) The impellers shall be of zinc-free bronze or grade 316 stainless steel, mechanically balanced and keyed shaft. The guides shall be gunmetal, and all water ways shall be finished smooth.
 - d) The shafts shall be of grade 316 stainless steel.
 - e) Stuffing boxes shall be of ample lengths with bronze lined gland and neck bush, fitted with approved packing and lantern ring water seal with piping. Alternatively, a mechanical seal may be offered. Plastic drain piping for gland leakage shall be provided and carried to drain.
 - f) It is essential that all materials used for the construction of the flushing water pumps be suitable for the use with sea water duty, and the Contractor shall advise the manufacturers of parts to this effect.
- A13.3.16 Pump Fittings
- a) Each pump shall be fitted with an air cock and drain plug and have a pressure gauge installed to indicate the discharge pressure. The gauges shall be mounted on a hardwood gauge board on the wall adjacent to the pumps. Gauges shall be 100mm diameter for water pumps. All calibrations shall be read from 0 to 200 metres for the discharge side of the pumps, whereas the calibrations shall be read from -5 to +5 metres for the suction side of the pumps.
 - b) Long radius bend fittings shall be used for the bends of the pump pipes.
 - c) 45mm diameter radial tee fittings shall be used for the branch joints of the pipes.
 - d) 45mm diameter bends are preferred to 90mm diameter bends.
- A13.3.17 Pump Valves
Each pump shall be fitted with valves to enable the pump to be isolated. In addition,

where shown on the drawings, a silent non-return valve shall be fitted at each pump discharge.

A13.3.18 Pump Bases

- a) For each pumping set, a structural compound base shall be constructed. The pump base shall be mounted on a concrete plinth, which shall be designed and provided by the Contractor. Neoprene mats of not less than 6mm thickness shall be provided between the plinth and the pump base by the Contractor. The Contractor shall also supply and set in position anti-vibration pads (e.g. 50mm 160 kg/m³ fibre-glass with waterproof caulking) between the foundation block and the inertia block as appropriate. The Contractor shall also supply and install holding-down bolts for casting into the pump base for pump fixing. Detailed design of the pump plinth shall be submitted by the Contractor to the Architect for approval.
- b) The Contractor shall isolate the pump and pressure booster units from all connected piping by flexible connectors. Electrical cabling to vibrating equipment shall be connected by flexible conduit or looped connections. Rigid connections, which may transmit vibration to the structure, shall not be permitted.
- c) The holding down bolts, nuts and washers shall be made of stainless steel to BS 970 :Part 1, grade 316.

A13.3.19 Pump Control

The Contractor shall provide the pump control system and shall supply and install all electrode holders and electrodes for the floatless water level control system. Probes shall be 100mm outside diameter polished stainless steel, length to suit tank depth. Earthing probes shall be connected to the wired earth system of the building.

A13.3.20 Hydropneumatic Booster Pump Sets

- a) Hydropneumatic booster pump sets shall be used for the pressurization of water to areas with low static head, and served by storage tanks for the potable water and flushing water supply systems.
- b) Hydropneumatic booster pump sets shall consist of the duty and standby booster pumps with materials as specified for potable water or flushing water usage. Configuration may be horizontal or vertical. The pressure vessel shall consist of a rust-proof steel tank internally and epoxy coated externally, and constructed to the relevant ASME or British Standards for pressure vessels. The vessel shall be provided with an inspection opening, and shall include a potable or salt water replaceable butyl bladder. The bladder shall contain the water with pre-charged nitrogen between it and the tank. Pressurisation shall be through a valve on the tank. No water shall come into contact with any part of the tank shell or connections. Valves shall be fitted to enable the tank to be isolated from the system. Pressure switches shall be installed to provide on/off control of the pump.
- c) The maximum number of starts/stops per hour shall be determined by the selected pump in conjunction with the pneumatic tank. Recommendation from the manufacturer shall be submitted for the Architect's approval. In general, the start/stop frequency shall not be greater than 20 times per hour.
- d) An adjustable time delay (up to 10 seconds) shall be installed to provide a time lag between the pressure control signals and the pump start or stop.

A13.2.21 Non-concrete Water Tanks

- a) Materials of non-concrete tanks shall be of the type approved by the Building Authority, Water Authority and Fire Services Department. Details of the materials shall be submitted for the Architect's approval.
- b) Fibre-glass water tanks may be used for potable water, cleansing water and flushing water as specified in the drawings.
- c) Grade 316 stainless steel tank with insulation shall be used for the hot water supply system.
- d) For fibre-glass or glass reinforced polyester (GRP) water tanks, the Contractor shall for the Architect's submission for the Building Authority's approval. The Contractor shall also be required to generally comply with all the requirements stipulated under the Building

Authority's Practice Note PNAP No. 222. The Contractor shall request the Architect for a copy of this Practice Note if he is not already familiar with its contents.

- A13.3.22 Connections for Water Tanks
All outlets, inlets, overflows, drains, vents and electrode level controller couplings shall be connected to the water tanks with approved gunmetal or cast iron puddle flange water tank connectors.
- A13.3.23 Stamping of Valves and Taps
All valves and cocks shall be of U.K. or Japanese origin or approved equivalent, and approved by the Water Authority.
- A13.3.24 Insulations
a) Insulations for the hot water pipe system shall be of British made non-combustible glass-fibre resin bonded factory formed sections complying with the requirements of BS 3958:Part 4, and wrapped in aluminium foil covers with self-sealing lap jackets along the longitudinal joints, or equivalent to be approved by the Architect.
b) All copper pipes and fittings for the concealed hot water pipes up to and including 50mm diameter shall be contained within a unique air-channeled white seamless plastic cover. The plastic shall be to BS 3412. The material shall be submitted to and approved by the Architect.
- A13.3.25 Water Meters
Water meters shall be installed by the Contractor. The following arrangements shall be carried out:
a) Provide a programme for acquisition of water meters for the Water Authority's agreement when the Contractor submits Waterworks Form WWO 46 (Form G).
b) Submit and undertaking form for the safe custody of the water meters (the form to be provided by the Architect) to the Water Authority when the Contractor or his representative collects the water meters from the Water Authority.
c) Fill in the meter size, type number and location of all the water meters installed in a meter installation table (to be provided by the Water Authority) after the Contractor completes the installation of the water meters.
d) The Contractor shall submit Waterworks Form WWO 6 (Form H) together with the said completed table to the Water Authority when he reports completion of the plumbing installation.
- A13.3.26 Water Heaters
a) The Contractor shall supply and fix all the electric and/or gas heaters including all the water piping connections as shown on drawings (connections for electrical and/or gas works will be done by others).
b) Electric heaters shall be installed in such a way that the heating elements can be taken out and replaced free from obstruction, and without dismantling the electric heaters and the associated pipework.
- A13.3.27 Stainless Steel Enclosures to Plumbing Pipes inside Electrical Rooms
a) Whether shown on drawings or not, all plumbing pipes including pump discharge pipes running inside switch rooms, transformer rooms, generator rooms, meter rooms, PABX rooms, lift machine rooms and computer rooms, etc. shall be enclosed with stainless steel enclosures of 1.6mm thick to prevent drops of water in the areas.
b) Adequate drain points shall be provided to the stainless steel enclosures and shall be discharged to an approved location.
c) Access panels shall be provided at the side of the enclosures for maintenance.
d) The enclosures shall be welded in construction.
e) All details of stainless steel enclosures shall be submitted to the Architect for approval prior to installation.
f) Whether shown or drawings or not, all plumbing pipes including pump discharge pipes running above trunkings and cable trays, etc. shall be enclosed with stainless steel

enclosures. All construction details of the enclosures shall be as specified in items (b), (c), (d) and (e) above.

A13.3.28 Co-ordination

- a) The Contractor shall be responsible for extensive co-ordination of the installation works with the Building Contractor and sub-contractors of other trades for proper execution of the works.
- b) The Contractor's particular attention is drawn to the complexity of the services installation, where considerable pipings, cables, trunkings, ductings, etc. run in the ceiling space.
- c) Proper co-ordination and installation procedures between the Building Contractor and other major sub-contractors, namely, HVAC, electrical, fire services, boiler plant and plumbing/drainage, etc. shall be established to the satisfaction of all parties concerned before the commencement of the works.

A13.3.29 Labelling

- a) All equipment provided under this Contract shall be labeled in both English and Chinese as to the duty or services; all such labeling shall correspond to the schedules, diagrams, etc. and shall be provided as part of the record drawings. Labels shall be made from sandwich type plastic materials with a black outer layer and a white inner layer and be engraved in English and Chinese. Details of lettering shall be submitted to and approved by the Architect. Lettering shall be engraved by cutting away the outer layer of the sandwich type label to the outline of the required letter thus exposing the white inner layer.
- b) The following refers to the specific items (but not by way of limitation) requiring labeling:
 - 1) All valves and equipment, etc.
 - 2) Distribution boards, starters etc. shall be labeled to indicate the circuit numbers, phases and items controlled.
 - 3) Inside the doors of the starter cubicle and engraved plastic circuit diagram shall be fitted.
 - 4) The size of the label shall match the object so that the label can be clearly seen.

A13.3.30 Cleaning after Installation

The Contractor shall clean the entire installation, including all sanitary fitments and fittings, etc. after installation.

A13.3.31 Painting

- a) All painted surfaces shall receive at least one primer coat and two finishing coats.
- b) All pipings exposed to view shall be painted.
- c) All pipings in false ceilings and pipe ducts need not be painted but shall be colour coded.
- d) All insulated pipes need not be painted but shall be colour coded.
- e) Colours and colour bands for the pipes shall be approved by the Architect.

A13.3.32 Incidental Works

Any works not explicitly indicated in the specifications or drawings, but are nevertheless necessary for the complete and proper operation of the plumbing installation, shall be provided by the Contractor at no cost to the Employer.

A13.4 Electrical Works

A13.4.1 General Requirements

- a) The Electrical Sub-contractor supplying and installing electrical services will provide an adequate electrical supply to the areas inside the pump rooms as directed by the Architect, which shall terminate with main isolators for all water pumps. From these isolators, all works including cabling, change-over switches, motors, starters, water level control float switches, ammeters, voltmeters alarms shall be included in the Contractor's works.
- b) Electrical supply will be 380/220 volt 3-phase 4-wire 50 Hertz.

- c) All electrical works shall satisfy the requirements laid down by the Electricity Supply Company, and the latest I.E.E. Regulations and special regulations issued by the Hong Kong SAR Government.
- d) All works shall conform to the best principles of modern practice.
- A13.4.2 Pump Control Panels

The pump control panels shall be enclosed units. The sheet metal used for the panels shall be of not less than 14 s.w.g. Doors shall be provided with dust-excluding gaskets of neoprene. All paint finishes shall be of high quality enamel type.
- A13.4.3 Electric Motors
 - a) For each pump the Contractor shall install an electric motor which shall have a margin of not less than 20% between the continuous rating of the motor (without overloading) and the maximum shaft horse power demanded by the pump under its most arduous operating conditions. Motors shall be continuously rated in accordance with BS5000 : Part 2 according to the rating. All motors shall be tropic-proof and shall be insulated with Class F materials. Motors shall be of the commercial silent type having sleeves or roller bearings. The enclosures of motors shall be splash-proof, fully enclosed, and of drop-proof pattern.
 - b) Motors from 1 H.P. up to 5 H.P. shall be of the squirrel cage type suitable for Direct-on-line starting. The starting current shall not exceed 6 times the full load current.
 - c) Motors above 5 H.P. shall be of the squirrel cage type suitable for Star-Delta starting. The starting current shall not exceed 2 times the full load current.
 - d) Motor speeds shall not exceed 1,450 r.p.m.
- A13.4.4 Direct-on-line Starters
 - a) Each starter shall include the following:
 - 1) Main contactor (with auxiliary contacts)
 - 2) Overload protection
 - 3) Phase failure protection
 - 4) Main and control circuit fuses of HRC cartridge type
 - 5) On/off switch (with auxiliary contacts)
 - 6) All necessary terminals of adequate rating, and all necessary internal wirings.
 - 7) Provision for cable entries
 - 8) All necessary ancillary contacts for sequence control
 - b) A green pilot light shall be fitted to the front cover of the MCCB which shall be illuminated when the equipment is running.
 - c) A red pilot light shall be fitted to the front cover of the MCCB which shall be illuminated when the starter has been "tripped" on overload.
 - d) Each starter shall have an auxiliary contact for remote indicating and start/stop use.
- A13.4.5 Star-Delta Starters

These shall be provided with contactors, overload protection, etc. as detailed above for the Direct-on-line starters, but arranged so that the star contactor opens before the delta contactor closes, the time intervals being controlled by an automatic timing device.
- A13.4.6 Contactors
 - a) Contactors shall be single pole or triple pole fitted with arc-shields and nominal rating of not less than 10 amps. Contactors shall generally be in accordance with BS 5424. Contactor coils shall be operated from 220 volt single-phase AC electricity.
 - b) All contactors shall have an auxiliary relay suitable for the normally open/normally closed position for remote monitoring at the B.A.S. Contactor.
- A13.4.7 Ammeters

Starters for pumps of 5 H.P. and above shall be provided with ammeters flush-mounted adjacent to the respective starters, and shall be of the moving iron pattern with compressed scale to comply with BS 89 : Part 1 for industrial accuracy. Current transformers shall be of the ring pattern to BS 3938. The dials shall be marked with red

lines to indicate the normal full load current of the motors controlled. The ammeters shall be provided with auxiliary contacts for connection by the B.A.S. Contactor for remote indication.

- A13.4.8 Switchgear
All fused switchgear and isolators shall conform to the requirements of BS EN 60947-3. The fuse links for fused switches shall be of high rupturing capacity, cartridge type conforming to BS 88.
- A13.4.9 Connections to Motors
a) Final connections to electric motors shall be made by means of PVC cables in rust-proof flexible steel conduits with separate tinned earth wires not less than 2.5mm² running outside the flexible conduits.
b) Flexible steel conduits shall be in accordance with BS 731 : Part 1.
- A13.4.10 Cables and Conduits
a) The Contractor shall supply and install all cabling and control wiring between starters, motors and float switches. Wiring systems shall be of PVC cables in galvanised conduits.
b) PVC insulated cables shall consist of copper conductors, PVC insulated to CMA standards and to BS 6004. Cables for three-phase and single-phase circuits shall be 600/1,000 volt grade. The current carrying capacity shall be in accordance with I.E.E. Regulations (latest edition) and shall be limited to the specified voltage drop. The minimum size of cable shall be 2.5mm² in section.
c) All conduits shall be of heavy gauge galvanised welded steel complying with BS 4568, Class 4. No conduits shall be less than 20mm in diameter.
- A13.4.11 Emergency Stop
In all instances emergency stop buttons of the lock-off pattern shall be fitted immediately adjacent to the motor/pump.
- A13.4.12 Operation Sequence
a) For one pump on duty and one pump on stand-by:
Pumps shall automatically change over after operation,
i.e. 1st operation : Pump A duty and Pump B stand-by
2nd operation : Pump B duty and Pump A stand-by
3rd operation : Pump A duty and Pump B stand-by
When overload occurs, the stand-by pump shall cut-in automatically.
b) For two pumps on duty and one pump on stand-by:
Pumps shall automatically change over after operation,
i.e. 1st operation: Pumps A and B duty and Pump C stand-by
2nd operation: Pumps B and C duty and Pump A stand-by
3rd operation: Pumps A and C duty and Pump B stand-by
4th operation: Pumps A and B duty and Pump C stand-by
Where overload occurs, the stand-by pump shall cut-in automatically.
- A13.4.13 Remote Alarms and Indicators
a) Visual indicators, and audible and visual alarms shall be provided at the remote indication panels located at the Management Office or a location appointed by the Architect.
b) Visual indications shall be provided for:
1) System on/off.
2) Motor running/stop of individual motor.
c) Audible and visual alarms shall be provided for:
1) Low/high water levels.
2) Tripped motor.

A13.5 Sanitary Fitments and Fittings

A13.5.1 General Requirements

The Contractor shall fix the sanitary fitments and fittings, and supply and fix all approved silicon sealants (colour shall be approved by the Architect), mortar, lead plugs and other accessory materials, cuts and pins or rawlplugs, brackets and make all connections to the water supply services, overflows and wastes.

A13.5.2 Chromium-plated Brass Fittings to Water Taps and Valves

The Contractor shall supply and fix chromium-plated brass short pieces, wall flanges, angle valve, risers and compression couplings to connect to pillar taps, bib taps, stop valves, etc. Compression couplings or soldered capillary joint couplings shall be used in connections to the water pipes.

A13.5.3 Chromium-plated Gunmetal Fittings to Water Cisterns

The Contractor shall supply and fix chromium-plated gunmetal short pieces, wall flanges, angle valves, risers and compression couplings to connect to the water cisterns. Compression couplings or soldered capillary joint couplings shall be used in connections to the water pipes.

A13.5.4 Jointing between Water Closets and Concrete Floor

Water closet pans shall be bedded onto the concrete floor by screwing to rawlplugs let into the concrete, and finished with an approved silicone sealant.

A13.5.5 Materials of Sanitary Fittings for Salt Water Use

All parts of sanitary fittings subject to salt water flushing shall be of materials not corrodible by salt water.

A13.5.6 Cleaning and Protection

Before handing over the completed works to the Employer, the Contractor shall ensure that all sanitary fitments and fittings, bathroom accessories are properly protected from damage and shall be cleaned and polished. The method of protective coverings for bath tubs in particular shall be submitted for the Architect's approval.

A13.6 Testing and Commissioning

A13.6.1 Requirements for Testing and Commissioning

- a) The Contractor shall perform testing and commissioning of the plumbing system to the satisfaction of authorities having jurisdiction and of the Architect. If, under test, and part of the installation or any piece of equipment fails to perform satisfactorily, the Contractor shall replace or make good that part or piece of equipment to the satisfaction of the Architect, and in the most efficient manner possible.
- b) All instruments, plant, supervision and labour required for equipment and system commissioning shall be provided by the Contractor. Instruments shall be accurately calibrated to the satisfaction of the Architect, prior to commissioning.
- c) Two months prior to testing and commissioning any system, the Contractor shall furnish the following information for each system or process to the Architect for approval:
 - 1) Types of instruments to be used
 - 2) Manufacturers of instruments
 - 3) Calibration methods for instruments
 - 4) Operating instructions for instruments
 - 5) Three (3) sets of details of testing and commissioning procedures
 - 6) Accuracy and tolerance of instruments
 - 7) Proposed formats for testing and commissioning reports
 - 8) Complete schedule and programme of all testing and commissioning activities.
- d) The Architect shall be notified well in advance of all tests (7 days minimum) to allow him to be present or be represented when the tests are conducted.
- e) The Contractor shall record all commissioning results on record sheets, and submit the

- format to the Architect for approval. On completion of commissioning and prior to final inspection and handover, the Contractor shall submit the commissioning results in a bound volume to the Architect, who reserves the right to witness such commissioning operations and procedures as necessary.
- f) All tests shall be properly certified in a format approved by the Architect. Test certificates shall be submitted in triplicate to the Architect on the completion of satisfactory tests.
- A13.6.2 Operating Tests
- a) The Contractor shall ensure that the installations or portions thereof which have been set to work comply with all specified requirements as follows:
- 1) That the plant or apparatus is of robust construction and of capacity for the duty specified.
 - 2) That all valves, switches, controls, etc. are regulated and capable of proper operation, and in the case of valves that they are capable of tight shut-off.
 - 3) That all apparatus is silent in operation.
 - 4) That all instruments are correctly calibrated and can be read accurately.
- b) Original factory test certificates, especially for water pumps and pressure tanks, shall be submitted to the Architect, proving that the materials/equipment have achieved the specified performance.
- c) The Contractor shall perform all tests and demonstrations as called for by the Architect and the relevant government departments.
- A13.6.3 Hydraulic Tests
- a) The Contractor shall carry out hydraulic tests on the completed water supply systems to show that these are functioning satisfactorily within the requirements of this Specification and the all relevant government regulations.
- b) The Contractor shall arrange and bear the costs of the supply of water required in connection with the testing of pipework and fittings.
- c) All pipework shall be hydraulically tested for a period of not less than 6 hours to a pressure of not less than twice the working pressure, or 90 metres head, whichever is greater. The Contractor shall note that the testing shall be witnessed by the Architect or his representative.
- d) Should a pipe section fail to meet the test requirements, the Contractor shall, without additional charges, replace the defective pipes and/or joints as may be required in order that the test requirements can be satisfied.
- A13.6.4 Electrical Tests
- a) Verification of polarity shall be carried out to ensure that all fuses and single-pole control services are connected to the line conductor only.
- b) Insulation resistance tests shall be carried out at 250 volt single-phase and at 500 volt three-phase circuit for:
- 1) Line to line
 - 2) Line to earth
 - 3) Neutral to earth
 - 4) Line to neutral
- in strict compliance with the latest IEE Regulations.
- c) Earth continuity tests shall be carried out by means of a line-earth loop test or neutral-earth loop test in accordance with the latest IEE Regulations.
- d) The earthing resistance test of equipment shall be carried out with a loop impedance test in accordance with the latest IEE Regulations.
- A13.6.5 Sterilization of Potable Water Pipework
- a) Prior to any section of the potable water pipework being taken over by the Employer, the Contractor shall carry out sterilization of the pipes in accordance with the method described in the following paragraphs, or as directed by the Architect:
- 1) The pipework shall be completely filled with water that has been dosed with a strong chlorine solution such that the final concentration of free chlorine in the water in the pipes is not less than 30 p.p.m.

- 2) This water shall be allowed to stand for a period of not less than 24 hours.
 - 3) At the end of this period the pipes shall be drained down and the heavily chlorinated water shall be thoroughly flushed out of the pipework using fresh water, until the chlorine concentration remaining is about 1 p.p.m.
 - 4) Samples for bacteriological analysis shall then be taken by the Contractor from several locations along the pipework.
 - 5) Subject to a satisfactory bacteriological analysis of all the samples and the Contractor's submission to the Architect of a report to this effect, the pipework will be deemed to be adequately sterilized.
- b) The sterilization of the pipework shall be carried out no longer than 7 days before the pipework is handed over to the Employer.
- c) The Contractor shall supply all plant, labour and equipment necessary to carry out the sterilization to the satisfaction of the Architect, including that required for any subsequent re-sterilization that is necessary as a result of unsatisfactory bacteriological analysis of samples. Water and all chemicals for dosing and testing shall be supplied by the Contractor.
- d) The Contractor shall inform the Architect well in advance of his intention to carry out the sterilization works, and shall allow at least two weeks between the completion of main laying and the start of the sterilization in order that any swabbing of the pipes that is required will be carried out before sterilization.
- A13.6.6 Instructing Employer's Staff
- a) The Contractor shall allow in his prices for providing the services of one skilled man for the purpose of instructing the Employer's staff in the operation and maintenance of the installed services and in the use of the instructions manuals.
- b) The instructions shall be given during normal working hours for a period of two weeks during the 'Defects Liability Period'.
- A13.6.7 Maintenance and Servicing
- a) General
- 1) Starting from the Date for Practical Completion of the Main Contract, the Contractor shall provide 12 months free maintenance and emergency breakdown service as follows:
 - i) Endance to all faults and complaints; and
 - ii) Provide inspections, checking, cleaning and adjustments on all installed equipment at the end of the free maintenance period.
 - 2) The Contractor shall, within one month of the Date for Practical Completion, complete all outstanding items and rectify all defects. Should the Contractor fail to do so, the Employer shall have the rights to have such works executed forthwith by others at the Contractor's expense without abrogating the Contractor's existing liabilities.
- b) Preventive Maintenance
- 1) The Contractor shall provide free preventive maintenance, including emergency breakdown service to the plant during the Defects Liability Period, to ensure that all the various systems installed operate satisfactorily.
 - 2) The Contractor shall give the Employer at least fourteen (14) days prior notice when each routine service call is due to be made.
 - 3) The Contractor shall report to the Employer prior to commencing each service, and before leaving shall compile a comprehensive report on all the works which have been carried out during each visit, including comments on any improper functioning of the various systems, and comments on any items requiring detailed examinations at or before the next scheduled visit.
 - 4) The service report shall also state the date when the next regular routine service call is due to take place.
- c) Service Reports
- 1) During each visit the Contractor shall complete a report in the form of a checklist which shall indicate the readings of all gauges, the conditions of all items, and any remedial works carried out.

- 2) The final payment of the retention money shall only be certified pursuant to the receipt of service reports which indicate that the maintenance and service requirements have been regularly and satisfactorily completed.
- 3) The Contractor shall submit for the Architect's approval a sample service report in sufficient time for possible amendments before the Certificate of Practical Completion of the Main Contract is issued.

GENERAL SPECIFICATION

DRAINAGE INSTALLATION

A14 DRAINAGE INSTALLATION

A14.1	<u>General Requirements</u>
A14.1.1	Scope of Work
A14.1.2	Connection to Government Main Drain
A14.1.3	Definitions
A14.1.4	Specialist Contractor
A14.2	<u>Submittals</u>
A14.2.1	Samples and Shop Drawings
A14.2.2	"As-Fitted" Drawings
A14.2.3	Instructions Manuals
A14.3	<u>Materials and Workmanship</u>
A14.3.1	Patterns
A14.3.2	Sheet Lead
A14.3.3	Galvanised Mild Steel Pipes
A14.3.4	Unplasticised PVC Pipes
A14.3.5	Cast Iron Spigot and Socket Pipes (Above Ground)
A14.3.6	Hubless Cast Iron Pipes (Above Ground)
A14.3.7	Ductile Iron Pipes
A14.3.8	Installation of Pipework
A14.3.9	Pipe Supports
A14.3.10	Pipe Sleeves
A14.3.11	Pipe Anchors and Guides
A14.3.12	Cutting of Holes
A14.3.13	Access Doors
A14.3.14	Rainwater Outlets
A14.3.15	Termination of Soil Vent Pipes at Roof
A14.3.16	Pipes Passing through Roofs
A14.3.17	Thrust and Anchor Blocks
A14.3.18	Valves
A14.3.19	Stainless Steel Enclosures to Drainage Pipes inside Kitchens, Function Rooms and Restaurants
A14.3.20	Stainless Steel Enclosures to Drainage Pipes inside electrical Rooms
A14.3.21	Co-ordination
A14.3.22	Labelling
A14.3.23	Cleaning after Installation
A14.3.24	Painting
A14.3.25	Incidental Works

A14.4	<u>Underground Drainage</u>
A14.4.1	Cast Iron Drain Pipes and Fittings
A14.4.2	Concrete Drain Pipes and Fittings
A14.4.3	Hubless Cast Iron Pipes
A14.4.4	Perforated uPVC Pipes
A14.4.5	Excavations for Pipe Trenches, Manholes etc.
A14.4.6	Channels and Gratings
A14.4.7	Laying Drains
A14.4.8	Jointing of Cast Iron Pipes
A14.4.9	Sleeves
A14.4.10	Rest Bends
A14.4.11	Waste and Rainwater Gully Traps
A14.4.12	Manholes
A14.4.13	Cast Iron Hatch Boxes with Inspection Chambers
A14.4.14	Vertical Drops
A14.4.15	Fresh Air Inlets
A14.4.16	Septic Tanks
A14.4.17	Soak-away Pits
A14.4.18	Filtration Tanks
A14.4.19	Grease Traps
A14.4.20	Petrol Interceptors
A14.4.21	Diluting Tanks
A14.4.22	Waste, Sewage or Stormwater Sump Pits
A14.4.23	Sub-soil Drains
A14.4.24	Test Certificates
A14.4.25	Testing
A14.4.26	Obstruction of Testing
A14.5	<u>Electrical Works</u>
A14.5.1	General Requirements
A14.5.2	Pump Control Panels
A14.5.3	Electric Motors
A14.5.4	Direct-on-line Starters
A14.5.5	Star-Delta Starters
A14.5.6	Contactors
A14.5.7	Ammeters
A14.5.8	Switchgears
A14.5.9	Connections to Motors
A14.5.10	Cables and Conduits
A14.5.11	Operation Sequence
A14.5.12	Remote Alarms and Indicators
A14.6	<u>Sanitary Fitments and Fittings</u>
A14.6.1	General Requirements
A14.6.2	Jointings between Water Closets and Concrete Floors
A14.6.3	Water Closet Pan Connectors
A14.6.4	Jointings of Waste Outlets
A14.6.5	Traps to Waste Fitments
A14.6.6	Floor Drains
A14.6.7	Materials of Sanitary Fittings for Salt Water
A14.6.8	Cleanings and Protections

A14.7	<u>Testing and Commissioning</u>
A14.7.1	Requirements of Testing and Commissioning
A14.7.2	Operating Tests
A14.7.3	Hydraulic/Smoke Testing
A14.7.4	Electrical Testing
A14.7.5	Instructing Employer's Staff
A14.7.6	Maintenance and Servicing

A14 DRAINAGE INSTALLATION

A14.1 General Requirements

A14.1.1 Scope of Work

The works to be carried out under this section comprise the provision of all materials, labour, plant, tools and other necessary items required for the supply, delivery, installation, testing, commissioning and maintenance of the entire drainage system as shown on drawings and as specified here below:

- a) Soil and waste drainage system
- b) Rain water drainage system
- c) Sanitary and waste appliances.

A14.1.2 Connection to Government Main Drain

The Contractor shall inform the Drainage Services Department in sufficient time for these works to be completed without delay to the programme of works.

A14.1.3 Definitions

- a) The Contractor appeared hereinafter in this Section and related specifications shall refer to the specialist contractor appointed to carry out the works under this Section.
- b) The Building Contractor appeared hereinafter in this Section and related specifications shall refer to the Main Contractor appointed to carry out the construction of the superstructure of the development.

A14.1.4 Specialist Contractor

- a) The whole of the drainage works included in this section of the specification shall be installed complete at the Contractor's own expense.
- b) All drainage works shall be carried out by the registered contractor and all works shall be in compliance with the requirements of the Building Authority.
- c) Notwithstanding that the drainage system has been approved in principle by the Building Authority, the Contractor shall be responsible for ensuring that the final installations are fully in compliance with the requirements of relevant Government Authorities.

A14.2 Submittals

A14.2.1 Samples and Shop Drawings

- a) Before the preparation of shop drawings and the commencement of installation, the Contractor shall acquaint himself with the latest information, layouts and details of other services, and the latest architectural and structural details, so that well-coordinated working drawings and installations are accomplished for the checking and inspection by the Architect. The Contractor shall at the same time cooperate and coordinate with the building contractor and other contractors to ensure that all installations are completed in a neat and satisfactory manner.
- b) The Contractor shall bear all the costs of any dismantling, modification, etc. of any works being installed due to failure of implementing sub-clause(a).
- c) Within two weeks after the award of this Contract, the Contractor shall submit schedules showing clearly the expected submission dates of proposed materials, samples, etc. for the Architect's approval. These schedules shall be prepared to match the building construction programme, and be reviewed every month.
- d) Shop drawings shall be submitted by the Contractor for the Architect's approval, showing installation details based on actual dimensions of materials/equipment used. These shall be submitted at least two (2) months before the commencement of the installation work, and shall include the following:
 - 1) Drainage floor plans and vertical line diagrams.
 - 2) Bathroom and kitchen details with sections (scale 1:50).
 - 3) Penetration drawings including the trenches for the surface/flat channels.
 - 4) The lowest invert level of drainage pipes for each floor.
 - 5) Pipe installation details for critical areas as required.

- 6) Pipe support details.
 - 7) Details of sump pits with sections (scale 1:50).
 - 8) Details of pipe anchors and guides.
 - 9) His own proposed electrical control wiring diagrams, with 1:25 scale control panel details with elevations.
 - e) The Contractor shall also submit for the Architect's approval samples of piping materials, valves, etc. and detailed catalogues and data of all equipment.
- A14.2.2 "As-Fitted" Drawings
- Upon completion of the installations, the Contractor shall provide six (6) sets (2 sets marked in colour) of 'as-fitted' drawings showing the details of piping, conduit run, etc. for record and maintenance purposes. These drawings shall be submitted to the Architect for approval within 60 days from the Date of Practical Completion.
- A14.2.3 Instructions Manuals
- a) Prior to Practical Completion the Contractor shall supply in hard-backed binders two (2) sets of record drawings and four (4) completed sets of instructions for the operation and maintenance of the services.
 - b) The instructions for the operation and maintenance of the services shall be detailed to include:
 - 1) A description of the installed services.
 - 2) Safety and control features.
 - 3) A description of the operation of the services.
 - 4) Instructions for normal starting and stopping.
 - 5) A schedule for maintenance and lubrication.
 - 6) An inventory of installed equipment listing type, size, serial number, rpm, motor size, etc.
 - 7) Spare parts lists and manufacturer's sectionalised diagrams for parts identification.
 - 8) Manufacturer's maintenance manuals for each item of equipment.
 - 9) "As-installed" drawings photographically reduced to binder size, of the plant and equipment rooms, and control and functional diagrams showing the instruments and equipment items.
 - c) A draft copy of the instructions for the operation and maintenance of the services shall be submitted for the Architect's inspection before final binding.
- A14.3 Materials and Workmanship
- A14.3.1 Patterns
- All patterns, templates etc. which may be required for the proper execution of the works shall be provided free of charge by the Contractor.
- A14.3.2 Sheet Lead
- a) The lead shall be new pig lead in accordance with BS1178, milled to an even thickness and texture, well and evenly dressed without injury to the surface and free from sand cracks and other defects.
 - b) The lead shall be of the specified thickness in all cases, and be measured when required at the Contractor's own expense. Unless otherwise required by the specification or drawings, 1.8mm thick sheet lead will be used.
- A14.3.3 Galvanised Mild Steel Pipes
- a) Galvanised mild steel pipes and fittings for use in the rain water, waste and anti-syphonage systems shall be of an approved make with screwed and socketed joints, tested by hydraulic test to withstand a pressure of 5 N/mm², and identified by a painted blue band in accordance with the medium thickness tubing as specified in BS1387, or medium grade of Japan origin.
 - b) All screwed joints for galvanised mild steel pipes and fittings shall be cleaned, properly threaded, put together with an approved jointing compound and fine stranded hemp and pulled up tightly in accordance with BS21.

- c) All galvanised steel pipes and fittings which are chased in concrete or masonry, or buried underground shall be wrapped with "Denso" tape or equal and approved, or alternatively (55% overlap) and painted with two coats of "ICI Dulux F432-LINE" coal tar epoxy or equivalent.
- d) Bolts, nuts and washers for piping connections shall be made of corrosion resistant material.

A14.3.4 Unplasticised PVC Pipes

- a) Unplasticised polyvinyl chloride pipes for use in the A/C condensate drain pipe system shall comply with BS 3505 Class E, whereas unplasticised polyvinyl chloride pipe for use in the soil and waste water system shall comply with BS4514.
- b) Fittings shall be supplied by the pipe manufacturer and be of the same standard colour and quality as the pipes.
- c) Bends in pipes shall be formed by filling the pipe with sand and gently heating over the entire surface to approximately 130°C, then cooling with water.
- d) All unplasticised PVC pipes and fittings shall be jointed with sockets and with jointing compound as recommended by the pipe manufacturer.
- e) Tapered gunmetal union joints shall be used for all joints which may be subject to disconnection.
- f) All unplasticised PVC pipes and fittings embedded in concrete or masonry, or buried underground, shall be wrapped with hessian or other approved material.
- g) Expansion joints should be provided at intervals as recommended by the pipe manufacturer.
- h) Bolts, nuts and washers for piping connections shall be made of corrosion resistant material.

A14.3.5 Cast Iron Spigot and Socket Pipes (Above Ground)

- a) Cast iron spigot and socket pipes and fittings for use in the rainwater disposal and the soil and waste drainage systems shall be of an approved make in accordance with BS 416 (medium grade) and coated inside and out with Dr. Angus Smith's solution of bitumen when heated to a temperature of 205°C or with an approved bitumastic solution.
- b) The joints shall be made with tarred yarn and run lead will be caulked into the socket generally as described in "Underground Drainage".
- c) The minimum weight of lead per joint for the various sizes of pipes shall be as follows:

50 mm internal diameter	1.10 kg
80 mm internal diameter	1.60 kg
100 mm internal diameter	2.00 kg
125 mm internal diameter	2.50 kg
150 mm internal diameter	3.00 kg
225 mm internal diameter	5.50 kg
300 mm internal diameter	7.25 kg

A14.3.6 Hubless Cast Iron Pipes (Above ground)

- a) Hubless cast iron pipes and fitting for use in the rain water disposal and soil and waste drainage systems shall be similar to Pont-A-Mousson SMU pipes. The pipes are internally coated with 150 microns epoxy tar and externally coated with anti-rust red paint. The fittings are coated with anti-rust red paint or red epoxy coating.
- b) SMU H range shall be used for the drainage from hospitals and laboratories and the joints shall be used as recommended by the pipe manufacturer.
- c) The joints shall be made with SMU rapid couplings. They consist of:
 - 1) Austenitic stainless steel collars with single zinc coated M8 bolts and bichromated cadmium coated steel axes.
 - 2) EPDM elastomer sleeves with the following requirements:
 - Hardness at 20°C :57 shore A
 - Breaking elongation :300%
 - Continuous use at 95°C
 - Perfect holding

- 3) Angular deflection :3°C
 - 4) Axis differential :4 mm
 - d) IGH couplings shall be used in case of accidental pressure between 4 to 10 bars. The couplings shall be tested for a static pressure of 10 atmospheres. (145 pounds per square inches)
- A14.3.7 Ductile Iron Pipes
- a) Ductile iron pipes and fittings for use in pump discharge pipe system shall be of an approved make in accordance with BS4772-Class K12 with flanged joints, and coated externally with an approved bitumastic solution, and internally with cement lining suitable for use with sea water duty.
 - b) All ductile iron flanged joint pipework shall be jointed with gasket rings suitable for use with sea water duty.
 - c) Where unplasticised PVC pipes connect to ductile iron pipes, special uPVC flanged fittings shall be used.
 - d) Bolts, nuts and washers for piping connections shall be made of corrosion resistant material.
- A14.3.8 Installation of Pipework
- a) All pipework inside or outside the building shall be run in parallel lines and in a neat and workmanlike manner. Horizontal pipes shall run parallel with walls. All pipes which will eventually be concealed shall be tested and approved by the Architect and the relevant Authorities before being covered. Failure to comply with the above requirements shall be a cause for the works to be rejected and reinstalled.
 - b) All pipe runs where not underground or in duct or light wells, shall be concealed as far as possible by careful positioning in concrete or block wall or shall be chased into walls as directed by the Architect.
 - c) Pipe runs, where exposed, shall be positioned at least 25mm from the finished wall surfaces, so as to enable subsequent cleaning and painting of all surfaces. Where such pipe runs are installed in angle, they shall be positioned 40mm from the finished surfaces.
 - d) All pipework shall be free from blurs, rust and scale, and shall be thoroughly cleaned before installation. Open ends during the progress of work shall be blanked-off with purpose-made metal or plastic caps.
 - e) Pipes shall be installed with correct falls for venting and draining. Attention shall be paid to the neatness of installation .Where two or more pipes are visible and change directions together, bends shall be struck from a common radius point.
 - f) The Contractor shall note the restricted space available in certain pipe ducts, and care shall be taken to ensure that all pipework is installed in the correct sequence, manner and position so that operation of all valves and maintenance will be possible.
 - g) Suspended pipework shall be positioned as close to slab soffits as possible, whilst maintaining required falls.
 - h) On all systems, long radius bends and pitcher tees shall be used. All fittings shall be suitable for working a test pressure not lower than that specified for the pipework system concerned.
 - i) No bends or curves in any pipes shall be made so as to diminish the waterway or alter the internal diameter of the pipes in any way.
 - j) For dissimilar metal joints in the water supply systems, special flanged connections with insulating gaskets plus insulation sleeves for flange bolts shall be provided and installed.
 - k) Unions or flanged joints shall be used to join adjoining lengths of pipe where it is not possible to rotate either length. They shall also be used for joints for equipment and apparatus items and additionally at 15m intervals to permit the ease of installation, dismantling and re-fixing.
 - l) All pump suction and discharge pipes shall be installed without contact with the concrete structure and masonry works. Sleeves and caulking shall be provided around piping.
 - m) Water delivery pump discharge pipework shall be fitted with approved "silent" check valves.
 - n) All vertical rainwater, soil and waste pipes shall be terminated in two 45° bends or a long radius bend at the bottom of the vertical run.

- o) Cement/paper packings for cast iron piping joints are strictly prohibited. The Architect reserves the right to check other joints if any cement/paper is found, the Contractor shall make good any inspected joints at his own expense

A14.3.9 Pipe Supports

- a) All pipework, fittings, valves, connections etc. shall be sufficiently supported and bracketed. All pipework shall be supported at intervals not greater than the following distances on straight runs; additional supports shall be provided at bends, valves, etc.:

Normal Bore of Pipe Diameter (mm)	Galvanised steel and ductile iron pipes		uPVC pipes and copper pipe	
	Interval (metres)		Interval (metres)	
	Vertical	Horizontal	Vertical	Horizontal
15	1.5	1.2	1.0	0.7
20	1.5	1.2	1.0	0.7
25	1.8	1.5	1.5	1.0
32	1.8	1.5	1.5	1.0
40	2.1	1.8	1.8	1.2
50	2.1	1.8	1.8	1.2
65	2.4	2.1	2.1	1.5
80	2.7	2.4	2.1	1.5
100	2.7	2.4	2.4	1.8

- b) The interval for vertical and horizontal cast iron pipes shall be 1.8 metres; additional supports shall be provided at bends and branches etc.
- c) No less than two supports shall be used on all pipes having a length less than the minimum interval indicated.
- d) All supports for cast iron pipes, galvanised steel pipes and uPVC pipes shall be of galvanised steel. For uPVC pipes, rubber plates shall be inserted between the pipes and supports.
- e) The Contractor shall be responsible for building in all supports etc., and shall allow for using Philips Redhead bolt fixings for concrete, and cutting away and building in bracket fixings for concrete, and cutting away and building in brackets in brickwork etc. The Contractor shall particularly note that it may not be possible to fix the bolt fixings directly above the pipes to be supported, and cantilever angles shall be used where required.
- f) All pipework connected to vibration isolated equipment and pump discharge pipes shall be mounted on spring hangers or supports. Samples and details of these supports shall be submitted for the Architect's approval prior to installation.

A14.3.10 Pipe Sleeves

- a) Cast iron or galvanised puddle flange sleeves shall be provided where pipes pass through walls, floors, beams etc. Where sleeves are fitted through floors, they shall extend at least 40mm clear of the finished floor. Sleeves shall be of a sufficient size to allow the free movement of pipes.
- b) The gap between pipes and sleeves shall be packed with a fiberglass blanket material. However, for pipe sleeves through fire barriers, the gaps shall be firmly sealed with soft packings having a period of fire resistance equal to that of the fire barriers, which shall be approved by the Fire Services Department. The ends of sleeves shall be caulked with non-hardening mastic to the Architect's approval.
- c) All sleeves in walls, floors, beams etc. shall be set in shuttering before concrete is poured.

A14.3.11 Pipe Anchors and Guides

- a) All pipes shall be anchored as required to control the movement of pipes due to thermal changes. Generally anchors shall also be fitted at the lower end of vertical pipes.
- b) The anchors shall securely hold the pipes in a rigid position to resist the attempted movement due to expansion and the weight of pipes and contents.
- c) Pipe guides shall be fitted on each side of each joint to keep the joints and pipes in true alignment. The metal guides for uPVC pipes shall be lined internally with a PVC material slightly oversized to allow axial movement of the pipes.

- A14.3.12 Cutting of Holes
Holes shall be arranged to be left in concrete or masonry works wherever possible to reduce the cutting of slabs and walls to a minimum. No cutting of reinforced concrete shall be allowed without the prior approval of the Architect.
- A14.3.13 Access Doors
a) Access doors shall be provided at the base of all rainwater, soil and waste stacks, opposite joints, on bends and elsewhere where required whether shown on the drawings or not, and in such positions that they can be conveniently inspected and cleaned at all times.
b) Cleaning eyes and access covers shall be fitted with greased felt washers and brass bolts. Cleaning eyes below horizontal pipes are not acceptable.
- A14.3.14 Rainwater Outlets
Rainwater outlets shall be of cast iron to BS 416, with hopper or vertical type drain, removable grating and bellmouth or side outlet, and coated inside and out with an approved bitumastic solution.
- A14.3.15 Termination of Soil Vent Pipes at Roof
All soil vent pipes shall be terminated 1.1 metres above the roof parapet level as shown on the drawings. Plastic vent cowls or copper wired mesh balloon gratings shall be securely fixed to the open ends of these pipes.
- A14.3.16 Pipes Passing through Roofs
Each pipe passing through the roof shall be fitted with a luting flange not less than 150mm above the roofing material. A sheet lead collar not less than 150mm high shall be dressed around the pipe and into the luting flange. A sheet lead slate of size 300mm wider than the diameter of the pipe shall be soldered on the end of the collar and dressed between layers of roofing.
- A14.3.17 Thrust and Anchor Blocks
a) Thrust blocks shall be constructed at all bends and branches on underground pipes of 50mm diameter and larger. In addition to the normal operating pressure of the system these thrust blocks shall resist internal pressure caused by the closing of valves etc.
b) In addition to the thrust blocks specified above, anchor blocks shall be positioned at intervals on straight lengths of pipework so that the distance between any consecutive thrust blocks or anchor blocks shall not exceed 15 metres.
- A14.3.18 Valves
a) Valves for drainage pump discharge pipe system
Valves shall be fullway valves with external rising screw, flanged or screwed to suit the piping and shall be of cast iron construction with nickel alloy faces and grade 316 stainless steel spindle to BS 5150. Ends shall be flanged to BS 4504 and suitable for sea water duty. Valves shall be supplied by Glenfield or other equal and approved makes fully suitable and approved for the use with sea water duty, and suitable for a test pressure of not less than 1495 KN/m². Bolts, nuts and washers for piping connections shall be of corrosion resistant material.
b) Check Valves
1) Check valves shall be zinc free brone conforming to BS 5153 for the drainage pump discharge pipe system.
2) Bolts, nuts and washers for piping connections shall be of corrosion resistant material.
- A14.3.19 Stainless Steel Enclosures to Drainage Pipes inside Kitchens, Function Rooms and Restaurants
a) Whether shown on drawings or not, all drainage pipes including drainage pump discharge pipes running at high level of kitchens, function rooms and restaurants etc. shall be enclosed with stainless steel enclosures of 1.6mm thick to prevent drips of foul water to the areas to meet the Urban Services Department's requirement.

- b) Adequate drain points shall be provided to the stainless steel enclosures and shall be discharged to an approved location.
 - c) Access panels shall be provide at the side of the enclosures for maintenance.
 - d) The enclosures shall be welded in construction.
 - e) All details of stainless steel enclosures shall be submitted to the Architect for approval prior to installation.
- A14.3.20 Stainless Steel Enclosure to Drainage Pipes inside Electrical Rooms
- a) Whether shown on drawings or not, all drainage pipes including pump discharge pipes running inside switch rooms, transformer rooms, generator rooms, meter rooms, PABX rooms, lift machine rooms and computer rooms etc shall be enclosed with stainless steel enclosures.
 - b) Whether shown or drawings or not, all drainage pipes including pump discharge pipes running above trunkings and cable trays etc shall be enclosed with stainless steel enclosures.
 - c) All construction details of stainless steel enclosures shall be as specified in Clauses A14.3.32.
- A14.3.21 Co-ordination
- a) The Contractor shall be responsible for extensive co-ordination of the installation works with the main contractor and sub-contractors of other trades for proper execution of the work.
 - b) The Contractor's particular attention is drawn to the complexity of the services installation, where considerable pipings, cables, trunkings, ductings, etc. have to run in the ceiling space.
 - c) Proper co-ordination and installation procedures between the main contractor and the major sub-contractors, namely, HVAC, electrical, fire services, boiler plant and plumbing/drainage etc. shall be established to the satisfaction of all parties concerned before commencement of work.
- A14.3.22 Labelling
- a) All equipment provided under this Contract shall be labelled in both English and Chinese as to the duty or services; all such labelling shall correspond to the schedules, diagrams, etc., and shall be provided as part of the record drawings. Labels shall be made from sandwich type plastic materials with a black outer layer and a white inner layer and be engraved in English and Chinese. Details of lettering shall be submitted to and approved by the Architect. Lettering shall be engraved by cutting away the outer layer of the sandwich type label to the outline of the required letter thus exposing the white inner layer.
 - b) The following refers to the specific items (but not by way of limitation) requiring labeling:
 - 1) All valves and equipment etc.
 - 2) Distribution boards, starters, starters, etc. shall be labelled to indicate the circuit numbers, phases and items controlled.
 - 3) Inside the doors of the starter cubicle an engraved plastic circuit diagram shall be fitted.
 - 4) The size of the label shall match the object so that the label can be clearly see.
- A14.3.23 Cleaning after Installation
- a) The Contractor shall clean the entire installation, including all sanitary fitments and fittings, drainage pipes etc. after installation.
 - b) The Contractor shall have cleaning eyes opened up and shall have all sections of drainage pipes thoroughly rodded and cleaned prior to Practical Completion. The Contractor must note that this cleaning work shall be witnessed by the Architect.
- A14.3.24 Painting
- a) All painted surfaces shall receive at least one primer coat and two finishing coats.
 - b) All pipings exposed to view shall be painted.
 - c) All pipings in false ceilings and pipe ducts need not be painted but shall be colour coded.

- d) All cast iron pipes, manhole covers and frames and grating for gully traps shall be painted after installation.
- e) Colours and colour bands for the pipes shall be appointed by the Architect.

A14.3.25 Incidental Works

Any work not explicitly indicated in the specifications or drawings but are nevertheless necessary for the complete and proper operation of the plumbing and drainage installation shall be provided by the Contractor at no cost to the Employer.

A14.4 Underground Drainage

A14.4.1 Cast Iron Drain Pipes and Fittings

- a) Cast iron drain pipes and fittings shall be in accordance with BS 437 cast from metal of a quality not less than that specified in BS 1452, grade 10.
- b) Pipes and fittings shall be coated inside and out with an approved bitumastic solution.

A14.4.2 Concrete Drain Pipes and Fittings

Concrete drain pipes and fittings shall be in accordance with BS5911 "Standard" and strength class and with "ordinary" spigot and socket joints.

A14.4.3 Hubless Cast Iron Pipes

- a) Hubless cast iron pipes shall be similar to Pont-A-Monsson SMU H range pipes. The pipes are internally coated with 300 micros epoxy tar and externally coated with zinc coating and anti-rust grey paint.
- b) The joints shall be used as recommended by the pipe manufacturer.

A14.4.4 Perforated uPVC Pipes

- a) Perforated uPVC pipes shall be of rigid-polyethylene pipes with apertures.
- b) The apertures shall be of a unique three-dimensional construction and have 10 to 100 times as high an opening ratio as that of conventional slotted pipes.
- c) Perforated uPVC pipes shall be similar to Netlon or equal.

A14.4.5 Excavations for Pipe Trenches, Manholes etc.

- a) The Contractor shall excavate trenches in straight lines and to even falls and carefully backfill so as not to disturb or damage the drains.
- b) No backfilling shall be carried out until the drains have been tested and approved.
- c) Any voids in the excavations below correct levels shall be filled in with concrete (1:4:8) at the Contractor's own expense.

A14.4.6 Channels and Gratings

- a) Surface channels shall be constructed to various sizes as shown on drawings with concrete of ordinary grade 1:2:4 mixture and minimum thickness of 75mm at sides and 100mm at the base and formed with half round water-ways of the diameters, depths and falls as shown on the drawings. Render exposed surface where required with cement and sand (1:3) 13mm thick and trowelled.
- b) 'U' channels are the same as surface channels except that the channels shall be formed with 'U' shaped water-ways of the diameters, depths and falls shown on drawings.
- c) Flat channels shall be constructed to various sizes as shown on drawings with concrete of ordinary grade 1:2:4 mix and minimum thickness of 75mm at one side and 100mm at the base and formed with flat bottom water-ways of the widths and falls as shown on the drawings.
- d) Stepped channels shall be constructed to various sizes with concrete of ordinary grade 1:2:4 mix and minimum thickness of 100mm at sides and base, formed with half round water-ways having a slope of 1:5 and complete with weep-holes, etc. and finished with 13mm thick cement rendering of 1:3 mix according to the detail drawings.
- e) Concrete channel gratings shall be constructed with 75mm thick reinforced concrete of ordinary grade 1:2:4 mix with appropriate steel reinforcement and 13mm slots according to the detail drawings.

- f) Cast iron channel gratings shall be of 15mm thick for light duty and 50mm thick for heavy duty as specified or shown on drawings. The construction of gratings shall be in accordance with the detail drawings.

A14.4.7 Laying Drains

- a) Every length of drain shall be accurately laid and perfectly true to line and gradient from point to point. Every pipe shall be clean before laying and jointing and any defect in the coating to cast iron pipes shall be made good with an approved bitumastic solution. Pipes shall be laid with sockets upwards commencing at the points of junction with existing drains or point of discharge.
- b) The interior of the pipes shall be kept clean by working a properly shaped disc or other approved device through the pipes after making each joint, and the whole left clean and free from obstruction on completion.
- c) Open ends of pipes shall be temporarily plugged whenever work is suspended to prevent the entrance of rubbish or rodents during construction.
- d) The invert levels shown to manholes are the invert levels of the main channels in the centres of the manholes.
- e) Unless otherwise shown on the drawings the following general rules shall be observed.
- 1) All cast iron or concrete pipes shall be laid on a concrete (1:3:6) bed which shall be 250mm wider than the pipe bore and 150mm thick below the socket of the pipes, haunched up (after the pipes have been tested) to the top of the pipes.
 - 2) All cast iron or concrete pipes with less than 600mm cover shall be surrounded with concrete (1:3:6) which shall completely surround the pipe (after the pipes have been tested) and be 250mm wider overall than the bore of the pipes. The beds shall be as specified in (1) above.
 - 3) All drain pipes under any road or driveway carrying vehicular traffic shall be cast iron with concrete beds as specified in (1) above or in the case of pipes having less than 900mm cover shall be surrounded with concrete as specified in (2) above.
 - 4) Expansion joints should be provided for all beddings at 5 metres centres.

A14.4.8 Jointing of Cast Iron Pipes

- a) Each pipe shall be properly lined in and brought to the correct level, the spigot end shall be wedged up concentrically with its respective socket and the socket tightly caulked with tarred yarn leaving unfilled the required depth of socket for lead. The depth of tarred yarn caulking shall not exceed one-quarter of the total depth of the socket. When the tarred yarn has been tightly caulked home a jointing ring shall be placed around the barrel and against the face of the socket. Molten pig lead shall then be poured in to fill the remainder of the socket. The lead shall then be solidly caulked with suitable tools and hammers of not less than 1.80 kg weight all round the joint to make up for the shrinkage of the metal on cooling. It is essential that the pipes have been perfectly dry before the run lead joints are made to prevent any blowing. The weight of the lead to be used in jointing the various sizes of pipes shall be not less than as follows:
- | | |
|-------------------------------|---------|
| 75 mm internal diameter..... | 1.80 kg |
| 100 mm internal diameter..... | 2.25 kg |
| 150 mm internal diameter..... | 3.50 kg |
| 225 mm internal diameter..... | 6.00 kg |
- b) Where it is necessary to cut cast iron pipe this shall be done with suitable wheel type cutters so as to leave a clean end square with the axis of the pipe.

A14.4.9 Sleeves

All drain pipes passing through ground beams or walls shall have cast iron or galvanised steel puddle flange sleeves cast through to prevent damage in the event of settlement occurring.

A14.4.10 Rest Bends

Cast iron rest bends shall be provided at the feet of all rainwater, soil, waste and ventilation pipes and bedded on and surrounded with concrete (1:3:6) not less than 100mm thick.

A14.4.11 Waste and Rainwater Gully Traps

- a) Gully traps shall be in the same material as the drains to which they are connected.
- b) All gullies shall be set on and surrounded with reinforced concrete of ordinary grade 1:2:4 mix not less than 150mm thick on the base and all round the sides, the reinforced concrete being continued up to ground level where shown or required to form hoppers over of internal dimensions not less than the internal dimensions of the gully inlet bodies.
- c) All cast iron components in gullies shall be coated with an approved bitumastic solution. Fixing screws for covers for sealed type gullies shall be brass flat head countersunk type.
- d) All gullies shall be set to levels such that sufficient depth is given to the hoppers where back or side inlets are shown or required. All exposed surfaces of hoppers shall be trowelled smooth.
- e) Where gullies are required in positions other than inverts to surface water channels, the gullies shall be provided with curbs of concrete (1:2:4) 75mm wide and extending not less than 75mm high above the surrounding finished surface levels. The curbs shall have slightly rounded tops and are to be trowelled smooth.
- f) Rebates shall be formed to top of hoppers and set in cement and sand (1:3) cast iron hinged gully gratings of the dimensions shown on the drawings.
- g) Cast iron gully taps shall comply with BS 437.

A14.4.12 Manholes

- Unless otherwise shown on the drawings the manholes shall be constructed as follows:
- a) The minimum internal dimensions of the manholes shall be 700 x 700 mm where not more than one main or branch pipe enters any one side with addition of 230mm, 340mm and 450mm for each 100mm, 150mm and 225mm diameter pipe beyond the first pipe entering any one side or as shown on drawings.
 - b) The bottoms, walls and cover slabs of manholes shall be in concrete Grade IIIA (1:2:4) reinforced with 13mm diameter mild steel rods at 150mm centres both ways with openings for covers and frames and 127 x 76mm x 13.36 kg RSJ supports on cover slabs. Bottoms and walls shall be 150mm thick and cover slabs shall be 130mm thick.
 - c) The manhole covers shall be cast iron in accordance with BS497, 550 X 550mm clear opening square pattern for foul drains and 600mm diameter circular pattern for stormwater drains with single seal for open areas and double seal for inside buildings, and weighing not less than 127 kg for single seal covers, weighing not less than 254kg for double seal covers. However, double triangular cast iron manhole covers weighing 393.6kg shall be used in Access Roads. Frames shall be set in cement and sand and covers sealed in heavy grease.
 - d) Internal walls of manholes shall be rendered 20mm thick in cement and sand (1:3) and trowelled smooth with steel trowel.
 - e) Main and branch channels shall be formed in concrete (1:2:4) benched up a height of 75mm above the top of the half round main channel, thence sloping upwards to the sides of the manhole. Branch channels are to be formed three quarter section and swept into the main channel. The benching, main and branch channels are to be rendered with cement and sand (1:3) 13mm thick finished with a steel trowel to fair and even surfaces.
 - f) 10mm thick (min.) galvanised mild steel or cast iron step irons shall be built into walls of manholes exceeding 900mm in depth at 300mm centres vertically, set alternately in two rows with centre lines 225mm apart; the top step being not more than 450mm below the cover and the bottom step not more than 300mm above the floor.

A14.4.13 Cast Iron Hatch boxes with Inspection Chambers

- a) Cast iron hatch boxes with inspection chambers shall be used for foul water in the vicinity of all gratering grounds.
- b) Samples of cast iron hatch boxes shall be submitted for the Architect's approval prior to ordering and installation.
- c) The jointing of cast iron pipes and hatch boxes shall be as specified in Clause A14.4.8.
- d) Construction of inspection chambers shall be as specified in Clause A14.4.12 (b), (c), (d) and (f).

- A14.4.14 Vertical Drops
Where vertical drops are indicated in manholes, use cast iron pipes of the appropriate size, fixed to the side walls of the manholes to discharge by means of cast iron bends into the main channel. The connection from vertical to horizontal shall be made of a junction with a removable cleaning eye to facilitate rodding of the horizontal drain. On no account may a branch drain enter the manhole above the benching without a vertical drop being provided.
- A14.4.15 Fresh Air Inlets
Where fresh air inlets are indicated on the drawings, they shall consist of stainless steel boxes approximately 150 x 100mm with fixing ears cast on, with stainless steel front screwed on and fitted with mica flaps. The inlets shall be fixed with pipe nails and distance pieces and connected to the manholes with 2.5 metres high 100mm diameter cast iron ventilating pipes. All terminal manholes shall be provided with fresh air inlets.
- A14.4.16 Septic Tanks
The tanks shall be constructed with reinforced concrete of ordinary grade 1:2:4 mix with cast iron manhole covers of appropriate type and 'U' shaped step irons fixed to the internal side walls of the tanks at 300mm centers as shown on the detail drawings including excavation and filling works.
- A14.4.17 Soakaway Pits
The pits shall be constructed with reinforced, concrete of ordinary grade 1:2:4 mix with cast iron manhole covers of appropriate type and 'U' shaped step irons fixed to the internal side walls of the tanks at 300mm centers as shown on the detail drawings including excavation and filling works.
- A14.4.18 Filtration Tanks
The tanks shall be constructed with reinforced concrete with R.C.C cover of ordinary grade 1:2:4 mix with cast iron manhole covers of appropriate type and 'U' shape step irons fixed to the internal side walls of the tanks at 300mm centres as shown on the detail drawings including excavation and filling works.
- A14.4.19 Grease Traps
The grease traps shall be constructed with reinforced concrete of ordinary grade 1:2:4 mix with cast iron manhole covers of appropriate type and 'U' shape step irons fixed to the internal side walls of the grease traps at 300 mm centres as shown on detail drawings including excavation and filling works.
- A14.4.20 Petrol Interceptors
The petrol interceptors shall be constructed with reinforced concrete of ordinary grade 1:2:4 mix with cast iron manhole covers of appropriate type and 'U' shape step irons fixed to the internal side walls of the petrol interceptors at 300mm as shown on detail drawings including excavation and filling works.
- A14.2.21 Diluting Tanks
a) The tanks shall be constructed with reinforced concrete of ordinary grade 1:2:4 mix with manhole covers of appropriate type and 'U' shape step irons fixed to the internal side walls of tanks at 300mm centres as shown on detail drawings including excavation and filling works.
b) Materials used for construction of the tanks shall be of acid and alkali resisting.
- A14.4.22 Waste, Sewage or Stormwater Sump Pits
a) The pits shall be constructed according to the detail drawings with reinforced concrete of ordinary grade 1:2:4 mix with cast iron manhole covers having a minimum size of 600 x 750mm (for each submersible pump) or big enough for the entry of the submersible pumps whichever is the greater, including excavation and filling works, 150mm thick concrete filling of ordinary grade 1:3:6 mix shall be provided at the bottom of pits as

- pump based. Internal rendering faces shall be of the following construction and requirement:
- b) The pumps shall be of the following constructions and requirements:
- 1) Type - vertical submersible centrifugal non-clogged
 - 2) Casing - cast iron
 - 3) Impeller - zinc free bronze or grade 316 stainless steel
 - 4) Shaft - grade 316 stainless steel
 - 5) Seal - double mechanical seal
 - 6) Bearing - ball thrust type
 - 7) Passage - capable of delivering sewage containing solids up to 50mm diameter.
 - 8) Type of seal - closed coupled
 - 9) Cooling method - water cooled
 - 10) Pump speed - not exceeding 1450rpm
 - 11) Accessories - automatic control boxes, level regulators with neoprene cables for duty pump start, stand-by pump start, common stop and high level alarm, A.C. alarm bell, cable holders, upper and lower guide holders for discharge connection, grade 316 stainless steel guide bars for the pumps.
- c) The automatic level control devices consist of submersible level regulators with sufficient length control cable level control relays and motor starters. The control cables shall be of water-proof type of minimum size 1.5 mm² copper conductor. The motor starters shall be direct-on-line type or star-delta type according to the H.P. rating of the motors as specified here-in-after, and completed with on/off push buttons. Normally the system shall be put under "auto" mode operation through an auto-changeover switch but the pumps can also be put on control. One pump will be on duty with the other pump on stand-by. The operation of the pumps shall be automatically controlled by the appropriate level regulators. Upon reaching a certain predetermined level, the duty pump shall automatically start and shall cut off when the level falls to another predetermined lower level. If there is an upsurge of sewage or the duty pump fails to cope with, the stand-by pump shall start automatically when the level rises to a higher predetermined level. All pumps shall then be operating until the sewage reaches the lowest level. The exact levels of the regulators will be determined on site under the instruction of the Architect.
- d) Operation Sequence
- 1) For the pump on duty and one pump on stand-by:
Pumps shall automatically change over after operation,
i.e. 1st operation : Pump A duty and Pump B stand-by
2nd operation : Pump B duty and Pump A stand-by
3rd operation : Pump A duty and Pump B stand-by
When overload occurs, the stand-by pump shall cut-in automatically.
 - 2) For two pumps on duty and one pump on stand-by:
Pumps shall automatically change over after operation,
i.e. 1st operation : Pumps A and B duty and Pump C stand-by
2nd operation : Pumps B and C duty and Pump A stand-by
3rd operation : Pumps A and C duty and Pump B stand-by
4th operation : Pumps A and B duty and Pump C stand-by
When overload occurs, the stand-by pump shall cut-in automatically
- e) The holding down bolts, nuts and washers shall be made of stainless steel to BS970 : Part 1, grade 316.
- f) Pump Fittings
- 1) Long radius bend fittings must be used for the bend of the pump pipes.
 - 2) 45° radial branch fittings must be used for the branch joint of the pipes.
 - 3) 45° bends are preferred to 90° bends.
- g) Pump Valves
- Each pump shall be fitted with valves to enable the pumps to be isolated. In addition where shown on the drawings, silent non-return valves shall be fitted at discharge side of the pumps.

- h) Level Regulators
- 1) A level regulator consists of a mercury switch in a plastic casing and is freely suspended from its cable at the required height.
 - 2) When the liquid level has risen to the level regulator, its position will change, although the regulator will not float. The mercury switch will close or open the circuit and start or stop a pump. It can also be wired for initiation an alarm.
 - 3) When the liquid level has fallen, the regulator will tilt again and the mercury switch will change over.

A14.4.23 Sub-soil Drains

- a) The sub-soil drains shall be 225mm U channel and constructed with ordinary grade 1:2:4 mix reinforced concrete and minimum thickness of 100mm at sides and 150mm at base and formed with 'U' shaped water-way. The top of sub-soil drains shall be laid in dry with 425mm x 610mm x 100mm thick and 13mm slots precast reinforced concrete slabs of ordinary grade 1:2:4 mix. Render surfaces with 13mm thick cement and sand (1:3) and trowel to smooth finish with a steel trowel.
- b) The hand pack stone shall be laid on the top of sub-soil drain to a height not exceeding 3 metres and the width not less than 300mm.

A14.4.24 Test Certificates

Test certificates for drain pipes, gully traps, manhole covers etc. shall be submitted to the Architect. Local made fittings are acceptable but samples shall be submitted for the Architect's approval prior to installation.

A14.4.25 Testing

- a) After the drains have been laid and jointed and before backfilling, the pipes shall be tested by filling with water having a head of not less than 1500mm above the invert of the pipe being tested at its lowest end. Should pipes leak or burst, or joints be found unsatisfactory during testing, they shall be taken up, re-laid, re-jointed and re-tested all at the Contractor's expense. Manholes will be tested as for drains by filling with water as required.
- b) All applications for drain testing, submitted pursuant to Building Regulation 73, must be copied to the Architect at the same time. Within 2 days from attending the drain test, the Contractor shall submit to the Architect a report on completion of drain test which shall indicate test method, the readings of all drain pipes and a drawing showing the tested drainage pipelines with colour.
- c) All drains that have been tested and approved shall be marked in the crown with a tar streak to clay and concrete pipes and with a limewash streak to cast iron pipes.

A14.4.26 Obstruction of Testing

Pipelines of 525 mm of diameter or less shall be tested to ensure that they are free from obstruction after having successfully withstood a water test. A loose spherical or cylindrical plug of the diameter shown in the schedule shall be passed through the whole of the pipelines including gully traps. Any obstruction encountered shall be moved or any unevenness of invert shall be made good to the satisfaction of the Architect.

Pipe Diameter (mm)

100 to 150

175 to 225

250 to 525

Plug Diameter (mm)

5mm less than pipe diameter

10mm less than pipe diameter

2mm less than pipe diameter

A14.5 Electrical Works

A14.5.1 General Requirements

- a) The Electrical Contractor supplying and installing electrical services will provide and adequate electrical supply to the areas inside the pump rooms and near the sump pits as directed by the Architect, which shall terminate with main isolator for all water pumps. From these isolators, all works including cabling, change-over switches, motors, starters, water level control float switches, ammeters, voltmeters, alarms shall be included in the

- Contractor's works.
- b) Electrical supply will be 380/220 volt 3 phase 4 wire 50 Hertz.
 - c) All electrical works shall satisfy the requirements laid down by the Electricity Supply Company, and the latest I.E.E. Regulations and special regulations issued by Hong Kong Government.
 - d) All works shall conform to the best principles of modern practice.
- A14.5.2 Pump Control Panels
- The pump control panels shall be enclosed units. The sheet metal used for the panels shall be of not less than 14 s.w.g. Doors shall be provided with dust-excluding gaskets of neoprene. All paint finishes shall be of high quality enamel type.
- A14.5.3 Electric Motors
- a) For each pump the Contractor shall install an electric motor which shall have a margin of not less than 20% between the continuous rating of the motor (without overloading) and the maximum shaft horse power demanded by the pump under its most arduous operating conditions. Motors shall be continuously rated in accordance with BS 5000 : Part 2 according to the rating .All motors shall be tropic proof and shall be insulated with Class F materials. Motors shall be of the commercial-silent type having sleeves or roller bearings .The enclosures of motors shall be splash-proof, fully enclosed, and of drop-proof pattern.
 - b) Motors from 1 H.P. up to 5 H.P. shall be of the squirrel cage type suitable for Direct-On-Line Starting. The starting current shall not exceed 6 times the full load current.
 - c) Motors above 5 H.P. shall be of the squirrel cage type suitable for Star-Delta starting. The starting current shall not exceed 2 times the full load current.
 - d) Motor speeds shall not exceed 1450 r.p.m.
- A14.5.4 Direct-on-line Starters
- a) Each starter shall include the following:
 - 1) Main contactor (with auxiliary contacts)
 - 2) Overload protection
 - 3) Phase failure protection
 - 4) Main and control circuit fuses of HRC cartridge type
 - 5) On/off switch (with auxiliary contacts)
 - 6) All necessary terminals of adequate rating, and all necessary internal wirings
 - 7) Provision for cable entries
 - 8) All necessary ancillary contacts for sequence control
 - b) A green pilot light shall be fitted to the front cover of the MCCB which shall be illuminated when the equipment is running.
 - c) A red pilot light shall be fitted to the front cover of the MCCB which shall be illuminated when the starter has been "tripped" on overload.
 - d) Each starter shall have an auxiliary contact for remote indicating and start/stop use.
- A14.5.5 Star-Delta Starters
- These shall be provided with contactors, overload protection etc. as detailed above for the Direct-On-Line starter, but arranged so that the star contactor opens before the delta contactor closes, the time intervals being controlled by an automatic timing device.
- A14.5.6 Contactors
- a) Contactors shall be single pole or triple pole fitted with arc-shields and nominal rating of not less than 10 amps. Contactors shall generally be in accordance with BS 5424. Contactor coils shall be operated from 220 volts AC single phase electricity.
 - b) All contactors shall have an auxiliary relay suitable for the normally open/normally closed position for remote monitoring at the B.A.S. Contactor.
- A14.5.7 Ammeters
- Starters for pumps of 5 H.P. and above shall be provided with ammeters flush-mounted

adjacent to the respective starters, and shall be of the moving iron pattern with compressed scale to comply with BS 89, Part 1 for industrial accuracy. Current transformers shall be the ring pattern to BS 3938. The dials shall be marked with red lines to indicate the normal full load current of the motors controlled. The ammeters shall be provided with auxiliary contacts for connection by the B.A.S. Contactor for remote indication.

A14.5.8 Switchgears

All fused switchgears and isolators shall conform to the requirements of BS EN 60947-3. The fuse links for fused switches shall be of high rupturing capacity, cartridge type conforming to BS 88.

A14.5.9 Connections to Motors

- a) Final connections to electric motors shall be made by means of PVC cables in rust-proof flexible steel conduits with separate tinned earth wires not less than 2.5mm² running outside the flexible conduits.
- b) Flexible steel conduits shall be in accordance with BS 732 Part 1.

A14.5.10 Cables and Conduits

- a) The Contractor shall supply and install all cabling and control wiring between starters, motors and float switches. Wiring systems shall be of PVC cables in galvanised conduits.
- b) PVC insulated cables shall consist of copper conductors, PVC insulated to CMA standards and to BS 6004. Cables for three phase and single phase circuits shall be 600/1000 volt grade. The current carrying capacity shall be in accordance with I.E.E. Regulations (latest edition) and shall be limited to the specified voltage drop. The minimum size of cable shall be 2.5mm² in section.
- c) All conduits shall be of heavy gauge galvanised welded steel complying with BS4568, Class 4. No conduits shall be less than 20mm in diameter.

A14.5.11 Operation Sequence

- a) for one pump on duty and one pump on stand-by:
Pumps shall automatically change over after operation,
i.e. 1st operation : Pump A duty and Pump B stand-by
2nd operation : Pump B duty and Pump A stand-by
3rd operation : Pump A duty and Pump B stand-by
When overload occurs, the stand-by pump shall cut-in automatically.
- b) For two pumps on duty and one pump on stand-by:
Pumps shall automatically change over after operation,
i.e. 1st operation : Pumps A and B duty and Pump C stand-by
2nd operation : Pumps B and C duty and Pump A stand-by
3rd operation : Pumps A and C duty and Pump B stand-by
4th operation : Pumps A and B duty and Pump C stand-by
When overload occurs, the stand-by pump shall cut-in automatically.

A14.5.12 Remote Alarms and Indicators

- a) Visual indicators and audible and visual alarms shall be provided at the remote indication panels located at the Management Office or the locations appointed by the Architect.
- b) Visual indications shall be provided for:
 - 1) System on/off
 - 2) Motor running/stop of individual motor.
- c) Audible and visual alarms shall be provided for:
 - 1) Low/high water levels.
 - 2) Tripped motor.

A14.6 Sanitary Fitments and Fittings

A14.6.1 General Requirements

The Contractor shall fix the sanitary fitments and fittings, and supply and fix all approved

silicon sealants (colour shall be appointed by the Architect), mortar, lead plugs and other accessory materials, cuts and pins or rawlplugs, brackets and make all connections to the water supply services, overflows and wastes.

- A14.6.2 Jointings between Water Closets and Concrete Floors
Water closet pans shall be bedded on concrete floors in an approved silicon sealant and screwed to rawlplugs let into the concrete.
- A14.6.3 Water Closet Pan Connectors
Water closet outlets and soil pipes shall be connected with white plastic water closet pan connectors to BS 4514 completed with rubber rings or as directed by the Architect.
- A14.6.4 Jointing of Waste Outlets
Waste outlets to lavatory basins, sinks, etc. shall be bedded in an approved silicon sealant or other approved materials.
- A14.6.5 Trap to Waste Fitments
Unless otherwise shown on the drawings or described in Sanitaryware and Fitting Schedule traps to lavatory basins, sinks, etc shall be of chromium plated brass and shall comply in every respect with BS 1184 with 80mm deep seal.
- A14.6.6 Floor Drains
All floor drains supplied and fixed by the Contractor shall have chromium plated brass gratings with chromium plated brass flat head countersunk type fixing screws and brass anti-syphonage trap with 80mm deep seal.
- A14.6.7 Materials of Sanitary Fittings for Salt Water
All parts of sanitary fittings subject to salt water flushing shall be of materials not corrodible by salt water.
- A14.6.8 Cleanings and Protections
At all times, all sanitary fitments and fittings, bathroom accessories shall be properly protected from damaged and shall cleaned and polished. The method of protective coverings for bath tubs shall be obtained from the Architect's approval.

A14.7 Testing and Commissioning

- A14.7.1 Requirements of Testing and Commissioning
- a) The Contractor shall perform testing and commissioning of the drainage system, to the satisfaction of Authorities having jurisdiction and the Architect. If, under test, any part of the installation or any piece of equipment fails to perform satisfactorily, the Contractor shall replace or make good that part or piece of equipment to the satisfaction of the Architect and in the most efficient manner possible.
- b) All instruments, plant, supervision and labour required for equipment and system commissioning shall be provided by the Contractor. Instruments shall be accurately calibrated to the satisfaction of the Architect, prior to commissioning.
- c) Two months prior to testing and commissioning any system, the Contractor shall furnish the following information for each system or process to the Architect for approval:
- 1) Types of instruments to be used
 - 2) Manufacturers of instruments
 - 3) Calibration methods for instruments
 - 4) Operating instructions for instruments
 - 5) Three (3) sets of details of testing and commissioning procedures
 - 6) Accuracy and tolerance of instruments
 - 7) Proposed formats for testing and commissioning reports
 - 8) Complete schedule and programme of all testing and commissioning activities
- d) The Architect shall be notified well in advance of all tests (7 days minimum) to allow him to be present when the tests are conducted.

- e) Record all commissioning results on record sheets. Submit format to the Architect for approval. On completion of commissioning and prior to final inspection and handover, submit the commissioning results in a bound volume to the Architect, who reserves the right to witness such commissioning operations and procedures as necessary.
 - f) All tests shall be properly certified in a format approved by the Architect and test certificates shall be submitted in triplicate to the Architect on completion of satisfactory test.
- A14.7.2 Operating Tests
- a) The Contractor shall ensure that the installations or portions thereof which have been set to work comply with all specified requirements as follows:
 - 1) That the plant or apparatus is of robust construction and of capacity for the duty specified.
 - 2) That all valves, switches, controls, etc. are regulated and capable of proper operation, and in the case of valves that they are capable of tight shut-off.
 - 3) That all apparatus is silent in operation.
 - 4) That all instruments are correctly calibrated and can be read accurately.
 - b) Original factory test certificates especially for submersible pumps shall be submitted to the Architect, proving that the materials/equipment have been achieved the specified performance.
 - c) The Contractor shall perform all tests and demonstrations as called for by the Architect and the relevant Government departments.
- A14.7.3 Hydraulic/Smoke Testing
- a) The Contractor shall carry out hydraulic tests on the completed smoke tests on the rainwater, soil, waste and anti-syphonage systems to show that these are functioning satisfactorily within the requirements of this Specification and the Hong Kong Government Regulations (all departments).
 - b) The Contractor shall arrange and bear the costs of the supply of water required in connection with the testing of pipework and fittings.
 - c) Smoke tests shall be carried out in accordance with Government requirements.
 - d) Should a pipe section fail to meet the test requirements, the Contractor shall, without additional charges, replace the defective pipes and/or joints as may be required in order that the test requirements can be satisfied.
- A14.7.4 Electrical Testing
- a) Verification of polarity shall be carried out to ensure that all fuses and single pole control services are connected to the line conductor only.
 - b) Insulation resistance tests shall be carried out at 250 volts single phase and at 500 volts three phase circuit for:
 - 1) Line to line
 - 2) Line to earth
 - 3) Neutral to earth
 - 4) Line to neutralin strict compliance with the latest IEE Regulations.
 - c) Earth continuity tests shall be carried out by means of a line-earth loop test or neutral-earth loop test in accordance with the latest IEE Regulations.
 - d) Earthing test the earthing resistance of equipment shall be made with a loop impedance test in accordance with the latest IEE Regulations.
- A14.7.5 Instructing Employer's Staff
- a) The Contractor shall allow in his prices for providing the services of one skilled man for the purpose of instructing the Employer's staff in the operation and maintenance of the installed services and in the use of the instructions manuals.
 - b) The instructions shall be given during normal working hours for a period of two weeks during the 'Defects Liability Period'.

A14.7.6 Maintenance and Servicing

a) General

- 1) Starting from the Date of Practical Completion, the Contractor shall provide 12 months free maintenance and emergency breakdown service as follows:
 - i) Attendance to all faults and complaints; and
 - ii) Provide inspections, checking, cleaning and adjustments on all installed equipment at the end of the free maintenance period.
- 2) The Contractor shall within one month of the Date of Practical Completion, complete all outstanding items and rectify all defects. Should the Contractor fail to do so, the Employer shall have the rights to have such works executed forthwith by others at the Contractor's expense without abrogating the Contractor's existing liabilities.

b) Preventive Maintenance

- 1) The Contractor shall provide free preventive maintenance, including emergency breakdown service to the plant during the Defects Liability Period to ensure that all the various systems installed operate satisfactorily.
- 2) The Contractor shall give the Employer at least fourteen (14) days prior notice when each routine service call is due to be made.
- 3) The Contractor shall report to the Employer prior to commencing each service, and before leaving compile a comprehensive report on all the work which has been carried out during each visit, including comments on any improper functioning of the various systems, and comments on any items requiring detailed examinations at or before the next scheduled visit.
- 4) The service report shall also state the date when the next regular routine service call is due to take place.

c) Service Reports

- 1) During each visit the Contractor shall complete a report in the form of a checklist which shall indicate the readings of all gauges, the conditions of all items, and any remedial works carried out.
- 2) The final payment of the retention money shall only be certified pursuant to the receipt of Service Reports which indicate that the Maintenance and Service requirements have been regularly and satisfactorily completed.
- 3) The Contractor shall submit for the Architect's approval a sample Service Report in sufficient time for possible amendments before the Certificate of Practical Completion is issued.

GENERAL SPECIFICATION

ELECTRICAL INSTALLATION

B1 ELECTRICAL INSTALLATION

B1.1	<u>General Requirements</u>
B1.1.1	General
B1.1.2	Definitions
B1.1.3	Standards and Regulations
B1.1.4	Metric Units
B1.1.5	Warranties and Guarantees
B1.1.6	Testing and Commissioning
B1.1.7	Period of Notice
B1.1.8	"As-New" Condition
B1.1.9	As-Built Drawings
B1.1.10	Working (Shop) Drawings
B1.1.11	Builder's Work Drawings
B1.1.12	Maintenance and Operating Manuals
B1.1.13	Submissions
B1.1.14	Building Provisions
B1.1.15	Environmental Conditions
B1.1.16	Sizes of Plant and Equipment
B1.1.17	Makes and Types of Equipment
B1.1.18	Programme of the Works
B1.1.19	Building Contractor's Programme
B1.1.20	Notations
B1.1.21	Utilities Connections
B1.1.22	Silence of Operation
B1.1.23	Limited Access
B1.1.24	Co-ordination Between Trades
B1.1.25	Special Tools
B1.1.26	Training of Operators and Maintenance Staff
B1.1.27	Fire Protection Provision at Work
B1.1.28	Maintenance and Operation During Defects Liability Period
B1.2	<u>L.V. Switchboard</u>
B1.2.1	Construction and Finish
B1.2.2	Air Circuit Breakers (ACBs)
B1.2.3	Accessories & Components
B1.2.4	Power Factor Correction System
B1.2.5	Testing
B1.3	<u>Emergency Diesel Generator</u>
B1.3.1	General
B1.3.2	Diesel Engine
B1.3.3	Engine Cooling
B1.3.4	Engine Fuel Injection
B1.3.5	Generator
B1.3.6	Vibration Isolator
B1.3.7	Exhaust Silencers and Flue
B1.3.8	Fuel System
B1.3.9	Engine Starter Motor and Control
B1.3.10	Starting Battery and Charger
B1.3.11	Control and Protection
B1.3.12	System Operation and Performance
B1.3.12.1	Automatic Operation
B1.3.12.2	Manual Operation
B1.3.12.3	Interfacing
B1.3.13	Earthing
B1.3.14	Testing

B1.4	<u>Sub-circuit Distribution Equipment</u>
B1.4.1	General
B1.4.2	Switch, Fuse-switch and Switch-fuse
B1.4.3	Circuit Breaker
B1.4.4	Air Circuit Breaker (ACB)
B1.4.5	Moulded Case Circuit Breaker (MCCB)
B1.4.6	Miniature Circuit Breaker (MCB)
B1.4.7	Residual Current-operated Circuit Breaker
B1.4.8	Fuse
B1.4.9	Busbar Chamber
B1.4.10	MCCB Distribution Board
B1.4.11	MCB Distribution Board
B1.4.12	Fuseboard
B1.4.13	Contactors
B1.4.14	Starter
B1.5	<u>Busbar Trunking Distribution Equipment</u>
B1.5.1	General
B1.5.2	Busbar Casing
B1.5.3	Busbar Insulation
B1.5.4	Busbar
B1.5.5	Joint in Busbar
B1.5.6	Short-circuit Capacity
B1.5.7	Expansion Unit
B1.5.8	Feeder Unit
B1.5.9	Tap-off Unit
B1.5.10	Fire Barrier
B1.5.11	Busbar Trunking Accessories
B1.5.12	Support of Busbar Trunking System
B1.5.13	Special Requirements for Air-insulated Busbar Trunking System
B1.6	<u>Cable Duct & Cable Tray</u>
B1.6.1	Cable Duct
B1.6.2	Metal Cable Tray
B1.7	<u>Trunking and Conduit</u>
B1.7.1	Wiring System in Trunking
B1.7.2	Materials for Trunking Installation
B1.7.3	Installation of Trunking System
B1.7.4	Trunking Tool and Workmanship
B1.7.5	Conduit System and Material
B1.7.6	Conduit and Wiring Installation
B1.7.7	Conduit Tool and Workmanship
B1.7.8	Plastic Conduit or Plastic Trunking System
B1.8	<u>Power Cable</u>
B1.8.1	General
B1.8.2	PVC Insulated Steel Wire Armoured Cable
B1.8.3	PVC Insulated and PVC Sheathed Cable
B1.8.4	Mineral Insulated Copper Cable
B1.8.5	XLPE Insulated Armoured Cable

B1.9	<u>Wiring Accessories</u>
B1.9.1	Wiring Accessory
B1.9.2	Domestic Switch
B1.9.3	Socket Outlet
B1.9.4	Connection Unit
B1.9.5	Insulated Terminal Block
B1.9.6	Lamo
B1.10	<u>Lighting Protection</u>
B1.10.1	General
B1.10.2	Alternative 1
B1.10.3	Alternative 2
B1.11	<u>Earthing Arrangement</u>
B1.11.1	General
B1.11.2	Main Earthing Terminal
B1.11.3	Earth Electrodes
B1.11.4	Earthing Conductor
B1.11.5	Main Equipotential Bonding Conductor
B1.11.6	Supplementary Bonding Conductor
B1.11.7	Circuit Protective Conductor (CPC)
B1.11.8	Identification and Labelling
B1.11.9	Sizing of Protective Conductors
B1.11.10	Use of Residual Current Operated Circuit Breaker (RCCB)
B1.12	<u>Miscellaneous</u>
B1.12.1	Label and Notice
B1.12.2	Guard and Railing for Moving or Rotating Parts of Equipment
B1.12.3	Identification of Cable and Conduit
B1.12.4	Painting of Metal Work
B1.13	<u>Testing and Commissioning</u>
B1.13.1	General

B1 ELECTRICAL INSTALLATION

B1.1 General Requirements

B1.1.1 General

- a) This Specification describes the standards, performance, materials, manufacture, supply, installation, testing, commissioning, operation and maintenance of all systems described in this section and shown on the Drawings.
- b) Unless otherwise stated, the Contractor shall furnish all labours, superintendence, materials, tools, equipment, storage, permits, certificates, drawings, temporary work, inspection, testing and all accessories, auxiliaries and incidentals necessary to complete the works under this section in a proper, safe, thorough and skillful manner to the satisfaction of the Architect.

B1.1.2 Definitions

- a) The Contractor appeared hereinafter in this Section and related specifications shall refer to the specialist contractor appointed to carry out the works under this Section.
- b) The Building Contractor appeared hereinafter in this Section and related specifications shall refer to the Main Contractor appointed to carry out the construction of the superstructure of the development.

B1.1.3 Standards and Regulations

- a) The works shall be consistent with good practice in Hong Kong to the satisfaction of the Architect.
- b) All materials and equipment shall comply with appropriate British Standards Specification and Codes of Practice. Where materials or equipment offered are not of British origin, they may comply with other standards of specifications, subject to the written approval of the Architect.
- c) All aspects of the works shall comply in all respects with the statutory obligations and other regulations listed in this specification.
- d) In the event of any conflict, the requirements of statutory bodies and local government departments shall take precedence. In all other cases the requirements of this Specification shall be adhered to.

B1.1.4 Metric Units

The Contractor shall provide all information, manufacturers' data and materials in metric (S.I.) units and dimensions or include a conversion table which must be printed on or within the data sheets produced by the manufacturers.

B1.1.5 Warranties and Guarantees

- a) The Contractor in providing a specific piece of equipment or apparatus, whether specified herein by name or whether of a make selected by the Contractor, shall be deemed to warrant its satisfactory performance under all working conditions which may be encountered.
- b) Unless otherwise stated in this Specification, the Contractor's guarantee for the works under this section shall extend for a period of one year from the Date of Practical Completion of the Building.
- c) The Contractor is responsible for obtaining manufacturer's guarantee on all major items of equipment.
- d) All guarantees which extend beyond the expiry of the Defects Liability Period shall be vested in the name of the Employer.

- e) The Contractor shall, without additional charge to the Employer renew any defective equipment under guarantee during the guarantee period and arrange that the renewed equipment or parts shall be guaranteed for another period of time equal to the guarantee period of the original.
- f) All equipment and parts under guarantee which require replacement shall be delivered and installed promptly at no extra charge to the Employer. This shall include air freight for delivery from overseas and overtime working for installation.
- g) In the event of anything described in the Specification or shown in the Drawings being, in the Contractor's opinion, unsuitable or inconsistent with his guarantee or responsibilities, the Contractor shall draw attention there to at time of tendering.
- h) Neither the time limit imposed on the Contractor's guarantee, nor the Practical Completion Certificate issued by the Architect, nor the acceptance of the installation by the Employer, nor the approval by the Architect of any material or method shall in any way relieve the Contractor his responsibility for any latent defects in the Contact works which may become apparent in the future and which are, in the opinion of the Architect, due to the Contractor's failure to use materials and methods which comply to this Specification and Drawings.

B1.1.6 Testing and Commissioning

- a) In addition to and notwithstanding any testing that may be carried out by or required by Government Authorities or Public Utility Companies, the Contractor shall satisfy the Architect and the Employer's representative that the whole installation has been tested and commissioned to their satisfaction in accordance with relevant section(s) of this Specification. This requirement will be a condition of the issue of the Practical Completion Certificate.
- b) In order to achieve this requirement, the Contractor shall:
 - 1) Within three (3) months of the date of issuance of the Letter of Acceptance produce comprehensive testing and commissioning procedures and test record formats for the Architect's approval. The procedure shall be specifically written for the project and not copies of institution's publications.
 - 2) Three (3) months before the programmed completion of the main contract works produce a detailed programme indicated how the whole installation shall be tested and commissioned before the programmed completion of the works. Before submitting this programme, the Contractor shall obtain the approval of the Building Contractor that it is acceptable.
 - 3) Within seven (7) days of completing the tests to the satisfaction of the Architect and the Employer's representative but before the issue of the Certificate of Practical Completion, the Contractor shall produce a complete, hard cover bound, record of all the test results and conclusions. The record shall contain the following:
 - i. a description of the tests carried out;
 - ii. date of tests and names of people present;
 - iii. copies of the relevant specification, standard or control data against which the tests were assessed;
 - iv. a complete record of the test results, and
 - v. an assessment of the findings and conclusions and a demonstration of whether the test results met the specification.
- c) The Contractor shall provide the Architect and the Employer's representative at least seven (7) days notice in advance of any testing and shall also provide all the necessary facilities, labour and instruments for the witness and checking of the tests.
- d) The Contractor shall satisfy himself prior to any witnessed testing of the adequacy of the installations and that the installations are fully checked and precommissioned.
- e) Should the test results indicate that the plant or equipment is not functioning in a satisfactory manner or complying with the requirements of the Specification, the Contractor shall carry out at his own expense any alterations, replacements or

adjustments as may be required to correct the faculty work. The Architect's decision as to what constitutes a satisfactory test shall be final.

- f) Test shall be repeated to the satisfaction of the Architect at no extra cost.
- g) All testing and commissioning shall be carried out by suitably trained, qualified and experienced personnel.

B1.1.7 Period of Notice

- a) A minimum of seven (7) days' notice shall be given to the Architect or his representatives before testing and commissioning operations are commenced on site.
- b) A minimum of four (4) weeks' notice shall be given in the case of factory tests on major plant.
- c) The Contractor shall notify the Architect at least seven (7) days in advance of his application for government authority tests and inspections. On receipt from government authority of a confirmed dated for test and inspection, the Contractor shall, without delay, inform the Architect.

B1.1.8 "As-New" Condition

At the time of handover of the Contract Works after the Practical Completion, the whole installation shall be in "as-new" condition. The Contractor shall, during the course of the Contract, protect all plant and equipment, and shall restore / repaint as necessary before completion of the Contract.

B1.1.9 As-Built Drawings

- a) The Contractor shall submit at least one month prior to the programmed completion of the works three (3) sets of "as-built" drawings of the whole of the work as installed for the Architect's approval.
- b) Unless otherwise specified, all "as-built" drawings shall be fully dimensioned and drawn to a scale of 1:100. Equipment plant room layouts and details shall be drawn to a scale of at least 1:25.
- c) The drawings shall show all services installed and include ratings and sizes of actual equipment, plant, ductwork, pipework, conduits, trunking, underfloor ducting, cable trays together with all inspection and testing point, plant and valve numbers, all to scale and shape and with the manufacturer, model, rating, etc., marked on the drawings.
- d) Wiring diagrams of control panels, equipment subcircuits, inter-locking wiring etc. shall also be provided.
- e) Symbols used shall be to British Standards and a list of symbols used shall be provided.
- f) Upon the Architect's approval but not later than two months after Practical Completion, the Contractor shall submit one microfilm negative and four sets of approved prints.
- g) The Contractor shall provide a detailed drawing list of all "as-built" drawings.
- h) In addition to the above "as-built" drawings, the Contractor shall provide suitably frame hang in the appropriate plant area:
 - 1) Equipment room "as-built" drawings.
 - 2) Control and system schematics for installation and plant installed in and operated from such rooms.
 - 3) Operating instructions for all equipment installed in or controlled from such rooms.
- i) At the end of the Defects Liability Period, the Contractor shall furnish to the Employer one complete set of film sepia of all the "as-built" drawings.

B1.1.10 Working (Shop) Drawings

- a) The Contractor shall, at the times specified and well before the relevant work proceeds, prepare and submit for approval, detailed, fully co-ordinated working drawings based on the Drawings, taking into account any modification either to the Building on to the installation which may have taken place and correctly related to the detailed of the actual items of plant and equipment to be installed.
- b) The Contractor shall similarly prepare all necessary schedules of equipment, etc., and also all necessary wiring diagrams, both internal wiring diagrams for items of electrical equipment and diagrams showing the interconnections between different items.
- c) Four copies of all such drawings schedules diagrams, etc., shall be submitted to the Architect for approval in writing before any work is commenced. After approval, twelve copies of all approved drawings, schedules etc., shall be supplied by the Contractor, free of charge, for distribution.
- d) To assist the Contractor in the initial preparation of his installation drawings, a set of dyeline prints of architectural general plans will be provided after the award of the Contract. The Contractor shall be fully responsible for updating his installation drawings based on any changes to the general plans which may from time to time be required.
- e) Working drawings shall be submitted within six months of the award of the Contract or at least two months prior to the commencement of the works on site, whichever is the sooner, and shall thereafter be resubmitted within two weeks of the approval of any alternation to any system.

B1.1.11 Builder's Work Drawings

- a) The Contractor shall furnish to the Architect for approval and subsequent distribution drawings or schedules showing details of builder's work required in connection with the installation of all services.
- b) In cases where preliminary builder's work information has already been given on the Drawings, such information is to be checked by the Contractor and incorporated in his own drawings.
- c) It is the intention that all holes, chases, etc., shall be left in the structural building work as it proceeds and not cut out subsequently, except in so far as may be necessary due to subsequent authorized variations to the Works.
- d) The Contractor shall acquaint himself throughout the period of the Main Contract Works with the Building Contractor's detailed construction programme and shall prepare the builder's work drawings in such order and at such times as to enable them to be checked and approved and subsequently issued to the Building Contractor not less than three weeks before the actual construction is planned to take place.
- e) No claims will be entertained in respect of additional holes, chases, etc., required after the structure has been constructed unless these are necessary due to authorized variations to the works. Should the Contractor fail to give the Building Contractor reasonable notice and full particulars of the "Builder's Work", all additional work incurred shall be at the Contractor's expense.

B1.1.12 Maintenance and Operating Manuals

- a) The Contractor shall produce six copies of draft Operation and Maintenance Manuals three months in advance of the programmed completion of the works for the Architect's approval.
- b) The manuals shall be encased in A4 size, loose leaf ring binders, with hard covers. Drawings larger than A4 shall be folded and accommodated in the binder so that they may be unfolded without being in any way detached from the rings.
- c) The manuals shall be properly indexed.

- d) Attention is drawn to the fact that a Practical Completion Certificate will not be issued until the manuals have been approved and issued. The manuals shall be written in English and / or Chinese as required. The manuals shall included, but not be limited to, the following:
- 1) general description of the whole installation, its location, function and operation,
 - 2) start-up and operating instructions for all equipment installed,
 - 3) an index of associated "As-built" drawings,
 - 4) manufacturer's literature appertaining to the model of equipment installed including performance data,
 - 5) routine maintenance procedures and fault finding for each equipment and, where applicable, the whole installed system,
 - 6) a maintenance schedule detailing frequency of servicing, lubrication charts, overhaul, replacement, etc.,
 - 7) an equipment schedule, recommended list of spare parts and list of special tools required,
 - 8) commissioning test result as specified in the relevant section of this Specification, and
 - 9) all other information required for proper operation and maintenance of the entire installation.

B1.1.13 Submissions

- a) At the time of tendering, the Contractor shall provide all information in accordance with the Form of Tender.
- b) All submissions must be made early enough to enable the Architect to fully check each item prior to giving approval. Generally, a period of at least two months will be required from the receipt of the complete submission and the Contractor shall ensure that his submissions are made at least two months before any equipment requires to be ordered to meet the Building Contractor's Programme.
- c) No claims for extension of time or additional expenses shall be entertained as a result of the Contractor's failure to make his submissions in adequate time.
- d) If, in the opinion of the Architect, the Contractor's failure to make his submissions in adequate time may result in a delay in the completion of the project as a whole, then the Architect shall have the authority to instruct the Contractor to order materials and or equipment of type from a source approved and nominated by the Architect at no extra cost to the contract sum.
- e) If the Contractor subsequently fails to place such orders within a period of four weeks from receipt of the Architect's instruction, then the Employer shall have the right at his sole discretion to order the materials and / or equipment directly from the manufacturer(s). the cost of all such orders, including freight, shipping, insurance, handling and administrative charges shall be deducted from the Contract Sum or recovered from monies payable to the Contractor.

B1.1.14 Building Provisions

- a) Certain provisions will be made in the Building for the accommodation of the works. These provisions will include space allocation, holes / openings through structural slabs, walls and beams, reinforced concrete plant bases except anti-vibration pads, trenching, backfilling and manholes, etc.
- b) Before proceeding with the works, the Contractor shall confirm in writing that the provisions shown in the drawings are satisfactory and where necessary, additional information shall be provided by the Contractor.
- c) It is the Contractor's responsibility to ensure that the Building Contractor is informed of all holes / openings required in the structure prior to the pouring of concrete, and where additional holes / openings are required after pouring of concrete, they shall be provided at the Contractor's expense, unless they are covered on a duly authorized basis by an Architect's Instruction. It is also the Contractor's

responsibility to ensure that these holes are correctly reserved and protected during construction.

- d) Repairs around openings in the building structure for the passage of building services will be carried out by the Building Contractor.
- e) Structural bases and / or foundations required for support or anchoring of mechanical equipment to be installed for the works shall be provided on site by the Building Contractor except where otherwise specified. The Contractor shall provide the Building Contractor with the dimensions and locations of the bases in adequate time. Where anchor bolts are to be set in the structural beams, the Contractor shall furnish and set the bolts, and where the structural base is to be constructed of concrete, the anchor bolts shall be set and held in place by a template, secured by wires, before concrete is poured.
- f) All structural and supporting steelwork required for the installation of the works shall be supplied and fixed by the Contractor, except where otherwise specified.
- g) All materials and fixings for sleeves where pipes, cables and busbars pass through walls, slabs, beams or columns shall be provided by the Contractor. The Contractor shall provide puddle flanges where specified.

B1.1.15 Environmental Conditions

- a) The Contractor is assumed to be familiar with environmental conditions prevailing at the site.
- b) The Contractor in submitting a tender is assumed to warrant all materials and items of equipment as suitable for continuous operation under all local conditions, and to provide all necessary precautions and arrangement to ensure no deterioration arises prior satisfactory completion of acceptance test.
- c) Notwithstanding the above, environmental restriction may dictate the Specification of more severe limits of operating conditions. The Contractor shall ensure that their equipment shall operate satisfactorily under all specified conditions.

B1.1.16 Sizes of Plant and Equipment

- a) The sizes of all plant and equipment herein or in the drawings are minimum sizes and the Contractor shall check them with the Architect, taking into account any variations which may be made to the systems during the progress of the works.
- b) The Contractor shall be required to demonstrate at site that the duties required of the equipment are obtainable.
- c) Physical sizes of all plant and equipment are to be suitable for the spaces allocated for the accommodation of such plant and equipment, taking in account the requirement of access for maintenance purposes.
- d) Before ordering equipment, the Contractor shall provide the Architect with full details of the weights of the equipment for purposes of determining floor loadings, etc.

B1.1.17 Makes and Types of Equipment

- a) The Contractor shall in his tender, submit proposals incorporating his particular types of equipment and installation techniques while at the same time ensure that the building services comply fully with the basic requirements and fit into the building, having regard to the architectural and planning requirements and to the provisions which are being arranged in the structure for the accommodation of the works.
- b) The Employer reserves the right to reject any tender which in this opinion disregards the basic requirements or intentions stated herein, or which seeks to vary the scope of the works, the contract conditions or any other requirements of the tender documents.
- c) In selecting makes and types of equipment, the Contractor shall ascertain that facilities for proper maintenance, repair and replacement can be provided without

- such a delay as could cause inconvenience or loss to the Employer.
- d) All items of equipment shall be supplied by manufacturers experienced in the design and construction of similar equipment and who have made this type of equipment for at least five years.

B1.1.18 Programme of the Works

- a) The tender shall include a bar chart programme giving realistic schedules of work periods to conform to the Main Building programme as stated in the Preliminaries Section for assessment in conjunction with the tender. The Contractor shall agree the bar chart programme with the Building Contractor to form the basis of a comprehensive critical path programme for the entire Main Contract Works.
- b) The bar chart programme shall indicate how the various activities will be scheduled in order to complete the works within the Main Contract Period.
- c) Activities included in the Contractor's programme shall take account of, without limitation, the following:
- 1) submission for approval of all equipment and shop drawings;
 - 2) ordering of equipment;
 - 3) manufacture of equipment;
 - 4) delivery of equipment;
 - 5) installation of equipment indicating methods, sequencing, and duration of each activity;
 - 6) testing, balancing and commissioning; and
 - 7) submission of as-built drawings and maintenance programme.

B1.1.19 Building Contractor's Programme

- a) The Contractor's attention is drawn to the phased construction of the building, if any, in the Preliminaries Section.
- b) The Contractor shall conform to the Building Contractor's programme of Works and shall include everything necessary to complete the works within main contract period and in a sequential manner acceptable to the Building Contractor.

B1.1.20 Notations

- a) Notations and symbols used throughout the tender documents are as listed on the Drawings.
- b) All other notations used shall have their normally accepted meaning and where any doubt or ambiguity is found, then the Contractor must seek clarification in writing from the Architect at the time of tendering.

B1.1.21 Utilities Connections

The Contractor shall be responsible for the co-ordination with all relevant local utilities authorities regarding connection of the incoming mains with the inside services.

B1.1.22 Silence of Operation

- a) The works as installed shall be reasonably silent in operation having regard to the conditions under which they will be called upon to operate and in any case, shall be such that no unreasonable noise or vibration is discernible outside the plant rooms or similar space in which the equipment is housed.
- b) The Contractor shall take all necessary steps to ensure that the equipment supplied by him is silent as specified and shall include sound absorbing or anti-vibration material or devices as are necessary to ensure a satisfactory degree of silence and absence of vibration in the structure of the building.
- c) The Architect's decision as to what constitutes satisfaction in this respect shall be final.

- d) If on completion the system is not, in the Architect's opinion, sufficiently silent, the Contractor shall, without additional charge, carry out such modifications or additions as may be required, until the system is made silent to the Architect's satisfaction.

B1.1.23 Limited Access

- a) The Contractor shall note the limited access available in ceilings, pipe and duct shafts.
- b) All pipes and ducts shall be installed in the correct sequence to ensure that all services can be accommodated. Where works by other trades are to occupy the same pipe and duct space, care must be taken to leave clear access for sequential or future provision of these services within builder's work shafts, plant rooms and false ceilings, etc.

B1.1.24 Co-ordination Between Trades

The Contractor shall liaise with the Building Contractor and other contractors, sub-contractors and tradesmen who will be carrying out other services work on the Site, prior to the commencement of actual installations, so as to ensure that the work of all trades will be co-ordinated.

B1.1.25 Special Tools

- a) The Contractor for operation and maintenance of the equipment shall provide 3 sets of any special tools required as part of the tendered price. These shall be handed over prior to completion of the works.
- b) The Contractor shall list all special tools required in the Operating and Maintenance Manuals.

B1.1.26 Training of Operators and Maintenance Staff

- a) The Contractor shall arrange with the Employer for a training course for operating personnel at a mutually agreeable time before the completion of the works.
- b) The basic text book for the course shall be the Operating and Maintenance Manuals produced by the Contractor.
- c) The Contractor shall provide a team of skilled personnel for the operation of plant from the date of the plant ready for operation to the date of issuance of Practical Complete Certificate. Within this period, the contractor's operating team shall work together with the Employer's operating team and instruct and advise on the operating / maintenance procedure. Prior to the issuance of the Practical Completion Certificate, acknowledgement from Employer of have received instructions in the operation of the equipment and systems is required.

B1.1.27 Fire Protection Provision at Work

- a) Wherever there is hot work carried out by any employee of the Contractor, whether they are employed directly or indirectly, there shall be at least 2 nos. 9 litre gas expelled water hand fire extinguishers to be located within 5m reach of the said employee in a readily accessible and safe position. In addition, the Contractor shall also provide "passive" fire protection measures for materials and to the structure in the form of fire resistant cover sheets or otherwise as directed and approved by the Architect.
- b) Wherever there is materials / equipment housed in a locked shed wholly or partly used by the Contractor, the Contractor shall provide at least 2 nos. 9 litre gas-expelled water hand fire extinguishers to be located at the normal entrance door to the shed.

B1.1.28 Maintenance and Operation During Defects Liability Period

The Contractor shall provide labour and materials to properly maintain and rectify all the works included under this Contract for the period commencing after completion of the works until twelve months after the date of practical completion of the whole of the Main Contract works. Upon instruction by the Employer whether verbal or written in case of fire or when there is operational defects discovered in the systems, the Contractor shall provide qualified engineers and technicians on 24-hour-on-call basis to take responsibility for the maintenance / rectification and operation of the works.

B.1.2 Low Voltage (L.V.) Switchboard

B1.2.1 Construction and Finish

The L.V. Switchboard, shall be of multi-cubicle type assembled from compartments housing the busbars, switches, etc. as shown on the Drawings, suitable for Service Conditions as specified and complying where relevant, to the appropriate British Standard, Code of Practice, the IEE Wiring Regulations and the Supply Co's requirements.

The L.V. Switchboard shall be assembled from factory-made switch units which have been type-tested by the Association of Short-Circuit Testing Authority (ASTA), UK. Appropriate technical information and literature in English language and copies of type-test certificate and drawings must be made available for examination.

The L.V. Switchboard shall be constructed in the same manner, as similar switchboard which type test certificates have been issued to the manufacturer by ASTA.

The L.V. Switchboard shall be of steel construction, self supporting, with cubicle tops, side panels and doors of not thinner than 2.00mm sheet steel so formed as to give a rigid construction without cross-struts, and to have clear accessibility to all internal components within the Switchboard. Steelwork shall be treated to prevent corrosion before being painted, steel parts normally left bright shall be cadmium plated.

The bottom of the L.V. Switchboard shall be closed and made vermin-proof by means of non-magnetic fire-proof barrier plate cut away where required to suit the cables as specified.

L.V. Switchboard shall be of uniform height, uniform depth front-to-back, throughout its length and shall present a neat and tidy appearance.

Unless otherwise specified, the L.V. Switchboard shall be constructed generally to Form 3 of B.S. 5486 Part 1. Main busbars shall be enclosed and segregated from the remainder of the switchboard by partitions. The Switchboard shall have segregation between the switch units, circuit breakers etc, in the front of the Switchboard by vertical partitions. The whole busbars, including the conductors connecting the busbars to each outgoing circuit, shall be arranged to withstand short circuit at any point.

All switches shall be provided with mechanical interlocks to prevent any positive access to an equipment inside the Switchboard when the switch is the "ON" position. The exterior of each Switchboard shall be finished to an opaline green or the nearest standard colour with the end plates and heads of any external fixing bolts or set screws finished to match. The interior of each Switchboard shall be finished matt white.

The "space" provision for future outgoing circuits shall comprise blank panels, undrilled, and provision for accommodating fuseswitches and / or circuit breakers. Busbars shall be extended as necessary and drilled for future connection of conductors. The spaces schedules or shown on the Drawings are indicative of minimum requirements and may be varied to suit the arrangement offered, subject to approval.

Insulators, including busbar supports, shall be non-hygroscopic and non-deteriorating. The use of fibrous materials, linseed oil, varnish, "Presspahn" etc. is prohibited.

The Switchboard shall be suitable for indoor use and be dust and vermin proof generally to IP31 as specified in BS EN 60947-1. Detachable panels at the back of switchboard shall each be provided with a pair of handles for easy fixing / removal of the panels.

Ventilating louvers shall be provided on the sides and backs of panels and shall be of approved design. All louvers shall be secured and provided with vermin proof wire mesh.

B1.2.2 Air Circuit Breakers (ACBs)

ACBs shall comply with BS EN 60947-2. The circuit breakers selected shall be trip free, metal clad, horizontal drawn-out pattern, and meet the following requirements:

Number of poles: 4

Rated insulation voltage: 1000A.C.

Rated frequency: 50Hz.

Rated uninterrupted current: as show on Drawings

Rated working temperature: 40deg. C.

Rated short-circuit making capacity: 84kA at 0.25 power factor

Rated short-circuit breaking capacity: 40kA.

Rated short-time withstand current for breakers rated at 1600A and above 40kA for 3 seconds.

Rated short-time withstand current for breakers rated below 1600A: 40kA for 1 second.

Short-circuit performance categories: P-2

Closing mechanism: hand charged spring.

Tripping mechanism: shunt trip at 30V D.C.

All breakers shall be certified by a recognised national testing authority / ASTA to show compliance with the short circuit duty as specified above.

Mechanical interlocks shall be provided for ACB to cater for the following functions:

1. The circuit breaker cannot be inserted or withdrawn when in the closed position. Attempted withdrawal shall not trip a closed circuit breaker and vice versa.
2. Cover of door giving access to the circuit breaker cannot be removed or opened unless the circuit breaker is fully isolated and withdrawn.
3. Means shall be provide to padlock the breaker in the OPEN AND ISOLATED position.
4. Means of isolation and withdrawal shall be provided so that the breaker may be maintained with the busbars alive.

Each ACB shall be equipped with, but not be limited to, the following:

1. A mechanically operated indicating device to indicate breaker positions.
2. One 100mm scale MISC ammeter complete with selector switch and current transformers to measure all line current.
3. One 100mm scale MISC voltmeter complete with selector with protection HRC fuses for line and phase voltage reading (for incoming breakers only).
4. One power factor meter (for P.F. capacity bank connecting breaker only).

5. Overcurrent protection relay where indicated on the Drawings. The relay shall be triple pole non-directional IDMT relay with current settings between 50% and 200% adjustable in seven equal steps and time setting of 0-3.0 second at 10times current setting. The relay shall comply with BS 142.
6. Earth fault protection relay where indicated on the Drawings. The relay shall be single pole non-directional IDMT relay with current settings between 10% and 40% adjustable in seven steps and time setting of 0-1.3 seconds at 10 times current settings. The relay shall comply with BS 142.
7. Trip supply healthy, breaker open, breaker close, breaker trip and phase indicating lamps.
8. Control circuits to effect circuit breaker opening and tripping.
9. Auxiliary contacts for local status indications, control and 20% spares.
10. Lamp test push button.
11. Automatic safety shutter completely shroud the main fixed isolating contacts when the circuit breaker is withdrawn.
12. Other requirement shall be as per clause B1.4.4.

B1.2.3 Accessories and Components

a) Busbar

Busbar shall be made of hard drawn, electro-tinned high conductivity, bare rectangular solid copper bars to BS 1433 or BS 1432. Full size neutral bars shall be provided.

Busbars shall be adequately treated at 40 deg. C, rigidly praced and supported. The complete assembly shall be capable of withstanding the maximum mechanical stresses of which it may be subjected under fault conditions.

Busbars, busbar connections and bare conductors forming part of the equipment of switchboards shall comply as regards current-carrying capacity and limites of temperature with the requirements of BS 5486 : Part 1.

The rated short-time withstand current shall be 40kA for 3 seconds for circuits of 1600A and above, and 40kA for 1 second for circuits below 1600A. all main busbars / risers / droppers shall be type tested in accordance with BS 5486 : Part 1. Additional type test for connection between the main busbars / risers / droppers with the outgoing switchgear accordance with BS 5486 : Part 1 may also be required where considered necessary.

The clearances and creepage distances between phase busbars and between phase busbars and between phase busbars and earth shall be not less than those of the apparatus with which they are immediately associated.

Busbars risers and droppers shall be as short and as straight as possible and shall be so arranged that all conductors of outgoing circuits can be brought onto the bars without undue bending.

All conductors between the main busbars and the outgoing switchgear shall be of high conductivity copper bars as specified, having a current rating of not less than that of the outgoing switchgear to which they are connected. The busbars shall be labelled to BS colour code for phase identification.

Insulators for busbar supports shall be non-hygroscopic.

Busbars shall be segregated as specified.

b) Fused Switchgear

All fused switchgear shall comply with BS EN 60947-3 for uninterrupted duty, utilization category AC-23, unless otherwise indicated on the Drawings. All contact shall be fully shrouded.

All fused switchgear shall be of uninterrupted duty and shall have a rated fuse short circuit current of 40kA. Fused switchgear shall have mechanical interlocks between the panel door and the switch operating mechanism and shall be so arranged that the panel door cannot be opened with the switch in the ON position. Similarly, it shall not be possible to close the switch with the cubicle door open, except that provision shall be made within the cubicle for an authorized person to defeat the mechanical interlock and close the switch with the door in the open position for test purposes.

All switchgear shall be flush mounting and be fitted with mechanical ON / OFF indicators with operating handles of the semi-flush or telescopic pattern. Means shall be provided for padlocking in either on ON or OFF position.

Fused switchgear shall be independent manually operated and shall be triple pole with bolted neutral link, triple pole with switches neutral, double pole or single pole with bolted neutral link, as specified. The neutral link shall be accessible and detachable from the front of the fused switchgear panel.

Fuses shall be of HRC type to BS 88 : Part 2, Class Q1 fusing factor.

c) Automatic Change Over Switch

Automatic changeover contractor shall be electro-magnetically controlled at mains voltage, double air-break, four pole type and tested to BS EN 60947-4-1.

They shall be rated in Utilization Categories AC-3 and capable of making, breaking and carrying continuously the rated current without overheating, damage or deterioration. They shall be electrically and mechanically interlocked in operation. Unless otherwise specified, the changeover action shall be automatically in response to the failure or resumption of supply mains.

Illuminated indicator for "Mains ON" and "Essential Supply ON" shall be provided at the cover of the compartment housing the automatic changeover contractor.

Two N/O and two N/C auxiliary switches shall be provided for each changeover contractor for signal wiring connection to other systems.

d) Protective Relays

Protective relays shall comply with BS 142.

Where plug selection is specified, the design shall be such that the plug setting can be changed on load without open circuiting the current transformers, and the highest current tapping point will automatically be selected when the plug is removed.

Relays shall be of draw-out pattern, suitable for flush mounting and finished in phenolic black. A contact shall be fitted which shall short circuit the associated current transformers on withdrawal of the relay.

A mechanical flag indicator shall be fitted to indicate the relay operation. A hand-operated reset service shall be mounted in the relay cover to reset the indicator and the auxiliary tripped relay, if any.

A sealing device permitting the use of sealing wire shall be provided to prevent unauthorized opening of the relay cover.

A filter shall be fitted to the relays to equalize the pressure inside and outside the case without admitting dust.

The relay contacts shall be capable of making and breaking the maximum current which may occur under fault conditions in the circuit in which they are connected.

e) Control and Auxiliary Relays

Control and auxiliary relays shall be provided where necessary to ensure a sound and effective operations of the ACBs, MCCBs and automatic changeover switch.

Relays shall be plug-in type, rack mounted, provided with cable connection sockets and anchored by quick fastening vibration-proof devices.

All contacts shall be double breaking type. Relay coils shall be rated at 220V single phase A.C. supply and they shall operate between 85% and 110% of the coil rating. Drip out voltage shall not occur at voltages exceeding 65% of nominal.

f) Volt-free Contacts (Dry Contacts)

Volt-free contact shall be provided where required. They shall comprise a pair of contacts operated directly by the equipment but electrically separate such that no electrical potential derived from the equipment appears at the contacts. Volt-free contacts shall also be used to complete external control, alarm or indication circuits.

g) Current Transformers

All current transformers shall comply with BS 3938 and shall be rated for Class B temperature rise and a primary voltage of 660V.

Current transformers shall be of epoxy resin encapsulated type and shall be capable of providing the necessary output to operate the connected protective devices or instruments.

One secondary terminal of each set of current transformer shall be earthed through a removable link.

Protection current transformers shall be suitably rated and of Class 10P15 accuracy.

Measurement current transformers shall be suitably rated and of Class 1 accuracy.

h) Ammeters

Ammeters shall be of moving iron type Class 1.5 accuracy to BS 89 : Part 1 and 2 and be capable of carrying their full load current without undue heating and shall not be damaged by the passage of fault currents up to the maximum fault levels of the switchgear.

The range selected shall be suitable for the permissible maximum current to be indicated.

Ammeters shall be suitable for vertical flush mounting, rectangular pattern, enclosed in dust and damp proof pressed steel cases not less than 90mm wide, and with a minimum sweep of 240 deg.

Mechanical zero adjustment shall be provided and accessible from the front without dismantling.

i) Ammeter Selector Switches

The ammeter selector switches shall be mounted on the front of the panel and shall be of the rotary type with make-before-break contacts for selection to read red-yellow-blue-neutral currents with R-Y-B-N marked clearly on the switch.

j) Voltmeters

Voltmeters shall be of Class 1.5 accuracy to BS 89 : Part 1 and 2.

The range selected shall be suitable for the voltage level to be indicated.

Other requirements shall be same as Clause 5.3.8.

k) Voltmeter Selector Switches

The voltmeter selector switches shall be mounted on the front of the panel and shall be of the rotary type with break-before-make contacts for selection to measure red-yellow, yellow-blue, blue-red, yellow, blue phase voltage with RY, YB, BR, R-Y-B marked clearly on the switch.

Contacts shall be rated for thermal current of 6 amperes, 220V, 50Hz.

l) Energy Metering (Kwh meter)

Provision shall be made, where specified and / or shown on the Drawings, for the accommodation of the energy metering equipment upon the L.V. Switchboard. The metering compartment shall be completed with a hinged glazed door for meter viewing.

The accommodation for the energy metering shall include a suitable insulating panel for mounting the meters and suitable fuses to protect the voltage coil circuits to each meter. Fuses shall be of the H.R.C. type rated at 5 amp., with provision for sealing to prevent unauthorized removal.

The L.V. Switchboard shall also be provided with suitable mounting brackets for mounting the energy meters current transformers upon the incoming busbars in accessible positions.

Wiring between the current transformers and the meters shall be carried out on Site, the L.V. Switchboard shall be provided with cable clips or conduit for installing the wiring.

m) Terminal Blocks

Terminal blocks for control wiring shall be rated at not less than 20 amperes and shall clamp the wire securely between two plates secured by a capative screw. Terminal blocks shall have easily removable copper links to short circuit adjacent terminals or shall be fitted with suitable fuse / fuseholder where required. Pinch screw type terminal blocks will not be accepted.

Terminal blocks for circuits of difference voltage shall be segregated into groups, distinctively labelled and provided with permanent rigid barriers. Terminals in groups shall have separate flame retardant transparent plastic covers.

100% spare terminals shall be provided on each terminal block.

Insulated conductors shall not rest against bare live parts or sharp edges.

Generally, only one conductors shall be connected to a terminal; the connection of two or more conductors to one terminal is not permissible unless if it is designed for this purpose.

All terminals shall be shrouded, and those terminals which may remain live with the mains isolated shall be adequately labelled with cautionary signs.

All internal wiring shall be PVC insulated. Wiring shall be neatly bunched by nylon type cable ties, run on supporting PVC cleats or trunkings and shall be coloured and adequately labelled or sleeved for identification.

Where wiring is carried across door hinges, it shall be enclosed by a flexible PVC tubing and be looped to permit the opening of doors and removal of components for inspection without disconnecting and over-flexing of the cables.

All circuits shall be provided with removable links / fuses to facilitate isolation, checking and maintenance.

Cables having the same number shall be terminated at adjacent terminals and connected by means of cable links at the terminal block. The incoming cable cores shall be terminated at the lower or outer side of the block, the outgoing cable cores at the upper or inner side of the terminal block, and cable links on any free side.

Terminals which may remain live when the equipment is isolated from the main supply shall be adequately shielded from accidental contact and be clearly identified and inscribed accordingly.

n) Battery / Charger System

The battery shall be nickel cadmium type, sealed, requiring no maintenance and having long life.

Charger shall be of constant potential current limiting type with preset float and booster charger with charger failure alarm.

Input voltage to charger shall be 220V nominal with $\pm 10\%$. Protective device on the input and output circuits shall be provided.

Under fully charged condition, the battery shall be capable of supplying the indicating lights for two hours and tripping all circuit breakers and automatic changeover switch in 20 consecutive operations without recharging or cause any damage to the battery.

Voltmeters, ammeters and associated indication lamps shall be provided to monitor the working condition of the battery bank.

o) Earthing

A tinner copper earth bar of dimensions not less than 50 x 6mm shall be provided along the whole length of the switchboard and shall be provided with terminals for connections to the armouring or metal sheath of all incoming and outgoing circuits, the integral earth busbars of busducts, and to the electrical earth.

External earth terminals on both sides of the end panels shall be provided for

earthing connection to the electrical earth.

p) Indication Lights

Panel mounted indicating lights shall be provided with twin filament lamps behind a common lens for the following indications.

- Red to denote ACB / contactor closed
- Green to denote ACB / contactor opened
- Amber to denote ACB / contactor tripped

Indicating lights to designate supply voltage healthy and trip circuit healthy shall also be provided.

Indicating lights shall be so designed as to permit removal of lamp glasses and bulbs from the front of the unit without the need of any special tool.

q) Labels

Laminated "Traffolyte" or similar labels of sample sizes shall be provided for each of the units on the Switchboard engraved in English and Chinese characters. A means of fixing these labels shall be provided, other than by adhesives.

During the progress of manufacture of the L.V. Switchboard a schedule of labels shall be submitted for approval by the Architect before engraving is carried out.

Warning labels shall be affixed to the rear panels, and shall be coloured red with white lettering in both English and Chinese characters denoting "DANGER – LIVE BUSBARS INSIDE".

In addition to automatic screening shutters and barriers, warning labels shall also be provided for all live parts, such as test terminal blocks.

r) Cable Arrangements

The L.V. switchboards shall be provided with all necessary cable lugs etc. fixed in positions on mounting plates and straps, to suit the types and directions of entry of the cables as shown on the Drawings or as specified.

Cable conductors for all circuits within the Switchboard shall be arranged in a tidy manner and mechanically secured at regular intervals such that any movement occurring to the conductors, either under normal operation conditions (e.g. thermal expansion, vibration, etc.) or due to short circuit in any one of the circuits, shall not cause any damage or short circuit to any healthy bare live parts in the Switchboard.

s) Discrimination

Full discrimination is required within and between the switchboard ACBs and other switchgear ensuring that short circuits or overloads on sub-circuits will not trip the switchboard circuit breakers but will effectively isolate the faulty circuit, leaving the healthy circuits unaffected. The contractor shall be responsible for ensuring discrimination is maintained.

t) Control Interface

All necessary control relays, wirings, contactors, etc. to effect the following:

1. Upon failure of one or more phases of main supply or a reduction of voltage 70% of nominal value, at the busbars of incomer, the standby generating plant shall automatically start up.

2. When the generating set is ready to accept load, a signal shall be issued from the generator's control circuit to the automatic changeover equipment to open the main circuit breaker and close the standby circuit breaker.
3. Upon restoration of the mains power supply, which has been determined stable, all the essential loads back to the main supply.
4. Detailed control scheme and wiring diagrams shall be submitted for approval prior to execution.

B1.2.4 Power Factor Correction System

The power factor improvement system shall include capacitors, cables, control relays, contactors, voltmeter, ammeter, etc. as required to form a complete installation as shown on the Drawings.

The capacitor banks shall be of cabinet type integrated in the low voltage cubicle switchboards and built up from static primary capacitor units. The primary capacitor unit shall be hermetically sealed and manufactured from continuous metal foil and high quality dielectric material. The primary capacitor unit shall comply with the requirement of B.S. 1650. Each capacitor bank shall be filled with a discharge to the peak alternating voltage to a voltage not exceeding 50 volts measured at the capacitor bank terminals one minute after disconnection from the supply. The capacitor bank terminals one minute after disconnection from the supply. The capacitor banks shall have the following characteristics:

Rated operating voltage	: 380 volt 3 phase
Rated frequency	: 50Hz
Rated output	: As specified on Drawings
Admissible temperature	: Ambient temperature during operation up to 45°C and during transportation and storage -40°C to +70°C

The capacitor shall be controlled by the automatic multistep capacitor control relay capable of switching the appropriate amount of capacity 'IN' or 'OUT' in 6-stages minimum to achieve the best average power factor. A no-volt resetting feature shall be incorporated to ensure that, in the event of power interruption, all capacitors involved are disconnected from the L.V. installation and reconnected in accordance with the aforementioned arrangement upon supply resumption.

The control relay shall have the following characteristics:

Measuring control operating voltage	: Suitable for supply systems of 380/220V with neutral conductor
Control current	: Can be connected without any additional adaptor to C.T., rating as specified on Drawings, burden 10VA, Class 1.
Contacts for contactor switching	: Control relay capable of withstanding -250V a.c., 5Amps., 1200VA.
Test voltage	: Supply connecting cable & contactor connecting cable: 2500V, 50Hz. C.T. connecting: 500V, 50Hz.
Harmonics	: A filter is incorporated to avoid falsified measuring results. Not to be confounded with filter circuits for the P.F. correction equipment.
C/K value	: Adjustable from 0.05 to 1.0.
P.F. reversal point	: Adjustable from 0.8 lagging to 0.9 leading.
No-voltage release	: If voltage fails, the no-voltage release operated automatically due to drop-out of control relay.
Indicator for operating and steps	: Illuminated diodes.
Switching time from one step to	: From 10 seconds to 3 minutes according to

another	reactive load.
Manual Switching	: Two push-buttons for manual operation, suitable to check functioning of relay.
Connection	: With 3 cable whips, i.e. 3-wire supply cable; 2-wire C.T. connecting cable; and 6 or 12-wire control cable.
Mounting	: With angle brackets and threaded bolts.
Temperature range	: From -10°C to +60°C.
Power consumption	: Approx 0.5W/KVAr.

B1.2.5 Testing

The following tests shall be included, but not be limited to, at the manufacturer's workshop during the course of assembly and on completion immediately prior to transport to site.

1. Inspection of the Switchboard including wiring, electrical and mechanical connections, external and internal finish etc.
2. Mechanical tests including checking of all mechanical and electrical connections, interlock etc.
3. Primary and secondary injection tests to check if all measuring protection and control circuits and associated components are operative.
4. Continuity and dielectric tests.
5. Functional checks of all control circuits including the chunt trip operation of breaker at 70% and 110% of the rated control supply voltage.
6. Calibration of metering instrument, CT, etc.
7. Battery / charger load tests.
8. Any other tests as recommended by manufacturer.
9. Mechanical operation tests of switchgears. Each switchgear to be operated through at least three (3) close-open-cycles in both operating and test positions. All control circuits, changeover operations and interlocks shall be tested for correct operation check for ease of rack-in and rack-out of all withdrawable equipment to be carried out.

After the transport and erection of the Switchboard on site, the following tests, but not be limited to, shall also be carried out:

1. General inspection of the Switchboard.
2. Mechanical tests
3. Continuity and dielectric tests
4. Functional checks
5. Secondary injection test to re-calibrate all measuring protection and control circuits and associated components.

The following commissioning inspections and tests, but not be limited to, shall be carried out before the Switchboard is put into normal service:

1. Voltage tests between any two combination of each phase, neutral and earth.
2. Phase sequence tests on each outgoing units.
3. Functional check, especially on the controlling devices.

B.1.3 Emergency Diesel Generator

B1.3.1 General

The generating sets shall be suitable for starting and acceptance of full rated load immediately after attaining normal voltage and frequency in less than 15 seconds. All equipment shall be suitable for tropical climatic operation.

The generating set shall comprise a diesel engine directly coupled to an A.C. generator and mounted in line on a common skid type bed plate, which is to be completed with

anti-vibration mountings.

All exposed ferrous metal surfaces of the machines, underframe and auxiliary equipment shall, where applicable, be treated with rust-inhibiting primer plant, undercoat and grey finishing coat to B.S. colour No. 631 in B.S. 3810.

The generator shall be fully equipped for radio interference suppression to B.S. 800.

B1.3.2 Diesel Engine

The engine shall be of the water or air cooled industrial pattern as specified in the drawings, high speed, mechanical injection, four stroke single acting compression ignition type and of adequate capacity to drive the generators herein specified and shall comply with B.S. 5514 continuous rating except that the engine shall be sized to be able to provide 110% of rated output for at least one hour in any period of twelve hours continuous operation under the design ambient condition. The voltage regulation shall be maintained to within $\pm 2.5\%$ from no load to 110% overload.

The engine shall be provided with an accurately balanced flywheel and shall be flexibly coupled to the generator. The driving half of the coupling shall be directly attached to the engine flywheel, the driven half of the coupling being provided with a suitable boss for the driven unit. The flywheel, couplings and any other exposed moving parts shall be provided with substantial guards.

The engine shall be complete with a suitable torsional vibration damper mounted on the free end of the crankshaft.

The engine water jacket shall be extended to cover the exhaust manifold in order to limit the heat rejection to the room.

The engine shall be provided with crankcase pressure relief doors and shields of the non-flameproof type. Notwithstanding the above, the engine shall be of the type with both turbo charged and intercooled.

The engine shall be equipped with filters for aspiration air, fuel oil and lubricating oil.

B1.3.3 Engine Cooling

Cooling system shall comprise remote or set mounted tropical duty pressurized radiator. The hot air from the radiator shall be ducted out of the generator room through a louvered panel fitted with silencer. The necessary ductwork complete with anti-vibration flexible joint shall be provided by the Contractor. The method of fixing the duct and silencer shall be approved by the Architect.

All ductwork and materials shall be provided, including linings, adhesives, flexible ducts, flexible connections, gaskets, sealants, etc. The complete installation shall comply fully with all the requirements of the F.S.D. and shall satisfy B.S. 5588 : Part 9 and B.S. 8313 in respect of resistance to penetration of fire and spread of flame and smoke.

All ductwork shall be of hot dipped galvanized steel sheet to B.S. 2989, Grade 22, coating type 'C' as specified in DW/142.

All ducting shall be constructed to the recommendation of the UK Heating and Ventilating Contractors' Association, Ductwork Group in their Publication DW/142.

The cooling system shall be fitted with the manufacturer's recommended anti-corrosion solution.

B1.3.4 Engine Fuel Injection

The engine shall be supplied with and designed to run on diesel fuel oil conforming to B.S. 2869: Part 1 Class A1.

The engine shall have monopole fuel injection pumps and be complete with a governor to maintain the generator output within the limits specified in B.S. 5514, Class A1.

B1.3.5 Generator

The generator shall have a continuously rated output at 0.8 power factor lagging 380V 3 phase 4 wire 50Hz when driven at 1500 r.p.m. and shall be capable of operating without damage when the engine is operating at full load as specified above.

The generator shall be of the brushless, revolving fields, screen protected, salient pole, horizontal foot mounting type provided with a direct coupled overhung exciter armature, shaft mounted assembly, flange mounted exciter magnet shaft with bare shaft extension suitable for receiving a flexible coupling. Two end frame mounted grease lubricated ball and / or roller bearing shall be provided.

The generator shall be constructed with the types of enclosure to IP21 comply with B.S. 4999 : Part 105, having Class F insulation or better.

The generator shall be complete with anti-condensation heaters which shall only operated when the set is shut down.

The generator shall be complete with termination box mounted on the side of the stator designed to accept flexible cable from below and with the neutral brought out.

Terminal identification shall comply with the requirement of B.S. 822 : Part 6. Terminals shall be fitted with compression type cable sockets and shall be housed in a suitably earthed metal enclosure, having provision for external flexible cable connections. Locking washers shall be provided on the terminals to ensure that connections will not loosen under normal working conditions. Termination details must be designed to suit the exhaust cables connection.

An automatic voltage regulation shall be provided to control the voltage between $\pm 1\frac{1}{2}\%$ from no-load to full load steady state.

Adjustment shall be provided at the control panels for presetting the speed frequency of the unit which thereafter shall maintain a frequency of 50Hz $\pm 1\%$ from no load to full load under steady state conditions.

Radio and television interference suppression shall be provided in accordance with the requirements of B.S. 800 and shall include screening as necessary for the suppression of radiated interference.

B1.3.6 Vibration Isolator

The generator set shall be mounted on a concrete plinth c/w antivibration device. The concrete plinth will be provided by Building Contractor. The vibration isolators shall be of spring type.

The numbers and locations of the isolators shall be in accordance with the generator manufacturer's recommendation.

The isolators shall be capable of 40mm minimum static deflection.

Vertical limit stops shall be included to prevent spring extension when weight is removed. The installed and operating heights shall be the same.

Aluminium clearance of 12mm shall be maintained around restraining bolts so as not to interfere with the spring action.

Limit stops shall be out of contact during normal operations.

B1.3.7 Exhaust Silencers and Flue

i. Flue

Stainless steel flexible bellows connectors and adapter, sized to match the engine and exhaust silencer, shall be provided for installation between the engine and the associated silencer.

A flue pipe shall be of steel complete with flexible bellows connectors, all adequately sized, shall be connected beyond the silencer to discharge the flue to location as shown on the Drawings.

The entire system shall be insulated with glass fibre blanket wrapped on galvanized metal mesh and supported on 25mm mild steel air spacing stool strips such that a 25mm air gap is maintained around the flue.

ii. Exhaust Silencer

The generator exhaust shall be fitted with primary and secondary silencers.

The primary silencer shall be of the reactive (residential) pattern and the secondary of the absorption type. To avoid breakout to surrounding areas, both primary and secondary silencers shall be fitted within the generator room.

The Contractor shall provide and install soundproof and acoustics enclosures for the generator set.

The soundproof and acoustics enclosures for the generator set shall be installed in accordance with the manufacturer's instructions.

The Contractor shall ensure that the sound level measure from the acoustic enclosure of the generator set during operation of the generator set shall comply with EPD requirements.

The external face of the acoustic linings shall have a flameproof scrim to prevent fibre-fly and shall be further restrained by 13 x 13mm galvanized metal mesh covering the whole internal surface and secured by rivets to the g.s.s. sections where they are folded flush to the external face of the lining.

All filter media sound absorbent linings and insulating materials shall comply with Hong Kong Government requirement.

Flameproof material shall specifically comply with HKFSD requirement.

B1.3.8 Fuel System

A complete fuel storage and distribution system shall be provided and installed by the Contractor as indicated on the Drawings. The Contractor shall install oil supply pipework from the main storage tank via the oil pump to the service tank, and from the service tank to the generator set. The system shall operate on fuel oil conforming to Class A1, B.S.

2869 : Part 1.

The Installation shall be of the form generally as shown, but the Contractor shall note the following:

- a) Notwithstanding any description or detail (implied or otherwise) specified herein, the Contractor shall ensure that the final installation complies with all necessary requirements of F.S.D. (Dangerous Goods Section) and any other relevant regulations to enable the installation to be operated.
- b) The written approval of the F.S.D. and Architect shall be obtained by the Contractor before any site work is commenced.
- c) The oil storage and distribution system shall be deemed to include all those works necessary for the efficient operation for the Generator System. Should the static head provided by the daily fuel tank be insufficient for the generator selected, then the Contractor shall include for the necessary run and standby circulation pumps.
- d) The Contractor shall supply and install all dura steel enclosure for the oil pipe where and when as required by F.S.D. the sand in the enclosure and other oil pipe duct shall be by Contractor.

The tanks shall be fabricated from high quality mild steel plate of 5mm thick, and free from imperfections and sufficiently braced with steel sections to ensure complete rigidity and freedom from deformation during installation and subsequent operation. Each tank shall be suitably stayed and braced as necessary and tested to 1.5 times the static pressure in accordance with B.S. 799 : Part 5.

Before the tank is installed, all rust and scale shall be removed from the external surface immediately before applying one coat of red lead to B.S. 2523. Type 'B' followed by two coats of bituminous paint. Where damage is sustained to the protective coating due to handling, etc., such coating shall be made good.

The tank shall be provided with an access manhole of adequate size and a means of measuring the contents in the form of dipstick. The dipstick shall be manufactured of a non-ferrous material and accurately calibrated. A 6mm thick disc shall be welded to the tank bottom immediately beneath the dip pipe to prevent damage to the tank.

In addition to the dipstick, the contents of the tank shall be measured by a suitable direct reading gauge positioned on the tank.

The tank shall be provided with all necessary fill, feed, vent and drain connections.

The tank shall be provided with a suitable level switch to control the oil feeding from the bulk storage tank. The Contractor shall provide solenoid valves and all wiring necessary to effect the control. Solenoid valves if used shall operate with D.C. coils.

The bulk storage tank shall have a fill-in point provided on the outside wall, installed and labelled strictly in accordance with the F.S.D. requirements.

The bulk storage tank shall be completed with a location content gauge, and facilities for remote indication of this content gauge at the respectively oil pump control panel with an alarm for low level and high level.

The overflow from the tanks shall be completed in a manner acceptable by the F.S.D.

Drip trays complete with flow alarm sensors shall be provided underneath the daily tanks. The signals shall be connected to an alarm indicating panel and interface with the BMS.

The vent pipe shall discharge upwards in the open air where indicated on the Drawings. The upper end of the vent pipe shall be terminated with a flame trap of adequate construction to preclude the entry of birds, leaves, etc.

The feed pipework from daily work to the generator shall be embedded in the floor screed, where possible.

A dead-weight valve shall be installed where the feed line leaves the tank.

Fusible links in the generator room, and the emergency pull handles outside the generator room and the fuel tank room shall shut off the dead weight valves respectively in the event of fire.

All fuel pipework between pumps, tanks and generator shall be black mild steel seamless tube with minimum wall thickness of 6.3mm.

All pipework shall be coated with a bitumen compound and wrapped in polythene before being concealed.

All pipework shall be free from burrs, rust and scale and shall be thoroughly cleaned before installations. Open ends during the progress of work shall be blanked –off with purpose made metal or plastic caps and the use of wooden plugs, paper, cotton waste etc., is forbidden.

Suspended pipework must be positioned as close to slab soffits as possible, whilst maintaining required falls.

Vertical stacks must be positioned as hard against walls, columns. All fuel pipe running outside the bulk storage tank room and the generator room on shall be enclosed with sand fill to the HKFSD requirements, Sand Filling and fire rated enclosures shall be by others.

All pipes shall be rigidly fixed with suitable brackets at 1m interval.

The exact fuel pipe route shall be approved by the Architect before installation.

All pipes shall be properly painted with two coats of primer and two coats of final finish with colour to be approved.

A quick closing valve, labelled and painted red, shall be installed in the fuel supply pipe on the generator room side. The valve shall be located in an easily accessible location.

On completion of the fuel pipe installation, all oil fuel pipework shall be X-rayed for acceptance at the joints and pressure tested to 2.5 times working pressure of the system.

Following commissioning of the installation, the Contractor shall supply and fill the tank to its rated capacity with fuel oil. This oil shall be used for testing and initial running of the plant and the Contractor shall refill the tank once again before handing over the system.

B1.3.9 Engine Starter Motor and Control

The generator set shall be equipped with an engine starter motor which shall be suitable for 24V D.C. operation, complete with manual and automatic starting and starter cut-out switch as described herein.

The engine starting control equipment shall be arranged to disconnect the mains operated battery charger to prevent its being overloaded during starting.

The starter motor shall be of adequate power for its duty and of "non-hold-on" type in which the pinion is moved axially to engage with a gear-ring on the engine flywheel before the starter motor is fully energized. The pinion shall positively disengage when the engine starter or when the motor is de-energised.

The starting equipment shall incorporate a fail-to-start device for automatically disconnecting the starter motor if the engine fails to start within a pre-determined time, say 15 seconds, so as to avoid undue discharge of the batteries.

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B1.3.10 Starting Battery and Charger

A 24 volt D.C. engine starting battery set of nickel-cadmium type of adequate ampere hour capacity and discharge rate shall be mounted adjacent to the engine underbase. The battery shall comply with BS 6115 and be capable of providing six (6) consecutive starts with a ten seconds interval between in one minute, without being discharged to a level where damage may be caused to the battery as advised by the manufacturer. The battery shall be housed in a corrosion resisting container of an approved type.

The battery charger shall be constant potential type, complete with D.C. voltmeter and ammeter, surge suppressor, controls, float and boost charging selection, battery discharging indication, protection against over-charging and indication, charger failure alarm. All controls and sensors shall be wired to the set mounted control panel.

B1.3.11 Control and Protection

Control cubicle shall be provided for the generating plant. All control and protective devices shall be housed in the control cubicle.

The control cubicle shall be free standing type and shall be constructed of materials capable of withstanding the mechanical vibrational, electrical and thermal stresses, as well as the effects of humidity and temperature, which are likely to be encountered in normal service.

The engine shall be provided with the following protective devices and control as a minimum to effect early warning and / or shut down in the event of:

- low lubricating oil pressure
- high engine coolant temperature
- low coolant level
- engine overspeed
- engine overcrank
- low fuel level

The engine protection shall be in two stages; it shall give a visual and audible warnings at an initial stage and shall shut down the engine when reaching a pre-determined danger level.

All visual alarms, audible and the associated muting switches shall be wired to the control panel.

The generating set shall be provided with a key operated protection over-ride switch. The generator set shall be kept running as long as possible irrespective of faults occurring upon actuation of the key-switch.

The engine shall be provided with control devices to govern the speed and regulate the voltage. The speed of the engine shall be adjusted by an electronic speed sensing governor which shall be to B.S. 5514 : Part 4, Type 1, Class A1.

Overspeed protection shall be fitted and shall trip the running set automatically at 110% of the rated speed.

The speed shall normally be preset to ensure rated frequency at full load.

Provision shall be made for the manual adjustment of speed within the range of plus or minus 5% under all load conditions.

An automatic voltage regulation system shall be provided to adjust the output voltage at any level within the design parameters.

The performance of the voltage regulation system of the generator shall be of Grade VR2.33 as specified in BS 4999 : Part 140.

The control cubicle shall furnish with Busbar complete with full neutral circuit breaker with adjust trips for generator overcurrent, reverse power relays, control and all necessary relays and dry contact to provide for remote indication and control. The cubicle shall also finish with various meters and indications to monitor the frequency, power factor, hour running, A.C. voltage, A.C. current etc. of the generator and meters to monitor the battery voltage.

The control cubicle shall contain but not be limited to the followings:

a) Meters

- KW meter
- Frequency meter
- power factor meter
- hours run meter
- A.C. voltmeter with phase selector switch, to monitor generator output voltage
- A.C. ammeter with phase selector switch and current transformers, to monitor generator output current
- D.C. voltmeter to monitor battery voltage
- D.C. ammeter to monitor charging current

b) Push buttons

- engine start push button
- engine stop push button
- system reset push button
- push button to simulate mains failure

c) Red indicating lights with audible alarm

- breaker overcurrent trip
- breaker reverse power trip
- engine overcrank lockout
- engine overspeed shutdown
- engine fail-to-start
- low fuel level
- low lubricating oil pressure
- high coolant temperature
- battery system fail

d) Indication lights without audible alarm

- Read lights:
breaker closed
engine control in auto mode
engine control in manual mode
low coolant temperature
high battery voltage
high fuel voltage
battery discharging
- Green lights:
breaker open
generator on load
main supply available
- Amber lights:
breaker charged
breaker trip circuit healthy

e) Other control devices

- lamp test button
- frequency present device
- voltage preset device engine starting control
- battery charger and associated equipment
- solid state automatic voltage regulator
- "manual-auto" rotary control switch
- audible alarm and muting switch
- all necessary relays and dry contacts to provide for remote indications, engine starting and engine shutdown, generator protection override, etc.

B1.3.12 System Operation and Performance

A. Automatic Operation

A voltage sensitive relay shall be provided within the control panel to monitor the mains voltage condition of the LV switchboard.

Failure of one or more phase of mains supply or a reduction of voltage to 70% of nominal for a duration exceeding 1 second shall initiate the starting programme, causing the generating set to start, accelerate to rated speed and build up to rated voltage.

Should the generator fails to start, a further attempt to start shall then be made. If it again fails to start, the starting sequence shall be locked out, an audible and visual alarm shall be given locally and at the Fire Control Panel, and it shall remain in this locked out condition until manually reset.

Restoration of the normal mains supply during the starting period shall not interrupt the starting sequence but shall prevent the load transfer command from functioning.

When the generating set reaches its rated frequency and voltage, a signal shall be initiated to operate the automatic changeover switches and deliver the power to essential busbars within 15 seconds.

Upon restoration of the mains power supply which as been determined stable, all loads shall be switched back to the mains. The generating set shall run unloaded for a short cool-down period of 0-15 minutes adjustable, and then shut down, the emergency power system circuitry shall then automatically rest and remain in readiness for the next mains power failure.

B. Manual Operation

The control panel shall also be equipped with an "Auto/Manual" rotary control switch. The System shall operate as described above in "Auto" selection and shall, on all automatic controls and shall hold the existing status of the system until controls are effected.

The generating set shall be able to start manually, by control switches located on the control panel. Once started and stable, the generator can be manually connected to the switchboard.

During the whole of the manual starting sequence, all the loads shall not be transferred to the generator as long as the mains power remains available. However, upon actuation of a series of push buttons, load can be transferred to the generator sequentially or removed from the generator sequentially.

C. Interfacing

I. Electrical Interfacing

The Contractor shall be responsible for providing the necessary indication and control signals to allow for the effective operation of the standby generating plant as described under relevant Clause the Specification.

The tendered price shall be deemed to include for all the N.O. and N.C. dry contacts and associated relays for various functions mentioned hereunder to give a satisfactory operation:

- set ready to take load
- 3 phase mains voltage signal to sense the voltage conditions at the main busbars

II. Lift Interfacing

Main supply failure and generator supply available signals in the form of dry contact (N.O.) shall be provided inside each lift machine rooms by this Contract. All signal cables, conduit, trunking, cable tray and the termination box in the control room shall also be included in this contract. The Lift Contractor will pick up the signals thereon.

B1.3.13 Earthing

An earthing terminal shall be provided in the Generator Room for the earthing of the standby generating plant.

The generator frame, generator neutral, fuel tank, generator switchboard, cable trays, etc. shall be individually connected to the earth terminal. The size of the protective conductors shall not be less than 3mm x 25mm.

B1.3.14 Testing

Test shall be carried out on the major components of the plant during manufacture, and certified records in guarduplicate of all such tests shall be submitted. The completed and fully assembled set shall be tested at the manufacturer's works before dispatch, including governor trails, transient response, temperature rise test and fuel consumption test in accordance with B.S. 5514 : Part 3, 4 and 5 and B.S. 5000 : Part 99.

The Contractor shall also take measurements on noise output of the generator for compliance of specification at no load and full load conditions.

On completion of the installation of the completed plant on site and with all cabling and piping connected, site tests shall be carried out and shall include the following.

Series of test starts and checks on ability to take up the load within the specified time:

- Functional check of all devices.
- Check that speed variation is within specified limits.
- Six hour full load run and fuel consumption check.
- One hour 10% overload test.
- Temperature rise (compliance with B.S. 5000).
- Voltage regulation.
- High voltage test (B.S. 5000).
- Fuel pump control and alarm indication.
- Fuel oil leakage test.

All tanks shall be subject to an internal air pressure of 2 bar under the supervision of the Architect and the pressure maintained for 24 hours.

All fuel oil pipe joints shall be X-ray tested and test certificate submitted.

Each section of pipeline shall be tested to 2.5 time working pressure for a period of four hours.

The Contractor shall provide enough full and lubricating oil to carry out the tests as specified above.

The site tests shall be conducted to satisfaction of the Architect.

B.1.4 Sub-Circuit Distribution System

B1.4.1 General

a) Scope

This Section specifies the general requirements of low voltage switchgear and associated equipments which are intended for assembly on site from individual items of components.

The component equipment covered in this Section shall include the following:

- (1) Switches, disconnectors (isolators), fuse-switches and switch-fuses
- (2) Circuit-breakers comprising air circuit-breakers (ACBs), moulded case circuit-breakers (MCCBs), miniature circuit-breakers (MCBs) and residual current-operated circuit breakers (RCCBs)
- (3) Fuses
- (4) Busbar chambers, and distribution boards including consumer units and fuseboards
- (5) Starters and contractors

b) Services Condition

The following service conditions shall apply

- (1) Ambient temperature – peak from minus 12 degree C to plus 40 degree C for 4 hours continuously with an average from minus -5 degree C to plus 35 degree C over only 24 hour period
- (2) Altitude – up to 2000m above sea level
- (3) Relative humidity – up to 0.99 saturation

c) Short-circuit Rating and Continuous Current Rating

Low voltage switchgear shall be suitably rated for the specified prospective short-circuit current which can occur at the point of its installation. It shall also be rated for uninterrupted duty when carrying continuously the specified full load current. For non-automatic switching devices the rated short-time withstanding current shall be at least 20 times of the continuous current rating for 1 second.

Where equipment components are installed in enclosures, they shall be suitable for operation at the actual maximum temperature which will be reached within the enclosures under normal loaded conditions when the ambient temperature is 40 degree C.

d) Voltage Rating

Low voltage switchgear and associated equipment shall be suitable for use on 220V (single phase) or 380V (3 phase) 50Hz supply.

e) Degree of Protection for Enclosure

Enclosures for low voltage switchgear and associated equipment shall have an index of protection, of at least IP30 for indoor applications and of at least IP54 for outdoor applications.

f) Material

Unless otherwise specified, low voltage switchgear and associated equipment shall be of metalclad. All ferrous metal parts shall be galvanised or chrome plated unless the final finish has been painted or enamelled in the manufacturer's factory.

g) ON and OFF Indication

The design of a switching device shall incorporate some positive means to indicate clearly and the ON (or CLOSE) and the OFF (or OPEN) positions of the contacts. Indication of either position shall only occur when the ON or OFF position on every pole has been attained. Such indication shall be provided on the outside of the device and shall be prominently visible to an operator when the device is installed in the normal manner.

When the switching device is also used for isolation purpose, then an indication of the OFF position shall occur only when all contacts are also in the OFF position and the isolating distance between contacts in every pole has attained a clearance not less than those specified for isolators (disconnectors) according to BS EN 60947-3.

h) Identification of Circuit

Engraved labels or other means of identification shall be provided for every item of switchgear and associated equipment to indicate the purpose of the item. The labels shall either be fixed at the front cover of the equipment or at the inside surface of the hinged front cover.

For a split-busbar consumer unit, the labels shall identify all outgoing MCBs which are protected by on RCCB from those which are not.

B1.4.2 Switch, Fuse-switch and Switch-fuse

a) General

Switches and disconnectors shall comply with and be tested to BS EN 60947-3 and shall have air-break type contacts which are designed for uninterrupted duties. They shall be either three pole with switched neutral, triple-pole with neutral link, double-pole, or single pole with neutral link as specified, and shall each be fitted with earthing facilities. The neutral link and the earthing facilities shall form integral parts, and be located within same casing, of the equipment. All live parts shall be efficiently shrouded with insulate materials. Rotary switches or isolators shall not be used for circuits of 50A or above.

b) Operating Mechanism

Switches and disconnectors shall be of the quick-make and quick break type. The switch mechanism shall be of independent manual operation with suitable means such as accelerate springs.

For switches and disconnectors with switched neutral, the neutral pole shall open after phase pole contacts and shall close before or at the same time as the phase pole contacts.

c) Front Cover

Switches and disconnectors shall be constructed with an interlocked front cover so that it is not possible to gain access to the interior parts of the equipment when the contacts are in the CLOSE position. However, facilities shall be provided to allow the checking of contact alignments.

The fastening devices for the front cover shall be of captive type.

d) Mechanical and Electrical Endurance

The mechanical and electrical endurance of the switches and disconnectors shall be tested in accordance with BS EN 60947-3. The number of no-load operating cycles shall not be less than the values given in Table III of BS EN 60947-3 and the number of on-load operating cycles shall not be less than 1/20 of the corresponding number of no-load operating cycles.

e) Utilization Category

Switches shall be to utilization categories AC-22 for general applications and AC-23 for electrical motor circuits; unless otherwise specified.

f) Padlocking Facility

Switches and isolators shall be fitted with padlocking facilities so that they can be padlocked in either the ON or Off position.

B1.4.3 Circuit Breaker

a) Scope of Circuit Breaker

This sub-section covers the general requirements of ACBs, MCCBs and MCBs, RCCBs. Additional requirements relevant to a particular type of circuit-breakers shall be given in other clauses.

b) Number of Poles

Circuit-breakers shall be of triple-pole with switch neutral, three-pole, double-pole or single-pole, as specified, and shall have air-break contacts. All poles, except the neutral poles, shall be designed to have their contacts open or close simultaneously.

The neutral pole contacts shall open after the phase pole contacts and shall close before or at the same time as the phase pole contacts.

c) Operating Mechanism

The operating mechanism of a circuit-breaker shall be trip-free.

When an MCCB or MCB or RCCB trips opens its contacts, the operating toggle shall automatically resume the OFF or TRIPPED position.

d) Casing

The casing of an MCCB, and MCB or an RCCB shall be formed from an insulating material. The construction shall be capable of withstanding the appropriate rated short circuit current and reasonably rough use without fracture or distortion.

e) Current Rating

The rated current of a circuit-breaker shall be taken as that rated continuous current when the circuit breaker is installed in the enclosure together with other equipment if any under normal operating conditions as specified in the Particular Specification.

B1.4.4 Air Circuit Breaker (ACB)

a) General

ACBs shall be of triple-pole with switch neutral, or triple-pole with bolted neutral, as specified, fully metal clad with earth terminals. They shall be of horizontally withdrawable type.

ACBs shall comply with and be type tested to BS EN 60947-2.

Unless otherwise specified, all ACBs shall have built-in overload protection with IDMT characteristics.

b) Performance Characteristic

ACBs shall be certified, in accordance with BS EN 60947-2 to have the following performance characteristics:

- (1) Rated short-circuit breaking capacity – not less than 50kA
- (2) Rated short-circuit making capacity – not less than 105kA
- (3) Rated short-time withstand current – not less than 50kA for 1 second
- (4) Short-circuit performance category – P2

c) Closing and Tripping Operation

Unless otherwise specified, ACBs shall be suitable for independent manual operation utilizing energy stored in a spring. For automatic closing ACBs, the spring mechanism shall be wound by a universal motor fitted with limiting switches. In addition, the spring mechanism shall have manual charging facilities for emergency use.

Trip coil of 24V or 110V D.C. as specified shall be fitted where required for remote or relay tripping.

"Trip" push buttons shall be provided on the front plate of each ACB. These push buttons shall be direct acting mechanically.

When automatic closing is specified, the control circuit of the ACB shall be fitted with suitable auto-pumping devices.

d) Racking Gear

The ACB enclosure shall be fitted with a set of racking gear which shall lock the ACB to the runner rails in three distinct positions, i.e. CONNECTED, TEST and ISOLATED. The ACB can only be closed fully when it is in the CONNECTED positions. In the TEST position, it shall be possible to operate the ACB (for ACB with motorized charging spring only) to close and test the secondary and auxiliary contacts, but not the main contacts.

The racking gear shall consist of rollers fitted to the ACB frame. All parts shall be accurately aligned and adjusted so that the ACB can be moved freely along the runner rails within the enclosure between the two extreme positions, i.e. CONNECTED and ISOLATED. Facilities shall be provided to padlock the ACB in its CONNECTED, TEST and ISOLATED positions.

e) Indicator

Position-indicators and breaker-condition-indicators shall be provided. These indicators shall be arranged so as to be prominently visible when the ACB is in its normally installed position.

f) Interlocking Facility

Suitable interlocking facilities shall be provided such that:

- (1) the ACB cannot be plugged in or withdrawn when it has been closed;
- (2) the ACB cannot be closed until it is fully engaged in either the CONNECTED or the TEST position;
- (3) the ACB cannot be slowly closed except in the TEST or ISOLATED position;
- (4) it shall not be possible to initiate the closing action of the energy-stored spring mechanism until the spring has been fully charged.
- (5) Where key interlocking (e.g. Castell or Similar) is employed, tripping of a closed ACB shall not occur if an attempt is made to remove the trapped key from the mechanism.

g) Main Isolating Contact and Safety Shutter

The main isolating contacts shall be self-aligning and shall be protected by insulated barriers forming the safety shutter.

Two sets of safety shutters shall be provided for every ACB, one for the incoming terminals of the main isolating contacts and the other for the outgoing terminals, each set shall be capable of being operated individually.

When the ACB is not in the CONNECTED position, the safety shutters shall close automatically, screening off the main isolating contacts. When the ACB is being racked into the CONNECTED position, the safety shutters shall automatically open the insulation barriers, thereby allowing the entry of the movable isolating contacts but without lowering the degree of protection.

Safety shutters shall be fitted with properly designed and securely fixed warning labels. In addition, facilities shall be provided to padlock the safety shutters after the ACB has been withdrawn from the enclosure.

h) Contact

All contacts shall be self-aligning, provided with spring accelerated opening mechanism.

Main contacts shall be fitted with detachable arc chutes for each pole.

Sufficient auxiliary contacts shall be provided for connection of secondary wiring. These auxiliary contacts shall remain engaged when the ACB is in the TEST or CONNECTED position and shall be disengaged when the ACB is in the ISOLATED position.

All ACBs shall be fitted with the maximum number of auxiliary contacts as the manufacturer's standard provision. In any event not less than two pairs of normally-closed auxiliary switches and two pairs of normally-open auxiliary switches shall be provided. All auxiliary contacts and switches shall be wired to an easily accessible terminal strip for external connection.

Terminals for external connections of the secondary / auxiliary contacts and switches shall be of clamping yoke type for wires of minimum CSA of 1.5mm square. All terminals shall be clearly labelled to identify the functions of the circuits connected to the terminals.

Terminals for each ACB for secondary auxiliary contacts shall be separate from all other terminals by means of a spacer of 20mm width.

B1.4.5 Moulded Case Circuit Breaker (MCCB)

a) General

MCCBs shall be four-pole, triple-pole or double-pole. They shall be totally enclosed in a moulded casing.

MCCBs shall comply with and be type tested to BS EN 60947-2.

b) Operating Characteristic

MCCBs shall have thermal-magnetic tripping mechanism giving a fixed, stable, inverse time-current characteristic which cannot be adjustable on site. The operating characteristic shall be such that:

- (1) the time delay on overload tripping shall be inversely proportional to the overcurrents up to a threshold value of approximately 7 times the rated current;
- (2) there shall be no intentional time-delay on overcurrent tripping due to short-circuit or heavy overcurrents exceeding the threshold value.

The operating characteristics shall be calibrated at 40 degree C.

c) Performance Characteristic

MCCBs shall be certified to have the rated short circuit breaking capacity, according to BS EN 60947-2 with P1 performance category.

d) Shunt Trip Release

Where shunt release is specified, this shall operate correctly at all values of supply voltage between 70% and 120% of the nominal supply voltage under all operating conditions of the MCCB up to the rated short-circuit breaking capacity of this circuit breaker. MCCBs incorporating shunt release shall be provided with block terminals and shunt release lead cables.

B1.4.6 Miniature Circuit Breaker (MCB)

a) General

MCBs shall be of triple-pole or single-pole. They shall be totally enclosed in a moulded insulating case, designed for safe use by unskilled people and shall also be designed to be maintenance-free.

MCBs shall comply with and be type tested to BS 3871 : Part 1 and shall have a category of duty not less than M6.

b) Operating Characteristic

The operating mechanism of an MCB shall be thermal-magnetic, designed to give a fixed, stable, inverse time-current characteristic in accordance with Table 5 of BS 3871 : Part 1. The calibration temperature shall be 40 degree C.

c) Short Circuit Breaking Capacity

The rated short circuit breaking capacity shall be certified, in accordance with BS 3871 : Part 1.

d) Contact

Contacts of the MCBs shall be of non-weld type.

e) Locking Facility

MCBs shall be provided with facility for locking the operating toggle on either the ON or OFF position.

B1.4.7 Residual Current-operated Circuit Breaker (RCCB)

a) General

RCCBs shall be of double-pole or four-pole as specified, type-tested to BS 4293. Unless otherwise specified, the rated residual operating current shall be 30mA and the rated short circuit breaking capacity shall be as specified in the Particular Specification or the Drawings.

b) Operation

RCCBs shall be suitable for independent toggle operation. The automatic tripping operation shall be of the passive type, i.e. it shall not involve the amplification of the operating residual current and shall not be dependent on the supply voltage for successful operation.

Where integral overcurrent protection is required for an RCCB, the tripping characteristic shall be as specified for MCBs in relevant clause.

c) Test Devices

An integral test device shall be provided on the front of every RCCB to enable the automatic tripping operation to be tested. Operation of the test device shall create an "out-of-balance" condition simulating an earth fault.

B1.4.8 Fuse

a) General

Fuses shall comply with, and be tested to, the following British Standard Specifications, where appropriate:

- (1) BS 88 : Part 1 and 2 – Cartridge fuses for voltages up to and including 1000V a.c. and 1500V d.c.
- (2) BS 1361 – Cartridge fuses for a.c. circuits in domestic and similar premises
- (3) BS 1362 – General purpose fuse links for domestic and similar purposes (primarily for use in plugs)
- (4) BS 3036 – Semi-enclosed electric fuses (ratings up to 100A and 240V to earth)

b) Scope of Fuse

All reference to fuses shall include fuses forming part of a fuse-switch, a switch-fuse or a fuse board.

c) Fuse Carrier and Holder

Fuse carriers and fuse holders shall be constructed of ceramic porcelain or of plastic. Plastic units shall be unaffected by heat generated by an overloaded fuse or by a blown fuse. Fuse carriers shall be as designed that there is no risk of touching live parts when the fuse is being withdrawn.

The maximum rating of a fuse inserted in a fuse holder shall not be greater than the rating for which the holder is designed.

d) Semi-enclosed Fuse

Semi-enclosed fuses shall not be used unless specified by the Architect. In any case, a semi-enclosed fuse shall not be rated in excess of 30A.

Elements of a semi-enclosed fuse shall be provided in accordance with the manufacturer's instructions. In the absence of such instructions, the element shall be of plain or tinned copper wires having appropriate diameters as specified in the IEE Wiring Regulations.

e) Cartridge Fuse to BS 88 Part 1 & 2

Cartridge fuses to BS 88 : Part 1 and 2 shall have a fusing factor of class Q1 with a rated breaking capacity of 80kA. All dimensions shall be standardized in accordance with Table 2 of BS 88 : Part 2.

B1.4.9 Busbar Chamber

a) General

Busbar chambers shall comply with, and be tested to, BS 5486 : Part 1 and 2.

Busbar chambers with rated operational currents about 400A shall be type tested to a short time current capacity equivalent at least to that of the incoming switchgear and

type tested to the rated operational current.

b) Construction

A busbar chamber shall contain 4 sets of fully sized, hard drawn copper busbars electro-tinned and supported on epoxy resin or other approved insulators. The busbar chamber shall be totally enclosed and manufactured from sheet suitably rust-proofed and painted or hot dip galvanised. The front cover and end plates shall be removable and normally held in position by non-ferrous metal screws and shall be in accordance with IP41 to BS EN 60947-1.

c) Colour Identification of Busbar

Each busbar shall be coloured to indicate the phase to which it is connected. Colouring shall comprise a band of paint in one position on the busbar, but the busbar shall not be painted throughout its length.

d) Interconnection to Other Equipment

Items of switchgear or associated equipment shall be connected or jointed to a busbar chamber by means of properly designed connection flanges having similar material and finish of the busbar chamber, or by means of conduit couplers and bushes.

Interconnection cables between a busbar chamber and other items of switchgear or associated equipment shall be copper conductors and shall be sized in accordance with BS 5486 : Part 1 and 2 and the IEE Wiring Regulations.

B1.4.10 MCCB Distribution Board

a) General

The enclosure of an MCCB distribution board shall be constructed from sheet steel having a thickness of not less than 1.5mm, and shall be designed for indoor applications.

The design, construction and testing specifications of the distribution boards shall comply with relevant clauses of BS 5486 : Part 1.

b) Type of MCCB Distribution Board

MCCB distribution boards shall be of two types, viz Type A and Type B. Type A MCCB distribution boards shall be suitable for accommodating, in any combination, the double-pole and triple-pole MCCBs of 100A frame size. Type B MCCB distribution boards shall be suitable for accommodating triple-pole MCCBs of 225A frame size.

All MCCB distribution boards shall each be provided with a moulded-case isolating switch having a current rating not less than that of the supply side protective device. The moulded-case isolating switch shall meet the requirements of relevant sections.

c) Busbar

MCCB distribution boards shall be provided with vertical triple-pole and neutral copper busbars of rating not less than that of the supply side protective device subject to a minimum of 250A. The configuration of the busbars, busbar supports and busbar mounting arrangement shall be type tested to a short-time withstanding current of not less than 14kA in the case of type A boards or 22kA in the case of Type B boards for 0.2 second at a voltage of not less than 380 volts.

Outgoing MCCBs shall be mounted horizontally on both sides of the vertical busbars. The connection between the MCCBs and the phase busbars shall be by means of copper tapes and bolted joints.

B1.4.11 MCB Distribution Boards

a) General

The enclosure of an MCB distribution board shall be constructed from sheet steel having a thickness of not less than 1.5mm, and shall be designed for indoor applications.

The design and construction of all MCB Distribution boards shall comply with and be type tested to BS 5486 : Part 12.

b) Type of MCB Distribution Board

MCB distribution boards shall be of two types, viz Type I and Type II. Type I MCB distribution boards shall be suitable for accommodating single-pole MCBs only while Type II MCB distribution boards shall be suitable for accommodating, in any combination, single-pole and multi-pole MCBs.

All Type I MCB distribution boards shall each be provided with a moulded-case, double-pole incoming which disconnection having a current rating not less than of the supply side protective device. This incoming switch-disconnector shall meet the requirements of relevant section.

c) Busbar

Type I MCB distribution boards shall have single-pole and neutral busbars rated at not less than 100A. Type II MCB distribution boards shall have triple-pole and neutral busbars rated at not less than 200A. The configuration of the busbars, busbar supports and busbar mounting arrangement shall be type tested and certified to a short-time withstanding current of not less than 4.5kA for 0.2 second at a voltage of not less than outgoing MCBs shall be connected to busbars by means of bolted joints.

d) Method of Mounting

Type I MCB distribution boards shall be suitable for flush or surface mounting as specified. Flush mounting board shall be so arranged that the assembly is flush with the surface of the wall.

Type II MCB distribution boards shall be suitable for surface mounting only.

B1.4.12 Fuseboard

a) General

Fuseboards shall utilize cartridge fuses to BS 88 and BS 1361. The use of semi-enclosed fuses shall not be permitted.

Fuseboards shall comply with, and be type tested to, BS 5486 : Part 1.

b) Construction

Fuseboards shall be totally enclosed, constructed from sheet steel having a thickness of not less than 1.0mm. The front covers shall be hinged or screwed-on, and access

to the fuses for replacement shall only be possible after the front cover is opened or removed.

The overall dimensions of the fuseboards shall not exceed those given in Table VII of BS 5486 : Part 11.

c) Rating

Individual outgoing circuits shall have rated currents not exceeding 200A.

Fuseboards shall be type tested and certified to have a fused short circuit current of not less than 16.5 kA at a power factor of not exceeding 0.3 lagging.

d) Shrouding of Live Part

Fuseboards shall be fully shrouded so that:

- (1) additional circuits can be wired and connected in safety whilst the existing circuits remain alive and on load;
- (2) when the door of the fuseboard enclosure is open, there will be no possibility of accidental contact with any live parts whilst fuse carriers, etc are fitted into their bases and whilst any insulation barriers, etc are correctly fitted;
- (3) the fixed contacts of the fuse bases are screened to satisfy the requirements of IP20 of BS EN 60947-1 even when the fuse carriers are removed from their bases.

B1.4.13 Contactors

a) General

Contractors shall be electromagnetically controlled, double air-break, four-pole, triple-pole, double-pole or single-pole as required. They shall comply with and be tested to BS EN 60947-4-1.

b) Utilization Category

Unless otherwise specified, contractors shall be of utilization categories AC-1 for general application and AC-3 for motor circuits. Contactor of categories AC-3, shall be of both uninterrupted duty and intermittent duty Class 0.1 60% on-load factor.

c) Mechanical and Electrical Endurance

The mechanical and electrical endurance of the Contractors shall be tested in accordance with BS EN 60947-4-1. The mechanical endurance of the Contractors shall not be less than 0.1 million no-load operating cycles. Unless otherwise specified, the number of on-load operating cycles for categories AC-3, DC-2, DC-4 shall not be less than 1/20 of the number of no-load operating cycles corresponding to the mechanical endurance of the Contractor.

d) Contacts

Both the main and auxiliary contacts shall be rated for uninterrupted and intermittent duty. The main contacts of the contractors shall be silver or silver-faced.

e) Control Circuit

The rated control circuit voltage shall be the same as that of the main circuit, otherwise, it shall be 24V or 110V D.C. as specified.

f) Insulation

Insulation shall be of Class B as per BS 2757.

B1.4.14 Starter

a) General

Starters shall be air-break triple pole electromagnetic contactor type and shall comply with and be tested to BS EN 60947-4-1. Unless otherwise specified, each starter shall comprise an isolating device, a thermal overload protective device, main and auxiliary contacts, on / off controls and indications.

b) Utilization Category

Starters shall be of utilization categories AC-3 for general motor circuits and AC-4 for motor circuits with plugging facilities. Motor starters for AC-3 utilization category shall be of both uninterrupted duty and intermittent duty Class 0.1 60% on-load factor. Starters of category AC-4 shall be of intermittent duty Class 0.3 60% on-load factor.

c) Mechanical and Electrical Endurance

The mechanical and electrical endurance of the starters shall be tested in accordance with BS EN 60947-4-1. the mechanical endurance of the starters shall not be less than 0.1 million no-load operating cycles for category AC-3 starters and 0.3 million no-load operating cycles for category AC-4 starters. The number of on-load operating cycles for category AC-3 starters shall not be less than 1/20 of the number of no-load operating cycles corresponding to the mechanical endurance of the starters.

d) Thermal Overload Relay

Thermal overload relay shall be Type B compensated for ambient temperature of 40 degree C and have a setting range of 50% - 150% rated operational current.

e) Auxiliaries

For assisted start starters, timers shall be solid state plug-in type with 0-15 a setting. For star / delta and reversing starters, mechanical and electrical interlocks shall be fitted with the contactors.

B.1.5 Busbar Trunking Distribution System

B1.5.1 General

Busbar trunking systems shall be manufactured to BS 5486 : Part 2.

Accessories for the busbar trunking system such as bends, tees, feeder units and tap-off units shall be specially made to suit the busbar trunking system concerned by the same manufacturer.

B1.5.2 Busbar Casing

The casing of the busbar trunking system shall be rigidly constructed from galvanised sheet steel of not less than 1.2mm thick for the width or height of the casing not exceeding 100mm, and not less than 1.5mm thick for a width or height exceeding 100mm to withstand heavy mechanical loads and, without permanent distortion, the electrical, mechanical and thermal stresses caused by the rated short-time withstand current of the busbar trunking system. The casing shall be finished in enamel paint to a grey colour or

the nearest manufacturer's colour of standard production.

Facilities should be incorporated in the busbar casing to provide access to the busbars at regular intervals throughout the entire length. Removal of the cover for access facility should necessitate the use of tools.

B1.5.3 Busbar Insulation

The busbars shall be insulated from the busbar casing to maintain the clearances and creepage distances as specified in BS 5486 and BS EN 60439.

The insulation material shall be of heat-resistant, self-extinguishing, non-hygroscopic and high electrical and mechanical strengths to withstand the stresses under normal and short-circuit conditions.

B1.5.4 Busbar

Busbars shall be of high conductivity copper. The mean ohmic resistance of the busbar trunking system per meter length per phase, and the mean reactance of the trunking system per meter length per phase at rated frequency shall be stated by the manufacturer for each busbar trunking system.

The busbars shall be of adequate size to carry the rated current of the busbar trunking system continuously at ambient temperature of 40 degree C without exceeding the temperature-rise limit specified in BS 5486 : Part 1.

Neutral busbars shall have the same CSA as the phase busbars.

The joint part of the busbars, and contact part of the busbars in the event of plug-in busbar trunking systems, shall be electro-plated with tin or other approved materials.

B1.5.5 Joint in Busbar

Joints in busbars shall not cause any loss in mechanical strength, electrical continuity, current carrying capacity and short circuit capacity of the busbars compared with an unjointed busbar.

B1.5.6 Short-circuit Capacity

Unless otherwise specified by the Architect, all busbar trunking systems shall have an appropriate rated short-time withstanding current given below:

Current Rating of system	Minimum Short-time withstanding Current with short circuit protection by		
	HRC fuses to BS 88	Circuit Breakers to BS En 60947-2	Circuit Breakers to BS EN 60947-2 (with IDMT relays)
Up to and including 800A	22kA for 50ms	22kA for 200ms	22kA for 1s
Above 800A but up to and include 1500A	35kA for 50ms	35kA for 200ms	35kA for 1s
Above 1500A	50kA for 50ms	50kA for 200ms	50kA for 1s

B1.5.7 Expansion Unit

Expansion units shall be provided to take up the axial expansion or contraction of the busbar trunking system under normal service conditions. In particular, expansion units

shall be provided where both ends of the busbar trunking system are fixed or where the busbar trunking system is installed across a building expansion joint.

B1.5.8 Feeder Unit

A feeder unit shall be provided for each busbar trunking system for connection of incoming supply. The rated current and rated short-time withstand current of the feeder unit shall not be less than that of the busbar trunking system to which it is connected.

B1.5.9 Tap-off Unit

- a) Tap-off units shall be used for branch circuits taken off from the busbars. H.R.C. fuses to BS 88 or MCCBs to BS EN 60947-2 appropriate current ratings and short-circuit breaking capacities shall be provided as near as practically possible to the tapping position for protection of the branch circuits.
- b) Interconnecting conductors between the busbars and tap-off units shall have a current rating not less than that of the tap-off units. The temperature rise of interconnecting conductors under normal service conditions shall not exceed that of the busbars specified in the relevant clauses.
- c) Plug-in tap-off units shall be attached on the busbar casing and held in position by means of wing nuts or other quick fastening and quick releasing device. Mechanical interlocks shall be incorporated such that the tap-off unit cannot be inserted or removed from the busbar trunking unless it is in the switch OFF position.

B1.5.10 Fire Barrier

Fire barriers shall be incorporated in the busbar trunking system in positions where the trunking passes through structural walls, slabs and fire compartments.

B1.5.11 Busbar Trunking Accessories

Beds, tees and intersection units shall be specially designed and manufactured for the particular type of busbar system with which it is to be used. The casing shall be of same material it is to be used. The casing shall be of same material and finish as the busbar casing and shall have a cross-sectional area not less than that of the busbar casing. No loss in mechanical strength, electrical continuity, rated current and rated short-circuit capacity shall be caused due to insertion of bends or tees.

B1.5.12 Support of Busbar Trunking System

Busbar Trunking System shall be securely fixed to the building structure according to manufacturer's recommendations. For horizontal run of busbar trunking system the hanger support shall be suitable for heavy mechanical load, i.e. additional loads such as the weight of a person in addition to the normal mechanical loads of the busbar trunking system.

B1.5.13 Special Requirements for All-insulated Busbar Trunking System

The insulation material of the busbars shall be of at least class A (105 degree C) and it shall cover the entire length of the conductor except for joints and plug-in contacts.

Drilling of busbars for connection of cables will not be permitted.

Two sections of the busbar trunking shall be joined by connecting the joint-ends of the busbars in an interleaved manner. The contact pressure shall be maintained by insulated bolts inserted through the joint. The bolt shall either be torque-indicating or be tightened up by means of a torque wrench as recommended by the manufacturer.

Expansion units shall be provided for every 30m run of the busbar trunking unless otherwise specified by the Architect.

Supports for the busbar trunking system shall be by means of hangers and brackers supplied by same manufacturer as the busbar trunking system. Unless otherwise specified the hanger shall be spaced at intervals of not more than metres for horizontal mounting and 3 metres for vertical mounting. In addition, for vertical mounting, the busbar trunking system shall be supported on every floor.

B1.6 Cable duct and cable tray

B1.6.1 Cable duct

B1.6.1.1 Internal Barrier

- a) In every vertical duct, which is designed as totally enclosed without ventilation, internal barriers shall be provided to prevent the air at the top of the duct from attaining an excessively high temperature. The distance between adjacent barriers shall be the distance between floors. Where the floor distance exceeds 5 m, additional barriers shall be provided at an interval not exceeding 5m.

B1.6.1.2 Fire Barrier

- b) Where a cable duct passes through fire resistant structural elements, such as floor or wall designated as fire barriers, the opening thus formed shall be sealed with fire resistant materials having the same degree of fire resistance as the structural element. In addition, suitable internal fire barriers shall also be provided. An internal fire barrier may also serve as an internal barrier described in 1.6.1.1a.

B1.6.1.3 Steel Conduit Terminated at Duct

Steel conduits terminating at a duct shall each be securely fixed by means of conduit coupler and brass male bush.

B1.6.1.4 Sealing of Duct Entry to Building

After the cables have been installed, both the cables and the exposed duct end shall be sealed to form a gas, water and fire barrier. Open ends of spare ducts shall be closed with tapered hardwood plugs and then sealed similarly.

B1.6.2 Metal Cable Tray

a) Material for Tray

Material cable trays shall be perforated, formed from plain steel sheet complying with BS1449, and shall be hot-dipped galvanized after perforation. Cable trays shall have corrosion protection not lower than Class 2 to BS4678: Part 1, i.e. medium protection.

b) Dimension of Tray

Cable trays shall be the following dimensions:

<u>Nominal Width</u>	<u>Minimum Height of upstand</u>	<u>Nominal Thickness of Steel Sheet</u>
100 mm	12 mm	1.2 mm
150 mm	12 mm	1.2 mm
225 mm	12 mm	1.5 mm
300 mm	20 mm	1.5 mm
450 mm	20 mm	2.0 mm
600 mm	20 mm	2.0 mm

c) Bend Piece

Bend pieces shall be of the same material, thickness and finish as the main body of the cable tray and shall have an inner radius of 50mm and a straight length of 100mm at each end.

d) Perforation on Bend

No perforation shall be made in the circular portion of all bend pieces having a normal width of 150mm or 100mm. Perforation may be allowed in bend pieces having a nominal width of 225mm or above provided that the perforation is made along a line passing through the centre of curvature of the bend pieces and set an angle θ to the normal of the axis of the cable tray. The values of θ are tabulated below:

Nominal width of cable tray	Value of θ
255 mm and 300 mm	45 degree
450 mm and 600 mm	30 and 60 degree

e) Tee piece

Tee pieces shall be of the same material, thickness and finish as the main body of the cable tray. The distance measured between the point of inter-section and the end of the tee piece shall not be less than 100 mm.

f) Connection Between Adjacent Lengths of Tray

Connections between adjacent lengths of tray, tee or bend pieces, shall be made by butt joints and fixed by mushroom-head steel roofing bolts and nuts complying with BS1494: Part1.

The Connection shall be mechanically strong so that no relative movement between the two lengths can occur.

g) Cutting of Tray

Cable trays shall be cut along a line of plain metal only, i.e. they shall not be cut through the perforation. All out edges of the galvanized cable tray shall be prepared and treated with a cold galvanized paint.

h) Cable Tray Accessory

Manufacturer's standard items of accessories shall be used. Site fabrication of accessories shall only be allowed upon approval of the Architect and shall be kept to a minimum.

Where special sections are required, the material, thickness and finish shall be as specified for the standard items.

i) Hole in Tray

Holes cut in cable tray for the passage of cable shall be provided with grommets. Alternatively they shall be bushed or lined.

j) Space Behind Tray

A minimum clear space of 20 mm shall be left behind all cable trays.

k) Fixing of Tray

Cable trays shall be fixed securely to the walls, ceiling or other structure by means of mild steel hangers or brackets of adequate mechanical strength. The hangers or brackets shall be painted. Fixings for cable trays shall be disposed at regular intervals not exceeding 1.2 m and on both sides of, and at a distance not exceeding 255 mm from, a bend or intersection.

l) Fixing of Cable on Tray

Saddles for securing multi-core cables to the cable tray shall be made from PVC covered metal strip, and shall be shaped to the form of the cables to be secured. The saddles shall be fixed to the cable tray by means of corrosion resistant cheese-headed screws and nuts.

The shanks of the screws shall not protrude beyond the nuts by more than three threads. Where saddles exceed 150 mm in length, intermediate fixings shall be provided such that the maximum spacing between screws shall not exceed 150 mm.

Single-core cables shall be secured to the cable tray by clamps made of wood or other non-ferrous materials specially designed to suit the dimension of the cables. The clamp shall be secured to the cable tray by means of bolts, washers and nuts.

A continuous strip of 25 mm × 3 mm tinned copper tape shall be installed to the full length of the tray.

B1.7 Trunking and Conduit

B1.7.1 Wiring System in Trunking

a) Arrangement of Cables

Cables in each final circuit and/or in each sub-main shall be bunched and tied or clipped together.

b) Provision of Cable Retaining Bar and Cable Support

Trunking, which is installed in such a position that the cables would fall out when the cover is removed, shall be fitted with cable retaining bars or other suitable devices to prevent the cables from falling out.

Trunking installed in a vertical plane shall contain sufficient supporting services within the trunking to prevent strain on the cables due to the weight of the cables, and to prevent vertical moment of the cables.

c) Cable Capacity of Trunking

The number of cables put into a trunking shall be such that no damage is caused to the cables or the trunking. In determining the size of the trunking required for a particular installation, the "unit system" method as described in the Code of Practice for the Electricity (Wiring) Regulations.

For cables and trunking not included in the "Unit System" method, the number of cables to be enclosed in the trunking shall be such that the resulting space factor shall not exceed 45%.

d) Correction Factor for Grouping

Where more than three loaded conductors or more than one multi-core cables are enclosed in a common trunking, suitable correction factor for grouping, as recommended by the IEE Wiring Regulations, shall be applied in determining the size of the cables to be installed.

e) Segregation of Cables of Different Circuit Categories

Where a common trucking is used to accommodate cables for different circuit categories, they shall comply with the Code of Practice for the Electricity (Wiring) Regulations.

B1.7.2 Materials for trunking installation

a) General

Trunking and fittings shall be compatible to the requirements laid down in BS4678: Part 1 and shall be fabricated with sheet steel having a nominal thickness as indicated in Code of Practice for the Electricity (Wiring) Regulations.

Underfloor (duct) trucking shall be compatible to the requirements laid down in BS4678: Part 2 and shall be fabricated with sheet steel having nominal thickness of:

- not less than 1.2 mm for compartment width up to & including 100 mm;

- not less than 1.6 for compartment width over 100 mm; and
not less than 1.0 mm for partitions & connector material

Manufacturer's standard fittings such as tee or angle pieces, connectors etc. shall be used throughout unless prior approval has been obtained from the Architect.

b) Class of Protection against Corrosion

Trunking and fittings shall have at least Class 2 protection against corrosion in accordance with BS4678: Part 1 i.e. medium protection (e.g. electroplated zinc having a minimum thickness of zinc coating of 0.0025 mm plus stove enamel or air drying paint).

c) Construction

Steel trunking shall be of square or rectangular across section. One side of the trunking shall be removable or hinged. No projection from screw or other sharp object will be allowed inside the trunking.

Underfloor (duct) trunking shall be so designed and constructed as to permit the laying of the trunking on a structural floor without ingress of cement whilst the floor is screeded.

d) Connection between Lengths of Trunking

Connection between adjacent lengths of trunking, tee or angle pieces, accessories, etc. shall be made by means of butt joints. The two adjacent ends of trunking shall be fixed so that no relative movement can occur between them.

Connectors for underfloor (duct) trunkings shall also provide adequate mechanical strength.

Electrical continuity shall be achieved by means of connecting a copper tape of adequate size across the two adjacent ends of the trunking.

For underfloor (duct) trunking, such continuity bonding links shall be of such material so as to prevent electrolytic corrosion.

e) Trunking Cover

Trunking and fittings shall have removable or hinged covers extending over the entire length. The covers shall be of the same material and finish as those of the trunking body. Removable covers shall be held in position on the trunking either by the natural elasticity of the material of the cover (e.g. spring capped trunking) or by a means which shall form an integral part of the cover (e.g. retaining screws).

Bends, tee junctions, etc. shall also be fitted with removable or hinged covers.

f) Screw Used

Screws used for securing the cover or connector and for the fixing of trunking shall have ISO metric threads. They shall be of brass or steel and if of steel they shall be of zinc plated (electro-galvanized), Class B coating, to BS1706. Electro-brass plated screws or self tapping screws shall NOT be acceptable.

B1.7.3 Installation of Trunking System

a) General

Trunking shall be installed neatly on the surface of the walls, columns or beams and shall be truly vertical and horizontal.

b) Trunking Continuity

The trunking installation shall be mechanically and electrically continuous throughout, and efficiently earthed.

Electrical continuity should be achieved by means of connecting a protective conductor (copper tape) of adequate size across the two adjacent ends of the trunking.

c) Connection to Apparatus

Connection between trunking and apparatus shall be by a screwed coupler and brass male bush, or a standard flange coupling or an adaptor neck, fabricated or casted. Direct attachment of trunking to apparatus will only be permitted if cable entries are provided with smooth bore bushes or grommets and the return edge of the lid of the trunking is left intact.

d) Connection to Distribution Board

Where connection is made between trunking and a distribution board, the cable entry or entries shall be sized to accept all cables from all used and "spare" ways.

e) Fixing of Trunking

Individual pieces of trunking shall be independently supported by means of at least two fixed points per pieces. On straight runs supports for trunking shall be fixed at regular intervals with maximum spacings as given in Code of Practice for the Electricity (Wiring) Regulations. For runs with bends, supports shall be fixed as near to the bend as practicable.

Overhead trunking shall be suitably supported by means of mild steel hangers, brackets or other approved devices, so that no visible sag is observed when loaded with cables. These supports shall be painted with at least two coats of an approved anti-rust paint to prevent corrosion.

f) Cable through Trunking

Cables penetrating through trunking shall be protected by conduits except for PVC insulated and sheathed cables if such cables form part of a surface wiring system. In such case, the holes in the trunking, through which such cables penetrate, shall be fitted with suitable rubber grommets to or insulated bushes.

g) Fire Barrier

Whenever trunking passes through a fire resistant structural element, such as floor and wall, designated as fire barrier, the opening thus formed shall be sealed with approved type of fire resisting material according to the appropriate degree of fire protection required. In addition, suitable internal fire barriers shall also be provided to prevent the spread of fire or smoke through the trunking.

In vertical trunking installations, internal fire barriers shall be provided between floors or at intervals of 5 m apart, whichever is the less.

h) Prevention of Electrolytic Action

Whenever the trunking is installed in damp situations, or where the trunking is likely to be exposed to weather, the trunking shall be kept away from other metalwork with which electrolytic action is liable to set up.

i) Prevention of Ingress of Water

Every entry to the trunking shall be so placed as to prevent and/or to be protected against the ingress of water.

j) Trunking Crosses Expansion Joint

The trunking system shall be used which will allow for expansion & maintain earth continuity. The system used shall be approved by the Architect prior to be used.

B1.7.4 Trunking Tool and Workmanship

- a) Cutting in Trunking
Holes in trunking shall be drilled, punched or cut by ring saw. After cutting, burrs and sharp edges on the trunking shall be removed to prevent abrasion of cables.
- b) Making good of Damaged Coating
Where the protective coating on the trunking has been damaged after installation, such surface shall be painted with at least two coats of an approved anti-rust to prevent corrosion.

B1.7.5 Conduit System and Material

- a) Concealed Conduit System
Unless otherwise specified in the Particular Specification or on the Drawings, conduits shall be concealed within walls, floor slabs, false ceilings, or other suitable space.
- b) Surface Conduit System
Where surface conduits are specified, they shall be fixed by distance saddles, and shall run only in a vertical or horizontal direction.
- c) Minimum Size of Conduit
The minimum outside diameter of any conduit to be used shall be 20 mm. Where special situation demands, 16 mm conduit may be used subject to prior approval being obtained from the Architect.
- d) Steel Conduit
Steel conduits, except flexible conduits, shall be of heavy gauge, screwed, longitudinally welded. All conduits shall comply with BS4568: Part 1 Class 4.
- e) Flexible Steel Conduit
Flexible steel conduits and solid type brass adaptors shall comply with BS731: Part 1. In addition, where flexible conduits are exposed to weather or in damp situations, the conduits shall be of the metallic water tight pattern, PVC oversheathed and with a separate circuit protective conductor drawn into the conduit for each continuity.
- f) Conduit Fittings
All conduit fittings shall comply with BS4568: Part 2.

Adaptable boxes complete with covers shall be of cast iron, galvanized, or sheet steel having class 4 protection against corrosion in accordance with BS4568: Part 2. Unless otherwise specified, boxes of the preferred sizes only, as given in BS4568: Part 2, shall be used.

Circular boxes, dome covers and hook covers shall be of malleable cast iron, galvanized. Ceiling mounted boxes shall be of deep pattern type having an internal depth of not less than 60 mm.

Bushes and plugs shall be of brass.

Distance saddles shall be of cast iron, galvanized. The screws for fixing the saddles shall be of brass.

Solid or inspection tee-pieces or couplers or elbows shall NOT be used on any conduit installation.

- g) Metal Box for Accessory
Metal boxes for the enclosure of electrical accessories in conduit installation shall comply

with BS4662.

35 mm and 47 mm deep boxes shall be used to house accessories such as domestic switches, socket outlets, etc.

16 mm and 25 mm deep boxes may be used to house specially designed electrical accessories of shallow pattern subject to prior approval being obtained from the Architect.

h) Class of Protection against Corrosion

Steel conduits shall have Class 4 protection against corrosion in accordance with BS4568: Part 1, i.e. Heavy Protection both inside and outside (e.g. hot-dip zinc coating or sherardizing).

Steel conduit fittings shall have Class 4 protection in accordance with BS4568: Part2, i.e. Heavy protection both inside and outside (e.g. hot-dip zinc coating or sherardizing).

Metal boxes for the enclosure of electrical accessories shall have heavy protection both inside and outside in accordance with BS4662 (e.g. hot-dip galvanized coating or sherardizing).

B1.7.6 Conduit and Wiring installation

a) Conduit Continuity

The steel conduit installation shall be mechanically and electrically continuous throughout, and efficiently earthed and comply with BS31, BS6053, BS6099 Part 1.

Earth continuity of the conduit installation shall be tested before concreting of floors and walls and also on completion of the entire installation.

Where the circuit protective conductor is formed by the conduits, the terminal of the socket outlet shall be connected by a separate protective conductor, having the same CSA and type as the live conductors, to an earth terminal incorporated in the associated metal box or enclosure.

Flexible conduit shall not be used as a protective conductor and it should have a separate circuit protective conductor of adequate size for earth continuity.

b) Joint in Steel Conduits

Joint in steel conduits shall be made by means of a solid coupler into which the adjacent ends of the two conduits shall be inserted and screwed up tightly in order to make the conduit un mechanically and electrically continuous. Running couplings shall be avoided. In case where such a coupling cannot be avoided, the coupler shall be screwed up tightly onto the short threaded portion of one conduit, the threaded portion of which shall project approximately half way into the length of the coupler. The threaded portion of the mating conduit should also project approximately half way into the coupler. Electrical continuity should be ensured by tightening up a hexagon locknut against the coupler. Any exposed threads on either conduit shall be painted with at least two coats of anti- rust paint.

c) Provision of Adaptable Box

An adequate number of suitably sized adaptable boxes shall be provided in all conduct runs to enable cables to be drawn in easily and without damage. Adaptable boxes shall be provided immediately after every two bends, or after a bend plus a total maximum straight run of 10 m, or after a maximum straight run of 15 m.

Where an adaptable box is required for conduits installed in the floor screed, it shall be fitted in such a manner that the lid is covered by the same material as the remainder of

the floor, and shall remain accessible at all times.

d) Spacing between Conduits

Adjacent or parallel conduits cast in concrete shall be separated by a spacing of not less than 25 mm so as to allow concrete aggregate to pass and set between them.

e) Termination of Steel Conduits at Metal Casing

Where a steel conduit terminates at a metal casing, a coupler or a brass adaptor for flexible conduit together with a brass male bush shall be used. The brass male bush shall be screwed into the coupler or adaptor from the inside of the metal casing through a clearance hole drilled in the metal casing to suit the bush. Both the conduit and the bush shall be screwed tightly into the coupler or adaptor so as to grip the metal casing securely for mechanical and electrical continuity. Threads on the steel conduit shall be at least half the coupler length, and no threads on the metal casing shall be allowed. The connection between the flexible conduit and the adaptor shall be securely fixed and effectively watertight.

Where the metal casing is painted or enameled, the electrical continuity between the conduit and the casing shall be achieved by means of a separate protective conductor of adequate size connecting the conduit and the earth terminal inside the metal casing through a copper earthing placed between the bush and the metal casing. A copper earthing piece placed between the bush & the metal casing may be used as an earthing terminal of the conduit. Neither the paint nor the enamel shall be damaged or removed to achieve electrical continuity.

f) Conduit Bend

Conduit shall not be bent more than 90 degrees. The internal radius of the bend shall not be less than 2.5 times the outside diameter of the conduit.

g) Chase for Conduit

Chases for conduits to be concealed in walls columns or beams shall be vertical or horizontal.

h) Conduit Crossing Expansion Joint

Where a conduit crosses an expansion joint, special arrangement shall be made to allow relative movement to occur on either side of the expansion joint. A separate circuit protective conductor shall be installed to maintain an effective electrical continuity across the expansion joint. The circuit protective conductor shall have a cross-sectional area rated to suit the largest live conductors drawn into the conduits in accordance with the IEE Wiring Regulations.

i) Prevention of Ingress of Foreign Matters

During the building construction, all open ends of the conduit termination, which are liable to be filled with water, moisture or other foreign matters, shall be plugged with approved conduit stooping plugs; paper or rag materials shall NOT be allowed for this purpose. Conduit boxes in similar circumstances shall also be similarly plugged to prevent concrete or plaster from entering the boxes during the building construction.

j) Prevent of Accumulation of Water or Moisture

The conduits shall be so laid to prevent accumulation of condensed moisture in any part of the installation. Due care shall also be taken to prevent the ingress of water into the conduits from leakage in wall and ceiling of the building structure.

Approved type of sealant for the prevention of condensed moisture shall be applied to ceiling conduit outlets installed in a cool space subject to the influx of warm air.

k) Conduit laid Direct in Ground

Steel conduits laid direct in ground or buried in soil shall be painted with two coats of

bituminous paint before installation.

l) Fixing of Surface Mounted Box

In surface conduit installation, conduit boxes, adaptable boxes and metal boxes for accessories shall be securely fixed to walls, ceilings or other substantial parts of a structure by means of suitable brass screws correctly spaced. The fixing of these boxes shall be independent of the fixing of the associated conduits.

m) Fixing of Saddle

Galvanized distance saddles, for the support of surface conduits, shall be provided throughout the entire route at regular intervals. The spacing between adjacent saddles shall not be more than those given in Code of Practice for the Electricity (Wiring) Regulations.

Each bend of a surface conduit shall be supported by a saddle on either side of the bend, and the saddles shall be fixed as near to the bend as practicable.

Distance saddles shall be fixed with brass screws in Rawplugs or other approved method.

n) Conduit Installed Outdoors or in Damp Situation

Where conduits are installed outdoor or in damp situations all conduit fittings and conduit accessories, shall not be placed in contact with other metals with which they are liable to set up electrolytic action. In addition, where the conduit installation is subjected to weather, the conduit fittings and conduit accessories shall be provided with weatherproof sealant or other materials to ensure that the installation is completely weatherproof.

o) Swabbing Out of Conduit

Conduits shall be swabbed out and free from moisture before wiring work is commenced. The swabbing operation shall be carried out under the supervision of the authorized representative of the Architect. Only approved draw-in tape or steel wire of appropriate size and absorbent cloth shall be used.

p) Fire Barrier

Where conduits pass through fire resistant structural elements, such as walls and floors designated as fire barriers, the opening made shall be sealed according to the appropriate degree of fire resistance of the walls and floor. In addition, where conduits are installed in channels, ducts, ducting, trunking or shafts which pass through such elements, suitable internal fire-resistant barriers shall also be provided to prevent the spread of fire.

q) Identification

Conduits, where required to be distinguished from pipelines of other services, shall use orange the basic identification colour in compliance with BS1710.

r) Cable Capacity of Conduit

The number of cables drawn into a conduit shall be such that no damage will be caused to the cables or to the conduits during their installation.

In determining the size of the conduit, the "unit system" method is described in the Code of Practice for the Electricity (Wiring) Regulations.

s) Method of Drawing Cables into Conduit

Cables shall be drawn into a conduit by using approved draw-in tape or steel wire of the appropriate size. Under no circumstances shall the use of lubricants, e.g. grease, graphite, talc, etc., be permitted to assist in the drawing-in of the cables.

t) Segregation of Cables of Different Circuit Categories

Separate conduits shall be provided for cables of different circuit categories.

u) "Looping-in" Wiring System

Each conductor in a run shall be of one continuous length and wired on the "Loop-in" system. No joint in cable run will be allowed.

v) Number of Final Circuits in Conduit

A conduit serving final circuits direct from a distribution board or from an adaptable box used as a final distribution point shall contain one final circuit except in the case of lighting final circuit where two circuits with 1.5 mm square cables will be permitted in a 20 mm conduit. For 3 phase final circuits, a separate conduit shall be used for each circuit.

w) Grouping of Cables in Conduit

Where an adaptable box is used as the final distributing point, a number of final circuits may be grouped together between the distribution board and the adaptable box by means of conduits of appropriate diameter. All live conductors of the same a.c. circuits shall be drawn into the same conduit.

Correction factors for grouping, as recommended by the IEE Wiring Regulations, shall be applied in determining the size of cables to be installed.

x) Neutral Cable of Lighting Point

The neutral cable of a lighting final circuit shall be routed in the conduit direct to the lighting point and shall not pass through the switch box.

B1.7.7 Conduit Tool and Workmanship

a) Cutting of Hole

Holes in metal work for the termination of conduits shall be drilled on site with a twist drill of the correct size or by means of an approved hole cutting device.

b) Removal of Burr and Sharp Edge

Burrs and sharp edges are to be removed from the ends of conduits before they are installed.

c) Making Good of Damaged Coating

Where the protective coating on a steel conduit has been damaged after installation, such surface shall be painted with at least two coats of an approved anti-rust paint to prevent corrosion.

B1.7.8 Plastic Conduit or Plastic Trunking System

a) Application

Wiring systems with cables enclosed in plastic conduits or plastic trunking shall only be allowed when they are specified in the Particular Specification.

b) Rigid Plain PVC Conduit and Conduit Fitting

Rigid plain PVC conduits and conduit fittings shall comply with BS4607: Part 1 and 2 and BS6099: Part 1 and 2. Conduit shall be type 'A', i.e. they shall be suitable for installation, storage or transport at temperatures not normally below minus 5 degree C. (Couplers shall be of the slip-type).

c) Pliable Conduit

Pliable conduits shall be formed of self extinguishing plastic material and shall comply with BS4607: Part 3, classification type A. Conduits may be corrugated, plain, or re-inforced. Pliable conduits shall not be used in situations where they would be subjected to continuous flexing.

d) Plastic Box

Adaptable boxes and boxes for the enclosure of electrical accessories shall be made from

insulating materials and shall comply with BS4662. The Dimensions of the plastic boxes shall be such that they can be interchangeable with steel boxes. The minimum wall thickness of boxes shall be 2 mm.

Boxes for the suspension of luminaires or other equipment, where considerable heat will be produced, shall be fitted with steel insert clips. Plastic boxes shall not be used in situations where the temperature of the box is likely to exceed 60 degree C or where the mass suspended from the box exceeds 3 kg.

e) Conduit Bend

Conduit bends shall have an internal radius of at least 4 times the outside diameter of the conduit.

f) Bending, Jointing and Terminating of Conduit

The method of carrying out the conduit bends, conduit joints, fixing conduits to boxes without spouts, and the tools and materials to be used shall be as recommended by the manufacturer of the conduits.

g) Trunking and Fitting

Trunking of sizes up to 100 × 100 mm shall have covers of the clip-on type. Larger sizes shall have covers secured by special plastic rivets.

h) Fixing of Trunking

The trunking shall be fixed and supported in the normal way by screws, but the holes in the trunking are away made oversize to allow for the movement of expansion. Washers shall be used under the head of the screw which should not be tightened to its full extent. The spacing between adjacent supports for trunking shall be larger than those given in Code of Practice for the Electricity (Wiring) Regulations.

i) Earthing

A PVC insulated cable shall be drawn into the conduit or trunking system to serve as the circuit protective conductor (CPC), the cross-sectional area of which shall comply with the IEE wiring Regulations for the site of the largest live conductors enclosed. Where the PVC conduit system is made between metal conduit system, the earthing connection should be made at the steel conduit/trunking and at the nearest boxes with proper terminals.

j) Allowance for Thermal Expansion

The allowance shall be made for the expansion of the PVC tubing at high temperatures. Expansion coupling or other fittings shall be included in a straight run of 8 m or more. Saddles or clips shall be of sliding fit.

B1.8 Power Cable

B1.8.1 General

This Section covers the supply, installation, testing and commissioning of all the cabling work in accordance with the Specification and the Drawings. Cables manufactured in UK will only be accepted.

B1.8.2 PVC Insulated Steel Wire Armoured Cable

- a) The cable shall be 600V/1000V grade complying to BS6346 multi-core with each conductor of the same cross sectional area. The cores of cables shall be high annealed copper conductors complying with BS6360. The PVC insulated cores shall be sheathed with PVC which shall serve as a bedding for the galvanized steel single-wire armouring. The armouring shall be covered with an outer PVC sheath complying with the requirements for Type 1 compound as specified in BS6746.

b) Identification of Core

Each core of a power cable shall be identified continuously throughout its entire length. The identification shall take the form of appropriate colour or number codes in accordance with the Code of the Practice for the Electricity (Wiring) Regulations.

c) Size of Neutral Conductor

The CSA of the neutral conductor shall have the same size as that of the phase conductors, unless otherwise specified.

d) Bending Radius of Cable

The internal bending radius of every power cable shall not be less than 6 times O.D. of cable.

e) Cable Mounted on Surfaces

Power cables mounted on the surface of walls or ceilings or other building structures shall either be cleated in position by approved type cable cleats or cable saddles. Cable cleats or cable saddles shall be provided along the entire cable route at regular intervals as shown below. Alternatively, the cables shall be supported on cable trays in accordance the requirements of relevant section.

For vertical cable runs exceeding 100 m, tension releasing sections shall be provided in accordance with the recommendation of the cable manufacturer.

Overall Dia. of cable (mm)	Max. Spacing of clips (m)	
	Horizontal	Vertical
1. Exceeding 9 but not exceeding 15	0.35	0.45
2. Exceeding 15 but not exceeding 20	0.40	0.55
3. Exceeding 20 but not exceeding 40	0.45	0.60

f) Cable laid in Enclosed Trench

When more than one power cables are laid in an enclosed trench, the cables shall be spaced in accordance with the latest edition of IEE Wiring Regulations. Correction factors shall be applied to the current ratings as indicated in the above said Wiring Regulations.

g) Cable Enclosed in Duct

Power cables installed in ducts shall conform to the provisions of relevant sections. Prior to the drawing-in of the cables, the cylindrical ducts shall be cleaned with a cylindrical brush of appropriate size.

Attachment to facilitate the pulling of cables through a duct shall be made to the cores, insulation, inner and outer sheath and not to the armour in order to avoid twisting. Attachment to the armour will only be permitted for small cables with the approval of the Architect. When pulling power cables into small ducts, an emulsion of graphite powder and soft soap in water may be used for brushing onto the cable surfaces where they enter the duct to reduce friction during pulling. The use of 'French Chalk' or other methods will not be precluded provided that much materials or methods shall not damage the cables and that the prior approval of the Architect has been given.

h) Cable Buried Direct in Ground

Power cables buried direct in ground shall be armoured. They shall be buried at a depth of not less than 450 mm and shall be protected by means of approved cable cover tiles. The bottom of the trench shall be covered by a layer of sand or fine soil to a depth but less than the diameter of the cable before the cables are laid. On top of the cables, and after layer of sand or fine soil, to a depth of 100mm, shall again be provided. The sand or fine soil shall not be larger than 13 mm sieve. Particular care shall be taken to ensure that there shall be no pebbles or small stones in the bedding layer or after layer of the fine sand or soil. The cables shall then be covered, throughout the entire route, by cable cover tiles which shall be laid on top of the after layer.

i) Earth Continuity across Joint

A circuit protective conductor having adequate CSA and of same material as the phase conductors shall be installed and connected to maintain the effectiveness of the earth continuity across every cable joint.

j) Termination

The cables shall be terminated in a gland fitted with an armour clamp. Provision shall be arranged to enable a watertight seal to be made between the gland and inner PVC sheath. The gland body shall be provided with an internal conical sealing to receive the armour clamping cone and a clamping nut which shall secure the armour clamping cone firmly to the armour wires ensuring that the armour wires are tightly clamped between the armour cone and conical armour seating. The spigot on the gland body shall be threaded to suit standard conduit accessories. A PVC shroud shall be fitted to cover the body of the gland and the expose armour wires.

B1.8.3 PVC Insulated and PVC Sheathed Cable

General

PVC insulated and PVC sheathed non-flexible cables shall be used for surface wiring in fixed installations. The cables shall not be buried in concrete or plaster.

PVC insulated and PVC sheathed flexible cables or flexible cords shall be used for connection to apparatus, appliances or equipment viz an appropriate wiring accessory. Flexible cables or flexible cords shall not be used in fixed installation, except for final connection to a fixed equipment.

a) Type of cable

Cables shall be PVC insulated, PVC sheathed and non-armoured to BS6004 or BS6346 as appropriate.

b) Grade of Cable

PVC insulated, PVC sheathed cables having CSA of up to 35 mm square shall be 300/500v grade to BS6004.

PVC insulated. PVC sheathed cables having CSA of 50 mm square and above shall be 600/1000v grade to BS6346.

PVC insulated non-sheathed cables shall be 450/750v grade to BS6004.

c) Minimum Size of Live Conductor

Cables for circuits or ratings not exceeding 10A shall have CSA of not less than 1.5 mm square.

Cables for circuits rated at 15A and above shall have CSA not less than 2.5 mm square.

Flexible cables and flexible cords shall have CSA of not less than 0.75 mm square.

d) Circuit Protective Conductor (CPC)

Cables having CSA of 16 mm square and below used for single phase circuit shall be twin-core with integral CPC except where:

- (i) they are used in earth free situations, or
- (ii) they are used for extra low voltage circuits, or
- (iii) the CSA of the integral CPC cannot meet the requirement of the IEE Wiring Regulation.

Separate CPC shall be single core cables, PVC insulated and PVC sheathed, to BS6004 or

BS6346.

Tee connection in CPC shall not be allowed.

e) Minimum size of CPC

The minimum CSA of a CPC shall be 1.5 mm square if the CPC is incorporated in the same cables as the associated live conductors, otherwise the minimum CSA shall be 4 mm square.

f) Identification of Cable Core

For non-flexible cables, the phase conductors shall be coloured red or yellow or blue, as appropriate, and the neutral conductor shall be coloured black.

For flexible cables or flexible cords, the phase conductor shall be coloured brown, and the neutral conductor shall be coloured blue. Where there are more than one phase conductors in a flexible cable or flexible cords, the coding L1, L2 and L3 shall be used.

All circuit protective conductors shall be coloured exclusively in green-and-yellow.

g) Protection to Cable Susceptible to Damage

Cables susceptible to damage shall be protected by means of metal channels. Where protection is required for cables running up a wall from the floor, the metal channel shall be fixed to a minimum height of 1.5 m above finished floor level.

h) Cable Passing Through a Building Structure

Where cables pass through a building structure such as a wall or column, the cables shall be drawn through PVB sleeves inserted into the building structure. The size of the PVC sleeves shall be such that the space factor shall not exceed 45%.

i) Cable Crossing Expansion Joint

Cables crossing an expansion joint shall be formed into a loop such that any movement in the joint shall not stress the cables.

j) Cable Passing Through Metal Work

Rubber grommets or insulated bushed shall be used to protect the cables passing through metal part of a distribution board, a luminaire, a metal box or any other metal work.

k) Segregation from other Services

Cables shall be run at least 150 mm clear of all other non-electrical services.

l) "Looping-in" Wiring System

The cables shall be wired on the "looping-in" system. Cable joints of any type in cable runs shall not be allowed.

m) Neutral Conductor at Switch Position

The neutral conductor of a cable for lighting final circuit shall be looped through an insulated connector enclosed in the moulded box or pattress housing the switch.

n) Termination of Cable

Cables terminated at a moulded box or pattress, a luminaire or other fittings shall have the overall protective sheaths carried into the moulded box or pattress, luminaire or other fittings for a minimum of 13mm.

The circuit protective conductor shall be terminated at the earth terminal provided in the moulded box or pattress housing the wiring accessories.

Where it is not required to terminate the circuit protective conductor in an accessory, the

circuit protective conductor shall not be cut back or removed. Instead it shall be coiled away from the live terminals or any bare conductors and shall be insulated and sleeved with a green-and-yellow PVC sleeve.

o) Bending Radius of Cable

The internal bending radii of cables shall not be less than the values give below:

<u>Overall Diameter of Cable, D</u>	<u>Minimum Internal Radius of Cable</u>
Not exceeding 10 mm	30
Exceeding 10 mm but not exceeding 25 mm	40
Exceeding 25 mm	60

p) Fixing of Cable

Cables having an overall diameter not exceeding 10 mm shall be fixed by means of buckle clips. Cables of other diameters shall be fixed by means of cables saddles.

Where a number of cables running together on the surface of walls, columns, partitions or ceiling such that their aggregated width exceeds 50 mm, a 13 mm thick hard wood batten of adequate width shall be fixed along the cable route for mounting the cables. The hard wood batten shall be finished with one coat of approved priming on front and edges, and waterproof compound treated at the back. Lengths of the batten shall be properly fitted together and fixed in position by counter-sunk brass screws in rawplugs.

q) Fixing of Clip

Buckle clips shall be fixed to the surface of wall, column, partition or ceiling by pins secured to one plug inserted to a minimum depth of 20 mm. Where the buckle clips are fixed to plaster, concrete, etc. the plugs shall be made from teak dwelling of parallel length. The head of every pin shall be level with the surface of the clip so that no damage to the sheath of the fixed cables can occur.

Every hole in the buckle clip shall require a fixing pin.

A separate buckle clip shall be required for every cable of size above 2.5 mm square twin with CPC, or of equivalent size. Not more than two cables shall be allowed in one clip under all circumstances.

Buckle clips shall be provided along the entire cable route at regular intervals not exceed 250 mm on horizontal runs and 400 mm on vertical runs.

A clip shall also be provided at a distance not exceeding 75 mm from a termination and from both sides of a bend.

r) Fixing of Cable Saddle

Cable saddles shall be securely fixed by fixing screws. Saddles shall be provided along the entire cable route at regular intervals. The spacing between adjacent saddles shall not exceed the values given on the Table below.

<u>Overall Diameter of cable (mm)</u>	<u>Maximum Spacing</u>	
	<u>Horizontal Run</u>	<u>Vertical Run</u>
Not exceeding 20 mm	350 mm	450 mm
Exceeding 20 mm	400 mm	550 mm

A saddle shall also be provided at a distance not exceeding 150 mm from a termination and from both sides of a bend.

s) Correction Factor to Current Rating of Cable

Where more than two twin cables are fixed together, or when the cables are installed at

or in thermally insulated materials, etc., suitable correction factors, as recommended by the IEE Wiring Regulations, shall be applied in determining the size of the cables to be installed.

B1.8.4 Mineral-Insulated Copper Cables

a) Type of Cable

All mineral-insulated cables shall be copper sheathed with copper conductors complying with BS6207.

b) Grade of Cable

Unless otherwise specified, all mineral-insulated cables shall be of the following grade:-

- (i) For power supply to equipment – 1000v (heavy duty)
- (ii) For lighting and small power outlets – 600v (light duty)

c) Cable saddle and Clip

Saddles and clips for fixing mineral-insulated cables shall be of the type specially made by the cable manufacturer for this purpose. Where the cables are fitted with PVC outer covering, the saddles or clips used shall also have PVC covering.

d) Cable Route

Mineral-insulated cables shall be run neatly on the surface of the walls, columns, beams, or ceilings in a vertical or horizontal direction, and at least 150 mm clear of all plumbing and mechanical services. The use of conduit and/or cable trunking to enclose such cables shall be kept to the minimum.

e) Cable Support

Mineral-insulated cables shall be adequately supported by saddles which shall be of the same manufacturer as the cables. Saddles shall be provided through the entire cable route at regular intervals. Saddles shall also be provided at a distance not exceed 150 mm away from a termination and from both sides of a bend.

f) Bending Radius

The minimum internal bending radius for mineral-insulated cables shall be 6 times the overall diameter of the cable.

g) Cable Loop for Prevention of Vibrating

A loop shall be introduced in a cable immediately before its entry into the connected equipment which is subject to vibration or occasional movement. A clear space of at least 10 mm shall be maintained at the point in the loop where the cable passes over itself.

h) Cable Termination

The cable to be terminated shall be cut, screwed, sealed with cold compound and fitted with brass terminating glands, nuts, compression ring, gland body, sealing pot., disc and sleeves. The conductors shall be carried unbroken through the sealing pot to the terminal sockets or clamping screws.

The sealing shall be properly carried out to protect the cable ends from moisture and the insulation shall be thoroughly dry before the sealing is applied. The sealing material and any material used to insulate the conductors when they emerge from the insulation shall have adequate insulating and moisture-proofing properties and shall retain these properties throughout the range of temperature they may be subjected to in service.

Where a mineral insulated cable is terminated at an insulating casing or enameled / painted metal casing, the sealing pot shall be provided with a copper circuit protective conductor, complying with the requirements of BS6360.

Where more than one cable terminate at a galvanized or zinc coated enclosure, the gland

plate shall be of brass or insulating materials.

PVC shrouded terminating glands shall be used when the cables are fitted with PVC outer covering.

i) Insulation Resistance

The insulation resistance between the cores and between each core and the sheath shall be measured before the cable and is sealed. The measured resistance shall be infinity on a 500v insulation resistance tester. If the reading is less than infinity, the cable shall be heated by means of a blowlamp or similar device so that moisture is driven out to the open end of the cable and evaporated there. Heating shall be continued until the measured insulation resistance reaches infinity, and the sealing shall be applied without delay. The insulation resistance shall be measured when the cable end has been sealed, and shall be infinity.

For mineral-insulated cable with PVC outer covering, adequate length of the PVC outer covering shall be cut out in the event of low insulation resistance to achieve the required insulation resistance.

j) Identification of Core

The cores of the mineral-insulated cables shall be identifiable at their termination by the application of sleeves or discs of appropriate colours as prescribed below. Identification sleeves shall comply with BS3858, Type 3, where appropriate and shall have temperature rating similar to that of the seals.

- (i) For Protective Conductors: Green-and-Yellow.
- (ii) For Phase Conductors: Red or yellow or blue, as appropriate.
- (iii) For Neutral Conductors: Black.

k) Bonding of Cable Sheath to Metalwork

Where a mineral-insulated cable passes through or makes contact with any metal, the metal and cable sheath shall be effectively bonded together.

l) Use of Single-core Cable

Single-core mineral-insulated cables running together shall be laid with the cable sheaths in contact. Mineral-insulated cables for 3-phase circuits shall be laid in trefoil formation. Where the cables used are rated at 100A or above, gland plates of apparatus shall be of brass.

m) Protection from Mechanical Damage

The mineral-insulated cables shall be protected by steel conduits or steel sheathings where the cables are exposed in vulnerable positions. Where cables pass through floors, ceilings and walls, the holes shall be made good with cement or other non-combustible material and where pass through steelwork, the holes must be bushed.

B1.8.5 XLPE insulated Armoured Cables

a) General

Cable used shall be multi-core cross-linked polythene insulated, steel wire armoured with PVC oversheath (XLPE/ SWA/ PVC), comply to BS5467.

The insulated cores shall be sheathed with flame retardant, termite repellent XLPE insulation which shall serve as a bedding for galvanized single steel wire armouring. The armouring shall be covered with an outer flame retardant and termite repellent PVC oversheath.

The conductors shall be plain annealed stranded copper complying with BS6360 and screened by a layer of extruded semiconducting compound.

Galvanized steel wire armour shall be provided to protect from mechanical damage. Extruded layer of black PVC compound over-sheathing shall be applied overall to BS6746, Type 9 requirements.

The overload characteristics and short-circuit current rating of the cable shall comply with the relevant statutory requirements and also local authorities approval.

The PVC oversheath shall have flame retardant characteristic tested to BS4066. The PVC material shall contain approved anti-termite additives.

b) Cable installation

All cables shall be installed in accordance with the latest edition of IEE Wiring Regulations.

The Sub-contractor shall be responsible for off-loading and landing of the cables on site and that they shall be delivered on robust cable drums with cable ends treated to for an effective seal. When a cable is cut from a drum the cable end and the end left on the drum shall be immediately sealed in an approved manner to prevent the ingress of moisture.

Cable routes shall be agreed in detail with the Architect before any work is commenced.

All cables shall be installed in one continuous length between terminal points; intermediate joints will not be accepted.

Cabling within cable duct and draw-pits shall be carried out by means of normal hand running off the cable drum. Roller guides shall be used all through and be drawn through by hand. Cable winches shall not be employed without the approval of the Architect.

Drilling and fixing all supporting steel work, brackets, hangers, saddles, clamps and all other fixings necessary for the support of an approved type and of adequate strength for the cable(s) they are supporting and shall be hot dip galvanized to prevent corrosion.

Care shall be taken when installing cables to ensure that the temperature of each cable is raised above 5 degree C.

c) Labeling

All cables shall be provided with identification labels at each end of the cable, at entry and exit points of buried ducts, and in such other positions as are necessary to identify and trace the route of any cable. Where cables are not enclosed in ducts, and are of multiple runs, labels shall be provided at ten (10) metre intervals. Labels shall be manufactured from metal disc engraved to show the size of the cable, phase and the equipment being fed.

B1.9 Wiring Accessory

B1.9.1 Wiring Accessory

Wiring accessories shall meet the general requirements of BS5733. Unless otherwise specified, they shall be white or ivory in colour.

Lighting switches, socket outlets and switches for electrical appliances shall be designed for flush mounting. In surface cable installation, they shall be fixed onto moulded boxes or pattresses. In conduit installations, they shall be mounted in steel or cast iron surface type galvanized boxes. Where a waterproof or flameproof pattern is required, they shall be mounted as the particular circumstances demand.

Moulded boxes or pattresses and steel or cast iron boxes for the enclosure of wiring accessories shall comply with BS4662 and shall meet the requirements specified in 31.7 – 31.3 where appropriate.

B1.9.2 Domestic Switch

a) General

Switches for domestic and similar purposes shall comply with BS3676: Part1. They shall be mounted at a height of 1350 mm above finished floor level unless otherwise specified.

b) Lighting Switch

Lighting switches shall be of the microgap type suitable for used on a.c. circuits, and shall be of the quick make-and-break type when in d.c. circuits and comply with BS3676: Part 1. The front plate shall be of plastic insulating material. Suspension pear type switches shall not be permitted.

Lighting switches shall be single pole rated at 5A or 10A as specified on the Drawings.

When lighting switches are mounted adjacent to one another, they shall be grouped in a single enclosure (multigang box) and shall share a common switch plate, subject to a maximum of three lighting switches per single-gang plate.

Lighting switches, installed adjacent to a door shall be located on the handle side of the door and shall be as near to the door as practicable.

c) D.P. Switch for Appliance

Switches controlling appliances with heating elements or appliances permanently connected to the supply shall be of double pole type with an integral pilot light, and shall have a rating not smaller than the current capacity of the appliances being controlled. The front plate of each such switch shall be properly engraved.

The pilot light shall be formed by a neon lamp with resistor and a red coloured lens.

d) Sparkless Switch

Sparkless switch shall be of the tilting mercury type. The contacts of a sparkless switch shall be contained in a sealed glass capsule. The rating shall be as specified on the Drawings.

e) Time Switch

Time switches shall be of self-starting, self-winding driven by synchronous motor. They shall be of the plug-in type, and shall be housed in a metal enclosure provided with a removal cover of clear plastic material.

The time switches shall be suitable for operation at 200/250v, and the rated current shall be 20A unless otherwise specified.

Time switches shall incorporate the following features:

- (1) A spring reserve of not less than 30 hours to drive the mechanism during electricity supply interruptions;
- (2) An easily replaceable cartridge fuse-link complying with BS646 or BS2950, inserted in the motor circuit;
- (3) A day-omitting device to render the switch inoperative;
- (4) An ON-OFF manual switch to enable the circuit to be controlled at will without affecting normal dial operation;
- (5) A 24-hour dial with one ON and one OFF lever and a single pole, single throw, switch;
- (6) A solar dial suitable for Hong Kong climate, when specified.

f) Switch Exposed to Weather

Switches mounted outdoors, or in positions where they may be exposed to rain or water, shall have watertight enclosures with IP54.

B1.9.3 Socket Outlet

a) General

Socket outlets rated at 5A and 15A for general application shall comply with BS546. Socket outlets rated at 13A shall comply with BS1363. All socket outlets shall be of 3 pin, and shall be of the shuttered typed.

b) Integral Switch for Socket Outlet

Socket outlets used to supply appliances mounted at high level shall be unswitched, otherwise all socket outlets shall be fitted with an integral switch. The integral switch shall be of single pole, forming part of the same front plate as the socket outlet.

c) Weatherproof Socket Outlet

Weatherproof type socket outlets shall comply with BS4343 and BS EN 60309-2, provided with a push-on cap and cap retaining ring or a screw-on cap with rubber gasket. The socket outlets shall have a degree of protection of at least IP54.

d) Shaver Supply Unit

Electric shaver supply unit shall comply with BS3535: Part 1 and 2 and shall be all insulated, suitable for both flush and surface mounting. Each unit shall comprise two outlets one for 110V and the other at 220V obtained from a double wound transformer. The complete unit shall be enclosed in a galvanized metal box for flush mounting, or a cast iron or plastic surface box for surface mounting.

e) Socket Outlet on Surface Conduit Installation

In plant rooms and other places where surface conduits and accessories are installed, socket outlets shall be of metal clad, with B.M.A or bronze front plate.

f) Socket Outlet at Hazardous Areas

The installation of socket outlets in hazardous areas should be avoided as far as possible. Where it is absolutely essential to install a socket outlet in such area, the socket outlet shall comply with BS4343 and shall be controlled by a sparkles switch. The socket outlet shall be interlocked with the plug so that removal or insertion shall not be possible unless the controlling switch is in the OFF position. The plug shall have shrouded pin and the design of the pin contacts shall be such as to guard against development of hot spots or sparking.

g) Socket Mounting Height

Unless otherwise specified socket outlets shall be mounted at a height of 1350 mm above finished floor level in kitchens, sculleries, ironing rooms and the like, and not at a height of 300 mm above finished floor level in other locations.

B1.9.4 Connection Unit

a) Fused Connector Box

Fused connector boxes are used for connecting clocks, fixed domestic fans etc. They shall be of the two-pole type with earthing facilities. The plugs shall incorporate in one of the poles connected to the phase conductor, a cartridge fuse link not exceeding 3A complying with BS1362 or BS646 as appropriate. The plug shall only be removed by the use of a tool.

b) Fused Spur Box

Fused spur boxes are intended for final connection to fixed equipment or appliances which have a full load current of not exceeding 13A. They shall be switched (double pole) type with neon indicator meeting the requirements of BS5733 and if appropriate and outlet for flexible cable. Each shall incorporate a fuse link to BS1362 rate to suit the appliance to be fed. An earth terminal shall also be provided for the connection of the CPC to the appliance.

B1.9.5 Insulated Terminal Block

The rated voltage of terminal blocks shall not be less than 435V between terminals and 250V to earth.

Terminal blocks shall comprise brass connectors with screw connections, all contained within a moulded block suitable for working temperatures up to 100 degree C.

Terminals shall be designed to clamp the conductor between metal surface with sufficient contact pressure but without causing damage to the conductors. With the largest recommended conductor in position, and tightly clamped, there shall be at least two full threads of the screw engaging in the connector.

B1.9.6 Lamp

a) Tungsten filament Lamp

Tungsten filament lamps complying with BS161 shall be internally frosted, and suitable for use on a 220V supply. They shall have single coil filaments for sizes up to 25W and coiled coil filaments above 25W. Lamps rated up to 200W shall have bayonet caps and those above 200W shall have Goliath Edison Screw caps.

b) Tubular Fluorescent Lamp

Tubular fluorescent lamps complying with BS1853: Part 1 shall have bi-pin caps and silicone coated glass envelopes, or shall be similarly treated so that a deposit of moisture on the tube will not prevent the arc from striking under starting conditions. They shall be either of the quick start pattern or switch start as specified.

c) Discharge Lamp

Discharge lamps shall comply with the BS3677 & BS3767 mercury vapour and metal halide lamps shall have fused silica discharge tubes whereas low pressure sodium lamp shall employ glass having an internal layer of a different glass resistant to sodium vapour. The discharge tube of a high pressure sodium lamp shall be made of translucent aluminium. Discharge lamps shall be started without heating the electrodes.

d) Lampholder

Batten lampholders complying with BS5042 shall be of the all-insulated bayonet socket pattern manufactured from moulded hard white or ivory colour plastic material which shall be unaffected by the heat from the lamp. They shall be fitted with a shade-carrier ring, a ventilated shield, or a white plastic cone as required. White moulded plastic break joint rings shall be used.

B1.10 Lighting Protection

B1.10.1 General

Lightning protection systems shall be installed in accordance with BS6651.

B1.10.2 Alternative 1

The lightning protection system shall comprise an air termination, and a network of interconnecting horizontal and down conductor copper tapes brazed to the individual and exclusive reinforcing steel to be supplied and installed by the Contractor in columns, earthing electrodes and associated equipment.

a) Horizontal Conductor

Horizontal conductors shall be of 25 × 3mm strips made of plain annealed copper strip to BS6360 Drawings.

Strip fixings shall be provided at intervals not exceeding 1.2m centres and shall consist of gunmetal spacers brackets.

b) Earth Termination

Unless otherwise specified, earth termination shall be of hard drawn copper rod electrodes of 16mm diameter and 4.3 long driven into the earth pit.

The whole of the lightning protective system shall have a combined resistance to earth not exceeding 10ohms.

c) Joint in Conductors

Joints in roof conductors shall be made by double riveting or by suitable tape clamps. When clamps are used, the tape clamps shall each be provided with at least 4 screws or bolts. All such joints shall be tinned and shall have negligible resistance and good mechanical strength.

B1.10.3 Alternatives 2

This section covers lightning protection systems applicable to buildings and similar structures. It does not cover the protection of overhead lines, and other specialized applications. The installation shall conform to the requirement and recommendation set out in the British Standard Code of Practice 326 "Protection of Structure against Lightning".

a) Type of Lightning Protection System

The complete system shall comprise air termination(s), mechanical support, down conductor(s) and earthing system to the following specification.

b) Air Termination

The air termination shall be of the type that enhances Photo-ionisation by creating repetitive arcing around the air termination during storm conditions.

Arcing is not to continuous and shall only exist in the presence of an electrical storm.

The air termination shall be non-radioactive and require no special licensing.

The range of protective radius of the air termination shall be traceable to High Voltage test and computer analysis based on known and accepted lightning research.

The protective zone provided by the terminal shall be such that it becomes the preferred strike point for all discharges exceeding 6.5kA or 10kA according to whether high or standard level protection is required. The design will have taken account of streamer competing building projections.

The air termination shall be insulated from the protected structure and have no moving parts.

The materials of the air termination shall be non-corroding in normal atmosphere.

The unit shall not be dependent on batteries for any part of its operation.

c) Termination Support

A insulating mast of adequate height shall be provided on the roof for air termination support. The support structure shall be an insulating fiberglass tube with bell at upper end to directly and neatly fit the air termination.

The support structure shall be capable of cantilever mounting and capable of withstanding hurricane typhoon conditions when mounted 3 metres above the structure.

The support structure shall also be capable of being guyed to withstand hurricane typhoon conditions when mounted 4, 5 or 6 metres above the structure.

d) Downconductor

The downconductor for the system shall consist of two conductors which are insulated from one another and from the structure.

The arrangement of the conductors shall be such that one is coaxially placed about the other. Each conductor shall have a minimum of 35mm square cross sectional area of electrical grade copper.

The insulating medium between inner and outer conductor shall have a 1/50 microsecond impulse withstand not less than 209kV.

The inner conductor shall be capable of direct crimp press to the base of the air termination. The downconductor shall be installed in accordance with manufacturer's instructions and shall not be subject to bend of less than 0.6 metre radius.

e) Earthing

A separate earth system shall be provided for the system.

The earth system shall not exceed 10 ohms.

Earthing will be by copper strip buried not more than 500mm deep, or by deep driven copper clad steel rods especially designed for electrical earthing.

B1.11 Earthing Arrangement

B1.11.1 General

All metalworks associated with an electrical installation but not forming part of a live conductor, including exposed conductive parts and extraneous conductive parts, shall be solidly and effectively bonded and earthed in accordance with the latest edition of the IEE Wiring Regulations and the Code of Practice for the Electricity (wiring) Regulations.

B1.11.2 Main Earthing Terminal

A solid copper main earthing terminal of ample size shall be provided for every electrical installation at a position near the main incoming switch or switchboard for the connection of the circuit protective conductors, the main equipotential bonding conductors and the functional earthing conductor to an earth electrode or a group of electrodes.

Where an installation distributes to a number of buildings or units, a separate main earthing terminal shall be provided for each individual building or unit at the point of intake thereby creating a separate equipotential zone in each building or unit.

The size of bonding conductor connecting the consumer's main earthing terminal and the electricity supplier's transformer earth or metallic sheaths of service cable, should not be less than 150mm² copper equivalent. Provisions should be made for disconnection of the bonding conductor for testing purposes.

The main earthing terminal should be effectively connected to the earth electrode(s) by the earthing conductor.

B1.11.3 Earth Electrodes

a) Types of Earth Electrodes

The material used and the construction of earth electrodes should be such to withstand damage due to corrosion. The following types of earth electrodes are permitted:

- rod electrodes
- tape electrodes

- plate electrodes
- metallic reinforcement of concrete, including sheet piles

Unless otherwise specified in the Particular Specification or Drawings, rod electrodes shall be installed.

Metal work of public gas or water services shall not be used as the sole protective earth electrode.

b) Rod Electrode

The overall diameter of the rod shall not be less than 12.5 mm and the thickness of the copper sleeve shall not be less than 0.25 mm. The minimum length shall be 2.4m. Additional lengths, whenever required, shall each be of 1.2m, connected together by a coupling. The penetrating end of the rod electrode shall be a hardened steel point.

Rod electrodes shall be driven into the ground within an earth pit. Only approved tools e.g. electric hammer or pneumatic hammer shall be used for their installation.

In case the earthing resistance achieved by one rod is not sufficiently low for the purpose required, additional lengths or additional rods shall be installed. For the latter application, the additional rods shall be driven into the ground outside the resistance areas of the previously installed rods. Under normal circumstances, a mutual separation of 3.5m is considered adequate. All rods thus installed shall be connected together by means of 25 × 3mm copper tapes enclosed in PVC ducts and laid at a minimum depth of 600mm below the ground surface. The connecting copper tapes shall be run in direct lines between the rods.

c) Tape Electrode

Tape electrodes shall be untinned copper strip of not less than 25 × 3mm in cross section. Tape electrodes shall be used only if specified by the Architect.

In case where several tapes are required for connection in parallel to achieve a low earthing resistance, they may be installed in parallel lines or they may radiate from a point.

d) Plate Electrode

Plate electrodes shall be of copper not less than 3mm in thickness, having dimensions as indicated on the Drawings subject to a maximum of 1200 × 1200mm.

In case the earthing resistance achieved by one plate is not sufficiently low for the purpose required, additional plates shall be installed. The plates shall be installed outside the resistance area of the previously installed plates.

B1.11.4 Earthing Conductor

a) Conductor Material

Earthing conductors shall be copper tapes 25 × 3mm in cross section. Aluminium conductors shall not be used as earthing conductors.

b) Connection to Electrode

The earthing conductor shall be connected to the earth electrode(s) by means of approved copper connector-clamps such that the connection can only be disconnected by means of a tool. The connection shall be contained within a concrete lined earth pit with a substantial removable cover to ensure accessibility and maintainability.

B1.11.5 Main Equipotential Bonding Conductor

a) Conductor Material

Unless otherwise specified, main equipotential bonding conductors shall be of copper.

Aluminium or copperclad aluminium conductor shall not be used for bonding connections to water pipes likely to be subjected to condensation in normal use.

b) Bonding Position

Main equipotential bonding conductors shall connect the extraneous conductive parts of other services within the premises to the main earthing terminal of the installation. Such extraneous conductive parts shall include main water and gas pipes, other service pipes and risers and exposed metallic parts of the building structure liable to transmit a potential. Connections shall be made as near as practicable to the point of entry of the non-electrical services into the premises concerned, provided that where there is an insulating section or insert at that point, the connection should be made to the metalwork on the consumer's side of that section or insert.

In particular for gas services, the bonding connection should be made on the consumer's side of the meter (i.e. between the meter outlet union and any branch pipework). This connection is recommended to be made within 600 mm of the gas meter.

c) Bonding Method

The main equipotential bonding conductors shall be securely and reliably connected to extraneous conductive parts of the non-electrical services by means of a copper connector-clamp of an approved type suitable for the particular applications. All contact surfaces shall be clean and free from non-conducting materials, such as grease or paint, before the connector-clamp is installed.

Main equipotential conductors should have cross-sectional areas not less than half the cross-sectioned area of the earthing conductor of the installation, subject to a minimum of 6mm² copper equivalent, and need not exceed 25mm² copper equivalent.

B1.11.6 Supplementary Bonding Conductor

a) Conductor Material

Unless otherwise specified, supplementary bonding conductors shall be of copper. Aluminium or copperclad aluminium conductor shall not be used for bonding connections to water pipes likely to be subjected to condensation in normal use.

b) Bonding Position

Within the zone formed by the main equipotential bonding, local supplementary bonding connections should be made to metal parts, to maintain the equipotential zone, where those parts are: -

- (i) extraneous conductive parts, and
- (ii) simultaneously accessible with exposed conductive parts or other extraneous conductive parts, and
(Note: a separation of not more than 2 m is generally considered to be simultaneously accessible.)
- (iii) not electrically connected to the main equipotential bonding by permanent and reliable metal-to-metal joints of negligible impedance.

Metalwork which may be required to be bonded includes service pipes or substantial parts which are at a distance not exceeding 2 m from exposed conductive parts. Examples are water pipes adjacent to electric heater or window frame supporting a ventilation fan or air-conditioner or adjacent to a socket outlet.

c) Bonding Method

The supplementary bonding conductors shall be solidly and effectively connected to the extraneous or exposed conductive parts by means of a copper connector-clamp of an approved type suitable for the application. All contact surfaces shall be clean and free from non-conducting materials, such as grease or paint, before the connector-clamp is installed.

For surface conduit installations, the supplementary bonding conductors shall be terminated at the nearest conduit or conduit box forming an integral part of the conduit installation.

For surface conduit installation, the supplementary bonding conductors shall be terminated at, viz a telephone cord outlet plate, a copper earth terminal fitted inside a BS4662 metal box forming an integral part of the conduit installation. The BS4662 metal conduit box shall be located as near as possible to the bonding position and the exposed part of the supplementary bonding conductor shall be made as short as possible.

The minimum cross-sectional area of a supplementary bonding conductor should comply with the code of Practice for the Electricity (Wiring) Regulations, subject to the following conditions:

- (i) The bonding conductor connecting two exposed conductive parts should have a cross-sectional area not less than that of the smaller protective conductor connected to the exposed conductive parts.
- (ii) The bonding conductor connecting exposed conductive parts to extraneous conductive parts should have a cross-sectional area not less than half that of the protective conductor connected to the exposed conductive part.
- (iii) The bonding conductor connecting two extraneous conductive parts, where one of the extraneous part is connected to an exposed conductive part, should have a cross-sectional area not less than half that of the protective conductor connected to the exposed conductive part.

B1.11.7 Circuit Protective Conductor (CPC)

a) General

Circuits protective conductors (CPC) may be formed by a separate conductor/cable, the metallic sheath or armour of a cable, part of the same cable as the associated live conductor, rigid steel conduits, trunking or ducting, or the metal enclosure of the wiring system. Flexible conduits and the exposed conductive parts of equipment shall not form part of the circuit protective conductors.

b) CPC for Socket Outlet

For every socket outlet, a separate circuit protective conductor shall be provided connecting the earth terminal of the socket outlet and that inside the enclosure accommodating the socket outlet.

c) CPC for Flexible Conduit

For every length of flexible conduit, a separate circuit protective conductor shall be provided inside the conduit to ensure the earth continuity of the installation between the two ends of the flexible conduit.

d) CPC for Busbar Trunking and Busway

A copper tape, 25 × 3mm in cross section shall be provided for the entire length of a busbar trunking or busway. The copper tape shall be bonded to the busbar trunking or busway at intervals not exceeding 3m and at the position of each tape-off point.

Subject to the prior approval of the Engineer or Architect, the provision of copper tapes for a busbar trunking or busway may be exempted provided that the enclosure of the busbar trunking or busway can be proved to satisfy the full requirements of the circuit protective conductor.

e) CPC for Final Ring Circuit

For wiring system using PVC insulated, PVC sheathed cables, the circuit protective conductor of every ring final circuit shall also be run in the form of a ring having both ends connected to the earth terminal at the origin of the circuit.

f) Joints in Protective Conductors

Provision shall be made in an accessible position for disconnecting a protective conductor from the main earthing terminal or the earth electrode to permit testing and measurements of earthing resistance. Such joints shall only be disconnected by means of a tool, be mechanically strong and shall be tinned to maintain the electrical continuity reliably.

No switching device shall be inserted in a protective conductor.

Any joint and connection made for the earthing conductor should be mechanically strong and electrically sound. The contact at the connection with the earth electrode(s) should be tinned where necessary to maintain reliable electrical continuity.

B1.11.8 Identification and Labeling

a) Colour Identification

All cables used as protective conductors, including earthing conductors, main equipotential bonding conductors, supplementary bonding conductors and circuit protective conductors shall be identified by the colour combination "green and yellow". Such colour combination shall not be used for other identification purposes.

Bare conductors used as protective conductors shall also be made similarly identifiable, where necessary, by the application of tapes, sleeves or discs, or by painting with the above colour combination.

b) Label for Earthing and Bonding Connections

Every point of connection for earthing and bonding shall be provided with a warning notice in accordance with the relevant section.

B1.11.9 Sizing of Protective Conductors

a) General

The cross sectional area of a protective conductor, other than an equipotential or supplementary bonding conductors, shall be selected in accordance with the Code of Practice of Electricity (Wiring) Regulations.

Where a protective conductor does not form part of a cable and is not formed by, or not contained in, steel conduit, trunking, ducting or other metallic enclosure of a wiring system, the cross sectional area shall not be less than that given in the Code of Practice for Electricity (Wiring) Regulations.

When metal enclosures for cables are used as protective conductors, they shall have CSA equivalent to that of copper, not less than that resulting from the above mentioned Regulations.

b) Protective Conductor Buried in Soil

Where protective conductors are buried in the soil, they shall have minimum CSA as given the Code of Practice of Electricity (Wiring) Regulations.

c) Equipotential Bonding Conductor

The cross sectional area of a main equipotential bonding conductor shall not be less than half the cross-sectional area of the earthing conductor of the installation subject to a minimum of 6 mm square copper equivalent and a maximum of 25 mm square copper equivalent.

d) Earth Fault Loop Impedance

(i) Automatic Disconnection Time

For circuits supplying only fixed equipment within the equipotential zone, the earth fault loop impedance at every point of utilization is such that disconnection occurs within 5 seconds.

For circuits supplying fixed equipment outside the equipotential zone or for circuits supplying any equipment inside a bathroom which is simultaneously accessible with exposed conductive parts of other equipment or with extraneous conductive parts, the earth fault loop impedance at every point of utilisation is such that disconnection occurs within 0.4 second.

For distribution boards supplying circuits for both socket-outlets and fixed equipment, the impedance of the protective conductor between the distribution board and the point at which the protective conductor is connected to the main equipotential bonding does not exceed $50 Z_s/U_o$ ohms, where Z_s is the earth fault loop impedance corresponding to a disconnection time of 5 second.

(ii) Maximum Earth Fault Loop Impedance

The maximum permissible earth fault loop impedance shall comply with the Code of Practice for the Electricity (Wiring) Regulations.

B1.11.10 Use of Residual Current-operated Circuit Breaker (RCCB)

a) General

RCCBs shall be installed for final circuits whenever the prospective earth fault current in a circuit is insufficient to cause operation of the overcurrent protective device within the specified automatic disconnection time of 0.4 second or 5 seconds. In such case, the product of the rated residual operating current in amperes of the residual current-operated circuit breaker and the earth fault loop impedance in ohms of the circuit shall not exceed 50.

Residual current-operated circuit Breaker shall meet the requirements specified in the relevant section.

b) Application in Household Installation

RCCBs used to protect socket outlet circuits shall have a rated operating residual current not exceeding 30mA.

B1.12 Miscellaneous

B1.12.1 Label and Notice

a) Inscription of Label and Engraving

Inscription of labels and engraving shall be in both English and Chinese characters. Details shall be submitted to the Architect for approval prior to engraving.

b) Material for Label

Labels shall be made of sandwich plastic material with white outer layers and a black or red inner layer as required. Lettering shall be engraved on the plastic material by cutting away one of the outer layers to the outline of the required letter, exposing the inner layer underneath.

c) Fixing of Label

Labels shall be fixed to switchgear and distribution board by screws. Where drilling and tapping of the equipment is impracticable, approved adhesive means may be used subject to prior approval of the Architect.

d) Label for Switchgear and Distribution Board

Each metalclad switch, fuseswitch, switchfuse, busbar chamber, checkmeter and distribution board shall be labelled on the front cover to indicate the circuit name/number, the rating of the fuse or circuit breaker, and the purpose of each circuit in accordance with the schematic wiring diagram, and in case of essential supply, red colour labels should be provided. For fuses and circuit breakers fitted in a distribution board which are not visible

without opening/removing the front cover of the distribution board, labels shall be fixed inside the distribution board in such a manner as to allow easy identification of the individual fuses or circuit breakers when the front cover is opened/ removed.

Labels may be fixed in other position as specified or as directed by the Architect.

e) Warning Notice

The following warning notices in English and Chinese shall be provided at the appropriate positions:-

- (i) A label marked with the words 'SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE' in lettering not less than 5mm high to be fixed in a visible position at or near the point of connection of every earthing conductor to an earth electrode, and the point of connection of every bonding conductor to extraneous conductive parts.
- (ii) A label having minimum size of 65 × 50 mm marked with the words 'DANGER – HIGH VOLTAGE' in lettering not less than 5 mm high to be fixed on every container on enclosure of ancillary equipment for discharge lighting installations operating at voltages exceeding "Low Voltage".
- (iii) A label to be fixed in such a position that any person gaining access to the live parts of an item of equipment or enclosure, which are not capable of being isolated by a single device and not provided with an inter locking arrangement to isolate all circuits concerned, will be adequately warned of the need of taking special precautionary measures to use the appropriate isolating devices.
- (iv) A label to indicate the maximum voltage present in an item of equipment or enclosure within which a voltage exceeding 250 volts exists, or items of equipment or enclosure which can be reached simultaneously and a voltage exceeding 250 volts exists between simultaneously accessible terminals are normally not expected to exist with the equipment or enclosure.
- (v) A label with the words 'FOR EQUIPMENT OUTDOORS' for each socket outlet intended to supply equipment used at outdoors or area outside the same equipotential zone.

B1.12.2 Guard and Railing for Moving or Rotating Parts of Equipment

All moving or rotating parts of equipment shall be provided with an approved guard and railing.

Guards shall be rigid and of substantial construction and shall consist of heavy mild steel angle frames, hinged and latched with either heavy galvanized mild steel wire crimped mesh securely fastened to frames or galvanized sheet metal of 1.2 mm minimum thickness. All apertures shall be such that finger access to dangerous part is not possible. All sections shall be bolted or riveted. Railings shall be 32 mm galvanized mild steel pipe and railing fittings.

B1.12.3 Identification of Cable and Conduit

Cables for control circuits, inter-communication circuits, and bell wiring shall be identified as required for each particular circumstance. Cables for power and lighting circuits shall be identified in accordance with the IEE Wiring Regulations.

B1.12.4 Painting at Metal Work

Before painting, the surface of the metal work shall be completely clean and free from rust, scale and grease and rust inhibitor shall be applied at least twelve hours prior to painting. Non-galvanized surfaces, both internal and external, other than nuts, bolts and washers that may have to be removed for maintenance purpose, shall receive one coat of metallic zinc-rich primer to BS4632, Type 2 or lead primer to BS2523, two undercoats and one finish coat. Paints shall be of approved type, brand and colour to BS4800; approval shall be obtained from the Architect before starting work. Undercoats and finish coat shall be of properly matching type and the finish coat shall give a hard gloss finish or as required.

B1.13 Testing and Commissioning

B1.13.1 General

Inspection and testing shall be carried out in accordance with the Code of Practice for the Electricity (Wiring) Regulations and IEE Regulations.

PARTICULAR SPECIFICATION

GLASS AND ALUMINIUM WORKS

PART 1 GENERAL

1.1 SCOPE OF WORKS

1.1.1 General Description of the Works

The works described in this specifications and indicated on the drawings comprises of the following:

- A. Aluminum Window w/. Double Glaze (clear glass) with necessary fittings at 5/F – IS Laboratory, Biology Laboratory and Preparation Rooms.

The works described in the drawings and works are as follows:

- A. The drawings are to show the design intent only. The Main Contractor (MC) shall submit shopdrawings with details for Architect's approval prior to commencement of work.
- B. The MC shall submit drawings to Buildings Department for record (Minor Works).
- C. All details designed by the MC shall be in compliance with the Building Ordinance, the Relevant Regulations, C.O.P and PNAP, especially APP-16, APP-37, APP-110, APP-116 and APP-156, where necessary.

1.1.2 Works of this Contract Includes

Provide labour, material, equipment and related items to engineer, design, supply, test, and install and guarantee the works mentioned above, and described in the drawings and specifications. Provide items not specifically mentioned but necessary to complete the Work. Items include:

- A. Extruded aluminum frames with finishes, hinges, handles, closers, adjusters, limitors etc.
- B. Preliminaries including the followings items, but not limited to:
 - 1. Insurance for employee's compensation & third parties shall be included.
 - 2. General cleaning and sufficient protection (both external and internal) shall be provided before handover
- C. Anchorage to building structure, including bracing of primary building structure if required for support of forces applied by work of this Contract, and patching of any fireproofing at anchors.
- D. Embeds for anchorage. The embeds shall be placed by the MC before formwork construction, if applicable.
- E. Glass and glazing for systems provided under this specification.
- F. Form A of Hong Kong Customs and Excise Department showing origin of all glass material
- G. Sealants, flashing, and rain water gutters within work of this specification and at boundaries with work of other sections to maintain weatherproof envelope.
- H. Weathertight, and vapour tight backpans behind all curtain, spandrel glass wall and glass cladding.
- I. Thermal insulation and vapour barriers to prevent condensation.
- J. Fire stop insulation between facade works and the structure.
- K. Glass works mock-up tests and water test in the Site.
- L. Field test of curtain wall, glass wall and windows for water leakage.
- M. Electrical continuity for lightning protection.
- N. Spare stock. (PVF2 paints/ handles/ hingers etc.)
- O. Setting out by MC for all installation of works
- P. Shop drawings shall be prepared in 1 month for approval. Prior approval shall be required before fabrication. Otherwise, special penalties may be involved.
- Q. Prepare print review and test reports if any structural sealant involved.
- R. Prepare fabrication drawings for all steel & aluminum works for submission.
- S. Prepare all necessary test reports if any welding and anchor bolts works included, where necessary.

1.1.3 Coordination with Works by Other Trades

Works done in other sections, and which require interfacing with works of this Contract, and requiring coordination by this Contractor includes but is not limited to:

- A. All related Sub-contract Works.
- B. Stone cladding works.
- C. ELV works.

1.2 CODES AND STANDARDS

1.2.1 General

- A. The Glass and Aluminium Works Contractor shall comply with the following codes and standards unless otherwise specified.
- B. All works shall comply with statutory Regulations and Standards required by the Government of Hong Kong. British Standards (BS), and American Society for Testing and Materials (ASTM) Standard.
- C. The relevant standard shall be the current edition unless otherwise specified.
- D. Where conflicts arise between these specifications and the code or standards listed below, the more stringent requirement shall apply.
- E. Similar codes or standards used in the home country of the manufacturer may be used if applicable, subject to the acceptance by the appropriate Hong Kong Government Department. In such case it shall be the responsibility of the manufacturer to demonstrate to the satisfaction of the Architect and the Hong Kong Government that such codes is essentially equal to the one specified.

1.2.2 General References

	Hong Kong Buildings Ordinance (Chapter 123)
	Hong Kong (Construction) Regulations
	Hong Kong (Administration) Regulations
	Technical Memorandum for Supervision Plans under 39A of the Buildings Ordinance
	Building Authority Hong Kong:
	Code of Practice on Wind Effects Hong Kong - 2004
	Code of Practice for Fire Resisting Construction – 1996
	Code of Practice for Site Safety Supervision (Draft)
BS 6399.1	Code of Practice for Dead and Imposed Loads
BS 6399.2	Code of Practice for Wind Loads
BE SN 14179-1:2005	Glass in building. Heat-soaked thermally-toughened soda lime silicate safety glass.
BS 5750	Quality systems
BS 7543	Guide to the Durability of Buildings and Building Elements, Products and Components
APP-16	Cladding Works
APP-37	Curtain Wall, Window and Window Wall Systems
APP-110	Protective Barriers
APP-116	Aluminium Windows
APP-156	Design and Construction Requirements for Energy Efficiency of Residential Buildings (RTTV)
ASTM C1279	Standard Test Method for Non-Destructive Photoelastic Measurement of Edge and Surface Stresses in Annealed, Heat-Strengthened, and Fully Tempered Flat Glass

1.2.3 Fabrication

BS EN 288	Specification and Approval of Welding Procedures for Metallic Materials

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

BS 4870	Specification for Automatic Fusion Welding of Materials, Including Welding Operator Approval
BS 4871	Specification for Approval Testing of Welders Working to Approved Welding Procedures
BS 3019	TIG Welding
BS 3571	MIG Welding
BS EN 287	Approval Testing of Welders for Fusion Welding
BS 7475	Specification for Fusion Welding of Austenitic Stainless Steel

1.2.4 Aluminum, Steelwork, Stainless Steel and Concrete

BS 8118	The Structural Use of Aluminum (British Standard)
BS 5950	Structural Use of Steelworks in Buildings
BS 7613	Specification for Hot Rolled Quenched and Tempered Weldable Structural Steel Plates
BS 7668	Specification for Weldable Structural Steels. Hot Finished Structural Hollow Sections in Weather Resistant Steel
BS EN 10029	Specification for Tolerance on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3mm Thick or Above
BS EN 10210	Hot Finished Structural Hollow Sections of Non-alloy and Fine Grain Structural Steels
BS 2994	Specification for Cold Rolled Steel Sections
BS 4848	Hot Rolled Structural Steel Sections
BS 1449.2	Specification for Stainless and Heat-Resisting Steel Plate. Sheet Strip
BS 6105	Specification for Corrosion Resistant Stainless Steel Fasteners
BS EN 485	Aluminum and Aluminum Alloys. Sheet Strip and Plate
BS EN 515	Aluminum and Aluminum Alloys. Wrought Products. Temper Designations
BS EN 573	Aluminum and Aluminum Alloys. Chemical Composition and Form of Wrought Products
BS 1474	Specification for Wrought Aluminum and Aluminum Alloys for General Engineering Purposes; Bars, Extruded Round Tubes and Section
BS EN 10143	Continuously Hot Dip metal coated steel sheet and strip. Tolerances on Dimension and Shape.
BS 4190	Specification for ISO Metric Black Hexagon Bolts, Screws and Nuts.

Aluminum Standards and Data, Aluminum Development Council of Australia

Building Authority Hong Kong Code of Practice Structural Use of Steel, 2011

Building Authority Hong Kong Code of Practice for Structural Use of Concrete, 2013

AISI Stainless Steel Cold-Formed Structural Design, Manual, Current Edition

1.2.5 Glazing and Caulking

BS 952	Glass for Glazing
BS 5889	Silicone Seals
BS 6206	Specification for Impact Performance Requirements for Flat Safety Glass and Safety Plastics for Use in Buildings
BS 6262	Code of Practice for Glazing of Buildings
BS 4255	Rubber used in performed gaskets for weather exclusion from buildings. Part 1: Specification for Non-cellular Gaskets.
ASTM C509	Specification for Cellular Elastomeric Performed Gasket and Sealing Material
ASTM C794	Test Method for Adhesion – in Peel of Elastomeric Joint Sealants
ASTM C1036	Specification for Flat Glass
19/GP-18M	Sealing Compound Elastomeric Type, Multi-component.

TT-S-0227E	(Canadian Government Specification Board) Sealing Compound Elastomeric Type, Multi-component.
AS 1288	(US Federal Interim Specification Board) Glass in Buildings – Selection and Installation

ASTM E774-97 Specification for Sealed Insulating Glass Units.

Insulating Glass Certification Council (IGCC) Certified Products Directory, current edition; a listing with a CBA rating is required.

ASTM C1048-97 Specification for Heat Treated Flat Glass.

Flat Glass Marking Association Glazing Manual (USA), Current Edition.

ASTM C1122-96el Standard Specification for Laminated Flat Glass.

Code of Practice for Structure Use of Glass, 2018.

1.2.6 Operable Windows

BS 6375	Performance of Windows
CP 153	Code of Practice for Windows and Roof Light (British Standard)
APP-116	Aluminium Windows

ANSI / AMMA 101-93 Voluntary Specification for Aluminum and PVC Rime Windows and Glass doors.

Code of Practice for Structure Use of Glass, 2018.

1.2.7 Fire Protection

BS 476	Fire Tests on Building Materials and Structures

1.2.8 Protective Coatings

BS 729	Specification for Hot-Dip Galvanized Coatings on Iron and Steel Articles
BS 1706	Method for Specifying Electroplated Coatings of Zinc and Cadmium on Iron and Steel AMD 6731, May 1991 (Gr. O)
BS 2569	Specifications for Sprayed Metal Coatings
BS EN 22063	Metallic and Other Inorganic Coatings. Thermal Spraying. Zinc Aluminum and Other Alloys.
BS 6338	Specification for Chromate Conversion Coatings on Electroplated Zinc and Cadmium Coatings
BS 7773	Cleaning and Preparation of Metal Surfaces
BS 6161	Methods of Testing Anodizing Aluminum Finishes
BS 5493	Code of Practice for Protective Coating of Iron and Steel Structures Against Corrosion
BS 6161	Methods of Test for Anodic Oxidation Coatings on Aluminum and its Alloys
BS 6161	Part 8: Determination of the Fastness to Ultraviolet Light of Coloured Anodic Oxide Coatings
BS 6497	Specification for Powder Organic Coatings for Application and Stoveing to Hot-dip Galvanised Hot-rolled Steel Sections and Performed Steel Sheet for Windows and Associated External Architectural Purposes, and for the Finish on Galvanised Steel Sections and Performed Sheet Coated with Powder Organic Coatings
ASTM D523	Test Method for Specular Gloss

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

ASTM D4214	Test Methods for Evaluating Degree of Chalking of exterior Paint Films
ASTM D714	Test Method for Evaluating Degree of Blistering of Paints
ASTM D968	Test Method for Abrasion resistance of organic Coatings by the Falling Abrasive Tester
ASTM D1654	Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D2244	Method for Instrumental Evaluation of Colour Differences of Opaque Materials
ASTM D2247	Method for Testing Coated Metal Specimens at 100% Relative Humidity
ASTM D3363	Test Methods for Film Hardness by Pencil

GSA Specification TT-P-645 for Alkyd Type Zinc Chromate Primer Paint.

1.2.9 Painting Reference Specification

AAMA 605.2	Voluntary Specification for High Performance Organic Coating on Architectural extrusions and Panels

1.2.10 Performance Testing

AAMA 501-94	Method of Testing for Exterior Walls
AAMA 501.2	Specification for Field Testing of Metal Curtain Walls: Field Check of Water Penetration Through Installed Exterior Windows, Curtain Walls and Doors by Uniform Air Pressure Difference
APP-37	Curtain Wall, Window and Window Wall Systems

1.2.11 Lightning Protection

BS 6651	Code of Practice for the Protection of Structures Against Lightning

1.2.12 Quality Assurance

ISO 9001 to 9004	Quality Systems for Design, Development, Production, Installation and Service

1.3 Design Requirements

1.3.1 Sub-contractors Design Responsibility

Contract Documents define the design intent, minimum standards and performance requirements. The Architect's details show preferred profiles, sizes and thicknesses to define the sightlines or aesthetics only. The Sub-contractor shall be solely responsible to provide the final design to comply with the design intent, standards and performance requirements defined in the contract documents.

1.3.2 Cladding System Type

All glazing, and cladding works shall be designed and fabricated in the factory as far as practicable and delivered to site in a form ready for installation.

1.3.3 Sightlines

Unless otherwise defined by Contract Documents, appearance of exposed elements, including width and depth, shall be consistent throughout project.

1.3.4 Glass Thickness

Unless otherwise defined by Contract Documents, overall thickness of each glass type, and component thickness of multiple layer glass types, shall be consistent throughout the project to ensure continuity of optical appearance of the glass in elevation from interior and exterior.

- 1.3.5 Anchor Adjustments
Provide anchor adjustment capability for full range of specified tolerances for the building structure.
- 1.3.6 Cast-in-place Embeds
Design all cast-in-place embeds and mounting mechanisms between the curtain wall and the RC superstructure for the Architect's approval. The design shall also include structural adequacy checking of all the affected RC elements.
- Provide cast-in-place embeds and setting out drawings in line with the concrete programme of the Main Contractor for placement into the forms.
- Before works are covered by concrete, conduct a joint survey with the Main Contractor or Architect's representative to confirm acceptance of placement of the embeds and provide written confirmation of acceptance to the Architect.
- 1.3.7 Design Wind Pressures
Design wind pressures act perpendicular to flat surfaces, regardless of surface orientation. Wind pressures act perpendicular to tangents of curved surfaces. At corners and to other changes in plane, both surfaces shall be assumed to experience inward pressure simultaneously, and onward pressure simultaneously. Design for simultaneous occurrence of inward pressure on one surface and outward pressure on adjoining surface is not required. A corner is defined as the five (5) meters to either side of each outside building corner.
- 1.3.8 Independent Checking Engineer
The Glass and Aluminium Sub-contractor shall employ an independent checking engineer (ICE) experienced in all curtain wall, glass wall, glass balustrade, glass cladding and aluminium louvres design and having an RSE qualification to ensure that the glass wall and cladding system complies with the Hong Kong Building Regulations, especially with respect to materials and installation. The ICE shall also endorse the curtain wall, glass wall, glass balustrade, glass cladding and aluminium louvres drawings to be submitted to the BD, although the project RSE will sign the drawings for submission. The Contractor / ICE must make all changes and revisions required by the BD for approval.
- 1.3.9 Framing Members
General Requirements
- (i) Glass, sealants and interior finishes shall not be assumed to contribute to framing member strength, stiffness or lateral stability.
 - (ii) Compression flanges of flexural members may be assumed to receive effective lateral bracing only from anchors to building structural and unbraced length shall be the distance between effective lateral braces.
 - (iii) Splice joint which permit movement shall be assumed to have zero moment capacity.
- 1.3.10 Fasteners
General Requirements
- (i) All fasteners are to be concealed unless approved in writing by the Architect.
 - (ii) All design criteria adopted for the structural calculation of fixings shall be submitted for review by the project Registered Structural Engineer.
- 1.3.11 Structural Silicone
General Requirements
- (i) Structural silicone shall not support dead load.
 - (ii) Structural silicone shall not be applied to edges of insulating glass or to edges of laminated glass unless written endorsement is provided by glass fabricator and accepted by the Architect.
 - (iii) All design criteria adopted for the structural calculation of structural silicone shall be as per the sealant manufacturer's recommendations and be submitted for review by the project Registered Structures Engineer.

- (iv) Allowable tension stress or shear stress (but not combined tension and shear stress) shall not exceed 138KPa at design pressures and loads. The allowable stress is subject to specified material tests, which may result in a value of less than 138KPa.

1.3.12

Glass
General Requirements

- (i) Design wind pressure shall be assumed to have one minute duration. Gravity loads shall be assumed to have one week duration.
- (ii) Probability of breakage upon first application of design pressures shall not exceed 8/1000 for vertical glass, and 1/1000 for sloped and horizontal glass.
- (iii) Tempered glass shall have heat soak testing to minimize spontaneous breakage. The testing method and standards shall be submitted at time of tender for acceptance by the Architect.
- (iv) All glass within 1100mm of the finish floor shall be designed and withstand the balustrade loading as per the HK Building (Construction) Regulations.

1.3.13

Movements
General Requirements

- (i) Provide movable joints to accommodate full range of manufacturing tolerance, field tolerance, thermal movement, wind sway, seismic movement, floor sag, beam sag and column shortening. Theoretical and as-built glass bite relative to metal frame shall not be less than 10mm. Theoretical and as-built glass edge clearance to nearest metal shall not be less than 6mm. All joints widths shown in the architectural drawings are to define the aesthetic intents, and the final joint widths to accommodate all specified movements shall be determined and provided by the Contractor.
- (ii) Thermal component of joint movement shall be based on minimum material temperature increase of 55°C and decrease of 55°C relative to nominal condition. Assume entire cross section has uniform temperature. For thermal design other than joint movement, design winter surface temperature shall be 0°C. Design summer surface temperature shall be at least 71°C. All components including adhesives and sealants shall be capable of withstanding, without failure, design winter temperature to design summer temperature with simultaneous specified loads.
- (iii) At any floor, in-plane displacement shall be assumed to occur while floors immediately above the below remain stationary. There shall be no failure or permanent distortion of anchors, frames, glass or metal cladding; structural silicone shall not experience adhesive and / or cohesive failure; gaskets and weather-strips shall not disengage; weather seals shall not fail.

1.3.14

Internal Drainage and Ventilation

Provide internal gutters and weep system to collect and drain all leakage and condensation to the exterior. Punched windows shall have an isolated gutter cavity at each glass perimeter, so that leakage is confined to and weeped out without damaging internal finishes. Unitized curtain walls shall have continuous spliced gutters at horizontal stack joints, with sealed end caps at termination conditions. There shall be no water allowed to weep into the spandrel shadow box or non-vision area cavity. If a high light transmittance spandrel glass of greater than 40 percent is used to form a shadow box, all ventilation of the shadow box shall be only to the interior side of the building, with suitable filtering material at ventilation openings to prevent dust and dirt from entering the shadow box, and there shall be no air, vapour, water penetration from the exterior into shadow box.

Vertical strip windows shall have a continuous gutter and weep holes at the glass sill, and a continuous gutter at the glass head which either drain directly to exterior or directs leakage to the exterior without damage to the window system or the building interior.

1.3.15

Glass Replacement

Glazing details shall permit glass replacement after initial construction, shall permit reuse of original gaskets, shall permit replacement glass of same nominal size as original glass, and shall not require cutting of framing members or removal of interior finishes. Vision glass in conventional frames shall be replaceable from interior. Spandrel glass shall be replaceable

from exterior. Silicone supported vision glass shall be replaceable from exterior and / or interior.

- 1.3.16 Snap Engage Components and Trims
Snap engaged components shall be secured against migration, and shall not serve any primary structural function, such as retention of glass or panels. Snap engaged plastic components are not permitted, except as nonstructural thermal improvement for interior trim. Joints in continuous snap covers and other continuous trim shall have splice sleeves of same material and finish as cover or trim.

1.4 Performance Requirements

1.4.1 Performance Criteria

A. Structural Adequacy

(i) Structural adequacy to be demonstrated against the following:

- wind loads
- dead loads
- live loads
- maintenance related loads
- movements

(ii) Acceptable evidence of adequacy:

- by calculation
- test
- manufacturers test data

B. Structural Serviceability

(i) At pressures and loads from zero to 150 percent of design values:

- (a) Framing member residual deflection after pressure or load is removed shall not exceed 1/1000 times distance between supports or 2/1000 times cantilever length.
- (b) At anchors, framing member deflection relative to building structure shall not exceed 5mm, nor 3mm after pressure or load removed.
- (c) Upon reversal of pressure or load direction, relative movement between two components that are fastened or clamped together shall not exceed 5mm.
- (d) There shall be no disengagement, failure or gross permanent distortion of any component, including glass and gaskets.

(ii) At 50 percent of design pressures, glass centre deflection relative to glass edges shall not exceed 25mm. Glass deflection at 1.5 times design pressures shall be limited to prevent glass disengagement from frame.

(iii) At 100 percent of design pressures and loads:

- (a) Net deflection perpendicular to enclosure surface for framing members supporting glass or metal panels shall not exceed: 1/180 times distance between supports or 20mm, whichever is lesser; 2/180 times cantilever length, not to exceed 10mm.
- (b) Net deflection of framing members parallel to enclosure surface shall exceed smallest of: 3mm due to dead load; 3mm change in opening size at any point; 1/360 times distance between supports, not to exceed 10mm.
- (c) Net deflection parallel and perpendicular to enclosure surface for framing member at perimeter sealant joints shall not exceed smallest of: values specified above; 50 percent of joint width, movement capacity of sealant.
- (d) Metal panel centre deflection shall not exceed 0.01 times the shorter panel dimension.
- (e) Deflection of louver blade stiffener shall not exceed 1/180 of the span. Vector sum of louver blade deflections parallel to blade principal axes

- shall not exceed 1/175 times span.
- (iv) Acceptable evidence:
- by calculation
 - by test
- C. Attachment to the Building Structure
The fixing shall resist dead loads, live loads, wind loads, vertical and lateral loads, and all building movements, individually and in combination. All fixings to accommodate the worst out of tolerance under design loading.
- D. Waterproofing
Design approach:
- pressure equalized and drained joints for curtain wall generally
 - rain screen principle for cladding generally
- Evidence required:
- fully specified
 - by inspection
 - by test
- E. Air Infiltration
- | | | |
|--------|-----------------|---------------------------------|
| Limit: | Curtain Wall | 1.0L/m ² .S at 300Pa |
| | Operable Window | 1.6L/m ² .S at 150Pa |
- F. Louvres
- | | | |
|-----------------------|---|--|
| Free area | : | Minimum 50 percent |
| Resistance to airflow | : | 10Pa pressure drop to an airflow of 4m/s |
| Water penetration | : | Resist rainfall rate 75mm/hour with wind Speed 13m/s |
| Evidence required | : | |
| by calculation | | |
| - by test | | |
- G. Thermal Performance
Minimum U value:
- for double glazed units
 - 1.80 W/m²°C winter nighttime
 - 1.90 W/m²°C summer daytime
 - for spandrel thermal insulation
 - 0.53 W/square meter - K
- H. Electrical Continuity
Lightning protection required:
Provide up to 4 numbers of 4mm tapped holes at 200mm above false ceiling at each floor in order to allow the Electrical Sub-contractor to carry out connection to the building's earthing system. Exact location of connection points to be coordinated with the Electrical Sub-contractor. This Contractor shall be responsible for the electrical continuity of the metal facade works.
- I. Accoustic Performance
The facade works shall be free of rattles, creaks, wind whistles, and other noise due to thermal or structural movements, or differential pressures.
- J. Fire
Material and construction requirements:
- 2 hour fire stop at spandrel level and at sides of R.C. walls to separate adjacent floors.
 - fire rated spandrel to comply with the Hong Kong Building Authority Code of Practice for Fire Resisting Construction.

K. Design Life

Design Life and Durability

- (a) The facade is to perform satisfactorily for the following periods:
 - 25 years with minimum maintenance (apart from regular cleaning)
 - 50 years with appropriate planned maintenance
- (b) Requirements for warranties are given in the Contract Document. The expected life of products used in the facade shall be confirmed by providing at least the information below as a part of the material and sample submissions.
 - (i) the economic life of the product / material in the environment in which it shall be used (this is not a warranty or guarantee);
 - (ii) requisite maintenance procedures which must be followed in order to achieve the economic life of the product / material;
 - (iii) an assurance from the supplier / manufacturer that the product is suitable for the proposed application;
 - (iv) relevant product data including names of supplier and manufacturers.
- (c) The Architect shall have the absolute right to have any deficient products or materials to be rectified or replaced at the Contractor's expense in order to achieve the expected life as stated in the specification. The Contractor will under no circumstances enter into a claim for correction of a product or installation by virtue of the product or material being unfit for its intended purpose.
- (d) All materials which are exposed to sunlight, including materials exposed through glass, shall not be affected due to exposure to heat or ultraviolet radiation such that the material can no longer perform as intended, for a minimum period of 25 years.

L. Maintenance and Replacement Capacity

Maintenance must be identified in terms of routine (e.g. cleaning) and in terms of component repair / replacement.

Each system shall be analysed to define the sequence under which components are likely to fail.

The design must be developed such that removal and replacement of vision or spandrel glass and Aluminum panels can be carried out without the cutting of framing members.

A strategy must be developed to ensure, that elements likely to deteriorate significantly and which have been accepted in writing by the Architect can be replaced or rectified.

Preparation of a Facade Maintenance Manual is a requirement of this specification which lists the contents that should be considered for inclusion (see Appendix 5).

M. Glass

1. Glass provided for test mock-ups shall be identical (including strength) to glass provided for corresponding zone on building. Glass in mock-ups is required to support up to 1.5 times design pressure without breakage. It is recognized that any one glass plate can break at any pressure. Therefore a limited amount of breakage of mock-up glass is acceptable, providing that replacement glass with the same nominal strength eventually passes all tests.
2. Insulating glass shall have been tested in accordance with ASTM E 774-92 and shall have satisfied requirements for Classes C, B and A.
3. Insulating glass shall not experience fogging, wetting or staining within the sealed space, spacer corrosion, spacer migration, adhesive or cohesive failure of primary or secondary edge seal.
4. Glass reflective coating shall not crack, peel stain or discolor.
5. Where glass is supported by structural silicone, glass edge construction (including insulating glass primary and secondary seal) reflective coating, ceramic frit, pacifiers shall withstand specified design and test pressures without failure.

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

6. Glass shall not experience spontaneous breakage.
7. Glass center deflection relative to glass edges at 50 percent of specified design pressures shall not exceed 25mm. Glass deflection at 1.5 times design pressures shall be limited to prevent disengagement from frame.
8. Spandrel glass opacifier shall not crack, peel, wrinkle, delaminate, stain or discolor.
9. Glazing generally to be in accordance with BS 6262.

N. Sealants

Sealants used as weather seals shall not experience adhesive or cohesive failure. Sealants shall withstand movements up to the limits prescribed by manufacturers. Exposed sealant surface shall not crack or bubble. Sealant and primers shall not stain adjacent materials. Sealants shall be used only if manufacturer's adhesion, compatibility and stain tests yield favorable results.

O. Snap Engage Components

Snap engaged components shall not disengage when subjected to a concentrated force in any direction of 45 Newtons or during mock-up structural tests.

P. Operable Windows

1. Operable windows shall conform to requirements of this specification. In addition, and as minimum, operable windows shall also conform to ANSI/AAMA 101-93 classification PAW90. This specification governs with respect to any conflicts.
2. Prior to any other mock-up tests, operable windows shall be unlocked, fully opened, closed and locked for minimum 50 cycles. If any repairs or adjustments are performed after cycling, the minimum 50 cycles shall be repeated.
3. As part of mock-up tests, provide separate unglazed vents in fixed frames in the largest size for this project to the laboratory for concentrated load tests per ANSI/AAMA 101-93.
4. All hardware to be used in the operable window shall be heavy duty stainless steel and European origin, or approved equivalent.

Q. Condensation Control

For condition listed under the performance Criteria in this specification, condensation inside the curtain wall or cladding works is acceptable only if resulting water would be contained and drained to exterior without adversely affecting the performance and durability of the facade works, without wetting indoor surfaces visible to building occupants, and without staining or damaging the building.

R. Testing and Actual Building Performance Requirements

Performance requirements specified for test mock-ups and specimens also apply to actual building, and vice versa. Variations in criteria over the surface of building, such as wind pressure, are taken into account in testing requirements. Where certain performance is required for specific test conditions of mock-ups and specimens, that same performance is required of actual building, for conditions equivalent to or less severe than test conditions.

1.4.2

Basic Data

A. Wind Loads

The facade works is to be designed for wind loads in accordance with the Hong Kong Building Ordinance and the Code of Practice on Wind Effects (Hong Kong) latest edition. The wind load requirements therein shall be satisfied taking into account topographical effects as outlined below:

Height of Building above:

Artificial Base Level (0.00mPD)
0 – 10m

Basic Wind Pressure in kPa
1.2

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

10 – 30m	2.2
30 – 50m	2.5
50 – 100m	3.0
100 – 150m	3.5

The minimum outward (negative) wind pressure shall be 3.1kPa.

The minimum inward (positive) wind pressure shall be 2.2kPa.

Notwithstanding the above basic wind pressures the curtain wall and its anchorages shall be designed to withstand wind pressures of not less than the following:

Suction on external face	1.4 x (Number) kPa	= (Number) kPa
Pressure on external face	1.0 x (Number) kPa	= (Number) kPa

B. Live / Dead Loads

Interior window sill trim with the sill board installed shall not have residual deflection of more than 2mm after subjected to a concentrated force of 650 Newtons at any point for 10 seconds. The minimum thickness shall be 2mm.

C. Balustrade

Code determined Building (Construction) Regulations

D. Building Movements

(a) Instantaneous dead load	24mm maximum
(to be eliminated by precambering with mm per meter span for all spans in excess of 5.0m. for cantilevers, 4mm per 1.0m at end of span)	
(b) Instantaneous live load	20mm maximum
(c) Long term creep and shrinkage	12mm maximum

E. Ventilation Requirement

Minimum 1% of usable floor area to be operable windows.

F. Internal and External Environment

Internal:	dry bulb temp. range (operating)	• 15°C to 27°C
	relative humidity	• 30 percent
	air conditioning	• Yes – operates between 7am & midnight pprox.
External:	dry bulb temp. range ambient relative	• 2°C to 40°C
	humidity	• 98 percent
	surface allowance	• 0°C to 80°C

G. Construction Tolerances of R.C. Structure

A. All insitu concrete work shall be dimensionally accurate to within the following tolerances, unless closer tolerances are further specified or shown:

Item	Tolerance
1. Variations from the plumb,	
(a) In the lines and surfaces of columns, piers, walls and arises:	
In 3m	5mm
In any storey or 6m maximum	10mm
In 12m or more	20mm
(b) For exposed corner columns, control joint grooves and other conspicuous lines:	
In any storey or 6m maximum.....	5mm
In 12m or more	10mm
2. Variation from the level, or from the grades indicated on the drawings*	At any point +/-10mm from the true elevation but not more than 5mm variation between two points within 6m in a horizontal plane.

3.	Variation of the liner building lines from established position in plan and related position of columns, walls and partitions:	
	In any bay or 6m maximum	10mm
	In 12m or more	25mm
	No tolerance that would result in encroachment on adjoining properties is permissible	
4.	Variation in the sizes and locations of sleeves, floor openings and wall opening ...	5mm
5.	Cross sections of columns and beams, thicknesses of walls, slabs and other parts of the building:	
	Up to 0.5m	+5/-3mm
	Over 0.5m	+/-5mm
6.	Footings:	
(a)	Variation in dimensions in plan	+25mm# -10mm
(b)	Misplacement or eccentricity: 2 percent of the footing width in the direction of misplacement but not more than	+25mm#
(c)	Reduction in thickness	-5% of specified thickness
7.	Variation in steps:	
(a)	In a flight of stairs:	
	Rise	3mm
	Tread	5mm
(b)	In consecutive steps:	
	Rise	2mm
	Tread	3mm
*	Variation in floor level are to be measured before removal of supporting shores.	
#	Applies to concrete only, not to reinforcing bars or dowels.	

- B. Closer tolerances will generally be specified for the following:
- (i) Precast concrete.
 - (ii) Measuring flume contours.
 - (iii) Filter bed and drying bed floors.
 - (iv) Machinery bases.

1.5 SUBMITTALS

1.5.1 Tender Submissions and Requirements

The tenderer shall submit as a minimum the following documents with demonstrate his ability to perform the work as specified and to provide the necessary systems to meet the specified criteria.

- A. Preliminary design drawings of the exterior wall systems including glass and aluminium works – for all types. Details to be drawn full size on A2 size sheets, or submitted on a reduced set on A3 size sheets.
- B. Preliminary structural calculations coordinated with tender drawings.
- C. Itemized list of specification requirements and architectural drawing requirements which are being proposed in the tender and are not in conformance with the contract, or intended contract, for work of this section. Identify specification page and paragraph, or architectural drawing sheet, elevation, plan, section or detail for each

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

item. Deviations not specifically identified shall not be deemed valid in submittal review. If there are no deviations, provide written statement of full compliance with architectural drawings and specifications. Failure to provide an itemized list of deviations or statement of full compliance shall, at reviewers' discretion, be cause for return of submittals without review.

- D. Description of glass types, thicknesses, strengths, colors and coatings.
- E. Scope and method of heat soak testing for tempered glass.
- F. Preliminary program of the entire works of this sub-contract with milestone dates identified, including glass order, extrusion order, visual and test mock-ups, commencement of installations and closing-in of building.
- G. Proposed method statement for fabrication and installation of the curtain wall, glass walls, entrance glass canopy and skylight.
- H. Detailed list of proposed Contractors for fabrication and installation of major components including coating applicator, and material suppliers for the glass, aluminum extrusions, aluminum cladding, aluminum louvre, glass wall, glass sliding door, windows, insulation, glazing gaskets, and door hardware.
- I. Confirmation that Contractor can and will provide the warranty as required by the specifications.
- J. Quality control and protection plans. In particular, the protection of the installed glass wall shall be outlined.
- K. Factory facilities descriptions and factory equipment lists.
- L. Previous projects completed of similar magnitude and complexity.
- M. Resumes of key personnel to be assigned to the project.
- N. Information on the proposed mock-up testing laboratory.
- O. Samples of finish for curtain wall, aluminum window and louvre.
- P. Visits for factories of manufacturing aluminium, stainless and glass, etc.

1.5.2 Submittals for Information Only

- A. Prior to, or simultaneous with, first submittal of structural calculations for approval, submit dimensioned die drawings for aluminum extrusions. If extrusion profiles are not finalized, provide die drawings for interim profiles. If profiles are revised, provide revised die drawings with first calculation or shop drawing submittal which follows revision. Die drawings shall show profile dimensions, metal thickness, alloy and temper.
- B. Submit die drawings of gaskets and weather-strips. Die drawings shall show profile dimensions and shall identify materials.
- C. Submit glass manufacturer's wind pressure analysis, thermal stress analysis, and review of shop drawings stating that details are suitable for proposed glass products, and full size dimensioned drawing of insulating glass edge with identification of primary and secondary seals.
- D. Submit certification that insulating glass shall be tested in accordance with ASTM E774-92 and has satisfied requirements for Classes C, B and A.

- E. Submit sealant manufacturer's test reports confirming sealant adhesion, compatibility and absence of staining, and acceptability for structural silicone application. Submit application and quality control procedures for sealants.
- F. Submit reports for quality control uniform pressure tests of shop applied structural silicone.
- G. Submit reports for peel test of field applied structural silicone.
- H. The Contractor shall submit a maintenance manual for the exterior facade system(s) inclusive of all metal part, cladding components, glass, finishes, etc.

1.5.3 Shop Drawings Calculations and Reports for Review by Consultants and BD Submissions

- A. Shop Drawings
Submit drawings showing materials in place on building. Drawings shall include elevations, floor plans, sections and full size details. Details shall be fully drawn (not outlined). Drawings shall include the following information.
 - (i) Joinery and internal seals and drainage.
 - (ii) Glass and metal thickness.
 - (iii) Metal allow, temper and finish.
 - (iv) Glass strength, tint, coating, pacifier, and opacifier.
 - (v) Fastener alloy, strength, finish, diameter, length and spacing.
 - (vi) Glazing materials identification.
 - (vii) Sealants identification by product name.
 - (viii) Relative layout of walls, beams, columns and slabs with dimensions noted.
 - (ix) Dimensioned position of glass edge relative to metal daylight.
 - (x) Provisions for movements.
 - (xi) Location of, and details for, embedded anchors.
 - (xii) Identification of, and details for, thermal insulation and safing insulation.
 - (xiii) Weld information and weld symbols conforming to specified conventions.
 - (xiv) Glazing details applicable to replacement glass, with outline of procedure for glass replacement.
 - (xv) Provision for adjustment of anchors to allow for tolerances of building structure and installation.
 - (xvi) Electrical bonding.
 - (xvii) Colours of finish coatings.
 - (xviii) Window and door hardware.
- B. Phasing Shop Drawing Packages
Shop drawings and calculations shall be submitted in reasonable large and comprehensive packages to allow the consultants to efficiently perform their reviews. Incomplete and an unreasonable amount of small packages shall not be reviewed by the consultants. A minimum of 15 working days shall be allowed for each review by the consultants.
- C. Resubmissions
Submittals shall be complete and in required form. Resubmits shall include requested corrections and shall respond to previous comments. Each revised sheet shall bear a revision date and number. Revisions shall be clouded and flagged with conspicuous revision symbols and numbers. Failure of submittals to be complete, in the proper form, responsive to comments, or identify revisions shall be cause for disapproval and return of documents without review. Failure of review comments to note a noncompliance with plans and specifications shall not relieve the Contractor from his obligation to comply. Failure of review comments to note a noncompliance on given submittal shall not preclude a directive to comply on future submittals.

D. BD Submission

The MC shall be responsible for preparation of drawings, structural calculations and Site Safety Supervision Plans (Appointment of Technically Competent Person) to be submitted to the Buildings Department (BD) for approval and / or consent. The Contractor shall submit up to four sets, prepared in compliance with this specification, to the Architect and Project Registered Structural Engineer for review and onward submission to the BD. Allow a minimum of 12 working days for checking by the Architect and Project Registered Structural Engineer. The MC will be responsible for all submissions required to obtain approval and consent of the curtain wall, glass wall, glass balustrade, glass cladding and aluminium louvers system from the Hong Kong statutory bodies. The MC will make adequate allowance in his programme for the gaining of approval and consent of the works from BD. The MC will be responsible of any delays in the checking caused by inadequacies in his documentation. The programme shall allow a minimum, prior to the commencement of site installation works, 60 calendar days for the Approval application and 28 calendar days for the application of Consent from BD.

For heat soak test of tempered glass, the MC shall provide necessary travel vehicle between the test factory and agreed pick-up place.

E. Drawing and Calculation Units

Drawings and calculations shall use international units of measurement and shall be in English.

F. Mock-ups

Drawings and structural calculations are required for test mock-ups. The required content is the same as for actual building shop drawings.

G. Reglazing Demonstration

The MC may choose to waive the reglazing demonstration on mock-ups, subject to the Architect's approval.

H. Structural Silicone Test

Request to perform tensile test on substitute structural silicone (Subcontractor option), and laboratory report if test is performed.

I. Consultants Responsibility for Review of Shop Drawings

Review of shop drawings by the consultants shall be for design content only and shall not relieve the sub-contractor of his responsibility as stated in the specifications, and for the correctness of dimensions, structural adequacies, and suitability of the fabrication, assembly and erection processes, and compliance with all contract documents unless specific specified requirements have been waived in writing by the Architect.

1.5.4

Samples

A. Required Samples

The following samples are required to be submitted with all necessary technical information for the Architect's review, in accordance with a programme to suite the programme of works for this Contract, but not limited to:

- (a) Two (2) sets of labeled samples of each type and color of metal finish, 300 square of sheet metal materials. Samples shall show extremes of color and texture only. Compliance with other requirements is the responsibility of the Sub-contractor.
- (b) Two (2) sets of labeled 300mm square samples of each type of glass. Provide visual mock-ups using full size glass, for evaluation of color and distortion of reflected image. (See Glass Visual Mock ups in this specification).
- (c) Door hardware – (2) sets
- (d) Gaskets, sealants and other glazing materials – (2) sets

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

- (e) Thermal and fire stop insulation – (2) sets
 - (f) Stainless Steel Spider – (2) sets
 - (g) All exposed steel welded joints – (2) sets
 - (h) 300 long steel mullion sample – (1) set
- B. Miscellaneous Samples
Architect reserves right to require samples which show the fabrication techniques and workmanship of component parts, and design of accessories and other exposed auxiliary items.
- C. Production Materials
Provide production material to match approved samples. The procurement of production materials shall not commence until after its sample is approved.
- D. Consultants Responsibility for Reviewing Samples and Materials Submissions
Approval of samples and materials by the consultants shall be for design intent only and shall not relieve the Sub-contractor of his responsibility for the correctness of use and suitability for fabrication, assembly and processes proposed by the Sub-contractor, and compliance with all contract documents unless specific specified requirements have been waived in writing by the Architect.
- E. Two (2) sets of each extrusion that is exposed to view with its specified finish applied. These samples are to be 300mm long. Samples shall show extrusion appearance qualities and maximum range in the finish that will be provided for the project.

1.6 Qualifications

- A. Aluminum Cladding Fabricator
Company specializing in fabrication of architectural aluminum extrusions and sheet with minimum 10 years experience. Engineer who does structural design and lead designer who does cladding design shall have minimum 10 years experience designing architectural aluminum.
- B. Aluminum Anodizer
Company with minimum 10 years experience anodizing of works similar to scope and quantity of this project. Preferred country of origin is Germany and USA. Others may be submitted for Architects consideration.
- C. Glass Supplier and Fabricator
Company specializing in manufacture of flat glass and fabrication of architectural glass with minimum 10 years experience.
- D. Gasket Supplier
Company specializing in manufacture of products specified in this Sub-contract with minimum 10 years experience.
- E. Sealant Supplier
Company specializing in manufacture of products specified in this Sub-contract with minimum 10 years experience.
- F. Installer
Company specializing in performing work of this Sub-contract with minimum 10 years experience.
- G. Glass Wall Fabricator and Installer
Company spiced in design, supply and installation of glass walls in this Sub-contract with minimum 10 years experience.

1.7 MOCK-UPS

1.7.1 Test Mock-ups

- A. General
Furnish the design, labor and materials to build and test mock-ups as per Buildings Department requirement. The extent of the mock-ups and numbers of mock-ups shown in the drawings specified herein only define the minimum extent required to be tested under this Contract, and the Contractors is responsible to ensure that all required mock-up testing required by the Building Authority is included in the Contract. Mock-ups shall accurately represent job conditions including joints, sealant, glass, glazing, anchors and finishes. In case the Building Authority does not require the glass walls and cladding to be tested, or require it to be tested to a lesser extent than shown on drawings, the Architect shall have the option to omit such testing not required by the Building Authority, and the Contractor shall provide a credit which the amount shall be determined at time of submitting the tender.
- B. Gaskets
Each mock-up shall be glazed with one consistent set of gaskets. Use of multiple gasket profiles and / or thickness at the Contractor's discretion is not permitted.
- C. Reglazing
Prior to tests, remove and reglaze selected glass units, using the details and procedures intended for glass replacement on the actual building. Reglaze units must satisfy test criteria. Sub-contractor may submit for approval a request to waive this requirement for glass supported by structural silicone.
- D. Glass
Provide at least one extra light of glass for each type and size on mock-ups. Glass which breaks during testing shall be replaced with new glass and the tests continued. Repeated glass breakage shall constitute failure.
- E. Construction
Construction mock-ups in accordance with approved shop drawings and in a manner resembling the actual job assemblies. Deviations from or additions to details shown on drawings are subject to approval by the Architect.
- F. Testing laboratory and Fees
Sub-contractor shall pay laboratory fees for one series of successful tests. Testing laboratory shall conduct and report test, shall document the set up, testing and observations of the mock-ups tests, and state in the report whether test specimen conforms to requirements of Contract Documents, and shall note deviations from mock-up drawings.
- G. Retesting
If failures occur, revise and retest mock-ups, modifications must be realistic in terms of job conditions, must maintain standards of quality and durability, and are subject to approval.
- H. Additional Costs for Retesting
If failure necessitate retests, the Contractor shall pay the additional laboratory fees and other fees and expense, including architect's and consultant's fees.
- I. Laboratory Location
Construction, Research and Testing Laboratory in Hong Kong under HOKLAS (the Hong Kong Laboratory Accreditation Scheme) are acceptable. Other laboratories may be submitted for approval. Detailed information on proposed alternate facilities must be submitted for review and approval at the time of the tender.

- J. Attendance of Tests
Mock-ups are subject to observation by Owner, Architect and their consultants during construction and testing. Provide minimum two weeks notice before beginning construction of mock-ups. Delays in mock-up construction and testing due to lack of materials or personnel shall result in the Contractor being charged for fees and travel expenses of observers. The Contractor shall coordinate chamber availability, shipping schedules and mock-up construction schedules directly with the laboratory. The Contractor is to allow for in his tender the costs to cover all travel and related living expenses for two (2) persons (1 Owner or / and Consultants and 1 Architect, traveling from Hong Kong) to attend the testing, and one (1) person to attend the assembly, installation, and pre-testing of the mock-up at the test laboratory.
- K. Responsibility of Laboratory
The testing laboratory shall not perform any of the following functions.
- (a) Act as consultant to a Sub-contractor for this project.
 - (b) Modify Contract Document requirements.
 - (c) Modify mock-up configuration.
 - (d) Dismantle mock-ups until notified that no further testing is required.
- L. Undocumented test or test not witnessed by the consultants are not permitted. All observations relevant to the performance tests, test results and all remedial works shall be documented in the laboratory report.
- M. Water Test
Water test shall be carried out on the mock-ups after the performance test in the Laboratory.

1.7.2 Curtain Wall and Glass Wall

- A. Testing Sequence
- (i) Preload at 50 percent of inward design pressure.
 - (ii) Air infiltration and exfiltration.
 - (iii) Water infiltration under static pressure.
 - (iv) Water infiltration under cyclic static pressure
 - (v) Water infiltration under dynamic pressure.
 - (vi) Structural test at 50 percent and 100 percent of inward design pressure.
 - (vii) Structural test at 50 percent and 100 percent of outward design pressure.
 - (viii) Repeat water infiltration under static pressure.
 - (ix) Structural load tests to satisfy the requirements of the Hong Kong Codes per APP-37.
 - (x) Structural test at 75 percent of inward design pressure.
 - (xi) Structural test at 150 percent of inward design pressure.
 - (xii) Structural test at 75 percent of outward design pressure.
 - (xiii) Structural test at 150 percent of inward design pressure.
 - (xiv) Concentrated load test of BWU tieback.
- B. Air Infiltration Test
Air leakage test shall conform to ASTM E283, modified to include measurement of exfiltration. Differential static test pressure shall be 300Pa. Chamber leakage shall be accurately determined, not estimated. Air infiltration and exfiltration of fixed wall area shall not exceed $1.6\text{m}^3/\text{hr}/\text{m}^2$ of projected exterior surface, exclusive of operable window and door areas.
- C. Static Water Infiltration Test
Static water infiltration test shall conform to ASTM E331. Differential test pressure shall be 20% of the maximum inward design wind load but not less than 0.77KPa. There shall be no unacceptable water leakage as defined therein. Sources of water leakage shall be identified.

- D. Cyclic Static Water Infiltration Test
Cyclic static water infiltration test shall conform to AS/NZS 4284. Differential test pressure shall be 20% of the maximum inward design wind load but not less than 0.77KPa. There shall be no unacceptable water leakage as defined therein. Sources of water leakage shall be identified.
- E. Dynamic Water Infiltration Test
Dynamic water infiltration test shall confirm to AAMA 501.1-83 except as otherwise specified herein. Other standards may be proposed by the Sub-contractor at time of tender for acceptance by the Architect. Differential test pressure shall be 20% of the maximum inward design wind load but not less than 0.77KPa. There shall be no unacceptable water leakage as defined herein. Sources of water leakage shall be identified.
- F. Structural Test ASTM E330
Structural tests shall conform to ASTM E330. Deflection gages or transducers shall be set to zero prior to each application of pressure at 50, 75, 100 and 150 percent of design pressures. Deflection readings shall be recorded after each application of pressure. Deflection measurements are not required for initial preload. Specified deflection and set limitations apply to one application of pressure, not to cumulative effects of two or more loadings.
- G. Structural Tests to Satisfy Hong Kong Codes per APP-37
Skylight and glass wall systems with no previous test history, except those with similar support and design pressures, will be required to undergo a safety test to confirm that they will perform satisfactorily during service. In this project, it will be necessary to perform either the cyclic test or the static load test on the mock-up as stated in PNAP 106.
- H. Concentrated Load Tests for BMU Tieback
(i) Apply the loads in the direction specified under the performance requirements.
(ii) Apply for at least time specified under performance requirements.
(iii) There shall be no failure, deflection or permanent deformation as specified.
- I. Water Leakage
Water leakage is acceptable only if all of the following conditions are satisfied: (a) water is contained and drained to exterior; (b) there is no wetting of a surface that would be visible to building occupants; (c) there would be no staining or other damage to completed building or its furnishings. This definition of water leakage governs over other definitions which may appear in referenced standards and codes.
- J. Successive Water Infiltration Tests
Where test sequence or test failure requires successive water infiltration tests, the only means used to drain water from internal cavities shall be gravity drainage through weep system for a minimum of 15 minutes. Air pressure, removal of parts or other means of draining water shall not be used.

1.7.3

Glass Visual Mock-ups

- A. External of Mock-ups
As soon as possible after the award of the contract but no later than 60 days after the confirmation of the glass types and colours, provide at a site located in Hong Kong at or near the Contractor's factory and approved by the Architect a visual mock-up consisting of a full size vision light from curtain wall (as per drawings VM-01), from the project glass fabricator for the largest size of each proposed glass type, each mounted vertically in the same plane with capability of rotation about a horizontal axis at midpoint of the glass. Provide production quality, thickness, tint, coatings and heat treatment. All glass

mock-ups must be approved prior to fabrication of project glass.

- B. Review for Distortion
Owner and Architect shall inspect glass samples for flatness, as evidenced by appearance of reflected image. If transmitted and reflected image is acceptable, glass samples shall be retained as an acceptance standard for production material. If reflected image is unacceptable, provide additional samples for inspection until acceptable reflected image is obtained.
- C. Review Colour Match
Owner and Architect shall inspect glass mock-ups for appearance match against submittals for vision and spandrel glass. If match is acceptable, glass samples shall be retained as an acceptance standard for production material. If match is unacceptable, provide additional sample until acceptable appearance match is achieved.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protection
 - (i) All material shall be properly packed for shipping, handling and storage to protect if from damage.
 - (ii) All exposed Aluminum shall be protected with non staining and non marking heavy duty adhesive plastic film until prior to final cleaning on site.
- B. Storage
All materials shall be properly stored until use, to preclude damage.
- C. Replace damaged materials.

1.9 SEQUENCING

- A. Coordinate with requirements of material and personnel hoists. Defer installation at obstructed and left our areas in coordination with the main contractor.

1.10 WARRANTY

- A. System Warranty
Provide written warranty agreeing to repair or replace defective materials an workmanship during warranty period. Defective materials and workmanship include, but are not limited to:
 - (i) Abnormal deterioration, aging or weathering
 - (ii) Water leakage
 - (iii) Air leakage exceeding specified limits
 - (iv) Failure of operating parts to function normally
 - (v) Structural failure
 - (vi) Sealant (including structural silicone) loss of adhesion, loss of cohesion, cracking or discoloration
 - (vii) Disengagement of gaskets, weather-strips and snap engage components
 - (viii) Deterioration or discoloration of aluminum finish
 - (ix) Glass breakage including: secondary breakage caused by falling glass; spontaneous breakage of heat strengthened and tempered glass
 - (x) Failure of insulating glass edge seal as evidenced by frost, condensation, water, dust, corrosion or reflective coating damage within sealed air space
 - (xi) Insulating glass spacer migration
 - (xii) Loss of glass bite due to shifting of glass
 - (xiii) Loss of glass bearing on setting blocks due to shifting of glass and / or blocks
 - (xiv) Collapse of thermal insulation or safin insulation
 - (xv) Failure to meet specified performance criteria

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

- B. Exclusions
Warranty does not include damage caused by vandalism, or conditions exceeding the performance requirements. Warranty and its enforcement shall not deprive Owner of other action, right and remedy.
- C. Systems Warranty Period
Warranty period for entire system shall be ten (10) years after the end of the twelve (12) months Defect Liability Period or the issue of the Certificate of Making Good Defects, whichever is later. System Warranty includes materials and labor.
- D. Special Material Warranties
Certain materials are required to have Special Warranties. Special warranties shall not limit or reduce requirements of the System Warranty. Special Warranties may originate, in part or in whole, with manufacturers or fabricators and assignable through Subcontractor to Owner. Warranties as written or interpreted by manufacturers or fabricators shall not limit or reduce Special Warranty requirements of this specification.
- (i) Reflective glass whose reflective coating cracks, peels or discolors shall be replaced to no charge (material only) for minimum ten (10) year period beginning on date of manufacture.
 - (ii) Ceramic fritted glass whose frit cracks, peels, wrinkles, discolours, or stains shall be replaced at no charge (material only) for minimum five (5) year prior beginning on date of manufacture.
 - (iii) Paint which cracks, peels, fades in excess of specified limits or chalks in excess of specified limits shall be replaced at no charge (material and labor for application of the paint) for minimum ten (10) year period beginning on date of manufacture. Color changes shall not exceed 5E NBS units as defined by ASTM D 659 for specified Special Warranty period.
 - (iv) Structural silicone which loses adhesion, develops cracking, deterioration, discoloration, or cohesive failure shall be replaced at no charge (material and labor) for minimum ten (10) year period after the sealant has been installed.
 - (v) For clarity the date of manufacture define for the Special Warranty shall be before products which are newly manufactured specifically for this project. Products used which are from old inventory shall have the Special Warranty period starting from date of the material shipment for this project.
 - (vi) Water proofing on R.C. behind all facade works and on top of canopies which leaks shall be replaced at no charge (material and labour) for minimum of 10 years from Date of Practical completion of this Sub-contract's works.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel

- A. All steel shall conform to standards listed in this specification.
- B. Stainless steel shapes and sheet shall be AISI Type 302 for structural members only and type 316 for exposed cladding. Minimum thickness is: 1.5mm of frames; 0.79mm for trim covers; 0.30mm for concealed flashing.

2.1.2 Aluminum

- A. Acceptable alloy and temper combinations for extrusions subject to fabrication, finish and structural requirements are: 6063-T5; 6063-T6; 6061-T6. Other alloys of the 6xxx series and other tempers may be submitted for approval. Nominal wall thickness of 3.2mm or greater is acceptable for structural extrusions; wall thickness less than 3.2mm minimum nominal thickness may be acceptable and is subject to approval by the Architect. Minimal nominal wall thickness for non-structural trim shall be 1.6mm.

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

- B. Acceptable alloy and temper combination for sheet and plate subject to fabrication, finish and structural requirements are: 3003-H14; 5005-H14. Other alloys of the 3xxx, 5xxxx and 6xxxx series and other tempers and be submitted for approval. Provide 4mm thickness for aluminum cladding unless noted otherwise.
- C. All cladding panels shall have neatly cut square edges. All exposed corner bends shall have "V" shape groove cut at back of bend to allow a minimum radius bend unless approved by architect otherwise.

2.1.3 Glass

- A. Standards
 - (i) Flat glass shall conform to ASTM C1036, quality q3.
 - (ii) Heat-treated flat glass shall conform to ASTM C1048, except that surface compression of heat strengthened glass shall be in the range 24000 to 45000KPa.
 - (iii) Tempered glass shall conform to APP-37.
- B. Provide Tempered Glass at the Following Locations
 - (i) Doors.
 - (ii) Fixed and operable glazing with vertical edge within 30cm of a door in closed position and with bottom edge less than 150cm above walking surface.
 - (iii) Fixed glazing with area exceeding 0.83 square meters, with lowest edge less than 45cm above a walking surface, top edge more than 90cm above walking surface, with walking surface within 90cm of glass; safety glass is not required if there is a horizontal member with minimum 40mm width located between 60 to 90cm above walking surface.
 - (iv) Additional locations required by code.
- C. Use of Tempered Glass
 - (i) All glass shall be heat strengthened. Provide fully tempered glass only where safety glass is mandatory by regulations or stated in specification.
 - (ii) Heat soap test shall be carried out where tempered glass in use.
 - (iii) Full Time Technically Competent Person (TCP) in Contractor Team shall be attended the Contract is to allow the cost and provide all travel and related living expenses of all streams of TCPs (Registered Structural Engineer & Authorized Person).
- D. Glass Reflective Coatings
 - (i) Pinholes with diameter exceeding 1mm not acceptable.
 - (ii) Clusters of pinholes are not acceptable.
 - (iii) Scratches shall not have length exceeding 75mm and are permitted only within 75mm from an edge.
- E. Glass Edge Quality
 - (i) Shark teeth shall not penetrate more than half of glass thickness.
 - (ii) Serration hackle shall not penetrate more than 10 percent of glass thickness.
 - (iii) Flare shall not exceed 1.0mm as measured perpendicular to glass surface across edge.
 - (iv) Bevel shall not exceed 1.6mm.
 - (v) Flake chip depth shall not exceed 0.8mm and length or diameter shall not exceed 6.0mm.
 - (vi) Rough chips are not permitted. Rough chips are those which exceed dimensional limits for flake chips.
- F. Double Insulating Glass

Insulating glass shall have double edge seals. Primary seal shall be extruded polyisobutylene continuously bonded to glass surfaces and desiccant filled metal spacer, including corners. Minimum width of primary seal shall 3.2mm. Secondary seal shall be

General Electric IGS 3723 or Dow Corning 982. Secondary seal shall completely cover spacer with no gaps or voids, and shall be continuously bonded to both plates of glass. Where insulating glass is supported by structural silicone, secondary seal shall be designed to transfer specified pressures from outdoor glass to indoor glass. Insulating glass shall have been tested in accordance with ASTM E774-92, and compliance with requirements of Classes C, B and A shall be indicated by a permanent label on spacer or glass using capital letters with minimum height 1.27mm: label must be visible after installation.

G. Glass Flatness Tolerances

In addition to conforming to ASTM C1048, heat treated glass shall conform to the following flatness tolerances.

- (i) Bow and warp are defined as deviation of a glass surface from a true plane, with glass free-standing or installed in a frame and positioned in a vertical panel.
- (ii) Localized bow refers to any straight line segment on a glass surface with length of 300mm.
- (iii) Overall bow refers to any straight line segment on a glass surface which extends between opposite edges and is perpendicular to at least one edge. Length of line segment is gage length.
- (iv) Localized bow shall not exceed 1.6mm.
- (v) Overall bow shall not exceed: 1mm per 300mm gage length zero to 1000mm; 0.75mm per 300mm for gage length 1000mm to 2400mm; one half of the values listed in ASTM C1048, Table 2 for gage lengths exceeding 2400mm.
- (vi) Where heat treating results in parallel ripples or waves, maximum peak-to-valley deviation shall not exceed 0.127mm. Requirements for localized bow and overall bow shall also be satisfied. Direction of ripples shall be consistent throughout building.
- (vii) Specified bow and ripple tolerances are intended as manufacturing quality control limits. Refer to requirements for Glass Visual Mock-ups, which involve flatness, color, and appearance match of vision and spandrel. Glass visual mock-ups are the primary means of confirming acceptable glass appearance in the field.

H. Spontaneous Breakage

Heat treated glass shall be subjected to quality control measures to minimize inclusions which could result in spontaneous breakage. Such inclusions are defined as material defects by this specification. Installed heat treated glass which experiences spontaneous breakage shall be replaced (material and labor) under warranty provisions.

I. Glass Opacifier

Opacifier glass shall be opacifier with ceramic frit of a colour and pattern to be selected by the architect and a pattern as defined in the drawings and specifications.

J. Vision and Opacified Glass Type

(i) Mullion Glass Wall (ii) Glass Wall Sliding Glass Door (iii) Opacified Glass Cladding (iv) Balustrade Glass (v) All glass thickness specified above are the minimum thickness to meet the architectural standards. The minimum thickness of all glass to meet all the loading requirements shall be determined and provided by Contractors.	minimum 24mm insulated glass with minimum 6mm heat strengthened silver on clear glass plus minimum 6mm heat strengthened clear glass with low E coating. minimum 15mm tempered clear glass. minimum 10mm laminated glass with reflective on 2nd surface and opacified on 4th surface minimum 19mm tempered clear glass.

Notes: Curtain wall shall fulfill Residential Thermal Transfer Values (RTTV), visible light

transmittance (VLT_{Glass}) and external reflectance (ER_{Glass}) requirement as stated in PNAP APP-156.

2.1.4 Glazing System

- A. Gasket
Gasket system shall consist of a dense gasket against one glass face, and a sponge gasket against the other glass face. Refer to Glazing Materials and Glazing regarding injection molded corners and sealing of gasket corner joints.
- B. Structural Silicone
Structural silicone system shall consist of structural silicone at interior glass face, and an exterior silicone weather seal. At glass edges not supported by structural silicone, provide gasket system; either or both gaskets may be replaced by a recessed backer and silicone seal. Refer to FABRICATION regarding shop assembly of four-side structural silicone system.
- C. Butyl Tape
Butyl tape system is acceptable only for operable windows with glass area less than ten square feet. Provide recessed butyl tape at exterior with silicone cap seal, and dense gasket at interior.
- D. Setting Block
Weight of each glass unit shall rest on setting blocks which are supported by a metal frame. Stacking of glass units over a shared dead load support is not acceptable.

2.1.5 Elastomeric Gaskets, Weatherstrips and Blocks

- A. Gaskets and Weatherstrips Except at Structural Silicone
 - (i) Sponge gaskets shall be extruded black neoprene with hardness of 40 +/- 5 durometer Shore A and conforming to ASTM C509. Design sponge gaskets to provide 20% to 35% compression.
 - (ii) Dense gaskets shall be black extrusions with Shore A hardness of 75 +/- 5 for hollow profiles and 60 +/- 5 for solid profiles, and conforming to ASTM C864. Outdoor gaskets shall be neoprene. Indoor gaskets shall be neoprene, or EPDM. Where indoor and outdoor gaskets are reversible for reglazing, EPDM shall not be used for either gasket unless approved by the Architect.
 - (iii) Injection mold corners of gaskets where compatible with installation procedures.
 - (iv) Gaskets shall be designed to produce glass edge pressure of 0.70 to 1.75 N/mm.
- B. Glazing Gaskets Within Glazing Pockets
Glazing gaskets, sealant backers within glazing pockets, and continuous glass spacer pads at structural silicone shall be black heat cured silicone rubber conforming to ASTM C1115, Type C.
- C. Silicone Gaskets and Sheets
Silicone gaskets and sheet used to absorb movement at expansion joints shall conform to ASTM C1115, Type T.
- D. Fixing of Gaskets, Weatherstrips and Backers
Gaskets which maintain glass face clearance while serving as a backer for a silicone weather seal may have a friction fit. All other gaskets and weatherstrips, including backers for structural silicone, shall have a continuous spline or a continuous groove which engages a matching groove or leg on the aluminum frame.
- E. Glazing Tape
Norton V2100 Thermalbond tape is acceptable as a glass spacer pad when used in conjunction with structural silicone, subject to verification of compatibility.

F. Setting Blocks

- (i) Setting blocks shall be dense extruded neoprene, silicone or EPDM with hardness of 85 +/- 5 durometer Shore A, minimum length 102mm, and minimum width corresponding to glass thickness. Setting blocks shall be equidistant from glass centerline. Location of setting blocks at glass quarter points is acceptable. Distance from vertical glass edge to nearest edge of setting block shall not be less than 150mm, or 0.125 times glass width, whichever is greater.
- (ii) Shims used in conjunction with setting blocks shall be of the same material, hardness, length and width as the blocks.
- (iii) Setting blocks and chairs shall be secured against migration.
- (iv) Silicone setting blocks are required where structural silicone occurs at sill.
- (v) Silicone setting blocks are acceptable for insulating glass units with silicone edge seals. Neoprene or EPDM setting blocks are acceptable if permitted by glass fabricator and if structural silicone does not occur at sill.

G. Side Blocks

- (i) Provide side blocks at both jambs, between midheight and top corner of glass. Blocks shall be 55 +/- 5 durometer Shore A dense neoprene, silicone or EPDM. Block width shall be 3mm less than nominal glass edge clearance.
- (ii) Side blocks are not required where glass is continuously sealed with silicone at two or more edges.
- (iii) Extruded silicone side blocks are acceptable for insulating glass units with silicone edge seals. Neoprene or EPDM side blocks are acceptable if permitted by glass fabricator.

2.1.6

Anchors in Concrete and Masonry

A. Corrosion Protection

Anchors embedded in concrete and masonry shall be prime painted or hot dip galvanized rolled steel, or hot dip galvanized cold formed steel. All embedded anchors which may be exposed to moisture shall be hot dip galvanized.

B. Design Requirement

Strength of embedded anchors shall be developed by integral projections, welded deformed bars, or headed studs.

C. Through Bolts

At masonry, through bolts are acceptable provided that bearing plates are used at both masonry surfaces. Expansion bolts are acceptable provided they are designed for use in masonry.

D. Expansion Bolts

Expansion bolts are acceptable at concrete, and shall be stainless steel.

E. Self drilling, self threading screws are not acceptable. Screws in plugs and powder actuated fasteners are not acceptable.

2.1.7

Fasteners

A. Requirements Applicable to

Fastener requirements are applicable to screws, bolts, nuts, washers, rivets and pins.

B. Fasteners in Contact With Stone

Fasteners in contact with stone shall be stainless steel type 302 or 304.

C. Corrosion Protection

Fasteners outboard of or within a glazing pocket, gutter, flashed cavity or other potentially wet location (after completion of construction shall be stainless steel type

316. Fasteners inboard of potentially wet locations shall be stainless steel type 302 or 304 carbon steel with zinc plating, cadmium plating or Stalgard coating.

- D. Lock Washers
Provide lock washer or other locking device at all bolted connections.
- E. Powder actuated Fastness
Power actuated fasteners are not acceptable.

2.1.8 Shims

- A. Design Requirements
 - (i) At connections subject to movement, separate moving surfaces with friction reducing pads. Pads shall have minimum 1.6mm thickness, shall sufficiently reduce friction to permit movement, shall be resistant to wear, and shall be positively retained in position (open ended slots are not acceptable). Pads shall not be subjected to heat damage from welding or cutting, or to excessive pressure from over tightening of bolts.
 - (ii) Shims which transfer shear forces (tending to slide one shim against another) shall be steel plates, set in staggered pattern and fillet welded to each other and to adjacent steel surfaces. Shims and welds shall be structurally designed to support applied loads.
- B. Plastic Shims
Plastic shims are acceptable at static connections for which shims transfer only compressive forces. All plastic used for shims shall be of thermalset type.
- C. Wood Shims
Wood shims are not acceptable.

2.1.9 Weep hole Filters

Weep hole filters shall be 8 to 18 pores per centimeter PVC coated open cell urethane foam, compressed 30 to 50 percent.

2.1.10 Sealants

- A. Acceptable Products - for Nonstructural Seals
Acceptable products (subject to tests) for nonstructural seals are: General Electric Silpruf; Dow Corning 790, 795 and 995; Tremco Spectrem 1 and Spectrem 2.
- B. Acceptable Products for Structural Seals
Acceptable products (subject to tests) for structure seals are: Dow Corning 795, 983 and 995; Tremco Proglaze II; General Electric SSG 4000 and SSG 4400. Products requiring mixing of components are acceptable only for shop application.
- C. Run-off Stain Resistant Sealant
In exposed cladding and curtain wall areas, all weather sealant shall be Dow Corning 991.
- D. Other Sealants
Data sheets for and samples of other sealant any be submitted for approval. Oil base sealant are not acceptable.
- E. Back-up Material
Sealant back-up materials shall be polyethylene foam, urethane foam or extruded silicone as recommended by sealant manufacturer. Back-up shall not absorb water.

- F. Coordination for Compatibility
Coordinate with works of this subcontract and other sections to assure compatibility of intersecting sealant and with other materials and surfaces.
- G. Colours
Sealant color(s) shall be as selected by the Architect.

2.1.11 Thermal Insulation

- A. Material
Insulate spandrels and other non vision areas with USG Thermafiber or approved equal having 63mm minimum nominal thickness. Insulation can have an adhered 12.7 micron aluminum foil facing, 45.8 micro glass fibers spaced at not more than 19.0mm in a rectangular grid, and 38.1 micron polyethylene film. Edges of the aluminum foil on the inside of the insulation alone shall be 0.53inch (38.1 micron) polyethylene film. Edges of the aluminum foil on the inside of the insulation shall not be taped to prevent proper ventilation of the insulation. Minimum U-value for insulation alone shall be 0.53 W/square meter-K (0.10 BTU/square feet-F-h).
- B. Retainment
Insulation shall be retained by aluminum or galvanized straps, or internal pockets within window frames. Maximum spacing of straps shall be 610mm. Welded or glued impaling 300 center to center in any direction, and adhere with silicone sealant. Maintain 25mm nominal air space between insulation and glass.
- C. Bracing
Brace insulation where it contracts fire safing insulation, to prevent compression of insulation from pressure exerted by safing.

2.1.12 Fine Stop Insulation

- A. Material
Fill void at floor and roof edges with USG Thermafiber Safing Insulation or approved equal. Thickness shall be 102mm minimum top to bottom.
- B. Support
Support fire stop insulation with minimum 1mm thick continuous galvanized steel sheet which shall butt against a solid substrate and be sealed to form a continue smoke seal.

2.1.13 Non Vision Area Back Pan

- A. Location
All non vision glass or cladding areas shall be blank-off with a sealed in place metal backpan which may serve as the air and vapour barrier. The vapour barrier shall be on the exterior side of the insulation.
- B. Material
Backpan shall be aluminum sheet or minimum 1.2mm thick zincalume, (zinc / aluminum coated steel) unless noted otherwise.
- C. Finish
 - (i) All aluminum backpans behind non vision glass or cladding need not have any finish coating applied.
 - (ii) All zincalume backpans shall be finished on the external side with a dark grey colour coating which shall meet requirements of AAMA 605.2.

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

2.1.14 Primers

- A. Separation Between Aluminum and Masonry and Concrete
Coat aluminum surface in contact with masonry, concrete or steel with prime paint or bituminous paint.
- B. Prime Paint
 - (i) Prime paint steel parts of anchors, embedded anchors reinforcement and supports. After field welding, remove weld slag and touch up primed surface.
 - (ii) Provide minimum dry film thickness of one mil (0.0254mm) for paint and 30 mils (0.762mm) for bituminous paint. Prime paint shall conform to GSA specification TT-P-645.

2.1.15 Glass Doors

- A. Glass Doors
All glass door shall be minimum 12mm tempered clear glass, with all exposed edges chamfered, grinded smooth and polished, or with aluminium frame and approved painted finish.
- B. Hardware
All hardware shall be heavy duty stainless steel with a custom finish and manufactured by 'Dorma Door Controls Pte. Limited' or European origin, or approved equivalent. The following hardware shall be provided for each door:
 - (i) Floor spring – Dorma BTS80 or approved equivalent to come with a reinforcing underplate under the cover plate.
 - (ii) Patch fitting with pivot hinge.
 - (iii) Lock at bottom rail with stainless steel socket for recess mounting in floor finish. Patch lock to be added at top only if required for structural stability of door when in locked position.
 - (iv) Door stop on internal and external side of door and floor mounted.
 - (v) Push / pull handle shall be as per architects drawings.
 - (vi) Bottoms seal at base of each door to be neoprene weather strip.
 - (vii) All hardware shall be finish with a bead blast satin finish which shall be done by one finisher to achieve a uniform appearance.
 - (viii) A range of coarseness of the bead blast finish shall be submitted by the Sub-contractor to the Architect for selection.

2.1.16 Concealed Flashing

- A. Material
Acceptable materials are neoprene sheet, stainless steel sheet and mill finish aluminum sheet. Minimum thickness are 1.6mm for neoprene, 0.30mm for stainless steel, and 1.02 for aluminum. Aluminum is required to have a bituminous coating where it contacts dissimilar materials.
- B. Joints
Provide sealed lap joints, end dams and transitions to gutters. Provision to allow for thermal and other movements shall be made to ensure the weatherseal will last for the facade's design life.
- C. Gutters
Neoprene sheet is not acceptable for primary gutters, which shall be aluminum or stainless steel.

2.1.17 Gondola Restraint Tieback

Tiebacks shall be stainless steel type 316 sockets with quick release pins, and lanyards which are adjustable in length. Pins and sockets shall be same type as used for tower curtain wall,

PARTICULAR SPECIFICATION
DESIGN, SUPPLY AND INSTALLATION OF
ALUMINIUM WINDOWS

and pin diameter shall be at least 10mm. Provide sockets at locations shown on architect's drawings.

2.1.18 Spare Stock

A. General Requirements

Upon completion of construction, deliver to a designated storage area spare materials for maintenance and repair. Materials shall conform to the same requirements as material used for construction.

The replacement standby materials shall be stored in clearly labeled protective boxing and / or crates and positioned on support frames and / or storage racks which are placed in appropriate locations as directed by the Architect to ensure the material will not be damaged or deteriorate.

B. Glass

For the tension rod truss skylight and glass wall: 1 sheet of glass for all different glass sizes, with all bolt fixing holes ready for future installations.

C. Aluminum Extrusions

Aluminum extrusion works: sufficient quantity to replace two times the largest module for all extruded aluminum canopy and signband trims.

2.1.19 Painted Aluminum Finish

A. Painted aluminum finish shall be factory oven cured four cured coat finish based on Kynar 500 Fluoropolymer resin. Paint shall be supplied by a licensed formulator.

B. Application of finish shall be performed under specifications issued by licensed formulator, by an applicator specially approved by formulator.

C. Formulation shall have at least 70% Kynar 500 resin in residual solids.

D. Color shall match approved samples. Samples shall show extremes of color range.

E. Pretreatment of metal surfaces shall be done in accordance with procedures recommended by formulator.

F. Pigmented organic coatings for extrusions, structural shapes, sheet or plate, shall be spray applied in the factory, and shall meet requirements of AAMA 605.2-92.

G. Field touch-up of painted aluminum is permitted only with written permission from the Architect. Unless touch-up is authorized, replace damaged material with new material.'

H. The following colours are to be provided.

Colour Number 1 - Metallic Champagne Gold

Colour Number 2 - Dark Grey

I. All aluminum panels shall be fabricated before painting to avoid crazing of paint coating at bent corners.

2.1.20 Aluminum Finish at Structural Silicone

A. Mill finish is not acceptable at structural bonding surfaces.

B. Aluminum surface to which structural silicone will be adhered shall have a finish which demonstrates by test the ability to satisfy specified requirements. Subject to testing, acceptable finishes are as follows:

(i) Kynar 500 paint conforming to AAMA 605.2.

- (ii) Anodized finish.
- (iii) Alodine conversion coating.

2.1.21 Steel Finishes

- A. Cold formed carbon steel with thickness 0.168inch (4.27mm) or less and all steel which may be exposed to moisture shall be hot dip galvanized to meet or exceed requirements of classification BS729.
- B. Cold formed carbon steel with thickness exceeding 0.168inch (4.27mm) and hot rolled steel shall be prime painted tin conformance with GSA Specification TT-P-645, or hot dip galvanized in conformance with BS729. All exposed steel work shall be cleaned, primed and painted with 2 coats of polyurethane paint to manufacturer's specifications.
- C. Exposed steel mullions shall be free from surface dents, deep scratches, weld marks and other visible imperfections.
- D. Stainless steel exposed surfaces shall have a fine satin finish formed by bead blasting and with grade 316. Samples of various texture range shall be submitted to the Architect for selection and approval.

2.1.22 Waterproofing on R.C. Behind Glass Works

The Waterproofing on R.C. shall be carried out by Main Contractor.

- A. Material
The waterproofing on concrete surfaces shall be 'Vandex Super', applied in one coat to a density of 1.0kg/m², or a waterproofing with a single component cold applied emulsion containing natural latex rubber which once applied, dries to provide a waterproofing flexible film of at least 1.5mm thick. Submit manufacturer's literature and technical data for review at time of tender. The waterproofing sheet membrane on top of the canopy shall be by Grace or Tremco or approved equivalent.
- B. Generally
 - (i) The waterproofing works shall be carried out by a specialist applicator with minimum 7 years experience with scope of works similar to this project.
 - (ii) The Main Contractor shall be requested in writing to provide a list of the specialist applicator's opinion of factors that may affect the satisfactory execution or endanger the performance of his work.
 - (iii) Surfaces to receive waterproofing shall be examined by the specialist applicator / Sub-contractors and witnessed by Architect. Waterproofing work shall not commence until all defective surfaces have been rectified by the Main Contractor and accepted by the Sub-contractors.
 - (iv) The Main Contractor shall notify the Sub-contractor that his completion of application of waterproofing shall constitute his acceptance that the surface prepared by the Main Contractor is in proper condition.
 - (v) After such acceptance, the Sub-contractor shall be liable for rectifying all work and materials which are produced by installation of aluminium works. The Main Contractor shall provide all necessary waterproofing materials to MC.
 - (vi) The Main Contractor shall ensure and report to Architect that all works by other trades which have to penetrate the waterproofing have been properly installed after the Sub-contractor is informed to execute his work.
- C. Proprietary Waterproof Layer
 - (i) The proprietary waterproof layer shall be done according to directions and specification from the manufacturer.
 - (ii) Shop drawings, with full-size details of various types of junction, penetrations and the like, shall be prepared and submitted for the Architect's approval.

- (iii) The layer shall be able to withstand the specified degree of building differential movement free of defects.
 - (iv) Unless otherwise specified or explicitly stated to the contrary on drawings, proprietary waterproof layer shall be used at the following locations:
 - (a) External concrete surface behind metal, glass, and louver cladding.
 - (b) Roof upstands, parapets, and curbs with cladding or aluminum coping.
- D. Surface Preparation
Surface to receive waterproofing layer shall be prepared in full accordance with the manufacturer's requirement and has to satisfy the specialist applicator's requirements.
- E. Application
- (i) The membrane shall be applied in strict accordance with the manufacturer's instructions.
 - (ii) All penetration through the waterproof layer and vertical application of it shall be done in accordance with the approved shop drawings.
 - (iii) The Sub-contractor shall ensure that the completed work is properly protected and kept clean until it is inspected and accepted by the Architect before any subsequent work is carried out.

PART 3 FABRICATION AND EXECUTION

3.1 FABRICATION

- A. As far as practicable, fabrication shall be done in the shop.
- B. Exposed work shall be carefully matched to produce continuity of line and design. Joints in exposed work, unless otherwise shown or specified, shall be accurately fitted and rigidly secured.
- C. All cutting of exposed aluminum edges shall be done by machine to produce accurate and sharp edges. Ragged edges with burns or damaged paint finish is not acceptable.
- D. Except where otherwise shown, specified or directed, method of assembly and joining shall be at manufacturer's discretion.
- E. Welding shall be in accordance with standards listed in this specification and shall be done with electrodes and by methods recommended by suppliers of alloys being welded. Welds behind finished surfaces shall be done as to prevent distortion and / or discoloration on finished site. Weld spatter and welding oxides on finished surfaces shall be removed by desiccating and / or grinding.
- F. Unless otherwise shown or specified, weld beads on exposed surfaces shall be ground and finished to match and blend with finish on adjacent metal. Grinding and polishing of nonferrous metal shall be done only with clean wheels and compounds free from iron and iron compounds. Soldering and / or brazing are not acceptable.
- G. Provide exposed fasteners only where approved by the Architect. Exposed fastener heads shall be finished to match fastened material.
- H. Systems with glass supported at all edges by structural silicone shall be unitized and shall be fully assembled, including silicone and glass, in the shop.

3.1.1 Tolerances

Tolerances in current edition of Aluminum Association (American) "Aluminum Standards and Data" are applicable to finished, fabricated and assembled materials, except that flatness tolerance for fabricated aluminum sheet panels shall be as per the following. The definitions

for the dimensional tolerances are as defined in BS 485-3, Aluminum and aluminum alloys – sheets, strip and plate.

- (i) Width and Length – $\pm 1\text{mm}$
- (ii) Lateral Curvature – max. 0.0005 times the length of the edge.
- (iii) Panel Flatness:
 - Arch - max. 0.001 times the length
 - Buckles - max. 0.0017 times length of buckle
 - Edge wave - max. 0.0017 times length of edge wave

3.2 EXECUTION

3.2.1 Examination

- A. Verify that structure and site conditions are ready to receive work of this section.
- B. Establish lines and elevations.

3.2.2 Installation

- A. Install materials in accordance with approved drawings. Provide labor, material, equipment and supervision necessary for complete installation.
- B. Tolerances
 - (i) Provide anchor adjustment capability for full range of specified tolerances for building structure.
 - (ii) Work of this section shall be within the following tolerances.
 - (iii) Deviation from plumb, level or dimensioned angle shall not exceed 3.2mm per 3658mm of length of any member, 6.4mm in any total run in any line.
 - (iv) Deviation from theoretical position in plan or elevation, including deviation from plumb, level or dimensioned angle, shall not exceed 6mm total at any location. Change in deviation shall not exceed 3.2mm per 3658mm run in any direction.
 - (v) Maximum offset from true alignment between two consecutive members panel edges placed end to end shall not exceed 1.5mm.
 - (vi) Maximum offset between glass framing members at corners of glazing packet shall not exceed 0.8mm.
 - (vii) Maximum offset from true alignment for aluminum cladding or glass joints shall be 1mm.
- C. Anchorage
 - (i) Anchor component parts by bolting and welding. Install slip pads between moving parts.
 - (ii) Provide noncorrosive separators between dissimilar materials.
 - (iii) Remove weld slag and apply prime paint over welds. Prime paint exposed portions of embedded anchors. Touch up shop applied primer that is damaged by welding or other causes.
 - (iv) Where slots or oversize holes are provide for adjustment only, secure connection after final adjustment. Interlocking serrations in extruded aluminum brackets and washers are acceptable. Steel weld washers with 6mm minimum thickness are acceptable with steel brackets. Special washers or nuts which rely on friction and / or surface indentation of fastened part are not acceptable.
 - (v) Remove temporary shims and fasteners. Leave expansion joints free to move as designed.
- D. Clean and tape around surfaces to be sealed. Install backers, primers and sealant in accordance with drawings, test results as per manufacturer recommendations. Tool sealants as separation operation after application. Immediately remove masking.
- E. Install thermal insulation, vapor barrier, and safin insulation with specified supports.

3.2.3 Glazing

- A. Inspect frame for proper dimensions and squareness. Adjust frame and / or glass size as required to meet specified requirements.
- B. Clean glazing pocket before setting glass. Solvents shall be compatible with finished aluminum, glass and glazing materials. Setting blocks shall be equidistant from glass centerline. Location of setting blocks at glass quarter points is acceptable. Distance from vertical glass edge to nearest edge of setting block shall be located between midheight and top corner of glass. Side blocks, setting blocks and chairs shall be positively retained in position.
- C. Install gaskets with injection molded corners where indicated on drawings. Where gasket joints occur, tightly butt ends and seal with compliant sealant. Gasket joints shall not occur at locations other than corners.
- D. Inspect glass before installation. Do not install glass which does not conform to specification. Replace glass which is broken or damaged.
- E. Except as otherwise specified, comply with FGMA Glazing Manual provide minimum nominal glass bite of 13mm. Where joint movement will result in variable glass bite, increase nominal bite to provide 9.5mm minimum bite and 6 minimum edge clearance.
- F. Remove and replace stops and apply sealants as required for complete glass installation.
- G. Defer glazing of openings which are obstructed during construction. Glaze such openings when obstructions are removed.
- H. Clean, prime and mask at structural silicone joints during same work day on which silicone is applied.
- I. Temporarily clamp glass during cure of structural silicone. After sufficient cure, remove clamps and fill gaps in silicone.
- J. Mask glass and aluminum during application of structural silicone, remove masking immediately after tooling sealant.
- K. Structural silicone shall not be applied to edges of insulation glass units, or to edges of laminated glass units. Sealants used as weather seals shall not be placed against edge of laminated glass interlayer.
- L. All site glazing of structural silicone glazing to be done for remedial works only, or with the written approval of the Architect.

3.2.4 Adjustment

- A. Adjust operating windows and doors for proper fit within fixed frame.
- B. Adjust weatherstrips for continuous contact and seal in closed position.
- C. Adjust hardware for proper operation.

3.3 QUALITY ASSURANCE

3.3.1 General

- A. Sub-contractor's Responsibilities
The Sub-contractor shall be responsible for all quality control procedures necessary to

ensure that all materials, workmanship and finished elements conform with the requirements of this specification. Provide access to storage and manufacturing facilities for observation by Main Contractor, Owner and Architect.

- B. Quality Control Manual
The Sub-contractor shall prepare a manual documenting all quality control procedures followed, both as standard work practices, and to conform with the following quality control requirements. The minimum contents of this manual would be expected to include the quality control procedures outlined in this specification and those noted in the audit by the Main Contractor.
- C. Main Contractor Audit
An audit of the procedures shall be performed by the Main Contractor. Random regular inspections may be carried out by the Architect to confirm that the procedures are being followed.
- D. Adhesion, Compatibility and Stain Tests
 - (i) Provide to sealant manufacturers samples of all substrates which are in contract with sealant, regardless of whether adhesion must be achieved.
 - (ii) For substrates which must support adhesion, submit for record only sealant manufacturers' reports of adhesion test conducted in accordance with ASTM C794. Metal screen is an acceptable substitute for airplane cloth. Report shall specifically acknowledge suitability for structural silicone application where applicable.
 - (iii) For substrates which are in contract with sealant, submit for record only sealant manufacturers' reports of compatibility tests for sealants and primer conducted in accordance with ASTM C1087.
 - (iv) For stone, concrete, masonry and other porous materials submit for record only sealant manufacturers' reports of stain test performed in accordance with ASTM C1248.

3.3.2 Quality Control Procedures – Factory

- A. Off Site Audit by Main Contractor
 - (i) Off site audit of the Sub-contractor's adherence to the procedures in the factory is to be carried out by the Main Contractor.
 - (ii) At these visits the Sub-contractor's will be inspected and the factory quality control checklist will be completed for work currently being made. The progress of the factory quality control procedure will be monitored and a random inspection of stockpiled elements will be carried out. The packing of the elements for delivery to site will also be inspected.
 - (iii) Details of these visits will be recorded on a Quality Control – Factory Inspection Record. This record shows:
 - a. The element inspected during manufacture, together with the corresponding Factory Quality Control Checklist.
 - b. The Factory Quality Control Checklists reviewed and comments relating to the stockpiled elements that are inspected.
- B. Quality Control Checklist – Factory
The quality assurance checks shall include:
 - a. Aluminum components all assembled correct and true as per Architectural drawings and Sub-contractor's design drawings. Also check for design faults not obvious on drawings.
 - b. Appearance: damage, scratches or staining to aluminum frames or glass.
 - c. Silicone / sealants: continuous seal no gaps; cleaning, tooling and workmanship, bite sizes to drawings.
 - d. Handling / storage / transport to be carried out with no damage to elements. Any damage may result in rejection of elements.

- e. Test shop applied structural silicone by applying outward design pressure for at least 10 seconds. Test minimum 10 percent of units, using random selection throughout production. Record date of test, results and identification marking of unit tested. Mark each unit so that structural silicone batch numbers and dated of application can be traced. Submit the data for information only.

3.3.3 Quality Control Procedures – On Site

- A. On-site Audit by Main Contractor
An on-site audit of the quality control procedures of the Sub-contractor will be carried out by the Main Contractor.
- B. Quality Control Checklist – Site
 - (i) This inspection will be randomly done by the Main Contractor and fully done by the Sub-contractors which will include the inspecting of all steel and aluminum supports. Further installed elements shall be inspected as appropriate, and as listed below.
 - (ii) The quality control inspections will be recorded and submitted for information.
 - (iii) The items that will be covered during this inspection, as detailed on the recording sheet are:
 - (a) Tolerances
 - (1) face of adjoining panels
 - (2) width and alignment of horizontal joints
 - (3) width and alignment of vertical joints
 - (b) Defects to glass
 - (1) Cracks
 - (2) Chips and scratches
 - (3) Staining
 - (4) Consistency in colour and appearance
 - (5) Glazing bead installed correctly
 - (6) Orientation
 - (c) Sealing
 - (1) sealant joints filled and excess removed
 - (2) no obvious holes especially at junctions of non-typical details etc.
 - (d) Defects to aluminum
 - (1) panel surface dents and scratches
 - (2) edge damage
 - (3) orientation
 - (4) consistency of colour and appearance
 - (e) Installation
 - (1) accuracy of survey
 - (2) panel fixings and fixings to the structure
 - (3) trade clean off panels especially panel head transoms before erection
 - (4) proper flashing and water proofing
 - (5) cleaning and sealing
 - (6) removal of temporary fixings, spacers and packers
 - (f) Finishes
 - (1) sill board and drylining finish
 - (2) interior trims
 - (3) mullion and transoms
 - (4) flashings and copings
 - (g) Fire Resistant Construction
 - (1) fire stop insulation
 - (2) fire rated spandrel

- (iv) Method for field check for water leakage, but not interpretation of results, shall conform to AAMA 501.2-94, except as modified herein. There shall be no water leakage to any part of the interior. Provide powered scaffold, hose, water supply and manpower to perform at least one successful tests, plus any unsuccessful tests. The tension rod truss skylight and Entrance Hall canopy shall be tested as soon as the works is completed and available for such testing. A water spray shall be maintained on the glass roof and canopy roof for a minimum 10 minutes, and then allowed to dry for 15 minutes. This cycle shall be repeated 3 consecutive times. All gutter drains shall be temporally plugged up and the gutters flooded for 24 hours, after which they shall be inspected to ensure that no leakages have occurred. All tests shall be witness by the Architect, and a report shall be prepared and submitted by the Sub-contractor to document all tests. All gutters shall be tested before it is covered up by finish cladding below.
- (v) Periodically test sealants in place for adhesion, using methods recommended by sealant manufacturer. Promptly replace any sealant which does not adhere or fails to cure.
- (vi) Perform peel test on a least 10 percent of glass openings with field applied structural silicone. Record date, location and results. Submit records for information only. Replace silicone which fails tests.
- (vii) Test internal gutters by temporarily plugging weep holes and filing with water. After minimum of fifteen minutes, inspect for water leakage. Correct deficiencies and retest until successful tests are achieved. Remove weep hole plugs.

3.3.4 Reporting

- A. Factory
The Main Contractor's Factory Inspection Quality Control Checklists, together with the Sub-contractor Quality Control Checklists shall be reviewed during the contractual meetings.
- B. On-site
The On-site Quality Control Checklists, by both the Contractor and the Sub-contractor will also be reviewed at this meeting.
- C. Combined Defects List
A combined defect list should then be compiled which forms the reference for remedial work to be performed. Defects shall be corrected by the Sub-contractor.

3.4 PROTECTION AND CLEANING

- A. Protect materials and installation against damage and contamination. Clean surfaces as required to remove corrosive substances, during and at conclusion of construction. The method of protection shall be described in method statement. Special methods of protection shall be provided for the installed skylight and glass wall to prevent damage from ongoing construction works.
- B. Periodically remove from the site debris, excess materials and unused tools and equipment resulting from this work. At conclusion of construction, leave premises in clean condition. Sub-contractor is responsible for cleaning all works of this Sub-contract at completion.

PARTICULAR SPECIFICATION

TOWNGAS

TG1 TOWN GAS

TG1.1	Measurement of Excavations, Chases, Holes and Other Subsidiary Work
TG1.2	Measurement of Pipework
TG1.3	Measurement of Pressure Test of Existing Pipework
TG1.4	Measurement of Temporary Supply
TG1.5	Rates Generally
TG1.6	Rates for Pipework
TG1.7	Rates for In-line Pipework Equipment
TG1.8	Rates for Pressure Test of Existing Pipework
TG1.9	Rates for "Take Down and Clear Away" or "Take Down and Set Aside for Re-use"

TG1 TOWN GAS

TG1.1 Measurement of Excavations, Chases, Holes and Other Subsidiary Work

All trench excavation shall be measured separately and paid for at the appropriate rates under Excavation. All chases through existing walls, ceilings, etc. for tubing and pipes, (but not mortices or holes for brackets) shall be measured and paid for at the appropriate rates under Concrete Work, Brickwork and Blockwork or other applicable Work.

TG1.2 Measurement of Pipework

Pipework shall be measured in linear metres over all in-line fittings, short running lengths and branches.

TG1.3 Measurement of Pressure Test of Existing Pipework

Testing and commissioning including submission of Testing and commissioning Certificates and Records of Tests have been allowed in the rates under this Section. No measurement will be made for testing and commissioning except for pressure test of existing pipework where specifically ordered by the Maintenance Surveyor in writing.

TG1.4 Measurement of Temporary Supply

Where a temporary supply is ordered by the Maintenance Surveyor, the provision of all articles, labour and accessory materials (nails, screws, rawplugs and similar) necessary for fixing shall be of temporary nature. For "use and waste" of all materials, such as pipework, fittings and accessories, etc., for a period of not exceeding four weeks from the date of certified completion, 50 per cent of the value of the appropriate "supply and fix" items after the adjustment of contract percentage will be paid. For a period exceeding four weeks and not exceeding eight weeks, 55 per cent will be paid and for each subsequent month a further addition of 5 per cent will be made.

For a period of more than six months, the full rates, as for permanent works will be paid, and the materials will become the property of the Employer.

No extra payment will be made for the removal of materials in connection with the temporary supply, but the cost of which shall have been included in the payment as aforementioned in the first paragraph hereof. The date of certified completion of a temporary supply shall be the date when the installation is first brought into service. The date when it ceases to be used shall be the date from which the Maintenance Surveyor instructs the dismantlement of the installation, or the date when the installation is no longer in use, whichever is earlier.

TG1.5 Rates Generally

The rates for all items shall generally include for:-

- (a) Colour band and colour identification work.
- (b) Lettering and engraving for identification, signs, labels in both English and Chinese.
- (c) Identification plates, signs, notice plates, discs and labels in both English and Chinese.
- (d) Priming or painting off site and proprietary finishes or surface treatment applied as part of the production process whether applied before or after fabrication and assembly.
- (e) All protective and finishing painting work, apart from additional painting work specifically ordered by the Maintenance Surveyor in writing which shall be measured separately and paid for at the appropriate rates under Painting.

- (f) Any kind of fixing method including provision of screws, nuts, bolts, shims, washers, chips, brackets, hangers, supports and the like.
- (g) Provision of expansion joints in service runs wherever they coincide with structural expansion joints.
- (h) Submission of catalogues, technical literature, data, calculations, test certificates and approval documentation covering the equipment and materials being supplied.
- (i) Preparing and submitting detail working drawings as required and all shop drawings for the fabrication and installation.
- (j) Attendance, as required, of the manufacturers' representative to assist in the installation and subsequent testing and commissioning.
- (k) Testing and commissioning including submission of Testing and Commissioning Certificates and Records of Tests, except pressure test of existing pipework (Note: -Pressure test of existing pipework shall be measured separately if ordered by the Maintenance Surveyor in writing).
- (l) Provision of all necessary testing instrument of approved type for testing and commissioning.
- (m) Provision of mock-up work as specified.
- (n) Preparing and submitting operation and maintenance manuals and as-fitted drawings for items of works as required.
- (o) Provision of framed schematic diagrams c/w clear plastic front sheet and wooden back plate including fixing to wall.
- (p) Provision of manufacturer's guarantee.

TG1.6 Rates for Pipework

- (a) All short lengths, cutting and waste, and joints in the running length.
- (b) All pipework brackets, supports, hangers, guides, anchors and the like and alternative method of jointing and fixing as specified (if any).
- (c) All pipework fitting (e.g. bends, elbows, branches, reducers, tees, caps and the like) including connections, cutting and jointing pipes to fittings.
- (d) Screwed sockets, tappings, bosses and welding-necks welded to pipes or flanges including perforating the pipework or flanges.
- (e) Connections between pipework of different materials and differing grades of same material.
- (f) Wall, floor and ceiling plates.
- (g) All jointing including provision of flexible connections and / or necessary adaptors and connectors, welding consumable, jointing tapes, flanges, unions, gasket, bolts and nuts and the like where required.
- (h) Expansion loops and compensators including connections, cutting and jointing to pipes and fittings.

- (i) Provision of all sleeves for casting in our building in where pipes pass through slabs, walls or beams and caulking between pipe and sleeve where required.
- (j) Fixing in any position to floors, walls, and ceilings including laying in trenches and fixings in chases, ducts, false ceilings and similar positions, and wrapping with protective tape where required.

TG1.7 Rates for In-line Pipework Equipment

- (a) Cutting and jointing to pipes and fittings.
- (b) Stripping down repacking glands and preparing spindles, as appropriate, prior to installation.

TG1.8 Rates for Pressure Test of Existing Pipework

The rates for pressure test of existing pipework (including associated in-line fittings and in-line pipework equipment and the like) shall include for:-

- (a) De-gasing and cleaning of pipeline by any means necessary before carrying out any test.
- (b) All preparation work including temporary sealing ends of pipes and connections.
- (c) Provision of all necessary testing instrument of approved type for pressure test.
- (d) Provision of test record.
- (e) Submission of Surveyor Certificate as specified.
- (f) Making good all works disturbed.
- (g) Purging into service.

TG1.9 Rates for "Take Down and Clear Away" or "Take Down and Set Aside for Re-use"

- (a) Taking down all associated pipeworks and building services works (if any).
- (b) All in-line fitting including brackets, supports, hangers and the like.
- (c) Cutting into existing pipework in position.
- (d) De-gasing of existing pipework (including associated in-line fittings and the like) as required.
- (e) Plugging remaining ends of pipeworks and building services works (if any) to receive connections with new work if required.
- (f) Making good all works disturbed.

PARTICULAR SPECIFICATION

MOVEABLE PARTITION

PART 1 GENERAL

1.1 Product

Semi-Automatic

1.2 Model

The Partition Wall – consists of a series of individually operated, top hung panels with electric retractable seal operation with manual override via standard operating key

1.3 Acoustic Performance

Can be used to limit noise transmission between rooms, using optional dense cladding, optional internal insulation. The panels have been tested to achieve sound reduction ratings of up to Rw 53 dB, measured in accordance with EN ISO 140-3. Insulation typically related to panel weight. Average achieved site insulation typically less than laboratory conditions, due to flanking structures.

1.4 Panel General Requirements

- Panel Weight 50kg/m²
- Max. Panel Height: up to 9m as standard. Higher panels possible to special order.
- Panel Width: up to 1250mm as standard. Wider panels possible to special order. (minimum telescopic panel width is 800mm).
- Panel Thickness: 100mm

1.5 Head Track System and Configurations

Ceiling tracking shall consist of aluminum or cold rolled steel tracks with integral ceiling support, incorporating single or double wheel trolley. The track is to be supported by adjustable steel hanger bracket.

1.6 Operation

- Manual relocation of panels. Horizontal and vertical seals activated by a 24v electric motor concealed within panel thickness. Electrical supply to panels conducted through contacts in panel edge profiles. Remote master switching (to be within sight of TE panel, for safety).
- Mains connection by main contractor: 240v 13 AMP with isolated breaker and fused spur adjacent to control box, below ceiling level and adjacent to TE panel.
- The telescopic end panel (with nose extending to 120mm providing firm seal to Wall Jamb) is operated electrically; it is to achieve the final closure and to open up the partition wall to be stacked away.
- Retractable top and bottom seals, able to deal with floor level differences up to 20mm and shall be built using Scissor Action Jacking mechanism providing 2Kn of pressure for optimal acoustic performance.
- Inset Pass Doors, permanently hinged Full-height Doors and Double leaf Inset Pass Doors have recessed handles unless the Client otherwise specifies. Reduces overall acoustic insulation of installation.

1.7 Jamb Details

Female wall post (65mm x 100mm) and Male wall post (40mm x 100mm) are finished in clear anodized aluminum.

1.8 Head Fixing and Acoustic Baffling

Head track is typically suspended from a structural steel or concrete soffit with M10 galvanized steel rods at 450mm – 600mm centers. Can also be fitted directly to the soffit if required. Any acoustic baffling to ceiling and floor voids is designed to maintain the acoustic performance of the wall system.

1.9 Panel Construction

- Individual panel is constructed from aluminium / welded steel frame. Each panel shall be fabricated with panel surfaces of 1mm steel resiliently secured to the tubular frames with appropriate insulation to achieve specified Sound Transmission Class. The entire panel fabrication is non-combustible, dimensionally stable, with no protruding parts.
- The panels are to be clad on both sides with high quality MDF board and the MDF board should be conforming to the Formaldehyde Guidelines Emission Class E1. Minimum MDF board thickness is 12mm.
- Tongue and groove's vertical sides aluminum strip (in clear natural anodized) fitted with double acoustical seals. The panel is designed to be suspended at two points by dual high grade ball bearing trolleys. Which are Top-hung only, without floor tracks or guides. Sound insulation materials to the internal cavity as necessary to achieve the specific acoustic rating requirement.

1.10 Vertical and Horizontal Seals

- i) Vertical seals:
 - ♦ Panels consist of natural anodized aluminum tongue and groove elements. When panels are in a closed position, there will be a tighter joint in between with 8mm thick aluminum extrude profile corner bead each side.
- ii) Horizontal seals:
 - ♦ Top and bottom of the panel are fitted with black anodized extruded aluminum channels and housing with PVC seals, with a deflection of 35mm to be compensated by spring loaded telescopic arms which will stabilize panels as a single element when expanded. Extension for the Horizontal seals shall be able to accommodate 20mm to 50mm for the discrepancy for the finished flooring level.

1.11 Panel Finishes (including but not limited to)

- Suitable for internal use only with a wide variety of features and finishes.
- Melamine, Laminate, Wood Veneer, Drywipe, Magnetic Drywipe, factory-applied paint, MDF Primed (ready for decoration by others), Steel facing, Pin Board and Mirros.

1.12 Access Doors

- Single Inset Pass Door, Full-height Permanently Hinged Pass Door and Double Inset Pass Doors area available. Can either be finished as other wall panels or contrasting. Locking mechanism is available at the Clients request. Vision Panels manufactured to customer's requirements can be also be incorporated. Reduces overall acoustic insulation of installation.

1.13 Intersection of Multiple System

- Specification can include walls meeting to form corner junctions. 'T' or 'L' shape systems.

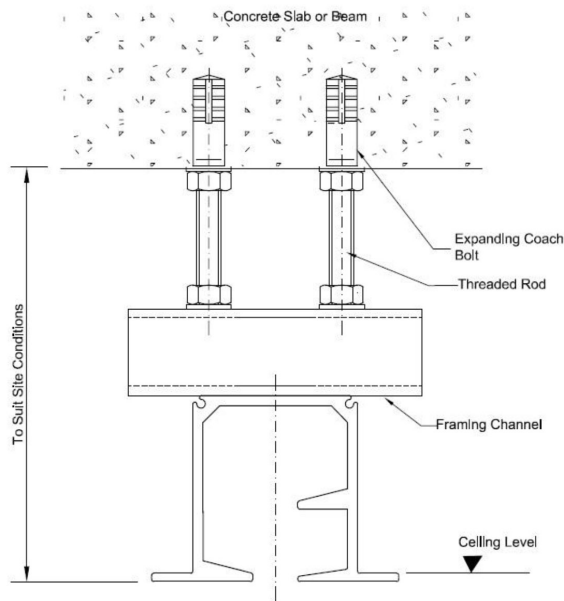
PARTICULAR SPECIFICATION
MOVEABLE PARTITION

1.14 Warranty

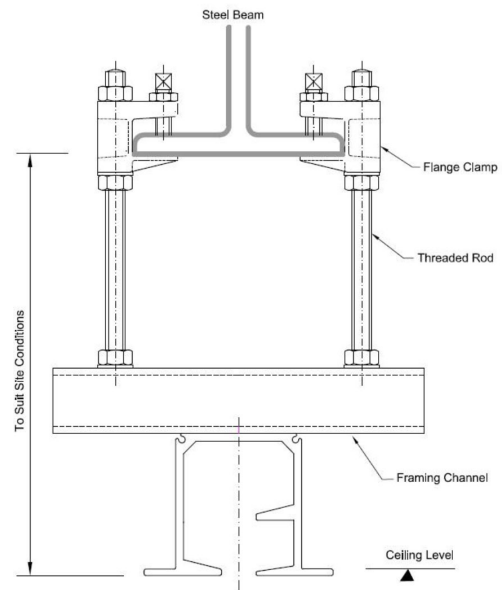
- The movable solid wall shall be fully guaranteed by the manufacturer against defects in workmanship or materials for a period of 12 months from date of installation.

1.15 Work by Others

- Floors shall be level in the path of the partitioning to a tolerance not exceeding $\pm 5\text{mm}$. the general contractor shall be responsible for rectification of floors outside this tolerance. Jams shall be plumb, the maximum variation of opening wide shall be $\pm 10\text{mm}$.



Typical Head Fixing to Concrete



Typical Head Fixing to Steel

PARTICULAR SPECIFICATION

LABORATORY FURNITURE

A. General

The Contractor shall design, supply, install and test the proprietary product / system all in conformity with the specifications as stated in the Preliminaries and all current amendments thereto, unless otherwise specified on the drawings or in this Particular Specification.

This Particular Specification shall be read in conjunction with the General Specification (GS) for Building, 2017 Edition, issued by Architectural Services Department with all current corrigenda / amendments thereto published before the date of first tender invitation for the Contract (GS) and all other relevant Particular Specifications.

In addition to the Standards and Codes of Practice stated in this Particular Specification, the Contractor shall comply with those specified in the GS. Where differences occur between codes, standards and criteria reference, and criteria requirement specified herein, the more stringent requirement shall govern unless otherwise agreed in writing by the Project Manager.

Notwithstanding the aforementioned design Codes of Practice, the Contractor shall not be relieved of his responsibility for providing a higher standard than the relevant Code of Practice or Standards where it is required to comply with this Particular Specification.

A.1 Scope of Works

A.1.1 The Contractor shall design, supply and install the proprietary laboratory furniture described under this Specification to the areas as shown on the drawings.

The Contractor shall also carry out the following:

- (a) Protection of all works by others against damage. Paying special attention to adjoining wall, floor, ceiling, skirting and service outlets, etc.
- (b) Checking all substrates and notifying the Project Manager immediately in writing for any areas that are not considered suitable for installing the furniture.
- (c) Protection of the installed furniture with boards, paper or film and final cleaning prior to the formal handover of the Project.

A.1.2 The proprietary laboratory furniture include the laboratory casework, side bench, island bench, sink, water tap, gas outlet, fume cupboard / hood and its blower and duct, eye-washing unit, and all their necessary components, fixings and accessories mentioned in this Specification.

B. Submittals

B.1 Product Data

Submit manufacturer's printed technical data, test reports with tested physical, chemical and performance properties, and installation instructions.

B.2 Shop Drawings

Drawings prepared specifically for this Project, showing locations and extent of the application, details for installation, joints and corner conditions, where appropriate.

B.3 Samples

A full range of catalogue and colour charts for each type of furniture.

B.4 Method Statement

Before on-site installation, the Contractor shall submit the method statement to detail the method and sequences of installation, tools employed, inspection and testing needed, etc. for the Project Manager's approval. The Contractor shall prepare the method statement in accordance with the

specifications, manufacture's recommendation and safety recommendations.

B.5 Manufacturer's Complete Company Detail
Full details of the company profile.

B.6 Project Reference(s)
List of related works project(s) taken in past five(5) years.

C. Technical Specification for Laboratory Casework and Its Accessories

Part 1 – General

1.1 Summary

Section includes:

- Steel casework;
- Table frames;
- Work surfaces;
- Sinks and outlets.

1.2 Casework Design Requirements

- (a) Flush Construction
Surfaces of doors, drawers and panel faces shall align with cabinet fronts without overlap of case ends, top or bottom rails. Horizontal and vertical case shell members (panels, top rails and bottoms) shall meet in the same plane without overlap, cracks or crevices.
- (b) Self-supporting Units
Completely welded shell assembly without applied panels at ends, backs or bottoms, so that cases can be used interchangeably or as a single, stand-alone unit.
- (c) Interior of Case Units
Easily cleanable, flush interior. Base cabinets, 30" and wider, with double swinging door shall provide full access to complete interior without center vertical post.
- (d) Drawers
Sized on a modular basis for interchange to meet varying storage needs, and designed to be easily removable in field without the use of special tools.
- (e) Case Opening
Rabbeted joints all four sides of case opening for hinged doors and two sides for sliding doors in order to provide dust resistant case.
- (f) Framed Glazed Doors
Identical in construction, hardware and installation to solid panel doors. Design frame glazed door to be removable for glass replacement.

1.3 Casework Performance Requirements

- (a) Structural Performance Requirements
Casework components shall withstand the following minimum loads without damage or permanent deformation to the component or to the casework operation:
 - ♦ Steel base unit load capacity: 500lbs. per lineal foot
 - ♦ Suspended units: 300lbs.
 - ♦ Drawers in a cabinet: 150lbs.
 - ♦ Utility tables (4 legged): 300lbs.
 - ♦ Hanging wall cases: 300lbs.
 - ♦ Load capacity for shelves of base units, wall cases and tall cases: 40lbs. per square

foot, up to 200lbs.

1.4 Quality Assurance

- (a) Single Source Responsibility
Casework, work surfaces, laboratory fume hood and equipment and accessories shall be manufactured or furnished by a single laboratory furniture company.
- (b) All casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. Independent third party testing must be submitted validating compliance and adheres to the architectural specifications.
- (c) Manufacturer's Qualifications
Modern plant with proper tools, dies, fixtures and skilled workmen to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:
 - ♦ ISO9001 certification;
 - ♦ Ten(10) years or more experience in manufacture of laboratory casework and equipment of type specified;
 - ♦ Five(5) installations of equal or larger size and requirements.
- (d) There would be one(1) year's maintenance on parts and labor for the laboratory casework from the date of substantial completion of the Project.

1.5 Delivery, Storage and Handling

- (a) Schedule delivery of equipment so that spaces are sufficiently complete that equipment can be installed immediately following delivery.
- (b) Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.

1.6 Project Conditions

- (a) Do not deliver or install equipment until the following conditions have been met:
 - ♦ Windows and doors are installed and the building is secure and weather tight.
 - ♦ Ceiling, overhead ductwork and lighting are installed.
 - ♦ All painting is completed and floor tile located below casework is installed.

1.7 Reference Standards

- (a) All casework, work surface and service fixture construction and performance characteristics shall be in full compliance with Scientific Equipment and Furniture Association (SEFA) standards. Independent, third party testing must be submitted validating compliance and adheres to the architectural specifications.
 - ♦ SEFA 1.2 – Laboratory Fume Hoods
 - ♦ SEFA 2.3 – Installation of Scientific Laboratory Furniture and Equipment
 - ♦ SEFA 3 – Work Surfaces
 - ♦ SEFA 7 – Laboratory and Hospital Fixtures
 - ♦ SEFA 8 – Laboratory Furniture

Part 2 – Products

2.1 Casework Materials

- (a) Sheet Steel
Mild, cold rolled and leveled unfinished steel.

- (b) Minimum gauges
 - 20 gauge: solid door interior panels, drawer fronts, scribing strips, filler panels, enclosures, drawer bodies, shelves, security panels and sloping tops.
 - 18 gauge: case tops, ends, bottoms, bases, backs, vertical parts, uprights, glazed door members, door exterior panels and access panels.
 - 16 gauge: top front rails, top rear gussets, intermediate horizontal rails, table legs and frames, leg rails and stretchers.
 - 14 gauge: drawer suspensions, door and case hinge reinforcements and fronts corner reinforcements.
 - 11 gauge: table leg corner brackets and gussets for leveling screws.
- (c) Glass for glazed swinging and sliding doors and / or unframed doors:
6mm (7/32") thick clear float glass

2.2 Casework Fabrication

- (a) Base Units and Cases
 - End panel and back, formed of one-piece, wraparound design.
 - Base units and 25", 31" and 37" high wall cases: end panels and back reinforced with internal reinforcing front and rear posts.
 - 49" and 84" high cases: formed end panels with front and rear reinforcing post channels; back shall be formed steel panel, recessed 3/4" for mounting purposes.
 - Posts: front post fully closed with full height reinforcing upright. Shelf adjustment holes in front and rear posts shall be perfectly aligned for level setting, adjustable to 1/2" o.c.
 - Secure intersection of case members with spot and arc welds, provide gusset reinforcement at front corners.
 - Base unit backs: provide drawer units without backs and cupboard units with removable backs for access to services behind units. And if necessary, provide fixed backs at all drawer and cupboard units.
 - Bottoms: base units and 25", 31", 37" and 49" high wall cases shall have one piece bottom with front edge formed into front rail, rabbeted as required for swinging doors and drawers and flush design for sliding doors.
 - Top rail for base units: interlock with end panels, flush with front of unit.
 - Horizontal intermediate rails: recessed behind door and drawer fronts.
 - Base for base units: 4" high x 3" deep with formed steel base and 11 gauge die formed steel gussets at corners. Provide 38" diameter leveling screw with integral bottom flange of minimum 0.5sq. in. area at each corner, accessible through openings in toe space.
 - Tops of wall cases: one piece, with front edge formed into front rail.
- (b) Drawers
 - Drawer fronts: 3/4" thick, double wall construction, pre-painted prior to assembly and sound deadened.
 - Drawer bodies: bottom and sides formed into one-piece center section with bottom and sides coved and formed top edges. Front and back panels spot welded to center section.
 - Drawer suspension: heavy duty coved raceways for both case and drawer with nylon tired, ball bearing rollers; self-centering and self-closing when open to within 3" of the closed position.
 - Provide drawer with rubber bumper. Friction centering devices are not acceptable.
 - File drawers: provide with 150 lbs. full extension slides for full access and operation.
- (c) Doors
 - Solid panel doors: 3/4" thick, double wall, telescoping box steel construction with interior pre-painted and sound deadened. Reinforce interior of front panel with welded steel hat channels. Hinges with screws to internal 14 gauge reinforcing in case and door. Hinges shall be removable; welding of hinges not acceptable. Doors shall

- close against rubber bumpers.
- ♦ Frame glazed doors: outer head to be one piece construction. Inner head to consist of top, bottom and side framing members which are removable for installation or re-placement of glass. Provide continuous vinyl glazing retainer to receive glass. In all other respects, framed glazed door construction and quality shall match solid panel doors.
- ♦ Sliding doors – solid or framed glazed: Design for tilt-out removal after removal of bottom guide. Doors shall be hung with nylon tired sleeve bearing rollers in formed steel top hung track and shall close against rubber bumpers.

(d) Shelves

- ♦ Form front and back edges down and back 3/4". Form ends down 3/4".
- ♦ Reinforce shelves over 36" long with welded hat channel reinforcement the full width of shelf.
- ♦ Pull out shelves: same suspension as specified for drawers.

(e) Hardware

- ♦ Drawer and hinged door pulls: aluminium / stainless steel wire finger pull or semi-recessed polypropylene pull.
- ♦ Hinges: institutional type, five knuckle projecting barrel hinges, minimum 2-1/2" long type 304 stainless steel. Provide two hinges for doors up to 36" high; three hinges for doors over 36" high. Drill each leaf for three screw attachment to door and frame.
- ♦ Door catches: adjustable type, spring actuated nylon roller catches.
- ♦ Locks and keying (option): based on customer's requirements.
- ♦ Label holders (option): formed steel with satin chrome finish, 1" x 1-1/2", screw installed.
- ♦ Shelf clips: die formed steel, zinc plated, designed to engage in shelf adjustment holes.
- ♦ Base molding: 4" black rubber or vinyl, to protect toe space of the cabinets.
- ♦ Corner base guards: 4" high black polypropylene corner guards.

2.3 Fixed Table and Mobile Table

(a) Table Frames

4-1/2" high "C" channel front and back aprons, end rails and cross rails.

(b) Table Drawers

Provide front and back rails; drawer unit, hardware and suspension same as specified for base unit drawers.

(c) Legs

2" x 2" steel tube legs with welded leg bracket. Attach legs with two bolts to front and back aprons and weld to end rails. Each leg shall have a recessed leveling screw and a black, coved vinyl or rubber leg shoe, 2" in height.

(d) Knee Space Frame

2" high apron where no drawers required.

(e) Leg Rails and Stretchers

Channel formed.

2.4 Metal Finish

(a) Metal Finish

- ♦ Preparation: spray clean metal with a heated cleaner / phosphate solution, pre-treat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.
- ♦ Application: electrostatically apply urethane powder coat of selected colour and bake

in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thickness:

- i. Exterior and interior exposed surfaces: 1.5 mil average and 1.2 mil min.
- ii. Backs of cabinets and other surfaces not exposed to view: 1.2 mil average.

(b) Metal Finish Performance Requirements

- Abrasion Resistance: maximum weight loss of 5.5mg per 100 cycle when tested on a taber abrasion tester #E40101 with 1000 gm wheel pressure and calibrase #CS10 wheel.
- Hardness: surface hardness equivalent to 4H pencil.
- Humidity Resistance: with stand 1000 hour exposure in saturated humidity at 100°F.
- Moisture Resistance:
 - i. No visible effect to surface finish after boiling water trickled over test panel inclined at 45°F for five minutes.
 - ii. No visible effect to surface finish following 100 hour continuous application of a water soaked cellulose sponge, maintained in a wet condition throughout the test period.
- Adhesion: score finish surface of test panel with razor blade into 100squares, 1/16" x 1/16", cutting completely through the finish but with minimum penetration of the substrate, and brush away particles with soft brush. Minimum 95 squares shall maintain their finish.
- Salt Spray: withstand minimum 200 hour salt spray test.

(c) Cabinet Surface Finish Chemical Tests

All casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. Independent, third party performance testing must be submitted validating compliance and adheres to the finish specifications.

Chemical Spot Test

1. Purpose of Test
 - The purpose of the chemical spot test is to evaluate the resistance a finish has to chemical spills.
2. Test Procedure
 - Obtain one sample panel measuring 14" x 24: (255.6mm x 609.6mm).
 - Place panel on a flat surface, clean with soap and water and blot dry. Condition the panel for 48-hours at 73±3°F / 23±2°F and 50±5% relative humidity. Test the panel for chemical resistance using forty-nine different chemical reagents by one of the following methods:
 - i. Method A – test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a one-ounce (29.574cc) bottle and inverting the bottle on the surface of the panel.
 - ii. Method B – test volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24mm watch glass, convex side down.
 - For both of the above methods, leave the reagents on the panel for a period of one hour. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24-hours at 73±3°F / 23±2°F and 50±5% relative humidity using the following rating system:
 - i. Level 0: No detectable change.
 - ii. Level 1: Slight change in colour or gloss.
 - iii. Level 2: Slight surface etching or severe staining.
 - iv. Level 3: Pitting, cratering, swelling, or erosion of coating obvious and significant deterioration.

Test #	Chemical Reagent	Test Method
1.	Acetate, Amyl	A
2.	Acetate, Ethyl	A

PARTICULAR SPECIFICATION
LABORATORY FURNITURE

3.	Acetic Acid, 98%	B
4.	Acetone	A
5.	Acid Dichromate, 5%	B
6.	Alcohol, Butyl	A
7.	Alcohol, Ethyl	A
8.	Alcohol, Methyl	A
9.	Ammonium Hydroxide, 28%	A
10.	Benzene	A
11.	Carbon Tetrachloride	A
12.	Chloroform	A
13.	Chromic Acid, 60%	B
14.	Cresol	A
15.	Dichlor Acetic Acid	A
16.	Dimethylformamide	A
17.	Dioxane	A
18.	Ethyl Ether	A
19.	Formaldehyde, 37%	A
20.	Formic Acid, 90%	B
21.	Furfural	A
22.	Gasoline	A
23.	Hydrochloric Acid, 37%	B
24.	Hydrochloric Acid, 48%	B
25.	Hydrogen Peroxide, 3%	B
26.	Iodine, Tincture of	B
27.	Methyl Ethyl Ketone	A
28.	Methylene Chloride	A
29.	Mono Chlorobenzene	A
30.	Naphthalene	A
31.	Nitric Acid, 20%	B
32.	Nitric Acid, 30%	B
33.	Nitric Acid, 70%	B
34.	Phenol, 90%	A
35.	Phosphoric Acid, 85%	B
36.	Silver Nitrate, Saturated	B
37.	Sodium Hydroxide, 10%	B
38.	Sodium Hydroxide, 20%	B
39.	Sodium Hydroxide, 40%	B
40.	Sodium Hydroxide, Flake	B
41.	Sodium Hydroxide, Saturated	B
42.	Sulfuric Acid, 33%	B
43.	Sulfuric Acid, 77%	B
44.	Sulfuric Acid, 96%	B
45.	Sulfuric Acid, 77% and Nitric Acid, 70% equal parts	B
46.	Toluene	A
47.	Trichloroethylene	A
48.	Xylene	A
49.	Zinc Chloride, Saturated	A

(d) Acceptance Level

Results will vary from manufacturer to manufacturer. Laboratory grade finishes should result in no more than four level 3 conditions. Suitability for a given application is dependent upon the chemicals used in a given laboratory.

Part 3 – Execution

3.1 Installation

(a) Casework Installation

- Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
- Bolt continuous cabinets together with joint flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.
- Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.
- Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8" between top units.

(b) Work Surface Installation

- Where required due to field conditions, scribe to abutting surfaces.
- Only factory prepared field joints, located per approved shop drawings, shall be permitted. Secure joints in field, where practicable, in the same manner as in factory, with dowels, splines, adhesive or fasteners recommended by manufacturer.

(c) Sink Installation

Sinks which were not factory installed shall be set in chemical resistant sealing compound and secured and supported per manufacturer's recommendations.

3.2 Adjusting

- (a) Repair or remove and replace defective work, as directed by Owner upon completion of installation.
- (b) Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.3 Cleaning

Clean shop finished casework, touch up as required.

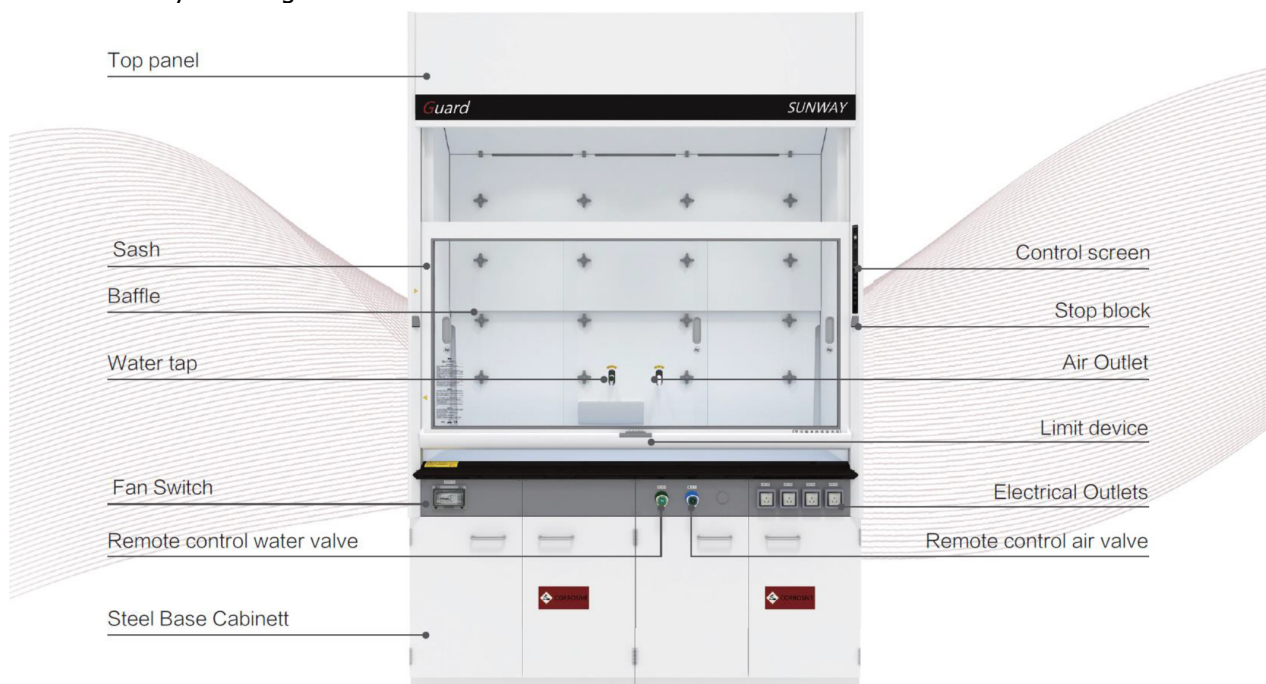
3.4 Protection of Finished Work

Provide all necessary protective measures to prevent exposure of casework and equipment from exposure to other construction activity.

PARTICULAR SPECIFICATION

FUME HOOD

1.0 Analytical Diagram



2.0 General Technical Requirements for Fume Hood

The materials and components used in laboratory fume extraction equipment, along with their installation, must meet the requirements specified in the documents and design drawings provided by the tender:

- 2.1 The supplier should be on the list of EMSD, Departmental Contractor List for Biomedical and Electronics Engineering Services – Cabinet, Microbiological.
- 2.2 The overall structure of the fume hood shall be constructed using high-quality cold-rolled steel plates and industrial-grade aluminum alloy profiles. (Combination structures of aluminum alloy profiles and wooden panels are not acceptable.)
- 2.3 The main support structure shall be made of full steel material with a thickness of $\geq 1.2\text{mm}$. the inner cavity shall be lined with anti-corrosion material, and the space below the work surface shall allow for the installation of utility pipelines and fittings.
- 2.4 To facilitate future maintenance, the top panel of the product shall have a quick-release structure for easy access during repairs.
- 2.5 All metal surfaces must be treated with a coating of $\geq 50\mu\text{m}$ thickness, ensuring a smooth and even finish. The coating must not exhibit any peeling, bubbling, dents, scratches, pitting, cracks, or sharp edges.
- 2.6 The coated metal surface shall have a high-gloss finish with high density, providing superior corrosion resistance. (Matte or wrinkled finishes are not acceptable.)
- 2.7 Pre-treatment processes shall include degreasing, water rinsing, acid washing, neutralization, phosphating, and water rinsing, or nano-ceramic pre-treatment technology.
- 2.8 Costing Performance and Chemical Resistance Test
The coated metal surface must pass the following tests, and a copy of the qualified test report from a third party institution, stamped with the manufacturer's seal, must be provided (Bonus Point):

- a. Adhesion Test
According to ASTM D3359-02, two sets of parallel lines spaced 1.6mm apart, each with six lines, shall be drawn perpendicular to each other, forming 25 squares. After applying adhesive tape and quickly peeling it off, no paint shall be removed.
- b. Humidity Test
The sample shall be placed at a 45 degree angle, and hot water shall be sprayed on the coated surface for 5 minutes. The coating shall shown no significant changes. The sample also be submerged in water for 100 hours with no visible changes.
- c. Hardness Test
According to ASTM D3363-05, the coating shall have a hardness of at least 4H pencil hardness.
- d. Salt Spray Test
According to EN ISO 9227:2017, the sample shall withstand 200hours of salt spray testing with no significant changes.
- e. Abrasion Resistance Test
According to ASTM D4060-14, the mass loss shall be $\leq 5.5\text{mg}$.
- f. Moisture Resistance Test/
The sample shall be placed in an environment of 100°F and 100% humidity for 1000hours with no significant changes.
- g. Chemical Resistance Test
According to SEFA 8M-2016, the coating shall resist 49 specified chemical reagents, with no more than 4 instances of grade 3 results.

- 2.9 All sheet metal seams shall be fully welded, and the welded areas shall be ground smooth to ensure a continuous, even surface. No sheet metal components shall be welded on-site to avoid damaging the epoxy resin coating.

3.0 Performance and Technical Requirements for Bench-Type Fume Hood

3.1 Compliance with ASHRAE 110-2016 Standard

A copy of the qualified test report from a third party testing institution, stamped with the manufacturer's seal, must be provided (Disqualification Item).

The AM test report must include at least the following test items and meet the specified technical requirements:

- a. Average Face Velocity
0.2m/s to 0.35m/s, with the maximum and minimum values deviating less than 15% from the arithmetic mean.
- b. Visualization – Small Smoke
No visible leakage or escape.
- c. Visualization – Large Smoke
No visible leakage or escape.
- d. Tracer Gas Concentration
The average leakage concentration shall not exceed 0.05ppm.
- e. Window Movement Impact
The average leakage concentration shall not exceed 0.05ppm.
- f. Peripheral Scanning
The average leakage concentration shall not exceed 0.05ppm.

Note: If the fume hood is equipped with an automatic door system, the system shall be turned off during testing, and manual operation shall be used.

3.2 Front Column Width

The width of the front columns shall be $\leq 85\text{mm}$ to provide more internal operation space (Disqualification Item).

3.3 Internal Height

The internal height of the fume hood shall be $\geq 1500\text{mm}$ (from the work surface to the top panel) to provide greater internal operating space (Bonus Point).

- 3.4 Work Surface
The work surface shall be made of ceramic with thickness $\geq 17\text{mm}$, with edges of at least 25mm. the surface shall be flat, with integrated water-resistant edges.
- 3.5 Inner Lining
The inner lining shall be made of auto-corrosion phenolic resin board with a thickness of $\geq 5\text{mm}$.
- 3.6 Baffle
The baffle shall be fixed with anti-corrosion plastic brackets, allowing users to easily remove and clean the baffle without tools. The brackets shall also support the installation of distillation racks.
- 3.7 LED Lighting
The top panel shall be equipped with energy efficient LED lights, providing soft, flicker-free illumination. The lighting device shall be separated from the internal space by a plastic panel, with an average illumination of $\geq 800\text{lx}$. A copy of the qualified test report from a third party institution stamped with the manufacturer's seal, must be provided (Bonus Point).
- 3.8 Sash Glass
The sash glass shall be made of safety laminated glass with a thickness of at least 2+2mm, ensuring safety in case of breakage. The maximum opening height of the sash shall be at least 720mm, and the sash shall move smoothly and stop at any position without obstruction.
- 3.9 Sash Limit Device
When the sash is raised to the design height a limit device shall be engaged. If a larger opening is required, the limit can be released with one hand, allowing the sash to open fully. Closing the sash shall not be require manual operation of the limit device (Bonus Point).
- 3.10 Fixed Skylight
The upper part of the sash shall have a fixed skylight made of safety laminated glass with a thickness of at least 2+2mm, providing maximum visibility for observing experiments inside the fume hood.
- 3.11 Front Sash
The front of the fume hood shall have a safety sash that can be vertically raised and lowered. The glass within the sash frame can also be opened horizontally (Bonus Point).
Note: Consideration should be given to installing a horizontal glass switch sensor if this configuration is selected.
- 3.12 Pressure Relief Port
The top of the fume hood chamber shall have a pressure relief port to release pressure in case of an explosion, minimizing the impact on the sash glass and protecting the operator.
- 3.13 Sash Track
The sash track shall be made of anti-corrosion plastic, ensuring smooth and quiet operation.
- 3.14 Balance System
The balance system shall use a synchronous belt drive structure, with high-strength polyurethane synchronous belts form a reputable international brand. The belts shall have low noise, high performance, and sufficient load-bearing capacity, with a tensile strength of $\geq 160\text{N/mm}$ and a tooth shear strength of $\geq 50\text{N/mm}$. a copy of the qualified test report from a third party institution stamped with the manufacturer's seal, must be provided (Bonus Point).

- 3.15 Balance System Performance
The balance system shall ensure that the sash does not tilt and can be easily operated with one hand, stopping at any height without slipping.
- 3.16 Sash Anti-fall Device
In the event of a sudden belt breakage, the sash shall remain in place, with a drop distance of no more than 25mm, preventing accidents (Bonus Point).
- 3.17 Sash Anti-drip Device
Any liquid splashed or condensed on the inner surface of the sash shall not drip directly below. Instead, the liquid shall be collected in a trough at the bottom of the sash handle and directed to one side, dripping onto the work surface (Bonus Point).
- 3.18 Airfoil (Lower Baffle)
The airfoil shall be designed with aerodynamic principles and coated with a special Teflon coating resistant to strong acids and alkalis. A copy of the qualified test report from a third party institution, stamped with the manufacturer's seal, must be provided (Bonus Point).
- a. How Water Test
The sample shall be placed at a 45-degree angle, and hot water shall be sprayed on the coated surface for 5 minutes with no visible effects.
 - b. Impact Test
A ball with a diameter of approximately 50.8mm shall be dropped from a height of 304.8mm onto the coated surface, with no cracks or crazing.
 - c. Paint Adhesion
According to ASTM D3359-02, two sets of parallel lines spaced 2mm apart, each with six lines, shall be drawn perpendicular to each other, forming 25 squares. After applying adhesive tape and quickly peeling it off, the coating shall achieve a grade of 4B or higher (95% or more of the grid area shall remain intact).
 - d. Paint Hardness
According to ASTM D3363-05, the coating shall withstand 4H pencil friction without penetrating the substrate or forming a complete circuit.
 - e. Chemical Resistance Test
According to SEFA 8M-2016, the coating shall resist 49 specified chemical reagents, with no more than 1 instance of grade 3 results.
- 3.19 Air Collection Hood
The air collection hood shall be made of anti-corrosion plastic with a conical design, ensuring low noise and uniform airflow for effective air collection and low pressure loss.
- 3.20 Distillation Rack
The distillation rack shall be made of solid rods with a diameter of at least 12mm, with high strength and corrosion resistance. The rack shall not be made of painted round steel or PP solid rods. The clamps shall be made of 304 stainless steel. (This configuration can be omitted if not required.)
- 3.21 Electrical Facilities
Electrical facilities shall be installed on the functional panel of the fume hood. The panel shall have a fixable, detachable structure for easy future adjustments. The panel shall also include a leakage protection device and at least four 220V, 10A waterproof sockets with a protection rating of IP55 or higher. The socket cover dimension shall not exceed 90mm(width) x 90mm(height) x 30mm(depth) to match the overall appearance and facilitate equipment use.
- 3.22 Electrical Junction Box
The electrical facilities shall include a junction box for connecting wires, ensuring safe transitions and protection of electrical circuits (Bonus Point).

- 3.23 **Auxiliary Airflow System**
The fume hood columns / lower baffle shall have an auxiliary airflow system that provides stable inward airflow to the edges of the columns / lower baffle, improving safety and interference resistance. The auxiliary airflow system can be integrated with the variable air volume (VAV) control system for coordinated operation (Bonus Point).
- 3.24 **VAV Control Panel**
The front columns can accommodate the VAV control panel, which shall be embedded within the column without exposed screws, ensuring a clean and aesthetic appearance.
- 3.25 **Base Cabinet**
The base cabinet shall be constructed similarly to the laboratory bench cabinet. Each cabinet shall be a complete, independent, floor standing, full-steel cabinets. Unless otherwise specified, each fume hood shall be equipped with two double-door base cabinet units. The rear of the cabinet shall have an easily removable back panel, and the top shall be sealed with a top panel for ventilation as needed (Bonus Point).
- 3.26 **Optional Configurations**
A frame support structure can be provided if needed. The base cabinet can be optionally configured as a safety cabinet or waste liquid collection cabinet (the waste liquid collection cabinet shall include a PP tray that can be easily pulled out).
- 3.27 **Fume Hood Resistance**
The fume hood resistance shall be less than 50Pa. A copy of the qualified test report from a third party institution, stamped with the manufacturer's seal, must be provided (Bonus Point).
- 4.0 **Acceptance Methods and Standards for Bench-Type Fume Hood (Disqualification Item)**
- 4.1 **Before project acceptance, the tenderer shall randomly sample the installed fume hood (sampling quantity: at least one unit per fume extraction system or no less than 5% of the total number of fume hood) and commission a third party testing institution with CMA or CNAS accreditation to conduct on-site testing and issue a test report (the test report must bear the accreditation seal). If the fume hood fail to meet the standards, the purchaser has the right to demand free rectification or consider it a breach of contract, with the supplier bearing all responsibility for the breach. If standards are updated, the new standards shall apply, or the purchaser and supplier shall negotiate a solution. Testing costs shall be borne by the supplier.**
- 4.2 **ASHRAE 110-2016 Standard A1 Test**
The fume hood shall have a design face velocity of 0.3m/s $\pm 10\%$, with the sash opened to the operation height of 457mm or the mechanical limit height. The following test items must be included, and the specified technical requirements must be met:
- Face Velocity**
The maximum and minimum values shall deviate no more than $\pm 15\%$ from the arithmetic mean.
 - VAV Face Velocity Control**
The average face velocity at 100% / 50% / 25% of the design operating height shall deviate no more than $\pm 10\%$ from the design face velocity.
 - VAV Response**
The VAV system response / steady-state time shall be ≤ 5 seconds.
 - Visualization – Small Smoke**
No visible leakage or escape.
 - Visualization – Large Smoke**
No visible leakage or escape.
 - Tracer Gas Concentration**
The average leakage concentration shall not exceed 0.1ppm, with a peak concentration of no more than 0.5ppm.

- g. Window Movement Impact
The average leakage concentration shall be exceed 0.1ppm, with a peak concentration of no more than 0.5ppm.
- h. Peripheral Scanning
The average leakage concentration shall be exceed 0.1ppm, with a peak concentration of no more that 0.5ppm.

Note: If the fume hood is equipped with an automatic door system, the system shall be turned off during testing, and manual operation shall be used.

4.3 ASHRAE 110-2016 AM Test

A copy of the qualified test report form a third part institution, stamped with the manufacturer's seal, must be provided (Bonus Point).

The report shall demonstrate compliance with ASHRAE 110-2016 standards for fume hood operating at a face velocity of 0.2m/s to 0.25m/s. The test items must include face velocity, visualization (large / small smoke with no visible leakage or escape), SF6 tracer gas static concentration (0.00ppm), SF6 tracer gas sash movement impact (0.00ppm), and SF6 tracer gas peripheral scanning (0.00ppm).

4.4 EN 14175-3:2019 Test

A copy of the qualified test report from a third party institution, stamped with the manufacturer's seal, must be provided (Bonus Point).

The report shall demonstrate compliance with EN 14175-3:2019 standards for fume hood operating at a face velocity of 0.2m/s to 0.25m/s. The test items must include face velocity, internal concentration test (<0.01ppm), external concentration test (<0.01ppm), interference test (<0.05ppm), and air exchange efficiency (>80%).

4.5 Optional Configuration

The sash can be equipped with a built-in glass horizontal switch sensor, which can provide feedback on the opening and closing status of each glass panel. This feature can be integrated with the VAV system to adjust the exhaust volume based on the sash position (Bonus Point).

Note: This is a non-standard configuration and may incur additional costs.

5.0 Sample Requirements for Fume Hood (Disqualification Item)

5.1 1.8m Standard Fume Hood

The bidder shall provide a fume hood with a self-contained exhaust fan. The fume hood must be connected to the fan (the bidder shall match the fan, which is not part of the sample), and the fan must be operational during testing. The test shall be conducted with the sash opened to the design operating height (457mm from the work surface or the mechanical limit height), with the average face velocity controlled at 0.3m/s $\pm$ 10%.

5.2 Pre-bid Testing

Before the bid opening, the bidder shall conduct face velocity and smoke tests on the fume hood sample. The tests shall be performed by the bidder as follows:

- a. Face Velocity
The face velocity shall be evenly distributed, with the maximum and minimum values deviating no more than $\pm$ 15% from the arithmetic mean.
- b. Visualization – Smoke (Large / Small)
No visible leakage or escape.
- c. Local Visualization Test
The test shall follow the steps outlined in the document.
- d. Comprehensive Visualization Test
The test shall follow the steps outlined in the document.

5.3 Testing Equipment Requirements

The smoke generation device shall not produce jet-like smoke, and the smoke shall not affect the airflow pattern of the fume hood. The smoke ejection speed shall not exceed

PARTICULAR SPECIFICATION
FUME HOOD

0.1m/s. the anemometer shall have an accuracy of $\pm 3\%$ of the reading. The face velocity measurement shall be conducted using a fixed sensor mount to ensure stability; handheld measurements are not acceptable.

SCHEDULE OF RATES

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES				

Notes:

When pricing the following works, the Tenderer is advised to inspect all the Drawings, Specification and visit the Site to acquaint himself with the full extent of the work, and he will be deemed to have done so before submitting his tender.

The Tenderer shall ensure that the tender price shall include all the costs for the Works on the Site as shown on the Drawings and / or described in the Specification.

The Tenderer is deemed to have allowed in his prices for all overheads, profits, labour, materials, temporary works and all costs and expenses incurred in connection with the execution and completion of the Works by whatsoever reasons and arrangements as described in the Tender Documents.

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
1.0	Generally	—	sum		
2.0	Definitions	—	sum		
3.0	Description of Works	—	sum		
3.1	Scope of the Works	—	sum		
3.2	Works to be carried out by Specialist / Direct Contractors employed by the Employer	—	sum		
3.3	Specialist Sub-contractors employed by the Main Contractor	—	sum		
3.4	Relationship w/. Specialist / Direct Contractors & Public Authorities	—	sum		
3.5	Design Responsibility & Requirement	—	sum		
3.6	Subsoil Conditions & Investigation Reports				N/A
3.7	Initial Site Checking	—	sum		
3.8	Existing Services	—	sum		
3.9	Guarantee	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

HTMS/FW.PHI/MC/SR1/2

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
4.0 Site of the Works					
4.1	Location	—	sum		
4.2	Site Visit	—	sum		
4.3	Access to the Site	—	sum		
4.4	Accept Site as found	—	sum		
4.5	Working Area	—	sum		
4.6	Control of Site	—	sum		
4.7	Work outside the Site / Working Area	—	sum		
4.8	Weather & Underground Water Conditions	—	sum		
5.0 Possession, Commencement & Completion					
5.1	Site Handover & Possession	—	sum		
5.2	Completion of the Works	—	sum		
5.3	Notices of Preliminary Inspections	—	sum		
5.4	Joint Inspection	—	sum		
5.5	Listed Snagging & Remedial Work to be completed before the issue of Substantial Completion Certificate	—	sum		
5.6	Substantial Completion	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
6.0 Conditions of Contract					
6.1	Form of Contract	—	sum		
6.2	Appendix to General Conditions of Contract	—	sum		
6.3	Special Conditions of Contract amending the Standard Conditions of Contract	—	sum		
7.0 Tender, Drawings & Specification					
7.1	Tender	—	sum		
7.2	No adjustment for rises or falls in Cost of Labour & Materials	—	sum		
7.3	Drawings used for preparation of Tender Documents	—	sum		
7.4	Schedule of Rates & Summary of Tender	—	sum		
7.5	Provisional Quantities	—	sum		
7.6	Provisional Sums	—	sum		
7.7	Drawings, etc. at the Site	—	sum		
7.8	Specification	—	sum		
7.9	Shop / Installation Drawings	—	sum		
7.10	As-built Drawings	—	sum		
7.11	Operation & Maintenance Manuals	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
7.0 Tender, Drawings & Specification (Cont'd)					
7.12	Dimensions	—	sum		
7.13	Drawings, Information Required, etc.	—	sum		
7.14	Combined & Co-ordinated Services Drawings and Combined & Co-ordinated Services Builders Works Drawings	—	sum		
8.0 Labours, Materials & Workmanship					
8.1	Labour	—	sum		
8.2	Compliance w/. Regulations	—	sum		
8.3	Samples	—	sum		
8.4	Testing of Materials	—	sum		
8.5	Proprietary Articles & Brand Names	—	sum		
8.6	Quality of Materials & Workmanship	—	sum		
8.7	Origin of Materials	—	sum		
8.8	Safe Custody of Materials & Plant	—	sum		
8.9	Delivery & Storage	—	sum		
8.10	Packing, Storage & Protection	—	sum		
8.11	Loading & Unloading of Materials	—	sum		
8.12	Off-site Storage	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
8.0 Labours, Materials & Worksmanship (Cont'd)					
8.13	Ordering Materials	—	sum		
8.14	Testing & Commissioning	—	sum		
8.15	Rejection of Unsuitable Materials, etc.	—	sum		
8.16	Spares Parts & Materials	—	sum		
8.17	Warranty / Guarantee	—	sum		
9.0 Instructions, Variations, Methods of Measurement & Valuation					
9.1	Site Instruction	—	sum		
9.2	Stop Work Instruction	—	sum		
9.3	Main Contractor's Claims for Extras	—	sum		
9.4	Main Contractor's Expenses in connection w/. variations & settlement of accounts	—	sum		
9.5	Measurement of Variations	—	sum		
9.6	Invoices, Receipts, etc.	—	sum		
9.7	Supportive Documentation for a Fair Valuation	—	sum		
9.8	Daywork Claims	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
10.0 Programme & Reports					
10.1	Programme for Works	—	sum		
10.2	Approval of Programme	—	sum		
10.3	Daily Reports	—	sum		
10.4	Weekly Reports	—	sum		
10.5	Progress Photographs	—	sum		
10.6	Site Meetings & Project Co-ordination Meetings	—	sum		
10.7	Construction Method Statements	—	sum		
11.0 Statutory Obligations					
11.1	Regulations	—	sum		
11.2	Working Hours, Rates of Wages etc.	—	sum		
11.3	Notices, Fees & Charges	—	sum		
11.4	Site Safety Inspections	—	sum		
11.5	Industrial Training & Pneumoconiosis Levies	—	sum		
11.6	Illegal Immigrants	—	sum		
11.7	Restriction of Nuisance of Dust & Noise	—	sum		
11.8	Construction Waste Disposal Charging Scheme	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
11.0 Statutory Obligations (Cont'd)					
11.9	Construction Workers Registration Ordinance	—	sum		
12.0 Safety, Health & Environment					
12.1	Safety of Personnel Engaged	—	sum		
12.2	Compliance w/. Safety Regulations & Procedures	—	sum		
12.3	Safety Management	—	sum		
12.4	Provision of Safety Precautionary Measures	—	sum		
12.5	Removal of Person from Site	—	sum		
12.6	Wearing Safety Equipment	—	sum		
12.7	Emergency Procedures	—	sum		
12.8	Responsibility of Sub-contractors	—	sum		
12.9	Compliance w/. Ordinances & Regulations	—	sum		
12.10	Report of Accident	—	sum		
12.11	Responsibility of Main Contractors	—	sum		
12.12	Precautionary Work in Case of Fire	—	sum		
12.13	Precautionary Work in Case of Typhoon or Heavy Rain	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES				
12.0 Safety, Health & Environment (Cont'd)				
12.14	Protection of Public	—	sum	
12.15	Ingredient of Materials	—	sum	
12.16	Site Health & Safety Management Committee	—	sum	
12.17	Monthly Health & Safety Report	—	sum	
12.18	Health & Safety Staff	—	sum	
13.0 Protection of Public Property, etc.				
13.1	Protection of Public	—	sum	
13.2	Protection of Public Property	—	sum	
13.3	Protection of Existing Property & Adjoining Property	—	sum	
13.4	Protection of Persons & to Existing Buildings, Adjoining Property, Roads, Utilities, etc.	—	sum	
13.5	Maintenance of Existing Roads, Footpaths, Steps, etc.	—	sum	
13.6	Maintenance of Existing Services	—	sum	
13.7	Dust Suppression Measures	—	sum	
13.8	Construction Works close to Buildings, Roads, & Other Structures	—	sum	

Carried to HTMS/FW.PHI/MC/SR1/14:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
14.0 Insurance & Surety Bond					
14.1	Employees' Compensation Insurance	—	sum		
14.2	Contractor's All Risks & Third Party Liability Insurance	—	sum		
14.3	Other Insurance	—	sum		
14.4	Approval of Insurance Company	—	sum		
14.5	Period of Insurance Cover	—	sum		
14.6	Main Contractor to give Notice of Injury	—	sum		
14.7	Surety Bond	—	sum		
15.0 Attendance & Overall Co-ordination Responsibility of Main Contractor					
15.1	General Attendance on Nominated Sub-contractors, Nominated Suppliers, Direct Contractors & Utility Undertakers	—	sum		
16.0 General Obligations					
16.1	Overtime	—	sum		
16.2	Foreman-in-charge	—	sum		
16.3	Detailed Safety Supervision Plan	—	sum		
16.4	Full Time Site Supervisor	—	sum		
16.5	Workmen Living on the Site	—	sum		
16.6	Watching	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
16.0 General Obligations (Cont'd)					
16.7	Protection & Cleaning of the Works	—	sum		
16.8	Removal of Debris during the Course the Works & upon Completion	—	sum		
16.9	Protection of Works	—	sum		
16.10	Property belonging to the Government & Public Utility Companies	—	sum		
16.11	Preparation for Substantial Completion	—	sum		
16.12	Defects after Completion	—	sum		
16.13	Working / Assess Permits	—	sum		
16.14	Workmen	—	sum		
16.15	Setting Out	—	sum		
16.16	Removal of Water	—	sum		
16.17	Effective Diversion of Storm Water	—	sum		
16.18	Removal of Underground Obstructions	—	sum		
16.19	Prevention of Mosquito Breeding	—	sum		
16.20	Bench Marks, Survey Check Point, etc.	—	sum		
16.21	Damage by Erosion	—	sum		
16.22	Protection & Cleaning upon Completion	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

HTMS/FW.PHI/MC/SR1/11

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES					
16.0 General Obligations (Cont'd)					
16.23	Clearance of Site on Completion	—	sum		
16.24	Liability	—	sum		
16.25	Fire Protection	—	sum		
16.26	Treasure Trove, Coins, etc.	—	sum		
16.27	Visitors	—	sum		
17.0 Temporary Works					
17.1	Plant, Tools, Scaffolding w/. Working Platform, Screens, Shed, etc. for Aluminium Window Use	30	LM		
17.2	Hoardings, Screens, etc.	—	sum		
17.3	Temporary Water Supply	—	sum		
17.4	Temporary Lighting & Power	—	sum		
17.5	Main Contractor's Storage Sheds, Workshops & Offices	—	sum		
17.6	Temporary Latrines	—	sum		
17.7	Telephones for his Own use	—	sum		
17.8	Temporary Facilities	—	sum		
17.9	Positions of all Site Offices, Temporary Latrines, Sheds, Hoists & the like	—	sum		

Carried to HTMS/FW.PHI/MC/SR1/14:

HTMS/FW.PHI/MC/SR1/12

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES				
17.0 Temporary Works (Cont'd)				
17.10	Restriction of Advertising	—	sum	
17.11	Notice Boards	—	sum	
17.12	Other Temporary Works	—	sum	
17.13	Electronic Submittal	—	sum	

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 1 – PRELIMINARIES				

COLLECTION

Page

HTMS/FW.PHI/MC/SR1/2

HTMS/FW.PHI/MC/SR1/3

HTMS/FW.PHI/MC/SR1/4

HTMS/FW.PHI/MC/SR1/5

HTMS/FW.PHI/MC/SR1/6

HTMS/FW.PHI/MC/SR1/7

HTMS/FW.PHI/MC/SR1/8

HTMS/FW.PHI/MC/SR1/9

HTMS/FW.PHI/MC/SR1/10

HTMS/FW.PHI/MC/SR1/11

HTMS/FW.PHI/MC/SR1/12

HTMS/FW.PHI/MC/SR1/13

Carried to Summary:

HTMS/FW.PHI/MC/SR1/14

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 2 – REMOVAL WORKS				

Notes:

All demolition and removal works include making good adjacent finishes and preparing surface to receive new finishes and removing demolished materials off site unless stated otherwise.

The area for demolition and removal is actual superficial working area.

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 2 – REMOVAL WORKS					
A.	Demolish existing wall at Existing Preparation Rooms	15	LM		
B.	Remove existing floor finish	230	m ²		
C.	Remove existing wall finish	215	m ²		
D.	Remove existing door with frame	2	nos.		
E.	Remove existing aluminum window w/. frame	30	m ²		
F.	Remove existing laboratory furniture and / or remaining items	1	sum		
G.	Allow for any items of Works as required by the Specification and / or Drawings for this Schedule				
H.	The Contractor shall insert hereinafter any addition items and pages as he deems necessary and include same on the collection of this Schedule				

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 2 – REMOVAL WORKS				

COLLECTION

Page

HTMS/WP/MC/SR2/2

Carried to Summary:

HTMS/FW.PHI/MC/SR2/3

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 3 – FITING-OUT WORKS				

Notes:

All fitting-out works are shown in drawings to be carried out, including all floor, wall, ceiling, and features, etc.

All sample and materials shall be submitted to the Architect for comment and approval prior to place order or / and commencement of works.

Interfacing work and co-ordination works with other contractors are included.

All electrical items are remeasurement items.

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 3 – FITING-OUT WORKS					
A.	Supply & install vinyl floor (light grey) (VL-1) at IS Laboratory and Biology Laboratory	220	m ²		
B.	Supply & install vinyl floor (dark grey) (VL-2) w/. skirting at Preparation Rooms	35	m ²		
C.	Erection of new block walls w/. plastering, c/s screed & paint finish at Preparation Rooms	55	m ²		
D.	Supply & install semi-automatic movable partition w/. plastic laminated wall finish (red and brown), track and all necessary fittings	8	LM		
E.	Supply & install plastic laminated wall finish at Laboratories w/. all necessary substrate	180	m ²		
F.	Wall Paint finish w/. plastering, c/s screed & finish w/. PVC skirting (75mm) at Preparation Rooms	120	m ²		
G.	Supply & install aluminum window (double glazed) w/. angle lock & all necessary fittings	30	m ²		
H.	Supply & install 20mm thk. stone (white) window sill	20	LM		
I.	Supply & install aluminium ceiling (25 x 75, 100c/c) w/. wood texture (AL-01) and swing down for maintenance at Laboratories	220	m ²		

Carried to HTMS/FW.PHI/MC/SR3/4:

HTMS/FW.PHI/MC/SR3/2

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 3 – FITTING-OUT WORKS					
J.	Ceiling paint finish w/. plastering & c/s screed	230	m ²		
K.	Supply & install 1hr FRR door w/. glass panel and all necessary fittings	2	nos.		
L.	Supply & install timber door w/. plastic laminated finish, glass panel and all necessary fittings (between Laboratories and Preparation Rooms)	2	nos.		
M.	Repaint existing FRR doors at Preparation Rooms (match to wall finish)	2	nos.		
N.	Relocate TV and blackboard at Laboratories w/. connection and fittings	2	nos.		
O.	Design, supply & install electrical roller blind w/. track and all necessary fittings	20	LM		
P.	Design, supply & install roller blind w/. track and all necessary fittings at Preparation Rooms	2.5	LM		
Q.	Design, supply & install by Registered Fire Services System and to provide the certificate for completion	1	sum		
R.	Allow for any items of Works as required by the Specification and / or Drawings for this Schedule				
S.	The Contractor shall insert hereinafter any addition items and pages as he deems necessary and include same on the collection of this Schedule				

Carried to HTMS/FW.PHI/MC/SR3/4:

HTMS/FW.PHI/MC/SR3/3

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 3 – FITTING-OUT WORKS				

COLLECTION

Page

HTMS/FW.PHI/MC/SR3/2

HTMS/FW.PHI/MC/SR3/3

Carried to Summary:

HTMS/FW.PHI/MC/SR3/4

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 4 – ELECTRICAL WORKS				

Notes:

All electrical works are shown in drawings to be carried out, including all floor, wall, ceiling, and features, etc.

All shop drawings, sample and materials shall be submitted to the Architect for comment and approval prior to place order or / and commencement of works.

Interfacing work and co-ordination works with other contractors are included.

All electrical items are remeasurement items.

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 4 – ELECTRICAL WORKS					
A.	MCB	2	sum		
B.	Single 13A	12	sum		
C.	13A outlet for Electrical Roller Blind & Semi-automatic Movable Partition	9	sum		
D.	Aluminum Alloy Removable Rail	30	LM		
E.	Aluminum Alloy Removable Socket	30	sum		
F.	Supply & install Low Voltage Experimental Power Unit (Control Box)	2	sum		
G.	14A DC Socket	13	sum		
H.	Network / Data / Wi-Fi Point	8	sum		
I.	Telephone	4	sum		
J.	TV	2	sum		
K.	LED Light Strip w/. outlets	155	LM		
L.	T5 Fluorescent Tube (LED) w/. fittings and connections	7.5	LM		
M.	Light Switches	4	sum		
N.	Exhaust Fan w/. 13A outlet	6	sum		
O.	Trunkings & Fittings	1	sum		
P.	Supply & install 5HP Cassette Split Type Air-conditioner w/. 13A outlet and all necessary fittings at Laboratories, by Japan origin	6	sum		

Carried to HTMS/FW.PHI/MC/SR4/4:

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 4 – ELECTRICAL WORKS					
Q.	Supply & install 2HP Split Type Air-conditioner w/. 13A outlet and all necessary fittings at Preparation Rooms, by Japan origin	2	sum		
R.	Supply & install hanging fan w/. 13A outlet and all necessary fittings at Laboratories on Ceiling	12	sum		
S.	Design, supply & install Loudspeaker System w/. 13A outlet and all necessary fittings	2	sum		
T.	Design, supply & install WIFI system w/. 13A outlet and all necessary fittings	2	sum		
U.	Design, supply & install telephone connection system w/. 13A outlet and all necessary fittings	2	sum		
V.	Design, supply & install "Intelligent (smart) System" at Laboratories w/. tablet control, 13A outlet and all necessary fittings	2	sum		
W.	Allow for any items of Works as required by the Specification and / or Drawings for this Schedule				
X.	The Contractor shall insert hereinafter any addition items and pages as he deems necessary and include same on the collection of this Schedule				

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 4 – ELECTRICAL WORKS				

COLLECTION

Page

HTMS/FW.PHI/MC/SR4/2

HTMS/FW.PHI/MC/SR4/3

Carried to Summary:

HTMS/FW.PHI/MC/SR4/4

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE				
<u>At Integrated Science Laboratory</u>				
A.	Side Bench with Sink - 1	1	set	
	Dim: 8800 x 750 x 850mm (WxDxH)			
	- Worktop: 19mm Phenolic Resin, Wilsonart;			
	- Colour: Grey			
	- Materials: High Quality Steel with Epoxy Powder Coated			
	- Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock			
	Include:			
	♦ PP sink, bottle trap x 2 sets			
	♦ Water facuet 3 way valve outlet x 2 pc & Single valve outlet water x 2 pc			
	♦ Single sided full length backsplash			
	♦ Cabinet with louver for town gas			
B.	Side Bench with Sink - 2	1	set	
	Dim: 8660 x 750 x 850mm (WxDxH)			
	- Worktop: 19mm Phenolic Resin, Wilsonart;			
	- Colour: Grey			
	- Materials: High Quality Steel with Epoxy Powder Coated			
	- Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock			
	Include:			
	♦ PP sink, bottle trap x 3 sets			
	♦ Water facuet 3 way valve outlet x 3 pc & Single valve outlet water x 3 pc			
	♦ Single sided full length backsplash			
	♦ Cabinet with louver for town gas			

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
C.	Hanging Cabinet - 3 Dim: 8660 x 400 x 2100mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Style: Combination of glass sliding and swing solid doors - With 4 adjustable shelves	1	set		
D.	Teacher Bench with sink - 4 Dim: 3124 x 750 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 2 Drawers, 1 adjustable shelf, with lock Include: ♦ PP sink, bottle trap x 1 set ♦ Water faucet 3 way valve outlet x 1 pc ♦ Cabinet with louver for town gas	1	set		
E.	Student Bench H-Frame - 5 Dim: 1300 x 900 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Style: H-Frame (50 x 50mm) Include: ♦ 1300 x 900 shelf underneath worktop for storage ♦ With 2 lockable castors	10	sets		

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
F.	Tall Case - 6 Dim: 1500 x 300 x 3800mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 6 adjustable shelf, - With locks	1	set		
G.	Movable cabinet - 7 Dim: 1200 x 600 x 1100 mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 2 adjustable shelf, - With door lock and lockable castors	3	sets		

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
H.	[5ft Fume Cupboard] 1500mm High Performance Fumehood Dim: 1500W x 900D x 2200H mm - Exterior Material: Cold-rolled steel with epoxy powder coated - Interior / Baffle Material: Compact Laminate board - Worktop: 25mm Epoxy Resin - Sash: 6mm tempered glass - 4 single socket, LED lighting - With PP sink x 1 and Single way valve water faucet x 1 - With towngas control valve and outlet x 1 - With air flow monitor x 1 - With Normal base cabinet - Fumehood comply to standard : ASHRAE 110-2016 ; EN14175-3:2019 - Contractor need to include below items: 1. Dismantle and disposal of the existing fumehood, blower, dampers and ducting 2. Replace with new blower, 1 manual and 1 motorized damper and uPVC exhaust ducting	1	set		
I.	Town gas outlet - single lift/turn gas fitting	10	sets		
J.	Town gas outlet - 2 ways lift/turn gas fitting 90°	1	set		

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE				

- K. Eye Shower with Two 45° Heads
Table mounted eye shower with two 45°
angled heads, incl. 1.5m inlet hose.
Trigger operated including a built-in
check valve and FLOWFIX for regulation
of water flow (14 l/min).

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
	<u>At Integrated Science Preparation Room</u>				
A.	Side Bench with Sink - 1 Dim: 1900 x 700 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock Include: ♦ PP sink, bottle trap x 1 set ♦ Water facuet 3 way valve outlet x 1 pc ♦ Single sided full length backsplash	1	set		
B.	Side Bench - 2 Dim: 2825 x 700 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock - Single sided full length backsplash	1	set		
C.	Tall Case - 3 Dim: 900 x 350 x 3800mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 6 adjustable shelf, - Combination of glass sliding and swing solid doors with locks	4	sets		

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE				
D. Hanging Cabinet - 4	1	set		
Dim: 4800 x 400 x 2100mm (WxDxH)				
- Materials: High Quality Steel with Epoxy Powder Coated				
- Style: Swing solid doors with 4 adjustable shelves				

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
	<u>At Biology Laboratory</u>				
A.	Side Bench with Sink - 1 Dim: 10,000 x 750 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock Include: ♦ PP sink, bottle trap x 3 sets ♦ Water facuet 3 way valve outlet x 3 pc & Single valve outlet water x 3 pc ♦ Single sided full length backsplash ♦ Cabinet with louver for town gas	1	set		
B.	Side Bench with Sink - 2 Dim: 7280 x 750 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock Include: ♦ PP sink, bottle trap x 2 sets ♦ Water facuet 3 way valve outlet x 2 pc & Single valve outlet water x 2 pc ♦ Single sided full length backsplash ♦ Cabinet with louver for town gas	1	set		

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
C.	Hanging Cabinet - 3 Dim: 7280 x 400 x 2100mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Style: Combination of sliding glass and swing solid doors - With 4 adjustable shelves	1	set		
D.	Teacher Bench with sink - 4 Dim: 2500 x 750 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 2 Drawers, 1 adjustable shelf, with lock Include: ♦ PP sink, bottle trap x 1 set ♦ Water faucet 3 way valve outlet x 1 pc ♦ Cabinet with louver for town gas	1	set		
E.	Student Bench H-Frame - 5 Dim: 1300 x 900 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Style: H-Frame (50 x 50mm) Include: ♦ 1300 x 900 shelf underneath worktop for storage ♦ with 2 lockable castors	10	sets		

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
F.	Tall Case with swing door - 6 Dim: 1500 x 300 x 3800mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coate - Inset Steel: 2 Swing Door, 6 adjustable shelf, - with locks	1	set		
G.	Tall Case with glass sliding door - 7 Dim: 1000 x 300 x 2000mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 3 adjustable shelf, - with locks	1	set		
H.	Movable cabinet - 8 Dim: 1200 x 600 x 1100 mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 2 adjustable shelf, - with door lock and lockable castors	3	sets		
I.	Town gas outlet - single lift/turn gas fitting	10	sets		
J.	Town gas outlet - 2 ways lift/turn gas fitting 90°	1	set		
K.	Eye Shower with Two 45° Heads Table mounted eye shower with two 45° angled heads, incl. 1.5m inlet hose. Trigger operated including a built-in check valve and FLOWFIX for regulation of water flow (14 l/min).	1	set		

Carried to HTMS/FW.PHI/MC/SR5/13:

HTMS/FW.PHI/MC/SR5/10

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE					
	<u>At Biology Preparation Room</u>				
A.	Side Bench with Sink - 1 Dim: 1900 x 700 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock Include: ♦ PP sink, bottle trap x 1 set ♦ Water facuet 3 way valve outlet x 1 pc ♦ Single sided full length backsplash	1	set		
B.	Side Bench - 2 Dim: 2825 x 700 x 850mm (WxDxH) - Worktop: 19mm Phenolic Resin, Wilsonart; - Colour: Grey - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door,2 Drawers, 1 adjustable shelf, with lock - Single sided full length backsplash	1	set		
C.	Tall Case - 3 Dim: 900 x 350 x 3800mm (WxDxH) - Materials: High Quality Steel with Epoxy Powder Coated - Inset Steel: 2 Swing Door, 6 adjustable shelf, - Combination of glass sliding and swing solid doors - with locks	4	sets		

Carried to HTMS/FW.PHI/MC/SR5/13:

HTMS/FW.PHI/MC/SR5/11

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE				
D. Hanging Cabinet - 4	1	set		
Dim: 4800 x 400 x 2100mm (WxDxH)				
- Materials: High Quality Steel with Epoxy Powder Coated				
- Style: Swing solid doors with 4 adjustable shelves				

	<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 5 – LABORATORY FURNITURE				

COLLECTION

Page

HTMS/FW.PHI/MC/SR5/2

HTMS/FW.PHI/MC/SR5/3

HTMS/FW.PHI/MC/SR5/4

HTMS/FW.PHI/MC/SR5/5

HTMS/FW.PHI/MC/SR5/6

HTMS/FW.PHI/MC/SR5/7

HTMS/FW.PHI/MC/SR5/8

HTMS/FW.PHI/MC/SR5/9

HTMS/FW.PHI/MC/SR5/10

HTMS/FW.PHI/MC/SR5/11

HTMS/FW.PHI/MC/SR5/12

Carried to Summary:

HTMS/FW.PHI/MC/SR5/13

		<u>Quantity</u>	<u>Unit</u>	<u>Rate</u>	<u>Total</u>
SCHEDULE NO. 6 –PROVISIONAL SUM AND PRIME COST					
A.	Contingencies	–	sum		200,000.00
B.	Supply & install aluminum grill w/. all necessary fittings	14	sum	1,200	16,800.00

Carried to Summary:

HK\$216,800.00

SUMMARY OF TENDER

HTMS/FW.PHI/MC/ST/1

SCHEDULE OF DRAWINGS

<u>Drawing No.</u>	<u>Rev.</u>	<u>Description</u>
DL-01	-	Drawing List
A-01	-	Abbreviations, General Notes & Remarks
MS-01	-	Material Schedule "1"
MS-02	-	Material Schedule "2"
MS-03	-	Material Schedule "3"
RP-01	-	Removal Plan
MLP-01	-	Master Layout Plan
FP-01	-	Layout Floor Plan
FP-02	-	Floor Finish Plan
FP-03	-	Layout Floor Plan - Open
EP-01	-	Electrical Plan
CP-01	-	Reflected Ceiling Plan 1
CP-02	-	Reflected Ceiling Plan 2
CP-03	-	Reflected Ceiling Plan 3
PD-01	-	P/D Plan
EL-01	-	Elevation A
EL-02	-	Elevation B
EL-03	-	Elevation C

<u>Drawing No.</u>	<u>Rev.</u>	<u>Description</u>
EL-04	-	Elevation D
EL-05	-	Elevation E
EL-06	-	Elevation F
EL-07	-	Elevation G
EL-08	-	Elevation H
SC-01	-	Sections
D-01	-	Details