B E A C H A U T H O R I T Y

BIDDING DOCUMENTS

Open National Bidding for

Implementation of Beach Management Plan (Phase 1) Construction of Parking Area, Low wall and Beach Amenities at La Prairie Public Beach

Procurement Reference No: [BA/ONB/02/2021-22]

Date: 25 October, 2021

7th Floor Ebène Heights Building, Plot 34, Ebène Cybercity, Ebène
Tel: 468 6209/10/11/12 – Fax: 468 6213 – Email: beachauthority@intnet.mu

Foreword

The Standard Bidding Documents in this publication follow the Standard Bidding Documents of the World Bank and have been prepared pursuant to section 7(c) of the Public Procurement Act 2006 for use by public bodies for procurement of works of values up to 50 million rupees under Open National Bidding method. It has been simplified to facilitate participation of Small and Medium Enterprises.

It can be used in the award of admeasurement (unit prices or unit rates in a bill of quantities) or lump sum types of contracts. In lump sum contracts, the concept of priced "Activity Schedule" is used, to enable payments to be made on the basis of percentage completion of each activity.

This document is to be used where the works are well defined and are unlikely to change in quantity or specification, and where encountering difficult or unforeseen site conditions (for example, hidden foundation problems) is unlikely.

Those wishing to submit comments or suggestions on the Bidding Documents or to obtain additional information on procurement in Mauritius are encouraged to contact:

Procurement proceedings for this standard bidding document have to be conducted as per the process specified in the Instructions contained below. Additionally, the principles governing standard clauses as contained in the Standard Bidding Document for Procurement of Works for values up to Rs. 300m shall apply to this SBD as well.

Procurement Policy Office
Ministry of Finance, Economic Planning and Development
Level 8, Emmanuel Anquetil Building, Port Louis, Mauritius
Tel: No. (+230)201-3760 & Fax: No. (230)201-3758
Email: pposecretariat@govmu.org

Section I: Instruction to Bidders

1. Introduction

The **Beach Authority** also referred as the Employer, invites eligible local contractors to submit their bid for the works described in detail hereunder. Any resulting contract shall be subject to the terms and conditions referred to in this document.

The Works are the **Construction of Parking Area, Low Wall and Beach Amenities at La Prairie Public Beach**.

Participation is limited to citizens of Mauritius or entities incorporated in Mauritius. Joint Ventures should be among entities incorporated in Mauritius

1.1 Clarifications, if any, should be addressed to:

The General Manager
Beach Authority
7th Floor
Ebène Heights Building
Plot 34, Ebène Cybercity
Ebène

The Employer will respond in writing to any request for clarification, provided that such request is received **14 days** prior to the deadline for submission of bids.

The Employer shall respond to such request at latest 7 days prior to the deadline set for submission of bids.

1.2 Bidders are advised to carefully read the complete Bidding document, including the Particular Conditions of Contract in Section IV, before preparing their bids. The standard forms in this document may be retyped for completion but the Bidder is responsible for their accurate reproduction.

2. Validity of Bids

The bid validity period shall be 90 days from the date of bid submission deadline.

3. Works Completion Period

The Intended Completion period is **120 calendar days** as from the Start Date of works.

4. Site Visit

Bidders or their designated representatives are invited to attend a pre-bid meeting on **Thursday 11 November, 2021 at 10.30 hrs at La Prairie Public Beach**. The purpose of the pre-bid meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

5. Sealing and Marking of Bids

Bids should be sealed in a single envelope, clearly marked with the Procurement Reference Number, addressed to the Public Body with the Bidder's name at the back of the envelope.

6. Submission of Bids

Bids should be deposited in the Bid Box located at:

Beach Authority
7th Floor
Ebène Heights Building
Plot 34, Ebène Cybercity
Ebène

not later than ***Wednesday 01 December, 2021 by 10:30 hrs at latest***. Bids by post or hand delivered should reach the above-mentioned address by the same date and time at latest. Late bids will be rejected. Bids received by e-mail will not be considered.

7. Bid Opening

Bids will be opened by the Beach Authority at **Beach Authority, 7th Floor, Ebène Heights Building, Plot 34, Ebène Cybercity, Ebène on Wednesday 01 December, 2021 at 10:45 hrs.** Bidders or their representatives may attend the Bid Opening if they choose to do so.

8. Evaluation of Bids

The Employer shall have the right to request for clarification during evaluation. Offers that are substantially responsive shall be compared on the basis of evaluated cost to determine the lowest evaluated bid.

9. Eligibility Criteria

To be eligible to participate in this bidding exercise, Bidder should:

(a) have the legal capacity to enter into a contract to execute the works;

(b) be duly registered with the CIDB under the grade that would allow him to perform the value of works for which he is submitting his bid. (Note 1)

(c) not be insolvent, in receivership, bankrupt, subject to legal proceedings for any of these circumstances or in the process of being wound up;

(d) not have had your business activities suspended;

(e) not be under a declaration of ineligibility by the Government of Mauritius in accordance with applicable laws at the date of the deadline for bid submission or appearing on the ineligibility lists of African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank Group and World Bank Group;

(f) not have a conflict of interest in relation to this procurement requirement; and

(g) have a Business Registration Card.

Note 1 - Sub-contractors undertaking works are also subject to registration with CIDB as applicable to Contractors.

10. Qualification and Experience Criteria

Bidders should have the following minimum qualifications and experience:

a) valid registration certificate with the CIDB under the grade that will enable the contractor to perform the works quoted for, under the following class(es): **Minimum Grade G in Civil Engineering Works**

b) experience in two works of a similar nature over the last 5 years, each of value not less than 10 million

c) Contract Manager having as minimum qualification: A Civil Engineer registered with the Council of Registered Professional Engineer of Mauritius with 5 years of post-registration experience.

d) Site Agent having as minimum qualification: A diploma in construction related field and 10 years' experience in the construction sector;

e) Foreman having as minimum qualification: 15 years' experience in the construction sector;

f) Minimum amount of liquid assets and/or credit facilities net of other contractual commitments of the Bidder of **5 million**.

g) List of equipment/machinery to be made available for the works:

SN	Equipment/Machinery
1	Backhoe Loader
2	Skid Steer Loader
3	Lorry with Crane
4	Trucks
5	Water Tanks
6	Pumps
7	Vibrating Roller (10T)
8	Chainsaw
9	Concrete Mixer
10	Vibrator Poker

11. Contents of bid

The Bid shall comprise the following:

(a) duly filled Bid Submission Form;

(b) duly filled Priced Bill of Quantities/Activity Schedule;

(c) duly filled Qualification Information Form and attachments required;

(d) report on the financial standing of the Bidder for the last three years, such as certified copies of Financial Statements or Audited Accounts as filed at the Registrar of Companies before the deadline set for submission of bids;

(e) valid Registration certificate with the CIDB, as applicable;

(f) signed C.V of Contract Manager; Site Agent and Foreman;

(g) documentary evidence of liquid assets and/or credit facilities (Note 1);

(h) the Authority to seek references from the bidder's bank;

(i) list of equipment/machinery;

(j) any other documents deemed necessary as per the requirements of this bidding document.

Note 1
Bidders to demonstrate access to, or availability of, financial resources such as liquid assets, lines of credit, and other financial means, other than any contractual advance payments to meet the overall cash flow requirements for the contract and its current commitments. Documentary evidence may comprise but not limited to Bank certificate, Certificate from Auditors, Certificate from a Professional Accountant registered with MIPA, Certificate from Insurance companies.

12. Joint Venture

Bids submitted by a joint venture of two or more firms as partners shall comply with the following requirements:

i. the Bid shall include all the information required as per the Qualification Information form for each joint venture partner;

ii. the Bid shall be signed so as to be legally binding on all partners;

iii. the Bid shall include a copy of the agreement entered into by the joint venture partners defining the division of assignments to each partner and establishing that all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms; **alternatively**, a Letter of Intent to execute a joint venture agreement in the event of a successful bid shall be signed by all partners and submitted with the bid, together with a copy of the proposed agreement;

iv. one of the partners shall be nominated as being in charge, authorized to incur liabilities, and receive instructions for and on behalf of any and all partners of the joint venture; and

v. the execution of the entire Contract, including payment, shall be done exclusively with the partner in charge.

13. Prices and Currency of Payment

Bidders should quote for the whole works. Prices for the execution of works shall be quoted and fixed in Mauritian Rupees. Items for which no rate or price is entered by Bidders, shall not be paid for by the Public Body when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities.

Bids shall cover all costs of labour, materials, equipment, overheads, profits and all associated costs for performing the works, and shall include all duties. The whole cost of performing the works shall be included in the items stated, and the cost of any incidental works shall be deemed to be included in the prices quoted. Bidders are required to submit their bid prices **exclusive of VAT**.

14. Bid Securing Declaration

Bidders are required to subscribe to a Bid Securing Declaration in the Bid Submission Form.

15. Margin of Preference

Margin of Preference shall not apply.

16. Award of Contract

The Bidder having submitted the lowest evaluated responsive bid and qualified to perform the works shall be selected for award of contract. Award of contract shall be by issue of a Letter of Acceptance in accordance with terms and conditions contained in Section IV: General Conditions of Contract and Particular Conditions of Contract.

17. Performance Security and signing of contract

Within twenty-eight (28) days of the receipt of the Letter of Acceptance from the Employer, the successful Bidder shall furnish a Performance Security, in the amount equal to 10% of the Bid price (inclusive of VAT), in accordance with the conditions of contract, using for that purpose the Performance Security Form included in Section V Contract Forms.

The contract agreement shall be signed within 28 days after the successful bidder receives the letter of acceptance unless the parties agree otherwise.

Failure of the successful Bidder to submit the above-mentioned Performance Security or sign the contract within the required time may constitute sufficient grounds for the annulment of the award.

18. Notification of Award and Debriefing

Prior to the expiration of the period of bid validity, the Employer shall, for contract amount above Rs 15 million, notify the selected bidder of the proposed award and accordingly notify unsuccessful bidders. Subject to Challenge and Appeal, the Employer shall notify the selected Bidder, in writing, by a Letter of Acceptance for award of contract. Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

The Public Body shall after award of contract, exceeding Rs 1 million and up to Rs 15 million, promptly inform all unsuccessful bidders in writing of the name and address of the successful bidder and the contract amount.

Furthermore, the Public Body shall attend to all requests for debriefing for contract exceeding Rs 1 million, made in writing within 30 days the unsuccessful bidders are informed of the award.

19. Advance Payment

Advance payment shall not apply.

20. Integrity Clause

The Public Body commits itself to take all measures necessary to prevent corruption and ensures that none of its staff, personally or through his/her close relatives or through a third party, will in connection with the bid for, or the execution of a contract, demand, take a promise for or accept, for him/herself or third person, any material or immaterial benefit which he/she is not legally entitled to.

21. Rights of Public Body

The Beach Authority reserves the right:

(a) to split the contract as per the lowest evaluated cost per lot; and

(b) to accept or reject any bid or to cancel the bidding process and reject all bids at any time prior to contract award without incurring any liability to the public body.

22. Challenge and Appeal

Unsatisfied bidders shall follow procedures prescribed in Regulations 48, 49 and 50 of the Public Procurement Regulations 2008 to challenge procurement proceedings and award of procurement contracts or to file application for review at the Independent Review Panel.

(a) The address, Tel. & Fax No & Email address to file Challenges in respect of this procurement is:

The General Manager
Beach Authority
7th Floor
Ebène Heights Building
Plot 34, Ebène Cybercity
Ebène
Tel : +2304686209/10/11/12
Fax : +2304686213
Email : beachauthority@intnet.mu

(b) The address to file Application for Review is:

The Chairperson
Independent Review Panel,
5th Floor,
Belmont House
Intendence Street
Port Louis

Tel : +2302602228

Emal : irp@govmu.org

Section II: Bidding Forms

Note: Bidders are required to fill all the forms in this section and submit as part of their bid. Non-submission of any form may lead to rejection of the bid

Bid Submission Form

Date: _____
Bid's Reference No.: _____
Procurement Reference No……

To:

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued;

(b) We offer to execute in conformity with the Bidding Documents the following Works: _____;

(c) The total price of our Bid excluding VAT is: _____(MUR):

(d) Our bid shall be valid for a period of **90 days** from the date fixed for the bid submission deadline in accordance with the Bidding Documents or up to ……..…., whichever is later, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(e) We hereby confirm that we have read and understood the content of the Bid Securing Declaration attached hereto and subscribe fully to the terms and conditions contained therein, if required. We understand that non-compliance to the conditions mentioned may lead to disqualification.

(f) If our bid is accepted, we commit to obtain a Performance Security in accordance with the Bidding Document;

(g) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 8;

(h) We are not participating, as a Bidder in more than one bid in this bidding process;

(i) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible under the laws of Mauritius;

(j) We have taken steps to ensure that no person acting for us or on our behalf will engage in any type of fraud and corruption as per the principles described hereunder, during the bidding process and contract execution:

i. We shall not, directly or through any other person or firm, offer, promise or give to any of the Public Body's employees involved in the bidding process or the execution of the contract or to any third person any material or immaterial benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

ii. We shall not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelisation in the bidding process.

iii. We shall not use falsified documents, erroneous data or deliberately not disclose requested facts to obtain a benefit in a procurement proceeding.

We understand that transgression of the above is a serious offence and appropriate actions will be taken against such bidders.

(k) We understand that this bid, together with your written acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed;

(l) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive; and

(m) If awarded the contract, the person named below shall act as Contractor's Representative:

Name: .....

In the capacity of: .....

Signed: .....

Duly authorized to sign the Bid for and on behalf of: .....

Date: .....

Seal of Company .....

Appendix to Bid Submission Form

BID SECURING DECLARATION

By subscribing to the undertaking in the Bid Submission Form:

I/We accept that I/we may be disqualified from bidding for any contract with any Public Body for the period of time that may be determined by the Procurement Policy Office under section 35 of the Public Procurement Act, if I am/we are in breach of any obligation under the Bid conditions, because I/we:

(a) have modified or withdrawn my/our bid after the deadline for submission of bids during the period of bid validity specified by the Bidder in the Bid Submission Form; or

(b) have refused to accept a correction of an error appearing on the face of the bid; or

(c) having been notified of the acceptance of our bid during the period of bid validity, (i) have failed or refused to execute the Contract, if required, or (ii) have failed or refused to furnish the Performance Security, in accordance with the Instructions to Quote.

I/We understand this Bid Securing Declaration shall cease to be valid (a) in case I/we am/are the successful bidder, upon our receipt of copies of the contract signed by you and the Performance Security issued to you by me/us; or (b) if I am/we are not the successful Bidder, upon the earlier of (i) the receipt of your notification of the name of the successful Bidder; or (ii) thirty days after the expiration of the validity of my/our bid.

In case of a Joint Venture, all the partners of the Joint Venture shall be jointly and severally liable.

Qualification Information

*[The information to be filled in by **bidders** in the following pages shall be used for purposes of post-qualification or for verification of prequalification as provided for in ITB Clause 6. This information shall not be incorporated in the Contract. Attach additional pages as necessary. Pertinent sections of attached documents should be translated into English. If used for prequalification verification, the Bidder should fill in updated information only.]*

1. Individual Bidders or Individual Members of Joint Ventures

1.1 Constitution or legal status of Bidder: [*attach copy]*

Place of registration: [*insert]*

Principal place of business: [*insert]*

1.2 Bidder shall provide *[insert number]* of works of a nature and amount similar to the Works performed as Contractor over the last 5 years.

Project/Contract name and country	Name of client and contact person	Type of work performed and year of completion	Value of contract (National currency)
(a) (b)			

1.3 Proposed subcontracts and firms involved. Refer to General Conditions of Contract Clause 7.

Sections of the Works	Value of subcontract	Subcontractor (Name and address)	Experience in similar work
(a) (b)			

[Bidders have to ascertain that sub-contractor executing works are duly registered with the CIDB in accordance with CIDB Act 2008.

1.4 Name, address, and telephone, telex, and facsimile numbers of banks that may provide references if contacted by the Public Body.

2. Additional

2.1 Bidders should provide any additional information Requirements requested in the Bidding Document.

BILL OF QUANTITIES

Item No	Brief Description of works	Unit of Measure	Qty	Unit Price (Rs)	Total Price (Rs)
A.	**Preliminary and General Items**				
A.1	Cost of Performance Bond	sum			
A.2	Cost of Insurance of the Works and Contractor's Equipment	sum			
A.3	Cost of Third-Party Insurance	sum			
A.4	Testing of materials to specifications	sum			
A.5	Allow for other preliminary items	sum			
A.6	Allow for submission of programme of works prior to mobilisation.	sum			
A.7	Site mobilisation costs	sum			
A.8	Allow for all temporary hoardings, temporary access roads and all other works, construction plant for the completion of the works, protection of existing services and making good for any damages.	sum			
A.9	Allow for the supply and erection of signboard in accordance with the specification prior to start of work. Signboard to be provided with the following information: - Project: Client: Contractor: Duration of Works:	nr	1		
A.10	Allow for general cleaning of site on completion of works.	sum			
A.11	Demobilization costs	sum			
	TOTAL BILL A (To be carried to Bill Summary Sheet)				

Item No	Brief Description of Works	Unit of Measure	Qty	Unit Price (Rs)	Total Price (Rs)
B.	**Construction of Infrastructures**				
B.1	Site clearance over the project area and carting away of debris.	m^2	1600		
B.2	Felling of trees of any girth. The rate quoted shall include for the felled trees to be returned to the Forestry Service at the Head Office, Curepipe, Botanical Garden Street. Rate shall also include for removal of stumps completely and carting away of all debris at an approved dumping site by a licensed waste lorry and backfilling of the holes with imported hardcore fill material.	nr	20		
B.3	Allow for carrying out a topographical survey over the project site and other surrounding features such as the main road. Drawing to be submitted in ACAD format and in 2 printed copies of size A0 paper.	sum			
B.4	Allow for the submission of detailed construction drawing for parking and landscape areas taking into consideration any cut and fill, levelling and access to the parking areas and the footpaths. The drawings shall include finished levels and shall be submitted to the Project Manager for approval.	sum			
B.5	Supply and laying of Kerbs Type K1. Rate shall include for excavation in any material, levelling works, casting of concrete haunching, backfilling, amongst others.	m	320		
B.6	Supply and laying of Kerbs Type K5. Rate shall include for excavation in any material, levelling works, casting of concrete haunching, backfilling, amongst others.	m	250		
B.7	Construction of Parking Lot 2. Rate shall include for any cut and fill, excavation in any material including sand and rocks, levelling and compaction of subgrade at 90% BS Heavy, supply, laying and compaction at 95% BS Heavy of 300mm thick crusher run 0-20, laying of evergreen precast blocks to lines and levels and placing of crushed corals 6-10mm within the interstices of the precast evergreen blocks, backfilling, testing for compaction at 10 points, etc. All sand removed on site to be stacked properly for reuse.	m^2	1600		
B.8	Construction of pathways and parking slots for persons with disabilities. Rate shall include for any cut and fill, excavation in any materials including rocks, levelling and compaction of subgrade at 90% BS Heavy, laying of lean mix (8-14Mpa), geotextile membrane and laying of 150 mm pervious concrete. Colour of pervious/permeable concrete to be approved by Project Manager.	m^2	450		
	TOTAL BILL B1 (To be carried to Bill Summary Sheet)				

Item No	Brief Description of Works	Unit of Measure	Qty	Unit Price (Rs)	Total Price (Rs)
B.9	**Painting of the following road markings with white thermoplastic paint**				
B.9.1	Line Marking of width 100mm	m	250		
B.9.2	Marking for disabled parking	nr	4		
B.10	**Supply and fixing of the following traffic signs. Rate quoted shall include for excavation in any materials, hot dipped galvanised metal post, fixing in mass concrete G30, backfilling, carting away of excess excavated materials, amongst others.**				
B.10.1	*Stop Sign*	*nr*	2		
B.10.2	*No Entry Sign*	*nr*	0		
B.10.3	*One way sign*	*nr*	0		
B.10.4	*In Sign`*	*nr*	1		
B.10.5	*Out Sign*	*nr*	1		
B.10.6	*Parking Sign*	*nr*	5		
B.10.7	*Disabled Parking Sign*	*nr*	2		
B.11	**Stone Masonry Wall**				
B.11.1	Construction of Stone Masonry Wall as per drawings. Rate shall include for excavation in any materials, levelling of subgrade, casting of 50mm thick blinding concrete G15, casting of strip footing and coping, inclusive of formwork, concrete G30 and reinforcement, sound undecomposed blue basalt stone, cement mortar (1:3), rendering of coping, etc.	m	500		
B.11.2	Supply and installation of wooden parapet with treated pine poles Ø 125 mm and handrails Ø 75 mm as per drawings. Rate shall include for excavation in any materials, levelling of subgrade, casting of 300mm x 300mm x 400mm deep mass concrete base G30 and application of 1 coat sealer and 2 coats marine varnish.	m	50		
B.12	**Landscaping**				
B.12.1	Planting of bottle palm Trees (trunk diameter approximately 300mm). Rate quoted shall also include for backfilling and levelling with sand, daily maintenance and watering of same over a duration of 6 months as from the completion date.	nr	250		
B.12.2	Planting of palm Trees (Palmiste Paques) (height approximately 1.5m above ground). Rate quoted shall also include for backfilling and levelling with sand, daily maintenance and watering of same over a duration of 6 months as from the completion date.	nr	10		
	TOTAL BILL B2 (To be carried to Bill Summary Sheet)				

Item No	Brief Description of Works	Unit of Measure	Qty	Unit Price (Rs)	Total Price (Rs)
C.1	**Signboard Displaying 3D Photo of the Proposed Works**				
C.1.1	Allow for the supply and erection of a signboard of dimensions 2400mm x 1200mm with a metal frame 50mm x 50mm x 2.5mm to affix a 3D layout of the parking to be designed and rendered by the Contractor. Same to be placed on hot-dipped galvanised metal posts 75mm x 75mm x 2.5mm at a total height of 2700mm above ground. Rate to include for any excavation works, concrete works and backfilling. The whole structure to be painted with 1 coat primer and 2 coats approved gloss paint.	nr	1		
C.2	**Lighting System**				
C.2.1	Supply and install pole and LED luminaire. LED type luminaire (minimum 50 w/4200 Lm) providing illuminance of 26 Lux over an area of 20m x 8m with integrated Battery, solar module and solar charge controller. (Minimum 5yrs warranty on complete system) as per specifications. A commissioning certificate to be submitted by the contractor after testing and shall comprise: (a) signature of an RPEM Civil Engineer certifying that the whole structure can withstand a 3-second gust wind speed of 275km/hr (b) Signature of an RPEM Electrical Engineer certifying that the whole installation is compliant to norms & standards. Rate should include excavation, carting away of excess soil and construction of reinforced concrete foundation with blinding for lighting columns, supply and install hot-dip galvanized octagonal light pole complete with double cross arm as per specifications and drawings on Reinforced Concrete foundation.	nr	5		
	TOTAL BILL C (To be carried to Bill Summary Sheet)				

Construction of Parking Area, Low Wall and Beach Amenities at La Prairie Public Beach

Bill Summary Sheet

No.	Description	Amount (MUR)
1	TOTAL BILL A	
2	TOTAL BILL B1	
3	TOTAL BILL B2	
4	TOTAL BILL C	
	Sub-total	
	Contingencies	**600,000.00**
	Total excluding VAT	
	VAT @ 15%	
	TOTAL AMOUNT INCLUSIVE OF VAT	

Bill of Quantities Authorised By:

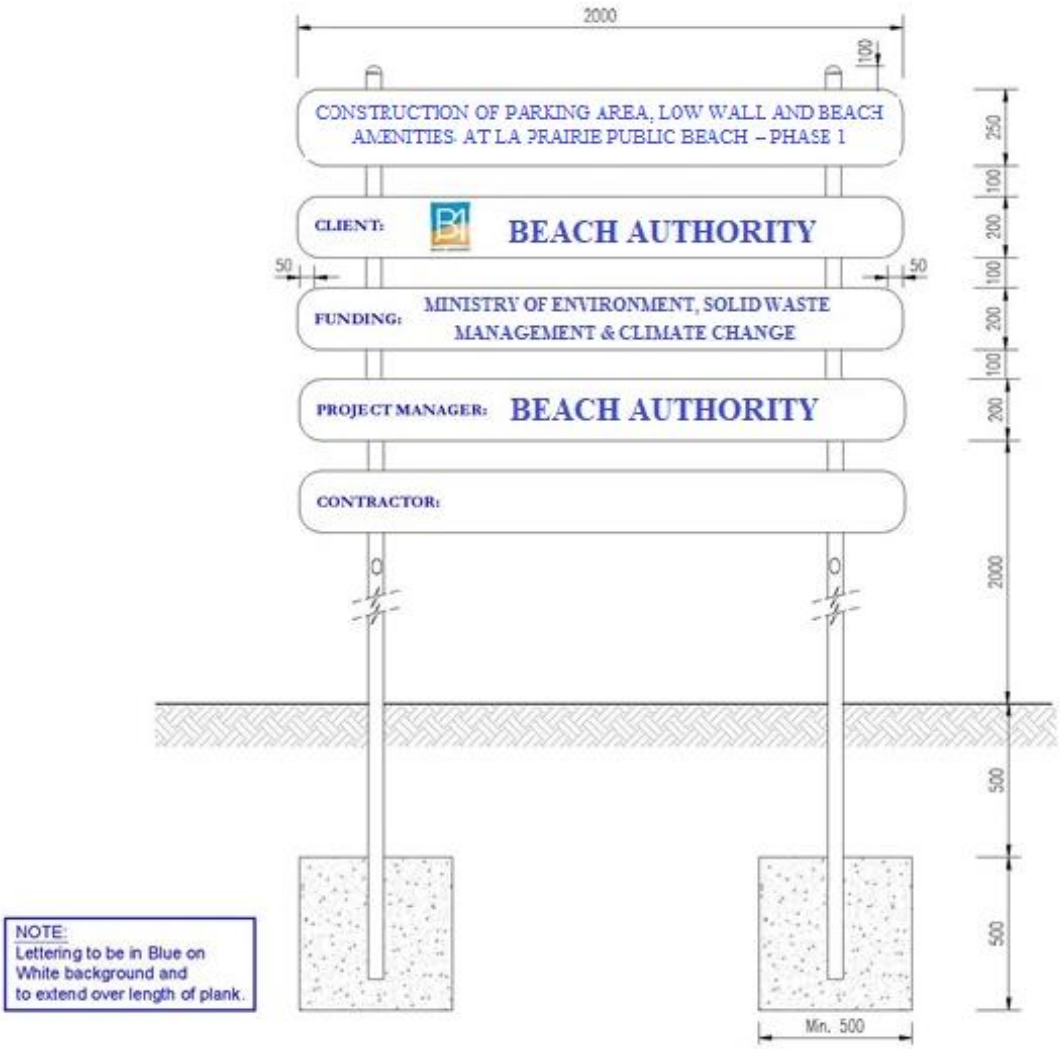
Name:		Signature:	
Position:		Date:	
Authorised for and on behalf of:		Company	

B. DRAWINGS

List of Standard Drawings

1	Masterplan	MD216/LP/M/01	-	La Prairie – Layout of Proposed Beach Amenities
2	Roadworks, Parking, Footpaths and Stone walling	MD216/G/RD/01	-	Parking Lot 2
		MD216/G/RD/02	-	Parking Details: Section thru Parking & Low Stone Wall
		MD216/G/SD/09	-	Typical Signage Details
3	Building Works	MD216/G/LS/02	-	Light Pole Details
4	Wooden Parapet	BA/LP/WP/01	-	Wooden Parapet Detail

C – SIGNBOARD



Note: Exact wordings to be displayed on the signboard shall be confirmed by the Project Manager prior to installation.

Section III: Statement of Requirements

A. SCOPE OF WORKS, SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

A1. Specifications

1. At least seven days before commencing works, the public should be notified with signboards to be placed on site.
2. The site should be properly cordoned and must be kept clean and safe during execution of works.
3. The Contractor shall ensure the safety of its employees and beach users during the felling of trees and during execution of all works throughout the duration of the project.
4. No debris or wastes, including construction materials, should have access onto the dynamic beach zone and the lagoon. All construction wastes should be carted away and disposed of during and after the works on a daily basis.
5. All excavated materials shall be carted away from site, unless otherwise agreed.
6. It shall be the Contractor's responsibility at all times to ensure the stability and safety of excavations and the Contractor shall take all measures necessary to ensure that no collapse erosion or subsidence occurs. In case of any damage caused both on the beach and in the lagoon, the remedial works and costs involved thereon will have to be borne by the contractor.
7. The Contractor shall take all necessary precautions to prevent public to access the working zones.
8. The felling of the trees should be carried out in the presence of an officer from the Forestry Service and the Beach Authority.
9. The Contractor shall return the felled trees to the Forestry Service at the Head Office, Curepipe, Botanical Garden street.
10. All stumps of trees shall be completely removed.
11. Provision shall be made to allow safe public access to the sea where required.
12. The contractor shall erect and maintain temporary hoardings in CIS sheetings around the project area for the parking prior to start of works and throughout the duration of the project.
13. Upon completion of the works, and prior to handing over, the site shall be cleared of all debris and cleaned to the Engineer's satisfaction.
14. For the stone masonry wall, the Contractor shall construct the wall as per drawing and the typical photograph. The Contractor shall construct a sample wall over a length of 1m and upon written approval of the sample by the Project Manager shall thereafter proceed with the construction of the wall.

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ABBREVIATIONS

ORGANISATIONS

AASHTO	American Association of State Highway and Transportation Officials
AFNOR	Association Française de Normalisation
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BS	British Standard Institution
DIN	Deutsches Institut Für Normung
IEC	International Electrotechnical Commission
IEE	Institution of Electrical Engineers (of Great Britain)
ISO	International Standards Organisation
MSB	Mauritius Standard Bureau
SBO	South African Bureau of Standards

UNITS

"	inch
°C	degrees Celsius
A	Amp
c/s	cycles per second
cc	cubic centimetres
cm	centimetre
cm^2	square centimetre
dB	decibels
g	gram
Hz	Hertz
in^2	square inches
kA	kilo Amp
kg	kilogramme
kgf	kilogramme force
km	kilometre
kN	kilo Newton
kVA	kilo Volt Amp
l/s	litre per second
lb	pound (weight)
m	metre
m^2	square metre
m^3	cubic metre
mg/l	milligram per litre
mm	millimetre
mm^2	square millimetre
N	Newton
V	Volt
W	Watt

OTHERS

%	percentage
ABS	acrylonitrile butadiene styrene
AMSL	Above Mean Sea Level
AWG	American Wire Gauge
BSW	British Standard Whitworth
CHS	Circular Hollow Section
CP	Code of Practice (British)
DN	nominal diameter
exc	exceeding
GMS	galvanised mild steel
GRP	glass reinforced polyester
HV	high voltage
LV	low voltage
MDPE	medium density polyethylene
ne	not exceeding
No	number
NP	nominal pressure
OD	outside diameter
PVC	polyvinylchloride (or unplasticised polyvinylchloride when applied to pipes)
RHS	Rectangular Hollow Section
SWA	single wire armoured

100 GENERAL

101 DESCRIPTION AND SCOPE OF THE WORKS

The Scope of Works proposed is to implement beach amenities and associated works to La Prairie Public Beach:

- Site clearance and earthworks
- Parking and stone walling
- Building works
- Landscaping
- Lighting system

The Works will be implemented in different phases and Works to be implemented in the present Phase 1 contract comprise:

SN	Description of Works
1.	Construction of Parking Lot 2
2.	Construction of low stone wall
3.	Supply and install GMS light mast with concrete base and solar powered LED Lights × 5 nos
4.	Landscaping works

102 ACCESS TO SITE

The Contractor shall make his own arrangements for access to the various parts of the Site where works are to be constructed but all such accesses shall be subject to the approval of the Engineer.

Where the access to the Site proposed to be used by Contractor lies across the land of any third party, the Contractor shall produce to the Engineer the written consent of the owner and the occupier of the land over which the access lies before making use of the same. The Contractor shall also make a record to be agreed by the Engineer of the conditions of the surfaces of any land (and of any crops on such land) over which access lies before he uses it for access purposes and he shall keep all such surfaces in a reasonable state of repair during the execution of the Works. On the termination of the Contractor's use of such access he shall restore the lands to a condition at least equal to that existing before his first entry on them.

103 SITE MEETINGS

The Contractor or his authorised representative shall attend weekly meetings on the site with representatives of the Employer and Engineer, at dates and times to be determined by the Employer. Such meetings will be held for evaluating the progress of the Contract which any of the parties represented may wish to raise.

No separate payment will be made for attending site meetings

104 SURVEYS

The Contractor shall check the level relative to the Ministry of Housing Survey Datum of any temporary bench marks to be used in survey of the Works and shall establish additional bench marks, bench-marks shall be numbered and their establishment shall be to the acceptance of the Engineer.

All existing level and other survey information is given without warranty regarding accuracy. Prior to commencement of any work the Contractor is required to undertake in the presence of the Engineer, a comprehensive survey of existing levels. All records of the survey and levelling work upon which the measurement of the Works will be based are to be agreed and signed by both Contractor and Engineer.

Unless otherwise approved, existing levels are to be measured and agreed at least seven days before such levels are to be disturbed by earthwork or other activities.

The method of surveying shall be to the acceptance of the Engineer. Field books and tabulated data shall be well maintained and shall be available for inspection and checking by the Engineer when requested.

105 PARTICULARS OF EXISTING STRUCTURE

Information given in the Contract regarding the condition and character of existing structures and the location and nature of pipes, cables and other services is given without warranty.

106 SITE INVESTIGATIONS

The Engineer may direct the Contractor to execute any further investigation deemed necessary at the Employer’s expense, and the Contractor shall be responsible for immediate execution of such works.

107 DRAWINGS

107.1 GENERAL

The drawings are included in Sub section B.

Further drawings may be issued to the Contractor by the Engineer from time to time in accordance with the Conditions of Contract. Any drawings which are submitted by the Contractor to further describe the Permanent Works and which are approved by the Engineer shall become Drawings upon the issue of such approval, but the accuracy of such drawings shall be the responsibility of the Contractor.

107.2 WORKING DRAWINGS

Before any part of the work is put in hand, the Contractor shall prepare and submit for the consent of the Engineer copies in duplicate, (in the first instance), of detailed working drawings for that part of the work and any other additional drawings that may be deemed necessary by the Engineer for such part of the work and at the same time call the attention of the Engineer to any alternative detail or modification of the Drawings that the Contractor may wish to make, together with a revised cost. These drawings shall include any revisions required to the Drawings to correctly record levels and measurements taken of existing structures.

No proposed amendment, other than that related to the actual dimensions of the existing structures, will be considered unless it can be shown to provide a saving in cost to the Employer.

107.3 AS-BUILT DRAWINGS

The Contractor shall establish and at all times maintain an up to date record of as built details. The primary element of this record shall be in the form of marked up versions of the working drawings. As soon as an element of work is complete the most recent working drawing of that element shall be used along with the as-built records to prepare record drawings.

In addition to details included in the design Drawings and Specification, record drawings and any supporting tables and other documents shall include:

- Original ground levels;
- Any structure or other obstruction found on the site;
- Any existing service found on the site, whether live or abandoned;
- Finished ground levels;
- Settlement records;
- Details of type and properties of materials used including test results.

Upon completion of the Works, the Contractor shall provide one original and two paper copies, of all engineering drawings, survey drawings, manufacturer’s drawings, instruction manuals and any other relevant drawings and documents, incorporating all changes made during the performance of the Contract, so that they form a true and accurate record of what has actually been provided or supplied.

Each drawing, document, instruction manual etc. shall be certified “Approved – As Built”, signed and dated.

Originals of drawings shall be in AutoCAD file format supplied on compact disc, unless otherwise agreed by the Engineer.

To accompany the drawings and documents the Contractor shall provide a Master Schedule of As-Built drawings and documents. This Master Schedule shall list all drawings and documents produced on the Project, recorded in Project Drawing number sequence and shall state the latest revision number, and where applicable shall indicate that each drawing has been certified “As-Built”. Where a drawing is not submitted as a record drawing, the reason (e.g. deleted, superseded, etc) must be stated. The Schedule shall be submitted to the Engineer for acceptance prior to submission of the record drawings and documents.

As part of the Taking-Over, the Schedule, As-Built drawings and documents shall be completed, certified and provided to the Engineer prior to the date on which the Works or Section of the Works are taken over by the Engineer.

108 LEVEL DATUM

The level datum used for setting out the Works shall be Ministry of Housing Survey Datum.

109 LEVELS, POSITION AND DIMENSIONS

The levels of the ground and the levels and dimensions of existing features shown on the Drawings are believed but are not guaranteed to be correct.

The Works are shown on the Drawings, but the precise positions, lines and directions of all the Works are not necessarily indicated and will be determined by the Engineer as the Contract proceeds.

Wherever dimensions or levels are marked on the Drawings such dimensions or levels shall take precedence over dimensions scaled from the Drawings. Where no dimensions or levels are shown on the Drawings, instructions shall be obtained from the Engineer's Representative. Large scale drawings shall be taken in preference to drawings of smaller scale.

110 BOUNDARIES OF WORKS

Existing boundary fences and walls shall not be disturbed without the prior approval of the Engineer's Representative.

The Contractor shall not enter upon or occupy with men, tools, equipment and materials any land other than land or rights of way provided by the Employer without the written consent of the owner of such land and the written consent of the Engineer's Representative.

The Contractor shall provide temporary fencing, or immediately install permanent fencing where such is required. Where the Permanent Works do not include fencing the Contractor shall submit his proposals to the Engineer as to how he intends to fulfil his obligations under the Contract for approval.

111 SETTING OUT

The Engineer will provide sufficient basic survey information to enable the contractor to set out the works and the Contractor shall be responsible for setting out all necessary reference points and for the maintenance thereof.

The Contractor shall satisfy himself as to the accuracy in line, level and dimension of the basic survey and setting out details provided and should the Contractor discover any error in

the information provided by the Engineer, he should at once notify the Engineer. If the information is confirmed to be in error the Engineer will issue amended drawings or instructions regarding the correction of the error.

The Contractor shall not remove, damage, alter or destroy in any way plot boundary stones or survey benchmarks. Should the Contractor consider that any boundary stones or benchmark will be interfered with by the works he shall notify the Engineer who, if he considers necessary, will make arrangements for the removal and replacement of the boundary stone or benchmark.

If the Contractor removes or disturbs a boundary stone or benchmark without permission of the Engineer, he shall be liable for the full cost of its replacement and any legal consequences thereof.

112 RESTRICTIONS ON USE OF ROADS

112.1 TRAFFIC RESTRICTIONS

The Contractor shall not run tracked vehicles or tracked plant on any public or private road without the written approval of the Engineer and the responsible authority or owner and subject to such conditions as each may reasonably require.

The Contractor shall observe all weight and dimensions restrictions which apply to roads and tracks in Mauritius and he shall comply with all restrictions which may from time to time be imposed by the Engineer, Employer, Police, responsible authority or owner. Where damage to roads and tracks is caused by the Contractor this shall be repaired at the Contractor's expense. In particular the Contractor shall fill potholes in roads with premix asphalt when these are deepened by his plant.

The Engineer shall have the power to restrict the Contractor's use of any roads, either in direction of traffic, speed of traffic or numbers of vehicles in order to preserve such roads or to make such roads safe for use by the general public.

Where other contractors require the use of these roads or tracks, the Engineer may prescribe times of usage, or any other form of control, which shall be executed by the Contractor, including the supply of traffic lights, flagmen, or any other thing.

112.2 WORK AT OR ADJACENT TO PUBLIC ACCESS

Notwithstanding the requirements stated elsewhere in the Specification, the Contractor shall comply with the additional requirements contained in this Clause whenever carrying out any work in or adjacent to public access.

The Contractor shall at all times carry out any work in or adjacent to public accesses in a manner to the approval of the Engineer and the responsible authorities and only at such times and during such hours as may be agreed by the competent authority. The Contractor shall obtain any permits from authorities that are required.

At no time shall the Contractor commence work in or adjacent to any public access without the prior approval of the Engineer's Representative.

The Contractor shall, when working in or adjacent to any public access, cause the least interference possible to the flow of traffic.

112.3 WATCHING AND LIGHTING

The Contractor shall be responsible for watching and lighting the Works.

112.4 ACCESS ROADS

All surfaced roads, tracks and surfaced areas used by the Contractor shall be continually maintained by him in good condition. Immediately after ceasing to use any road, track or surfaced area the Contractor shall restore it to the satisfaction of the Engineer's Representative and the responsible authority or owner. The provision of this Clause shall apply also to the shoulders and verges of any existing sealed road used by the Contractor and affected by his operations.

113 FACILITIES FOR ENGINEER'S REPRESENTATIVE

113.1 OFFICE AND FACILITIES FOR THE ENGINEER

The Contractor shall provide, furnish and maintain an office accommodation for the Engineer within his site offices whenever required.

113.2 PROVISION OF EQUIPMENT

The Contractor shall provide at any time required during the period of the Contract all such workmen and instruments for the use of the Engineer as he may deem to be necessary for carrying out his duties in connection with the Contract.

The instruments shall be in good working order and shall be insured against theft. The Contractor shall be solely responsible for the maintenance of all such instruments and shall ensure that they are at all times in good condition and adjustment. Repairs shall only be carried out by persons or organisations approved by the Engineer.

114 CONTRACTOR'S STAFF, COMMUNICATION, OFFICES ETC.

114.1 LANGUAGE OF CORRESPONDENCE AND RECORDS

All communications between the Contractor, the Engineer and the Engineer's Representative shall be in the English language. All books, time sheets, records, notes, drawings, documents, specifications and manufacturers' literature etc. shall be in the English language. If any document is in a language other than English a certified translation to English by an approved translator shall be submitted to the Engineer's Representative or his Representative.

114.2 CONTRACTOR'S DUTY STAFF & OFFICES

At least one responsible senior representative of the Contractor shall be on the Site during normal working hours and immediately available at all other times. This representative shall be delegated full authority to act upon instructions given by the Engineer's Representative or his authorised staff and shall be fluent in the spoken and written English language.

The Contractor shall provide and maintain at the site, offices for the use of his representative and to which written instructions by the Engineer's Representative can be delivered. Any instructions delivered to such offices shall be deemed to have been delivered to the Contractor.

115 CONTRACTOR'S YARDS, STORES AND ACCOMMODATION FOR WORKMEN

The Contractor shall make his own arrangements for all stores, workshops, offices, etc. and for all services in connection therewith.

The Contractor shall supply the Engineer with drawings showing the layout and general arrangement of all Temporary Works he proposes to construct for the purpose of the Contract.

No separate payment will be made for Temporary Works, the relevant cost being included in the rates of the Bill of Quantities for other work.

The Contractor shall provide sufficient closets and washing facilities to the satisfaction of the relevant authority. They shall be properly screened and maintained in a clean and sanitary state at all times. The mess rooms and closets shall be located in positions to be approved by the Engineer's Representative. The Contractor shall be responsible for making all arrangements for the disposal of waste from mess rooms and closets.

116 DEMOLITION OF CONTRACTOR'S TEMPORARY BUILDINGS

The Engineer may at any time before the end of the Defects Liability Period give the Contractor notice in writing to demolish and remove those Temporary Works which are no longer required. After the demolition and removal of the Temporary Works as required by the Engineer's Representative, the Contractor shall level, clear, restore and make good the sites and surrounding ground and after emptying them shall fill in all drains, pits and similar items leaving the whole area in a neat and tidy condition to the satisfaction of the Engineer's Representative and the relevant authority.

117 SAFETY ON SITE AND ENVIRONMENTAL PROTECTION

The Contractor shall plan and execute his work to minimize environmental impacts and shall establish the construction methods accordingly, and in compliance with all applicable environmental regulations. The Contractor shall follow strictly the following recommendations:

A. Fires and burning of rubbish on site will not be permitted.

B. Do not bury rubbish and waste material on site.

C. Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint produces on site.

D. Prevent the discharge off any oil, grease, or petroleum product into the sea.

E. Prevent water containing suspended materials from entering the sea.

F. Do not use seabed or beaches for borrow material.

G. Control emissions from equipment and plant to local authority emission requirements.

H. Cover wet down dry materials and rubbish to prevent blowing dust and debris.

I. Provide dust control for temporary roads.

J. Only clean granular material with fines less than 2 percent shall be used for construction of temporary access berms. All temporary materials must be removed upon completion of the Work to the satisfaction of the Engineers Representative.

Items under this section are considered incidental to the Work and will not be measured separately for payment.

118 PRECAUTIONS AGAINST CONTAMINATION OF THE WORKS

The Contractor shall satisfy the Engineer's Representative that all his personnel working on the Site are medically fit.

The Contractor shall at all times take every possible precaution against contamination of the Works. The Contractor shall give strict instructions to all persons employed by him to use the sanitary accommodation provided.

Throughout the Contract the Site and all Permanent and Temporary Works shall be kept in a clean, tidy and sanitary condition.

The Contractor shall at all times take measures to avoid contamination of existing drains by petrol, oil or other harmful materials.

119 TEMPORARY WATER AND ELECTRICITY SUPPLIES

119.1 WATER

The Contractor shall make all arrangements for and provide an adequate supply of water both for the execution of the Works and as potable water for his workmen.

119.2 ELECTRICITY

The Contractor shall make arrangements for and provide any electricity supply required for the execution of the Works.

120 INSPECTIONS BY ENGINEER DURING DEFECTS LIABILITY PERIOD

The Engineer will give the Contractor due notice of his intention to carry out any inspections during the Defects Liability Period and the Contractor shall thereupon arrange for an authorised representative to be present at the times and dates named by the Engineer. This representative shall render all necessary assistance and take note of all matters and things to which his attention is directed by the Engineer's Representative.

121 ADVERTISEMENTS

No advertisements shall be placed on any Site of Works without the written permission of the Engineer.

122 STANDARDS AND REGULATIONS

All Plant, materials and workmanship unless otherwise specified shall be in accordance with the standards or recommendations of the International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC) where such standards or recommendations exist.

In the absence of applicable ISO or IEC standards or recommendations the Plant, workmanship and materials shall comply with the relevant and latest editions of the standard specifications and codes of practice issued by the following organisations:

Name of Organisation	**Address**
American Society for Testing and Materials	100, Barr Harbor Drive, P.O. Box C700, West Conshohocken, USA.
Association Française de Normalisation	23, Rue Notre Dame des Victoires 75002, Paris France.
British Standard Institution	2, Park Street, London W1A 2BS, England.
Deutsches Institut für Normung	Benth Vertrich Strasse 1, Berlin 30, Germany.
Mauritius Standard Bureau	Moka, Mauritius
South African Bureau of Standards	Private Bag X191, Pretoria 0001, South Africa.

123 SAMPLES

123.1 GENERAL

Before incorporating in the Works any material the Contractor shall submit to the Engineer's Representative for approval a sample of each respective material and such samples shall be delivered to and kept at his office or a location specified by him for reference. All the respective kinds of materials used in and upon the Works shall be at least equal in quality to the approved samples. Each and every sample shall be a fair average of the material it represents. The Engineer's Representative shall decide on the method by which each sample shall be obtained.

123.2 TESTS OF MATERIALS BEFORE USE

Any or all of the material supplied by the Contractor for use in any of the Works shall be subject in advance to such tests as may be specified in the relevant Standard, the Specification or as may from time to time be deemed necessary by the Engineer's Representative.

123.3 FACILITIES FOR ENGINEER'S REPRESENTATIVE TO TAKE SAMPLES

The Contractor shall provide facilities for the Engineer's Representative to take samples for testing of any of the concrete or other materials to be incorporated in the Works. Such samples may be taken before or after incorporation into the Works or at any stage during construction at the discretion of the Engineer's Representative.

124 TESTING FACILITIES

The Contractor shall identify and inform the Engineer in writing a recognised material testing laboratory where tests may be performed to ensure that the quality of material and workmanship specified for the Works are being adhered to.

The cost of carrying out tests on material or workmanship shall be deemed to be covered in the rates for supply of the respective material and services.

125 QUALITY OF MATERIALS, WORKMANSHIP AND QUALITY CONTROL

125.1 GENERAL

The onus rests with the Contractor to produce work which conforms in quality and accuracy of detail to all the requirements of the Specifications and Drawings, and the Contractor shall,

at his own expense, institute a quality control system and provide experienced engineers, foremen, surveyors, materials technicians, other technicians and other technical staff, together with all transport, instruments and equipment, to ensure adequate supervision and positive control of the Works at all times. The Contractor shall provide chainmen and labourers as necessary for the Engineer to carry out checks on the Works.

The materials and workmanship shall be the best of their respective kinds and to the approval of the Engineer's Representative. The words "to the approval of the Engineer's Representative" shall be deemed to be included in the description of all materials and workmanship for the due execution of the Works.

125.2 PLANT AND MATERIAL

All plant and equipment proposed shall be suitable for operation in the temperature conditions prevailing in Mauritius.

The country of Mauritius is subject to cyclones during which the maximum recorded wind speed has been 280km/hour. Any equipment or piece of equipment supplied shall, if it is to be installed externally, be capable of sustaining without damage a one in fifty year storm with wind speed of 280km/hour.

125.3 REJECTED MATERIALS

Should any materials or manufactured articles be brought on to the Site which, in the judgement of the Engineer's Representative, are unsound or of inferior quality or in any way are unsuited for the purpose in which it is proposed to employ them, such materials or manufactured articles shall not be used upon the Works but shall be branded, if in the opinion of the Engineer's Representative this is necessary, and shall forthwith be removed from the Site.

125.4 QUALITY CONTROL

The Contractor shall be responsible for his own quality control and shall provide sufficient competent personnel for taking and preparing samples and for carrying out the necessary tests.

The Contractor shall conduct tests or have them conducted continually on a regular basis, to check the properties of natural materials and processed natural materials and of products manufactured on the site, such as concrete and asphalt. Although not a requirement for the Contractor to conduct regular tests on any commercially produced products such as cement, bitumen, steel and pipes, the Contractor shall remain fully responsible for any defective material or equipment provided by him. Similarly, the quality of all elements of the Works shall be checked on a regular basis so as to ensure compliance with the specified requirements.

The intensity of control and of tests to be conducted by the Contractor in terms of these obligations is not specified but shall be adequate to ensure that proper control is being exercised.

Where any natural materials or products made from natural materials are supplied, and upon completion of each element of the construction work, the Contractor shall test and check such materials, products and/or elements for compliance with the specified requirements and shall submit his results to the Engineer for approval. Such submission shall include all his measurements and test results and shall furnish adequate proof of compliance with the specified requirements.

No items are provided in the bills of quantities for the above obligations, including the provision of all samples delivered to the Engineer, the repair of places from which samples were taken, and the provision of the necessary personnel and testing apparatus and facilities, for which reimbursement is deemed to be included in the rates for the various items of work to which these obligations apply.

The Contractor's attention is drawn to the provisions of the Specification with regard to instituting specific process-control systems. The Contractor's attention is also drawn to the provisions of the various sections of the Specification regarding the minimum frequency of testing that will be required to undertake process control. The Contractor shall at his own discretion increase this frequency where necessary to ensure adequate control.

The Contractor shall submit to the Engineer for examination the results of all relevant tests, measurements and levels indicating compliance with the Specifications on completion of every part of the Work.

125.5 REMEDIAL WORK

(a) General

Any work which fails to comply with the Specifications shall be rejected and the Contractor shall, at his own expense, make good any defects, as directed by and to the satisfaction of the Engineer.

When any part of the Works or any equipment or material is found, upon examination by the Engineer, not to conform to the requirements or at any stage before final acceptance is damaged so that it no longer conforms to the requirements of the Specifications, the Engineer may order its complete removal and replacement, at the Contractor's expenses, with satisfactory work, equipment or material, or he may permit the Contractor to apply remedial measures in order to make good any such defects or damage. The actual remedial measures taken shall at all times be entirely at the Contractor's own initiative, risk and costs, but subject to the Engineer's approval regarding the details thereof.

In particular, remedial measures shall ensure full compliance with the requirements of the Specifications of the final product, shall not endanger or damage any other part of the Works, and shall be carefully controlled and submitted to the Engineer for examination when completed or at any intermediate stage as may be required.

For the guidance of the Contractor, an indication is given below of what would normally be required in the more common cases of defects or damage, but the Engineer will in no way be bound to accept or approve the measures given below, as the actual remedial measures will be dictated by the circumstances of each particular case.

(b) Concrete

Concrete work will normally require the cutting-back and complete removal of any weak or honey combed sections and making good by using special epoxy adhesives to bind fresh concrete to old concrete. Cracks, when permitted to remain, shall be injected with suitable epoxy compounds, and test cores shall then be drilled for testing the efficacy of the injection process.

126 EXISTING SERVICES AND INSTALLATIONS

126.1 LOCATION AND PROTECTION OF EXISTING SERVICES

The Contractor shall acquaint himself with the position of all existing services such as drainage channels and ditches, underground and overhead telephone and electricity lines, ducts, light masts, water mains, sewer lines, boundary walls and fences, retaining wall and the like and shall take every precaution to ensure that all these existing services within and near the line of excavation, are located, supported and safeguarded from damage.

The Employer will, in the Contract documents, provide information regarding the location of existing services, but the Employer does not assume responsibility for the accuracy of the information.

Any damage caused to any existing services attributable to the Contractor's operations, his constructional traffic or his negligence shall be made good by or for the Contractor by the authority concerned at the Contractor's own expense to the satisfaction of the Engineer's Representative, owner or responsible authority. In the event of the owner or responsible authority electing to repair such damage the Contractor shall pay the cost of so doing the work. Should the Contractor fail to pay the cost of the said work within a reasonable period of the account being presented, the Employer reserves the right to settle the account and deduct the sum paid by him from monies due or which may become due to the Contractor.

126.2 SAFETY NEAR OVERHEAD POWER LINES

Where work is to be carried out in the vicinity of overhead power lines, the Contractor shall ensure that all persons working in such areas are aware of the relatively large distance that high voltage electricity can "short" to earth when cranes, or other large masses of steel, are in the vicinity of power lines. The Contractor shall be required to work outside the clearances stated in BS 162 which gives safe clearance for the various voltages.

126.3 RELOCATION OF EXISTING SERVICES

If it should become necessary for the proper execution of the work temporarily to remove or divert any existing pipe, sewer, field drain, cable, drainage or irrigation ditch or other service, the Contractor shall obtain permission from the responsible authority or owner and shall carry out the work at his own expense in a manner and at times to be approved by such authority or owner and shall subsequently reinstate the work to the satisfaction of such authority or owner.

In the event of the owner or responsible authority electing to arrange for the temporary removal of an existing service, the Contractor shall pay the cost of his or their doing the work. Should the Contractor fail to pay the cost of the said work within a reasonable period of the account being presented, the Employer reserves the right to settle the account and deduct the sum paid by him from monies due or which may become due to the Contractor.

126.4 PERMANENT DIVERSION OF EXISTING SERVICES

If in the opinion of the Engineer's Representative and/or of the responsible authority or owner it should become necessary permanently to remove or realign any existing pipe, sewer, cable, ditch, or other service, other than allowed for in the Bill of Quantities, the Contractor shall obtain permission, where necessary, from the authority or owner and shall carry out and complete the work to the satisfaction of the Engineer's Representative and such authority or owner. Payment for such additional work will be made in accordance with the Contract, provided always that the necessity for such permanent diversion has not arisen due to the fault of the Contractor.

In the event of the owner or responsible authority electing to arrange for the permanent diversion of an existing service, the permanent diversion of which has become necessary due to the fault of the Contractor, the Contractor shall pay the cost of his or their doing the work. Should the Contractor fail to pay the cost of the said work within a reasonable period of the

account being presented, the Employer reserves the right to settle the account and deduct the sum paid by him from monies due or which may become due to the Contractor.

126.5 PERMANENT SUPPORT FOR EXISTING SERVICES, ETC

If in the opinion of the Engineer's Representative and/or the responsible authority or owner it should become necessary to provide permanent support for any existing pipe, sewer, cable, structure or other thing disturbed, exposed or injured during or after the execution of the Works, the Contractor shall carry out promptly such additional works as the Engineer may instruct and payment shall be made accordingly.

126.6 AUTHORITY OR OWNERS MAY CARRY OUT WORK

Any of the work involving repair, replacement or re-alignment of existing pipes, sewers or other services may be carried out by the responsible authority or owners if they so desire. In such case, the Contractor shall allow them the facilities and assistance they may require and shall bear the full expense of work except in the case of permanent removal or re-alignment which will be paid for by the Employer, provided that the necessity for such removal or re-alignment has not arisen due to the fault of the Contractor.

126.7 CARE OF BOUNDARY WALLS AND FENCES

The Contractor shall not cut through or remove any section of any boundary wall or fence without the prior approval of the Engineer's Representative who will determine the limits of such cutting or removal.

Approval for the cutting through or removal of boundary walls and fences will normally be limited to those crossing the route of mains and pipelines and the Contractor shall so conduct his operations as to minimise the extent of such cutting through or removal.

The Contractor shall repair and reinstate in a manner similar to the original or by other approved means any wall or fence which he may have cut through or removed with or without the approval of the Engineer's Representative or damaged during his operations and all such repairs and reinstatement shall be the Contractor's sole liability and shall be carried out to the satisfaction of the Engineer's Representative and the responsible authority.

The Contractor shall at his own expense provide temporary fencing and security measures at all times to protect any affected properties.

127 WORK AT ROAD INTERSECTIONS AND JUNCTIONS

Except where otherwise specified, no additional payment over and above payment for the various items of work included in this Contract will be made for the construction, within a restricted space.

The Contractor shall be required to provide the safe and unrestricted flow of traffic at all times during the construction.

128 UNITS

The International System of (metric) Units shall be used throughout the Contract except where otherwise provided.

129 SITE RECORDS

The Contractor shall ensure that records pertaining to the Works are kept up to date. These records shall include labour, plant and material on site, excavation, additional work ordered, price fluctuation if applicable, etc.

130 PROJECT SIGNBOARDS

The Contractor shall erect signboards at the start of construction work at locations to be agreed with the Engineer. The signboard shall be provided with text as indicated in Section C. The board shall be weatherproof and mounted on stout posts so as to withstand strong winds associated with cyclones. The board shall indicate relevant information about the project such as the Project name, the Employer, the Engineer / Project Manager and the Contractor, with lettering shown in blue on white background and in sizes not less than 80mm high for the headings and 50mm high for the sub-headings.

The Contractor shall maintain and reinstate the signboard damaged during cyclones or through, vandalism at his own expense.

The Contractor and subcontractors shall not erect any signs, notices or advertisements on or along the Works or the site of the works without the approval of the Engineer or according to format given by the Engineer. No sign boards other than those specified above will be permitted on or adjacent to the Works.

131 FINAL CLEARANCE

Upon completion of each section of the Works, the Contractor shall clean up the site, remove all temporary buildings, plant and debris. The whole of the site shall be left in a clean and workmanlike condition to the satisfaction of the Engineer. No separate payment shall be made for any work included in this paragraph and the costs shall be deemed to be included in the rates of the relevant items entered in the Bill of Quantities.

200 SITE CLEARANCE AND EARTHWORKS

201 CONDITIONS OF SITE

Before carrying out any work on the Site, the Site shall be inspected by the Contractor in conjunction with the Engineer's Representative to establish its general condition which shall be agreed and recorded in writing, and where in the opinion of the Engineer or his Representative it is deemed necessary, by means of photography.

Details recorded shall include the location of all boundary and survey beacons, the condition of structures, surfaces, roads, tracks, fences and other information relating to the Site and elsewhere which may be affected by the Contractor's operations.

In the case of wayleaves for mains and pipelines the boundaries of the wayleave will be defined by the Employer and the Contractor shall provide erect and maintain in position, from commencement to final completion of the Works, in every section substantial timber stakes or similar approved markers not less than 1.5m high indicating the position of the boundary at 100m or other such intervals as the Engineer's Representative may require.

In the event of any boundary or survey mark established for the purpose of land title being disturbed or displaced as a result of the Contractor's operations the Contractor shall forthwith replace the beacon and shall employ the services of an approved licensed surveyor for this purpose.

202 LOCATION OF EXISTING SERVICES

The location of existing services shown on the Drawings is approximate. Before carrying out any demolition or excavation for construction purposes the Contractor shall accurately locate and mark in both line and level all existing services within the Site of the Works whether indicated on the Drawings or not, and furnish the Engineer with 3 copies of the relevant information. Unless billed separately, the cost for carrying out this investigation is deemed to be covered in the rates for excavation. Any services damaged by the Contractor during his work operation shall be made good at his own cost.

203 SITE CLEARANCE

Site clearance shall be carried out over the areas to be occupied by the Permanent Works and for working space. The site clearance shall be carried out before beginning excavation or other work, and shall include the clearance of all physical obstructions. Any wall, fence or structures damaged or removed during site clearance shall be reinstated at no extra cost to the Contract. The limits of the areas to be cleared shall be as defined by the Engineer's Representative.

Clearing shall consist of the removal of all trees, bush, shrubs and other vegetation, rubbish, fences and all other objectionable material, including the disposal of all material resulting from the clearing and grubbing. Clearing shall also include the removal of all rocks and boulders of up to 0.15m³ in size which are exposed or lying on the surface.

Subject to the requirements of this clause all other materials arising out of site clearance shall be disposed by the Contractor off the Site, or on the site in a manner and place approved by the Engineer's Representative.

204 REMOVAL OF TOPSOIL

Topsoil shall be removed to a depth as instructed by the Engineer and conserved as instructed by the Engineer. The area specified shall be stripped of topsoil as directed by the Engineer.

The rate paid for clearing, grubbing and removal of topsoil shall include all cost for the removal of topsoil to the depth instructed by the Engineer.

If not used immediately, the topsoil shall be transported and deposited in stockpiles or spoil banks provided by the Contractor at his own expense and at locations approved by the Engineer. No additional payment will be made for stockpiling or re-handling topsoil. The cost of stripping and disposal of topsoil shall be included in the price bid for clearing, grubbing and removal of topsoil.

205 EROSION AND ENVIRONMENTAL POLLUTION

The Contractor shall take particular care at all times to prevent erosion on every site and elsewhere on land which may be affected by his operations and the Engineer may impose such reasonable limitations and restrictions upon the method of clearance and upon the timing and season of the year when clearance is carried out as the circumstances warrant.

The Contractor shall take precautions to minimise dust nuisance from his operation and these shall include damping down of dust as required by the Engineer's Representative.

206 SITE SURVEY AND GROUND LEVELS

Following the completion of Site clearance and before the commencement of any earthworks or demolition, the sites shall be surveyed in conjunction with the Engineer's Representative to establish existing ground and pavement levels and these agreed levels shall form the basis for the calculation of quantities of any subsequent excavation and filling.

207 TRIAL PITS

The Contractor shall, at his own cost, excavate refill and restore in advance of his programme such trial pits as he may require for the location of existing underground services and obstructions.

208 DEMOLITION AND REINSTATEMENT

Where services are aligned underneath concrete pavement or floors along part of their length the Contractor will be required to cut through any concrete slab and to reinstate the slab after work. Reinstatement of the slabs shall be paid under dayworks.

209 EXCAVATION GENERALLY

Excavation shall be made in open cutting unless tunnelling or heading is specified or approved by the Engineer's Representative and shall be taken out as nearly as possible to exact dimensions and levels so that the minimum of infilling will afterwards be necessary.

It shall be the Contractor's responsibility at all times to ensure the stability and safety of excavations and the Contractor shall take all measures necessary to ensure that no collapse erosion or subsidence occurs.

The sides of all excavations shall be kept true and shall where necessary be adequately supported by means of timber, steel or other type struts, walling, poling boards, sheeting, bracing and the like. All supports shall be of sound design and construction and shall be sufficiently watertight to permit excavation, concreting and other work to be completed satisfactorily.

Excavations shall be kept free from water and it shall be the Contractor's responsibility to construct and maintain temporary diversion and drainage works and to carry out pumping and to take all measures necessary to comply with this requirement.

In the event of soft or otherwise unsuitable ground being encountered at formation level in any excavation the Contractor shall forthwith inform the Engineer's Representative and shall excavate to such extra depth and refill with compacted granular or other approved fill or Grade C15P concrete as the Engineer's Representative may require.

The Contractor shall not deposit excavated materials on public or private land except where directed by the Engineer's Representative in writing or with the consent in writing of the relevant authority or of the owner or responsible representative of the owner of such land and only then in those places and under such conditions as the relevant authority, owner or responsible representative may prescribe.

210 EXCAVATION IN EXCESS

If any part of any excavation is in error excavated deeper and/or wider than is required the extra depth and/or width shall be filled with Grade C15P concrete or compacted granular or other approved fill to the original formation level and/or dimensions as the Engineer's Representative may require.

211 MECHANICAL EXCAVATION

Mechanical excavation shall be employed by the Contractor only if the subsoil is suitable and will allow the timbering of the trenches or other excavations to be kept sufficiently close up to ensure that no slips, falls or disturbance of the ground take place or there are no pipes, cables, mains or other services or property which may be disturbed or damaged by its use.

When mechanical excavators are used a sufficient depth of material shall be left over at the bottom of the excavation to ensure that the ground at formation level is not damaged or disturbed in any way. The excavation shall then be completed to formation level by hand.

212 EXCAVATION FOR FOUNDATIONS OF STRUCTURES

The Contractor shall give sufficient notice to the Engineer's Representative to enable him to examine foundations well in advance of concrete being placed and no placement shall occur until such inspection shall have been carried out and the formation approved.

If the formation has become weathered prior to the placing of concrete the Contractor shall remove the weathered material and replace it with Grade C15P concrete as directed by the Engineer's Representative.

If the Engineer's Representative so directs, a bottom layer of excavation of not less than 75mm thickness shall be left undisturbed and subsequently taken out by hand immediately before concrete or other work is placed. Similarly, where concrete or other materials is to be placed in contact with the side face of an excavation the Contractor shall, if the Engineer's Representative so directs, leave undisturbed the last 75mm thickness of the excavation to that face until it is taken out neatly to profile by hand immediately before the concrete is placed.

Areas of excavation which are to receive a layer of concrete blinding or drainage layer under structural concrete shall be covered with such blinding or layer immediately the excavation has been completed and inspected and approved by the Engineer's Representative.

All surfaces shall be free of oil, water, mud or any material which in the opinion of the Engineer's Representative is not desirable.

Excavations for foundations shall be to such depth as shown on the Drawings or as the Engineer's Representative may direct and no concrete or other materials shall be placed until the formation has been examined and approved. Due notice shall be given to the Engineer's Representative to enable him to examine the formation well in advance.

213 KEEPING ROCK FACES DRY

The Contractor shall keep free of running water and pools the surfaces of rock upon or against which concrete is to be placed and no concrete shall be placed until surfaces of the rock are properly drained. Special precautions are to be taken to prevent running water from washing out cement or concrete while it is setting or in any other way injuring the Works. Drains and pipes shall be provided in or behind concrete as may be necessary for the temporary conveyance of water and shall afterwards be grouted up.

214 EXCAVATED MATERIALS SUITABLE FOR RE-USE

In so far as they may be suitable and comply with the Specification, materials arising from excavations may be used in the Works.

During excavation, the Contractor shall ensure that all material suitable for re-use and which he intends for re-use are kept separate and set aside and protected as necessary to prevent loss or deterioration.

The materials forming the surface and foundations pavements shall when excavated, and if required for further use, be carefully separated. All hard materials shall be kept free from soil or other excavated materials.

In particular, during excavation the Contractor shall ensure that all granular or other approved material suitable for backfilling shall be kept separate and re-used for this purpose.

Paving slabs and similar surfaces shall be carefully removed and stacked. Prior to the commencement of excavation the number of badly broken and unsuitable paving slabs, etc. on the line of the excavation shall be agreed with the Engineer's Representative.

215 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

All surplus excavated material shall be disposed of by the Contractor to tips provided by the Contractor and approved by the Engineer's Representative.

The Contractor shall not sell any materials arising from excavation, demolitions and the like carried out on the site.

The Contractor shall not deposit excavated materials on public or private land except where directed by the Engineer's Representative in writing or with the consent in writing of the relevant authority, owner or responsible representative of the owner of such land and only then in those places and under such conditions as the relevant authority, owner or responsible representative may prescribe.

Surplus material may not be tipped on the site without the written permission of the Engineer's Representative. In the event of such permission being granted the Contractor shall observe all conditions attached thereto.

216 BACKFILLING OF EXCAVATIONS

All backfilling of excavations shall be thoroughly compacted in layers not exceeding 300 mm compacted thickness and by means which will not damage the Works.

Backfilling of excavations for reinforced concrete structures shall be with suitable material approved by the Engineer's Representative.

"Granular material" as backfill is defined as decomposed basalt, crushed stone, quarry dust, gravel, sand or similar in which the clay or silt content is not predominant.

217 MAKING GOOD SUBSIDENCES AFTER REFILLING

All refilling, whether over foundations or trenches, shall be thoroughly compacted and any subsidence due to consolidation shall be made up with extra compacted material.

Should subsidence occur after any surface reinstatement has been completed the surface reinstatement shall first be removed, the hollows made up, and then the surface reinstatement re-laid.

Any subsidence that occurs adjacent to the Site of the Works which is attributable to the Contractor's activities shall be reinstated to the full satisfaction of the Engineer's Representative.

218 REMOVAL OF SHORING FROM EXCAVATIONS

Shoring shall be removed from the excavations before or during the process of refilling except in so far as this removal would be likely to cause damage to adjacent property, structures or structure foundations in which event the Contractor shall leave in the excavation such shoring as he considers necessary or as may be ordered by the Engineer's Representative to prevent damage the proper repair of which the Contractor shall be solely responsible for in the event of any such damage occurring.

219 REINSTATEMENT OF SURFACES

All surfaces which are affected by the Works shall be reinstated temporarily by the Contractor in the first instance and in due course when the ground has consolidated fully he shall reinstate the surfaces permanently.

The temporary reinstatement and maintenance and permanent reinstatement and maintenance of all surfaces of roads, tracks, and any other surfaces which have been affected by the operations of the Contractor shall be his sole liability and shall be carried out to the satisfaction of the Engineer's Representative and of the responsible authority or owner.

Temporary reinstatement shall be carried out immediately the trenches are refilled.

Permanent reinstatement shall not be carried out until the ground has consolidated completely and the Contractor after first obtaining the approval of the responsible authority shall inform the Engineer's Representative before carrying out this work. In the event of further settlement occurring after the completion of the permanent reinstatement the Contractor shall forthwith make good the reinstatement to the approval of the Engineer or responsible authority.

If the work or reinstatement as carried out by the Contractor is not to the satisfaction of the Engineer's Representative and/or the responsible authority and should the Contractor not remedy the defect forthwith any remedial work considered necessary may be undertaken by the Employer and/or the responsible authority at the Contractor's expense.

220 RESTORATION OF BORROW AREAS, SPOIL TIPS AND QUARRIES

Any spoil tips, quarries or other borrow areas developed by the Contractor for the purpose of the Works shall be finished to safe and fair slopes to the approval of the Engineer's Representative.

300 ROADWORKS , PARKING, DRAINAGE AND AMENITIES

301. IMPORTED MATERIAL FOR FILL IN SUBGRADE LAYERS

Imported material for subgrade shall be non-cohesive soil from excavation or approved borrow pits, free from rubbish, roots, shrubs or other vegetable matter. Material shall be subject to the Engineer's approval prior to be used as fill. It should not in any case have a liquid limit exceeding 50% and/or a plasticity index exceeding 20%. The CBR value should not be lower than 7%.

The Contractor shall arrange for carrying out tests on material to satisfy the Engineer on the quality of the material to be used for each particular layer of fill.

If there is any doubt concerning the quality of material being imported at any time, the Contractor shall notify the Engineer immediately, an in any case before such material is brought onto the Works. The Contractor shall arrange for tests to be carried out as specified by the Engineer, who shall thereafter instruct him regarding the use of the material for fill.

The cost of carrying out test on fill materials is deemed to be included in the rates for the supply of the material.

The rate for the supply of fill material shall include the haulage, irrespective of the distance of the borrow pit.

302. CRUSHED AGGREGATE BASE COURSE AND ROAD BASE

302.1. SOURCE OF MATERIAL

The stones used for crushed aggregate course shall contain no contamination or deleterious material such as decomposed rock or clay. The Contractor shall take all necessary measures to prevent segregation of the material, including watering during crushing and screening and any other measures required in the opinion of the Engineer.

Crushed aggregate shall be made of hard, durable and un-weathered fragments made by the crushing of fresh quarried rock or boulders of minimum 0.3m diameter.

302.2. MATERIAL FOR SUB-BASE

Material for sub-base shall conform to the requirements given in the table below. The particle size distribution be a smooth curve within and approximately parallel to the following grading envelope.

Sieve Size (mm)	Grading Limits (% passing by weight)
50.0	100
37.5	95 – 100
20.0	60 – 80
10.0	40 – 60
5.0	25 – 40
2.36	15 – 30
0.60	0 – 15
0.33	0 – 5

Maximum Flakiness Index: 35%

302.3. MATERIAL FOR ROAD BASE

Material for road base shall conform to the requirements given in the table below. The particle size distribution shall be a smooth curve within and approximately parallel to the following grading envelope.

Sieve Size (mm)	Grading Limits (% passing by weight)
50.0	100
28.0	75 - 95
10.0	40 - 70
5.0	30 - 60
2.36	20 - 45
0.425	15 - 30
0.075	5 - 10

Maximum Flakiness Index: 35%

302.4. PREPARATION OF THE ROAD BASE

No sub-base shall be placed until approval is obtained from the Engineer and the sub-base is placed, compacted and finished in accordance with the Specifications and is tested and found acceptable to the full satisfaction of the Engineer. Before placing the base course, the sub-base shall be inspected and proof rolled as required by the Engineer in order to establish whether there is any damage, wet spots or other defects. Any such defect shall be rectified to the satisfaction of the Engineer before the next layer is placed.

302.5. SPREADING AND MIXING

Crushed aggregate complying with the requirements specified above shall be placed in quantities sufficient to ensure that the completed layer will comply with all the requirements in regard to layer thickness, level, cross-section and density. Segregation of the aggregate during spreading shall be prevented by appropriate choice of working method to the satisfaction of the Engineer. Allowance shall be made for sufficient extra material to enable the layer to be properly trimmed.

The dumps of material shall be spread out to a flat surfaced layer with a thickness which will be suitable for mixing. The required quantity of water shall then be added and the material mixed until a homogeneous mixture is obtained.

302.6. COMPACTION

After mixing, the crushed aggregate material shall be placed to the correct thickness and level and thoroughly compacted by suitable equipment so that the specified density is obtained throughout the entire layer.

The finally compacted layer shall be free from surface laminations, portions exhibiting segregation of the fine and coarse aggregate, corrugations, or other defects that may adversely affect the performance of the layer.

The minimum required compacted density for pavement layers made of crushed aggregate shall be as shown on drawings or the Bill of Quantities.

303 COMPOSITION OF ASPHALT SURFACING

The rates of application and mix proportions of bituminous binder, aggregates and fillers are given hereinafter.

The Contractor shall upon the materials becoming available produce a working plant mix in accordance with the design mix, which working mix must again be tested by him for compliance with the design requirements. Samples of the working mix shall also be made available to the Engineer, who shall authorise the use of the working mix proportions finally approved for use.

COMPOSITION OF MIX AND TEST REQUIREMENTS

(i)	Aggregate coarse grade	93.5%
	Bitumen	5.5%
	Active mineral filler	1.0%
(ii)	Aggregate medium and fine grade	93.0%
	Bitumen	6.0%
	Active mineral filler	1.0%
(iii)	Test requirements	

Design and testing requirements shall be determined by the Engineer, based on BS EN 13108 Bituminous Mixtures, Material Specifications and Asphalt Concrete for Roads and other Paved Areas.

304 LAYING OF ASPHALT CONCRETE BASE COURSE AND SURFACING

The bituminous base course shall be laid by an appropriate type of self-propelled mechanical spreader of a type approved by the Engineer and shall be kept in a good running condition and adjusted correctly according to the manufacturer's specifications. The pavers shall be equipped with a powerful tamper and vibrating screed. The pavers shall be capable of laying the material to widths, lines, grades cross-fall and thickness within the specified tolerances without causing separation, dragging or other surface defects.

The bituminous layer shall be laid and compacted in one or more layers giving a total thickness as specified.

305 OPEN DRAINS

Open-drain excavation shall involve the excavating of open drains and channels, including channels to direct the course of streams, all as shown on the Drawings or as directed by the Engineer.

Any excavation required for constructing a channel or open drain within the road prism, such as median drains, side drains and open drains on excavation-slope benches, shall be classed as Common Excavation or Rock Excavation as defined under the section on "Excavations".

Open drains shall be constructed true to line, grade and cross-section and shall be so maintained for the duration of the Contract.

Care shall be taken to avoid excavation below the required grades for the open rains and any excavation carried beyond the required grade shall be backfilled with suitable, approved,

material and compacted to at least 90% of BS-Heavy density by the Contractor at his own expense.

Material resulting from the excavations for open drains shall be used in the construction of fills, banks and dykes, or for other purposes, or shall be disposed of to spoil, all as directed by the Engineer.

If ordered by the Engineer, all existing open drains, but excluding open drains constructed by the Contractor himself, shall be cleared and, where necessary, shaped by removing the sediment and trimming the floors and sides.

306 PRECAST CONCRETE ELEMENTS

Precast concrete kerbs, slabs, channels, edgings and quadrants shall be to dimensions shown on the drawing and shall be in compliance with BS 340 and BS 368.

307 GROUTED STONE PITCHING

Stone pitching shall consist of selected sound broken basalt stones obtained from quarries approved by the Engineer. The stones shall have a maximum size of 300 mm and shall provide a minimum 150 mm thick layer, firmly grouted with 4:1 sand/cement mortar.

Any spaces between the stones shall be filled with cement grout of the same composition as the mortar. The mortar and the grout shall be placed in a continuous operation for any days run at any one location. The grout shall be worked into the pitching to ensure that all spaces or voids between the stones will be completely filled with grout to the full depth of the stone pitching. Grout spilt onto exposed surface of the stone shall be removed while still soft, and the joints between stones shall be neatly finished.

The grouted pitching shall be cured with wet sacking or other approved wet cover for a period of not less than four days after grouting, and shall not be subjected to loading until adequate strength has been developed.

Where required, weep holes shall be formed in the pitching.

308 STONE MASONRY WALL

(a) General

Stone masonry walls may be plain packed stone walls with dry joints or otherwise mortared stone walls with stones bedded in cement mortar as indicated on the Drawings, as specified or as may be ordered.

The minimum mass of each stone used shall be 10 kg and its minimum dimension 75 mm.

(b) Plain packed stone walls

A foundation trench shall be excavated down to rock or to material with an adequate bearing capacity at a minimum depth of 300 mm below ground lever. Flat and stratified stones shall be laid with the largest dimension in the horizontal plane. Stones shall be packed individually to stagger the joints and to provide a minimum of voids, and shall be firmly bedded against adjoining stones. The spaces between the larger stones shall be filled with spalls securely rammed into place. The larger stones shall not bear on the spalls used for filling the voids. The top and ends of the wall shall be neatly finished with selected coping stones. The appearance of the completed wall shall present an even and tight surface.

(c) Cement – mortared stone walls

The walling shall be constructed as specified in (b) above, with the exception that the stones shall be wetted and set in a 6:1 sand:cement mortar. The exposed parts of the stones on the wall faces shall be cleaned of all mortar by washing or wire brushing. The mortar shall be flush pointed to the satisfaction of the Engineer, who may require a capping and end treatment of the same mortar.

Weep holes shall be provided as prescribed and shall be cleaned of mortar or any other clogging material that may have entered during construction.

The walling shall be protected from the elements and kept moist for a minimum period of four days after completion.

309 FREE DRAINING FILL

Free draining fill for use as backing to walls shall consist of sound hard stone or broken rock or concrete derived from demolition of structures. The particles shall be roughly cubiform and shall be between 75 mm and 25 mm in size. All smaller particles dust rubbish and organic matter shall be excluded.

310 HARDCORE

Hardcore shall consist of sound hard stone or broken rock or concrete derived from excavations or demolition of structures and shall be graded from 150mm to 50mm in size, except that sufficient but not excessive blinding materials of smaller sizes may be permitted at the discretion of the Engineer's Representative.

311 GABIONS

Gabions if used in the Works shall be of the hexagonal wire mesh type, with mesh dimensions of 80mm x 100mm. The minimum dimension shall not exceed 83mm. Wire shall be galvanised prior to weaving the mesh to resist corrosion from river water.

All wire used in the fabrication of the gabion and in the wiring operation during construction shall be in accordance with BS 1052 Mild Steel wire appended having a tensile strength of 38-50 Kg/mm².

All wire shall be galvanised to BS 443: 'Zinc coatings on steel wire' with the minimum weight of Zinc coating in accordance with the table below. The sizes of the wires shall be as follows:

	Diameter (mm)	Minimum weight of coating g/m²
Mesh wire	2.7	260
Binding and Connecting wire	2.2	240
Selvedge wire	3.4	275

All wire used in the fabrication of gabions and in the wiring operations during construction shall, after galvanising, have extruded onto it a coating of polyvinyl chloride compound referred to as PVC. The coating shall be black in colour, not less than 0.4mm thickness and shall be capable of resisting deleterious effects of exposure.

The gabions shall be of the following standard sizes:

2m x 1m x 0.5m
2m x 1m x 1m
6m x 2m x 0.3m

The gabions shall be provided with diaphragms to divide the boxes in compartments with a maximum dimension in any direction of 1m.

Joints shall be flexible and shall consist of not less than one and a half full turns of wire, at each mesh point of the joint line.

Rockfill for Gabions shall conform to the requirements of Clause 232, but in addition the maximum size shall be 220mm, and the minimum size shall be 120mm; however, up to 10% of some smaller blinding material (min. 75mm) to fill the internal voids between the bigger rocks will be allowed.

The gabions shall be placed in their final positions prior to filling with rock, and shall then be tied together and filled with rock. After filling with rock the tops shall be closed and securely tied. The larger rocks shall be placed on the upper face of the gabion in order to present a reasonably closed surface. All assembly, erection, stretching, filling with rock and final filling shall be in accordance with the instructions as issued by the manufacturer.

312 GEOTEXTILE FILTER

The Geotextile Filter shall be a non-woven fabric consisting of a polymeric filaments or spun yarns of polyester material forming a stable matrix using needle punching.

The filter shall be inert to common chemicals and hydrocarbons, rot resistant, resistant to attack from insects, rodents and termites, and shall have the following minimum basic properties:

Geotextile Filter Average Weight	: 320 – 350 g/m²
Thickness	: 2.5 - 3.5 mm
Puncture Resistance to ASTM D-4833	: 55 kg
Permittivity	: 70 l/s/m²
Opening Size ASTM D-4751	: 100 US sieve
Tear Strength to ASTM D-4533	: 45 kg
Grab Elongation to ASTM D-4632	: 65 %

All details of the filter fabric must be submitted for approval by the Engineer and shall be installed in accordance with the Manufacturer's instructions.

313 ANCILLARY ROADWORKS

(a) Guardrails

Guardrails shall comply with the requirements of AASHTO designation M180-98 or equivalent.

The dimensions of guardrails and end units shall be in accordance with the details shown on the Drawings.

Guardrails shall be supplied together with all the bolts, nuts, washers and fixing materials required, including the bolts for fixing the guardrails to the posts.

Unless specified otherwise in the Special Specifications, all guardrails, steel posts, bolts, nuts and washers shall be galvanised with a hot-dip (galvanised) zinc coating which complies with the requirements of AASHTO designation M232M/97 or equivalent. Galvanised guardrails shall not be nested when stacked for storage.

(b) Guardrail posts

Guardrail posts shall be of steel and shall be of the type and size shown on the Drawings.

(c) Erection

The holes for the posts shall be of sufficient size to permit the proper seating of the posts and to allow sufficient room for backfilling the hole and tamping the filling.

Where shown on the Drawings or directed by the Engineer, posts shall be set at half the normal spacings. The hole for the concrete block at the end of a length of guardrail shall be neatly excavated and the top 120 mm shuttered.

The posts, spacer blocks (if applicable) and guardrails shall be completely erected and set true to line and level, so that the guardrails will be at the required height above the level of the completed road shoulder. Where jointed, the end of the guardrails which overlaps on the side of the traffic shall point in the direction of the traffic movement. The guardrail shall be suitably braced to prevent any movement and all bolts shall be tightened prior to any holes being backfilled.

After the Engineer has signified his approval of the guardrails so erected, the holes shall be backfilled with a 12:1 soil cement mixture. The material shall be mixed with the correct quantity of water to ensure that the mixture will be placed while at or near the optimum moisture content.

The mixture shall then be placed and thoroughly rammed in layers not exceeding 100 mm of compacted thickness. The approach ends, where the guardrail has to be bent down and anchored, shall be constructed as shown on the Drawings.

When the backfilling has been completed and the bracing removed, the posts shall be rigid and vertical, and the guardrail shall be true to line and level and firmly fixed to the posts. Excess excavated material shall be disposed of as directed by the Engineer.

All guardrails shall be so erected as to have no projecting ends which might interfere with or endanger traffic. The edges and the centre of the guardrails shall touch either the spacer block or the post where no spacer blocks are used. Guardrails, if specified, shall be provided with end units as shown on the Drawings. All splices of guardrails shall be at posts, and guardrails shall make contact over the entire area of the splice.

The completed guardrail shall have a neat appearance, and shall not show any visible deviations from line and grade. The posts shall be straight and vertical. The guardrails shall not be warped but shall be in a vertical plane parallel to the road centre line except at flared terminal sections. The painted or galvanised surface on the guardrail shall be smooth and continuous and free from abrasions or scratches. Any damage to the surface shall be repaired at the Contractor's expense.

400 STRUCTURAL CONCRETE

401. SCOPE

This Section covers the manufacture, transport, placing and testing of concrete used in the Works where plain, reinforced or prestressed concrete is specified.

All workmanship, materials, tests and performance in connection with the concrete work are to be in conformity with the latest issues of British Standards:

- BS 8110: Part 1: 1997 The Structure Use of Concrete
- BS 8007:1987: Code of Practice for the Design of Structures for retaining Aqueous Liquids

The environmental conditions and design life in accordance with BS 8110 are XS1 and 50 years respectively.

The maximum design crack width shall not exceed 0.2mm.

402. MATERIALS

402.1 CEMENT

Cement shall be Ordinary Portland cement or rapid hardening Portland Cement complying with the requirements of BS EN 197-1:2000.

Cement which is not fresh and dry before mixing shall not be used in the Works.

Cement certificates demonstrating compliance with the specification shall be submitted to the Engineer for approval of the proposed source. Each consignment of cement shall be accompanied by the manufacturer's certificate.

402.2 WATER

Water shall be from a reliable potable source and shall comply with the requirements of BS EN 1008 Sea water or brackish water shall not be used in concrete. The sulphate content shall not exceed 300ppm, the chloride content shall not exceed 500ppm and the alkali content shall not exceed 600ppm.

402.3 AGGREGATES

Coarse and Fine aggregates shall comply with BS EN 12620:2002: "Aggregates for concrete") and shall be free from harmful quantities of dust, clay, or other deleterious substances that may affect the durability of concrete.

Fine aggregate shall be natural well graded sand approved by the Engineer. Beach or sea-dredged sand shall not be used unless washed. Crushed sand along shall not be used without approval.

Coarse aggregate shall be crushed stone, approved by the Engineer.

Aggregate shall be tested at the frequency and to demonstrate compliance with the limits below.

AGGREGATE TESTING FREQUENCY			
TEST REFERENCE	***TESTING STANDARD***	***FREQUENCY OF TESTING ONCE PER PERIOD OF DAYS***	
		COARSE	***FINE***
(A) *GRADING*	*BS812-103.1*	*2*	*2*
(B) *SPECIFIC GRAVITY AND WATER ABSORPTION*	*BS 812, PART 2*	*14*	*14*
(C) *CLAY, SILT AND DUST CONTENT*	*BS812-103.1*	*2*	*2*
(D) *ORGANIC IMPURITIES*	*ASTM C40 & C87*	*INITIAL*	*INITIAL*
(E) *SULPHATE AND CHLORIDE CONTENT*	*BS 812, PART 117 & 118*	*7*	*2*
(F) *10% FINES VALUE*	*BS812, PART 111*	*14*	*-*
(G) *ELONGATION AND FLAKINESS*	*BS 812, PART 105.1 & 105.2*	*7*	*-*
(H) *POTENTIAL ALKALI REACTIVITY*	*CLAUSE 402.04*	*INITIAL*	*INITIAL*
(I) *DRYING SHRINKAGE*	*BS812, PART 120*	*INITIAL*	*INITIAL*
(J) *MOISTURE CONTENT*	*BS 812, PART 109*	*1/DAY*	*2/DAY*
(K) *HOLLOW SHELL CONTENT*	*BS 812 PART 103.1*	*2*	*2*
NOTES: ***TESTS (A),(C), (K) SHALL BE CARRIED OUT AS INDICATED ABOVE OR PER 300 TONNES, WHICHEVER IS THE MORE FREQUENT***			

Aggregate Testing Frequency

AGGREGATE TESTING LIMITS			
REF	***PARAMETER***	***STANDARD***	***LIMITS***
(A)	*GRADING*	*BS 812-103.1*	*FINE AGGREGATE: LIMITS C AND M, BS 882* *COARSE AGGREGATE: BS 882* *COMBINED GRADING NOT TO VARY BY MORE THAN 4%*
(B)	*DETERMINATION OF SPECIFIC GRAVITY AND WATER ABSORPTION*	*BS 812, PART 2*	*2% MAX WATER ABSORPTION FOR ALL AGGREGATES*
(C)	*CLAY, SILT AND DUST*	*BS 812-103.1*	*4% MAX FOR FINE AGGREGATE* *2% MAX FOR COARSE AGGREGATE*
(D)	*ORGANIC IMPURITIES IN SAND AGGREGATE*	*ASTM C40* *ASTM C87*	*ORGANIC PLATE NUMBER <3 (STANDARD) OR* *95% MIN STRENGTH RATIO AT 7 AND 28 DAYS*
(E)	*ACID-SOLUBLE SULPHATE*	*BS 812 PART 118*	*0.4% MAX*
	ACID-SOLUBLE CHLORIDE	*BS 812 PART 119*	*0.03% MAX*
(F)	*10% FINES VALUE FOR COARSE AGGREGATE*	*BS 812 PART 111 (SOAKED)* *(UNSOAKED)*	*100KN MIN* *REDUCTION OVER SOAKED LESS THAN 50KN*
(G)	*FLAKINESS INDEX OR ELONGATION INDEX OF COARSE AGGREGATE*	*BS 812 PART 105.1* *BS 812 PART 105.2*	*20% MAX (FOR PREDOMINANT)* *35% MAX (SIZE FRACTION)*
(H)	*POTENTIAL ALKALI REACTIVITY*	*REFER CLAUSE 402.04*	
(I)	*DRYING SHRINKAGE*	*BS 812 PART 120* *BRE DIGEST 357*	*0.075% MAX*
(J)	*MOISTURE CONTENT*	*BS 812 PART 109*	
(K)	*HOLLOW SHELL CONTENT*	*BS 812 PART 103.1* *VISUAL INSPECTION*	*3% MAX BY MASS OF COARSE AGGREGATE FRACTION OVER 2.36MM IN SIZE* *10% MAX BY MASS OF FINE AGGREGATE FRACTION 2.36-5MM IN SIZE*

Aggregate Testing Limits

402.4 ALKALI-REACTIVITY

Only aggregate which has been adequately demonstrated to be non-reactive in terms of alkali aggregate reaction shall be used in the permanent works. Samples of aggregate shall be sent to an approved specialist laboratory for petrographic examination in accordance with BS 812, Part 104.

Where potential alkali-aggregate reactivity is indicated by the petrographic examination then mortar-bar tests in accordance with ASTM C1260 (NBRI Method) shall be carried out. 14-day expansions greater than 0.1% shall be considered indicative of alkali-reactivity.

402.5 ADMIXTURES

Admixtures, if their use is allowed, shall comply with the following requirements:

(i) Admixtures shall be used only in liquid form and shall be batched in solution in the mixing water by mechanical batcher capable of dispensing the admixture in quantities accurate to within 5% of the required quantity.
(ii) All admixtures shall comply with the requirements of BS EN 934-2:2001 or ASTM C-494 or AASHTO M-194 and shall be of an approved brand and type.
(iii) Air entraining agents shall comply with the requirements of ASTM C-260 or AASHTO M-154.
(iv) Admixtures shall not contain any chlorides.

402.6 CURING AGENTS

Curing agents shall be tested in accordance with ASTM C-156 and shall comply with the requirements of ASTM C-309, except that the loss of water within 72 hours shall not exceed 0.40kg/m². Approved curing agents only shall be used.

402.7 FIBRES

Synthetic structural fibres shall be Strux 90/40 from Grace Construction Materials Ltd, or similar approved. The Contractor shall submit written confirmation from the manufacturer that the fibres are suitable for the intended application.

403 STORAGE OF CONCRETING MATERIALS

(a) Cement

Cement stored on the site shall be kept under cover which provides adequate protection against moisture and other factors which may promote deterioration of the cement.

When the cement is supplied in bags, the bags shall be closely and neatly stacked to a height not exceeding 12 bags and arranged so that they will not be in contact with the ground or the walls and can be used in the order in which they were delivered to the site.

Cement in bulk shall be stored in waterproof containers so designed as to prevent any dead spots from forming, and the cement drawn for use shall be measured by mass.

Cement shall not be kept in storage for longer than eight weeks without the Engineer's permission, and different brands and/or types of the same brand of cement shall be stored separately.

(b) Aggregate

Aggregates of different nominal sizes shall be stored separately and in such a manner as to avoid segregation occurring. Intermixing of different materials and contamination by foreign matter shall be avoided.

Aggregates shall be stored on a concrete slab with a fall and adequate drainage. Aggregates exposed to a marine environment shall be stored in enclosed hoppers to protect them from salt contamination.

(c) Admixtures

Admixtures shall be stored in strict accordance with the manufacturer’s recommendations and shall be agitated daily immediately before use.

404 DESIGN OF CONCRETE MIX

404.1 MIX COMPOSITION

The concrete shall be in accordance with the strength and proportions given in Table 3.3

The total estimated chloride content of the concrete shall not exceed the following limits:

(a) For concrete containing steel: 0.20% by mass of cement
(b) For other concrete: 0.50% by mass of cement.

The total estimated sulphate (SO_3) content of the concrete shall not exceed 3.7% by mass of cement.

The above limits shall apply in addition to the limits for the individual ingredients of the mix given elsewhere in this specification.

Requirement	**Schedule**	
	1	2
Reference	Reinforced concrete	Fibre reinforced concrete
Type of mix	Designed	Designed
28-day compressive strength (N/mm^2)	40	30
BS8110 exposure classes	XS1	
Maximum w/c ratio	0.5	0.55
Minimum cement (kg/m^3)	340	300
Maximum cement content (kg/m^3)	450	350
Cement or combination types	CEM I, IIA, IIB-S	CEM I, IIA, IIB-S
Chloride class	0.2	0.5
Maximum aggregate size (mm)[3]	20	20
Min air content (%)	Not applicable	Not applicable
Required admixtures		Superplastciser ASTM C494 Type F or G
Additives	-	4.5 kg/m^3 Grace Strux 90/40
Colour	Not applicable	Not applicable
Target Slump (mm) and range [1]	100 (55-145)	75 (40-110)
Nominal Cover[2]	55	
Placing Temperature (°C)	5 - 30	5 - 30

Notes:
1. To be determined by the Contractor
2. Actual cover to be as shown on the drawings
3. Limestone aggregate or an aggregate with a low thermal expansion coefficient (not exceeding $10x10^{-6}$ m/m°C) should be used to reduce the risk of early-age thermal cracking

Concrete Mix Composition

404.2 DESIGN OF PROPOSED MIX

The Contractor shall design the mixes, which he proposes to use in the Permanent Works to achieve acceptable workability and resistance to segregation during handling and placing and submit full details of the mixes to the Engineer for approval.

Mixes shall be in accordance with BS EN 206-1:2000 and BS 8500 and Table 3.1 and shall also comply with the following:

(i) The water/cement ratio shall be the maximum necessary to achieve the desired workability and complete compaction. Due allowance must be made for the presence of all admixtures, if any permitted by the Engineer, and the free moisture content of the aggregates.

(ii) The design target mean strength of the concrete shall be the sum of the characteristic compressive strength plus a margin of at least 1.64 x the current standard deviation for the concrete plant. The minimum standard deviation used shall be 3.5N/mm^2. Where a plant is newly established then a standard deviation of 7.5N/m^2 shall be adopted until at least 40 results have been obtained to permit an accurate value to be calculated.

(iii) The Contractor shall submit data on the proposed mix either from historic records or laboratory trial mixes to confirm compliance with the specification. In particular:

- workability
- 28-day compressive strength
- free water/cement ratio.

404.3 FIELD TRIAL MIXES

At least 35 days before the commencement of concreting, the Contractor shall make field trial mixes for each proposed concrete mix using the same type of constructional plant and of the same materials as proposed for the Works.

For each concrete mix the Contractor shall in the presence of a representative of the Engineer prepare a separate batch of concrete on each of three days.

From each batch of concrete 3 No. 150mm concrete cubes shall be made and tested at 28 days and 3 No. at 7 days. In addition, trial pours shall be undertaken.

The slump of the concrete carried out in accordance with BS EN 12350-2 shall be recorded.

The density of all cubes shall be determined prior to crushing the cubes.

The average value of the crushing strength of the three cubes at 28 days shall be greater than the design target mean strength otherwise the mix shall be re-designed.

Further trial mixes shall be made if the range (the maximum minus the minimum of the three cube results in any batch) exceeds 15% of the average of that batch, or the range of the three batches exceeds 20% of the overall average of the batches.

No mix shall be used in the Works without the final approval of the Engineer.

The Contractor shall submit full details of the mix design and the results of the field trial mixes to the Engineer.

405 PRODUCTION TESTING

For each class of concrete for use in the Permanent Works, samples of concrete shall be taken in accordance with the procedures described in BS 1881 at the point of mixing or of delivery as instructed by the Engineer.

A slump test in accordance with BS 1881 shall be carried out for each sample at the point of delivery or mixing.

The frequency of samples shall be one for every 20 m³ of concrete placed but never less than one sample per day or one sample for each concrete pour, whichever is applicable.

3 No 150mm test cubes shall be cast from each sample, marked, cured and tested as set out in BS 1881. One cube shall be tested at seven days and two at 28 days. The average strength of the two cubes crushed at 28 days shall be referred to as one test result.

Concrete shall be deemed to comply with the strength specified when both the following conditions are met:

- the average strength determined from the first two, three or four consecutive test results (4, 6 or 8 cubes respectively) complies with the appropriate limits in column A of the table below.

- Any individual test result complies with the appropriate limits in column B of the table below.

GROUP OF TEST RESULTS	***A***	***B***
	THE MEAN OF THE GROUP OF TEST RESULTS EXCEEDS THE SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH BY AT LEAST	***ANY INDIVIDUAL TEST RESULTS IS NOT LESS THAN THE CHARACTERISTIC COMPRESSIVE STRENGTH LESS:***
	N/MM²	*N/MM²*
FIRST 2 (4 CUBES)	*1*	*3*
FIRST 3 (6 CUBES)	*2*	*3*
FIRST 4 (8 CUBES)	*3*	*3*

Characteristic compressive strength compliance requirements

406 STEEL REINFORCEMENT

406.1 MATERIAL

(a) Steel bars

Steel reinforcing bars shall comply with the requirements of BS 4449 or equivalent on the approval of the Engineer unless where otherwise noted on the Drawings. For each consignment of steel reinforcement delivered on the site, the Contractor shall submit a certificate issued by a recognised testing authority to confirm that the steel complies with the specified requirements.

(b) Welded steel fabric

Welded steel fabric shall comply with the requirements of BS 4483 or AASHTO M55 or equivalent on approval of the Engineer. The grade of wire shall be W4 in accordance with AASHTO M32 or equivalent on approval of the Engineer unless where otherwise noted on the Drawings.

(c) Mechanical couplers

All mechanical couplers used shall be subject to the approval of the Engineer. The tensile properties determined on a test sample which consists of reinforcing bars butt-jointed by a mechanical coupler shall comply with requirements as given in the Special Specifications.

406.2 STORING REINFORCEMENT STEEL

Reinforcing steel shall be stacked off the ground and, in aggressive environments, shall be stored under cover.

All reinforcement which, in the opinion of the Engineer, has been adversely affected or which is unfit for use in the works shall be removed from the site. The Contractor shall, at his own expense, replace such reinforcing bars with suitably approved replacement.

406.3 BENDING THE REINFORCING STEEL

Reinforcement shall be cut or cut and bent to the dimensions shown on the bending schedules and in accordance with BS 8666:2005 or as prescribed by the Engineer.

No flame-cutting of high-tensile steel bars shall be permitted except when expressly authorised.

All bars of less than 32 mm in diameter shall be bent cold and bending shall be done slowly, a steady even pressure being exerted without jerking or impact.

If approved, the hot bending of bars of at least 32 mm in diameter will be permitted, provided that the bars do not depend on cold working for their strength. When hot bending is approved, the bars shall be heated slowly to a cherry-red heat (not exceeding 840C) and shall be allowed to cool slowly in air after bending. Quenching with water shall not be permitted.

Already bent reinforcing bars shall not be re-bent at the same spot without authorisation.

406.4 SURFACE CONDITION

When the concrete is placed around the reinforcing steel and/or dowels, the reinforcing steel and/or dowels shall be clean, free from mud, oil, grease, paint, loose rust, loose mill scale or any other substance which could have an adverse chemical effect on the steel or concrete, or which could reduce the strength of bond.

406.5 PLACING AND FIXING

Reinforcement shall be positioned as shown on the Drawings and shall be firmly secured in position within specified tolerance by being tied with 1.6 mm or 1.25 mm diameter annealed wire or by suitable clips being used, or, where authorised, by tack welding. Any cover and spacer blocks required to support the reinforcement shall be as small as may be consistent with their use and shall be of an approved material and design.

The concrete cover over the projecting ends of ties or clamps shall comply with the specifications for concrete cover over reinforcement detailed in the table at the end of the Section.

Where protruding bars are exposed to the elements for an indefinite period, the bars shall be adequately protected against corrosion and damage and shall be properly cleaned before being permanently encased in concrete.

406.6 COVER AND SUPPORTS

The term "cover" in this context shall mean the thickness of concrete between the face of the concrete and the surface of the reinforcement closest to the face of the concrete.

The nominal cover shall be as shown on the Drawings, where the nominal cover is the minimum cover for durability plus a tolerance for reinforcement fixing.

The cover shall be increased by the expected depth of any surface treatment, e.g. when concrete is bush hammered or when rebates are provided.

Cover blocks or spacers and their use shall be in accordance with BS7973-1 and subject to the acceptable by the Engineer.

Concrete spacer blocks made on site shall be demonstrated to have the same strength and durability as the concrete into which they are to be placed.

Ties cast into spacer blocks shall not extend deeper into the spacer block than half the depth of the spacer block.

The Contractor shall provide stools as shown on the Drawings, or where they are not detailed on the Drawings, wherever the Engineer requires them to be installed. The stools shall be suitably robust, and fixed securely so that they cannot swivel or move. The stools shall have sufficient strength to perform the required functions, taking into account amongst others temporary loads such as the weight of workmen and wet concrete, and forces caused by vibrators and other methods of compacting the concrete.

Checks on the concrete after casting shall be undertaken using a cover meter in accordance with BS1881, 204. The cover values shall not be less than the minimum given in the table below.

MINIMUM COVER (MM)	***DEVIATION TOLERANCE (MM)***	***NOMINAL COVER (MM)***
40	*15*	*55*

MINIMUM CONCRETE COVER TO REINFORCEMENT

406.7 LAPS AND JOINTS

Splicing of bars, except where shown on the Drawings, will not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible.

Steel mesh reinforcement shall overlap each other sufficiently and tied together properly at ends and edges to maintain a uniform strength. The lap at the edges shall not be less than 40 times the diameter of the main reinforcement bar or 350mm whichever is the greater.

Reinforcement shall not be welded unless agreed by the Engineer. If the Contractor is allowed by the Engineer to use welding, the procedures shall be as directed by the Engineer and the operations are to be carried out in his presence.

406.8 WELDING

Reinforcement shall be welded only where shown on the Drawings or as authorised.

Flash butt welding shall be done only with the combination of flashing, heating, upsetting and annealing to the satisfaction of the Engineer, and only those machines which control this cycle of operations automatically shall be used.

Metal-arc welding of reinforcement shall be done in accordance with BS EN 1011-1:1998, and with the recommendations of the reinforcement manufacturers, subject to approval by the Engineer and the satisfactory performance of trial joints. Hot-rolled high-yield-stress steel

shall be preheated to between 240°C and 280°C and low-hydrogen electrodes only may be used.

Trial welding joints shall be made on the site in circumstances similar to those which will govern during the making of production welding joints by the person who will be responsible for the production welding joints.

Other methods of welding e.g. resistance welding may be used subject to approval by the Engineer and to their satisfactory performance in trial joints.

Welded joints shall be full-strength welds and their strength shall be assessed by destruction tests on samples selected by the Engineer.

407 FORMWORK AND FORMED CONCRETE SURFACES

Formwork shall be accurately formed and shall be of sufficient strength and rigidity as to carry the weights and pressures of the concrete without deformation. It shall be tight so as to avoid the loss of grout and shall be clean and free from damage.

The surface finish to be achieved on formed concrete surfaces shall be as shown on the Drawings and as defined hereunder.

407.1 CLASS F1 FINISH

This finish is for surfaces against which backfill concrete will be placed.

Formwork may be sawn boards, sheet metal or any other suitable material which will prevent the loss of fine material from the concrete being placed.

407.2 CLASS F2 FINISH

This finish is for surfaces which are permanently exposed to view but where the highest standard of finish is not required.

Forms to provide a Class F2 finish shall be faced with wrought thick tongued and grooved boards with square edges arranged in a uniform pattern close jointed or with suitable sheet material.

The thickness of boards or sheets shall be such that there shall be no visible deflection under the pressure exerted by the concrete placed against them.

Joints between boards or panels shall be horizontal and vertical unless otherwise directed.

This finish shall be such as to require no general filling of surface pitting, but fins, surface discolouration and other minor defects shall be remedied by methods approved by the Engineer in accordance with Clause 408.05.

407.3 CLASS F3 FINISH

This finish is for surfaces prominently exposed to view where good appearances are of special importance.

To achieve this finish, which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets.

The sheets shall be arranged in an approved uniform pattern.

Wherever possible, joints between sheets shall be arranged to coincide with Engineerural features or changes in direction of the surface.

All joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets.

Unfaced wrought boarding or standard steel panels will be permitted for Class F3 finish.

The Contractor shall ensure that the surface is protected from rust marks, spillages and stains of all kinds.

407.4 CURVED SURFACES

For curved surfaces where F2, F3 finishes are called for, the formwork face shall be built up of splines cut to make a tight surface which shall then be dressed to produce the required finish.

Alternatively single curvature surfaces may be faced with plastic or plywood linings attached to the backing with adhesive or with escutcheon pins driven flush. Linings shall not bulge, wrinkle or otherwise deform when subjected to temperature and moisture changes.

407.5 FORMWORK STRIKING

Striking of formwork shall be carried out having regard for the climatic conditions prevailing, and shall be undertaken at the sole risk of the Contractor. Where premature removal of formwork takes place and excessive deformation is apparent, with or without distress in the concrete, the work shall be made good as described in this Specification.

The following striking times are included as a guide for normal conditions and shall be treated as a minimum requirement:

Falsework and formwork for	**Striking time (days)**
Walls, beam sides, columns	1
Suspended Slabs (props left under)	4
Ditto (props removed)	8
Beam soffits (props left under)	7
Ditto (props removed)	16

Formwork striking time for different types of elements

All exposed concrete arises are to have 25 mm x 25 mm chamfer.

If on stripping any formwork the concrete surface is found in any way defective, the Contractor shall make no attempt to remedy such defects prior to the Engineer's inspection and approval of the proposals to rectify in accordance with Clause 408.05.

408 UNFORMED CONCRETE SURFACES

408.1 CLASS U1 SURFACE FINISH (ROUGH)

This surface finish is required on the blinding concrete beneath the base of the floodwall.

408.2 CLASS U2 SURFACE FINISH (FLOATED)

This surface finish is required on the tops of the concrete base and tops of the concrete floodwall.

The surface shall first be given a Class U1 surface finish and after the concrete has hardened sufficiently, it shall be wood-floated to a uniform surface free from trowel marks. For non-skid surfaces such as on the emergency gate access steps, the surface shall then be given a broom finish. The corrugations so produced shall be approximately 1.0 mm deep, uniform of appearance and width and shall be perpendicular to the centre line of the steps.

408.3 CLASS U3 SURFACE FINISH (SMOOTH FINISH)

This surface finish shall be required on the Gate Apron areas. The surface shall first be given a Class U1 surface finish, and after the concrete has hardened sufficiently, it shall be floated with a steel float to a smooth surface to within specified dimensional tolerances.

Rubbing with carborundum stone after the concrete has hardened shall be allowed but under no circumstances will plastering of the surface be permitted.

409 MIXING, PLACING AND COMPACTING CONCRETE

409.1 MIXING CONCRETE

All concrete shall be made in a mechanical mixer. Concrete shall be placed within 30 minutes of completing the mixing. Mixing may be continued in the mixer up to a maximum period of 90 minutes and for not less than the period required to achieve an even consistency of the mix.

Materials shall be batched by weight to the following tolerances:

- Cement ±2% of the target batch mass
- Aggregate ±2% of the target batch mass
- Water ±2% of the target batch mass
- Admixture ±5% of the target batch mass

409.2 PLACING AND COMPACTING CONCRETE

(a) General

Concrete shall not be placed in any part of the Works until the Engineer's approval has been given. If concreting is not started within 24 hours of approval having been given, approval shall again be obtained from the Engineer.

Placing and compacting the concrete shall at all times be under the direct supervision of an experienced concrete supervisor.

Once the casting of concrete has begun, it shall be carried out in a continuous process between construction joints. Concrete shall be placed within 60 minutes from the start of mixing. These times may be extended by the Engineer where a retarding admixture has been used. All excavations and other contact surfaces of an absorbent nature such as timber formwork shall be damp but no standing water shall be permitted to remain on these surfaces. The formwork shall be clean on the inside.

(b) Placing under adverse conditions

Concreting during hot weather conditions shall comply with the established requirements of good practice as indicated in ACI 305. The temperature of the concrete shall not exceed the value in section 404.1.

During wet weather adequate covering shall be provided to both materials and concrete.

(c) Placing in thick sections

Precautions shall be taken against the risk of early-age thermal cracking and delayed ettringite formation in sections exceeding 0.6m in minimum thickness. The maximum temperature after placing the concrete shall not exceed 70°C. The temperature gradient in the concrete section shall not exceed 20°C (where temperature gradient is defined as the difference in temperature between the surface of the concrete and the centre of the pour or at a distance of 1.5m whichever is the shortest).

The precautions may include but not be limited to the following:

- Shading the materials and the concrete plant
- Painting the concrete plant white
- Adding flaked ice as a proportion of the mix water
- Placing concrete at night.

The Contractor shall provide suitable thermometers and temperature measurement equipment to permit the ambient and concrete temperature of the concrete to be monitored and recorded during the works.

An initial trial block shall be cast as part of the field trials and thermocouples used to assess the temperature development in the concrete using the proposed precautions.

(d) Compaction

Concrete shall be fully compacted during and immediately after placing. It shall be thoroughly worked against the formwork, around reinforcement bars and into corners to form a solid mass free from voids and excessive evidence of segregation and bleeding.

Unless otherwise permitted by the Engineer, concrete shall be compacted by means of vibrators. Internal vibrators shall be capable of producing not less than 10000 cycles per minute and external vibrators not less than 3000 cycles per minute. Sufficient standby vibrators shall be kept available in case of breakdowns.

The concrete shall be free from honeycombing and planes of weakness, and successive layers of the same lift shall be thoroughly bonded together.

409.3 CONSTRUCTION JOINTS

(a) General

Concreting shall be carried out continuously up to the construction joints shown on the working drawings or as approved, except that if, because of an emergency (such as breakdown of the mixing plant or the occurrence of unsuitable weather), concreting has to be interrupted, a construction joint shall be formed at the place of stoppage and in the manner which will least impair the durability, appearance, and proper functioning of the concrete.

Unless otherwise shown on the Drawings, the exact position of horizontal construction joints shall be marked on the framework by means of grout checks in order to obtain truly horizontal joints.

Stub columns, stub walls and stays on footings shall be cast integrally with the footings and not afterwards, even where another class of concrete is being used.

(b) Preparing the surfaces

When the concrete has set and while it is still green the surface film and all loose material shall be removed, without disturbing the aggregate, by means of a water jet assisted by light brushing to expose the aggregate and leave a sound, irregular surface. Where this is not possible, the surface film shall be removed after the concrete has hardened, by mechanical means appropriate to the degree of hardness of the concrete so as to expose the aggregate and leave a sound, irregular surface. The roughened surface shall be washed with clean water to remove all laitance, dirt and loose particles.

Surface retarding agents may be used only with the approval of the Engineer.

(c) Placing fresh concrete at construction joints

Where fresh concrete is placed the same day as that on which the construction joint was formed, the fresh concrete shall be cast directly against the face of the construction joint.

When concreting recommences a day or more after the construction joint has been formed, the following procedure shall be followed:

(i) The construction joint shall be kept constantly wet for a period of at least six hours. The surface shall be in a saturated, surface dry condition when concreting has to recommence.

(ii) Any dirt, excess water and loose particles shall be removed prior to reconcreting being started.

(iii) For vertical construction joints the fresh concrete shall be placed against a surface prepared in accordance with sub-clause (b) above, which is in a saturated, surface-dry condition.

Epoxy resins specially designed for bonding old concrete to new shall be used at construction joints where so specified. The preparation of the construction joint surface and the application of the epoxy resin shall be strictly in accordance with the manufacturer's recommendations and the Engineer's instructions. The actual brand and type of resin used shall be subject to the Engineer's approval.

409.4 CURING

Formwork shall be retained in position for the appropriate times as specified, and as soon as may be practicable, all exposed concrete surfaces shall be protected from loss of moisture by one or more of the methods described below. The curing period shall be continuous for at least seven days. The above shall be supplemented as necessary by protection and insulation of surfaces to prevent early-age thermal cracking and damage from construction traffic and the weather.

(a) Method 1

Retaining formwork in place for the full curing period.

(b) Method 2

Ponding the exposed surfaces with water.

(c) Method 3

Covering it with sand or mats made from a moisture-retaining material, and keeping the covering constantly wet.

(d) Method 4

Constantly spraying the entire area of the exposed surfaces with water.

(e) Method 5

Covering with a waterproof or plastic sheeting firmly anchored at the edges.

(f) Method 6

Using an approved curing compound applied in accordance with the manufacturer's instructions, except that, where the surface has to be subsequently waterproofed, coated or gunited, this method may not be used.

(g) Method 7

Steam curing the concrete (precast units).

409.5 WORKMANSHIP

The finished concrete shall be dense, durable and free from cracks and honeycombing.

All exposed faces of concrete shall be hard, smooth and free from honeycombing and other blemishes. All projections shall be rubbed down with carborundum stone.

The normal finish to slabs and screeds, unless otherwise specified, shall be formed by wood floating to the accurately levelled or screeded surface.

Any section of the work which, in the opinion of the Engineer, does not conform to the requirements or clear intent of this Specification, or to the requirements of established good practice, shall be made good or removed and replaced as directed by the Engineer at the expense of the Contractor.

409.6 REMEDIAL TREATMENT

This section deals with the remedial treatment for the following defects:

- Cracking
- Honey combing
- Low cover

Cracks with the opening greater than the limiting value shall be repaired by resin injection.

Defective surfaces shall not be made good by plastering. Repairs shall be generally based on proprietary cementitious repair materials.

Areas of honeycombing which the Engineer agrees may be repaired shall be cut back to sound concrete or to 75mm whichever is the greater distance.

In the case of reinforced concrete the area shall be cut back to at least 25mm clear distance behind the reinforcement. The cavity shall have sides at right angles to the face of the concrete. After cleaning out with water and compressed air, a thin layer of cement grout shall be brushed on to the concrete surfaces in the cavity and it shall then be filled immediately with concrete of the same class as the main body but with aggregate larger than 20mm nominal size removed. A form shall be filled to a point above the top edge of the cavity. After seven days the lip concrete shall be broken off and the surface ground smooth.

Surface irregularities which are outside the limits of tolerance set out in Table 6.1 shall be ground down in the manner and to the extent instructed by the Engineer.

Defects other than those mentioned above shall be dealt with as instructed by the Engineer.

Where sections of concrete which have failed to comply with the Specifications are required to be further investigated by extracting and testing concrete cores, 100 mm or 150 mm cores shall be drilled and tested. The sampling and testing procedure to be followed shall be in accordance with the publication Concrete core Testing for Strength – Concrete Society Technical Report No.11, published by the Concrete Society of Great Britain.

410 MOVEMENT JOINT

Movement joints may be in the form of expansion joints or contraction joints designed to allow for thermal or other movements in the concrete.

While expansion joints are formed with a gap between the concrete faces to allow for subsequent expansion of the concrete, contraction joints are introduced to permit initial contraction of the concrete and may include provision for subsequent filling.

Movement joints shall be formed in the position and in accordance with the details shown on the Drawings or elsewhere in the Specification.

411 JOINT SEALANT

The selection, applications and use of sealant shall comply with BS 6213. Attention need to be paid on the interface between the seal and the components to be joined and the nature of the sealing material. Before application of the joint sealant, the surfaces of the joint shall be cleaned, dried and primed, and a backing rod shall be installed, in accordance with the manufacturer's instructions.

The joint shall be finished true and flush with the adjacent surfaces, subject to the manufacturer's instructions for final profile. Joint sealant shall be products from Grace Building Products or similar approved. The Contractor shall submit written confirmation from the manufacturer that the joint sealants are suitable for the intended application. The sealant material shall have a minimum MAF of 25% and be suitable for application in a minimum joint gap of 25 mm with a maximum joint spacing of 10 m to accommodate the length change of walls under temperature and moisture variation effects.

412 JOINT FILLER

Joint fillers shall be compatible with the sealant and be obtained from a single manufacturer.

They should be one of the following:

(a) Resin bonded Cork.
(b) Closed-cell polyethylene joint filler.
(c) Bitumen impregnated fibreboard expansion joint filler.

413 SEALING STRIPS

Sealing strips should be hydrophilic taking into account of the exposure condition of the structure. They should be of suitable size to be maintained under a degree of compression specified by the manufacturer, throughout the range of joint movements. Sealing strips shall be products from Grace Building Products or similar approved.

500 BUILDING AND MISCELLANEOUS WORKS

501 CEMENT MORTAR

Cement used for mortar, rendering, grout, screeding and other construction work shall be in accordance with Section 508.

Cement mortar for blockwork, rendering, tiling and screeding shall consist of ordinary Portland cement and approved natural sand mixed by hand or approved mechanical mixer in the proportions by volume of one part cement to five parts sand unless otherwise specified or shown on the Drawings. The cement and sand shall first be mixed dry until the cement colour can no longer be distinguished from the sand in any part of the mass and the whole shall then be uniformly wetted by approved means while undergoing further mixing. The water content shall be just sufficient to ensure mixing. The water content shall just be sufficient to ensure a dense mortar of stiff consistency and adequate workability to permit trowelling or floating into place. The workability of cement mortar to be used for rendering may be improved by adding an approved plasticiser in the proportions recommended by the supplier of the plasticiser.

Mortar shall be prepared and used as rapidly as possible after mixing. Under no circumstances shall any mortar be used that has stiffened by commencing to set. Fresh mortar shall not be mixed with mortar prepared earlier and all batches shall be used entirely separately.

Water used for cement mortar, rendering, screeding and other construction work shall be in accordance with Section 508.

502 CONCRETE WORK

502.1 SPECIAL SPECIFICATION ISSUED BY ENGINEER

The contractor is to allow here or in his rates for all items therein. In the case of the Contractor leaving this item unpriced, he will be deemed to have considered that his rates are sufficient to enable him to perform the services and obligations in the Specification without extra charge.

502.2 CONCRETE SURFACE FINISH TO FLOORS

Where a tamped finish for concrete surfaces is specified, the surface shall be a levelled and screeded uniform plain or ridged finish which shall not be disturbed in any way after the initial set and during the period of curing; surplus concrete being struck off immediately after compaction.

Where a wood float finish is specified floating shall be done after the initial set of the concrete has taken place and the surface has hardened sufficiently. The concrete shall be worked no more than is necessary to produce a uniform surface free from screed marks.

Where hard smooth steel-trowelled finish is specified trowelling shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being worked into the surface. The surfaces shall be trowelled under firm pressure and left free from trowel marks.

Where the surface is to be power floated smooth it shall be carried out by mechanical means and skilled operatives. On completion the surface shall be checked to ensure that the final finish is within 5mm of required levels and shall be smooth and dense and free from marks

and similar imperfections. The finished surface shall be adequately protected against damage by subsequent trades as agreed with the Engineer.

502.3 PRECAST CONCRETE

All precast units shall be laid, bedded, jointed and fixed in accordance with the lines, levels and other details shown on the drawings.

All angles and prominent parts are to be suitably protected injury during the execution of the works.

502.4 PATCHING AND REPAIRS TO CONCRETE

No patching or repairs to be honeycombed or defective surfaces shall be carried out.

The Engineer may reject the whole or part of the structure if in his opinion the appearance is affected by defective work. Plastering of defective will not be permitted.

502.5 FORMWORK GENERALLY

Formwork shall conform to the shapes, lines, levels, and dimensions of the concrete as shown on the drawings.

Where the surface of the concrete is intended to remain "off the shutter" or "class I" finish without further covering, wire ties passing through beams or columns shall not be used.

For this purpose, steel rods passing through small tubes shall be used. After striking of forms the steel rods shall be removed and the tubes, which remain embedded in the concrete, shall be tightly filled with cement and sand mortar (1:3) as described herein.

The practice of driving nails into concrete for the purpose of securing timber cleats to support formwork components will not be permitted; where special difficulties arise out of this prohibition, the Contractor may apply to the Engineer for permission to nail into the concrete on specific occasions.

502.6 FORMWORK FINISH

Formwork may be of steel or timber and will be specified for use in accordance with the following classifications:

Class 0 - Formwork intended for use in forming concrete faces with special surface features which will not be covered by any other finishes and shall be such as to impart to the resultant concrete face as for class 1 formwork.
Board marked feature shall be achieved with the use of 75mm sawn timber boards to the patterns as shown on the drawings.

Class 1 - Formwork intended for use in forming concrete faces which will not be covered other than by painting, if at all shall be such as to impart to the resultant concrete face a finish equal to that which would result from the use of plywood faced shutter boards or special steel forms which are new when concreting commences and are thoroughly cleaned after each use.

The Engineer may require that parts of the concrete be rubbed down with a carborundum stone to obtain this finish.

Where this class of formwork is used to form the soffits of slabs or the faces of walls, the arrangement of panels shall be symmetrical, set out from edges or centre lines.

Odd dimension fill-in panels shall be cut to size and symmetrically place in approved positions.

All joints between shutter panels shall be straight and tight to approval.

Class 2 - Formwork intended for use in forming concrete faces which will be plastered or covered with tiles, or other similar finishes shall be such as to impart to the resultant concrete face a finish equal to that which would be obtained by the use of sawn timber of ordinary steel plates.

502.7 FORMWORK FINISH

Face groove or rebate formers where shown or noted on the drawings, forming strips of approved plastic; timber or similar material shall be inserted in or between formwork elements to soffits or faces in such a manner as to form grooves, rebates in the concrete.

The grooves or rebates shall be straight, to true lines and arranged in approved patterns.

502.8 MEASUREMENT AND PRICING

All costs incurred by the Contractor for complying with the provisions concerning the preparation and use of graded mixes shall be allowed herein.
All rates for concrete shall include for mixing and depositing at the various levels required throughout the building, and shall also include for forming or hacking a satisfactory key for all faces receiving asphalt and plaster work.

Rates for concrete work shall include for all labour and material for forming all construction and day joints and kickers.

Prices for concrete are to include for all necessary curing. Concrete in small projections, hoods, nibs, fins and the like unless otherwise described is included in the relevant concrete item to which they are attached.

Concrete poured against faces of excavation and beds laid on earth are measured to net volumes. The Contractor shall allow in his prices for any formwork or extra concrete he may consider necessary for such items.

Notwithstanding the provisions of Clause C4 1.4 of the principles of measurement (International) for works of construction, Formwork to sides of foundations is not measured and shall be allowed for by the Contractor in his rates for concrete if he so desires.

502.9 MEASUREMENT AND PRICING OF FORMWORK

The term "formwork" is to be taken to include centering, casing, shuttering and the like. Rates for all formwork shall include for fitting together in the required forms, horsing, strutting, shoring, staging, bracing and wedging, plumbing and fixing to true surface and angles, all straight and raking, cutting, splayed edges, notchings, holes for electric conduits, service pipes, etc., cutting and fitting around projecting pipes and continuity bars and the like, narrow widths and small quantities nails, bolts, clamps, wedges, including waste in cutting, overlaps and passings, and properly fixing at intersections, cleaning out before concreting, maintaining in position for the period directed, easing, striking and removing.

The formwork is measured to the actual net area in contact with the finished face of concrete.

The Contractor shall allow in his rates for formwork for forming all grooves or rebates as shown or noted on the drawings and as required at all formwork joints.

The cost of the formwork required to form construction joints and the like, which may be necessary to uphold the concrete during the operation and setting is deemed to be included in the rate for concrete.

Notwithstanding the provisions of Clause C4.1 item 3 of the Principles of Measurement (International) for works of construction formwork to.-sloping upper surfaces of concrete shall be measured only where the slope is in excess of 45 degrees from horizontal. In all other cases, the Contractor must allow in the prices for the concrete for any formwork he considers may be necessary.

502.10 REINFORCEMENT

Nominal sizes and lengths are shown on the drawings. No allowance has been being made for waste, rolling margin, supports, spacers or tying wire or for cutting to lengths.

The Contractor shall also allow in his rates for wire or other material required for binding or supporting the reinforcement as well as that of bending, hooking and all other work in providing and fixing the reinforcement as shown on the drawings or specified.

The Contractor shall allow in his rates for fabric reinforcement for the extra material at laps, for cutting the fabric to the sizes required, and for bends, binding wire, distance blocks and waste. Notwithstanding the provisions of Clause C 3.2 of the Principles of Measurement (International) for works of construction, reinforcement bars of differing diameters are grouped together and irrespective of location.

503 BLOCKWORK

503.1 CONCRETE BLOCKS

Concrete blocks shall comply with BS 2028 for strength, drying, shrinkage, moisture movement, curing and mix. Blocks shall be obtained from an approved source and shall be good, hard, well cured and pressed and of a regular size and dimensions.

Load bearing walls shall be type "All and non-load bearing walls type "B" all as specified in the Special Specification issued by the Engineer. Samples of blocks shall be submitted to the Engineer for approval which approval does not relieve the Contractor from complying with the Engineers Special Specification.

503.2 CEMENT

Cement used for making mortar and blocks shall be ordinary Portland cement to comply with BS 12.

503.3 ROCKSAND

Sand used for making mortar and blocks shall be washed rock sand and comply with the relevant BS standard.

The rocksand used shall be clean, well graded and hard. It shall be free from organic or other deleterious matter, stone, salt and dust and shall be sieved and washed if so directed by the Engineer.

503.4 WATER

Water shall be clean, fresh and pure water from the mains and shall be kept free from any impurities.

Water shall be tested in accordance with BS 3148 if so instructed by the Engineer.

503.5 JOINT FILLERS

Expansion joints compressible filler shall be Flexcell as manufactured by Expandite Ltd., Chase Road, London and used in accordance with their written instructions.

503.6 MASTIC

Pointing mastic shall be Thioflex 600 or other equal approved polysulphide mastic and used in accordance with their written instructions.

503.7 STORAGE OF MATERIALS

All materials shall be stored in accordance with the recommendations in CP 121 and the manufacturer's written recommendations.

503.8 MIXING PLATFORMS

All mortar shall be mixed on a level, non-absorbent and close jointed timber or steel platform. Platforms are to be kept clean and old mortar removed before any new batch of mortar is prepared for mixing.
All materials shall be measured in approved and tested gauge boxes.

503.9 MORTAR

Cement mortar shall, unless otherwise specified, be composed of cement and sand (1:3). The specified mix proportions are measured by volume using dry sand in proper gauge boxes and bulking shall be allowed for if the sand is damp.
Mortar shall be made and used in accordance with CP 121. The cement and sand is to be mixed dry on a platform until the mix is uniform in colour and then water added gradually through a fine rose and the mixture turned over until the ingredients are thoroughly incorporated and brought to a proper consistency.

Only sufficient water shall be used to obtain a workable mix. Cement-mortar is to be mixed in small quantities and must be used within one hour of mixing and no partially or wholly set mortar shall be reused or remixed.

503.10 SETTING OUT

All walls, partitions, projections, openings, etc., are to be carefully set out in accordance with the drawings, checked up with any reinforced concrete work and overall dimensions.

The Engineer's attention shall be drawn to any discrepancies or if any doubts occur in the setting out before proceeding.

503.11 WORKMANSHIP GENERALLY

Blocks which are misshapen or which have broken arises or are chipped, cracked or otherwise damaged shall not be used.

Workmanship shall be in accordance with CP 212 and unless otherwise specified all blockwork shall be built in stretcher bond.

Blocks shall be well and fully soaked before being laid and top of walling where left off shall be well wetted before recommencing block laying.

All courses shall be kept level and in line, and all wall faces, angles and features shall be accurately plumb and true to the lines and true in vertical plane.

Walls shall be set out carefully to ensure satisfactory junctions and joints with adjoining or built in elements and components. All perpends and angles are to be plumbed, and jambs and reveals properly formed.

Proper setting out rods shall be provided and all work shall be set out for course, opening, heights etc., to the widths, depths and heights indicated on the drawings and as directed by the Engineer.

503.12 WALLS

Bonding shall be in accordance with CP 121.

All walls shall be constructed with all materials fully bonded or tied together, and joints filled, to ensure compliance with design requirements for stability, strength and fire resistance.

All walls shall be built entirely solid in blocks, without voids, with alternate courses of walls at all angles and intersections carried through the full thickness of the adjoining wall and shall be properly bonded and secured at such intersections.

All walls of 200mm thickness or less shall be built in single thickness of block.

503.13 JOINTING AND POINTING

Jointing and pointing shall be in accordance with CP 121.

Blocks shall be well buttered with mortar and shall be solidly bedded and jointed at each and every course throughout the width of each course in cement mortar as described with beds and joints not more than 12mm or less than 10mm thick, all flushed up and grouted solid as work proceeds.

Walls shall be built in such manner that no vertical joint in any one course shall be within 110mm of a similar joint in the courses immediately above or below.

Walls which are to receive rendering shall have joints raked out as work proceeds as key for plaster.

503.14 MORTAR

All walls shall be properly protected while mortar is setting and all walls throughout the work shall be carried out up more than 1.0 metre higher at one time than any other part of the wall being built.

All putlog holes shall not be less than one course deep and shall be carefully filled with a block cut to fit the size of the hole with beds and joints filled in solid with mortar and well tamped in after scaffolding is removed.

503.15 CURING

Walls shall be kept thoroughly wet for at least three days or for such longer period of time as the Engineer may direct. Walls exposed to the sun shall be protected with a sacking which shall be kept wet.

503.16 SAMPLE BLOCKWORK PANELS

Allow for constructing two sample blockwork panels approximately 2 sq m each 150mm thick and when approved sample panels shall form the standard to be maintained throughout the contract.

503.17 CUTTING

All rough cutting, raking cutting, curved cutting or cutting to special Engineerural profiles shall be executed true to the lines and neatly in accordance with the drawings or as directed.

503.18 BUILDING IN

Cramps, gratings, air blocks, dowels, etc., shall be built in cement mortar.

BUILDING-IN, BEDDING Steel door and window frames and the like shall be built as the work proceeds and shall be set up in positions for building in and securely strutted to prevent distortion whilst the walls are being built.

Pressed steel door frames shall be grouted in solid at back with concrete as specified as the work proceeds.

Where steel windows or pressed steel door frames are built against concrete they are to be plugged and screwed on dovetailed hardwood blocks or proprietary fixings cast into concrete walls, beams, columns, etc.

All door, window and similar frames shall be bedded and carefully pointed all round and made perfectly watertight in cement mortar as described.

Where door, window and similar frames are specified to be bedded and pointed with mastic compound, they shall be pointed all round externally and/or internally with an approved waterproof compound of such composition that it will not stain surrounding surfaces, and that it will adhere tenaciously, remain plastic without sagging or running, be capable of accommodating any normal movement of the joint sealed and in the case of steel receiving paint without "bleeding". The pointing material shall be forced into the joints, which shall have previously prepared to receive same, by means of a pressure gun or by other suitable method, all in accordance with the manufacturer's instructions.

503.19 CHASES AND HOLES

All chases, recesses, projections, etc. cut Or formed for electrical conduits, switch boxes, distribution boards, etc., are to be formed as and where shown on drawings and details.

Pockets and holes for pipes are to be formed or neatly cut as required and properly made good thereafter. The positions of all chases and holes shall be agreed with the Structural Engineer.

All chases, recesses, projections, holes, etc., are to be cut or formed neatly and to true lines and levels using suitable power tools to prevent any damage to the blockwork.

503.20 PROTECTION

The whole of the blockwork shall be kept clean and protected as the work proceeds.

503.21 RATES AND MEASUREMENTS

The Contractor shall allow in his rates for walling for all plumbing angles, rough cutting whether straight, raking or splay and waste, split courses necessary for bond, bonding at angles, intersections and junctions of walling of different thickness, forming solid tops under beams and soffits of slabs, forming any split course and cutting and fitting around ends of cills and linters or other members, cutting and pinning ends of structural timbers, steel sections, forming all door, window or other openings including forming reveals to same and for all cutting and waste to walling in short lengths to mullions or jambs of openings; for hoisting and building off beams and slabs at any level, all necessary scaffolding and for work built overhand and building in of items as described.

504 WOODWORK

504.1 DEFINITIONS

The term "(f)" qualifying an expression of size means that the work shall be finished to the sizes given. The term it (f)" means that all dimensions contained in an expression so qualified are finished dimensions.

The term "Plugging" shall mean the provision and fixing of hardwood or approved proprietary plugs, or, at the contractor’s option fixing by other approved mechanical means to any background e.g. blockwork, concrete, etc.

504.2 TIMBER GENERALLY

All timbers shall be suitable for the purpose for which it is intended and is to be well and thoroughly seasoned, sound, free from sap, shakes, large, loose or dead knots, cracks, decay, live insect attacks or other defects.

Timber are to be straight and true and any warped or twisted timbers shall be rejected. Timbers are to be sawn die square and shall hold the full sizes specified. All timbers are to be in one piece.

504.3 PRESERVATIVE TREATMENT

Where described as treated, timber shall be pressure impregnated with Tanalith preservative to a dry salt retention of 5.3 kg of preservative per cubic metre of timber. Timber to be treated shall be machined down to its final dimensions before treatment.

Pressure impregnation shall be carried out in accordance with the preservative manufacturer's recommendations and the recommendations in BS 4072 and BS 5268.
After pressure impregnation the timber shall be dried to the moisture content specified hereinafter. All surfaces of timber which are cut or machined after impregnation shall be treated with preservative as recommended by the manufacturer of the preservative used for the impregnation.

Any metal used to fix or fix to timber which has been treated with preservative shall be compatible with the preservative or be treated so as not to corrode under any conditions.

Adhesives used to fix or fix to timber which has been treated with preservative shall be compatible with the preservatives in accordance with the recommendations of the adhesive and preservative manufacturer's recommendations.

504.4 TIMBER FOR CARPENTRY

All timber for carpentry shall be as specified and of first grade best quality and treated.

504.5 TIMBER FOR JOINERY

All timber for joinery shall be as specified and of first grade, best quality and selected.

504.6 WROUGHT TIMBER FOR JOINERY

The quality of timber shall be in accordance with BS 1186. Timber to receive a clear finish shall comply with the requirements specified therein. Timber to receive a paint finish shall comply with the requirements specified therein. Timber grounds and other concealed framing shall comply with the requirements for "concealed or semi-concealed surfaces".

504.7 HARDWOOD VENEERS

Hardwood veneers shall be as stated.

504.8 PLYWOOD

Plywood shall comply with BS 1455 Grade 2, veneer WBP bonding. Marine plywood shall be as specified.

504.9 PLASTIC LAMINATE

Plastic laminate shall be matt "Formica".

504.10 MOISTURE CONTENT

All timber for joinery shall be kiln dried to a moisture content which shall not be less than 10% nor exceed 12%.

The Contractor shall ascertain the particular moisture content for doors and other joinery items in respect of their location in the finished building before placing orders.

The specified moisture content shall be maintained during the execution of the Works.

504.11 SOURCE

All timber shall be obtained from an approved source of supply and shall be in compliance with the specified requirements.

504.12 EXPOSED JOINERY

All exposed woodwork, unless otherwise specified shall be wrote.

All wrot surfaces shall be finished clean, smooth and free from tool marks.

For each wrot face , 1.5mm and 3mm will be allowed off specified sizes for hard and soft woods respectively except where specified as 11(f)" or "(f sizes)" in which case the timbers must hold the full size specified.

504.13 WORKMANSHIP GENERALLY

The quality of workmanship shall be at least equal to the applicable recommendation in BS 1186.

All joinery shall be scribed to fit perfectly in position and unless otherwise described all joinery shall be slightly rounded on all exposed arises.

When fixed in position, doors and all other joinery work shall remain free from shrinkage, swelling, twisting, splitting, warping or any other defect which will detract from satisfactory performance or appearance.

504.14 TREATMENT OF TIMBERS AGAINST PESTS

No timbers, whether permanent or temporary, which are or show evidence of being, or have been, infected with borer or any other insects, pests are to be permitted on site, and such timbers are to be removed and replaced.

504.15 CARPENTRY

All carpentry shall be executed with workmanship of the best quality and be accurately set out and in strict accordance with the Drawings. Constructional carpentry shall be framed together in the best and strongest manner and secured with all the necessary straps, bolts and other ironwork.

All plates and similar items shall be in long lengths, properly halved at joints, etc., all according to the best practice and to approval. The provision of all brads, nails, screws, plates or other fixings as directed or approved by the Engineer shall be deemed to be included.

504.16 SCREWING

No nails whatsoever shall be used. All timber shall be fixed with brass screws or pins. Screws shall comply with BS 1210 as appropriate.

Brass screws or pins shall be of the best quality and of gauge, length and strength suitable for the particular work for which they are used.

Screws shall be long enough to enter the second timber by at least one-half their entire length. All screw heads shall be countersunk below the timber surface. All work shall be secret fixed wherever possible.

504.17 PELLETING AND STOPPING

Colour and grain match pellets not less than 6mm thick, cut from matching timber only shall be used and shall be finished off flush with face.

The exposed face of the pellets shall be perfectly circular and fit in neatly.

Stopping to timber shall match the timber in colour and appearance so as to be indistinguishable from the surrounding woodwork.

504.18 FIXING OF JOINERY

All joinery works shall be executed in accordance with the Engineer's drawings and not from measurements at the building. It shall be the responsibility of the Contractor to ensure that the surrounding or enclosing carcass where joinery works are to be fixed in or inserted in the positions are built accurately to the dimensions shown and true to the lines and levels so that all joinery works to be fixed in or inserted in position fit in accurately and neatly in the surrounding or enclosing carcass.

It shall be the responsibility of the Contractor to ensure that the necessary fixings are incorporated in the carcass or surrounding, alternatively, the Contractor shall construct such grounds as are required to provide a suitable base and fixing for the joinery works.
Joinery works shall not be fixed in position .until after all floor, wall and ceiling surfaces have been formed or constructed and the building enclosed.

504.19 JOINERY

All joinery manufacture shall be put in hand immediately after the order has been given to commence work or upon receipt of details. Joinery must be stacked in an approved manner in a dry place and shall not be wedged or glued until just before fixing in the building.
Should the joints of any joiner's work open or give, or any shrinkage take place before payment of the final certificate, such defective work shall be taken down, refitted and redecorated or new joinery put in its place at the Contractor's expense.

Unless otherwise specified, all joinery shall be purpose made and worked to detail drawings and shall be constructed in accordance with approved best standard practice, morticed and tenoned, dowelled, dovetailed, tongued, grooved, glued, pinned, screwed, etc., as is best suited for the particular part.

All morticed and tenoned joints shall be pinned with hardwood pins in addition to wedging and glueing. -Single lengths of skirtings, rails, architraves and such items of joinery are to be used wherever possible in preference to lengths made up of shorter pieces. Heading joints will not be permitted except where unavoidable.

Such heading joints are to be splayed and made invisible. Where there are joints in joinery which are to be finished for waxing or oiling, then the ends must be matched for grain. All exposed screw-heads shall be covered with wood pellets finished flush.

504.20 DEFECTIVE WORK

Any work with defects such as shrinkage, warping, etc., appearing before the expiration of the maintenance period for this Contract is to be removed, refitted and redecorated or replaced by new joinery and any other work disturbed in consequence thereof must also be made good, all at the Contractor's expense.

504.21 DOORS

(a) Framed doors

All framed doors shall have continuous stiles, properly morticed for rails, ledges, braces, etc., as detailed, and all these members shall be properly tenoned to fit neatly and tightly into the mortices and shall be securely glued and dowelled in position, the whole frame being held in a metal clamp during dowelling. Where doors are lined with tongued and grooved boarding, the stiles and heads shall be rebated, grooved and V-joined for the boarding, which shall be properly cramped up, secret bradded and twice screwed at intersections with ledges and bottom rail with galvanised countersunk screws.

(b) Framed, ledged and Braced Doors

Unless otherwise described, all "framed and ledged" doors and "frame, ledged and braced" doors are to have the ledges and braces chamfered and are to be filled in with grooved, tongued and V-joined both sides boarding in narrow widths, rebated on outer-edges and fixed in grooves in stiles and top rail, flush one side and twice countersunk screwed at each intersection with ledges and braces.

The inner edges of framing and abutting edges of boarding are to be chamfered to form a V-joint. All edges of boarding and framing and back of ledges and braces are to be primed before assembling.

(c) Solid, Semi-solid and Hollow-Core Doors

Solid, semi-solid and hollow-core doors are to be of approved manufacture, of the best quality material and workmanship and are to comply with the requirements of BS 459 unless otherwise specified.

(d) Concealed Edges to Doors

Doors described as "with one edge concealed" are to have an .edge strip of material similar to the veneer tongued or glued to one edge of each door. Doors "with all edges concealed" are to have similar edge strips tongued or glued to all edges of each door or leaf.

(e) Hanging Doors

Allowance is to be made in rates for hanging and fitting all doors to steel or wood frames.

504.22 PANELLED WORK

All panelled or veneered woodwork, whether stained, varnished or painted, etc., is to be of timber carefully selected for uniformity of grain and colour and all to approval.

504.23 PRIMING

The surfaces of all joinery work shall be prepared and primed to receive a paint finish prior to delivery to the site to receive a paint finish on site.

Preparing and priming shall be in accordance with the specification therefore in "Painting and Decorating" hereinafter.

Fill and rub down open grained surfaces to give a smooth even surface suitable for the subsequent site applied finish.

504.24 IRONMONGERY

All ironmongery shall be either of the make and to the exact specification described or of an approved make and design giving similar action. In the latter case actual samples shall be submitted to the Engineer for approval and comparison with the goods specified. All ironmongery shall be fixed with screws to match.

All locks shall be stampered with distinctive consecutive numbers and the keys shall be tagged and referenced to the doors which they operate the lock of and hand over to the Engineer on completion.

All locks are to be "en suite" and are to be supplied with three keys.

All locks are to differ so that the key of any one lock will not open any lock other than that to which it belongs and shall be determined according to the master keying system.
The Contractor shall be responsible for ordering correct "hands" of ironmongery and supplying accurate site dimensions for kicking plates and similar items where required.

504.25 PROTECTION

The whole of the joinery works shall be properly protected as directed by the Engineer and kept clean and neat during the course of the works and should any joinery works be damaged or disturbed they shall be made good to the satisfaction of the Engineer all at the Contractor's expense.

505 METAL WORK

505.1 STEEL

Mild steel shall be of an approved manufacture and comply with BS 4360.

505.2 BOLTS

Bolts, nuts and screws shall be of the sizes shown and with hexagonal heads and nuts and washers where required. All bolt holes shall be true and opposite. Bolts and nuts shall comply with BS 916 or BS 1494 as appropriate.

505.3 RIVETS

All rivet heads are to be countersunk at all bearings, joints and wherever necessary.

505.4 GALVANISED METALWORK

Metalwork to be galvanised shall comply with BS 729 Part 1.

505.5 GALVANISING

All hot dipped galvanising is to be executed in accordance with BS 990. Where this is impractical because of tolerances on screw threads, the finish shall be electro galvanised to BS 1706 Class A or BS 3382. The latter process shall be used for making good any damage to hot dipped galvanising if so directed by the Engineer.

505.6 STAINLESS STEEL

Stainless steel shall comply to BS 1449 or BS 4127.

505.7 GENERALLY

All metalwork shall be delivered to the site quite clean and free from rust, pitting or any corrosion.

505.8 STEEL WINDOWS

All steel windows shall be from galvanised sections or hot dipped galvanised after manufacture. A sample window shall be submitted to the Engineers for approval before any order is placed.

All sectional frames, casements and glazing bars are to be free from flaws and other imperfections.

All steel windows and doors and frames shall be constructed in FX6 and FX8 section with tee glazing bars as specified. All top, bottom and side-hung opening casements, unless otherwise-described or shown on the drawings, are to be hung on stout steel pivot hinges with gunmetal centres.

All top hung opening fanlights and casements, unless otherwise described or shown on the drawings, are to be fitted with brass peg stays with pegs arranged to lock window when closed. All side-hung casements, unless otherwise described, or shown on the drawings, to be fitted with brass handles and pivot with night ventilating notches to engage with striking plate and adjustable brass sliding stay.

All horizontal and vertical pivot hung sashes are to be fitted with approved bronze friction centres capable of adjustment and fitted with brass fastening, unless otherwise described or shown on the drawings.

Steel doors with frame and sash frame are to be as described. Kicking plates and other solid plates are to be of 5mm mild steel fixed with metal beads screwed on.
Locks and furniture are to be as described and to have three keys.

Each leaf of doors is to be fitted with two 150mm brass square pattern tower bolts.
All large windows are to be provided with temporary braces or stiffeners to prevent coupling screws or sections being strained during transit, hoisting and handling.

After windows are built in and prior to glazing, each window must be carefully tested and adjusted to ensure that opening sections are in perfect working order, make good contact and are watertight and that glazing bars are perfectly aligned.

505.9 PRESSED STEEL DOOR FRAMES

Pressed steel door frames are to be of 1.60mm (for once rebated frames) and 1.20mm (for twice rebated frames) close annealed and hydraulically flattened galvanised steel sheets, pressed to shape, mitred and welded at angles and provided with six approved steel lugs (three to each jamb) with ends split and flanged for building into walls.

Frames described as suitable for fixed or opening fanlights are to have transomes of similar steel with welded seams at edges and ends tenoned into and welded to frames.
Frames are to be fitted with solid plates or bracing bars across bottom.

Unless otherwise stated, each frame is to be fitted as described with approved heavy steel butts welded on. Each frame to doors fitted with a mortice lock is to be slotted for bolt, correctly positioned and to have a mortice cap welded on at back of perforation.

All necessary drilling for sundry ironmongery such as fanlight openers, bolt sockets, etc., should be executed by the steel frame manufacturers at the works and the Contractor is to undertake to supply the correct information to the manufacturer to ensure that this is done.

All frames are to be fitted with a pair of anti-slam buffers.
Fixings for set-screws are to have a solid welded on at back in all cases. All steel frames are to be thoroughly cleaned free from rust, scale, etc., and to be primed prior of delivery to the site.

505.10 ROLLER SHUTTERS

Roller shutters shall be in galvanised mild steel plates of 18 S.W.G sheets and be obtained from an approved manufacturer.
Shutters shall be complete with guides, channels manual gear, gearbox caning, lock and cyclone bars as appropriate.
Roller shutters are to be designed, manufactured and fixed to withstand the worst cyclonic conditions and a written guarantee shall be provided by the manufacturer together with any supporting evidence and samples before any order is placed.

505.11 OPENINGS

506 GENERALLY

506.1 PRELIMINARY SUBMISSIONS

Submit prior to start of fabrication the following for approval:

(a) Shop drawings approved by manufacture of profiles and showing clearly all profiles and materials to be used.

(b) Detailed design calculations for cyclonic wind of 250 km/h

(c) Drawings / sketches with detailed window assembly including: large scale details of members and materials, of brackets and anchorage devices and of connection and jointing details; fully dimensioned layouts for positioning of brackets and anchorage devices to structure; dimensions gauges, thickness; glazing details; description of materials including catalogue numbers, products and manufacturer's names; finish specifications and all other pertinent details.

(d) Certificate of origin

(e) Catalogue of all sections to be used.

506.2 DESIGN CRITERIA / CONSIDERATIONS

Design and fabricate windows, brackets and anchorage devices so that when installed they will:

(a) Compensate for unevenness and dimensional differences in structure to which they are secured.

(b) Allow full expansion and contraction of window framing members without causing stress within window assembly as a result of such expansion and contraction.

(c) Tolerate structural deflection and distortion of structure under design criteria conditions, without imposing load on window assembly.

506.3 MATERIALS GENERALLY

Materials shall comply with the relevant British Standard Specification. The following shall generally be complied with:

(a) Glass to bear manufacturer's labels, indicating quality and thickness

(b) Finish to Consultant's selection

(c) Colour schedule to Consultant's selection

(d) Float glass –6mm thick unless otherwise noted; reject any glass having surface distortion.

(e) Safety glass – fully toughened plate or float complying with BS 952.

(f) Glazing tape – vulcanised butyl tape with continuous neoprene spacer. Black colour.

(g) Weather stripping – mohair pile Schlegel inserted into keyed grooves.

(h) Neoprene diameter according to gap to be sealed

(i) Accessories – shims, spacers, expansion bolts and screws, non-ferrous, clips, angles and fastening devices, galvanised steel, stainless steel.

506.4 HARDWARE

(a) Unless otherwise specified herein, supply and install all finishing hardware associated with windows and doors including but not limited to floor stops where required. Perform drilling necessary to install stops and other hardware items fixed to adjacent construction.

(b) All lock cylinders and keys to be supplied and keys to be fitted with appropriated tags.

(c) Provide for each swinging door:

(i) Push/pull combination as selected by Consultant
(ii) Overhead concealed closer in transom rail complete with bottom pivots or floor springs with top pivots. Single leaf doors shall have no door closer.

506.5 FABRICATION GENERALLY

(a) Conceal nut, bolts, screws clips and other means of fastenings in finished work except where shown or specified.

(b) Insert concealed steel reinforcements into all door jamb members and any other units as required, sized to adequately withstand wind pressure requirements of British Standard and action of hardware.

(c) Maintain dimensional tolerances to closest possible accuracy for various parts, and to vertical and horizontal planes.

(d) Assemble, secure, anchor, seal and make weathertight all windows, doors and frames in manner which does not restrict thermal movement and in strict accordance with certified shop drawings.

(e) In assembly of various components, make allowances for deflection of structure above; when making connections ensure that no structural load is transmitted to frame or door.

(f) No manufacturer's name plate shall appear on exposed face of window, door or frame assembly (while in closed position).

(g) Accurately joint and fit corners of windows or doors to flush hairline joints. Weld unexposed sides leaving no surface imperfections such as pitting, discoloration or weld halo.

(h) Do all fitting and assembly as far as practicable in factory.

(i) Accurately prepare and reinforce with backing plates to ensure adequate strength, all cut outs, recesses and mortising required for hardware.

(j) Provide removable frame bottoms at concealed closers.

(k) Where no masonry or structural beam occurs above entrance screens, extend mullion reinforcing to under slab above for anchorage. Blast clean and galvanise brackets and other steel supplied under this section. Galvanise after fabrication.

(l) Clear bay dimensions are given on Engineer's drawings, Contractor is requested to take physical dimensions on site prior to fabrication to ensure dimensional co-ordination.

506.6 DELIVERY AND STORAGE

(a) Adequately protect profiles and profile finishes to prevent damage thereto during shipping, fabrication, storage, handling and installation.

(b) Deliver, handle and store units methods approved by manufacturer. Protect from damage and staining.

(c) Protect sills and stools after installation with boards, heavy paper or other suitable protection, secured in place to prevent staining or scratching. Do not remove protection before final cleaning.

506.7 ERECTION.

(a) Contractor should ensure that main contractor hands over to him rendered masonry frame with rebate to accommodate openings. After erection final external rendering to be applied to jambs and lintol of opening. A 6mm gap should be kept between frame and cill for drainage of condensed water.

(b) After alignment positively lock anchorage devices to prevent movement other than designed to accommodate deflection and thermal expansion and contraction.

(c) Erection tolerances for operable elements consistent with smooth operations and weatherproof performance.

(d) Perform necessary drilling of concrete, masonry and steel necessary to install the works. Site located fixing to the masonry and concrete shall be stainless steel lag screws and lead shield. Cost of repair of concrete chipped by drilling or fixing operations shall be borne by Contractor.

(e) Apply a heavy brush-coat of asphaltic paint to aluminium or galvanised steel placed in or in contact with concrete, masonry mortar or dissimilar metals.

(f) Make the completed installation free from objectionable noise, rattles, wind, whistles, cracks or noise due to movement.

(g) Gun-apply 3 continuous beads of sealant under extruded aluminium frame. Make bead diameter sufficient to ensure a full-width seal. Remove sealant by approved means.

(h) Leave labels on glass until it has been set and inspected and approved. Glass to be without cracks, scratches and other defects and shall be with settings in perfect conditions at completion to the approval of the Consultant. Remove rejected, broken or damaged glass due to defective materials or improper setting and replace with perfect materials. Reject units producing distorted vision and replace.

(i) One length gasket heat-welded at corners has to be used. The jointing of the two ends has to take place on the top part of the panel.

(j) Glass stops shall provide edge margins as recommended by glass manufacturer.

(k) Upon completion of the project and just prior to handing over of the building to the owner or at a time as directed inspect, test and adjust installation as follows: -
  (i) Inspect all units for damage and correct same immediately.
  (ii) Test and adjust all hardware and replace all faulty items.
  (iii) Adjust all weather stripping so as to leave each opening unit in its most weather tight position.
  (iv) Test all operable elements and ensure easy and smooth operation.
  (v) Inspect all units for cleanliness and freedom from burrs and debris.

506.8 WARRANTY

The Contractor shall provide a written guarantee, of the products for a period not less than 10 years starting at the expiry of the Defect's Liability Period.

506.9 ANODISED ALUMINIUM OPENINGS

Anodised aluminium openings shall comply with BS 4873: 1986 and BS 3987: 1991 and shall be fabricated from extruded aluminium alloy 6063TF, 6063TE or 6063 TB complying with BS 1474.

Aluminium framing shall have a clear anodic oxidation coating of not less than 25 microns.

Clear anodised aluminium surfaces shall be sealed to BS 6161: Part 3.

506.10 POWDER COATED ALUMINIUM OPENINGS.

Powder organic coated aluminium openings shall comply with BS EN 12206. The colour of powder coated aluminium openings shall be of approved colour.

The supplier shall produce a certificate stating that the powder coating complies with the performance requirements stipulated in the British Standards.

Powder coating thickness shall not be less than 60 µm or greater than 120 µm and to QUALICOAT 'Seaside' class standard from approved supplier.

506.11 PVC-U OPENINGS

Plastic openings made from PVC-u extruded hollow profile shall comply to BS 7412: 1991 (incorporating amendment 01 of May 1997). White PVC-u extruded hollow profiles forming such openings shall comply with BS 7413: 1997.

Sliding sashes shall be horizontally sliding. The sashes shall be supported on beams or locating devices that facilitate the movement between the sashes and the outer fixed frame other than by seal. Top hung panels shall open out. All openings shall be provided with hermetically sealed double glazing units to comply with BS 571 and shall be glazed in accordance with BS 6262.

Metal reinforcement shall be from one of the following materials:

(a) Mild steel sheet hot-dipped zinc coated
(b) Austenitic stainless steel sheet or strip
(c) Extruded aluminium alloy.

The construction of the plastic openings shall be based on the following consideration:

(a) Glazing and reglazing facilities without the need to remove the outer frame.
(b) Drainage from horizontal members etc.
(c) Sliding action
(d) Weather tightness comprising air permeability, water tightness and wind resistance.

506.12 COMPOSITE ITEMS OF METALWORK

The fabrication, assembly and erection of all composite items of metalwork shall be executed in accordance with the Engineer drawings.

Metalwork which are bent or distorted during loading, transporting, off loading or in storage will be rejected by the Engineer.

All composite items of metalwork shall be hot dipped galvanised after manufacture as described.

506.13 FIXING AND ERECTION

All metalwork including doors and windows shall be inspected for damage on arrival on site and any damage to hot dipped galvanising or paint shall be made good as described.

All seatings and surrounds shall be checked for line, level and bolt setting before commencement of fixing.

Errors which cannot be accommodated without distortion shall be brought to the attention of the Engineer.

Drifting or burning of holes will not be permitted.

506.14 FREEDOM FROM SURFACE DEFECTS

All welded fillet or butt joints shall be ground smooth and shall be free from porosity, cavities and entrapped slag before hot dipped galvanising.
Welds which are to be hot dipped galvanised shall be neatly formed and the surfaces shall be acceptably free from cracks in the welds or heat affected zone, from overlap, undercuts, porosity, entrapped slag and spatter in or associated with the welds.

The welds shall seal completely the edges of all overlapping or contacting surfaces.
The profile of the weld shall be uniform of approximately equal leg length and free from overlap at the toes of the weld. Unless otherwise specified, the surfaces shall be either flat or

slightly convex in the case of fillet welds and with a reinforcement of not more than 3mm in the case of butt welds.

The weld face shall be uniform in appearance throughout its length.

506.15 TEMPORARY BRACING OF METALWORK

The Contractor shall be responsible for whatever temporary bracing is necessary. Upon completion of the Works all temporary bracing, brackets, cleats and the like shall be removed and all surfaces made good or painted as specified.

507 STONE WALLER

507.1 STONES

All stone for walls shall be approved local fieldstone of blue or yellow basalt stone carefully selected for size, strength, colour and texture. Stones shall be sound and hard throughout, free from any defects.
Stones shall be mixed evenly throughout the work to avoid any inconsistencies in pattern or variation in colour or texture.

507.2 CEMENT

Cement used for making mortar shall be ordinary Portland cement to comply with BS 12.

507.3 SAND

Sand used for making mortar shall be washed coral sand and the relevant BS standard.

The sand used shall be clean, well graded and hard. It shall be free from organic or other deleterious matter, stone, salt and dust, and shall be sieved and washed if so directed by the Engineer.

507.4 WATER

Water shall be clean, fresh and pure water from the mains and shall be kept free from any impurities. Water shall be tested in accordance with BS 3148 if so instructed by the Engineer.

507.5 STORAGE OF MATERIALS

All materials shall be stored in accordance with the recommendations in CP 121 and the manufacturer's written recommendations.

507.6 MIXING PLATFORMS

All mortar shall be mixed on a level, non-absorbent and close jointed timber or steel platform. Platforms are to be kept clean and old mortar removed before any new batch of mortar is prepared for mixing. All materials shall be measured in approved and tested gauge boxes.

507.7 MORTAR

Cement mortar shall, unless otherwise specified, be composed of cement and sand (1:3).
The specified mix proportions are measured by volume using dry sand in proper gauge boxes and bulking shall be allowed for if the sand is damp.

Mortar shall be made and used in accordance with CP 121. The cement and sand is to be mixed dry on a platform until the mix is uniform in colour and then water added gradually through a fine rose and the mixture turned over until the ingredients are thoroughly incorporated and brought to a proper consistency. Only sufficient water shall be used to obtain a workable mix.

Cement mortar is to be mixed in small quantities and must be used within one hour of mixing and no partially or wholly set mortar shall be reused or remixed.

507.8 WORKMANSHIP

Walls are to be built to the thickness shown on the drawings and the stones shall be bonded solid for the full width and all voids filled in solid with cement mortar as described.
Excessive gaps between adjacent stones shall be filled in neatly with smaller stones as the wall is built.

All stones shall be "as found" and laid uncoursed.

Mortar joints shall be raked to a depth of 25mm from the face of the wall to give a dry stone wall appearance or flush pointed as described.

All vertical faces, returns and reveals of stone walls dressed to true lines and levels.
Stones shall be soaked before being laid and top of walling where left off shall be well wetted before recommencing of stone laying.

All wall faces, angles and features shall be accurately plumb and true to the lines and true in vertical plane.

Walls shall be set out carefully to ensure satisfactory functions and joints with adjoining or built in elements and components.

All perpends and angles are to be plumbed, and jambs and reveals properly formed.
Proper setting out rods shall be provided and all work shall be set out for course, opening, heights etc., to the widths, depths and heights indicated on the drawings and as directed by the Engineer.

507.9 BONDING

All walls shall be constructed with all materials fully bonded or tied together, and joints filled, to ensure compliance with design requirements for stability and strength.

507.10 STAGING

All walls shall be properly protected while mortar is setting and all walls throughout the work shall be carried up evenly, no part being allowed to be carried out up more than 1.0 metre higher at one time than any other part of the wall being built.

All putlog holes shall not be less than one course deep and shall be carefully filled with a stone cut to fit the size of the hole with beds and joints filled in solid with mortar and well tamped in after scaffolding is removed.

507.11 SAMPLE STONEWORK PANELS

Allow for constructing two sample stonework panels approximately 2 sq m each 450mm thick and when approved sample panels shall form the standard to be maintained throughout the contract.

507.12 CUTTING

All rough cutting, raking cutting, curved cutting or cutting to special Engineerural profiles shall be executed true to the lines and neatly in accordance with the drawings or as directed.

507.13 COPINGS

Copings to top of stone walls shall be dressed on all exposed faces.

507.14 PROTECTION

The stone wall shall be properly protected from mortar droppings, etc., and kept clean and neat as the work proceeds and the whole of the stonework shall be wirebrushed and cleaned down to the satisfaction of the Engineer on completion. Should the Contractor be unable to clean the wall from mortar droppings etc., to the satisfaction of the Engineer, he will be required to re-execute the work to the extent which the Engineer may deem necessary at no extra cost.

508 WATERPROOFING

Waterproofing works shall be carried out by a specialist firm approved by the Engineer.

The work shall be executed strictly in accordance with the manufacturer's instructions and shall carry an irrevocable ten year guarantee with the guarantee conditions as approved by the Engineer.

The guarantee shall be deposited with the Engineer at the end of the defects liability period.

The waterproofing treatment shall be applied over all expansion joints, parapets, upstands, flashings and dressed into all rainwater heads.

All surfaces to be waterproofed shall be inspected by the Specialist who must satisfy himself that the surfaces are in a perfect state to take the waterproofing. All the surfaces shall be cleaned and prepared as required by the Contractor at his own expense.

Waterproofing of concrete, by addition of approved crystalline admixture to the concrete at batching stage, at the rate as per the manufacturer’s instructions. The Contractor shall submit all quality assurance measures, tickets of dosage, batch mix constituents to ensure that adequate control of quantity of additive used in roof concrete is put in place and corresponding documents submitted to the Project Manager / Engineer.

509 FINISHES

509.1 GENERAL

The whole of the plasterwork shall be executed to the entire satisfaction of the Engineer and in accordance with the following applicable BS and CP documents:

BS 5262 for external rendered finished
BS 5385 for wall tiling and the backings thereto
CP 202 for tile flooring and slab flooring and beds thereto
CP 203 for sheet and tile flooring and beds thereto
CP 204 for insitu floor finishes and beds thereto

All materials and accessories used in connection with finishings shall comply with the above requirements of the above applicable documents.

Any work rejected by the Engineer shall be re-executed by the Contractor at his own expense.

509.2 CEMENT

Cement shall be ordinary Portland cement as described.

509.3 SAND

Sand used shall be washed coral sand of fine grains screened through a 1.6 mm mesh sieve and shall have three washings.

509.4 WATER

Water used shall be as described.

509.5 STORAGE OF MATERIALS

All materials shall be stored in accordance with the recommendations in CP 121 and the manufacturer's written recommendations.

509.6 MIXING PLATFORMS

All render or screed shall be mixed on a level, non absorbent and close jointed timber or steel platform. Platforms are to be kept clean and old mortar removed before any new batch of mortar is prepared for mixing. All materials shall be measured in approved and tested gauge boxes.

509.7 RENDER OR SCREED

Render of screed shall, unless otherwise specified, be composed of cement and sand (1:3).

The specified mix proportions are measured by volume using dry sand in proper gauge boxes and bulking shall be allowed for if the sand is damp.

Render or screed shall be made and used in accordance with CP 121.

The cement and sand is to be mixed dry on a platform until the mix is uniform in colour and then water added gradually through a fine rose and the mixture turned over until the ingredients are thoroughly incorporated and brought to a proper consistency.

Only sufficient water shall be used to obtain a workable mix. Cement render or screed is to be mixed in small quantities and must be used within one hour of mixing and no partially or wholly set render or screed shall be revised or remixed.

509.8 PREPARATION OF SURFACES

All surfaces of concrete receiving rendering or similar finishings shall be scabbled or well hacked to form a good key immediately after the formwork is removed.

The hacked surfaces shall be wire brushed and well wetted and slushed over with cement slurry (1:2) to form a good key for the finish.

The slushing shall be allowed to set hard before any finish is applied. Concrete floors and roofs receiving screeds shall be hacked or scabbled to form a good key, washed thoroughly

cleaned with a wire brushed and thoroughly wetted and a coat of neat cement slurry (1:1) applied before any screeding is commenced.

No traffic shall pass over nor shall any building operations take place on the prepared surface without proper covering and protection.

509.9 THICKNESS OF RENDERING

Rendering on walls shall be not less than 13 mm or more than 20 mm in thickness and rendering on concrete beams and ceilings or hollow block soffits shall be not less than 13 mm or more than 16 mm in thickness unless otherwise specified.

Moulds, weathering, projecting or sunk bands, cores and other special Engineerural features shall be executed in accordance with the drawings to a true finish and are to include for any dubbing out.

Internal angles are to be coved to a radius of not more than 25 mm.

509.10 APPLICATION OF RENDERING

All walls shall be well wetted with a hose before rendering is commenced.

509.11 CEMENT AND SAND RENDERING

Cement and sand rendering on walls shall be one coat work composed of 3 parts of sand and 1 part of cement, all by volume, and mixed as described.

The surfaces of internal rendering shall be steel trowelled to a smooth, even and true finish.

External rendering shall be finished to a true even surface with a wood float and to a sponge textured finish.

Rendering shall be returned into reveals, soffits of openings, margins and sunk bands and the like and all angles shall be true and straight with salient angles rounded.

All rendered surfaces shall be free from blemish. All cracks, blisters and other defects shall be cut out and made good and the whole left perfect at completion.

509.12 CEMENT AND SAND RENDERING

All rendered surfaces shall be kept damp and moist for at least two days after the final coat has been applied.

509.13 EXPANSION JOINTS IN RENDERING

At the intersection of block walls with concrete walls, columns and beams and at straight joints between temporary and permanent block walls, form expansion joints in the render (all types) as follows:-

(a) Coincident with the junctions of the walls with the concrete and coincident with the above mentioned straight joints form a cut through the full thickness of the rendering coat with a steel trowel.
(b) Form a similar cut through the setting coat or finishing coat of render finished with a neat edge to give a thin straight cut in the plaster.
(c) Where concrete beam or column sides and block walls are to be finished with a flush coating of plaster, the two are not to be plastered in the first coat simultaneously but

shall be covered separately so that the exact position of the junction between the two bases are properly located and the expansion/contraction joint is made in the correct position.

(d) Where no joint is allowed between concrete and blockwork expanded metal lathing shall be fixed above junctions prior to rendering.

509.14 TYROLEAN RENDERING

Tyrolean rendering shall in two coat work consisting of a 12 mm backing coat of render as described of one part cement to four part of sand trowelled up to an even and true surface followed by a Tyrolean finishing coat of cement and sand of a suitable mix applied with a special spraying machine to fine grain and built up in three coats to a total thickness of 8 mm all as directed and to the approval of the Engineer.

Floated tyrolean rendering where specified shall consist of tyrolean rendering as described above but finished neatly to an even and true surface with a steel float.

All grooves, flush bands around openings, joints or returns to reveals, soffits of openings, margins, and sunk bands and the like shall be formed as directed by the Engineer.

509.15 RENDERING ON CEILINGS

Cement and sand (1:3) rendering to concrete ceilings shall be as described.

Tyrolean rendering concrete ceilings and beams shall be as described, finished to a fine grain tyrolean render.

509.16 SCREED TO FLOORS AND ROOFS

Screed to floors, treads of steps, thresholds and similar horizontal surfaces, unless otherwise specified, shall not be less than 25 mm thick composed of 3 parts of sand and 1 part of cement, all by volume, and mixed as described and shall be trowelled to a true, level and smooth surface to final finish or suitable to receive the final finish of tiles or similar finishings.

Screed to stair risers, sides of kerbs and other associated vertical surfaces, unless otherwise specified, shall not be less than 13 mm.
Exposed salient angles shall be neatly rounded to approximately 20 mm radius, unless otherwise specified.

Screed to roofs and gutters shall be laid to the thickness and falls, crossfalls as shown on the drawings.

All screeds shall be kept and as moist damp until hardening and curing is completed directed by the Engineer.

Any screeding to receive tiles or similar finishings shall be laid in good time to allow it to be perfectly dry when the finishings are laid.

509.17 ROCKSAND SCREED

Rocksand screed shall comprise I part of cement to 3 parts of washed rocksand of an approved grain, all by volume, and mixed as described and shall be trowelled up to a true, level and smooth surface to final finish or as preparation for further finish whilst unset.

509.18 COMPOSITE SCREED AND TILE FINISH

Tiles shall be laid on cement and sand bed to pattern as described hereafter, then rocksand screed shall be laid as described before in between the tile patterns to a true, level and flush surface.

509.19 BRUSHED ROCKSAND SCREED

Rocksand screed shall be laid as described and whilst the surface is unset it shall be finished by lightly wire brushing surface to expose fine aggregate with smooth plain borders or tile patterns as directed.

509.20 BUSH HAMMERED FINISH

Rocksand screed shall be laid as described and finished with a light bush hammered finish as directed with plain margins, bands, grooves and the like.

509.21 TILING

Screed floors to receive ceramic tiles shall be laid as described and whilst unset ceramic floor tiles shall be laid, with a thin contact layer of cement mortar slurry composed of one part cement to 1-2 parts of sand, grain size 0-1 mm, by volume and mixed as described to provide a true, level and neat surface.

Tiles shall be laid to patterns and profiles with continuous joints and shall have all joints rubbed in solid with neat cement as described.

Ceramic wall tiles shall be fixed to a plaster backing with an approved adhesive or fixed direct to walls in (1:3) cement mortar with horizontal and vertical joints continuous and shall have all joints rubbed in solid with neat white Portland cement.

All ceramic tiles shall be well soaked in water for at least 24 hours before fixing and thoroughly cleaned off and protected after fixing.

Tiling shall be returned into reveals of openings and on to window sills and shall be butted at internal angles and provided with special edge tiles to external angles, unless otherwise specified. All necessary cutting to tiles shall be properly performed with mechanical means.

Where rounded angles are not available, corner edges are to be mitred for the full length of the tile. The whole of the ceramic floor and wall tiling shall be cleaned using cleaning materials and methods as recommended by the manufacturer of the materials being cleaned and the applicable CP. In the absence of such recommendations only suitable cleaning materials and methods in accordance with the cleaning material manufacturer's recommendations shall be used.

509.22 TERRAZZO WORK

509.22.1 CEMENT

Cement shall be Portland cement as described.

509.22.2 AGGREGATES

(a) Aggregates for undercoat for floors shall be of one part Portland cement to two parts of washed coral sand as described and one part crushed quartzite, all of which is to pass a 10 mm mesh and to be free of dust and to approval.

(b) Sand for undercoat for walls shall be hard, clean washed coral sand graded from fine to coarse and to approval.
(c) Aggregate for finishing coat of terrazzo shall be marble chippings - granular not flaky - of the kind and colours specified. This aggregate is to be graded from coarse to fine.
(d) All aggregates are to be free from organic or other deleterious matter and samples of the marble aggregate are to be submitted for approval and the aggregate used is to comply with the approved sample or samples.
(e) Mixes: Cement and aggregates to be proportioned by volume.

509.22.3 TERRAZZO

(a) General

All terrazzo work is to be executed by artisans specialising in such work and approved by the Engineer. Samples of the finished terrazzo work (floors, stairs, walls, etc.) are to be submitted for approval and thereafter all terrazzo work is to be equal to the approved samples and in compliance with the specification. Such samples are to be not less than 600mm x 300mm or, in the case of steps, not less than 400mm in length and shall include the undercoat.

(b) Terrazzo floors

Terrazzo floors or pavings unless otherwise specified shall be constructed and laid as follows:

The concrete surface is to be thoroughly cleaned, wire brushed and well sprayed with water.

The undercoat to be of one part cement to three parts of fine aggregate brought to a true and even, but rough, level or face not less than 15mm below the finished surface of the terrazzo floor and not less than 25mm thick. On this undercoat is to be laid the terrazzo finishing coat not less than 15mm thick, divided into panels, as shown on drawings, with approved brass or white metal strips having approved "keyed" web, embedded into the undercoat and left projecting to suit finishing coat.

The terrazzo finishing coat, except where otherwise specified, is to be of waterproof cement (white or coloured) and marble chippings as described, in the required and approved proportions and to be mixed dry. After this dry mixing, water is to be added to make a paste. The finished surface is to show approximately 85% of marble.

The finishing coat is to be uniform in composition and appearance over the whole surface and throughout its entire thickness.

(c) Brushed Terrazzo

To be as before described but when the surface is sufficiently hard it is to be brushed with clean water and a hard brush to removal all surplus cement. All finished surfaces of in-situ brushed terrazzo are to match the finished surfaces of precast works.

(d) Polished Terrazzo

Where polishing is specified, this is to be executed with a fine abrasive stone.
(e) Precast Terrazzo

All precast terrazzo blocks are to be made and supplied by an approved manufacturer and such manufacturer shall be skilled and experienced in this class of work.

The Contractor is to submit samples of precast terrazzo for approval. Such sample blocks shall consist of the core and the facings (the facings on one side and on edge).

The final sample or samples as approved, to be lodged with the Engineer and thereafter all precast terrazzo blocks supplied for the works of this Contract shall be equal to the approved sample or samples.

All precast terrazzo blocks are to be made in accordance with the drawings and details and are to be cast with joggles, housings, frogs, slots, mortices, grooves, rebated joints, throatings, weatherings, etc., as shown on the drawings or as required.

All bottom edges and return bottom edges of sill blocks to be splayed for damp course' No beds or joints are to exceed 5mm in thickness. The Contractor, when making the blocks is to check all figured dimensions given on the drawings and before work is put in hand all dimensions are to be verified from the building. The Contractor will be held solely responsible for ascertaining the exact sizes of all blocks and slabs.

Full setting out drawings are to be prepared where necessary and to be submitted for approval before the moulds are made.

The Contractor is to indicate, before signing of the Contract, if he is not satisfied with the thickness of slabs detailed and method of fixing and after having the matter resolve, is to take full responsibility for twisting and other defects of slabs.

The blocks are to be finished perfectly straight and true and to be accurately profiled in accordance with details.

Stone is to be clean, sharp, machine crushed granite, free from dust, salt, clay or other deleterious matter and to be graded for concrete work and of a fine texture for finished work. Flats spalls or elongated pieces and crusher screenings are to be rejected.

The blocks (core and finishing) are to be adequate in crushing strength, durability and density and free from any tendency to absorb water or moisture and to be free from flaking, crazing and any all other defects.

(1) Core

The core is to consist of one part by volume of cement, two parts by volume of sand and four parts by volume of 10mm stone chippings. The whole to be distributed uniformly to not more than 15mm from the finished surface and to be deposited into the moulds in a wet state (not dry pressed) while facing is still wet.

(2) Facing

All precast terrazzo blocks are to be properly cured and matured. The blocks, after casting, are to be cured under continuous moist conditions, but are not to be exposed to free air for at least 10 days after casting.

The "facing" of the blocks is to be 15mm to 20mm thick and the core and facing shall be such that they will form together one consolidated integral mass.

The facing is to be of one part by volume of Portland cement, tinted to approval, to two parts by volume of marble chips 3mm gauge.

The marble and colour is to be approved. No colouring matter is to be used unless sanctioned by the Engineer, and if sanctioned, such colouring matter is to be used to the

extent as shall be decided upon, is to be mixed dry with the cement and to be uniform throughout the whole thickness of the facing.

The facing mixture is to be poured into the moulds in a wet state (not dry pressed) and thoroughly worked up against finished faces and finished clean from the moulds with all arises clean and sharp.

The finish of exposed surfaces is to be kept wet by spraying at regular intervals. All exposed surfaces of blocks to be of even colour, free from blemishes, cracks or other imperfections. All exposed faces externally to be highly polished with a fine abrasive machine.

The joints are to be raked out as the work proceeds and pointed with slightly ruled-in half round joints with 3:1 tinted cement mortar to approval.
All precast terrazzo blocks are to be kept clean during process of handling, building in and pointing.

Allow for covering up and protecting all work from damage and stains and cleaning off with soft soap and hot water immediately before occupation and finally treating with an approved colour fixing emulsion, all to the satisfaction of the Engineer.

All damaged blocks must be removed and replaced at the Contractor's expense.

(3) Non-slip surfaces

Where so specified terrazzo pavings, etc., to be thoroughly sprinkled with fine "Alundum" or other approved and similar abrasive material of a colour to match the terrazzo in the proportion of 1.22 Kgs of "Alundum" to each square metre of paving, well rolled into the aggregate immediately after the water is extracted.

(4) Damage

All terrazzo work is to be protected against damage or discoloration until the building is handed over. Should any terrazzo work be damaged during the process of the works, it is to be replaced to the satisfaction of the Engineer.

509.22.4 SAMPLES

The Contractor shall prepare samples of all finishings as directed until the quality, texture and finish required is obtained and approved by the Engineer after which all work shall conform to the respective approved samples.

509.22.5 MEASUREMENT AND RATES

Rates for plastering and screeds shall include for the preparation of all surfaces as described all temporary rules and grounds, forming all internal and external angles, fair edges, finishing against frames, windows, dishing to outlets, around pipes, holder bats, etc., narrow widths, small quantities, any extra thickness or dubbing out consequent upon the concrete not being finished to true levels, curing, protection and cleaning.

Rates for tiling shall include for narrow widths, small quantities, all cutting and waste, forming internal and external angles, bedding and pointing as described (backings measured separately) and cleaning down on completion.

510 PLUMBING AND SERVICES INSTALLATIONS

510.1 SPECIAL SPECIFICATION ISSUED BY SERVICES ENGINEER

The whole of the services installations shall be as specified in the Special Specification issued by the Services Engineer which shall take precedence over these specifications in so far as services installations or related matters are concerned.

510.2 RAINWATER INSTALLATION

All rainwater pipe drainage is to be arranged or planned out in detail by the Contractor in accordance with the drawings and details and all changes of direction, outlets, inlets, etc., are to be placed at the correct levels and positions as shown on the drawings and details.

Rainwater pipes and fittings shall be unless otherwise specified of PVC to BS 4514 and/or BS 5255 fixed to true lines with straps supplied by manufacturer, plugged and screwed to concrete or blockwork and all in accordance with the manufacturer's instructions.

Balloon gratings shall be of galvanised wire. The whole of the rainwater installation shall be tested with water to the satisfaction of the Engineer and the whole system left sound and perfect.

Where rainwater pipes are shown on the drawings or specified as being embedded through reinforced concrete columns, etc., these pipes are to be of PVC pipes as described.

They are to be placed in the correct positions shown on drawings and--in accordance with the requirements of the Engineer or of his drawings. Before any pipes are concreted in, each run of pipe is to be properly tested with a water test and the test is to be completed and approved before concreting. In this test the bottom end of the pipe is to be closed and the pipe run filled with water to the highest point and so on with each subsequent pipe run, from the bottom, until the full height or length of the pipe is reached. The tests are to be repeated if necessary until all the pipes are perfectly water-tight.

510.3 RAINWATER INSTALLATION

As soon as any pipes are placed in position the top end of the pipe or any inlets to it are to be adequately protected against the entry of any concrete, mortar, rubbish or dirt.

All rainwater pipes going through columns shall be fitted with a "Y" junction complete with cleaning eye and cover 300mm above the lowest floor level below which the pipe is to discharge into the sump.

All rainwater pipe drainage is to be arranged or planned out in detail by the Contractor in accordance with the drawings and details, and all changes of direction, outlets, inlets, etc., are to be placed at the correct levels and positions shown on the drawings and details.

510.4 ACTS, BYE-LAWS AND NOTICES

All the work shall comply with the requirements of the statutory authorities concerned, the Municipality and/or district council bye-laws and regulations and shall be executed to the satisfaction of the Engineer.

510.5 SANITARY FITTINGS

Sanitary fittings shall be supplied by an approved supplier and shall be free from any defect, cracks, chips or scratches.

All sanitary wares shall be protected during and after fixing and shall be fixed in accordance with the manufacturer's instructions with fixings and fastenings supplied by the manufacturer.

All sanitary fittings shall be properly connected to waste and soil pipes and cold water installations.

On completion, the whole of the fittings shall be tested to prove that they operate freely and be left in a clean and serviceable condition.

Any sanitary fittings damaged prior to handing over the works shall be replaced by the Contractor at his own expense.

510.6 WORKMANSHIP GENERALLY

All work shall be carried out in accordance with the drawings and specifications and in accordance with the best standard practice.

All work shall be executed in collaboration with other trades employed in connection with the works so that all trades will result in a neat and workman like job.
Working space shall be kept for repairs and cleaning. All holes are to be made good.

The positions of all pipe runs, including joints and connections, shall be agreed with the Engineer before work is commenced.

All plumbing work shall be carried out in accordance with the drawings and specification.

The Contractor is to provide all materials and labour necessary for the completed work.

Should there be any discrepancy between the drawings or specification and the requirements of any Bye-laws or Regulation the Contractor is to notify the Engineer and obtain instructions before proceeding with the work in question.

All plumber's work is to be executed in accordance with the best standard practice.

All plumber's work is to be executed in collaboration with any specialists employed in connection with the works - such as Electricians, and other Services Engineer, etc., so that all trades will result in a neat and workman like job, and so that space is conserved and working space obtained for repairs and cleaning.

510.7 BUILDER'S WORK DRAWINGS

The Contractor shall provide the Engineer before commencing any plumbing work all such drawings and details of the builder's work required in connection with these installations.

Pipes passing through walls, beams or slabs shall be done to approval and sleeves are to be provided and built into the correct positions.

All holes are to be properly made good - to the entire satisfaction of the Engineer.

Cutting of holes into or through any structural or related works shall only be done with the approval of the Engineer.

Pipes are to be so placed and fixed that there will be at least 25mm clearance between the pipe or pipe fittings and the finished wall or ceiling face. Where this is not possible the Engineer is to be consulted before proceeding.

No drains, joints or connections shall be covered in or encased in concrete until they have been approved and have been tested as specified.

All chases, recesses, projections, holes, etc., are to be cut or formed neatly and to true lines and levels using suitable power tools and shall be properly made good thereafter to the satisfaction of the Engineer.

510.8 TESTING

The Contractor shall from time to time as required to suit the progress of the building work, test the plumbing and internal drainage in sections, to the satisfaction of the Engineer, before any such work is covered.

On completion the whole installation shall be tested as the Engineer may direct and any defect made good. The Contractor shall include in his rates for providing everything necessary for these tests and storage tanks, filling and testing the whole of the water installations in accordance with CP 310 and CP 342.

510.9 PROTECTION

All pipework shall be properly protected from damage during the course of the works and during the backfilling of any trenches or closing up of any ducts.

Any pipework damaged due to non-protection thereof shall be replaced by the Contractor at his own expense.

510.10 BUILDER'S WORK DRAWINGS AND MEASUREMENT DETAILS

Notwithstanding anything contained in the principles of measurement of works (international) for works of construction, June 1978, builder's work in connection with plumbing and sanitary installation has been given as an item.

510.11 MEASUREMENT AND RATES

Rates for pipes shall include for fixing as required, the provision of all plugs, screws and other fixings, for all pipe clips, holder bats, etc., short lengths, cutting and joints in the running length.

All fittings, valves, taps, meters, sanitary ware, tanks, etc., shall include for jointing to pipes and prices shall allow for all necessary adapters, connectors, bolts, flanges, sealing rings, etc.

The Contractor shall also include for all testing as described and for complying with all bye-laws and regulations.

510.12 SETTING OUT

The position of all pipe runs, including joints and connection, shall be agreed with the Engineer before work is commenced.

510.13 STEEL WATER PIPES AND FITTINGS

Steel pipes for water supply shall comply with BS 1387 of medium grade and fittings shall be of equal quality. All pipes and fittings shall be galvanised.

Wherever possible, bends shall be used in preference to elbows. Pipes shall be firmly and neatly secured to blockwalls and all concrete surfaces with galvanised malleable iron brackets or saddle clips or holderbats as appropriate.

All pipes shall be screwed and socketed and jointed with sealing tape or other approved jointing compound.

All Bib taps and pillar valves shall comply with BS 1010 and shall be of brass or chromium plated where so described.

Stop valves shall comply with BS 1010 and shall be of brass with crutch handles. Those in exposed places shall have chromium plated polished bodies.

Sluice valves shall comply with BS 5163 and Gate valves to BS 5154.

510.14 COPPER PIPES

Copper pipes for water and gas supplied in all cases, and also for sanitation purposes, shall comply with the requirements of ES standard.

Pipes shall be firmly and neatly fixed to walls, with brass or copper bands or brackets for pipes up to-and including 65mm diameter and with approved holderbats for pipes over 65mm diameter,, all built into walls in (1:3) cement mortar and to timber work with brass or copper pipe clips screwed on.

Unless otherwise specified, all copper pipes shall be jointed with approved brass or gunmetal compression fittings of the expanded tube and cone type with coupling nuts and rotary sleeve pieces.

Copper pipes specified to be joined with capillary fittings, shall be jointed with approved capillary type fittings, each joint being formed by cutting end of pipe square, cleaning the bore of fitting and end of pipe in the bore with sand paper or steel wool, covering surface of pipe and inner surface of bore in fittings with flux supplied by the manufacturer of the fittings and inserting pipe into the fitting and heating same with a blow lamp until complete ring of solder appears around the mouth of the fitting.

Fittings and pipes shall be wiped clean after jointing. All necessary couplings, connectors, bends, elbows, tees and other fittings as may be required, shall be provided.

510.15 SOIL AND WASTE INSTALLATIONS

Soil and waste installation shall be in PVC pipes unless otherwise specified. All PVC pipes fittings and accessories shall comply with BS'4514 and BS 5255.

All jointing compounds, gaskets, washers and other jointing materials shall be of the types recommended by manufacturer and comply with BS 557 2.

Vertical pipes and horizontal pipes continuously supported shall be fixed with moulded holding clips at 1.0 m centres.

511 GLAZING

511.1 GLASS GENERALLY

All glass shall comply with BS 952 and shall be of the best quality of its respective kind, free from specks, bubbles, air holes, scratches, distortions and other surface imperfections and is to be of uniform thickness.

511.2 SHEET GLASS

The clear glass shall be polished plate glass of uniform thickness.

511.3 PUTTY

Putty is to be the best quality glazier's putty and obtained from an approved supplier. Putty for metal shall be an approved metal putty specially manufactured for that purpose. Putty for wood shall be approved wood putty specially manufactured for that purpose.

511.4 GLAZING

Glass must be cut in panes to suit all glazed openings required, with sufficient clearance to prevent cracking by expansion. All puttied glass shall be pressed tightly and bedded into a sufficiency of putty, thoroughly back puttied and held firmly.
The finished surface of putty is to be true in line and level and to be neatly cut in against the glass.

Putty must be neatly finished with smooth surfaces, sharp mitres, etc. All sashes, whether wood or metal, must be primed with an approved metal or wood primer prior to fitting and glazing.

All glass to metal openings shall be fitted with approved glazing clips.
Glass shall be springed in at wood sashes if puttied.
Putty for glazing in hardwood shall be tinted or stained to match the wood.

511.5 BREAKAGES AND CLEANING

Should any glass be cracked or broken prior to handing over of the building, the same shall be replaced by the Contractor at his own expense.

At completion all glass is to be-thoroughly cleaned both sides.

511.6 WORKMANSHIP GENERAL

All glass shall be carefully cut to the required sizes so that all panes of figured or textured glass are uniform in appearance.

Glazing shall be carried out in accordance with CP 152.

Only putty and/or other glazing compounds recommended in CP 152 as being suitable for the particular material to be glazed shall be used. All glazing shall be weathertight on completion.

511.7 MIRRORS

Mirrors shall be fixed in accordance with CP 152.

511.8 PRICES

All rates for glazing shall include for all labours in raking cutting, curved cutting and polished and bevelled edges.

512 PAINTING AND DECORATING

512.1 MATERIALS GENERALLY

All materials for and used in connection with Painting and Decorating shall comply with the requirements in CP 231.

All paint, oil stains, varnish, linseed oil, knotting, driers, distempers, etc., shall be of the best quality and of an approved brand and manufacture.

All materials shall be used in strict accordance with the manufacturer's instructions and otherwise in accordance with the best standard practice.

Only primers and sealers recommended and supplied by the paint manufacturer for the particular surface shall be used.

Only undercoats, as recommended by the paint manufacturer for the particular finishing coat, shall be used.

If necessary, paints, etc., shall be strained free from shins and similar impurities immediately before application.

Priming coats are to be applied over the whole surface and well brushed in to obtain the maximum penetration.

All materials shall be delivered to the job in their original sealed containers with the manufacturer's name and description of contents thereon.

Paint shall not be diluted unless in accordance with the manufacturer's instructions and no adulteration will be allowed.

512.2 COLOURS OF PAINTS

Samples of the final colours required are to be submitted for approval before putting the work in hand and the work is then to be finished to the colour or colours approved. Each coat of paint is to be a distinctive colour working up to the finished colour as approved.

512.3 STRIPPING, CLEANING AND FILLING MATERIALS GENERALLY

All stripping, cleaning and filling materials including knotting, stopping and fungicide solutions shall be-.-

1. suitable for the intended purpose
2. in accordance with the written recommendations of the manufacturer of the subsequent covering
3. compatible with the subsequent covering

512.4 KNOTTING

Knotting shall comply with BS 1336.

512.5 STOPPING AND FILLING

Stopping and filling for surfaces to receive a clear finish shall be tinted to match the colour of the surface. Stopping and filling shall be finished off flush with and to match the texture and appearance of the surface being filled.

512.6 WORKMANSHIP GENERALLY

Workmanship shall comply with the recommendations of CP 231.
External painting shall not be undertaken during rainy, damp or other adverse weather or where such weather is reasonably to be expected within the next 24 hours.

Before internal painter's work is commenced, all floors shall be swept clean and dirt and rubbish removed and the rooms left free from dust and dust free from conditions being maintained during the progress of the work. No sweeping or dusting is to be done whilst the painting is in progress.

512.7 PREPARATION OF SURFACES GENERALLY

The nature of all surfaces to be painted must be carefully inspected by the Contractor who must satisfy himself that the surfaces are in a perfect state to take the paintwork specified.

All loose material, mortar and render droppings, rust, oil, grease and any other deleterious and extraneous matter shall be removed so as to leave all surfaces perfectly clean, free from dust, dirt, grease, blotches before painting and decorating.
Any irregularities, cracks, holes, open grain and the like shall be filled and surfaces to be decorated shall be cleaned and prepared in accordance with:-

1. the recommendations in CP 231 and any other applicable BS and CP documents.
2. the written recommendations of the manufacturer of the paint or other decoration to be applied.
3. the best building practice.

and all surfaces shall be left clean, dry and level so as to ensure adhesion of the covering and its specified finished appearance.

Remove and ensure efflorescence has ceased before commencing decoration and treat mould infected surfaces with fungicide solution as directed.

Unless otherwise directed, the last coat of paint or finishing is to be done when all other work in the Contract is completed and the premises free from all rubbish and dirt.
On completion all painter's work is to be touched up where necessary and any defects made good.

512.8 APPLICATION OF PAINTS GENERALLY

Paint shall be applied by brush unless otherwise described or instructed. Each coat of paint shall be of even thickness.
Prime/seal immediately after cleaning and preparing the surfaces. Allow each priming/sealing and undercoat to dry and lightly rub down with fine abrasive paper to a smooth even surface prior to applying succeeding coats.

The Contractor shall ensure that surfaces which have been primed prior to delivery to the site have been properly prepared and that the primer is of a suitable type firmly adhering and in good condition.

Priming coats shall be touched up as necessary on joinery primed prior to delivery to the site and cleaned and prepared so as to be suitable to receive subsequent decoration.
Any surfaces of such joinery which are cut after delivery to the site shall be prepared and primed as described.

Painting adjacent to glazing with putty shall be extended across putty and on to glass up to the sight line. All painting shall be cut in neatly and cleanly to line.
The finished paintwork shall be smooth and even coloured., free from brush marks, sags, runs, dust, hair or other extraneous material adhering thereto and any other defects and shall be all to the entire satisfaction of the Engineer.

512.9 RENDERED SURFACES

Rendering is to be perfectly set and thoroughly dry before painting, etc., and the onus is on the Contractor to satisfy himself that rendered surfaces are in a fit condition to receive decoration before commencing the works.

Surfaces are to be brushed down, sanded smooth and cleaned down. All defects are to be patched and made good and given an extra coat of primer or sealer.
Hair cracks and other blemishes on rendered surfaces to be painted, shall be filled with an approved filler and any imperfections made good.

512.10 WOOD PRESERVATIVE

All timber built-in or in contact with walling and concrete shall be treated with two coats of an approved type of wood preservative.

512.11 IRONWORK AND STEEL SURFACES

Iron and steel surfaces are to scraped and all rust, scale dirt, grease, etc., removed by scrapers or wire brushes before painting.

512.12 GALVANISED SURFACES

Galvanised steel surfaces shall be treated with "Galvanised iron cleaner or other approved solution in strict--accordance with the manufacturer's instructions and thereafter thoroughly washed down with clean water and the surface allowed to dry before painting,

512.13 WOODWORK

All woodwork must be thoroughly prepared, sand papered and rubbed down to a smooth, even finish before painting or staining or varnishing and thereafter each successive coat of paint stain or varnish is to be rubbed down to a smooth face before the next coat is applied.

Knots are to be cleaned off and coated with an approved knotting. Stopping is to be tinted as required to match oiled or stained woodwork. Screw holes etc., are to be cleaned out, pellated or stopped with an approved filler or stopping as directed.

512.14 COPPER PIPES

Copper pipes shall be rubbed down with coarse emery, cleaned with a solution of one part acetone to two parts of benzene and left to dry before painting.

512.15 POLYURETHANE VARNISH

The polyurethane varnish is to be brushed on, using material as it comes from the can.

Before application and between coats, any nibs, raised fibres or sharp edges are to be rubbed down with fine dry abrasive paper and dusted off.
The polyurethane varnish is to be applied in four coats, the first two coats to be gloss finish rubbed down and the following two coats to be matt finish.

512.16 CLEANING AND PROTECTION

All painter's work shall be protected as necessary including the provision of caution signs as necessary and the whole of the work shall be left clean and perfect all to the entire satisfaction of the Engineer.

512.17 PREPARATION OF SURFACES

The preparation and pre-treatment of surfaces as described herein is to be taken in addition to the number of coats of paint hereafter specified and all rates are to include for such proper pre-treatment which is described in the Bills of Quantities as "Prepare". Rates shall also include for any required protection of Painter's work, providing the necessary caution signs and leaving all work clean and perfect.

513 HANDRAILING

Unless otherwise shown or specified, fixed hand railing shall be of the two-rail type and shall resist horizontal loadings as defined in BS 6399: Part 1.

Standards (uprights) shall be in 48.3mm diameter by 3.2mm thick circular hollow sections to BS 4 at 1.5 metre centres. Standards shall be fitted with either flat or palm bases bolted to base plates cast into the floor.

Handrails shall be in 33.7mm diameter x 3.2mm thick circular hollow sections to BS 4. The top rail shall be placed at 900mm centres from floor level and the second rail shall be placed at 500mm from floor level. All hand-railing shall be prevented from rotating or moving longitudinally from the standards.

Removable hand railing shall be as specified above except that they shall be fixed to the floor and walls by easily dismountable clamps of the kee klamp type of similar approved.

All handrails and their standards and all plates, fixtures, bolts and nuts shall be galvanised to BS 729 and where welding is carried out on Site, the surrounding area shall be thoroughly cleaned by grinding, wire brushing or other method approved by the Engineer or the Engineer's Representative. The area shall then be painted with a zinc rich paint, which shall be tinted to match the galvanising.

514 GALVANISING

Where galvanising has been specified the items shall after fabrication be hot dipped galvanised in accordance with BS 729, or where approved zinc coated in accordance with BS 2569 Part 1 to a thickness of 0.15mm (006”).

All items to be protected shall be prepared as specified in the above standards.

Articles altered at the manufacturers works in any way after galvanising are to be regalvanised as specified.

Articles subject to minor alterations at site or requiring minor repair at site shall be wire brushed to remove all rust and coated with 3 coats of approved zinc rich cold galvanising compound.

515 PERIMETER WALL

Perimeter walls, unless shown differently on the drawing shall be at least 2000mm above ground level measured to the top of the coping beam. Intermediate columns, 200mm wide shall be erected at every 3m intervals and shall be 350mm deep at ground level, tapering to 200mm at the top. Above the coping beam the posts shall have cranked tops either in reinforced concrete or in 37mm diameter galvanised mild steel tube at an angle of 45o facing outwards 600mm long, carrying three lines of barbed wire. The wall shall be erected in 150mm blockwork in accordance with clause 502 of the specification.

600 PIPEWORK AND PIPELINE

600.A PIPES AND PIPEWORK MATERIALS

601 GENERAL

601.1 GENERAL DESCRIPTION

In this Section "Goods" refers to pipes, valves and pipe fittings.

All goods to be supplied shall be suitable for sewerage purposes in the conditions prevailing in Mauritius and particularly in the location of the works, for the conveyance of wastewater. The tender has been prepared on the basis that all sewer pipes and fittings shall be manufactured from ductile iron and uPVC as detailed in the Project Description and Scope of Works. In accordance with this specification, pipes manufactured from other materials will not be accepted.

601.2 SCOPE OF WORK

The Work within the scope of this Section comprises manufacture, testing at works as necessary, supply and delivery to a storage yard of pipes, valves and fittings in accordance with the attached Schedules. The Contractor shall make his own arrangement for acquisition of storage area, access, fencing, storage cover, lighting and watching.

601.3 ORDER OF MATERIALS

Prior to placing any order for materials, the Contractor shall submit all relevant information for approval by the Engineer. The information shall include the list of materials, the supplier and origin, technical data on the quality and strength of the materials.

Notwithstanding the approval of order by the Engineer, any material found defective or unsuitable for incorporation into the Works shall be removed from the site.

601.4 PERIODS FOR DELIVERY

In order to comply with the requirements of the installation programme, the Contractor shall arrange his delivery programme to meet the stage delivery periods stated in the Schedules or Requirements calculated from the date of the Letter of Notification of Award.

The Contractor may be required to concentrate his earliest deliveries in order to meet the programme for installation and due flexibility should therefore be allowed for in manufacturing.

601.5 PROGRAMME

The Contractor shall submit within 30 days of the Engineer’s order to commence the Works, a programme showing the various elements of design, manufacture and delivery in sufficient details to demonstrate that the periods of delivery stated above will be met.

The programme shall also take due regard of the time required for drawing approval, testing and inspection at the works, freight and delivery to the specified storage area.

From the date of issue of the Notification of Award until the issue of the Taking Over Certificate, the Contractor shall be required to attend regular coordination or site meetings arranged by the Engineer to ensure the timely and satisfactory completion of the Project as a whole. The meetings will be held in Mauritius and at least one representative of the Contractor with the necessary authority to make decisions regarding the Contract shall be present.

601.6 APPROVAL OF DRAWINGS

The Contractor shall submit to the Engineer for approval within 30 days of the Engineer's order to commence the Works detailed drawings of the Goods and a general arrangement of a typical installation, including critical dimensions for associated civil works, in accordance with Article 19 of the General Conditions. They are to be accompanied, if required, by calculations and explanations to show that they comply with all requirements of these Specifications.

Two weeks shall be allowed for approval by the Engineer following receipt of drawings.

Alteration to approved drawings shall only be made with the written consent of the Engineer.

601.7 OPERATION AND MAINTENANCE MANUALS

One month before the Goods are subjected to any commissioning tests, the Contractor shall supply to the Engineer four good quality copies of the documents listed below. Each copy shall be ring bound between stiff durable suitably titled covers with transparent pockets of adequate size for all the drawings. The information shall cover all purchased and sub-contracted Goods in addition to the items manufactured by the Contractor.

(a) Service schedule with fully detailed instructions and diagrams for operating, maintaining and servicing the Goods.

(b) Fully detailed instructions and diagrams for stripping down the Goods for repairs and for reassembly.

(c) Comprehensive parts list for all Goods with fully detailed instructions for re-ordering any component.

(d) Set of record drawings including all amendments to the original approved drawings to show the Goods as finally commissioned.

601.8 INSPECTION AND TESTING AT WORKS

Details of the type of manufacturing process shall be submitted for the Engineer's approval. Independently of the tests to be made on the constituent materials and on the Goods in accordance with the provisions of the Specification the Engineer will have the right to ask that factory checks be made concerning either the ways in which materials are used or on the manufacturing processes such as casting, founding, cooling, annealing, burring, welding, riveting, centrifuging, machining, drilling of flanges or any other process.

In this respect, the Contractor shall authorise the Engineer to carry out the corresponding inspections at the various stages of manufacture.

The Engineer reserves the right to inspect all or part of the stages of manufacture of components at any Sub-Contractors factory under the same conditions as those applied for inspection at the Contractor's factory.

All Goods shall be tested at works in accordance with the provisions of Section 5.A of the Specifications.

All Goods shall be subject to inspection prior to packing for shipment. Such inspection shall include visual inspection, compliance with the Specification, checking of test results as required by the Specification and appropriate Standard or other superior internationally recognised standard and witness testing as required. An inspection of packing and marking of all items may also be undertaken prior to shipment.

For all tests and inspections the Contractor shall also provide the Engineer prior to dispatch with test and inspection certificates from an Independent Inspection Agency approved by the Engineer. The test and inspection certificates shall pertain to actual witness of test and physical inspection by the Agency on the particular consignment. Inspection by the Independent Inspection Agency shall not, however, relieve the manufacturer of his responsibility to furnish material and perform work in accordance with this specification and the relevant standards.

For the items tested, inspected and found to be satisfactory a Engineer's approval will be issued allowing the Contractor to proceed with arrangements to deliver the materials.

The Contractor shall furnish the Engineer with a manufacturer's certificate in respect of every consignment of the goods confirming that all items of goods comprising the consignment comply in all respects with the specified standard. The original and one copy of such manufacturer's certificate shall be delivered to the Engineer not later than 7 days prior to the intended date of delivery of the Goods to the storage area.

601.9 FINAL PRE-SHIPMENT INSPECTION

All finished pipes shall be required to be visually examined and shall be free of injurious defects such as cracks, laminations and undercuts. The final pre-shipment inspection shall be attested by a certificate from the same Independent Inspection Agency responsible for carrying the test and inspection at the place of manufacture.

601.10 MARKING

Except where expressly agreed between the Contractor and the Engineer all components of the Goods shall be marked in a clear and lasting manner with the following information:

- symbol of factory where component was manufactured;
- date of manufacture
- nominal diameter;
- pressure class

601.11 PACKING, TRANSPORTATION AND HANDLING

All materials are to be properly packed and clearly marked:

MAURITIUS.

In addition all fittings shall be marked according to their reference Bill of Quantities item number.

All sensitive materials such as gaskets etc., shall be fully protected by means of a moisture-excluding coating or a drying agent or a plastic sealant or plastic covers and/or wooden crates as appropriate to the approval of the Engineer.

The Contractor shall provide all necessary means of protecting the Goods during loading, transit, unloading and rehandling and delivery to the storage area. The measures adopted by the supplier at the port of shipment, at the port of unloading and for the transport to the site of work shall be to the approval of the Engineer. Likewise, the methods adopted by the civil works Contractor on site will be subject to the approval of the Engineer. No unprotected hooks or wire slings will be permitted.

All packing shall be suitable for unpacking and repacking during inspection and for storing the Goods at the site in the open air or at the Contractor’s storage area.

Transportation shall be effected in accordance with the Manufacturer's instructions. Vehicles used for transporting pipes shall have a body of adequate length so as not to occasion overhand and subsequent breakage of pipes. Nesting of pipes shall be permitted only in cases where there is no risk of damage to the interior lining. The Contractor shall be responsible for providing secure and adequate storage for all materials for use in the Works. Pipes shall be stacked clear of the ground and on timber supports spaced at such interval so as not to induce severe stress to the pipes. UPVC pipes and fittings shall be stored under cover free from direct sunlight.

All spare parts which are ordered shall be delivered with the main order and shall be adequately labelled, protected and packed in a suitable container or containers complete with three copies of a detailed inventory.

The Contractor shall supply all necessary materials and equipment for making good, where instructed by the Engineer, any damage to coatings of pipes, fittings and valves.

All materials shall be insured during shipment, delivery to site, storage, erection and the defect liability period.

602 DESIGN, MATERIALS AND WORKMANSHIP

602.1 DESIGN

The Contractor shall design the Goods to comply with the duties stated in this Specification, to the Engineer's satisfaction and in accordance with modern practice and it shall be such as will facilitate inspection, cleaning, maintenance and repair and ensure satisfactory operation under all conditions.

The general mechanical design of the Goods and particularly that of the seals, and other wearing parts, shall be governed by the need for long, trouble-free operation without frequent maintenance or attention being necessary.

602.2 STANDARDS OF WORKMANSHIP

The standard of workmanship shall be to the satisfaction of the Engineer and shall comply with the requirements of the standards or codes of practices issued by any of the organisations referred to in the Specification.

The Contractor may propose other internationally recognised codes of practice or regulations equivalent to those specified for approval by the Engineer. Such approval to these alternative standards must be obtained prior to manufacture of an items to be supplied under this Contract. Two copies of such alternatives standards are to be supplied in English to the Engineer when required.

602.3 MATERIALS

All materials used in the manufacture of the Goods shall be approved by the Engineer.

All materials shall be new and of first class quality, free from imperfections and selected for long life and minimum maintenance. Particular attention shall be paid to the prevention of corrosion either due to the proximity of dissimilar metals or due to severe ambient conditions. All parts shall be corrosion resistant or adequately protected against corrosion.

They shall have no modifying effect whatsoever on the physical, chemical bacteriological or organoleptical qualities of the water normally conveyed in the system under consideration,

either by reason of the materials construction or leaching from protective coating and painting system. All materials shall be such as have been proved under working conditions to be the most suitable for the purpose for which they are used.

602.4 RELIABILITY OF EQUIPMENT

The equipment shall be so manufactured as to ensure the highest standards of operational reliability. All items of equipment shall be capable for long life with a minimum of maintenance and to meet the following conditions:

(a) They shall be suitable for the conveyance of sewage;

(b) They shall be capable of withstanding without damage all stresses that will be induced during handling, testing and operation;

(c) They shall be watertight under all operating and testing pressure prescribed by the respective Standard;

(d) They shall have long-term resistance to all external factors by virtue of the nature of the materials used in their manufacture as far as water action is concerned and, in a more general manner, the surrounding environment

602.5 SPARE PARTS AND SPECIAL TOOLS

(a) The Contractor shall submit with his bid a priced list of recommended spare parts and special tools sufficient in his estimation to cover five years operation of the Goods.

The items are to be considered as optional extras to the bid sum and the Employer reserves the right to order none, part or all of the recommended list of spare parts and special tools.

All spare parts which are ordered shall be delivered with the main order and shall be strictly interchangeable with the corresponding parts of the Goods. They shall be packed and protected for storage at Site over long periods without deterioration due to adverse conditions. Sealed heavy gauge polythene packing, with included desiccants where necessary, or other approved methods are to be used. All parts shall bear clear indelible identification on the packing as to the contents, and each part shall be readily identifiable from an indelible label which shall be securely attached to each part.

The identification labels shall state the part number as well as the description of the item.

Two copies of a detailed schedule listing the items supplied together with their respective part numbers shall be handed to the Employer, against his signature, at the same time that each batch of spares is handed over.

(b) Any special tools necessary for dismantling, alignment, calibration reassembly or maintenance of the Goods shall be included in the list.

603 PARTICULAR TECHNICAL REQUIREMENTS

603.1 PIPES GENERAL

603.1.1 Supply

Ductile Iron (DI) pipes, steel pipes, unplasticized polyvinyl chloride (uPVC) pipes, vitrified clay (VC) pipes and polyethylene (PE) pipes shall be to the diameters, lengths and classes indicated in the Bill of Quantities and the Specification.

The Contractor shall supply the following information for each nominal diameter of pipe:

(a) External diameter
(b) Internal diameter
(c) Overall length per unit
(d) Effective length per unit
(e) Unit weight
(f) Thickness

The Contractor shall state the method and conditions for loading transport, unloading and storage of pipes. Restrictions regarding temperature, humidity, orientation and the like shall be stated, if any, together with maximum number of pipe diameters that can be stocked vertically, for each diameter.

603.1.2 Marking

Except where expressly agreed between the Contractor and the Engineer all pipes shall be marked with the following information.

- symbol of factory
- date of manufacture
- nominal diameter
- pressure class
- MAURITIUS.

All this information shall be marked in a clear and long-lasting manner.

603.2 FITTINGS GENERAL

603.1 Supply

Pipe fittings shall be to the diameters and classes indicated in the Price Schedules and in accordance with the specified standards.

The Contractor shall supply the following information for each nominal diameter of fittings:

(a) External diameter
(b) Internal diameter
(c) Overall length per unit
(d) Effective length per unit
(e) Weight
(f) Thickness

The Contractor's shall state the conditions of storage required for all fittings. Restrictions regarding temperature, humidity, orientation etc. and the like shall be stated, if any.

603.2 Marking

Except where expressly agreed between the Contractor and the Engineer all fittings shall be marked with the following information.

- symbol of factory
- date of manufacture
- nominal diameter
- pressure class
- MAURITIUS.

All this information shall be marked in a clear and long-lasting manner.

603.3 DUCTILE IRON PIPES AND FITTINGS FOR SEWERAGE APPLICATIONS

Ductile iron pipes and fittings shall comply with the latest version of BS EN 598 – Ductile Iron pipes, fittings, accessories and their joints for sewerage applications. Unless otherwise specified, they shall be supplied with flexible joints.

Rubber gaskets shall comply with the requirements of ISO 4633. Flanged joints shall comply with the appropriate EN or ISO standard.

Pipes and fittings for sewers shall be identified externally by a red colour. They shall be supplied in standard lengths of 6m.

Flanged pipes shall comply with EN 545. All flanges shall be supplied with a complete set of nuts, bolts and washers.

The dimensions of socket and spigot pipes shall be as given in table 11 of BS EN 598, reproduced hereunder:

Table 11 of BS EN 598

DN	**External diameter *DE* mm**		**Minimum iron thickness, *e* mm**
	Nominal	**Tolerance on diameter**	
100	118	+ 1/ - 2,8	2,5
125	144	+ 1/ - 2,8	2,5
150	170	+ 1/ - 2,9	2,5
200	222	+ 1/ - 3,0	3,0
250	274	+ 1/ - 3,1	3,5
300	326	+ 1/ - 3,3	4,0
350	378	+ 1/ - 3,4	4,3
400	429	+ 1/ - 3,5	4,6
450	480	+ 1/ - 3,6	4,9
500	532	+ 1/ - 3,8	5,2
600	635	+ 1/ - 4,0	5,8
700	738	+ 1/ - 4,3	7,6
800	842	+ 1/ - 4,5	8,3
900	945	+ 1/ - 4,8	9,0
1000	1048	+ 1/ - 5,0	9,7
1100	1152	+ 1/ - 6,0	12,0
1200	1255	+ 1/ - 5,8	12,8
1400	1462	+ 1/ - 6,6	14,4
1500	1565	+ 1/ - 7,0	15,1
1600	1668	+ 1/ - 7,4	16,0
1800	1875	+ 1/ - 8,2	17,6
2000	2082	+ 1/ - 9,0	19,2

603.4 UNPLASTICISED POLYVINYL CHLORIDE (UPVC) PIPES AND FITTINGS

Unplasticized "Non Pressure" PVC pipes for sewers shall conform to the requirements of BS 4660:Specification for unplasticized polyvinyl chloride pipes and plastic fittings of nominal sizes 110 and 160mm for below ground gravity drainage and sewerage or BS 5481: Specification for unplasticized PVC pipes and fittings for gravity sewers, with pipes dimensions in accordance with table 1 of the respective standards, reproduced hereunder.

Table 1 of BS 5481: Dimensions of pipe and fittings.

Nominal Diameter	Mean outside diameter of pipe and spigots		Extreme individual outside diameter of pipes and spigots		Wall thickness 'e' of pipes and of bodies and spigots of fittings
	Min	Max	Min	Max	Min
200	200.0	200.6	196.3	204.3	4.9
250	250.0	250.7	245.4	255.4	6.1
315	315.0	315.9	309.2	321.8	7.7
(355)	355.0	356.0	348.4	362.6	8.7
400	400.0	401.0	392.5	408.5	9.8
(450)	450.0	451.0	441.5	459.5	11.0
500	500.0	501.0	490.5	510.5	12.2
(560)	560.0	561.0	549.3	571.7	13.7
630	630.0	631.0	617.9	643.1	15.4

All dimensions are in millimetres.

Table 1 to BS 4660 Dimensions of pipes					
Nominal size (Nominal outside diameter)	Mean outside diameter d_e		Individual outside diameters d_i		Wall thickness 'e'
	minimum (mm)	maximum (mm)	Minimum (mm)	maximum (mm)	Minimum (mm)
110	110.0	110.4	108.0	112.4	3.2
160	160.0	160.6	157.1	163.5	4.1

Unplasticized "Pressure" PVC pipes where specified for sewers shall conform to the requirements of BS 3505: Specification for unplasticized PVC pipe for cold water services and shall be of class B. They shall have the characteristics shown below:

Table 1 to BS 3505 Pipe Dimensions For Class B					
			Wall thickness		
Nominal size	Mean outside diameter		Class B (6.0 bar)		
(mm)			Averaged value	Individual value	
	Min mm	Max Mm	Max mm	Min mm	Max mm
150	168.0	168.5	5.2	4.5	5.2
200	218.8	219.4	6.1	5.3	6.1
250	272.6	273.4	7.5	6.6	7.6
300	323.4	324.3	8.8	7.8	9.0

The joints shall be of the compression ring push type, complying with BS 4346 “Joints and fittings for use with unplasticized PVC pressure pipe”.

Ribbed or corrugated unplasticized PVC pipes shall be of the heavy-duty type having a pipe stiffness in excess of 370 kPa. They shall have the characteristics shown below: -

Nominal diameter (mm)	Average outside diameter (mm)	Average inside diameter (mm)
110	110	101.4
160	160	147.6
200	200	184.0

The joints shall be of the socketed type with seal rings.

603.5 VITRIFIED CLAY PIPES

Vitrified clay pipes shall be suitable for sewerage systems and shall conform to the requirements of BS 65 - vitrified clay pipe fittings and joints, DIN 1230-clayware for drains and sewers or ASTM C 700 - vitrified clay pipe and shall be provided with sockets or sleeve couplings.

The joints shall be flexible and of the compression ring push type. The rings shall satisfy the physical property and type test requirements of rings specified in BS 2494.

The pipes shall have the strength characteristics shown in the table below and shall not deviate from the nominal size beyond the limits of minimum and maximum shown.

Nominal Diameter	Crushing Strength (KN/m)	Bore Diameter	
		Min	Max
150	22	146	158
200	25	196	210
225	25	221	236
250	29	246	262
300	29	295	313

The selection of raw materials for the manufacture and manufacturing process shall be such as to achieve a low permeability in the finished pipe of less than 1 litre/mm pipe diameter/km length/day.

603.6 POLYETHYLENE PIPES

Polythylene pipes if required for the Works shall be manufactured in accordance with BS 3284, or DIN 8074 and 8075 and shall be able to sustain a nominal working pressure of 10 Bar. Joints shall be of the quick joint or electrofusion types or through other approved mechanical coupling. Diameters specified are outside dimensions.

Suitable additives, such as soot shall be incorporated in the moulding material to reduce the effect of ultra violet radiation to the pipe material.

Each coil or batch of pipes shall be clearly stamped and numbered and the relevant pressure test certificate must accompany delivery. Coils may additionally be subjected to a similar test by the Engineer, and any failure may result in the rejection of the whole consignment.

The Engineer will require copies of the test certificate of the material from which the pipes are made to be submitted with the first deliveries. If approved, all subsequent deliveries shall be of a similar mixture and texture.

603.7 MANHOLES AND CHAMBERS

Manholes shall be constructed in accordance with the recommendations of BS 8005: Part I. The invert of the manholes shall be of the same material as the sewer pipe. Alternatively, concrete with a granolithic finish shall be used. Sewer pipes shall be built into manholes as construction proceeds. The joints of the sewer pipes with the manholes shall be water-tight.

The benching shall rise vertically from the springing to at least the height of the soffit of the sewer, where it shall turn over with a nosing of about 25mm radius and rise at a gradient of about 1 in 30 to the wall of the chamber.

All manholes on sewers of diameter 600mm and over shall be provided with polypropylene hooks fixed to either side of the mouth of the outgoing sewer for fixing a safety chain when men are at work. Handrails shall be provided on the edges of benchings, and at platforms, etc., from which a man might fall into the sewer.

Precast concrete manholes and chambers shall be constructed in accordance with BS 5911.

603.8 MANHOLE AND CHAMBER FRAMES AND COVERS

Chamber frames and covers shall be of dimensions given below and shall be as manufactured by Messrs. Brickhouse Broads, Pont à Mousson or similar approved to BS EN 124.

They shall generally conform to the following applications:

On streets and roads	:	Non-ventilated Heavy duty class D400 square frame with water-tight circular cover, minimum clear opening 600mm
On sidewalks and driveways	:	Non ventilated medium duty class C250 square frame with water-tight circular cover, minimum clear opening 600mm
On washout and air valve chambers	:	Non-ventilated medium duty class C250 square frame with water-tight cover, minimum clear opening 600 mm.

603.9 STEP IRONS

Steps for use in manholes and inspection chambers shall be plastic encapsulated to BS 1247: Part 2: 1990 and shall be of the double rung type. The spacing between the two legs of the step shall not be less than 300mm.

Two holes of minimum diameter 20mm and depth at least 90mm shall be drilled into the manhole shaft and the steps affixed therein by means of cementious or epoxy grout having a compressive strength equivalent to the concrete.

603.10 GATE VALVES FOR SEWAGE

Gate valves will be installed either as pipeline isolating valves or at washouts. Valves will be double flanged with stainless steel or gunmetal spindles mounted vertically. They shall have a pressure rating of 10 bar, unless otherwise stated.

Stuffing boxes and glands shall be maintainable, repackable and replaceable without major dismantling of the valve.

Gate valves shall be designed so that any pockets where deposits could accumulate are self-cleaning.

Gate valves shall be of the inside non-rising spindle type.

Gate valves should be droptight at design pressures under open and testing.

The valve bodies shall be of cast iron. All bolts, nuts and screws shall be of stainless steel.

603.11 SLUICE GATES

Sluice gates shall be rectangular faced with a rectangular aperture offering an opening height of not less than the specified width and shall be channel mounted. The gate shall be simple in construction and offers direct operation by a hand wheel.

The frame and gate shall be constructed in high grade cast iron to BS 1452 or in stainless steel to BS 1449. Operating stems shall be in stainless steel. Sealing faces shall be of copper alloy or approved polyethylene.

The unit shall be drop-tight. The contractor shall ensure that the frame does not get distorted during installation. Leakage through the seating shall not exceed 0.15 litre.minute/m of seal perimeter (m).

603.12 DISC FLUSHING VALVES

Disc flushing valves shall have circular apertures and be manufactured in high grade cast iron and designed for wall or flange mounting applications. The valves shall include a hooking mechanism to secure the valves in an open or intermediate position.

The sealing face shall be manufactured from copper alloy or approved polyethylene and shall be fixed securely into a machined recess.

The lifting handle and wall hook shall be in electro zinc plated mild steel or other approved resistant material and the pivot pin in stainless steel.

603.13 AIR RELIEF VALVES

Air relief valves for sewage applications shall be designed with a large float chamber capacity to isolate the sewage from the orifice and the sealing surfaces and to prevent blockages. Air valves shall be flanged mounted and be double acting or of double orifice pattern, providing bulk air release and inflow capabilities.

Air valve bodies and covers shall be of cast iron to BS 1452 or spheroidal graphite cast iron to BS 2789 or approved material providing protection against aggressive service conditions.

All valves shall be flanged and supplied with an independent isolating valve or cock, which will enable overhauling or removal of air valves without disrupting waterflow in the pipeline.

603.14 FLAP VALVES

Flap Valves shall be installed at washout outlets. Valves will be one side flanged and faced with horizontally mounted shafts. Valves shall open when flow occurs and close by flap self weight, when flow stops.

Flap valve bodies and flaps shall be of high grade cast iron.

Hinge pins shall be of chromium-nickel stainless steel and shall be so designed as to allow their replacement without removal of the valve body.

Sealings shall be of copper alloy or approved polyethylene and shall be maintainable, repackable and replaceable without major dismantling of the valves.

Flap valves shall be designed so that any pockets where deposits could accumulate are self - cleaning, enabling drainage of all the water when washouts are opened.

603.15 CHECK VALVES

Check valves shall be double flanged free acting type specially designed for use in pumping sewage. The valves shall give rapid non-slam closure and low head characteristic when the door is in the open position. Check valves shall comply with the general requirements of BS 5153 and suitable for a working pressure of 10 bar.

The valves shall have a cast iron body and door with gunmetal or nickel bronze alloy door seatings, and an access cover of adequate dimensions for removal of the door. The hinge pin shall be of stainless steel carried in non-corrodible bearings.

603.16 PRESSURE SURGE RELIEF VALVES

Pressure surge relief valves shall be installed on the pumping mains to relieve excess surge pressures in the pipeline.

Pressure relief valves casing shall be of high grade cast iron or other approved metal coated by a fusion bonded epoxy unless otherwise specified to ensure protection against the aggressive service conditions. Unless otherwise specified, all other metallic parts, including bolts, nuts and screws shall be in stainless steel.

The calibration device shall be easily accessible for re-setting of the working pressure on site.

603.17 GULLIES

Gullies shall comply with BS 65, BS 437 or BS 5911: Part 2. Gullies shall incorporate a trap and a sump to retain detritus and shall be provided with a grating.

600.B PIPELINE CONSTRUCTION

604 GENERAL

The requirements of this section shall apply to the construction of sewer lines.

The Contractor shall, as soon as the Works have commenced, prepare for his own use and guide an exhaustive list of materials needed for each section of the permanent Works so as not to be delayed through shortage of fittings.

He shall immediately take precautionary measures if he considers that small items such as couplings will de deficient. He shall immediately inform the Engineer if he considers any discrepancy in the quantity of fittings between the drawings and the Bill of Quantities.

The Contractor shall satisfy the Engineer on the competence of the pipelayers prior to, and periodically during pipelaying operations.

605 SETTING OUT

The wayleaves, easements or other rights of way for pipelines will be defined by the Employer across any private land and by the Engineer's Representative across any land belonging to the Employer or to the Government.

The Contractor shall, where required by the Engineer's Representative set out the boundaries and shall provide, erect and maintain in the position until final completion of the works using substantial timbers, stakes or other approved members, not less than 1.5m high indicating the said boundaries. Such stakes shall be provided at each and any change of direction of the boundary and at intervals not exceeding 100m and at such intermediate points as are deemed necessary by the Engineer's Representative.

The Contractor shall, in the presence of the Engineer's Representative set out the pipeline alignments in accordance with the Drawings making any changes the Engineer's Representative may deem necessary, confirming also, the exact locations of all manholes, valves, air valves, washouts and hydrants, etc. The Contractor shall supply, install and maintain in position until trench excavation, marker posts at each and any change in direction of the pipeline and at intervals not exceeding 100m and at such intermediate points as are deemed necessary by the Engineer's Representative. Such markers shall be substantial posts in either concrete or steel or other approved materials and not less than 1.5m high.

No work shall commence upon any portion of the Contract until such time as ground levels and invert levels of existing manholes have been taken by the Contractor in an approved manner and checked and accepted by the Engineer to ensure that a firm record has been established for measurement and setting out purposes. Should the Contractor fail to comply with this clause, the Engineer shall base the final measurement on other survey data.

606 HANDLING AND TRANSPORT OF PIPES AND FITTINGS

The loading, unloading and handling of pipes and fittings shall be carried out using ropes, cranes, lifting beams and slings of approved design, strictly in accordance with the recommendations of the manufacturer and to the approval of the Engineer. Particular care shall be taken at all times to avoid damage of any kind.

The protective cover, discs, etc. provided by the manufacturer shall not be permanently removed until immediately prior to installation.

When pipes are loaded for road transport they shall be carefully handled to prevent damage. Pillows shall be provided between lashing (ropes, wires or chains, etc.) and the pipes. All cradles and lashings shall be of such widths as to prevent damage to the coating of the pipe, or distortion of the pipes.

In the event of any damage being caused, the Contractor shall be liable for the cost of all repairs or replacements and the costs of any delays. The Engineer shall determine whether the damage shall be repaired and if it is to be repaired, the manner of such repair, or whether the damaged piece shall be replaced.

607 STRINGING OF PIPES

Pipes shall be placed on suitable pillows or other supports approved by the Engineer. End caps shall not be removed until such time as the pipe is to be inspected and laid.

At places where the pipeline route crosses roads, tracks or any other access and where approved by the Engineer, the Contractor shall deposit the pipes so that access by the public is in no way restricted.

The Contractor may be prohibited from using certain roads and other tracks for the purpose of stringing on account of adverse weather conditions or restricted access and no extra cost he may incur on this account or for any other road restriction, delay, or any other thing which increases the cost of his haulage will be allowed.

608 EXAMINATION OF PIPES PRIOR TO LAYING

Shortly before laying any pipe, the Contractor shall carefully examine each pipe and fitting to ascertain damage or defect. All damage and all defects revealed by this examination shall be repaired and remedied to the satisfaction of the Engineer's Representative.

609 LAYING AND JOINTING OF PIPES

Pipelaying shall be carried out only by experienced pipelayers.

Immediately before any pipe is lowered into the trench the plug shall be removed from the end of the last pipe laid and the new pipe shall be carefully lowered into the trench in an approved manner.

Each pipe and fitting shall be laid true to alignment and gradient in accordance with the Drawings or as directed by the Engineer's Representative.

Pipes shall be boned to gradient and sight rails shall be provided for this purpose at intervals not exceeding 20m with a minimum of three sight rails along a pipe length to any one gradient.

Pipes laid in trench shall have the minimum cover stated on the Drawings or as otherwise directed by the Engineer's Representative.

Pipes laid in trenches shall be laid and firmly bedded on an even and uniform bed. Where pipes are not laid on a granular bed, the bottom of the trench shall be smooth and free from stones or other projections. Pipes shall not be dragged along the trench bottom. Joint holes shall be excavated below the trench bottom and shall be as small as possible and shall be filled in and compacted after the pipes are laid and before the refilling of the trench is commenced. Survey pegs in the trench bottom shall be removed.

Each type of joint shall be made in full compliance with the manufacturer's instructions. Pipe jointing shall only be carried out by experienced personnel and with close supervision by the Contractor.

The Contractor shall take all steps necessary to ensure that no extraneous matter is allowed to enter the pipes during or after laying. In the event of extraneous matter entering the pipes the Contractor shall immediately carry out the necessary cleaning as may be directed by the Engineer's Representative.

As pipelaying proceeds the Contractor shall prove pipelines are free from obstruction by passing through the pipeline a 'badger' which must be kept in the pipes at all times during construction of the pipelines. The 'badger' shall be pulled forward and any obstructions or dirt removed immediately after the laying of each pipe and before the next one is placed in position, so that the barrel of the pipe is left perfectly clean.

The 'badger' shall consist of polyurethane foam with dimensions approved by the Engineer, with suitable attachments to allow for pulling through the pipes.

Except when necessary for jointing, the end of the last pipe laid shall be plugged to the satisfaction of the Engineer's Representative and the Contractor shall provide a sufficient number of and use proper plugs for this purpose.

Pipe trenches shall not be backfilled until permission to do so has been obtain from the Engineer's Representative. Subject to such permission being obtained trenches shall be backfilled without delay.

610 CUTTING PIPES

Pipes shall be cut with an approved mechanical pipe cutter and in conformity with the pipe manufacturer's recommendations. The edges of the cut shall be clean, true and square.

The cut ends of pipes shall be chamfered and ground smooth or treated as recommended by the manufacturer prior to being jointed. Special tools needed for this purpose shall be kept on site by the Contractor.

611 PROPRIETARY JOINTS AND COUPLINGS

Proprietary joints and couplings shall be assembled in accordance with the manufacturer's instructions. The Contractor shall be responsible for obtaining such copies of the manufacturer's instructions as he requires, at his own expense.

The Contractor shall be responsible for obtaining all the necessary special tools, lubricants and appliances necessary for making the joints.

612 GRANULAR BEDDING TO PIPES

Granular bedding to pipes shall be 6mm single size aggregates. The material shall be evenly spread on a formation free of water and loose soil and shall be compacted and levelled to the underside of the pipe. After pipelaying the material shall be brought up to half barrel of the pipe.

613 CONCRETE SURROUND TO PIPES

Where pipelines pass under streams and rivers or where directed by the Engineer's Representative, the section of pipeline under the stream or river and for a minimum distance of 1.0m clear on either side of the bank or edge thereof or such greater distance as the

Engineer's Representative may require shall be surrounded with Grade C15P concrete or as shown on the Drawings so as to provide a minimum 150 thickness protective surround to the pipe.

Concrete surround shall be broken at all pipe joints to retain flexibility in the pipeline.Where concrete surround is specified, a minimum of two cradles shall be used as temporary supports to the pipes. No joints shall be concreted in without the prior approval of the Engineer's Representative.

614 FLOTATION OF PIPELINE

The Contractor shall be solely responsible for ensuring that flotation of the pipeline does not occur during construction. The extent of the backfill placed over each pipe after laying and before testing shall be such as will prevent flotation of the pipeline.

Should any section of the pipeline float out of line or level the section of pipeline so affected shall be removed and re-laid in accordance with the Specification to the satisfaction of the Engineer's Representative, and any damaged sections shall be discarded. The cost of the work and any pipe damaged and discarded through causes of flotation shall be borne by the Contractor

615 TESTING OF NON PRESSURE LINE

All non-pressure lines shall be subjected to a water test after backfilling. To satisfy himself on proper workmanship the Contractor may carry out a preliminary test prior to backfilling.

Tests shall be carried out from one manhole to the other.

The pipe length shall be plugged at its downstream end and filled with water. The upper end of the pipeline shall then be plugged with a stopper to which are connected a 90 degree bend though the centre and outlet pipe fitted with an air release valve near the upper circumference. A length of pipe shall then be jointed to the bend at the centre and extended vertically outside the manhole and to a minimum height of 2.0 m above the pipeline. Water shall then be added through the extension pipe via a funnel until all air has been expelled from the pipeline. The air release valve shall be closed and the water level in the upstand pipe topped up for 30 minutes to compensate for absorption. After the initial 30 minutes, the level of water in the upstand pipe shall be maintained by adding measured quantities of water and noting the elapsed time.

The test line shall be considered to have passed if the calculated loss of water is less than 1.2 litres per metre diameter per metre length of test line per hour or the amount tabulated below.

Nominal Pipe Diameter mm	Amount of water lost in 30 mins/100m of test line (litre)
150	9.0
200	12.0
225	13.5
250	15.0
300	18.0

Water tests may be substituted by an air test for pipes greater than 300mm diameter at the discretion of the Engineer.

616 TESTING OF MANHOLES

Completed manholes shall be subjected to a leak-proof test. The manhole shall be filled with water to the top of the cover level and left for 24 hours. After this period the water in the manhole shall be restored to its original level. The manhole shall be considered as having passed the leak-proof test if after 30 minutes the level of water in the manhole has not dropped by more than 10mm.

617 BUILDING IN OF SEWER

The end of sewer lines at manholes shall be neatly cut flush with the inside wall of the manhole the rubber ring joint adjusted in place and the boxing filled with concrete so that no ingress of water occurs.

618 CONNECTION TO EXISTING MANHOLES

Connections of new sewer lines to existing manholes and chambers shall be carried out with care so as not to interrupt wastewater flow. The contractor shall, if necessary, provide pumping and other equipment to divert flow from one manhole when building in sewers or carrying out modification works.

619 CLEANSING OF PIPELINES

After the sewer lines have been completed and tested satisfactorily as herein specified the Contractor shall flush out and cleanse the pipelines.

Sewer sections shall be cleansed by means of passing polyurethane foam swabs through the pipelines. The swabs shall be to the approval of the Engineer's Representative. Flushing shall be repeated until the discharge runs clean to the approval of the Engineer's Representative.

Swabs shall be passed through pipelines at speeds of between 0.2 and 0.4 metres per second to obtain the best cleaning results with the minimum number of passes.

The sewer lines shall then be flushed repeatedly until the discharge runs smoothly to the approval of the Engineer.

620 TESTING OF PRESSURE MAINS

All pressure lines shall be subjected to a water test after backfilling. The test pressure shall be the static pressure plus 5 bar.

Before a length of pipeline is tested, each pipe shall be securely anchored. All thrust and anchor blocks shall have been constructed and, when the pipeline is in trench, at least two thirds of the barrel of each pipe shall be covered with not less than 600mm of backfill material. Normally all joints shall be left exposed until pressure testing has been satisfactorily completed. Should circumstances make it necessary to backfill a pipeline completely before pressure testing it shall be the Contractor's responsibility to excavate joint holes during pressure testing in the event that this is necessary to locate leaks.

Pressure testing shall be carried out as the work proceeds in such lengths of pipeline as are convenient and meet the approval of the Engineer. The ends of the length of pipeline under test shall be closed by means of securely anchored caps or blank flanges. Pipeline sluice or butterfly valves shall not be used for this purpose. All washout valves shall be fitted with blank flanges and the valves opened before the commencement of any pressure test. At each air valve location, a special air release arrangement shall be provided to allow manual release of

air during filling operations. Pressure testing shall not be carried out with permanent air valves in place.

The Contractor shall be solely responsible for the provision of all caps and blank flanges necessary for testing of the pipeline. The section of pipeline to be tested shall be filled slowly with water in such a manner that all air is expelled. Air valves or air vents shall be checked to ensure that no air is trapped at high points.

The pressure in the pipeline shall be slowly raised to the test pressure, the test pump disconnected and the pipeline left charged under pressure with air valves in the operating position for a period of not less than 24 hours to allow air in the pipeline to be expelled. At the end of this period of time the test pump shall be reconnected and the pressure in the pipeline raised again to the test pressure and this pressure maintained for a period of 4 hours or such other period as directed by the Engineer.

During the pressure test all exposed joints shall be inspected and any leaking or seeping joints shall be remedied. Throughout this period the pressure in the pipeline shall not be allowed to fall or rise more than 6m head of water below or above the test pressure and this shall be accomplished by pumping water into or releasing water from the pipeline as required. The volume of water pumped into or released from the pipeline shall be carefully measured. At the end of the test period the pressure in the pipeline shall be adjusted to the test pressure by pumping water into or releasing water from the pipeline as required.

The apparent leakage from the pipeline shall be ascertained from the net volume of water that has been pumped into the pipeline during the test period. This shall not exceed the volume determined by the following formula:

$$\text{Apparent allowable leakage} = \frac{K.d.L}{9000} \text{ litres per day}$$

d = diameter of pipe in millimetres
L = length of pipeline under test in metres
K = 3

All signs of leakage shall be remedied whether total apparent leakage from the pipeline under test is less than the apparent allowable leakage or not.

Should any length of pipeline fail to pass the pressure test the Contractor shall at his own expense provide all fittings and carry out all work necessary to locate and remedy the faults and to retest the pipeline until it satisfactorily passes the test.

The use of air for testing is not normally acceptable. However a low pressure air test (not exceeding 0.3 bar) may be used for the purpose of detecting leakage in waterlogged ground, or as preliminary joint tightness test prior to backfilling.

The water used for pressure testing shall be provided by the Contractor and shall be free from impurities and of such a quality which will not pollute or injure pipelines and to the satisfaction of the Engineer. The Contractor shall be solely responsible for making all arrangements for obtaining the water and transporting it and for the provision of all equipment labour and other things necessary for the test.

700 ELECTRICAL WORKS

701 LIGHTING AND SMALL POWER

Lighting and small power distribution boards shall comply with the relevant parts of BS 5486. They shall be complete with incoming isolation switches and circuit breakers as required. The distribution boards shall generally be three phase and neutral type (TP & N). Enclosures shall have a minimum protection of IP 55.

Light fittings shall comply with all relevant British Standards. Mercury fluorescent lamps shall be high pressure MBFSD (HPL-C) type, alternatively, where appropriate, lamps of the high pressure MBFR (HPL-R) reflector type may be provided. Fluorescent tube fittings shall be of the switch start type complete with all separate control gear for each lamp and be complete with a capacitor to ensure that the power factor is a minimum of 0.85. The fittings shall have a high grade paint finish suitable for installation in a tropical climate. All fittings shall be of the corrosion resistant type with minimum enclosure protection of IP55. Weatherproof fittings shall have minimum degree of protection to IP 55. Bulkhead fittings, where specified, shall be suitable for industrial installations and have a minimum degree of protection of IP 55. Self-contained luminaries to provide emergency lighting in accordance with BS 5266 shall incorporate twin spot-lights or fluorescent tubes as appropriate and a maintenance free nickel cadmium battery, capable of preserving the light output for a period of 3 hours without mains supply, together with an automatic recharging circuit with a monitoring indicator to restore the charge within 24 hours. The units shall not be damaged by mains outages exceeding 3 hours. The units shall be of the non-maintained type. Where there is normally sufficient daylight, the emergency lights shall be controlled by a photo-electric unit to inhibit their operation in daylight.

The cable for this section shall be PVC insulated with PVC sheath and copper earth conductor, complying with BS 6004, for cables below 16mm^2. The cables shall be laid within conduits or trays. Cables of 16mm^2 and above shall be to BS 5467.

Fused spur units shall be double pole 13A switched type in surface mounted metal-clad boxes suitable for industrial installation and complying fully with BS 1362.

Socket outlets in offices and control rooms shall be twin 13A switched type in surface mounted metal-clad boxes suitable for industrial installation and complying fully with BS 1363. Elsewhere 13 Amp switched socket outlets shall be iron-clad with screw cap cover.

All switches shall be water and dust sealed suitable to provide a reliable installation in the environment of water treatment works. The switches shall be of heavy duty design to match the switched sockets specified above and shall not be less than 20 Amp rated.

Light switches shall be 20 Amp rated with required number of gangs and ways in a surface mounted metal-clad box suitable for industrial installation and complying fully with BS 3676.

Weatherproof light switches are to have a minimum degree of protection of IP 55.

All equipment shall be securely fixed to the walls of the existing building (most of which are constructed in reinforced concrete) and the contract shall include the supply of a tool for making fixings by means of an explosive cartridge. Such fixings shall be of threaded study allowing removal of the equipment without removal of the wall fixings.

702 EARTHING AND BONDING

All non-current-carrying metal parts of the electrical installation and other services shall be properly bonded together and connected by means of a protective conductor to an efficient earth in accordance with IEE Wiring Regulations.

All connections shall be by means of an approved mechanical joint or adjustable clamp which shall be accessible and made secure with brass nuts and bolts. On no account shall plain or spring washers of ferrous metal be used.

Protective conductors shall provide earth continuity either through the conduit, armouring, lead sheathing, copper sheathing, steel trunking or by independent earth tapes or PVC sheathed wires, according to the system of wiring employed. Where PVC conduits or trunking systems are employed the protective conductor shall be routed within the conduit or trunking.

Wherever cable armouring is used as a protective conductor, care must be taken to ensure an adequate earth bond and additional bonds to the metalwork shall be provided as required.

703 MAIN EARTH CONNECTIONS

Where a main earth bar is to be installed it shall be connected in a ring with the earth bar provided on the switchgear and any existing main earth ring in the building. The glands and wire armour of cables shall be connected to the switchgear earth bar or directly to the earth ring.

The main earth bar shall be formed from high conductivity, hard drawn copper bar Grade C101 to BS 1433 of not less than 31.5mm x 6.3mm cross-section. Any joints in the earth bar are to be brazed together using brazing alloy type CP1 to BS 1845 or pan head rivetted and sweated. The bar overlap/thickness ratio shall be not less than 5.

The earth bar shall be secured to an inside wall in an accessible position. Connections to the metalwork of electrical plant shall be made in soft drawn copper tape or equivalent sized cables. Where plant is subject to vibration, connections shall be made using flexible conductors. All earthing conductors and equipotential bonding cables shall have a green and yellow PVC sheath, and earth bars shall have a green/yellow marker tape applied.

Reinforced concrete or sheet steel piling shall be connected to the earthing system as directed by the Project Manager. Structures of steel framed buildings shall be bonded to the main earth bars.

Earth rods are to be 16mm (5/8") diameter driven by an automatic hammer to a depth of approximately 4 metres. Spacing between rods is not to be less than the depth of the rod. Inspection pits shall be provided for each electrode to allow subsequent access for testing.

The routing, dimensioning and arrangement of all main earth bars and connections shall be detailed on the schedules and drawings. Disconnecting links for testing purposes shall be provided at the main earth bar.

Where copper earth tape is buried below ground level it is to be served with PVC or double half lap wrapped with an approved grease-impregnated tape.

704 ELECTRICAL INSTALLATION

The electrical installation shall comply with the current edition of the Regulations for Electrical Installations published by the Institution of Electrical Engineers (IEE Wiring Regulations) and the requirements specified herein where these differ from the IEE Wiring Regulations.

The installation shall be arranged in a neat and orderly manner which may involve running out of direct lines in order to conform to building outlines etc, and to utilise any holes provided in the structure for cabling purposes. Unnecessary crossing of cables will not be accepted and due care should be given to this when selecting runs. Each cable shall be in one continuous length and no straight through joints will be permitted except as agreed with the Project Manager.

It shall be the entire responsibility of the Contractor to programme the whole of his work to ensure that the various parts of the electrical installation are executed at the proper stages of the construction.

Care should be taken that servings and sheathings of cables are not damaged during installation. Should any part be damaged, the damage shall be made good to the entire satisfaction of the Project Manager. Under no circumstances should cables be allowed to bend less than 8 times their diameter.

Armoured cables other than those laid in the ground shall be suspended on cable racks, cable tray, cleats or cable hangers supplied under this Contract which shall be arranged for bolting to steelwork, brickwork or concrete as required. All non-armoured cables shall be protected by conduit.

Where cables are run on open surfaces and exposed to the sun a metal shield shall be fitted over them. Similarly where cables are run up walls they shall be suitably mechanically protected to a height of 2m above ground or floor level.

705 CABLING AND WIRING

705.1 GENERAL

Cables shall, wherever possible, be arranged to enter equipment from below, particularly equipment located externally or in damp situations. Cables entering cubicles provided with sealed covers or timber or sheet steel shall be accommodated by drilling or dividing the covers with clearance hole as necessary to allow the cable to pass through and be terminated at glands or gland plates provided within such cubicles, so that the covers when replaced prevent entry of dust or vermin.

705.2 PROTECTION OF EXPOSED CABLES

Where Cables emerge through steel platforms or concrete floors, the Contractor shall provide and position protective curbing or sleeves made from galvanised material extending 75 mm above finished floor level. Sleeves shall be finished flush with the underside of the floor. Final details shall be agreed with the Project Manager on site in respect of all situations.

Cables rising into or against floor mounted equipment shall be secured to the equipment in a neat manner to ensure that the cables are properly supported and that no undue strain is put on the cable termination or the plant. Where vibration or expansion is a consideration, adequate precautions and vibration loops shall be made at the appropriate position.

Where cables emerge in an area exposed to vehicular traffic and on overhanging projection exists up to one metre above ground level, a galvanised steel pipe or protection cover fabricated from 3.0mm (10 SWG) galvanised mild steel (or heavier as appropriate) shall be provided and fixed to the associated structure for a minimum height of 1.5 metres above the local finished ground level.

705.3 SELECTION OF CABLE RUNS

The route and arrangement of all cables and the position of equipment and wiring points shall be marked out on site by the Contractor and agreed by the Project Manager before any work is put in hand. Where cable routes have been agreed, the Contractor shall be entirely responsible for measuring the lengths of cable to be ordered and ensuring that the cables are supplied in the correct length.

705.4 CUTTING AWAY AND MAKING GOOD

The Contractor shall be responsible for marking out the agreed positions of all chases, holes and fixings required for the passage of cables and conduit.

The Contractor shall carry out all the necessary drilling for fixing up to 25mm diameter in the buyilding fabric for the support and fixingsof all items supplied or specified herein. Such work shall be carried out in a neat and workmanlike manner without unduly defacing concrete or brick surfaces. The use of stud fixings employing cartridge guns will not normally be permitted.

705.5 CABLE MATERIALS

Cables shall be of approved design from a BASEC approved manufacturer having a certificate of Assessed Quality Management. They shall be manufactured within the 12 months prior to delivery and be delivered to site on cable drums or with protective wrappings.

The overall sheath of the cables shall be coloured as follows:

High Voltage	-	Red
Low Voltage	-	Black
Earth continuity conductor	-	Green/Yellow
Instrument	-	Grey
Intrinsically safe	-	Blue

Cables shall be of the voltage grade, conductor size and type detailed in the specific requirements. General specification of the cable type to be used is detailed hereunder.

(i) Cross-linked polyethylene cables shall have stranded, copper conductors with cross-linked polyethylene insulation. Multi-core cables shall be laid up in an extruded bedding, single wire armoured and sheathed overall with PVC, to BS 5467 (XLPE/SWA/PVC type).

(ii) Single core cables shall have aluminium wire armour. Cables rated over 6350V shall incorporate graded semi-conducting tapes and core screens in accordance with IEC 502.

(iii) Low smoke and fume emission cables shall be as above except that the bedding and sheathing shall be of low smoke and fume emission material, all in accordance with BS 6724 (XLPE/SWA/LSF type).

(iv) PVC armoured cables shall have stranded copper conductors with extruded PVC insulation, PVC sheathed, single wire armoured and sheather overall with PVC (PVC/SWA/PVC type). Cables shall be in accordance with BS 6346. Conductors of 1.5mm² and 2.5mm² shall have stranded conductors (7/0.50 and 7/0.67 respectively).

(v) PVC insulated wiring cables shall be 600/1000 volt grade single core stranded copper conductors PVC insulated to BS 6004 (PVC wiring type).

(vi) Telephone cables shall be thermoplastic insulated multipair cables having twisted pairs of copper conductors (telephone type).

(vii) Instrumentation cables shall be polyethylene insulated copper conductors with twisted individual pais screened, polyethylene bedded, steel wire armoured and PVC sheathed overall, all in accordance with BS 5308 Part 1 Type 2. Conductors shall be 0.5mm² stranded 16/0.2mm (PE/IS/SWA/PVC type).

(viii) Earth and bonding cables shall have stranded copper conductors PVC insulated and sheathed (PVC/PVC type).

(ix) Flexible cables shall have stranded, tinned copper, flexible conductors, EP rubber insulated and CSP sheathed all in accordance with BS 6007 (flexible type).

705.6 COMPRESSION GLANDS FOR CABLES

All the glands shall be supplied by the Contractor and shall be of the brass compression pattern, so designed that any strain on the cable is taken by the steel wire armoring. The glands shall incorporate watertight seals on both inner and outer sheaths and have a separate armour clamping ring to ensure a good mechanical connection for the earth continuity path. The glands shall be secured with heavy duty locknuts and the whole assembly is to be protected by and overall plastic sleeve, suitably sealed to prevent atmospheric attact.

Glands fitted to unthreaded gland or adaptor plates, non-metallic equipment, or where specified for circuits likely to pass high fault currents, shall include a brass earthing tag and connections arranged to effectively bond the gland body via a protective conductor to an effective earth point. Where instrument cable screen terminations need to be isolated, insulated gland daptors or non-metallic plates shall be used.

Glands and earthing tags shall be compatible with the gland plate and cable armouring materials to prevent electrolyte corrosion; e.g. brass for steel wire armouring/gland plate and aluminium for aluminium wire armouring/gland plates.

Glands fitted in Zone 0 to 1 potentially explosive atmospheres shall be similar to those described above, but shall be classified Ex (d) in accordance with BS 5501 Pt 5 and be suitable for use with Apparatus Groups IIA and IIB.

Where cables to BS 6346, BS 6116 or BS 5467 having an extgruded or taped bedding are used for direct entry into such apparatus Groups, a sealing stopper box or compoundsealed barrier gland shall be used in accordance with BS 5345 Part 3.

705.7 TERMINATION OF GLANDED CABLES

All cable compression glands shall be fitted by the Contractor, with the insulated conductors and sheathing being carried through the gland. The sheathing shall be preserved where required within the equipment and the insulated conductors properly connected to the terminals of the equipment concerned.

The armouring shall not be cut off short of the gland but shall be properly laid up and secured under the clamping ring provided. The gland shall be fitted finally with an overall PVC sealing sleeve.

All cable tails shall be of sufficient length to connect up to the equipment terminal boards, and in addition to making off the gland the Contractor shall strip, insulate, ring through and identify the individual cores, fit suitable termination lugs, ring or spade crimps or bootlace ferrules as appropriate, and fit numbered reference ferrules, lace the tails in a workmanlike manner and finally connect up.

All spare conductors within multi-core cables shall be terminated as shown on the connection diagram or be folded back with sufficient surplus to allow them to be connected if required in the future.

705.8 WIRING FERRULES

These shall be of durable materials suitable for permanently affixing to the cable cores and be of the interlockiong slide-on type, such that the interpretation of the reference is unambiguous.

All control circuits consisting of more than two wires shall be identified by means of wiring ferrules attached to the individual cores at each end of the conductor where it is connected to any apparatus or junction box.

Unless otherwise specified, it shall be the responsibility if the cabling contractor to obtain interconnection terminal data and references from the equipment manufacturer to enable proper connections to be made.

705.9 CABLE CLEATS

Cleats for fixing cables to walls, structures, etc. shall be of the non-corrodible hook and clamp type made of high impact plastic or cast aluminium comprising two halves fixed by means of galvanised rawlbolts or on to galvanised backstraps where the number of cleats makes this more economic.

All assemblies to be complete with necessary galvanised bolt, nut and washers.

The spacings of supports or cleats for cables shall in any case be not greater than shown in the following table but, where circumstances merit, closer spacing arrangements may be required by the Project Manager.

The vertical spacings shall be applied to runs sloping up to 30° from the vertical. For greater deviations, the spacing for horizontal runs shall apply.

For outdoor and damp situations, fixing bolts or studs for cleats shall not be less than 13mm overall diameter unless otherwise agreed by the Project Manager.

Cable Support Spacing (mm)

Cable Type	XLPE/SWA/PVCor PVC/SWA/PVC with stranded copper conductors	
Overall dia (mm)	Horizontal	Vertical
up to 15	350	450
15 - 20	400	550
21 - 40	450	600
41 - 60	700	900
over 60	1100	1300

705.10 SEGREGATION OF DUTIES AND SERVICES

Cables of different circuit categories shall be segregated as defined in the IEE Regulations. Instrument control cabling shall as far as possible be routed separate from electrical power cables and long parallel runs to these or pipeworks should be avoided. Where parallel routes and crossovers are necessary, a minimum separation of 250mm shall be maintained. Power cables shall not occupy the same ducts as instrument cables.

Similarly, separation between the three categories of instrument cables shall also be maintained as scheduled below:

Categories to BS 6739	Separation Cat 1	Cat 2	Cat 3
CATEGORY 1 Instrument power & control (over 50V, under 10A, AC or DC	-------	200mm	300mm
CATEGORY 2 High level signals (5V to 50V DC)	200mm	---------	300mm
CATEGORY 3 Low level signals (Less than 5V DC)	300mm	300mm	----------

Only conductors carrying signals of the same category shall be contained within any one multicore cable. Similarly, conductors forming part of intrinsically safe circuits shall be contained within multicore cables reserved solely for such circuits.

All screens for instruments cables shall be earthed at one point only, preferably at the main control centre.

705.11 CABLE TRENCHES

Trenches cast in floors or ground shall be of specified internal dimensions to suit the specific installation. They shall have smooth vertical sides and bottom with provision for vocer plates to finish flush with the finished floor surface.

Inside bends shall be either radiussed (150mm min) or chamfered at least 100mm back, equally angled from each direction. Such raduissing or chamfers shall extend the full height of the trench, however the top 100mm may be corbelled out to simplify the cover plate arrangement.

Trench covers shall be of aluminium or galvanised mild steel chequer plate (min 8mm thick) supported to prevent undue flexing and having suitable holes to allow removal by standard lifting keys. Support shall be by means of steel curbing rebates cast into the trench top edges, providing a landing width of at least 30mm.

Additional or alternative support for switchboards etc shall be from at least 75 x 35 mm channel section cross bearers and transverse trimmers, fixed or cast into the floor and located to suit equipment fixings, access requirements and floor cover spans.

To prevent differential deflection, butt straps shall be fitted to the underside of floor plates which have no other support.

Edging curbs suitable for mild steel chequer plate shall be painted in red oxide primer, the curbing may be tapped to accept cover securing screws. Where aluminium plates are used in contact with any mild steel supports, a bitumen coating on the points of contact shall be used.

705.12 GALVANISING AND FASTENINGS

Where manufactured or purpose-made steelwork, ladder, racking, tray supports and all fixings nuts, bolts and washers are specified as galvanised, this shall mean hot dipped galvanised finish to BS 729 as far as practicable. Bolts and nuts shall be in matched condition.

Fixings screws for boxes, saddles, clips and other accessories shall be of brass or other non-corrodible type e.g. cadmium plated steel.

705.13 RACKING

Cable racks shall be robustly constructed of mild steel, not less than 2.5mm (12 SWG) in thickness and galvanised after manufacture. Where cleats are not used, the rack shall be provided with a toe at the outer end. Racks of proprietary construction may be used subject to approval.

Main rack supports, where fixed to brickwork or concrete, shall be secured with bolts of not less than 13mm diameter. The fixing bolts shall be of the self-securing type with expanding sockets and shall not require grout to hold them in position.

Where fixed to walls in places subject to dampness and in cable subways, the racks shall be set off from the walls by 35mm x 18mm thick galvanised packers placed at the bolt fixing positions.

In cable basements, the lower tier of any row of racks etc. shall be not less than 100mm above finished floor level.

705.14 CABLE LADDER

Cable ladder shall be heavy-duty type, fabricated from mild steel not less than 2mm thick and galvanized after manufacture. The side rails shall be at least 120mm deep with rungs set towards one edge, space a regular intervals of approximately 300mm and having elongated slots to accommodate the cable fixings.

Lengths of ladder shall be coupled and changes in direction, level and width shall be achieved by means of standard accessories designed for the system, such as radiused risers and gusseted intersections. Cable tray shall be accommodated in not less than 40mm square galvanised channel sections fitted with plastic closure strips and suitable end caps in preferenced to tray, and subject to the Project Manager’s approval.

705.15 CABLE CHANNEL

Cables requiring mechanical support across voids may be accommodated in not less than 40mm square galvanised channel sections fitted with plastic closure strips and suitable end caps in preference to tray, and subject to the Project Manager’s approval.

705.16 CABLE TRAY

Cable tray shall be heavy duty pattern formed from galvanised sheet steel, perforated with elongated holes for cable fastenings. The tray shall have side flanges not less than 25mm deep with returned edges and be galvanised after fabrication. Material gauge shall be 1.5mm (16 SWG) minimum, except that for tray widths less than 400mm the gauge may be reduced subject to the flange depth and the approval of the Project Manager. Factory made tee sections and bends shall be used where possible.

The cutting of trays shall be kept to a minimum but where unavoidable, all cut edges shall be rounded or folded over and protected with zinc rich cold galvanising paint, holes for cables shall be bushed with nylon/PVC strip edging material. Mushroom headed bolts and nuts shall be used to join sections of tray and accessories and arranged not to present any obstruction on the tray. Capacity amounting to 25% usable tray area shall be left spare.

Where specified herein for damp or corrosive conditions, the trays shall be of unplasticised PVC with non-corrodible nuts and bolts.

705.17 CABLES ON TRAY OR LADDER

Cables shall be laid flat and straight, properly dressed into position and fastened by cable ties or straps of metal reinforced PVC strip material, secured at intervals not greater than 1m for horizontal and vertical runs. Where the run is horizontal but arranged in the vertical plane, support spacing shall be as specified under 'Cable Cleats'. Care shall be taken to space the cables to allow adequate cooling. Not more than seven cables shall be embraced by one group tie and not more than two layers of cables shall be run on one tray.

705.18 CABLES IN DUCTS

Before drawing any cables in ducts, the Contractor shall ensure that they are clean and free from obstructions.

Adequately spaced temporary supports and cable rollers shall be provided for the drawing in of cables such that abnormal strains and damage to the cable is prevented; approved lubricants shall be used as necessary. Cable stockings shall be used for general drawing work, core pulling eyes being specially fitted for hev\avt hauls.

Stresses shall not exceed : 10MN/m² (1500 lb/sq in) on the lead sheath

70MN/m² (10,000 lb/sq in) on the core

Maximum pulling tension shall not exceed 20 kN (4500 lb).

705.19 DUCT SEALS AND CABLE TRANSITS

After the cables are drawn in, the Contractor shall seal the ends of all ducts, pipes or trenches leading into buildings, passing though walls or floors within buildings or underground chambers containing equipment for cabling associated with this Contract, whether occupied or not.

All cables, conduits or pipes shall be sealed into the ducts by means of a secure and effective water, gas, vermin and fire-poof material which will accommodate settlement and vibration. This may be a self-supporting non-setting mastic packed into the annulus to a depth at least equal to the sleeve diameter, or approved multi-cable transit units with appropriate fillwers and insert blocks. All steelwork on such transit assemblies and frames shall be hot dip galvanised.

Where shown on the Specification drawings, transit frames will be incorporated in the construction by the Civil Works Contractor.

705.20 CABLE LAID IN GROUND

All cables laid in the ground shall be armoured**.** They shall be well bedded in fine soil or sand and shall be covered with protective tiles. Cable route markers shall be supplied and erected at every 30m along cable runs and at changes in direction. All cables running along any one portion of route shall be laid at the same time and no extra payment will be made for re-excavation should any cable be overlooked at the time of laying. The Contractor shall be responsible for all excavation, for the supply of fine soil or sand for bedding, and for the backfilling and reinstatement of cable trenches along previously agreed runs. Trenches shall not be back-filled until the installed cables have been inspected by the Engineer.

705.21 CLEARANCE AND COVERAGE FOR BURIED SERVICES

Trenches shall be excavated or ducts laid at such a depth that where cables are laid in the ground the minimum coverage to the top of the duct or the cable shall comply with the following:

Minimum Coverage

Type of Service	Vehicular Roadways	Open Ground or Footpaths
HV	1000mm	750mm
Others	750mm	500mm

Where possible, electric cables and their ducts shall be routed so that subsequent excavation to expose another service will not disturb cables and electrical ducts. Where separated routes are not practicable then the following clearance shall be ensured:

Minimum Clearances

Type of Cable	To HV Cable	To LV Cable	To Other Cable	To Gas/Water etc Pipes
HV	150mm	300mm	300mm	300mm
LV	300mm	150mm	250mm	300mm
Others	300mm	250mm	150mm	300mm

The spacing of cables installed at the same time shall be generally in accordance with the above table, but where circumstances permit a more economical arrangement may be specified by the Project Manager.

As far as possible electric cables shall avoid the same route as other services except where otherwise directed. Where such segregation is not possible then 50mm thick concrete slabs may be used as separators with the Project Manager's approval. Adequate slack shall be left at each bend for cables laid direct.

705.22 EXCAVATIONS AND PRECAUTIONS

Turf and topsoil shall be carefully removed and positioned where indicated on the drawings or as directed by the Project Manager for subsequent reinstatement in their original position.

Broken land drains and damage to other services shall be reported to the Project Manager and marked on site.

Excavations shall be kept free of water and properly shored up. Other services uncovered shall be adequately supported by slings or other means and protected.

705.23 BEDDING FOR CABLES

Prior to laying the bedding for the cable, the bottom of the trench shall be cleared of loose and projecting rubble etc. and evenly graded.

A sand bedding shall be applied below and around the cables and shall be thoroughly compacted. Thickness of bedding around the cable shall be 60mm except where soil contains high organic or other corrosive matter where the thickness shall be 200mm. Bedding shall be well graded sand, free of clay with minimum particle size of approximately 0.08mm (BS sieve No. 200) and maximum particle size of approximately 2mm (BS sieve No. 7). 60% of the material shall pass through BS sieve No. 72. Where the Engineer directs, local soil may be used for bedding after passing through a 10mm mesh sieve provided the material is evenly graded.

705.24 PROTECTIVE COVER TILES

These shall be of the concrete apex pattern engraved 'Danger - Electricity' or similar, of dimensions appropriate to protect the number of cables along a particular route.

Following the installation and compaction of the bedding soil or sand over the cable, covers shall be laid by the Contractor so that they overlap by approximately 30mm each side of the cable run. Where cables are displaced by no more than 300mm vertically, covers shall be installed only over the upper cable run.

705.25 BACKFILLING AND REINSTATEMENT

Reinstatement of soil following laying of cable shall be effected by backfilling in 100mm layers. Hand ramming shall be employed for the first two layers and power ramming for subsequent layers.

After hand ramming to a depth of 200mm, a yellow coloured plastic tape approximately 150mm wide with the words 'CAUTION CABLE BELOW' shall be provided and run over the centre of the route of each cable run by the Contractor.
Top soil is to be replaced and the level of the finished reinstatement shall not protrude more than 50mm above normal ground level.

All surplus spoil is to be removed from the site and areas surrounding the excavation shall be restored to their original condition.

Where tarmac surfaces have been excavated, the final 200mm backfilling after allowing the settlement shall consist of 120mm of compacted, graded hardcore, followed by a 60mm concrete screed and a 20mm top dressing of tarmacadam.

705.26 ROUTE MARKERS

These shall be of reinforced concrete with the words 'ELECTRIC CABLES' cast in one face. They shall either be of the flush block type approximately 300mm x 300mm x 150mm or the pillar type approximately 600mm high erected with 300mm projecting above the ground or as directed by the Project Manager.

As soon as site conditions allow, the location of each group of buried cables and every joint shall be accurately marked. Concrete marker posts or blocks shall be set at the origin, changes of direction, joints and otherwise at intervals of 20 metres or as directed by the Project Manager.

705.27 CABLE IDENTIFICATION

Identification labels of durable material shall be provided suitable for permanently affixing to the cable sheath by means of buckle type straps and shall carry the cable reference in PVC channel strip. The reference character sizes shall be not less than 4mm (5/32") high (Critchley Unilabel or similar.)

Cable identification labels shall be fitted to each cable end below its respective cable gland, also where the cable passes through ducts or trenches and at each entry and exit to a room or building.

705.28 TRUNKING MATERIALS

All trunking, bends, cover plates, tees, flanges, supports, fixings, etc. shall comprise an approved complete system capable of adaptation and erection without size modificaion and

with compatible manufactured bends and accessories being used as far as practicable. The trunking access covers shall comprise easily removable convenient sized lengths retained over the entire length by clip-on features or suitable fastenings which shall not obstruct cable entries. Overlapping covers and internal flanges or coupling sleeves shall be provided at all trunking junctions. All cable supports, edges, sharp internal angles etc. shall be protected with PVC or formed to present a smooth edge.

(i) Metal trunkings and fittings shall be zinc coated or galvanised mild steel not less than 1.2mm thick (18 SWG). Copper earth bonding straps shall be fitted at the junction of adjacent lengths of trunking and fittings.

(ii) PVC trunkings and fittings shall be of high impact heavy duty rigid PVC.

705.29 TRUNKING INSTALLATION

As far as practicable, trunking shall be installed clear of other services and positioned so that future access is not restricted. Drawings detailing supports, terminations, sizes and centre lines of trunking shall be submitted to the Project Manager for approval prior to commencement of the installation. Provision for expansion of the trunking materials shall be made in accordance with the manufacturer's instructions. Trunking shall include fire barriers of fibreglass wadding fitted at each point where the run passes through fire walls and floor levels. All cable and conduit exits shall be fitted with bushes without decreasing the effective cross-sectional area of the trunking.

When connecting adjacent sections of trunking or when fixing trunking to a wall or supports, round or mushroom headed bolts or screws shall be used such that no sharp edges project into the inside surface. When installed in damp situations the trunking shall be spaced from the wall by means of short tube collars.

All trunking shall be protected against damp and corrosion and where entries, joints and/or bends have been installed, cut and/or sawn edges exist, all damaged galvanising shall be made good by a minimum of two coats of primer (zinc based galvanised or similar approved equivalent) and two top coats of aluminium paint of an approved quality. For extensively damaged galvanised coatings the items shall be re-galvanised or replaced with acceptable components.

Conduit shall be connected to the trunking by means of couplings and male bushes to obtain a good earth connection.

To assist identification within trunking, final circuit wiring shall be formed into groups held by buckle clips or PVC straps. Each group shall be labelled where wiring enters or leaves the trunking and at intervals of approximately 15 metres in long trunking runs. In vertical runs the trunking shall be fitted with PVC coated pins at approximately 600mm centres t be used as cable supports.

Separate conductors comprising the same circuit shall be run enclosed together throughout their length.

705.30 CABLES IN CONDUIT

For wiring installations carried out with PVC insulated cables in conduit the wiring throughout is to be on the "looping in" system and no "Tee" or other intermediate joint between fittings will be permitted, and in no case must the cable or other fittings have been fixed permanently in position and approved by the Project Manager.

Any water which may accumulate in the conduit during erection shall be removed before any cables are drawn in. Sufficient slack shall be allowed at each point to ensure that all conductors are under no physical strain or tightness.

Separate conductors of the same circuit shall always be drawn into one conduit, but cables forming final circuits connected to different distribution boards shall not be drawn into the same conduit or box.

The cables shall be coloured RED or BLACK as required to distinguish opposite poles, a BLACK conductor shall be used throughout for neutrals and connected to the neutral pole of the supply system.

No reduction of the strands forming the conductors will be allowed at switch or other terminals; all the strands shall be efficiently secured by screws, nuts and washers or other approved means and all conductors shall be so proportioned that the drop of potential does not exceed that indicated by the IEE Wiring Regulations.

After the Contract award a table (in duplicate) showing the proposed arrangement of wiring circuits and the size of cables to be used shall be submitted to the Project Manager for his approval before any work is put in hand.

705.31 DUCTS AND COUPLINGS

Buried cable ducting shall be smooth bore uPVC pipe to BS 4660 (or medium density polyethylene, where greater flexibility is required) jointed by spigotted ends or couplings of compatible, non-deteriorating material. These couplings shall be a self-aligning, push fit and incorporate seals to prevent the ingress of water and other fluids as far as possible and the joint so formed shall be equal in internal diameter to the duct itself.

Ducts entering below ground level into a building or structure shall emerge inside the building either directly into an accessible trench or void, or the duct shall have an upturned bend to emerge adjacent to an inside wall face, or as otherwise specified.

All exposed upturned duct ends shall project at least 75 mm clear of the finished floor or ground level to prevent unwanted collection of water or debris and protect the cable exit.

705.32 BEDDING OF DUCTS

Prior to laying ducts in trenches, the trench bottom shall be evenly graded, cleaned of loose rubble etc. and compacted to form a solid foundation. In rocky soil a layer of loose, rock-free earth shall be used for this foundation.

Where ducts are laid beneath vehicular access roads, the ducts shall be haunched in C20 concrete for the full width of the road and extend each side beyond the curbside by at least 300mm.

705.33 DUCT ALIGNMENT AND CLEANING

Ducts shall be laid in a straight line as far as possible with minimum deviation. Where bends are required, these may be manufactured, pre-formed bends with a radius of not less than 10 times the bore diameter. No continuous duct run shall incorporate more than two bends nor turn through a total of more than 135° in any plane. No single bend shall exceed 90°.

Where greater changes of direction are necessary, cable draw pits shall be incorporated in the run as required or defined by the Project Manager.

A non-corrodible draw wire or rope shall be left in each duct and plugs shall be inserted at the ends of each section of duct to prevent entry of soil or stones. On completion of the ducts and prior to drawing in cables, a circular wire brush 6mm greater in diameter than the duct shall be pulled through each duct.

705.34 CABLE DRAW PITS

Cable draw pits shall be of concrete block enclosed construction fitted with suitable removable access covers and have bellmouthed duct entries into the pit interior. The interior dimensions shall be determined by the Project Manager but shall be not less than 750 x 600mm in plan and the depth shall be determined by the invert of the lowest duct with a minimum of 50mm clearance to the base of the pit.

Where specified, a pulling eye for the use of a 2000kg pulley block shall be provided opposite each group of ducts in the wall of the pits, and positioned to facilitate as straight a pull as possible on the cables with the use of a pulley block. The base of the pit shall be formed with a fall towards a sump, suitably placed for pumping dry.

705.35 INTRINSICALLY SAFE CIRCUITS

Circuits complying with the requirements of BS 5345 for intrinsically safe circuits shall be arranged such that all cables are identified and segregated as detailed in BS 6739.

Conductors forming part of an intrinsically safe circuit shall only be contained within multicolour cables reserved solely for such circuits and must be terminated separately.

Intrinsically safe circuits shall be connected to a separate earthing system as detailed in BS 6739 and any shunt diode barriers shall be installed in accordance with the certificate requirements.

705.36 MINERAL INSULATED CABLES

Cables shall be installed saddled to trays on the surface or as otherwise specified. The spacing of saddles shall be in accordance with the IEE Regulations. Cable termination accessories and saddles shall be brass or copper and shall be a temporary mastic seal applied during installation. Once cut to length, each cable shall be permanently terminated without delay by using an approved seal. Termination seals shall be anchored in approved glands and locked into screwed conduit entries or gland plates shall be locked in position with locknuts. Shrouds shall be fitted over glands except where they are encased in the structure of the building.

In cables where dampness may be present or where dissimilar metals are present, corrosion inhibiting paste shall be interposed in all voids between surfaces in contact.

Where MICS cable serves an inductive circuit liable to voltage surges or circuits subject to lightning surges, appropriate surge diverters shall be connected across the inductive sources (coil etc.) or between lines and earth at the point of entry in the case of lightning protection.

705.37 SEALING BOXES FOR LEAD SHEATHED CABLES

For terminations at plant items, these will be provided by others except as specified herein and will be of cast iron, compound filling type provided with filling plugs 8n the appropriate position for filling with compound when mounted on the associated equipment. Each will be

complete with wiping cone armour clamp. For through joints or tee joints, the contractor shall provide suitable boxes as details herein.

All necessary jointing materials, filling compounds and earthing requirements shall be included for all joints to be made under this specification.

705.38 LEAD SHEATH CABLE TERMINATIONS

The contractor shall submit to the Project Manager for approval the proposed method for terminating lead sheathed cables. Termination must ensure that moisture cannot creep along the cores of the cable nor in between cores.

Where cable tails are to be brought out, cores shall be cut back below the level of the sealing compound and connected to the tails using a brass ferrule sweated to provide a solid damp and oil migration barrier between tail and core.

Paper insulated tails shall be double half lapped with an approved non-hygroscopic insulating tape alternatively for LV cables, instead of an approved tape, a length of temperature sensitive, PVC sleeving may be heat shrunk over the tail, joint and cores.

The continuity of armoured cables shall be maintained by an efficient bond between the cable armour, the gland and the metalwork of the equipment at which the cable terminates, in order that a reliable path is provided for fault currents.

When the lead sheath has been wiped on to the cable gland, the steel armouring shall be brought over the wiped onto the cable gland to provide additional earth continuity and mechanical strength to the plumbed joint. The armour clamp shall sandwich a copper braid between the clamp and the armouring to ensure a bedded connection.

Compression glands shall be to an approved pattern providing adequate bonding and armour clamping facilities.

Cable cores shall be fitted with suitable termination lugs and be phase coloured as appropriate and marked with an approved label to correspond with the diagram of connections.

Glands exposed to weathering shall be totally wrapped in impregnated tape to exclude all moisture from the gland connection and have an outer wrapping of PVC tape.

705.39 JOINTING

Personnel employed for jointing power cables including all types of terminations for aluminium conductors shall have received specialised training. Joints in all buried or stranded cables shall be sweateed, but compression joints will be permitted for stranded copper or solid aluminium conductors at terminations only.

Joints shall be completed without pause or unnecessary delay. Reduction in the number of strands is not approved but limited reduction in the cross sectional area of solid conductors by an approved method is permitted. Cable cores shall be cut with due regard to fanned out terminations, leaving a neatly arranged minimum of slack core between cable and terminal. As far as practicable all HV joints shall be made to avoid crossed to twisted cores, final phasing put being arranged in the cable box termination.

Where a crossed joint is approved, a sleeve at least 30% longer than standard shall be use to minimise the distortion of cores. The Engineer shall witness the final termination in order that the Contractor may prove the phasing before the last joint in a cable run is made.

Cables shall be jointed colour to colour or number to number. Where numbered cores are to be jointed to existing coloured cores etc. the Engineer will direct the system to be used.

A reliable continuity path shall be provided for fault currents flowing via the lead sharth and/or armouring by means of an efficient earth bond between the cable armouring and sheath on each side of the joint.

Any semi-conducting screens incorporated in HV cables (e.g. XLPE rated at 6350/11,000V) are to be thoroughly removed before the application of any stress control components supplied with the necessary cable jointing kits.

705.40 SEALING COMPOUND

The outer protection boxes for joints or terminations shall be filled with compound of the hot or cold pouring variety of a type compatible with the cable materials to be agreed by the Project Manager.

Compounds which require heating shall be evenly heated, well stirred and the temperature maintained within the recommended pouring ranges. Cable accessories shall be thoroughly dried before filling and pre-warmed where possible.

Where cable sealing boxes are fitted beneath oil-filled compartments or where inverted cable sealing boxes are used due to cables entering from overhead, the compound shall be of the oil resisting type to prevent any risk of softening due to contamination from the insulating oil.

Cold pouring resin encapsulation materials shall be carefully mixed to avoid entrapped voids or uncured filler materials.

705.41 SINGLE CORE CABLES

Circuits utilising single core cables shall be installed under IEE ‘Defined Conditions’ but to minimise mutually induced voltages, three phase circuits shall be run for as long as possible throughout the route in close trefoil formation. Where a circuit employs more than a one cable per phase, each trefoil group shall contain one cable of each phase, allowing at least 50mm clearance between adjacent groups. Cleat spacing shall not exceed 1.2 metres.

Ferrous screens or armour shall not be used on such cables and associated terminations or enclosures must avoid the use of magnetic material which would provide a flux in service.

To control induced voltages, single core cables shall have their metallic sheathing and/or aluminium armouring bonded together at both ends of the run, the bonding being connected directly to the system earth bar or other approved points. Cables having no insulating oversheath shall have their metallic sheaths or armouring bonded together by the use of normally spaced. Well fitting, non-magnetic metallic trefoil cleats.

In all cases the bond shall be sized to carry the prospective fault dcurrent and have conductivity not less than that of the cable sheath and/or armouring. Bonds for cables laid in a flat formation shall also allow for the unequal sheath currents.

To prevent circulating currents, bonding and earthing at the supply end only of short runs of single core cables will be permitted where it can be shown to the satisfaction of the Project Manager that the induced voltages are safe under fault conditions.

705.42 BUSDUCTS

Connections between major electrical items shall (where specified) employ a fully integrated, totally enclosed, busduct system to BS 5486 (IEC 439-2), comprising HDHC copper conductors embedded in a non-flammable, self extinguishing, cast epoxy resin insulation.

The complete assembly including junctions shall be completely free of condensation and watertight to IP68. Fire resistance shall be Class M1 (F) and class B1 (D) to IEC 332.

All parts of the system shall be from the same manufacturer and comprise factory made lengths, bends, tees and terminating pieces to suit the physical application and layout of the installation.

The voltage and prospective fault ratings of the system shall be suitable for the application and the current rating shall be based on the most onerous method of installation for the circuit. The cross sectional area of the conductors shall not be reduced throughout a given circuit.

The installation shall allow for any necessary expansion, be properly supported and connected in accordance with the manufacturer's instructions. Fire and damp-proof barriers shall be provided when passing through walls, floors/ceilings etc.

Conductors shall be jointed by means of double junction plates, one on each side to ensure low joint resistance. The junction shall be compressed by means of high tensile steel nuts and bolts. After assembly, all junctions shall be overcast with the same materials mixed under vacuum, as used for the busduct elements, thus maintaining a homogenous and weatherproof enclosure throughout.

Provision for conductor shifting, transfers and paralleling, shall be made within the terminal elements.

705.43 LIGHTNING PROTECTION SYSTEM

The Contractor shall design, supply and install a lightning protection system to the storage buildings, the Quarantine and packaging building due to their hazardous wastes content, in accordance with BS EN 62306 – Protection against lightning Part 1 to 4

The Contractor must submit to the Project Manager for approval, the following detailed information: -

(i) Design assumption, parameters and lightning protection level.
(ii) Lightning protection zones and their boundaries.
(iii) Appropriate air-termination method
(iv) Components for air-termination, down conductor and earthing.
(v) Protection of roof mounted fixtures including surge protection devices.
(vi) Positioning of down conductors and test points
(vii) Soil resistivity and appropriate earthing arrangement.
(viii) Touch and step potential outside building
(ix) 2 copies of documentation for the system at preliminary, detail and following successful implementation of the system

800 LANDSCAPING AND GRASSING

800.1 GENERAL

Grass, trees and shrubs shall be planted as far as is practicable during periods of the year most likely to produce best growing results. The Contractor shall make every effort to programme his operations in such a manner that grass, trees and shrubs shall, as far as is possible, be planted during this period.

800.2 FERTILIZER / SOIL IMPROVEMENT MATERIAL

(i) The Fertilizer / Soil Improvement Material

The fertilizer / soil improvement materials to be used shall be ammonium nitrate or any other type of material prescribed by the Project Manager.

(ii) Grass Cutting

Grass cuttings shall be fresh cuttings of an approved type of grass with sufficient root material to ensure good growth.

(iii) Grass Seeds

Only fresh certified seed shall be used and the types of seeds in the seed mixture shall be as specified in the Special Specifications.

Mixing the various types of grass seeds for obtaining the prescribed grass-seed mixture shall be done on the Site in the presence of the Engineer. Storing and identifying the grass seeds and the grass-seed mixtures on the Site shall be the responsibility of the Contractor.

(iv) Trees, Shrubs ad Hedge Plants

The Contractor shall supply the number of plants as shown on the Drawings and/or Bill of Quantities. The Contractor shall give at least six week's advance notice of his requirements to the Employer. Upon receipt of the plants, the Contractor shall ensure that the plants are in a good condition and free from plant diseases and he shall accept full responsibility for maintaining the plants in a good condition throughout the Contract and the Defects Liability Period. The plants shall be fully maintained and watered during this period and any losses of plants on account of lack of care or disease during the Contract and Defects Liability Period, shall be replaced at the Contractor's own cost.

Each plant shall be handled and packed in the approved manner for that species or variety, and all the necessary precautions shall be taken to ensure that the plants will arrive at the site of the Works in a suitable condition for successful growth. Trucks used for transporting plants shall be equipped with covers to protect the plants from windburn. Containers shall be in a good condition.

Plants supplied by the Contractor shall be healthy, correctly shaped, and well rooted. The plants must be hardened off and be exposed to direct sunlight for at least 6 months prior to planting in the road reserve. Roots shall not show any evidence of having been restricted or deformed at any time. Plants shall grow well and shall be free from insect pests and diseases.

(v) Grass Sods

Grass sods shall be either nursery-grown or bush sods as described below. Both types shall be harvested, delivered, planted and watered within 36 hours unless otherwise authorised by the Project Manager. The grass sods shall be free from noxious weeds and diseases. Sods obtained from a nursery shall be in moist soil not less than 30 mm deep, and sods taken from the bush in moist soil not less than 50 mm deep.

(a) Nursery-grown sods

These sods shall be of the variety of grass specified. The grass shall have been grown specifically for sod purposes, mown regularly and cared for to provide an approved uniformity to the satisfaction of the Project Manager.

(b) Bush sods

These sods may be obtained from approved areas within or near the Site where a suitable type and density of grass and type of soil are found.

(vi) Top Soil

Topsoil shall consist of fertile loamy soil, obtained from areas with a good soil coverage of natural vegetation, preferably grasses. It shall be free from deleterious matter such as large roots, stones, refuse, stiff or heavy clays and the seeds of noxious weeds, which will adversely affect its suitability for grass being planted. Topsoil stripped from areas infested with weeds shall be stockpiled separately.

(vii) Manure

Manure shall, unless another type has been approved by the Project Manager, be pure cattle manure free from soil, weed seeds or other undesirable material. It shall not contain any particles that will not pass through a 50 mm screen and shall be approved by the Engineer before being delivered to the Site.

(viii) Compost

Compost shall be well decayed, friable and free from weed seeds, dust or any other undesirable materials. It shall not contain any particles that will not pass through a 50 mm screen and shall be approved by the Engineer before being delivered to the Site.

800.3 LANDSCAPING AREAS

(a) Shaping

Areas within the road reserve but outside the road prism which require shaping by means of bulk earthworks such as contoured areas at interchanges and intersections and rest areas which require earthworks shall be excavated, filled and compacted when required, and shaped to the correct contours to within a tolerance of plus or minus 150 mm. Such work shall be regarded as being earthworks.

(b) Trimming

Trimming shall consist of trimming the existing or previously shaped ground to an even surface with the final levels generally following the original surface. Trimming shall normally be done by grader, or in more confined or steep areas by bulldozer. Where machine operations are not practicable, because of confined spaces or steep slopes, or when

approved by the Engineer, trimming shall be done with hand tools. When trimming is done on slopes steeper than 1:3, the ridges shall be made parallel to the contour. Such ridges shall be approximately 100 mm wide, and the centres between the ridges approximately 400 mm. Trimming shall be done where instructed by the Project Manager to areas inside the road reserve but outside the road prism, i.e. normally outside the tops of cuts or the toes of fills, but trimming of rock outcrops will not be required.

Trimmed surfaces shall be left slightly rough to facilitate a better binding with topsoil or the natural establishing of vegetation.

When subsequent grassing is required or when it is ordered by the Engineer, areas previously shaped shall be trimmed as described above to within a tolerance of plus or minus 100 mm with all undulations following a smooth curve. The above tolerance shall apply only to areas where the final contours are given on the Drawings.

During trimming, all stones in excess of 100 mm in size and all excess material shall be removed. Areas which require grassing shall be trimmed in such a way that, after cultivation and the application of topsoil, the finished surface of the area shall be approximately 25 mm below the top of adjacent kerbing, channelling or pavement.

800.4 PREPARING AREAS FOR GRASSING

The various areas to be grassed shall be prepared as follows:

(a) Soil ripping

Where soil is too hard to be ploughed with a light tractor, the soil shall be ripped up to a depth of 300 mm before it is loosened by plough to a depth of 150 mm.

(b) Areas which do not require topsoil

Where the areas to be grassed consist of organically suitable material, the topsoil shall be loosened by ploughing to a minimum depth of 150 mm. All loose stones exceeding 50 mm in size on areas to be mowed by machine and falling within the road reserve and all stones exceeding 150 mm in size in other areas shall be removed.

(c) Areas which require topsoil

Where areas to be grassed consist of organically unsuitable material, the surface shall be roughened to ensure a proper bond between the topsoil and the subsoil. If required, the area shall be scarified as described in paragraphs (a) or (b) above.

Topsoil shall be placed on the prepared surfaces and trimmed to the uniform thickness required. The topsoil shall be scarified by means of hand raking or light
rotavators and all stones removed as specified for areas not requiring topsoil in subparagraph (b) above.

Areas inaccessible for topsoil being placed after the construction works have been completed shall be covered with topsoil and protected against erosion during construction works.

(d) Fertilising

For all areas to be planted, the Contractor shall have the top 150 mm of the prepared surface tested to determine the quantity and type of fertiliser which will be required for establishing proper growth conditions for the grass. The location of the soil sample taken shall be

indicated on plans by the Contractor. The Project Manager shall be furnished with the test results. Only after approval by the Project Manager of the nature and quantity of the fertiliser, may its application proceed. The fertilizer shall be evenly applied over all surfaces where grass is to be planted, and shall then be thoroughly mixed with the soil to a depth of 100 mm either mechanically or manually. Where hydroseeding is to be performed, the fertiliser may be mixed with the cellulose pulp and water used in hydroseeding.

(e) General

After an area has been prepared for grassing, the grassing shall be completed before crusting. Where a crust has been formed before grassing is done, the Contractor shall, at his own cost, loosen the crust by ploughing to a depth of 150 mm.

800.5 GRASSING AND SPRIGGING

The method of establishing grass shall depend on the circumstances relating to each case, and the Project Manager shall decide which method is to be used. Provision is made for the following methods:

- Planting grass cuttings
- Sodding
- Hydroseeding
- Topsoiling only, using, where available, topsoil selected for the presence of natural grass seeds
- Grassing with an approved grassing machine
- Hand seeding
- The use of any other method specified

(a) Planting grass cuttings

The areas to be grassed shall, unless already wet, be thoroughly watered before the cuttings are planted to ensure that the soil will be uniformly wet to a depth of at least 150 mm when the planting is done.

An approved variety of grass cuttings shall be evenly planted by hand or mechanically at a rate of at least 600 kg of cuttings per hectare. Fresh cuttings only shall be used. Any grass cuttings that have been allowed to dry out shall be discarded. Immediately after having been planted, the grass cuttings shall be given a copious watering, and, when sufficiently dry, shall be rolled with a light agricultural roller.

(b) Sodding

Areas to be grassed by sodding shall be given a layer of topsoil of at least 50 mm in thickness unless, where suitable soil is present, the Engineer orders the topsoil to be omitted. The areas to be sodded shall be thoroughly watered beforehand so that it will be wet to a depth of at least 150 mm during sodding. The surface shall be roughened slightly to ensure a good penetration of roots into the soil. Sods shall be protected against drying out and kept moist from the time of harvesting until they are finally placed.

The first row of sods shall, where possible, be laid in a straight line, and if on a slope, laying the sods shall start at the bottom of the slope. The sods shall be butted tightly against each other, and care shall be taken not to stretch or overlap the sods. Where a good fit cannot be obtained, any intervening spaces shall be filled with topsoil. The next row shall be similarly placed tightly against the bottom row with staggered joints, and so on until the entire area has been covered with sods. On steep slopes, when instructed by the Project Manager, the sods shall be held in position by a sufficient number of wooden stakes approximately 300

mm long by 20 mm in thickness and these stakes shall be knocked into the subsoil to a depth of 100 mm.

The Contractor shall water the sods directly after they have been placed to prevent undue drying out. As sodding is completed, each section shall be lightly rolled and thoroughly watered.

800.6 MAINTAINING THE GRASS

(a) Watering, weeding, mowing and replanting

All sodded and grassed areas shall be adequately watered at regular and frequent intervals to ensure the proper germination of seeds and growth of grass until the grass has established an acceptable cover and thereafter until the beginning of the defects liability period of the grass. The quantity of water and the frequency of watering shall be subject to the Project Manager's approval.

The Contractor shall further mow the grass on all areas where grass has been established whenever so instructed by the Engineer, until the end of the defects liability period. All grass cuttings shall be collected and disposed of if so directed by the Project Manager. Weeds shall be controlled by approved means. Any bare patches where the grass has not taken or where it has been damaged or has dried out shall be recultivated, planted, sodded at the Contractor's own expense.

All grassed areas shall have an acceptable cover as defined below at both the beginning and the end of the Defects Liability Period.

(b) Acceptable cover

An acceptable grass cover shall mean that not less than 75% of the area grassed shall be covered with grass and that no bare patches exceeding 0.25 m2 in any area of 1.0 m x 1.0 m shall occur. In the case of sodding, acceptable cover shall mean that the entire area shall be covered with live grass at the end of any period not less than three months after sodding.

(c) Defects Liability Period

The Defects Liability Period in respect of grass shall commence when an acceptable grass cover as defined in (b) above has been established and shall be one year. This means that the Defects Liability Period in respect of grass can commence earlier or later than the Defects Liability Period for other parts of the Contract. If the Defects Liability Period in respect of grass expires before the end of the defects liability period for the other roadworks, the Contractor shall further mow the grass on such areas as instructed by the Project Manager up to the end of the Defects Liability Period for the other roadworks.

800.7 TREES, SHRUBS AND HEDGING PLANTS

(a) Positions of trees and shrubs

The localities where trees and shrubs are to be planted are as follows:

(i) Trees and shrubs shall be planted at locations shown on the Drawings.

(ii) Plants in the median shall be planted in a line 1.5 m from the centre line of the median or as directed by the Project Manager.

(iii) When the carriageways are at different levels, the plants in the median shall be planted 2 m from the edge of the shoulder on the high side of the median or as directed by the Project Manager.

(iv) Where the road curves, the plants in the median shall be planted on the inside of the median centre line.

(v) Where the carriageways are at different levels as well as on a curve, the plants in the median shall be planted on the high side, provided they do not impede on sight distance, or as directed by the Project Manager.

(vi) At freeway crossings over roads or rivers, shrubs shall be planted in the positions shown on the Drawings.

(vii) At the headwalls of culverts or similar structures, trees and/or shrubs shall be planted to indicate the positions of these structures. The locations for planting the plants shall be as shown on the Drawings or as directed by the Project Manager.

(viii) Care shall be taken not to obscure traffic signs by plants.

(ix) Trees shall not be planted closer than 10 m from the yellow line on the outside shoulder.

(b) (b) Preparing plant holes

Unless otherwise directed by the Project Manager, holes shall be spaced and prepared as follows:

(i) All holes shall be square in plan.

(ii) Holes for hedge plants and shrubs shall be at least 500 mm square by 600 mm deep.

(iii) Holes for trees shall be at least 600 mm square by 700 mm deep.

(iv) The holes for plants shall be refilled with selected and approved topsoil thoroughly mixed with manure or compost (one heaped spadeful added to every plant hole) and, depending on soil-test reports, the required quantity and type of fertiliser.

(iv) (v) The holes shall be thoroughly watered before plants are planted. Where the soil is poorly drained, 150 mm of crushed stone shall be placed at the bottom of the hole before it is filled with soil.

(c) Planting

Before trees, shrubs and hedging plants are removed from their containers for planting, they shall be well watered.

Directly after having been planted, each plant shall be well watered with a view to settling the soil. After the soil has settled, additional soil shall be added where necessary to bring the replaced soil in the hole to within 150 mm of the ground surface, so as to ensure that sufficient water can be retained in the hole around the plant. All trees shall be tied to a suitable creosote treated timber stake with a minimum diameter of 35 mm or other suitable stake as approved by the Project Manager and firmly planted in the ground. The stake shall be 300 mm longer than the planted tree, and its maximum length shall be 1.5 m above

ground level. After planting, the ground surface around the plant shall be covered with straw or grass or any other type of mulch to minimise evaporation.

(d) Maintenance

During the defects liability period, which shall be twelve months after completion of the actual planting of trees, shrubs and hedges, the Contractor shall be responsible for watering the trees, shrubs and hedges and keeping the plants free from weeds and pests.

Every hedge plant, tree or shrub, which is not healthy or shows unsatisfactory growth, shall be replaced by the Contractor at his own expense, within one month of having been notified by the Project Manager, in writing.

900 CONSTRUCTION TOLERANCES, TESTING & QUALITY CONTROL

900.1 SCOPE

This Section covers the requirements in regard to the construction tolerances. Testing and quality control applicable to the various structures and structural members.

900.2 DEFINITIONS

Except where otherwise specified, the following aspects of construction to which tolerances apply shall have the meanings attributed to them below:

(a) Position

The position of a structure or structural member shall be the horizontal position of its centre line(s) and/or centre point(s) in relation to the overall layout of the Works as shown on the Drawings.

(b) Alignment

The alignment of a structure or structural member shall be the alignment of its centre line(s) in relation to the overall layout of the Works as shown on the Drawings. Deviation from true alignment shall be measured in degrees of an arc.

(c) Leading and cross-sectional dimensions

The leading and cross-sectional dimensions of a structure or structural member shall be the dimensions relating to width, length, height, thickness, etc, which collectively determine its shape, and are shown on the Drawings. Dimensional tolerances not relating to leading or cross-sectional dimensions shall be shown on the Drawings.

(d) Levels

The level of any structure or structural member shall be the level of the upper or lower surface, as may be relevant, with reference to an established datum-level on the site.

(e) Surface regularity

Surface regularity is the shape of a surface with reference to a 3m straight-edge (or template in the case of curved surfaces) placed on the surface.

The tolerance for surface regularity is expressed as a distance by which the surface tested may deviate from a straight-edge (or template in the case of curved surfaces) held against the surface.

900.3 TOLERANCES

(a) Concrete surfaces

The tolerances given below shall be the maximum permissible deviations from the specified dimensions, levels, alignment, positions, etc, shown on the Drawings of the structures or structural members.

All parts of formed concrete surfaces shall be in the position shown on the Drawings within the tolerances set out in Table 6.1.

In cases where the Drawings call for tolerances other than those given in the Table below the Drawings shall rule.

Where precast units have been set to a specified tolerance, further adjustments shall be made as necessary to produce a satisfactory straight or curved line.

When the Engineer has approved the alignment, the Contractor shall fix the units so that there is no possibility of further movement.

CLASS OF FINISH	***TOLERANCE IN MM***		
	A(1)	***B(1)***	***C(1)***
F1	***10***	***10***	***+25 TO -10***
F2	***5***	***10***	***+ OR - 15***
F3	***2***	***5***	***+ OR -10***
POSITION:			
10 MM			
ALIGNMENT:			
WALLS			***2 MINUTES***
DIMENSIONS:			
LEADING DIMENSIONS IN WALLS			***±25 MM***
THICKNESS OF WALLS:			
PLUS-TOLERANCE			***25 MM***
MINUS-TOLERANCE			***3% OF THE SPECIFIED DIMENSIONS WITHIN THE RANGE OF 5 MM TO 25 MM***
LEVELS:			
LEVELS: AVERAGE LEVEL OF FINISHED OR TRIMMED/CUT WALLS			***±10 MM***
VERTICALITY:			
USING ORDINARY FORMWORK			***1 IN 400. MAXIMUM 25 MM***
USING SLIDING FORMWORK			***1 IN 200. MAXIMUM 50 MM***

NOTES:

(1) ***A IS AN ABRUPT IRREGULARITY IN THE SURFACE DUE TO MISALIGNED FORMWORK OR DEFECTS IN THE FACE OF THE FORMWORK***

(2) ***B IS GRADUAL DEVIATION FROM A PLANE SURFACE AS INDICATED BY A STRAIGHT EDGE 3M LONG. IN THE CASE OF CURVED SURFACES THE STRAIGHT EDGE SHALL BE REPLACED BY A CORRECTLY SHAPED TEMPLATE.***

(3) ***C IS THE AMOUNT BY WHICH THE WHOLE PART OF A CONCRETE FACE IS DISPLACED FROM THE CORRECT POSITION SHOWN ON THE DRAWINGS.***

Tolerances

(b) Reinforcing steel

Except for the requirements given below, no tolerances are given for the placing and fixing of reinforcing steel. The steel, however, shall be neatly and accurately fixed in a manner which is consistent with proper workmanship and the structural integrity of the structural member. Specifically the following requirements shall apply:

(c) Tension steel

The actual position of tension steel shall not deviate from the true position by a distance which would reduce the effective lever arm by more than 2% of the overall depth of the member, or 10 mm, whichever is the greater.

(d) Concrete cover

The concrete cover on reinforcing steel shall nowhere be less than the specified minimum cover.

(e) Spacing between bars

The spacing between closely spaced parallel bars, especially in beams and columns, shall, unless otherwise specified, be not less than the maximum size of the aggregate used in the concrete.

(f) Bending of reinforcement

The requirements of BS 8666 or equivalent regarding dimensional tolerances for cutting and bending of the reinforcing steel shall apply, with the proviso that the other requirements set out in this Clause shall be complied with even if the tolerances in BS 8666 or equivalent are not exceeded.

(g) Miscellaneous

(i) Chamfers

Fillets used for forming chamfers shall be within a tolerance of 1.0 mm in cross-sectional dimensions, and the actual chamfer on the concrete shall not vary by more than 3 mm from the specified dimensions.

(ii) Kerbs, copings, sidewalks, bridge railings, parapets, etc.

The members shall be constructed within a tolerance of +5 mm for all dimensions. The alignment shall not deviate from the true alignment by more than 10 mm in any place, nor shall the alignment deviate by more than 5 mm from the true alignment over any length of 5 m.

(h) Fabrication and assembly tolerances for structural steel

(i) General

The fabrication and assembly tolerances on all dimensions for structural steel shall be +2 mm.

(ii) Cross-section

The tolerances on cross-sectional dimensions of rolled sections shall be as specified in the Structural Steel Tables, published by the SA Institute of Steel Construction or equivalent.

(iii) Straightness

A structural member before erection shall not deviate from straightness (or the specified shape) by more than the following:

For compression members and beams, one-thousandth of the length between points which are laterally restrained. For other members, one five hundredth of the overall length, but not exceeding 25mm.

(iv) Length

The length of a member shall not deviate from its prescribed length by more than the following:

For compression members faced at both ends for bearing, +1.0 mm

For other members: +0 mm and -4 mm

For such members as trusses and lattice girders, the above tolerances shall apply to the members as a whole. The lengths of component parts shall be such that the structural member can be properly assembled with the required accuracy.

(i) Bearing surfaces

Where two steel surfaces are required to be in contact for transferring compressive forces, the maximum clearance between the bearing surfaces shall not exceed 1.0 mm when the members in contact are aligned.

(ii) Accuracy of erection

Steelwork shall not be out of plumb over any vertical distance by more than 5 mm or one thousandth of the distance, whichever is the greater.

900.4 MATERIALS GENERALLY

All materials shall conform to the requirements of the Contract, the Drawings and the Specifications.

All materials shall be of approved manufacture and origin and the best quality of their respective kinds. Unless otherwise specified such materials shall be new (as compared to used or reprocessed).

No materials of any description shall be used without the prior approval of the Engineer and any materials condemned as unsuitable for use in the Works shall be removed immediately from the Site by and without recompense to the Contractor.

The Engineer's approval of any materials or mixtures shall in no way relieve the Contractor of his obligation to provide materials, mixtures and workmanship which comply with the Specifications.

900.5 STANDARD SPECIFICATIONS

Where in the Specifications tests on materials, tests on completed Works and construction control tests are called for or implied, they shall be carried out according to the relevant ISO Standards unless the test in question is not covered by these standards. When a particular test is not covered by the standards, then the method shall be an equivalent standard called for in the contract documents or as directed by the Engineer.

Materials shall comply with the requirements of the current edition of Specifications issued by the American Association of State Highway and Transportation Officials (AASHTO) or American Society for Testing Materials (ASTM) or ISO Standard (ISO) or, where applicable, an equivalent Specification called for in the contract documents or as directed by the Engineer.

Other equivalent national standard specifications may only be substituted for the above at the sole discretion of the Engineer.

900.6 MATERIALS TESTING AND ACCEPTANCE

As soon as possible after the Contract has been awarded, the Contractor shall submit to the Engineer complete statements as to the origin, composition and manufacture of all materials to be used in the Works together with a list of the suppliers from whom he proposes to purchase these materials.

Prior to delivery of materials to the job site, the Contractor shall submit certified test reports and samples to the Engineer of all materials proposed for use in the Works, whether from an outside supplier or whether supplied by the Contractor from his own resources. The certification(s) shall show the appropriate test(s) for each material, the test results, and a statement that the material meets the specification requirement. The Engineer's approval shall be received prior to any materials being delivered in bulk to the works. The Engineer may request further samples for testing, prior to and during construction to verify the quality of the materials and to ensure conformance with the applicable specifications. The Contractor shall provide all samples free of charge.

The Contractor shall test samples as specified from each quarry location and borrow pit proposed for use in the Works, in accordance with these Specifications. The results of these tests shall be submitted to the Engineer for approval at least 14 days before the quarry or borrow pit is required for use. Should any quarry or borrow pit prove to be unsuitable, the Contractor shall investigate further sites until suitable materials are found and approved.

The Contractor’s programme shall allow sufficient time for materials testing and no claim for delays or extra costs arising out of this will be accepted.

All materials supplied for use in the Works shall conform within specified tolerances, to the quality of the approved samples which will be retained at the Engineer’s office until the completion of the Contract.

Where a material has been specified by a manufacturer’s trade name, the product of another manufacturer will be accepted provided that, in the opinion of the Engineer, it is in all respects of an equivalent or higher quality.

900.7 TESTING BY THE CONTRACTOR

The Contractor shall assume that tests will be required on samples of all materials used in the works and on all finished work.

The Contractor shall carry out all necessary tests and shall report to the Engineer the results of such tests before submitting materials and finished work to the Engineer for approval. In appropriate circumstances, tests may be carried out at the premises of the suppliers.

900.8 ACCEPTANCE STANDARDS OF MATERIALS

All materials used in or upon the works shall comply with this Specification and shall be acceptable to the Engineer.

Samples of all materials proposed to be used shall be submitted to the Engineer and shall, where required, be tested prior to the material being delivered in bulk upon the works.

900.9 COST OF TESTING

(a) Process control

The cost of testing undertaken by the Contractor in terms of his obligations for purposes of process control, including the taking of samples, reinstating where samples have been taken, and all testing equipment, labour, materials, etc, shall be included in the rates for the various items of work supplied and will not be paid for separately.

(b) Producing certificates

Where the properties of materials or manufactured products are required in these Specifications to comply with specified specifications published by a Standards Authority approved by the Engineer, the Contractor shall produce, when called upon to do so, certificates from the manufacturer confirming that the materials or products supplied comply with the relevant specifications. All costs of providing such certificates shall be borne by the Contractor.

(c) Testing materials and products covered by certificates

The Engineer shall be entitled to take samples of, and order tests to be made on, products and materials in respect of which certificates of compliance may be required.

All costs for the tests shall be borne by the Contractor, unless separate rates are itemized in the Bill of Quantities.

900.10 TAKING AND SUBMITTING SAMPLES

The Engineer shall have full access to the Works for the purpose of taking samples. The Contractor shall render any assistance necessary for taking the samples and shall be responsible for the reinstatement of pavement layers or other structures at the positions where the samples have been taken. Full compensation for rendering assistance with sampling and for reinstatement where samples have been taken shall be included in the rates tendered for the various items of work tested, and no additional payment will be made in this respect.

All samples for testing shall be taken in a random pattern or as prescribed by the Engineer. Where specified or required by the Engineer, stratified random sampling methods shall be followed. For the testing of layer work stratified random sampling methods shall be used for obtaining all the sample portions and for determining the locations of in situ test sites.

900.11 TESTING METHODS

All tests shall be conducted in accordance with the standard methods specified in the Specifications. Other equivalent national standard specifications may only substitute the prescribed test method at the sole discretion of the Engineer.

The Contractor shall take all necessary steps as instructed by the Engineer to remedy works which fail to comply with the Specification.

1000 SOLAR LIGHTING SYSTEM

1000.1 SCOPE

The bidder shall provide Photo-voltaic Stand- Alone double bracket LED Lighting System, suitable for the beach. The system shall be easy to install. A minimum of five year warranty on the full system (inclu: LED lighting, columns & bracket & concrete foundation) shall be provided upon commissioning.

The columns shall be octagonal. All columns for lighting poles shall be provided with a galvanised flanged base-plate surface mounted on a reinforced concrete column using galvanised anchored steel bolts of grade 8.8. All steel works shall be hot dip galvanized and shall not be less than 85 micron.

The galvanized double bracket should fit exactly to the column top and should be safely & properly secured to the galvanized metal column.

The columns to be located at a minimum setback of 30 metres from High Water Mark and/or as instructed by the client.

The columns shall be further provided with an epoxy paint to a colour to the Engineer's approval. Unweathered galvanized coatings shall require special treatment prior to painting, in order to ensure good adhesion, e.g. "T-wash" etch primer.

1000.2 GALVANISING AND FASTENINGS

Where manufactured or purpose made of steelwork and all fixings including any welded joint, nuts, brackets, bolts and washers are specified as galvanized, this shall mean hot dipped galvanized. Thickness of galvanizing shall not be less than 85 micron.

The bidder shall submit a test certificate duly certified to ensure that the materials including lighting columns and brackets and any other galvanized steel components are in full compliance with the specifications. As regards to the galvanized steel components, the thickness of the galvanizing shall be stated.

1000.3 ADDITIONAL INSPECTIONS OR TESTS

The engineer may request the contractor to carry out additional tests, arrange for or submit additional data, samples or tests where necessary to ensure that the materials are in full compliance with the specification at his own expense.

The columns and brackets including anchor bolts shall be capable of supporting the two luminaires with integral accessories and shall be able to resist cyclonic gusts of at least 275 km/hr. The system shall be designed to resist the marine environment.

The double brackets shall be securely fixed to the column to prevent rotation. The brackets shall give a maximum outreach to the centre of Lantern as per the Lantern manufacturer's recommendation in order to achieve the best utilisation and uniformity of light.

The concrete foundation shall be constructed by the main contractor with a box out for the insertion and final concreting of anchor bolts. All concrete works to be Grade 30. The base plate

including bolts and nuts to be covered neatly with concrete mortar as per Project Manager's Approval.
After the pole has been plumbed, all the space below the base and bolts is to be grouted with Epidermix 372 or equivalent.

All works including all necessary civil works shall be carried out by the main contractor as per specifications.

The bidder shall cater for any associated civil works for achieving the above mentioned works.

1000.4 SPECIFICATIONS FOR SOLAR PANEL, CONTROL BOX AND BATTERIES

Country of origin shall be specified.

Manufacturer's authorization to be submitted

Shall be compliant with European standards

Supplied with charge controller and timer

Lithium Ion Battery suitable for solar application or equivalent with a minimum battery life of five years. Three days autonomy with a minimum of 12 hours daily operation.

All cables and other accessories such as stainless-steel nuts, connectors shall be provided. Solar charge controller with automatic lighting control functions. Functions to turn on/off the light automatically by detecting the brightness level all through the year. Function to protect the battery from overcharging or over discharging. The controller must have an aluminium shell, for easy heat dissipation. The controller must have an IP 68 water proof rating.

All accessories provided shall be resistant to marine environment.

The Solar lighting systems shall be fitted with dimming capabilities.

1000.5 SPECIFICATIONS FOR LUMINAIRE TECHNICAL DATA

European standard with five years warranty

High efficiency LED lamps (super bright LED)

LED street lantern minimum 50 W or greater

Color Temperature 4000 – 6000 K

Street lighting fixture to minimum of IP 65

Impact Protection of street lighting casing to be minimum of IK07/IK08

LED life cycle of 50,000 hours at L70, LM 80

Casing material to be of aluminium diecast

Rust and Corrosion free

Power efficiency>90%

Instant start

Operates in high humidity and marine environment

Viewing angle 1200

Working temperature – 30o C --- + 60o C.

Infrared motion sensor (min range of radius 15m)

Surge protector

1000.6 SPECIFICATIONS AND PERFORMANCE REQUIREMENTS

(a) Submission

Show all connections details for lighting pole, including large scale details of members and materials, of brackets and anchoring devices and of connection and jointing details fully dimensioned layouts for positioning on brackets, bolts and anchoring devices structures, dimensions gauges, thickness, description of materials including catalogue members, product and manufacturer's name, alloy, finishes specifications and all other pertinent data.

The manufacturers shall guarantee adherence to this Specification and the performance of their luminaire under all the required design conditions. Independent test reports shall be provided to show the luminaires will operate under these conditions.

(b) Delivery and Storage

Adequately protect lighting poles, accessories and finishes to prevent damages thereto during fabrication, storage shipping handing, transportation and installation.

Deliver, handle and store units by methods approved by manufacturer. Protect from damage and staining.

Protect stills and stools after installation with suitable protection, secured in place, to prevent staining or scratching.

(c) Warranty

The contractor shall submit a warranty in writing from the manufacturer certifying that the lighting poles can resist cyclonic winds of not less than 275 km/hr. (To be submitted upon award of contract)

At time of submission of bid: (i) Complete Test Certificate of the luminaire by an internationally recognized laboratory and IEC approved shall be submitted. (ii) The supplier shall also submit a warranty certificate of five years for the luminaires from the manufacturer.

Test certificate from accredited laboratory in Mauritius to certify that the thickness of galvanizing on steel columns, brackets and any other galvanized steel components is minimum 85 microns. (To be submitted for approval by client prior to Installation).

A Bank guarantee 5% of the value of solar lighting component inclusive of VAT to be submitted upon commissioning of project covering a period of five years for the whole

solar lighting system. (Inclu: Led luminaires, columns, brackets and associated components of the system).

Electrical installation shall be guaranteed against manufacturing defects, bad workmanship and other defects not related to normal wear and tear for a period of at least 1 year from date of successful commissioning in presence of the Client.

In the event of a defect, contractor shall make good within 48 hours at his own expenses to the satisfaction of the Client.

Commissioning and testing should be carried out by a professional Electrical Engineer registered with the Council of Registered Professional Engineer) for all solar lighting columns and test certificate duly certified by the latter.

Section IV: General Conditions of Contract and Particular Conditions of Contract

Any resulting contract shall be placed by means of a Letter of Acceptance and shall be subject to the General Conditions of Contract (GCC),
(Ref: W/GCC10/10-20), for the Procurement of Works (available on website *ppo.govmu*.org) except where modified by the Particular Conditions of Contract below.

The clause numbers given in the first column correspond to the relevant clause number of the General Conditions of Contract. *[This section is to be customised by the Public Body to suit the requirements of the specific procurement.]*

Particular Conditions of Contract

A. General	
GCC 1.1 (r)	The Employer is **The General Manager** **Beach Authority,** **7th Floor,** **Ebène Heights Building** **Plot 34, Ebène Cybercity** **Ebène**
GCC 1.1 (v)	The Intended Completion Date for the whole of the Works shall be **120 calendar days as from the start date of works**.
GCC 1.1 (y)	The Project Manager is the Technical Manager/Project Officer or its representative.
GCC 1.1 (aa)	The Site is located at La Prairie Public Beach.
GCC 1.1 (dd)	The Start Date shall be **7 days** as from the date signature of contract agreement.
GCC 1.1 (hh)	The Works consist of **Construction of Parking Area, Low wall and other amenities at La Prairie Public Beach. (Phase 1)**
GCC 2.2	Sectional Completions are: Not Applicable

GCC 2.3(i)	The following documents also form part of the Contract: • *Scope of works* • *Performance Security* • *Insurance Policies* • *Addendum (if any)* • *The Contract Agreement* • *The Letter of Acceptance* • *The Letter from the Bidder* • *The Bid Submission Form* • *The General Conditions of Contract* • *The Particular Conditions of Contract* • *The Employer's Requirements* • *Filled Priced Activity Schedule* • *Specifications* • *Drawings* • *The Bidder's Qualifications*
GCC 3.1	The language of the contract is **English** The law that applies to the Contract is the law of Mauritius.
GCC 5.1	The Project manager *may* delegate any of his duties and responsibilities.
GCC 8.1	Schedule of other contractors: *Not Applicable*
GCC 13.1	Except for the cover mentioned in (d)(i) hereunder, the other insurance covers shall be in the joint names of the Contractor and the Employer and the minimum insurance amounts shall be: (a) for the Works, Plant and Materials: (for *the full amount of the works including removal of debris, professional fee etc...)* (b) for loss or damage to Equipment: **Rs 5.0M** (c) for loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract *for an amount representing the value of the properties that are exposed to the action of the contractor in the execution of the works. It will extend to the property of the Procuring Entity as well).* **Rs 5.0M minimum for any one occurrence with the number of occurrences unlimited.**

	(d) for personal injury or death: (i) of the Contractor's employees: *[The Contractor shall take an adequate insurance cover for its employees for any claim arising in the execution of the works]*. **Rs 10.0M minimum for any one occurrence with the number of occurrences unlimited.** (ii) of other people: [*This cover shall be for an adequate amount for Third Party extended to the Employer and its representatives]*. **Rs 10.0M Minimum for any one occurrence with the number of occurrences unlimited.** (e) for loss or damage to materials on-site and for which payment have been included in the Interim Payment Certificate, where applicable. The Contractor shall choose to take the insurance covers indicated above as separate covers or a combination of the Contractor's All Risks coupled with the Employer's liability and First Loss Burglary, after approval of the Employer. All insurance covers shall be of nil or the minimum possible deductibles at sole expense of the contractor.
GCC 14.1	Site Data are: *N/A*
GCC 20.1	The Site Possession Date(s) shall be the start date.
GCC 23.1 & GCC 23.2	Appointing Authority for the Adjudicator: **No Adjudicator shall be appointed for this Contract.**
GCC 24.	In case a dispute of any kind arises between the Employer and the Contractor in connection with, or arising out of, the contract or the execution of works or after completion of works and whether before or after repudiation or other termination of Contract, including any dispute as to any opinion, instruction, determination, certificate or valuation of the Employer's Representative, the matter in dispute shall, in the first place, be referred in writing to the employer's representative, with a copy to the other party. The Employer and the Contractor shall make every effort to resolve the dispute amicably by direct informal negotiation. If, after twenty-eight (28) days, the parties have failed to resolve their dispute or difference by such mutual consultation, then either the Public Body or the Contractor may give notice to the other party of its intention to refer the matter to "the competent courts of Mauritius"
B. Time Control	
GCC 25.3	The period between Program updates is ***30*** **days**. The amount to be withheld for late submission of an updated Program is **Rs.2000 per occurrence**.

C. Quality Control	
GCC 33.1	The Defects Liability Period is **6 months.**
GCC 34.1	Delete sub-clause 34.1 and replace by the following: Should any defect arise during the contractual period and up to the end of the Defects Liability Period and the Contractor fails to correct the Defect within the time specified in the Project Manager's notice, this shall constitute a breach of the Contractor's obligations under the contract. The Project Manager shall assess the cost of having the defect corrected and recover the money from the Performance Security and/or monies due to the Contractor.
GCC 39.7	Interim Payment for Plant and Material on site **is not** applicable.
D. Cost Control	
GCC 40.1	Amend clause 40.1 by replacing 21 days by 7 and 42 days by 28 days.
GCC 41.1 (l**)**	*The term "exceptional adverse weather conditions" is hereby defined as any one of the following events:* *(i) Wind - Cyclone Warning Class 3 or 4 prevailing in Mauritius;* *(ii) Rainfall - An intensity equal to or exceeding 25 mm rainfall per 24 hours measured;* *(iii) Rainfall - Continuous rainfall on Site, causing an interruption of work exceeding 4 hours; or* *Extensions of time without costs (if any) will be granted for consequential delays as a result of exceptionally adverse climatic conditions which give rise to situations whereby it would be impossible or impractical for the Contractor to carry out works on site.* *The Contractor will be required to submit all relevant justifications to substantiate any disruption of works on site and shall provide rainfall records from the closest Meteorological recording station to the Site obtained from the Meteorological Services attesting the date(s) and amount(s) of rainfall for any such particular compensation event. Such justifications shall be provided not later than 14 days from the date of occurrence of the events."*
GCC 43.1	The currency of the Employer's country is: **Mauritian Rupees.**
GCC 44.1	The Contract is not subject to price adjustment.
GCC 45.1	The proportion of payments retained is: ***10% of the value of works completed.***
GCC 46.1	The liquidated damages for the whole of the Works are **Rs 7500 (VAT Excl.)** per day. The maximum amount of liquidated damages for the whole of the Works is **10% of the Contract price (VAT Excl.)**.
GCC 47.1	The Bonus for the whole of the Works is not applicable.

GCC 48.1	The Advance Payments is not applicable.
GCC 49.1	The Performance Security amount is 10% of the Bid price (inclusive of VAT), in the form of a Bank Guarantee as per the format in Section V and shall be valid until the end of the Defects Liability Period. Where the Performance Security and the Insurance Covers expire before the end of the date of completion of works, the contractor shall renew the insurance covers and the Security to cover the period up to the completion of works and shall extend these to cover the defects liability period at no extra cost. The contractor shall inform the client in writing of the steps taken. (The Performance Security amount is as specified in the ITB)
E. Finishing the Contract	
GCC 56.1	The date by which operating and maintenance manuals are required is *Not applicable*.
GCC 57.2 (g)	The maximum number of days is: N/A
GCC 59.1	The percentage to apply to the value of the work not completed, representing the Employer's additional cost for completing the Works, is *30% of the Contract Value.*

Section V- Contract forms

Performance Security

.....*Bank/Insurance Company's Name and Address of Issuing Branch or Office*.....

Beneficiary:.....*Name and Address of Public Body*.....

Date.....

PERFORMANCE GUARANTEE No.: .....

We have been informed that .....*[name of the Contractor]* .....(hereinafter called "the Contractor") has entered into Contract No.....*[reference number of the Contract]* ..... dated..... with you, for the execution of .....*[name of Contract and brief description of Works]*.....(hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance security is required.

At the request of the Contractor, we ..... *[name of Bank/Insurance Company]* .....hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of ..... *[amount in figures (amount in words)]* .....such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire and returned to us not later than twenty- one days from the date of issuance of the Defects Liability Certificate, calculated based on a copy of such Certificate which shall be provided to us, or on the.....day of ....., ..., whichever occurs first. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

……..*****Seal of bank/Insurance Guarantee and*****

*****Signature(s)*****.....

Letter of Acceptance

[on letterhead paper of the Employer***]***

. . . . . ***[date]***. . . . . ..

To: . . . . ***[name and address of the Contractor]*** . . . .

Subject: . . . . ***[Notification of Award Contract No]***. . . . . .

This is to notify you that your Bid dated . . . .***[insert date] . . .*** . for execution of the . . . . . ***.[insert name of the contract and identification number, as given in the Appendix to Bid]***. . . . . for the Accepted Contract Amount of .Rs . . . . . ***.[insert amount in numbers and words and name of currency]***, exclusive of VAT, as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by *(insert name of Public Body).*

You are requested to furnish the Performance Security in accordance with the General Conditions of Contract, using for that purpose of the Performance Security Form included in Section V (Contract Forms) of the Bidding Document.

Authorized Signature: .....

Name and Title of Signatory: .....

Name of Agency: .....

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made the . . . . . .day of . . . . . ., ..., between . . . . . ***[name of the*** Employer***]***. . . . . (hereinafter "the Employer"), of the one part, and . . . . . ***[name of the Contractor]***. . . . .(hereinafter "the Contractor"), of the other part:

WHEREAS the Employer desires that the Works known as . . . . .***[name of the Contract]***. . . . .should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein,

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents**.**

(a) the Letter of Acceptance

(b) the Bid

(c) the Addenda Nos . . . . . ***[insert addenda numbers if any]***. . . . .

(d) the Appendix to the General Conditions of Contract

(e) the General Conditions of Contract;

(f) the Specification

(g) the Drawings*;* and

(h) the completed Schedules,

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of Mauritius on the day, month and year indicated above.

Signed by: .....
for and on behalf of the Employer

Signed by: .....
for and on behalf the Contractor

in the presence of: .....
Witness, Name, Signature, Address, Date

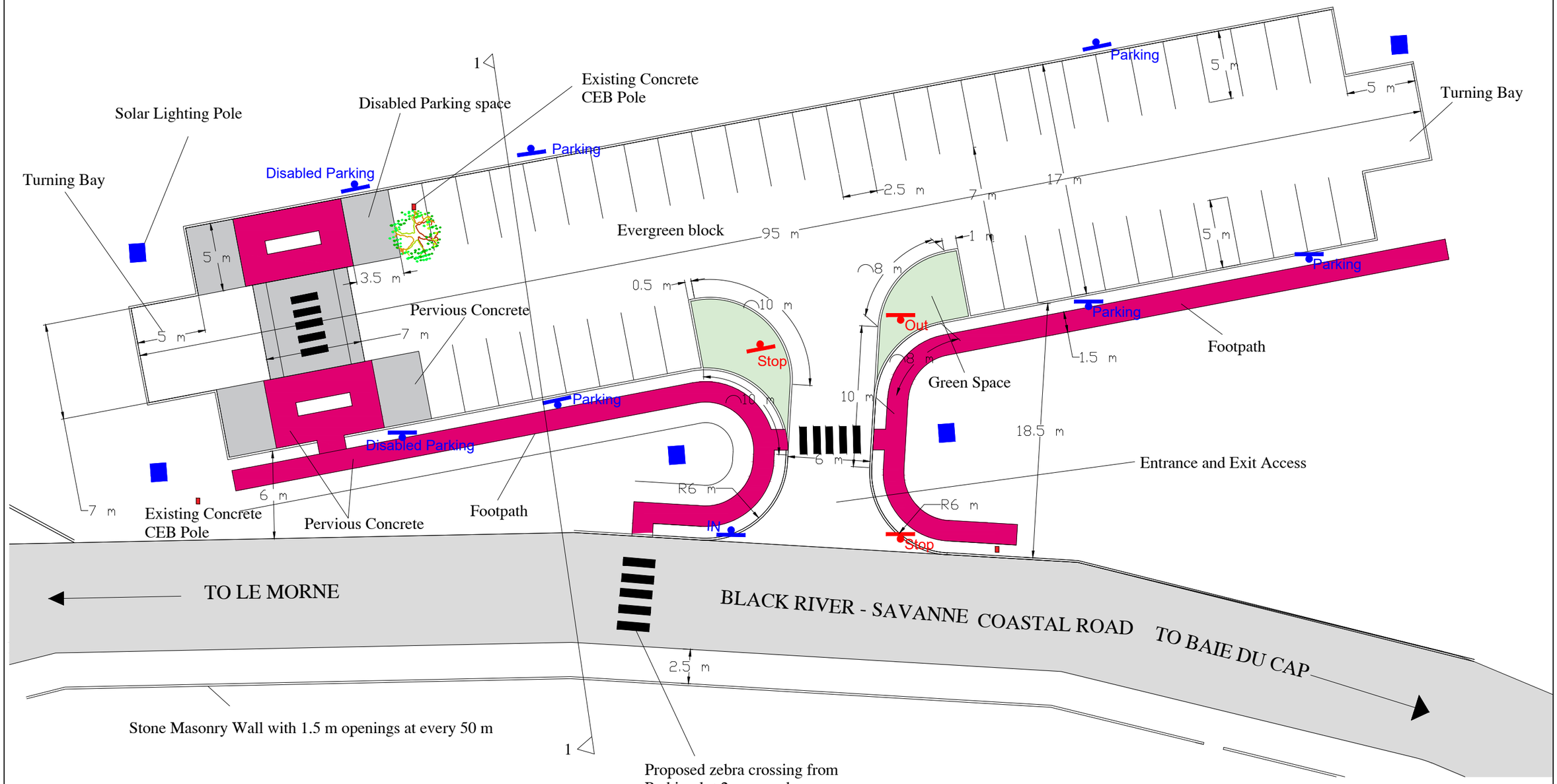
in the presence of: .....
Witness, Name, Signature, Address, Date

LEGEND :

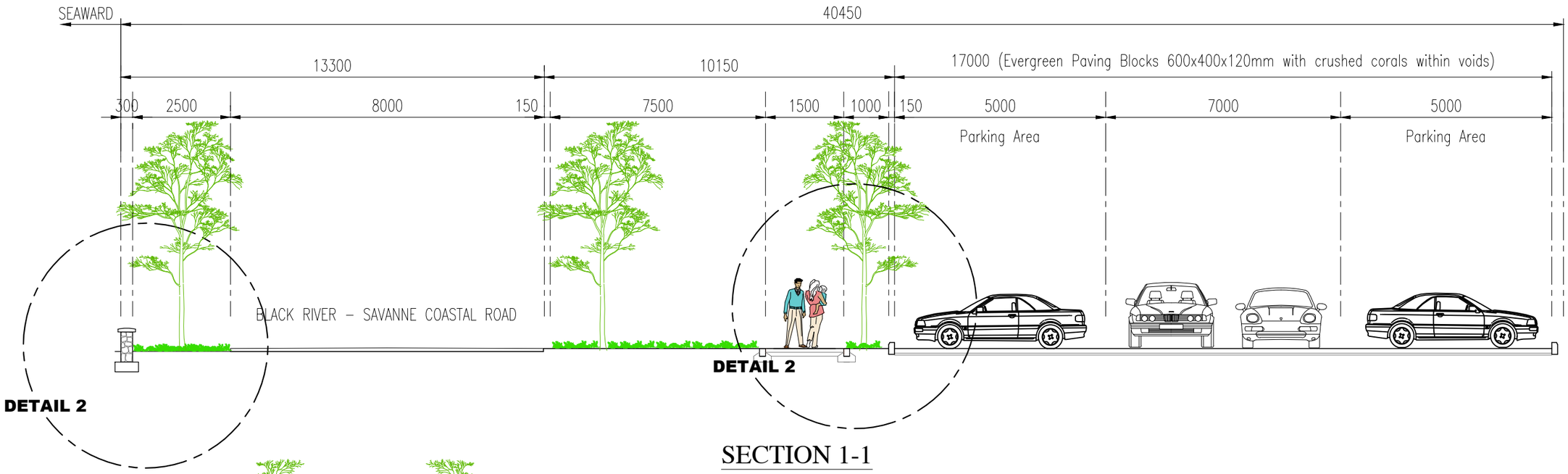
1. PARKING
2. PRIMARY DUNE & COASTAL FRINGE, BOARDWALK ACCESS EVERY 50M
3. FOODCOURT AREA
4. BEACH ROAD
5. BUS LAY-BUS
6. EXISTING PUBLIC TOILETS
7. NEW PUBLIC TOILETS
8. EXISTING MINI KIOSKS

- ROUND BIN
- BENCHES &PICNIC TABLE
- KIOSK
- STONE MASONRY LOW WALL
- SOLAR LIGHT POLES

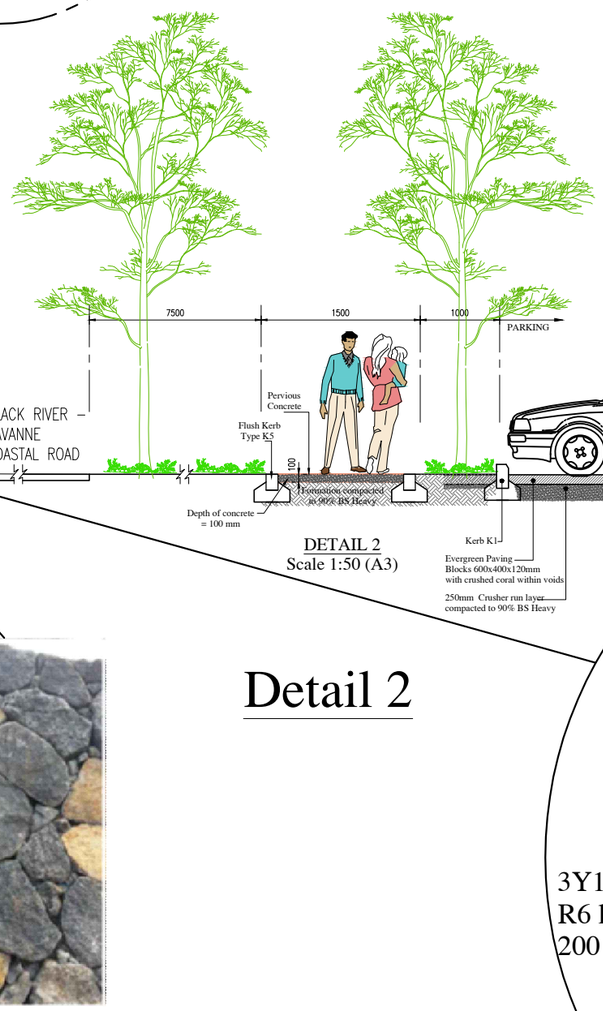
PROJECT:	BEACH MANAGEMENT PLAN - LA PRAIRIE PUBLIC BEACH
DRG TITLE:	LAYOUT OF PROPOSED BEACH AMENITIES
DRG NO: MD216/LP/M/01	DRWN BY:
SERIAL NO: -	REVISION NO: -
CHKD BY:	SCALE NTS



PROJECT:	BEACH MANAGEMENT PLAN - LA PRAIRIE PUBLIC BEACH		
DRG TITLE:	PARKING PLAN PARKING LOT 2		
DRG NO: MD216/G/RD/01		DRWN BY:	SCALE NTS
SERIAL NO: -	REVISION NO: -	CHKD BY:	



SECTION 1-1



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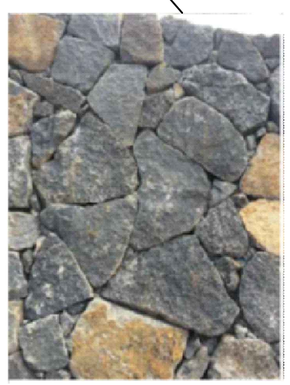
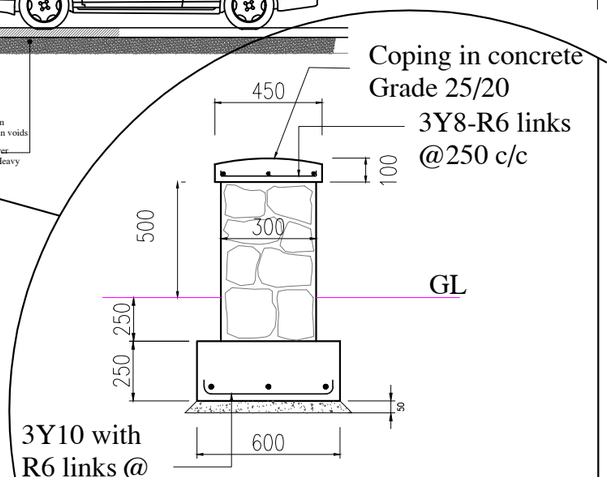
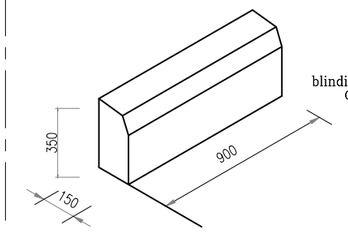
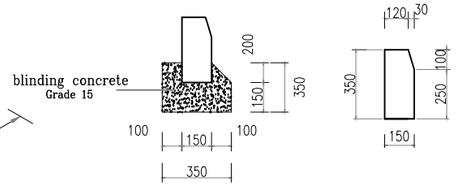


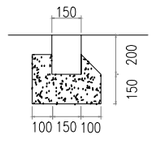
Detail 2



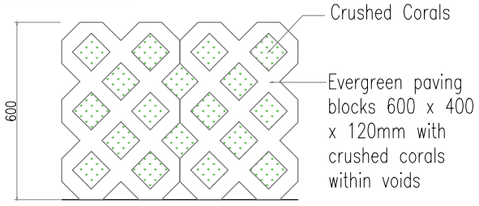




DETAILS OF KERB K1

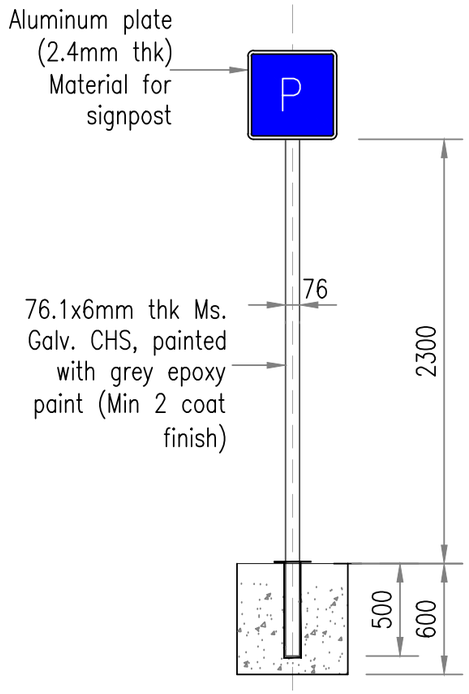


DETAILS OF KERB K5

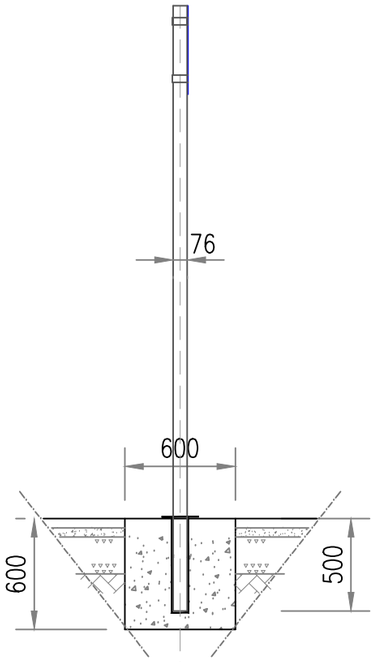


DETAIL 1

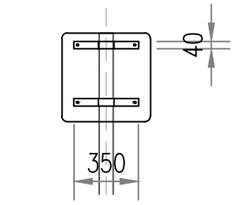
PROJECT: BEACH MANAGEMENT PLAN - LA PRAIRIE PUBLIC BEACH			
DRG TITLE: PARKING DETAILS PARKING LOT 2			
DRG NO: MD216/G/RD/02		DRWN BY:	SCALE NTS
SERIAL NO: -	REVISION NO: -	CHKD BY:	



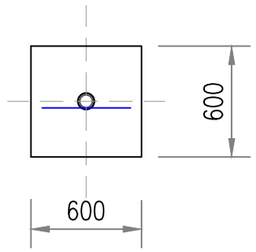
ELEVATION 0N SIGNAGE

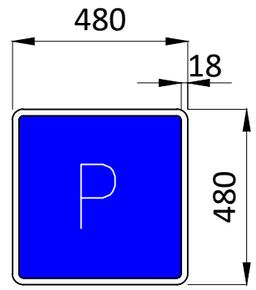


PLAN ON LOCATION OF SIGNAGE

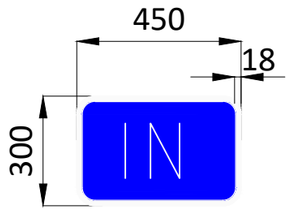


Signboard Fixing Details

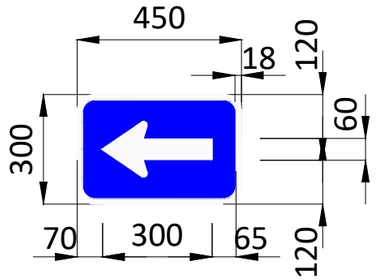




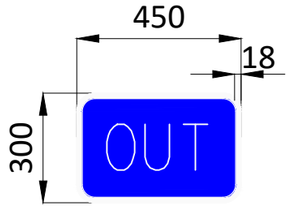
PARKING SIGN



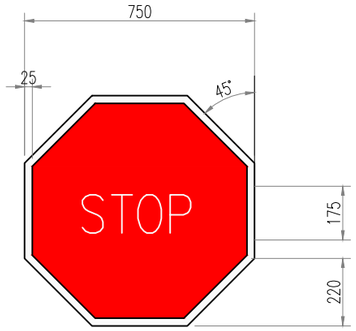
IN SIGN

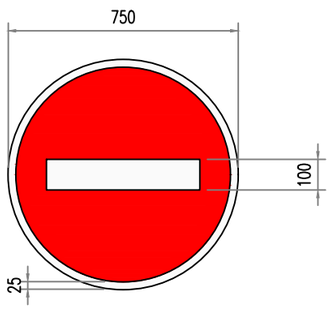


ONE WAY SIGN



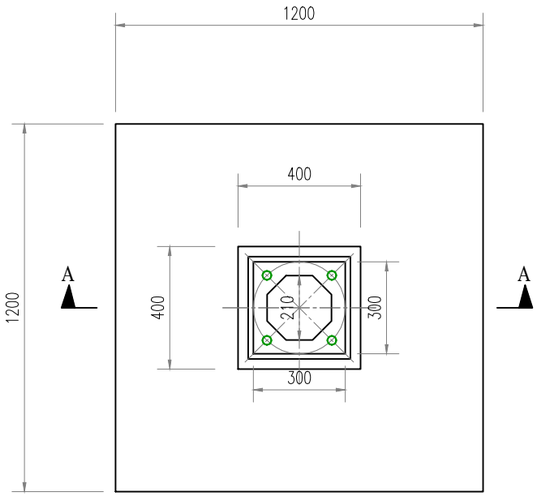
OUT SIGN



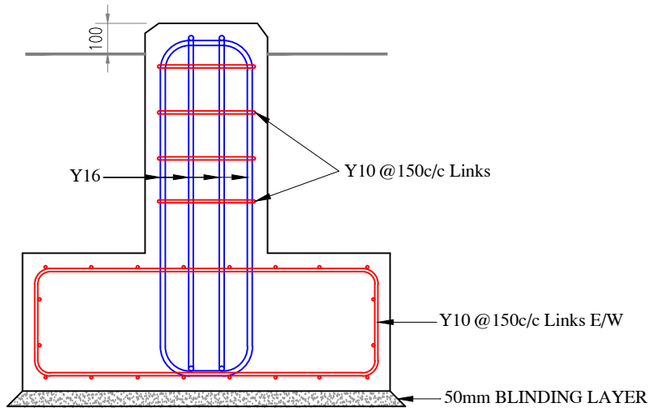


TENDER DRAWING

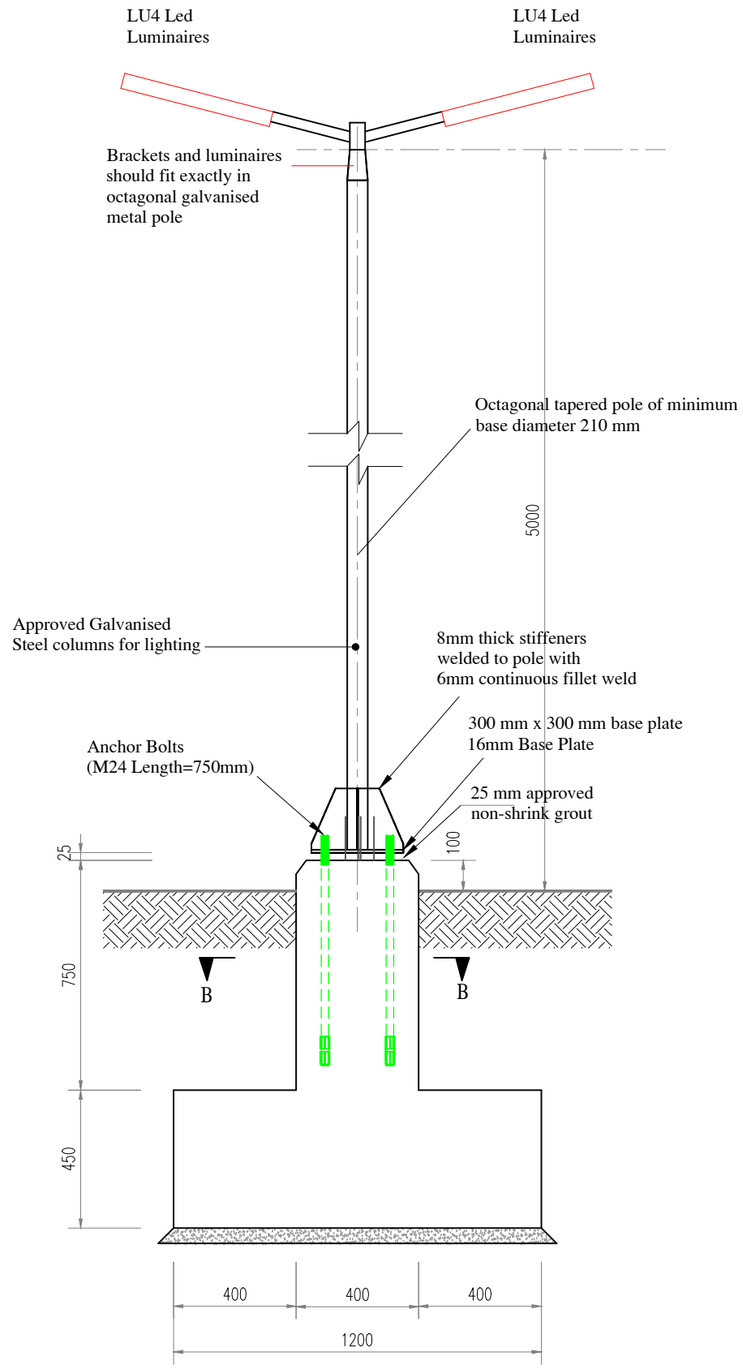
PROJECT: BEACH MANAGEMENT PLAN -			
DRG TITLE: TYPICAL SIGNAGE DETAILS			
DRG NO: MD216/G/SD/09		DRWN BY: R.R	SCALE 1:20 (A3)
SERIAL NO: -	REVISION NO: -	CHKD BY: D.S	



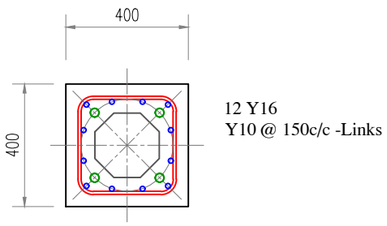
TOP VIEW



SECTION A-A
Scale 1:20 (A3)



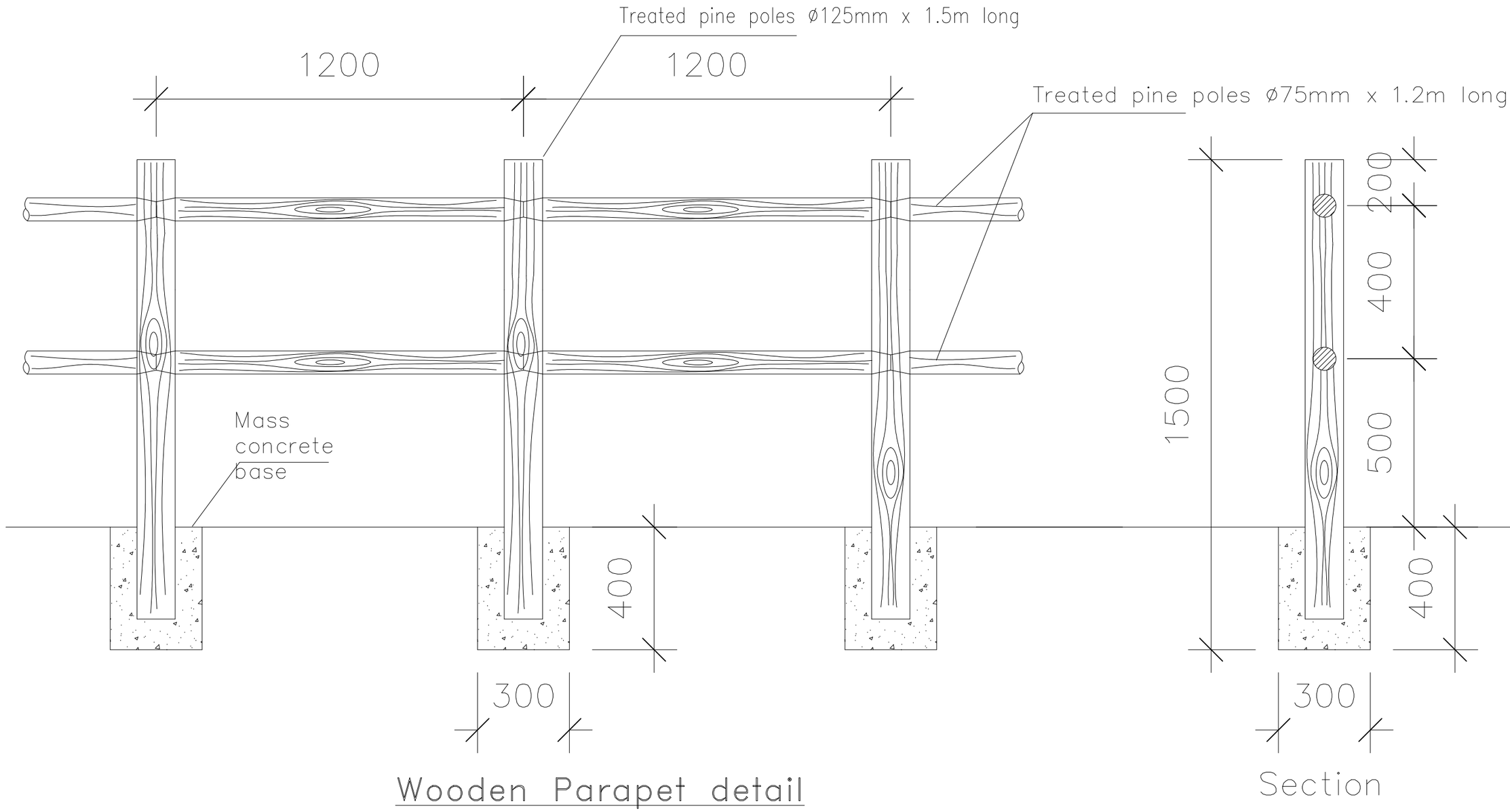
FRONT VIEW
Scale 1:20 (A3)



SECTION B-B
Scale 1:20 (A3)

TENDER DRAWING

PROJECT: BEACH MANAGEMENT PLAN			
DRG TITLE: LIGHT POLE DETAILS			
DRG NO: MD216/G/LS/02		DRWN BY:	SCALE 1:25 (A3)
SERIAL NO: -	REVISION NO: -	CHKD BY:	



Wooden Parapet detail

Section

PROJECT:	BEACH MANAGEMENT PLAN - LA PRAIRIE PUBLIC BEACH		
DRG TITLE:	WOODEN PARAPET DETAIL		
DRG NO: BA/LP/WP/01		DRWN BY:	SCALE NTS
SERIAL NO: -	REVISION NO: -	CHKD BY:	