TECHNICAL SPECIFICATIONS

CONTENTS

Section	Page Nr.
GENERAL	2
DEMOLITIONS AND ALTERATIONS	5
PROVISIONAL AND PRIME COST SUMS	9
EXCAVATION AND EARTHWORK	11
REINFORCED CONCRETE WORK	16
MASONRY	35
ROOFING	40
CARPENTRY AND JOINERY	41
STRUCTURAL STEEL WORK	45
METAL WORK	56
PLUMBING INSTALLATION	65
ELECTRICAL INSTALLATION	78
PLASTER WORK AND OTHER FLOOR, WALL AND CEILING FINISHINGS	87
GLAZING	91
PAINTING AND DECORATING	92
PAVING	94
BITUMINOUS PRIME COAT	97
IMPORTED CRUSHED BLUE METAL AGGREGATE	98
IMPORTED PITRUN GRAVEL SUB-BASE	100
LANDSCAPING	103
ENVIRONMENTAL PROTECTION MEASURES	104
QUALITY ASSURANCE	108
HEALTH AND SAFETY	109

GENERAL

Rates

A. The rates inserted by the contractor shall include for complying with all provisions of this section, unless specifically otherwise stated or measured.

Definitions

B. The term "the Works" shall mean the whole of the works envisaged by the Contractor, including deviations form the working details and in respect of setting out correct lines and levels, vertically, sizes and thickness of member, shall be removed and reconstructed or otherwise rectified to the approval of the Project Manager, and the Contractor shall be responsible for all additional costs incurred; all such remedial work shall be executed without undue delay.

C. Words importing the singular only also include the plural and vice versa.

D. The following abbreviations are used:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACI MCP	ACI Manual of Concrete Practice
AISC	American Institute of Steel Construction Inc.
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BS	British Standard
CISC	Canadian Institute of Steel Construction
CRSI	Concrete Reinforcing Steel Institute
GBS	Grenada Bureau of Standards

Standard of Specification

E. The Standard of Specification used in the main in this document is the ACI Manual of Concrete Practice ACI 318-05 Specification and the National Standards as established by the Grenada Bureau of Standards. Other international standards of specification are also acceptable in use. The Contractor shall ensure that whenever or wherever the standards of specification are used other than those mentioned must be comparable to and shall be subject to approval of the Project Manager.

Defective Work

F. The Project Manager reserves the right to check the work executed by the Contractor and his setting out in such cases and at such times as he may deem fit; there is, however no duty on his part to make such checks and any failure by him to observe errors shall not relieve the Contractor of his responsibilities in these respects.

Materials and Workmanship

A. All materials and workmanship shall comply with the requirements and recommendations of the relevant ACI, where applicable unless otherwise stated.

B. Any reference in these Bills of Quantities to the ACI shall be deemed to refer to the latest edition as most recently amended at date of tender.

C. Any reference in these Bills of Quantities which is at variance with any provision in the ACI referred to shall be deemed to take precedence over and to override the same.

D. No materials or workmanship described in the ACI 318-05 referred to in these Bills of Quantities shall be employed if at variance with these Bills of Quantities or the Project Manager's drawings, specifications or instructions.

Calculation of Quantities

E. All work unless otherwise has been measured net as fixed in position and the Contractor shall allow in his prices for waste, laps, etc.

F. Throughout these Bills of Quantities, the following abbreviations have been used. However, for convenience some metric abbreviations have also been used.

m3	-	Cubic Metre	cy
m2	-	Square Metre	sy
m	-	Linear Metre	y
mm	-	Millimetre	ft
cm	-	Centimetre	
g	-	Gram	lbs
Tonne	-	Metric tonne	
Nr.	-	Number	
Kg	-	Kilogramme	
Hr	-	Hour	

G. All weights and measurements mentioned in these Bills of Quantities are those normally used in Grenada. Unless otherwise described, tons shall be "long" tons of 2,240lbs, and gallons shall be imperial gallons.

H. All goods and materials are to be of the best quality unless otherwise described. All goods not otherwise specified are to be in accordance with the ACI 318-05 Specifications where such exist. Where not applicable, goods and materials shall be of the minimum approved standard consistent with the performance required.

I. Description of materials and workmanship given in any one work-section shall apply equally to all work-sections, unless otherwise described.

J. Notwithstanding any of the foregoing the whole of the materials and workmanship shall be subject to the approval of the Project Manager.

Materials or goods supplied at PC Rates

A. Where materials or goods are described as being supplied at PC rates, the Contractor shall allow in his prices for profit and all other costs necessary to complete the works.

Proprietary Products

B. All proprietary products shall be used strictly in accordance with the Manufacturer's instructions unless otherwise described.

DEMOLITIONS AND ALTERATIONS

Location

A The numbers, names or locations of rooms in the Bills of Quantities refer to the premises as they exist and are used at the time of preparation of the Bills of Quantities.

Inconvenience

B Carry out all cutting and pulling down in such a manner as to cause as little inconvenience as possible to adjoining occupants or the public and accept responsibility for any claim which may arise.

C Work undergoing demolition and alteration shall be dampened as necessary and the Contractor shall allow for taking measures to the satisfaction of the Project Manager to minimize dust. The Contractor shall keep all debris well watered during the work to prevent dust arising.

Control and protection

D Provide all requisite temporary shoring, strutting or other supports to walls, floors, roofs, etc., necessary for the controlled demolition, protection and safety of existing structures and all screens and other protection necessary to protect the adjoining occupants and the general public. Alter, adapt and maintain all such temporary work as may be necessary from time to time and clear away on completion.

Shoring and Scaffolding

E Shoring and scaffolding incidental to demolitions and alterations and making good all work disturbed thereby, shall be deemed to be included in the description.

Structure

F Shoring and scaffolding incidental to demolition of individual elements or structures and making good all work disturbed by such shoring and scaffolding shall be deemed to be included in the description.

Levels

G Where demolition is described as to be taken down to ground level and the like and the levels on opposite sides of the structure are different, the description shall be deem to apply to the lower of the levels, unless otherwise indicated.

Definitions

H The term “remove” as used in this section shall mean the demolition of the elements or structure by any means except the use of explosives and shall include grubbing of foundations and concrete beds and the grubbing up and sealing off of drains and services etc.

Plumbing, Engineering and Electrical Installations

A The descriptions of removing structures shall be deemed to include sealing off and making safe the mains to plumbing, Engineering and electrical installation shall be deemed to include disconnecting from the associated gutter work, pipe work, duct work, conduits, cables and the like.

Preparation of old work

B The Contractor's prices for hacking off plaster, wall and floor tiling are to include for preparing the backgrounds to form key for new work. Junctions and joints between new and old work must be properly made and finished in such a manner that they are not recognizable.

Stored Materials

C The items for refixing materials in the works, describe such materials as "stored", and this description shall be deemed to include selecting, cleaning, removing from stored to the appropriate location of the works, and fixing.

Protection

D The works and the existing structure shall be efficiently protected against the elements.

E The work shall be kept well damped to avoid excessive dust and all debris is to be cleared away from time to time and when directed by the Project Manager.

Materials arising from demolition

F Materials arising from demolition shall become the property of the Employer, unless otherwise stated. The Contractor shall remove the demolished materials and remove to a place designated on site by the Project Manager and shall store the material in a manner satisfactory to the Project Manager. Materials arising from the demolition work shall not be reused in the works unless approval in writing has been received by the Project Manager.

New Materials

G All materials other than those arising from the pulling down and described as to be reused, or approved in writing by the Project Manager shall be new materials to match the existing work and to the approval of the Project Manager.

Transfer of Materials

H All materials and things described to be transferred to anew positions or handed over to the Project Manager shall be taken out and carefully moved to avoid damage, marked as required for identification purposes and the Contractor's pricing shall include for moving to and setting up temporary stores.

Overhauling doors

I The Contractor's prices for overhauling doors and frames shall be deemed to include re-securing frames, taking off doors, easing, adjusting and re-hanging, cutting out as necessary and making good split or worn sections and panels, and piecing-in where ironmongery have been removed.

Overhauling Ironmongery

A The Contractor's prices for overhauling ironmongery including sliding gear shall be deemed to include for taking down as necessary, thoroughly examining, cleaning, oiling and renewing lock springs where necessary, fitting new parts, escutcheons, striking plates and the like as necessary, providing new keys where missing and polishing bright all parts.

Overhauling sanitary fittings

B The Contractor's prices for overhauling sanitary fittings shall be deemed to include for scouring, re-washing valves, re-fixing chains, renewing defective plugs and pulls, clearing wastes and polishing bright all parts.

Protection and existing materials

C Care shall be taken to protect existing materials intended for re-use, renovations or retention and the Contractor shall make good or replace with new at his own expense, as directed by the Project Manager any such materials which are missing or become damaged.

Avoidance of noise

D The pulling down is to be carried out in such a manner as to cause little inconvenience as possible to adjoining owners or the public, and the Contractor will be held responsible for any claims which may arise from disregard of this Clause. Debris is to be kept well watered during the work to prevent dust arising

E Concrete materials resulting from the breaking up of foot paths, ground floor slabs and the like with the approval of the Project Manager may be used for hardcore filling.

F The Contractor shall give due notice to the electricity and water authorities and shall allow them facilities for removing any fixtures, fittings or services which belong to them. The contractors shall arrange for all electrical fixtures, wiring, sanitary fittings which come within the area to be demolished, to be disconnected and stored for handing over to the Project Manager.

Temporary Screens

G Temporary screens shall be erected at the request of the Project Manager and shall be provided in the positions indicated by him.

H Screens shall be constructed in such in manner as to satisfy the particular requirements of the subsequent measured items and in a manner approved by the Project Manager. In addition, screens described as "dust-proof" shall be faced with a suitable rigid sheet of material so as to provide, in addition to the functions previously stated, a reasonable measure of security.

Pricing

I The Contractor shall be deemed to have visited the site to ascertain the full extent and nature of demolitions and alterations.

J No claim resulting from failure to do so will be entertained.

Pricing (cont'd)

A Allow in pricing for all incidental work directly associated with the items of demolition and alterations which, at the time of tendering, could reasonably have been foreseen. Prices shall be deemed to include also for making good of all other works disturbed in the execution of the work described in this section with materials and workmanship to match in every respect the surrounding work and properly bonded thereto unless otherwise described.

B Allow for all other consideration arising from the specification.

PROVISIONAL AND PRIME COST SUMS

DEFINITIONS

General Attendance

A General attendance on Nominated Sub-Contractors, Local Authorities and Public Undertakings shall include "the use of Contractor's temporary roads, pavings and paths, standing scaffolding, standing power operated hoisting plant, the provision of temporary lighting and water supplies, clearing away rubbish, provision of space for the sub-contractor's own offices and for the storage of his plant and materials and the use of messrooms, sanitary accommodation and welfare facilities".

B In addition, general attendance shall be deemed to include arranging with Local Authorities, Public Undertakings, Nominated Sub-Contractors and Nominated Suppliers the time for commencement of their work on the site or manufacture and delivery of their goods and materials, obtaining particulars of holes, mortices, chases, recesses, fixings and the like and supplying them with all dimensions and other information required for the proper execution of the Works.

PRIME COST SUMS

Nominated Sub-Contractors

C The Prime Cost Sums given are for work to which the terms of Contract Condition will apply.

D. Except for loss or damage by causes listed in Clause 20 of the Conditions of Contract the Nominated Sub-Contractor shall be responsible for loss and damage and insurance against such loss or damage to any materials and goods brought onto or delivered to the site for his own use until such materials and goods have been fully, finally and properly incorporated in the Works except also for any loss or damage due to any negligence, omission or default of the Contractor, his servants or agents, or any other Sub-Contractor of the Contractor, or of the Employer or any person for whom the Employer is responsible.

E The Contractor shall make arrangements with the various Nominated Sub-Contractors so that their work proceeds in accordance with the agreed programme and shall furnish to then all necessary dimensions, marks, lines, levels, pegs, etc., for setting out and shall be responsible for the accuracy of same.

F Nominated Sub-Contractors will be responsible for covering up and protecting their work during its execution but immediately upon its completion the Contractor shall assume this responsibility.

Nominated Suppliers

G The P.C. Sums given are for goods and materials to which the terms of Contract Condition apply.

H The costs required to be paid by the Contractor of conveying goods and materials to the site, of any special packing and the like, are included in the appropriate prime cost sums and particulars are not given on the measured items.

I Fixing of goods and materials shall be deemed to include for distribution of final point of installation.

PROVISIONAL NET SUMS

A The Provisional net sums given are exclusive of any profit or cash discounts to the Main Contractor. An item of Profit is therefore included which the Contractor should price accordingly as part of his tender.

Work by Local Authorities and Public Undertakings

B The provisional net sums given are for work to which the terms of Contract Conditions will apply.

C Where a whole or partial prepayment is required by a Local Authority or Public Undertaking as a prerequisite to commencing the Work the Contractor shall forward such prepayment before the work is begun and shall obtain any appropriate refund after the work has been completed. Since under the Conditions of Contract interim payments can only be made to the extent that they relate to works done and/or materials on the site, the Contractor must allow in his pricing of general attendance for any expense to which he is put in account of such prepayments.

Test of Materials

D The provisional net sum is for charges for testing materials which will be executed by the Laboratory named by the Project Manager and to which the terms of Contract Condition will apply.

E The terms Contractor's services in connection with these tests is to be read as take test sections of the work when required, store, pack, label, record details and dispatch carriage paid to the testing laboratory.

EXCAVATION AND EARTHWORK

EARTHWORK

Clearing and Grubbing

Description

A The Contractor shall clear, grub and clean up those areas staked or described in the Special Provisions. This work includes protecting from harm all trees, bushes, shrubs, or other objects selected to remain.

B "Clearing" means removing and disposing of all unwanted material from the surface, such as trees, bush, down timber, or other natural material.

C "Grubbing" means removing and disposing of all unwanted vegetative matter from underground, such as sod, stumps, toots, buried logs, or other debris.

D "Debris" means all non-usable natural material produced by clearing, grubbing, or roadside cleanup.

Disposal method - waste site

E Debris shall be hauled to a waste site obtained and provided by the Contractor.

Removal of Structures and Obstructions

Description

F The work described in this section includes removing and disposing of, or salvaging, materials named in the Special Provisions or identified by the Engineer. The work also includes the backfilling of trenches, holes, or pits that result from such removal.

Removal of foundations

G When removing foundations the Contractor shall:

1. Remove foundations to a depth of at least 1.5 meters below finished ground elevation or sub-grade elevation, whichever is lower.
2. Break up basement floors to promote drainage.
3. Fill basements or other cavities left by removal of structures. The fill shall match the level of surrounding ground. Fill within the slopes of the roadbed shall be compacted to meet the requirements of Section 2-03.3(14) C, Method B.

Removal of existing structures

H Unless otherwise directed, the Contractor shall remove foundations of existing structures to a point 0.6 meter below: the finished ground elevation, the adjacent ground elevation, or the natural stream bottom. It a foundation lies wholly or partially on the site of a new structure, it shall be removed to a level that accommodates building the new structure.

EXCAVATION

General

A The excavation is to be carried out to the lines and levels shown on the drawings or to such other dimensions as the Project Manager or his representative may supply.

B Excavation and backfilling shall be carried out in such a manner as to avoid damage to adjacent structures and the Contractor shall provide any temporary support that may be required. The Contractor shall be fully responsible for damages to any services or property which might be disturbed or damaged.

Nature of Ground

C Ascertain the nature of ground and sub-soil and determine whether water, running sand or any other difficulties are likely to be encountered or whether cutting by hand or mechanical means must be used. A soil investigation report is available for inspection at the office of the Project Manager.

D Where mechanical excavation is used, the Contractor shall ensure that the sub-soil is capable of taking any such additional loads imposed by such equipment. A sufficient depth of materials shall be left over the bottom of the excavation to ensure that the ground at finished excavation level is not disturbed in any way. The excavation shall then be completed to the finished levels required.

E Remove any rocks encountered with wedges and levers or rock drills. Blasting will not be permitted on site without the written permission of the responsible authorities and then only after written permission of the Project Manager.

F Excavations must be kept dry regardless or the source of the water. If sump holes are necessary, the positions are to be approved by the Project Manager.

G Measures must be taken to control and reduce seepage of water from higher levels on to the site as far as practicable.

H Every precaution must be taken to ensure that moisture conditions in the soil are so controlled as to have no deleterious effect on the foundations. Excessive drying out or wetting must therefore be avoided during construction. Foundations are to be cast promptly after completion of excavation.

Surplus excavation

I All surplus excavated material shall be removed from site on the written permission of the Project Manager or stockpiled on site in location given by the Project Manager. All cleared vegetation shall be removed from the site or otherwise disposed of by the Contractor as approved.

Water Level

J A water level in the ground has not been established.

Approval of bottoms

A The Contractor shall at all times establish bottoms in undisturbed soil. The excavation for all foundations shall be inspected by the Project Manager or his representative before any concrete is placed and the Contractor shall give a minimum of 24 hours notice that such an inspection will be required.

B The bottom 75mm of excavation for concrete shall be removed on the same day as the concrete (or blinding layer) is placed on it. If the excavation should become disturbed or weakened by water or other means the Contractor shall be required to remove a further thickness of soil as the Project Manager or his representative may direct, and to backfill same with plain concrete with characteristic strength of 7.0N/mm^2 at the Contractor's own expense.

Levelling and Compacting

C Level and compact surface of ground and bottom of all excavations to receive concrete to attain a compaction of not less than ninety-five percent Standard Proctor Density.

D Compaction of fill material is to be done with a 6 tonne roller or approved equipment in layers not exceeding 200mm compacted thickness. The Contractor is to allow for watering where necessary and for delays which may occur to allow soil to dry out to an appropriate moisture content. Any soft areas which may develop during compaction shall be removed and replaced and selected excavated material.

Excessive excavation

E Should excavation be taken below the specified levels, the difference in level shall be made up in concrete 7.0N/mm^2 at the Contractor's own expense.

Backfill

F Backfill shall be carried out with selected excavated material, free from wood, debris or other combustible materials, vegetable matter or any other material subject to decay or disintegration and alkaline debris such as lime, plaster and cement from current operations as approved by the Project Manager.

G Backfilling shall be carried out around foundations at the back of walls etc., up to original ground level or as directed. It shall be carried out in horizontal layers not exceeding 200mm loose thickness, moistened or dried as required and thoroughly compacted by mechanical or other approved means to a dry density not less than ninety-five percent of the Standard Proctor Density.

H The Contractor shall take due precaution to ensure the safety of any block or reinforced concrete walls which may be subjected to excessive load during the compaction of the fill and/or hardcore by shoring or otherwise protecting these walls.

I No fill material shall be placed where free water is standing on the surface of the area where the fill is to be placed and no compaction of fill will be permitted with free water on any part of the surface of the fill to be compacted.

J No backfilling shall be carried out which covers work which has not been inspected and approved.

Fill under slabs on ground

A Fill materials to areas under floor slabs shall be materials approved by the Project Manager or his representative and compacted in layers not exceeding 150mm compacted thickness. Where rotten rocks, quarry overburden or similar approved materials have been used, the Contractor shall ensure that the moisture content is suitable for optimum density after compaction and shall water where necessary and allow for delays which may occur to allow the soil to dry out to an appropriate moisture content. Any soft areas which may develop during compaction shall be removed and replaced with selected materials as directed.

Materials arising

B No materials found in the excavations are to be used in the Works without the written permission of the Project Manager.

C Hardcore is defined, for the purposes of this contract, as material that can be excavated by mechanical equipment including a D8 tractor with ripper. Rock is defined, for the purposes of this contract, as material that can be excavated only be the use of wedges and levers or rocks drills and blasting.

Planking and Strutting

D The Contractor shall provide adequate timbering to prevent collapse of the earth cuts where appropriate. The Contractor shall be entirely responsible for the excavations and any damage caused by them to other parts of the Works. Excavations are to be left exposed for as short a time as possible.

Hardcore

E Hardcore other than pitrun is to consist of clean crushed natural stone, broken block or gravel or concrete rubble approved by the Project Manager, free from clay, silt or organic material, not exceeding 75mm maximum size and is to be consolidated with a 6 tonne roller or approved equivalent. The hardcore is to be well wetted and blinded with sand 25mm thick to present a uniform and even upper surface.

F Where pitrun gravel is specified it shall be graded from 75mm down to fine and shall contain approximately 25% of natural clay for blinding purposes and well rolled with a 6 tonne roller or approved equivalent. No sand blinding shall be required where pitrun is used.

Termite treatment

G All termite treatment used by the Contractor must be a GBS approved pesticide. Prior to obtaining approval to use a particular brand of pesticide, the Contractor must provide satisfactory evidence that the said brand satisfies this criteria. The Contractor must also submit to the Project Manager, manufacturer's recommendations on the toxicant proposed prior to its usage

H The Contractor is to provide a five year warranty in the name of the Employer, in the event of the reoccurrence or evidence of reinfestation of termites.

Termite treatment (Cont'd)

A For effective pre-construction subterranean termite control, it must be ensured that an unbroken vertical and/or horizontal chemical barrier between timber in the structures and the termite colonies in the soil is established.

B Vertical barriers are to be established in areas such as around the base of foundations, plumbing, backfilling soil against foundations walls and other critical areas. Specified toxicant emulsion shall be applied at the rate as recommended by the manufacturer. The emulsion is to be applied using effective current control practices including trenching, rodding, substab injections and low-pressure spray applications to achieve subterranean termite control. Application must attain a depth of three (3) feet to vertical sides of all excavations.

C Horizontal barriers to be established in areas covering ground floors, concrete slabs and other superficial concrete/timber surfaces to be incorporated into the works. The specified toxicant emulsion must be applied at the rate as recommended by the manufacturer over the surface area of the construction.

Pricing

D Prices for Excavation and Earthworks shall include:-

1. All consideration arising from the Specification.

2. Hand and/or mechanical excavation and disposal in whatever types of soil and fillings encountered excluding concrete and rock but including roots, drainpipes and other obstructions and the Contractor shall judge for himself the nature of the conditions.

3. Separating vegetable soil from sub-soil including the provision of separate spoil heaps.

4. Extra difficulties of getting out, disposal and the extra bulking of concrete and rock.

5. Planking and strutting left in at the Contractor's volition.

6. Temporary retention of fillings.

7. Disposal of trees and other vegetation cut down and grubbed up.

8. Excavation in gravel and hardcore.

REINFORCED CONCRETE WORK

General

A Concrete shall be made with cement, fine aggregate, coarse aggregate, and water. No other agent or ingredient shall be added to the concrete without the prior approval of the Project Manager. The Contractor shall ensure that the use of such approved additive will not adversely affect the strength, durability or appearance of the finished concrete works.

Definitions

B The following terms whenever used in the specification shall be taken to have the meanings assigned to them below:-

C "Plain concrete" shall mean concrete used in members made with a structural grade of concrete listed, but not containing steel reinforcement.

D "Structural props" shall mean those components of the strutting to formwork which will be retained in position when the shuttering is removed from concrete faces.

E "Satisfactory" shall mean to the satisfaction of the Project Manager's representatives.

F "Approved" shall mean approved by the Project Manager's representatives.

G "Required" shall mean required by the terms of this specification, or any other contract document.

H "Passed by the Project Manager's representative" shall mean accepted as complying with specification requirements as far as can be judged from visual inspection.

I "Current issue" shall mean latest issued at the date of the tender invitation.

J "Failure to comply with this specification" shall mean failure to comply satisfactorily with all requirements of this specification.

Responsibility

K No approval or acceptance by the Project Manager or his representative shall in any way relieve the Contractor of his responsibility for the quality of materials and the standard of workmanship in the finished works and for the strength, durability and appearance of the finished concrete works.

DESIGN

Reinforced concrete

L The reinforced concrete works have been designed generally in accordance with the recommendations contained in the ACI 318-05. The reinforced concrete work is to comply with the recommendations of this ACI MCP unless specifically excluded or modified hereafter.

Plain Concrete

M Plain concrete works shall comply with all the relevant requirements for reinforced concrete.

MATERIALS

General

A All materials in the works shall comply in all respects to the best standard available locally, based on the relevant British Standard, except for any deviations specifically authorized in subsequent clauses of this specification.

B The constituent materials of concrete shall be cement, aggregates and water. No admixtures to this concrete shall be permitted without the prior approval of the Project Manager.

Cement

C Cement shall be ordinary Portland Cement complying with ACI 318-05. All cement shall be delivered to site in bulk cement lorries of approved design or in sealed bags.

D Minimum cement content of concrete shall be 350kg/m^3 for all work below ground level and 250kg/m^3 for all work above ground level. Maximum cement content of concrete shall not exceed 550kg/m^3.

E No rebagged cement will be permitted to be brought on to the site. On no account shall a change in the type of source of supply be permitted during the course of construction and every endeavor shall be made to ensure that the colour of the cement is constant throughout the contract except with the permission of the Project Manager.

Aggregates

F Aggregates shall comply with the recommendations of ACI 318-05. In special circumstances a deviation from ACI 318-05 in respect of grading of aggregate may be accepted, subject to the prior approval of the Project Manager.

G The nominal maximum sizes of coarse aggregate shall be 20mm, except where otherwise directed by the Project Manager.

Water

H Water to be used in the works shall be clean and free from all harmful matter, in suspension or solution, that would have adverse effects on setting, hardening and strength of Portland Cement. A continuous supply of water shall be available during all mixing, placing and curing operations.

Reinforcement

I All cast-in-place concrete shall be made with type-1 Portland Cement, find and coarse aggregates and shall develop 3750 psi compressive strength in 28 days with a slump of 2 to 4.

J Slabs, toppings, footings and walls shall not have joints in horizontal plane. Any stop in concrete work must be made a centre of span with vertical bulkheads and shear keys, unless otherwise shown. All construction joints shall be as detailed or as approved by the engineer.

Reinforcement (cont'd)

K All concrete work and reinforcement detailing shall be in accordance with ACI building code 318-05. All exposed edges of concrete work shall have ½" min. chamfer. Use standard hooks on dowels unless otherwise noted.

A Mixing, placing and curing of all concrete to be by the recommendations in ACI 305R-02, hot weather concreting.

B Any admixture to be used in concrete shall be approved by the engineer prior to usage.

C GDS 63 - 2002 All ready mix concrete shall comply with the GBS.

D GDS 50 - 1999 All Portland Cement must comply with the GBS

E All reinforcement shall be high strength deformed bars conforming to ASTM A615-04 grade 60.

F Welded wire fabric shall confirm to ASTM A185-02 and shall be lapped one full mesh at sides and end splices and wired together.

G Reinforcement protection (cover)

H Concrete poured against earth 3"

I Concrete poured against forms (exposed to weather) 2"

J Columns and beans 1-½"

K Slabs and walls (not exposed to weather) ¾"

M No splices of reinforcement shall be except as detailed or authorized by the engineer. Lap splices where permitted shall be as follows:

Minimum lap for 3/8" dia. bars	1'-6"
Minimum lap for ½" dia. bars	2'-0"
Minimum lap for ¾" dia. bars	3'-0"
Minimum lap for 1" dia. bars	4'-0"

N Place #5 Bar (1 - Qty per 6" thick) with 2'-0" projection around all openings in slab or walls. Also provide 1 #5 x 4'-0" diagonally at each corner.

O Continuous top and bottom bars in beams shall be spliced as follows:
4.6.1 Top bars at mid-span
4.6.2 Bottom bars over supports

P Provide all accessories necessary to support reinforcement at positions shown in the drawings. All reinforcement is to be held securely in proper position in accordance with ACI 318-05. All accessories are to be galvanized.

Q All ties and stirrups shall be 135deg. Seismic hooks in accordance with ACI 530-05.

Admixtures

A Admixtures for improving the concrete may be permitted but only after the Contractors have satisfied the Project Manager that it will be to his advantage. Use of the admixtures shall be made only on the written permission of the Project Manager and in any case the permission to use the same shall not be construed to mean that extra will be paid.

Concrete Densifier and Chemical Hardener

B Surface hardener as approved by the Project Manager shall be applied by either manual sprayer, soft bristle broom or mechanical scrubber to the concrete surface as per manufacturer's specification.

Storage

C All cements shall be stored in a weatherproof shed of adequate size having a raised dry floor, or in silos of approved design.

D Aggregates shall be stored on hard paved areas with adequate dividing walls, or in approved container, to prevent mixing of different types of aggregate and be kept clean and free from contamination.

E Cements and aggregates shall be used in the order in which they are received on site and their storage shall be arranged to facilitate this procedure.

F Reinforcement shall be stored in racks clear of the ground.

G Where materials are to be stored on suspended floors or roofs the Contractor shall ensure that such storage will not overload or distort the structural frame.

Rejected

H All materials which have been damaged or are contaminated, or have deteriorated or do not comply with the requirements of these specifications shall be rejected and shall be removed from the site immediately at the Contractor's expense.

TESTS

General

A Before the commencement of the Contract, the Contractor shall submit to the Engineer, for his approval, the name of the Testing Authority he proposes to employ.

B The Contractor shall provide all equipment necessary for carrying out all tests on site specified or described in this specification, and he shall make and provide for all necessary arrangements for the delivery of all samples and test pieces to be tested by the approved Testing Authority.

C The Contractor shall provide for maintaining all testing equipment on site in proper working order to the satisfaction of the Engineer.

D The Contractor shall provide for sending copies of all tests results to the Engineer.

E The Contractor will bear the cost of all tests specifically required in this specification.

F The Contractor will not be paid for any special tests called for by the Engineer in consequence of any failure by the Contractor to comply with this specification.

G The Contractor will be paid, at rates to be agreed, for any other special tests called for by the Engineer unless the tests results show failure by the Engineer to comply with this specification.

H The Contractor shall state his source of cement to be used on the site and verify that these comply with the national standards as established by GBS.

I The manufacturer's certificates of test including compressive strength tests, carried out in accordance with ACI 318-05 for Portland Cement shall be supplied and kept on site for each consignment of cement delivered to the works. At the commencement of the contract, the Contractor shall deliver a 22.68kg sample of each type of cement he intends to use to the approved Testing Authority.

Aggregates

J Samples of aggregates to be used shall be supplied to the Project Manager and the source identified for approval by the Project Manager.

K All sampling and testing of aggregates shall be carried out in accordance with the relevant recommendations of B.S. 882:1992.

L At the commencement of the contract, the Contractor shall deliver to the Approved Testing Authority for inspection and analysis, 3 separate samples of each type of aggregate to be used in the structural concrete grades. For each type of aggregate the 3 samples shall be taken at the proposed source of supply at intervals of not less than one day. For fine aggregates, the samples shall be 22.68 kg weight each and for coarse aggregates, the samples shall be 45.36 kg weight each.

M To ensure that no significant variation in the grading of the aggregates occurs during the contract, sieve analyses shall be carried out on site at fortnightly intervals. The results of these analyses shall be recorded on a chart to be kept on the site and to be handed to the Project Manager fortnightly.

Aggregates (Cont'd)

A If the grading of any aggregate is changed, the Project Manager shall be notified before any of this aggregate is used in the works.

B The quantity of water contained in the aggregate shall be determined by an approved method at least once a day, when concrete mixing is in progress. The Contractor will be required to show the adjustments to be made to batch weights and added water.

Mixing plant

C Weight batching plant shall be checked weekly in the presence of the Project Manager's representative. The checking shall be carried out with approved weights provided by the Contractor for this purpose.

D The water gauge of the concrete mixer shall be inspected and tested daily when concreting is in progress.

E If any fault in the mixing plant is detected by these tests or otherwise; the fault shall be rectified to the satisfaction of the Project Manager's representative before further use is made of the equipment.

Concrete tests

F Concrete test cubes shall be made, cured and tested and the results recorded, in accordance with the recommendations of the current issue of ACI 318-05, unless specifically modified in subsequent clauses of the specification.

G The test specimens shall be 150mm cubes made in steel moulds of approved design. The test cubes shall be taken from typical batches of concrete as directed by and in the presence of the Project Manager's representative, without prior notice.

H Subject to the Project Manager's approval tests of works cubes may be carried out on site with a testing machine of approved design, in the presence of the Project Manager's representative. Otherwise the test cubes shall be properly packed, suitably labeled and sent, carriage paid, by the Contractor to the Approved Testing Authority.

I Slump test or compaction factors tests of the mixed concrete shall be carried out at regular intervals and the results recorded and kept on the site.

Exposed concrete finishes

J Where exposed concrete finishes are required, the Contractor shall provide in a suitable position test samples of each type of finish to be used in the works. The test samples shall be approved by the Project Manager before these finishes are put in hand in the works. No correction or repair to surfaces will be allowed unless instructed in writing by the Project Manager.

Load tests

A Load tests of completed parts of the structure may be called for by the Project Manager at any time.

B The test procedure and the standard of acceptance will be specified by the Project Manager.

C Where the results of such tests indicate that any member or part of the structure does not comply with this specification, that part of the structure shall be classed as defective work.

CONCRETE

Concrete Mixes

D For structural concrete mixes made with Ordinary Portland Cement, the average 28 day works strength shall be not less than specified in the table below.

E The following concrete mixes shall be required:-

Grade	28 Days Works Strength in N/mm^2	Proportions	Fine Aggregate	Coarse Aggregate
Plain Concrete	No strength	1:8	-	37 mm all-in
20	20	1:2:4	100 - 4mm	5mm – 19mm
25	25	1:1 ½:3	100 - 4mm	5mm – 19mm
30	30	1:2:2		

Mix Proportions

F Mix proportions shall be designed by the Contractor for each structural concrete mix listed in the table.

G The concrete mixes shall be designed to have target mean strength which exceeds the required characteristic strength by the following margins:-

Grade 20	10N/mm^2
Grade 25	13N/mm^2
Grade 30	15 N/mm^2

H A reduction in the current margin specified above may be permitted subject to the following conditions:-

(i) The Contractor shall satisfy the Project Manager that the standard of supervision and concrete control to be exercised on site for the duration of the structural works, justifies such a reduction.

(ii) The average strength of the concrete used in the works shall be assessed accordingly to the statistical method, applied to works cube tests results.

Mix Proportions (cont'd)

(iii) Trial mixes are made from three separate batches of concrete which are prepared and four cube tests obtained from each batch.

The trial mix proportions will be approved provided that:-

(a) The mixes have sufficient workability to allow concrete to be placed and properly compacted by the methods to be used on site.

(b) The average strength of the mix cubes tested at 28 days exceeds the specified characteristic strength by the current margin less 3.5 N/mm^2.

Tests at an earlier age may be permitted provided that satisfactory age-strength relationships have been established by experiment.

A The mixes shall be designed to have sufficient workability to allow concrete to be placed and properly compacted by the methods to be used on site.

B Complete calculations for the mix proportions and the information and assumptions on which they are based, shall be submitted to the Project Manager, for each mix listed in the table, before the cubes for the preliminary strength tests are made.

Preliminary strength

C Preliminary strength cube test shall be carried out to check the calculated proportions for each structural concrete mix.

D Preliminary cubes shall be made for each mix from the three samples of aggregates and samples of cement sent to the approved Testing Authority. From each samples of aggregate 6 cubes shall be made, 3 for test at seven days and 3 for test at 28 days.

E Each set of cubes tested at 28 days shall be accepted as satisfactory if, either all three cubes have a crushing strength greater than the preliminary design strength, or the strength, or the average strength of the three cubes is greater than the preliminary design strength and the difference between the greatest and the least is not more than 20% of that average.

F If for any mix in the table, the test result in one set of three cubes tested at 28 days fall below this requirement, the mix shall be rejected, the proportions revised and the testing procedure repeated.

G For each structural concrete mix, the 28 day preliminary strength shall be calculated as the average of all the cubes tested at 28 days and the 7 day preliminary strength shall be calculated as the average of all the cubes tested at 7 days.

H Results for all preliminary tests shall be sent to the Project Manager as soon as they are available.

Works strength

A Compliance with the specified characteristic strength shall be judged by test made on concrete cubes at 28 day. Tests at an earlier age may be accepted provided that satisfactory age-strength relationships have been established by experiment.

B The minimum rate of sampling shall be for every $20m^3$ or every 20 batches of concrete supplied whichever is the lesser volume. No variation in this sampling rate will be permitted without the prior approval of the Project Manager.

C Four cubes shall be made from each sample for testing at 28 days or at an earlier age approved by the Project Manager.

D The samples where practicable shall be taken at the point of discharge from the mixer or in the case of ready-mixed concrete, at the point of discharge from the delivery vehicle.

E Each set of four cubes tested at 28 days shall be accepted as satisfactory provided that:-

(a) The average strength determined from any group of four consecutive test cubes exceeds the specified characteristic strength by not less than 0.5 x the current margin.

(b) Each individual test result is greater than 85% of the specified characteristic strength.

F If at any time the mean strength or the standard deviation fails to satisfy the requirements given above, the Project Manager shall be notified immediately and action shall be taken as the Engineer shall direct.

G In all cases, an estimate of the corresponding 28 day strength may be obtained from the 7 day cube tests by assuming the ratio of 28 to 7 day strengths to be the same as that obtained from the average strengths of the tests for the trial mixes.

H Results of all works cube tests and test analysis shall be kept on site and copies shall be sent to the Project Manager as soon as the results are available. All records of works cube tests shall indicate clearly which part of the structure each sample of concrete represents.

Works test failure

I If any set of 7 day sub tests results indicate a low 28 day strength to be expected, the Project Manager shall be notified immediately and no props shall be removed from the affected part of the structure until the cause is determined.

J If any set of 28 day cube test results fall below the specified strength, the Engineer shall be notified immediately and the cause of the failure investigated.

K The extent of the area of the structure affected shall be as defined by the Project Manager.

L All the cost of and all charges in consequence of the courses of action the Contractor is directed to follow, shall be borne by the Contractor.

Site Control

A The water-cement ratio determined in the calculation of proportions for each mix shall be accurately maintained. The amount of water in each batch shall be controlled by direct measurement and due allowance shall be made for water content of the aggregate as determined by the daily test.

B A slump of 75mm to 100mm or a compaction factor of 0.92 shall be used as a guide to the workability of the mixed concrete.

C If a change in the grading of any aggregate is unavoidable, the proportions of all structural concrete mixes affected shall be revised to take account of the altered grading.

Ready-mixed Concrete

D Permission must be obtained, and the name of the supplier submitted before the used of ready-mixed concrete. Permission must also be obtained to change the supplier of ready-mixed concrete and also to revert back to site mixed concrete. The concrete must be discharged into the formwork within 1 hour of mixing. All the requirements for site mixed concrete, previously given must be complied with, except for time of discharge. Any ready-mixed concrete that has not been deposited within 1 hour of mixing shall not be used and shall be removed from site. If required to do so, certificates showing batching records of the ready-mixed concrete shall be produced by the contractor. Experienced ready-mix truck drivers only will be allowed to deliver the ready-mixed concrete and they, when told to mix-up by the Contractor's Supervisor, will discharge into the mixer drum the exact amount of water required in accordance with previous clauses of this specification. The amount of water in the mix can only be changed on the authority of the Project Manager.

E Although testing is sometimes performed by the ready-mixed concrete suppliers, the Contractor must carry out his own testing in accordance with the requirements for site-mixed concrete. The concrete cubes shall be tested for strength by an independent authority and the results submitted to the Project Manager without delay.

STEEL REINFORCEMENT

General

F Reinforcement bending schedules will be provided listing the cut length, diameter or size, bending dimensions and location of each bar in the works.

G Before the bars are cut to length the Contractor must check:-

(i) That reinforcement schedules are provided for each part of the structure sufficiently in advance of his concreting programme.

(ii) That each schedule includes the correct quantities of reinforcement as detailed on the drawing to which it relates.

(iii) That the grades of reinforcement given in each schedule corresponds to those shown on the relevant drawing.

General (cont'd)

A The Contractor shall submit test certificates to show that the reinforcement complies with the specification.

B The Project Manager shall be notified of any errors disclosed by these checks.

C The Contractor shall be responsible for all delays and charges arising directly from failure to comply with these requirements.

Bending

D All reinforcement bars shall be accurately shaped in a manner that will not injure the material, to the details shown on the drawings and bending schedules. Bars shall not be bent hot.

E The minimum diameter of former to be used when high tensile bar shall be six times the bar diameter. The bar diameter shall be the diameter of the largest circle that can be inscribed in the cross section of the bar.

Cleaning

F All reinforcement shall be free of all loose mill scale and thoroughly cleaned to remove all loose rust, oil, grease, or other harmful matter, immediately prior to being placed in position in the works.

Placing

G All reinforcement shall be accurately placed, securely fixed and adequately maintained in the positions shown on the drawings.

H The concrete cover to the reinforcement detailed on the drawings shall be maintained by use of approved methods e.g biscuits on fairface work.

I The Contractor shall supply and fix all necessary chairs required to maintain the reinforcement in the correct position. The spacing of chairs and the diameter of bars used in their manufacturer shall be agreed with the Project Manager. The weight of mild steel used for chairs not included in the reinforcement bending schedule will be paid for at the appropriate rates in the specification.

J All laps of fabric and all intersections of bars shall be securely connected with malleable iron wire of suitable size or by another approved method. The wire is to be arranged with ends bent away from the formwork so that the concrete cover is not reduced by more than the diameter of the wire.

K No metal part of any device used for connecting bars or for maintaining reinforcement in the correct position shall remain permanently within the specified minimum concrete cover to the reinforcement.

L The concrete cover to reinforcement shall be as detailed on the structural drawing.

Welding

A Welding of steel reinforcement is **not** required for structural purposes. No welding of reinforcement for fixing shall be put in hand without the written permission of the Project Manager.

B Welding of cold worked high tensile steel reinforcement will not be permitted.

Formwork

C Before construction commences the Contractor shall notify the Project Manager of the general method and system of formwork he proposes to use for all the main structural members.

D Formwork and its supporting members shall be sufficiently strong to carry the works and all incidental loading. The props and lateral supports shall be sufficiently closely spaced to prevent displacement or visible deflection of the shutters under the weight or hydraulic pressure of the wet concrete. All joints in the formwork and joints between the formwork and previous work shall be sufficiently tight to prevent loss of liquid from the concrete through these joints. The Contractor shall submit calculations for design of the formwork and supports for approval.

E Methods of fixing and locating formwork, which result in holes through the concrete when the formwork is removed, shall not be used.

F No metal part of any device for maintaining formwork in the correct location shall remain permanently within the specified concrete cover the main reinforcement.

G The use of concrete retarders or similar preparations to the formwork surfaces shall be subject to the prior approval of the Project Manager.

Mortices, holes, chases in concrete

H Fixing blocks, ends of brackets, bars, bolts, etc., shall be cast in the concrete at the time of placing and all mortices, holes, apertures, chases, grooves, etc., shall be accurately set out in the formwork as the concrete is placed. No part of the concrete works shall be cut away for any such item, or for any other reason, without the Project Manager's permission.

I The Contractor shall obtain from all sub-contractors complete information of their requirements regarding conduits, pipes, fixing blocks or boxes, chases, holes any other items to be cast or formed in the concrete members, subject to the condition that failure of a sub-contractor' to supply such information shall not be allowed to delay the progress of the Contract.

J The Contractor shall ensure that all sub-contractors are informed of his programme for the structural works at the commencement of the Contract. He shall also ensure that sub-contractor's requirements relating to concrete members are approved by the Project Manager before the work is commenced.

K At the commencement of the Contract, the Contractor shall supply all sub-contractors with written copies of the items under this heading of the specification.

Propping

A The vertical propping to all formwork shall be carried down sufficiently far to provide the necessary support without damage, overstress or displacement of any part of the construction.

B Structural props shall be retained in position until new construction is sufficiently strong to support its own weight and any loads to be placed on it during the contract period.

C Structural props for beams and slab shall be positioned to divide the clear span of each member into equal lengths. The number of props provided in each span shall be at least one for clear spans of 6.00m or under and at least two for clear spans over 6.00m and less than 12.00m. For two-way spanning slabs, structural props as specified above shall be provided for each direction of span. For slabs spanning in one direction only, the spacing of props in the direction perpendicular to the span shall not exceed half the span. All members with spans exceeding 12.00m shall be propped to the Project Manager's satisfaction.

Beam and slab formwork

D All formwork to soffits shall be constructed so that it can be removed without disturbing the structural props.

E Unless otherwise detailed on the drawings, the formwork of all floor beams and slabs shall be constructed with an upward camber giving a rise at mid span of 3mm for each 3.00m of span. For roof beams and slabs the formwork shall be cambered to give rise at mid-span of 6mm for each 3.00m of span.

Final preparation

F The internal faces of the formwork may be coated with an approved preparation to prevent adhesion to the concrete to the forms, provided that the use of this preparation will not stain the surface of the finished concrete. None of this preparation shall be allowed to touch the reinforcement.

G Immediately before the concrete is placed in any section of the formwork, the interior of that section shall be completely cleared of all extraneous materials.

H Each section of the formwork to structural members shall be inspected and passed by the Project Manager's representative immediately before the concrete is placed in that section. At least 24 hours notice shall be given when such an inspection is required.

Exposed concrete faces

I Unless otherwise specified all concrete faces to be exposed in the finished works shall be left as struck with a fair face, true to line and level within the specified tolerances for the works.

J After inspection, all superfluous fins and similar projections shall be carefully removed. No render or other applied finish shall be used to obtain a fair face to the concrete.

K All concrete faces to be exposed in the finished works shall be adequately protected against damage and surface staining during the execution of subsequent works.

Exposed concrete faces (Cont'd)

A All finished works which the Project Manager shall judge inferior in any part respect to the standard of the relevant approved sample or which is subjected to subsequent damage or surface staining shall be rejected and treated as defective work.

Formwork to produce a boardmarked finish

B Form of form lining to consist of approved rough textured softwood boards seasoned to a moisture content of not more than 25% and not less than 18%.

C Arrange boards of varying textures and uniform 100mm width alternating the thickness by 10mm to give indentations to the surfaces and a uniform overall pattern. Assemble boards to prevent penetration of grout between them and soak reassembled forms with clean water before erecting and keep damp until concrete is placed.

D Obtain approval for use of and type of release agent.

E Do not use cover spacers without approval. Formwork ties to occur in a regular pattern in positions agreed with the Project Manager.

F The finish is to be left as struck. Making good will not normally be permitted.

Formwork to produce a ribbed finish

G Ribbed concrete finish shall be achieved using timber moulds to achieve the profiles shown on the drawings.

H The ribs shall be 50mm deep x 50mm wide (extreme) splayed 6mm form back to front on either face and shall be true, plumb and align exactly on each side of the other.

I The concrete shall be finished fair as described elsewhere.

J Obtain approval for use of and type of release agent.

K Formwork ties shall occur in a regular pattern in position agreed with the Project Manager and filled with concrete to match surrounding work. The making good of holes for ties shall be finished 6mm recessed from the general recessed surface of the ribbing.

CONSTRUCTION JOINTS AND EXPANSION JOINTS

Position of construction joints

L The Contractor shall ensure that all construction joints are arranged to minimise the effect of shrinkage of the concrete. Generally the distance between construction joints in walls and slab shall not exceed 9 metres.

M The position of all joints shall be agreed with the Project Manager before the work is commenced.

N Concrete placing shall be carried out continuously between consecutive construction joints.

Position of construction joints (cont'd)

A Construction joints between different grades of concrete and between concrete mixes using different cements shall be made and positioned as the Project Manager will direct.

Treatment of construction joints

B All construction joints other than horizontal joints shall be formed with proper stop-boards and the stop-boards shall be fixed vertically unless otherwise directed. All joints shall be joggled.

C All construction joints shall be hacked and all laitance and honeycombed concrete removed from the contact face before the adjacent section is poured. Where an adjacent face of the concrete is to be exposed in the finished works, hacking of the contact face shall be terminated 12mm away from the face to be exposed. Air and water jetting immediately after striking stop ends may be used instead of hacking subject to the prior approval of the Project Manager. All loose materials shall be removed from contact face immediately after hacking or jetting has been completed.

D When work is to be resumed at a construction joint, it shall be swept clean and treated with 2:1 sand/cement slurry or approved bonding agent before starting the new pour. The approved bonding agent shall be Vandex super or equal applied in accordance with the manufacturer's guide.

E At vertical joints the fresh concrete shall be placed directly against the hacked and treated contact face.

Expansion joints

F Expansion joints shall be positioned and formed in accordance with the details shown on the drawings.

G All expansion joints shall be filled with an approved compressible material and joint sealant unless otherwise indicated on the drawings.

Mixing

H Concrete shall be mixed in an approved mechanical batch type concrete mixer. Mixing shall be continued until there is a uniform distribution of the materials in the mixer and the mass is uniform in colour. The mixing time for each batch shall not be less than the minimum period recommended by the mixer manufacturer.

I The volume of mixed materials in each batch shall not exceed the rated capacity of the mixer. Each batch of concrete shall be completely discharged before the mixer drum is re-charged.

J The mixer drum shall be thoroughly washed out whenever mixing ceases.

Transporting

A Concrete shall be transported as rapidly as possible from the mixer to its final position without segregation or loss of any of the ingredient.

B All plant and equipment used for transporting concrete shall be kept clean; all containers used for transporting concrete shall be thoroughly washed out whenever mixing ceases.

Transporting (cont'd)

A Runs or gangways for concrete transporters and mains runs for foot traffic shall not be supported or allowed to bear on the fixed reinforcement.

Placing

B Concrete shall be placed while still sufficiently plastic for adequate compaction without segregation or loss of any of the ingredients.

C At all times when reinforced concrete is being placed, a competent steel fixer shall be in continuous attendance on the concretors, and he shall adjust and correct the position of any reinforcement, which may be displaced.

D The Contractor shall keep on site a complete record of the works showing the time and date when concrete is placed in each part of the works. These records shall be available at all times for inspection by the Project Manager.

Compacting

E Concrete shall be thoroughly compacted during placing and shall be carefully worked around all reinforcement and embedded fixtures and into the sides and corners of the formwork, using a heavy-duty, poker type vibrator with minimum frequency of 12MHZ. The Contractor shall have standby vibrators on site during pours.

Curing

F All surfaces of freshly placed structural concrete shall be covered with an approved material and kept constantly wet for 7 days except that for concrete made with rapid hardening cement the minimum curing period shall be 3 days. Degradable clear plastic curing coating may be used with prior written approval by the Project Manager or his representative.

G Soffit and side forms left in position will be regarded as effective in keeping those surfaces wet.

H The Contractor shall notify the Project Manager of the system and method of curing he proposes to use for all structural concrete members before the works are commenced.

STRIKING OF FORMWORK

I The structure shall not be distorted, damaged or overloaded in any way by the removal of the formwork form concrete members.

J The responsibility of the safe removal of any part of the formwork or strutting shall rest with the Contractor.

Record of temperatures

K A maximum and minimum thermometer of approved design shall be kept on site close to the works for measuring atmospheric shade temperature.

Minimum striking times

A The minimum striking times for removing formwork to structural members shall be determined from the table below. The times are given in days, where each day is to be 24 hours duration. Before the formwork is removed from any structural member the Contractor shall ensure that the concrete in that member has attained sufficient strength for striking to proceed.

Location	Minimum Time O.P.C. Concrete
Slab soffits (structural props left in)	4
Beams soffits (structural props left in)	6
Slab structural props	10
Beam structural props	14

CONCRETE IN WATERTIGHT CONSTRUCTION

General

B All work required to be watertight in the finished works will be so indicated on the drawings.

C The Contractor shall include in his rates for any waterproofing additives he proposed to use but the use of such additives shall be subject to the prior approval of the Project Manager.

D Where in the opinion of the Project Manager, damp patches or leakage of water in the finished works are due to incorrect placing or inadequate compaction of the allowance for shrinkage, the affected works shall be made good at the Contractor's expense.

Water-bars

E Where shown on the drawings, water-bars of approved material, make and design, shall be incorporated in construction joints in concrete in water tight construction. Water-bars shall be jointed in an approved manner.

F Before commencing the works, the Contractor shall obtain the Project Manager's approval of the methods to be used to support and maintain the water-bars in the correct locations while the concrete is placed.

PRECAST CONCRETE WORK

General

G Except as provided herein, the whole of the specification for Concrete Works shall apply.

Concrete strength requirements

H The required minimum concrete strength or works cubes shall be:-

3750 p.s.i. after 28 days	
28 days after placing	30.00 N/mm^2

Concrete proportions

A The concrete mix shall be designed by the supplier, or where the Main Contractor choose to precast, they shall be designed by him.

B The design of the mix shall be based on the method given in U.K. Road Research Note 4, or other approved method. Complete calculations for the mix design and the information on which they are based, such as sieve analysis of the aggregates, the water/cement ratio, workability, etc., shall be submitted to the Project Manager before the preliminary cube test are carried out.

C Preliminary cube tests must be carried out to confirm the mix design calculations.

D The mix must have sufficient workability to enable the concrete to be placed without difficulty.

E When the mix has been decided upon, no variations must be made without the approval of the Engineer.

F The design mix calculations shall be submitted to the Project Manager, together with cube test results, for his approval.

Manufacture of precast units

G The concrete in one precast piece shall be placed in one preparation. The moulds and methods shall be such that the dimensions of the finished work are accurate within the limits of ± 6mm the surfaces and edges clean and true, not winding and free from all defects, with the ends square. The concrete shall be dense and homogeneous of a colour to the Engineer satisfaction. Pressure, vibration, or other effective methods shall be used to consolidate the materials subject to the Project Manager's approval.

H Fixing plugs shall be accurately positioned, as indicated on the detailed drawings.

I The concrete shall be "fairfaced" and free from mould oil staining.

Handling of precast units

J No element shall be removed from the mould until sufficiently matured to ensure that no damage shall be done to it.

K The units shall be delivered to site in such a manner as not to damage then during transport. The Project Manager or his authorised representative shall be at liberty to reject any units which are damaged, or in any way do not comply with this specification. Such units must be removed from the site immediately.

Pricing

A Prices for Concrete Work shall include:-

1. All considerations arising from the specification.

2. Where concrete is cast in earth cuts (i.e. not described as filled into formwork) for any additional concrete over the size stated or shown necessitated by the irregularity of the surfaces retaining the concrete.

3. Cutting, bends, hooks, tying wire, distance blocks and ordinary spacers for reinforcement.

4. All cleaning and oiling of forms and making good of exposed concrete surfaces after removal of formwork, e.g. cutting off projecting fins, filling out small voids and brushing to exposed aggregate.

5. Where formwork is described as “wrought” or “dressed” for producing a fair face finish either by lining the formwork with suitable material and/or filling in voids, etc., and rubbing down to a smooth finish to the Project Manager’s approval.

6. Transporting concrete, hoisting or lowering, placing in position, working around reinforcement where necessary and curing.

7. Formwork including all temporary supports and strutting, notches, overlaps and passings at angles, easing, striking and removing.

8. Precast units including hoisting and fixing in position and bedding, jointing and pointing where necessary in cement mortar similar to that used in adjoining work.

MASONRY

General

A All construction and details to be in accordance with ACI 530.1-05, or latest.

B All reinforced concrete blockwork shall be constructed using two and three cell masonry units only, unless otherwise detailed.

C Walls shall be reinforced horizontally at 2' O.C. The wire shall conform to ASTM A82-01, standard gage, galvanized unless shown otherwise.

D Exterior wall shall also be reinforced with 2 - #5 bars vertically at the ends corners, each side of door or window openings and not over 1-#5 at 24" O.C. typically or per structural drawings. Reinforcement shall be fully grouted in place. Grout shall develop 3000psi in 28 days and met ACI 530.1.

E Fill all foundation block cells with concrete or 3,000 p.s.i. 28-day strength.

Cement and water

F Cement and water shall be as described under "CONCRETE WORK".

Sand

G Sand shall be clean fine plastering sand, free from salt, organic matter, clay, loam, dirt or other deleterious matter.

Plasticiser

H Plasticiser shall be "Rendaplas" or approved equal and used in accordance with the manufacturer's instructions.

Mortar

I Mix mortar for blockwork of cement and sand (1:3) mixed on site in a similar manner to concrete including a plasticiser additive at the rate of 0.142 litres of plasticiser to every bag of cement and use within one hour of mixing. Mortar, which has commenced to set, is not to be knocked up again to re-use.

J Mortar shall be mixed by placing one half of the water and sand in the operating mixer then adding the cement, plasticiser and the remainder of sand and water. After all the ingredients are in the batching mixer, they shall be mechanically mixed for not less than three minutes. Hand mixing shall not be employed unless specifically approved. Mortar should be retempered to maintain high plasticity but shall not be used after 1½ hours from the initial mixing time.

Clay blocks

K Hollow clay blocks shall conform to the national standards as established by GBS and be of first quality good, sound, hard and well burnt, true to shape and size, ribbed and scored for plaster, unless otherwise described.

Concrete blocks

A Concrete blocks shall conform to the national standards as established by GBS and be of first quality good, sound, hard and well cured and true to shape and size of the types described with surfaces free from laitance and honeycombing. Blocks must be selected free from any fault with whole, even and sharp arises. Blocks are to be smooth or rough finish as indicated on the drawings and even in feature and colour throughout.

B Load bearing blocks shall have an average crushing strength (average of 5 units) of not less than $7N/mm^2$ measured over the gross area. Concrete masonry units shall be tested in accordance with A.S.T.M. C-140. The Contractor shall allow for testing 5 random units, prior to commencement of the job. The units shall be selected in the presence of the manufacturer's representative and the Project Manager's representative.

C No dimensions shall differ by more than 3mm from the specified standard dimension. "Standard Dimensions" refer to the manufacturer's designated dimensions and are not to be confused with "nominal dimensions" of modular size units which are equal to the standard dimensions plus 10mm thickness of one standard mortar joint.

D Minimum face-shell thickness and web thickness shall be as specified below:-

Nominal Unit Width	Minimum face shell	Web thickness
150mm	25mm	25mm
200mm	31mm	25mm
250mm	35mm	28mm
300mm	38mm	28mm

E Measurement shall be the average of 5 units taken at the thinnest point.

Laying blocks

F At the time of laying, all masonry units shall be free of excessive dirt and dust. Proper masonry units shall be used to provide a minimum of cutting. Where cutting is necessary, cuts shall be neat and true. Where masonry is to be bonded to a concrete beam or footing, the concrete surfaces shall be clean with laitance removed. Unless shown otherwise, blocks are to be laid in uniform courses with regular bond.

G Units shall be laid to preserve the unobstructed vertical continuity of the cells to be filled. Such cells shall be not less than 50mm x 75mm clear.

H Grouted cells are to be kept clear of all overhands, mortar droppings and other material. Cleanout holes shall be provided for each pour by leaving out every other unit in the bottom course of this section being poured. These cleanouts shall be sealed after inspection.

Laying blocks (cont'd)

A Mortar joints shall be straight, clean and uniform in thickness and shall be tooled as shown on the plans. Joints shall be tooled in a manner which compacts the mortar, pressuring the excess mortar out the joint rather than dragging it out. The mortar shall be well bonded to the block at the edges. Tooling shall be done when the mortar is partially set but still sufficiently plastic to bond. Where walls are to receive plaster or water-proofing agent, the joints shall be struck flush. Joints which are not tight at the time of tooling shall be raked out, pointed and then tooled. If it is necessary to move a unit after it has once been set in place, the unit shall be removed from the wall, cleaned and set in fresh mortar. Joints shall be 10mm thick unless specified otherwise and shall have full coverage on face-shells, webs and vertical ends.

B Where reinforcement is used in horizontal mortar joints, the thickness of the joints shall be at least twice the thickness of the diameter of the reinforcement. Alternatively, block cells can be notched twice the rod diameter and fully bedded in mortar.

C When hot, dry weather exists, units shall be wetted with a light fog spray, but not immersed into any vessel. The work shall be carried up course by course and no one portion shall be raised more than four courses at any time. All perpends and quoins shall be kept strictly true and square and carefully levelled through every second course. Build cross walls at the same time with main walls and properly bond together.

D Thoroughly wet clay blocks before laying.

E Tool joints of exposed blockwork which is not plastered for a depth of 20mm before the mortar has set to form an even joint and leave the edges of blocks well defined and sharp.

Grouting

F Where vertical reinforcement is specified or described, the reinforced cells are to be grouted for the full height of wall.

G Grout shall consist of concrete mix 21 N/mm^2. Sufficient water shall be added to make a workable mix that will flow into all the parts of the masonry cell without separation or segregation. The slump of the grout should be in the region of 75mm – 100mm. Grout shall be placed before any initial set occurs and in no case more than 1½ hours after water has been first added. Admixtures may be used subject to prior approval by the Engineer.

H Grout shall develop a minimum compressive strength of 21 N/mm^2 at 28 days when tested as follows:

I Grout shall be placed in a cell of a hollow concrete block of the type being grouted. The prism of grout so formed shall be separated and tested in compression in the same way as concrete test cubes except that any rough surface may require to be capped. For ease in separating the prism, the cell may be lined with porous paper. A minimum of ten preliminary tests will be required plus at least two tests for each day on which grouting is undertaken.

Grouting (cont'd)

1. Grout shall not be placed to a height of more than 1 block course at one time and there shall be a minimum interval of 60 minutes between pours. When work is stopped for one hour or longer, the horizontal construction joints shall be formed by stopping all tiers at the same elevation with the grout 38mm below the top. Grout shall be compacted with a suitable pencil vibrator.

2. The final pour where a block wall is constructed to abut a fixed soffit shall be carried out through a chute fixed to the side of the wall so that grout may be poured up to soffit level. The resultant surplus may be removed and cleaned off as soon as the grout has reached an initial set. After grouting, walls shall be hosed down to clean off scum and stains. No grout shall be placed until such time as the masonry mortar has sufficiently hardened to prevent "blow outs".

A Where the top of the grouted wall is exposed, it shall be kept moist for curing purposes for at least three days after pouring

Water-proofing

B Water-proofing of bedding courses to blockwall shall be Vandex Premix or approved equal applied in a continuous solid layer in accordance with the manufacturer's instructions and of sufficient depth to equal that of the blockwork regular course joints.

C Where an alternative waterproofing agent is to be utlised, the Contractor will first seek the written approval of the Project Manager.

D The Contractor shall submit details of the alternative procedure he intends to follow and the manufacturer's instructions.

E All surfaces are to be properly prepared, checked and approved by the Project Manager before application of the waterproofing compound.

Reinforcement

F Block walls generally shall have "Brick force" reinforcement laid in the joints after every third course of blockwork in addition to any rod reinforcement as shown on Project Manager's drawings.

G When a foundation dowel does not line up with a vertical core, it shall not be sloped more than one horizontal in six vertical. Vertical reinforcement shall be held in position at the top and bottom and at intervals not exceeding 192 diameters of reinforcement. Vertical reinforcing steel shall have minimum clearance of 6mm from the masonry and not less than one bar between bars.

H Wire reinforcement shall be completely embedded in mortar. Wire reinforcement shall be lapped a minimum of 225 mm at splices and shall contain at least one cross wire of each piece of reinforcement in the lapped distance.

I Overlapping horizontal wire reinforcement is to be used at all block corners and wall junction together with ties to framing concrete columns and vertical faces.

Reinforcement (cont'd)

J Where blockwork and concrete are joined with flush faces to be render finished, the joint is to be covered by stapled galvanised chicken wire or equal with 150mm overlap each side of the joint.

Chases and openings

A No chases and openings whatsoever shall be allowed without written permission from the Project Manager. Should chasing be necessary, they shall not be deeper than one-half the wall's thickness. No horizontal chase or the horizontal projection of a diagonal chase shall exceed 1.20m. Where openings are approved, they shall have lintels of reinforced concrete and such lintels shall have a bearing of 200mm minimum at each end. All such chases to be filled solid with mortar and flushed fair on completion.

B Block opening to receive joinery are to be exact dimensions within a tolerance agreed with the joiner that can be easily absorbed by the rough ground scribed to the opening.

Pricing

C Prices for blockwork shall include:-

1. All consideration arising from the specification.

2. All rough cutting, cutting and pinning up at top of walls, cutting at ends and around openings, cutting and bonding at intersections and building off beams and plates, filling exposed ends with mortar and forming and filling reveals.

3. All labours implied by the use of reinforcement where described as reinforced.

ROOFING

Sheet covering

A Sheet roof covering shall be corrugated metal roofing sheets; 'PBR' panel profile or other equal and approved; 24 gauge base metal from cold rolled steel to ASTM A625 grade D with aluminum / zinc hot dipped coating on both sides; pre-painted finish comprising a minimum of 5 microns thick baked on epoxy primer and 20 microns PVF2 to top and bottom surfaces (colour to be determined by Employer).

Screws

B Screws shall be #14 x 0.75 Tek lapping fasteners and #12 x 1" Tek fasteners for fixing to metal purlins unless otherwise specified, with neoprene washers and to centres as specified by the supplier of the roof sheeting.

Flashings and cappings

C Flashings and cappings shall be 24 gauge pre-painted roof panels bent to the required profiles and of equal coating and colour as the sheet covering; include for tape seal mastic sealant between lap of flashing and roof sheeting and fix in position in accordance with the supplier's details. Side laps to be with the prevailing wind direction.

Laying

D Lay roof sheeting and fix to metal purlins with single corrugation side lap and no joints in the running length or as prescribed by the manufacturer.

E Lay ridgings and flashings with minimum 12" end laps with tape seal mastic sealant and joint; include for filler block and tape seal mastic sealant along both sides of running length of cappings in accordance with manufacturer's recommendations and fix to steel purlins at 12" centres generally with #12 x 2" Tek fasteners and washers.

Water-tight

F Leave the roofs clean and watertight at completion and to the satisfaction of the Project Manager.

Pricing

G Prices for Roofing shall include for all considerations arising from this specification.

CARPENTRY AND JOINERY

Timber generally

A Timber shall be sound with reasonably straight grain and at least 95% heartwood free from warp waney edges, post hole beetle, splits, fringes, decay, infestation or other deformation and from sign of rot. Worm and beetle and shall not contain large, loose or dead knot, sapwood, shakes or other defects to such an extent or so situated in the piece as to render it insufficient in strength or stiffness for the work to be done.

B Timber, which is in the opinion of the Project Manager inferior in quality or condition or is not suitable for requirements of this work, shall not be used. No piece of exceptionally light wood shall be permitted. Samples of materials shall be submitted to the Project Manager for his approval before the start of the operations.

C Unwrought timber shall be sawn full to the dimensions stated, except that occasional variations in sawing are permitted. No variations in sawing shall be more than 5mm under the stated dimension when this is less than 200mm, or more than 6mm under the stated dimension when this is more than 200mm.

D Timber specified “dressed” on one, or both opposite sides, shall be more than 12mm less than the nominal dimension, unless stated to be “actual dimension”. Timber shall be held to be “dressed” by machine unless otherwise stated.

Pitch pine

E Pitch pine shall be best imported quality of mature growth, free from gross defects, air seasoned and having a minimum density of 0.578kg/cubic metre at 25% moisture content.

Plywood

F Plywood shall conform to B.S. 6566:1985 Grade 2 Veneer bonded with “weather and boil proof” synthetic resin adhesive unless otherwise described and shall be protected against infestation by the powder post beetle and like insect pests.

Teak

G Teak shall be prime quality, selected for appearance and left clean for oiling 100% free from sap.

Mahogany

H Mahogany shall be Honduras type local mahogany and of prime quality.

Treated timber

I All timber is to be vacuum/pressure impregnated with ”Wolmanised” preservative to a dry salt net retention of 8.009kg of “Wolmanol” per cubic metre of timber. Where timber is cross cut or bored after treatment all surfaces exposed should be liberally treated with “Wolmanol” preservative. All treated timber will be subject to test and shall be accompanied by a supplier’s certificate of conformity with this Specification.

Exposed faces

A Timber which is to be exposed in the finished work shall be "dressed" unless otherwise described.

Standards

B The following British Standards shall apply insofar as they refer:-

Isometric block hexagon bolts, screws and nuts	BS 4190
Nails	BS 1202
Wood screws	BS 1210
Workmanship and Maintenance	BSCP 112 :Part2
Preservative Treatment for constructional Timber	BSCP 98

Natural finish

C When natural finish or staining, clear polish or varnishing is specified, the timber in adjacent pieces shall be matched or uniform or symmetrical in colour and grain.

Shrinkage

D Arrange, joint and fix all joinery work in such a manner that shrinkage in any part and in any direction shall not impair the strength and appearance of the finished work and shall not cause damage to adjoining materials or structure.

Moisture content

E The moisture content of timber as delivered for the work shall not be more than 15 percent for joiner's work, nor shall this content be allowed to increase whilst work is in progress.

Joints

F The Contractor shall perform all necessary tenoning, grooving, matching, tongueing, housing, rebating and all other works necessary for the correct jointing. He shall provide all metal plates, screws, nails and other fixings that may be ordered by the Project Manager or that may be necessary for the proper execution of the works unless otherwise stated on the drawings.

G All joints are to be type specified or as is most appropriate in the circumstances. The joints shall be designed and secured so that the stresses to which they are subjected may be either resisted or compensated. Loose joints are to be made where provision must be made for shrinkage or other movements acting other than in the direction of the stresses of fixing of loading.

H Glued joints are to be used where provision need not be made for shrinkage or other movement in the connection and here sealed joints are required. All glued joints shall be cross tongued or otherwise reinforced.

I All nails, sprigs, etc. and other joinery works shall be accurately scribed to fit the contours or any irregular surface against which they may be required to form a close butt connection.

Screws

A All screws shall be non-corrosive, pre-drilled and countersunk with dowel filling or matching timber.

Nails

B All nails used shall be galvanised wire nails driven into pre-bored holes not exceeding 4/5 of the nail diameter.

Bolt holes

C Bolt holes shall be large enough to permit easy access for the bolt but may not exceed D+D/16 or 4mm whichever is the larger, where D is the bolt diameter.

Tolerance

D All structural timbers shall be sawn timbers to the section given on the drawings. Permissible tolerance on cross section dimension will be +6mm and –3mm with no allowance for wane.

E Provide reasonable tolerance at all connections between joinery work and the building carcass so that any irregularities, settlement or other movements shall be adequately compensated for .

Fabrication

F Joinery work shall be carried out by competent craftsmen. The Contractor shall check the exact dimensions of masonry openings to ensure that the rough grounds can absorb the tolerances of exact dimensions.

G Free-standing or independent joinery shall be dimensioned from the Project Manager's drawings. Any discrepancies shall be brought to the attention of the Project Manager in writing before fabrication is commenced. Allowance shall be made for the production of prototype joinery units for testing and written approval by the Project Manager.

H Put in hand all joinery work immediately on commencement of the Works and store in a dry place and put together without wedging up for the inspection and approval of the Project Manager. Care shall be taken in fabrication to avoid excessive wetting or drying of the timber.

I Where joinery works are shown built-in or erected in position before the surrounding or enclosing works of the main building carcass have been carried out, it shall be the responsibility of the Contractor to ensure that the works are set plumb and shall not be damaged or be displaced by subsequent operations.

J Where necessary, the joinery shall be temporarily braced and encased. Provide and secure suitable anchors or other fixings so that these may be "built-in" to the carcass while it is being constructed. The anchorage connections shall be constructed so that they shall permit settlements in the building carcass without stressing or otherwise loading the joinery works. No fixing of temporary strutting into the finished joinery will be allowed.

K Joinery works shall not be fixed in position until after all floors, walls and ceiling surfaces have been formed and constructed, unless otherwise specified.

Fixing

A All fixings, plates, shoes or straps shown on the drawings shall be neatly formed of mild steel plate drilled and welded as necessary. Prior to erection, all mild steel components shall be wire brushed and primed with one coat or red lead zinc chromate primer. All surfaces in contact with the wood shall be painted with a further two coats of bituminous paint.

Shop drawings

B Shop drawings shall be produced for all joinery work for review and approval by the Project Manager.

Ironmongery

C Provide samples of all ironmongery not included in the Ironmongery Schedules for selection by the Project Manager without charge.

D Carefully wrap and protect all ironmongery until completion of the work and replace any which may be defaced or damaged without charge as the Project Manager shall direct. Oil all locks and adjust and leave in perfect working order on completion and properly label all keys and deliver up in accordance with the Project Manager's instructions.

E Fix all ironmongery with screws of the same metal and finish as the fittings themselves. Remove and replace with new ones all screws damaged when driven by the turn screw or from any other cause.

F Remove all ironmongery when painting or carrying out other works likely to damage the fittings and replace on completion.

Pricing

G Prices for Carpentry/Joinery shall include:-

1. All considerations arising from the specification.
2. Pre-finished built-in joinery fittings including all frames, legs, bolts, screws, straps, spacer blocks, etc. ironmongery and decoration.

STRUCTURAL STEEL WORK

Standards of Construction

A Structural steel work and testing shall comply with the relevant Clauses of BS 449, CAN/CSA-S16 or AISC Specification for the Design, Fabrication and Erection of Structural steel buildings.

Fabrication and Erection Documents

Connection Design Details

B Connection design shall be prepared in advance of preparing shop details and submitted to the designer for confirmation that the intent of the design is met. Connection design details shall provide details of typical and special types of connections, and other data necessary for the preparation of shop details. Connection design details shall be referenced to the design drawings.

Shop Details

C Shop details shall be prepared in advanced of fabrication and submitted to the designer for review.

D Shop details shall provide complete information for the fabricator of various members and components of the structure, including the required material and product standard; the location, type, and size of all the mechanical fasteners; bolt installation requirements; and welds.

Erection Diagrams

G Erection diagrams shall be submitted to the designer for review. Erection diagrams are general arrangement drawing showing the principal dimension of the structure, piece marks, sizes of the members, size and type of bolts, field welds, bolt installation requirements, elevations of column bases, all necessary dimensions and details for setting anchor bolts, and all other information necessary for the assembly of the structure.

Contractor to submit drawings

H The Contractor shall include for the preparation of all shop details from the drawings supplied by the Project Manager. All such details shall be approved, by the Project Manager in writing before the work is put in hand.

I Every drawing shall show the number and sizes of all rivets and bolts, complete details of welds, types of electrodes, welding procedure, whether the welds are to be made in the shop or elsewhere and any other relevant information.

Accuracy of drawings

J The Contractor shall be responsible for the correctness of his shop details and for shop fittings and site connections.

Erection scheme/procedures

A The Contractor shall submit to the Engineer for his approval, drawings showing the proposed erection scheme together with all calculations for erection stress etc. Erection procedures shall outline the construction methods,, erection sequence, temporary bracing requirements, and other engineering details necessary for shipping, erecting, and maintaining the stability if the steel frame. Erection procedures shall be supplemented by drawings and sketches to identify the location of the stabilizing elements. Erection procedures shall be submitted for review when so specified. The approval by the Project Manager will not absolve the Contractor in any way from his responsibility.

Fieldwork details

B Fieldwork details shall be submitted to the designer for review. Field work details shell provide complete information for modifying fabricated members in the shop or on the job site. All operations required to modify the member shall be shown on the fieldwork details. If extra materials are necessary to make modifications, shop details shall be required.

Description

C Structures shall be built as indicated on the plans, in accordance with the specifications for the various items which constitute the complete structure, and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or established by the Engineer.

The Contractor shall so plan and carry out on his work, including fabrication, erection, and construction, that the structure as a whole and all its components parts will function as contemplated in the design.

Verification of dimensions

D The Contractors shall take the dimensions from the site or buildings, and he shall verify all dimensions given on the drawings and satisfy himself as to the correctness thereof and the mutual agreement of parts before the work is put in hand.

Copies of orders

E A copy of all orders for materials shall be supplied by the Contractor to the Project Manager at the time of ordering, for identification purposes.

Rejection

F Any portion of the work which, in the opinion of the Project Manager is not in accordance with the drawings or specifications shall be rejected whether before or after delivery and must be removed from the site, if delivered, within a reasonable time after receipt of the Project Manager's notice of rejection, at the Contractor's expense.

G Any delay caused by this shall not relieve the Contractor from his responsibility to complete within the date stated in the contract.

H If any welding is found to be defective, the cost of all remedial measures shall be borne by the Contractor including the cost of re-testing and subsequent inspection of welds.

Rejection (cont'd)

A The Contractor is responsible for good quality welding work and no exceptions will be made on the grounds that the Project Manager has inspected and approved any part or parts of the work at some stage during production.

Temporary Erection

B Trial erection of major units may be required at the Project Manager 's discretion. The cost of such temporary erection, testing, packing, marking, carriage and delivery is deemed to be included in the Contractor's tender figure.

Cutting

C Cutting may be by shearing, cropping, sawing or machine flame cutting. Hand flame cutting may be permitted, subject to the approval of the Project Manager.

D Sheared or cropped edges shall, if necessary be dressed to a neat workmanlike finish and be free from distortion.

Holes

E All matching holes for bolts shall register with each other so that a gauge 2mm less in diameter than the diameter of the hole will pass freely through the assembled members in a direction at right angles to such members. Finished holes shall not be more than 2mm in diameter greater than the diameter of the bolts passing through them.

F Holes for bolts shall not be formed by a gas cutting process.

Damage

G Any damage to materials on the site due to inadequate precautions being taken during the erection of the steel work shall be made good to the satisfaction of the Project Manager at the Contractor's expense.

Fabrication

H The Contractor shall fabricate all steel work off the site. The Project Manager shall be informed of all work before fabrication, and the location of such work shall be stated. The Project Manager shall have access at all reasonable times to all places where work is being carried out and shall be provided by the Contractor with all necessary facilities for inspection during fabrication and erection. The Contractor shall give at least 48 hours' notice to the Project Manager when the fabrication work is ready for inspection before delivery.

I The Project Manager shall at his discretion and at the Contractor's cost direct the tests be carried out on materials and workmanship to ensure that the Specifications and the assumptions made in design are being satisfied.

Straightness

J All material before and after fabrication shall be straight and shall be free from twists.

Clearance

A Care should be taken to ensure that the clearances specified are worked to. The erection clearance for cleated ends of members connecting steel to steel shall not be greater than 2mm at each end. The erection clearance at ends of beams without web cleats shall not be more than 2mm at each end.

Bolting

B The bolt shall be provided with a washer of sufficient thickness, under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together.

C The threaded portion of each bolt shall project through the nut at least 6mm.

Materials

D Quality of Structural Steel

(a) Structural steel shall comply with BS 4360, AISC, ASTM A36 or CAN/CSA G40.20/G40.21 350W

(b) Mild steel rivets shall comply with BS 4361 Part 1 and BS 4360 or ASTM 502

(c) Mild steel and medium tensile steel electrodes or metal arc welding shall comply with the requirements of BS 639 or AWS.

(d) High tensile steel electrodes for metal arc-welding shall comply with the requirements of BS 2549 or AWS.

(e) All mild steel bolts, nuts and washers shall comply with the requirements of BS 4190, 3692 and 4320 or ASTM A307.

(f) All high tensile friction grip bolts, nuts and washers shall comply with the requirements of BS 4395 or ASTM A325 or A490.

Structural steel

E Structural steel and other structural metals shall conform to CAN/CSA G40.20/G40.21 350W, "*General Requirements for Rolled or Welded Structural Quality Steel" and "*Structural *Quality Steels" respectively and* AISC "*American Institute of Steel Construction"*. The yield strength, F_y, and the tensile strength, F_u, used as the basis for design shall be 350 MPa and 450 MPa respectively.

Steel Bolts, nuts and washers

F Steel bolts, nuts and washers shall meet the provisions of ASTM A325, "*Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength";* ASTM A490, "*Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength".*

Welding

C The welding of steel shapes and plates for structural purposes is governed by CAN/CSA-S16.1, "*Limit States Design of Steel Structures",* and CSA Standard W59*, "Welded Steel Construction (Metal-Arc Welding)".*

Marking of steel

D Each piece of steel shall be so marked so as, to trace the manufacturer or cast from which it was made and the consignment from which it came.

E For rivets and small pieces of metal, tag marks will be sufficient.

Dimensions

F The dimension and allied requirements of all structural steel sections shall be to the following British Standards or equivalent American Standards.

G Rivets shall comply with the requirements of BS 275 for dimensions.

H Black bolts, nuts, studs, lock nuts and washers shall comply with the requirements of BS 916 for dimensions and with BS 84 for screw threads, or with BS 2708 and BS 1580 for unified black bolts etc.

I Turned bolts shall have the shank turned to the specified diameter allowing only a minus tolerance to 0.13mm.

Weights of steel

J The weight of steel per pound given on the drawings do not include the shelf angles, brackets, riveted angles to web, nor the plates riveted or welded to flanges of structural rolled sections joists and other structural members.

Surfaces

A All surfaces of steelwork shall be clean, free from loose mill scales and loose rust.

Tests and Inspection

B Where and when required by the Engineer, the Contractor shall take and deliver samples of structural steel to him for testing. Should the results of the tests be unsatisfactory the whole consignment of steel, which the sample represents, shall be rejected and shall be replaced by other material of proper quality at the expense of the Contractor.

C The Project Manager shall be given at all reasonable times free access to the site of the works where work is being prepared for the site.

Paints

Shop Painting

D Steel surfaces specified to be painted shall receive a prime coat applied in the shop for which is included in the price bid from structural steel.

Primer for steel work shall be Zinc Chromate Anti-corrosive primer or other equal and approved. Where bituminous paint is specified, it shall be black bituminous paint to BS 3416 type 1 or other equal and approved.

Workmanship

Generally

E The whole of the fabrication and erection of the steelwork shall be carried out in accordance with BS 4360 or AISC specifications.

F Welding steel must conform to BS 1859 "General requirements for the metal-arc welding of mild steel" or AWS specification.

G For welding any particular type of joint the Contractor shall provide evidence that the welder has satisfactorily carried out and completed the appropriate tests.

H Any welder's tests shall be made at the Contractor's expense. The right to make such test to determine if the welds conform to the standards above is reserved to the Project Manager.

Work off site

Shop details

I Except as noted on the drawings or as otherwise specified herein, shop details shall be governed by AISC specification for the Design, Fabrication and Erection of Structural Steel for Buildings or BS 4360: Part 2 as revised and amended to date.

J Substitution of sections or modifications of design details or both shall be made only when approved by the Project Manager and at no additional cost to the Project Manager.

K All details shall develop full strength of main members and shall be of such design as to use the minimum amount of material. However, all connections of main members shall be at least equivalent to an AISC or BS 4360 standard connection. In bracing and other work where members have been determined by using minimum size the connection shall develop 50% of the strength of the member, not less than 435kg. In beam and girder work, connections shall be equivalent to an AISC or BS 4360 standard connection. Provide "DRAW" on all tension bracing.

Shop connections

L All shop connections shall be welded unless otherwise noted or specified.

M Field connections shall be made with high tensile steel bolts, except that standard bolts may be used where so indicated on the drawings or allowed by the Project Manager.

Shop work

A Shop work shall be governed by AISC specification for the Design, Fabrication and Erection of Structural Steel for Buildings, or BS 4360 as revised and amended to date.

B Rolled materials, before being laid out or worked shall be straight within the tolerances allowed by ASTM specification A6 or BS 4360. If straightening is necessary, it shall be done by methods that will not injure the metal.

C Gas cutting shall preferably be done by a machine. Gas cut edges which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be free from gouges. Any gouges that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 12mm.

Shop painting

D After inspection and approval and before leaving the shop, all steelwork shall be cleaned by wire brushing, or by other approved methods, of weld slag, flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed with a solvent cleaner. Area specified to have no shop paint shall, after fabrication, be cleaned of oil or grease and other foreign material by thorough sweeping with a fibre brush.

E All structural steel shall be given one shop coat of paint. Surfaces not in contact but inaccessible after assembling, shall have one additional shop coat of paint before assembling. Surfaces in contact after assembling need have no paint. Surfaces of '"friction type" high strength bolted connections and surfaces within 50mm of field welds shall not be painted.

F Paint shall be fixed and applied in strict accordance with the paint manufacturer's printed directions. Paint applied to the steelwork, when dry, shall have a minimum thickness of 0.025mm.

G Machine finish surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

H Where noted on the drawings, structural members shall be shop-assembled, checked for alignment and match-marked to insure correct and accurate fit.

Shop welding

I Welding shall be done in accordance with the requirements of the American "Code for Arc and Gas Welding in Building Construction" of the American Welding Society or BS 639. All welding, whether shop or field, shall be done by the electric-arc method.

J Every effort and precaution shall be taken and methods used in making continuous welds to avoid distortion of the member due to welding operations. Unless otherwise approved on the basis of results obtained, continuous welds shall be made up of intermittent welds spaced to prevent excessive heating of the metal and jointed into a continuous weld by filling in between intermittent welds with a series of short welds. Welds shall be solid and homogenously a part of the metals joined and free from pits or slab or scale inclusions. Surfaces of welds shall be uniform and regular and shall be full area indicated or required to develop the necessary strength of the joint.

Shop welding (cont'd)

A Welding plant, instruments, cables and accessories shall conform to the requirements of the appropriate British or American Standards and welding shall be carried out in accordance with BS 1856 or AWS requirements for the metal-arc welding of mild steel.

B Electrodes used for the making of weld shall conform to the requirements of BS 639 or AWS.

C Any electrodes, which have areas of the flux covering broken away or damaged shall be discarded.

D The welder shall ensure that the weld metal can be fully and satisfactorily deposited throughout the length and thickness of all joints, so that the distortion and shrinkage stresses are reduced to a minimum and that the welds meet the requirements of quality given under workmanship in BS 1856 or AWS.

E The parts to be welded shall be maintained in their correct positions during welding and parts to be fillet welded shall be brought into as close contact as practicable and the gap due to faulty workmanship is incorrect fit-up should not exceed 2mm. If greater separation occurs locally, the size of fillet weld shall be increased at such positions by the amount of gap.

F After making each run of welding all slag shall be thoroughly removed.

G The weld metal, as deposited, shall be free from cracks, slag inclusions, gross porosity, cavities and other deposition faults. The surface of the weld shall be uniform with consistent contour and regular appearance.

H Welding shall not be done under unsatisfactory weather or other conditions, which might adversely affect the efficiency of the welding.

Work on site

Delivery

I Fabricated steelwork shall be delivered to the job site in accordance with a sequence and schedule that will permit efficient, continuous erection. Steelwork shall be correctly and legibly marked and match-marked.

Unloading and storage

J Erection of the steelwork and joists shall include receiving, unloading and any necessary temporary storage of the fabricated material. Carriers shall be unloaded promptly. The Contractor shall pay for any demurrage charges resulting from failure to do so.

K Materials stored at the job site shall be so placed that no members shall be damaged and shall be protected against corrosion or deterioration of any kind. The Project Manager reserves the right to reject material that has become damaged or corroded because of improper storage.

Schedule

L The Contractor shall submit an erection schedule giving the proposed method and sequence of erection prepared to avoid delay or any damage to the work of other Contractors. The location of supports for cranes, hoists, rigging and material shall be carefully studied and shall be as approved by the Project Manager.

Handling and setting

A The Contractor shall use care in handling and erecting all material and shall support same properly at all times to insure that no piece will be bent, twisted or otherwise damaged. Materials damaged due to the carelessness of the Contractor shall be corrected at his expense, to the approval of the Project Manager.

B All structural steel shall be set accurately to the lines and elevations shown on the drawings. All members shall be connected temporarily with sufficient bolts to ensure the safety of the structure until the permanent connections are made.

C The Contractor shall assume full responsibility for the correct plumbing and alignment and for setting of all structural steel members. He shall provide all guys, braces, etc. necessary to maintain the structure plumb and in proper alignment until such time as the work of the other trades is in place, and in the opinion of the Engineer, the guys and bracing are no longer necessary.

D The Contractor shall exercise utmost care in erecting steel to avoid endangering the structure, construction personnel, or other personnel having legitimate business at the site. The Contractor shall protect the work of other Contractors from damage and make good any damage caused by the installation of his work.

Fitting

E If members do not fit properly in the field, corrections shall be made as directed by the Project Manager. Any new holes necessary shall be drilled; material shall be cut with a hacksaw. No cutting with a torch will be allowed except where specifically approved by the Project Manager. If consent is given, burned members shall be finished to an acceptable appearance, which shall be the equal of the finish.

F Warped or bent members shall be straightened to the approval of the Project Manager before being erected.

G Only light drafting will be permitted to draw parts together. Drifting to match unaligned holes will not be permitted. Any enlargement of holes necessary to make connections shall be done by reaming with twist drills, and the proper size bolts used.

Connections

H Field welding, unless shown on the approved shop drawings will not be allowed except where specifically approved by the Project Manager.

I High strength bolting methods shall be in accordance with the "Specification for Structural Joints using ASTM A-325 or A-490 Bolts", latest edition, as published by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation or BS 4395. The Project Manager will require that all stipulations of this specification are met and shall approve the procedure for calibration of wrenches and installation of bolts. The Project Manager will further observe the field installation to determine that these procedures are followed.

Connections (cont'd)

J Where assembled, all connection surfaces, including those adjacent to the bolt head, nuts or washers, shall be free of scale, and shall also be free of burrs, dirt and other foreign material that would prevent solid seating of the parts. Where bolts and welds are used in the same connection, all bolts shall be fully tightened and inspected before welds are made.

A Bolts shall be tightened with properly calibrated impact wrenches or by the turn-of-nut method. If required because of bolt entering and wrench operation clearances, tightening by either procedure may be done by turning the bolt while the nut is prevented from rotating.

B Impact wrenches, if used, shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Impact wrenches shall be calibrated with a Skidmore-Wilheim calibrator not less than once daily in mild weather, not less than twice daily in cold weather, or as often as directed by the Project Manager. Each bolting crew shall distinctly mark each joint so that it can be determined which impact wrench was used to tighten the joint.

C If the turn-of-the-nut method is used, nuts and protruding bolt points shall be match-marked with a crayon or dab of paint before final tightening to permit inspection of the accuracy of final tightening.

D The Contractor shall furnish for the Project Manager, facilities, such as ladders, scaffolds, and safety assistance to permit inspection of any and all work. Co-operation in assisting and permitting access to all places of work is mandatory.

Clean up

E After the erection of steel, the shop coat of paint shall be made suitable to receive the touch-up and finish coats. Where surfaces are damaged during erection or where necessary for the Contractor to scrape off shop coat and repaint same, or to remove clay, mud or other foreign materials, the cost of this work shall be borne by the Contractor.

F Upon completion of this work, the Contractor shall remove all equipment, tools, and refuse occasioned by his work, and leave the site in a clean and orderly condition.

Pricing

G Prices of Structural Steelwork shall include for all considerations arising from the Specification.

Quality assurance

A Fabricate structural steel members in accordance with AISC specifications.

B Welders shall be qualified in accordance with AWS D1.1 for each process, position and joint configuration.

C Maintain one copy of each referenced document on site.

D Survey anchor bolts for location and elevation prior to casting concrete.

E Fabricator Qualifications: The Company shall submit written documentation of experience in performing the work of this Section prior to award of the Subcontract.

F Erector Qualifications: Company with a documented experience in performing the work of this Section.

G The design of connections not detailed on the Drawings shall be under the direct supervision of a licensed Structural Engineer experienced in design of this work.

METAL WORK

Generally

A Mild steel plates, bars, sections, tubes, etc., shall conform to B.S. 4360:1979.

B The surfaces of steel shall be smooth, clean and free from rust. Loose rust and scale shall be removed from the steel prior to dispatch for the Works and any subsequent accumulation of dirt, oil or grease shall be cleaned off immediately prior to erection.

Welding

C Weld by an approved method giving ductility and tensile strength comparable with that of the metal joined. Fillet welds only shall be used.

D Grind all soldered or welded joints, seams, etc., to a smooth finish, remove all rough edges and leave the whole perfect to the satisfaction of the Project Manager.

Forged work

E Clean all forged work and put together in the best and most workmanlike manner, drill all holes and clean off burrs and ensure that all countersinkings are concentric and treads and tappings are accurately fitted.

Bolts

F All bolts unless otherwise described shall be British Standard Whitworth black bolts with hexagonal heads and nuts and round washers. Use splayed washers where necessary to effect tight joints.

Fixing

G Form all mortices, chases, etc., and securely anchor to the structure all metalwork and make good the surfaces to which they are fixed.

Leave clean

H Clean all exposed metal surfaces on completion with water or an approved petroleum product such as methylated spirit or kerosene. Make good any damage caused by the use of an improper cleaning material.

Galvanising

I Where galvanising is specified, provide a zinc coating as follows:-

1. Iron and steel hardware to ASTM A153.
2. Rolled, pressed and forged steel sections to ASTM A123.
3. Assembled steel products to ASTM A386.

Inspection

A Examine areas and conditions under which work is to be executed and make corrections as necessary to ensure its proper and timely completion.

Shop drawings

B Shop drawings shall be produced for all fabricated metalwork for review and approval by the Project Manager.

Painting

Metalwork

C Prepare surfaces of metalwork for painting by removing dirt, grease, etc., with an approved solvent and rust and scale by wire-brushing, chipping, etc., allowing to dry.

D Paint metal surfaces with one coat of primer and two coats of oil paint allowing at least one hour drying between coats.

Pricing

E Prices for Painting and Decorating shall include:-

1. All considerations arising from the specification.
2. Varying colours in individual rooms or areas in accordance with the Engineer's colour schemes.
3. Preparing fairly large sample panels of finishing colours as and when directed by the Engineer.
4. All preparatory work to the surfaces to be painted.

STEEL-FRAMED STAIRS

General

F Construct stairs to conform to sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, handrails, railing systems, newels, balusters, struts, clips, brackets, bearing plates, or other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.

a. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated.

G Commercial class, unless otherwise indicated.

General (Cont'd)

A Stair Framing: Fabricate stringers of structural steel channels, plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; and bolt or weld newels and framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finish surfaces.

B Metal Pan Risers (Inside Use Only): Shape metal pans for risers to conform to configuration shown.

Provide thicknesses of structural steel sheet for metal pans indicated, but not less than that required, to support total design loading.

a. Form metal pans of galvanized-steel sheet, where indicated.

b. Directly weld risers to stringers; locate welds on side of metal pans to be concealed.

c. Provide sub platforms of configuration and construction indicated; if not indicated, in thicknesses required to support design loading. Attach sub platform to platform framing members with welds.

C Floor Plate Treads and Platforms: Provide formed treads (and platform) of 1/4 inch thick steel floor plate with integral nosing and back edge stiffener. Weld steel supporting brackets to stringer and weld treads to brackets.

a. Pattern: Manufacturer's standard.

b. Finish: Galvanized.

D Fabricate treads with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

Steel pipe handrails and railing systems

Scope of Works on site

E. The work on site consists of the following:

i. Supply and installation of railing as per designs in drawings.
ii. Supply and installation of stairs handrail as per designs in drawings.

Allied Documents

F. The following documents are to be read in conjunction with all of the following specifications:

i) Drawings
ii) Bill of Quantities

General

A Fabricate pipe handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.

B Interconnect railing and handrail members by butt-welding, unless otherwise indicated. a. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe to which end is joined, and weld all around.

C Form changes in direction of handrails and rails as follows:

a. As detailed.

D Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E Close exposed ends of pipe by welding 3/16-inch-thick steel plate in place or with prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.

F Flanges, Fittings, and Anchors: Provide end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of handrails and railing systems to other work. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work.

a. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

G For galvanized handrails and railing systems, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

Finishes

General

H Finish metal stairs and railings after assembly.

a. Comply with NAAMM "Metal Finishes Manual" for recommendations on application and designations of finishes.

Galvanizing

I Hot-dip galvanize items indicated to be galvanized to comply with applicable standard listed below:

a. ASTM A 153 for galvanizing iron and steel hardware.
b. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
c. Fill vent and drain holes that will be exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

STEEL BAR GRATINGS

Standards

A Comply with NAAMM MBG 531, "Metal Bar Grading Manual for Steel, Stainless Steel and Aluminum Gratings, and Stair Threads."

Materials

B Steel Plates, Shapes, and Bars: ASTM A36.

C Wire Rod for Grating Crossbars: ASTM A510.

Type

D Weld.

Traffic Surface:

E Standard Applications: Plain.

F Wet or Slip Hazard Application: Abrasive.

Finish

All Areas

G Hot-dip galvanized with a coating weight of not less than 1.8 oz. /sq. ft. of coated surface.

CHAIN LINK FENCING

General

Reference Documents

A. American Society for Testing and Materials (ASTM):

A.1 ASTM A53 / A53M - 12 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

B. Canadian General Standards Board (CGSB):

B.1 CAN/CGSB-138.1-96 Fabric for Chain Link Fence.

B.2 CAN/CGSB-138.2-96 Steel Framework for Steel Fence.

B.3 CAN/CGSB-138.3-96 Installation for Chain Link Fence.

Detail Drawings

C. Following detail drawings are separate and form part of the Bidding Documents.

Sheet Number	Sheet Title
32 31 00.01	Gate Set-Back Detail
32 31 00.02	Standard Chain Link Fence
32 31 00.03	Typical Chain Link Pedestrian Gate
32 31 00.04	Typical Chain Link Vehicle Gate

Delivery, Storage And Handling

D Separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74 19 – Waste Management and Disposal.

Products

E Standards

E.1 Steel Pipe to ASTM A53.

E.2 Chain Link Fabric to CAN2-138.1.

E.3 Fence, Chain Link, Frame Work, Zinc-Coated, Steel to CAN2-138.2.

E.4 Fence, Chain Link Installation to CAN2-138.3.

Materials

F Pipe: Steel butt weld, Schedule 40, hot dip galvanized to 550 g/m^2 coating.

Materials (Cont'd)

A Mesh Wire: [Galvanized steel wire hot-dipped galvanized to 490 g/m^2] [Galvanized steel wire hot-dipped galvanized to 90 g/m^2] and polyvinylchloride coated to [0.560] [0.380] mm thickness.

B Concrete: [Sulphate resistant] [Normal] Portland cement, 20 MPa @ 28 days, 50 mm to 80 mm slump, 20 mm aggregate, 6% air entrainment.

Components

C Line Posts: [48 mm O.D.,4.05 kg/m] [60 mm O.D., 5.43 kg/m].

D Corner, Terminal and Straining posts: [60 mm O.D., 5.43 kg/m] [73 mm O.D., 8.62 kg/m] [89 mm O.D., 11.28 kg/m].

E Gate Posts: [89 mm O.D., 11.28 kg/m] [114 mm O.D., 16.06 kg/m] [168 mm O.D., 28.23 kg/m].

F Top and Brace Rail: [33 mm O.D., 2.51 kg/m] [42 mm O.D., 3.38 kg/m] plain end, sleeve coupled.

G Gate Frame: 42 mm O.D., 3.38 kg/m. Gate leaves to have horizontal and vertical intermediate brace on gate leaves 3.0 m wide and over.

H Post Caps: Cast aluminum, sized to post diameter, set screw retained.

I Extension Arms: Cast aluminum to accommodate 3 strands of barbed wire, [vertical] [sloped 45°], top strand 300 mm from fence fabric].

J Line Post Eye tops: Cast aluminum.

K Rail Ends: Cast aluminum.

L Fittings: Sleeves, bands, clips, tension bars, fasteners and fittings galvanized steel.

M Fabric: 50 mm diamond mesh, interwoven 3.5 mm wire, top selvage twisted tight, bottom selvage knuckle end closed.

N Bottom tension Wire: 3.0 mm steel single strand hot-dipped galvanized to 490 g/m^2

O Barbed Wire: 2.5 mm wire, three strands, four point barbs at 150 mm on centre, zinc coated steel.

P Single Gate Hardware: 2 piece [drop] [lift] latch and latch catch. Gate hinge 180° male and female [hardware for padlock] [chain hold open].

Q Double Gate Hardware: Gate centre rest, [2 piece [drop] [lift] latch and latch catch with foot bolt] [3 piece drop latch and latch catch with drop bolt]. Gate hinge 180° male and female [[Hardware for padlock] [chain hold open] [gate keeper post and ground latch stop]].

R Sliding Gates: 48 mm O.D., 4.05 kg/m for top, bottom and upright members and 42 mm O.D., 3.38 kg/m for horizontal and diagonal members. Free-operating roller assembly.

Execution

Installation

A Install to alignment specified, line posts, corner posts, gate posts and top rails to provide rigid structure for [ ] [1.2 m] [1.8 m] high fabric and gates.

B Maximum spacing of posts: 3.0 m on centres

C Install line and corner posts plumb.

D Set posts in cylindrical cast-in-place concrete footings sized as follows:

Location	Depth	Diameter
Fence height up to 1.2 m:		
Line posts	900 mm	250 mm
Gate and corner posts	1000 mm	300 mm
Fence height 1.2 to 1.8 m:		
Line posts	1000 mm	250 mm
Gate and corner posts	1200 mm	300 mm

E Set posts to within 150 mm from bottom of concrete footing.

F Set top of concrete footing 50 mm above finished grade. Slope top of footing to ensure water runoff.

G Position bottom of fabric 50 mm above finished grade with tension wire stretched taut between posts.

H Align top of posts to ensure that top rail varies gradually with changes in ground elevations.

I Pass top rail through line post tops to form continuous bracing. Install 150 mm long couplings mid-span at pipe ends.

J Brace each gate and corner post back to adjacent line post with horizontal centre brace rail. Install brace rail, one bay from corner and gate posts.

K Install 10 mm steel truss rod and truss tightener diagonally from top of gate post back to adjacent line post.

SPEC NOTE: Specify truss rod and tightener where gate leaves are 3.0 m wide and over or for gate leaves for 1.8 m high and over fence.

L Fasten fabric to top rail, line posts, braces and bottom tension wire with 3.5 mm wire ties maximum 500 mm centres.

M Attach fabric to corner and gate posts with tension bars and tension bar clips. Stretch fabric between posts at intervals of 30.0 m maximum.

Execution (Cont'd)

Installation

A Install straining post at 90 m approximately.

B Install 3 strands of barbed wire on arms, tensioned and secured. Slope extension arms for barb wire [inward] [outward.

C Install gates of sizes shown using fabric [and vertical extension arms] to match fence. Install 3 hinges per leaf and hardware specified.

D Provide concrete centre rest and drop bolt retainers at centre of double gate openings.

E Install sway brace units on gate posts where gate leaves are 4.9 m and over in width.

END OF SECTION

PLUMBING INSTALLATION

General

A. The works as described in this specification relate to the plumbing installation works to the Grenville Commercial Complex Ltd. (GCCL), located in Grenville in the parish of St. Andrew, Grenada.

Compliance and Codes

B. Compliance with the Specification

1) Comply in full with the requirements described or implied by the technical specification as well as all relevant drawings issued under the Contract. In this respect, the specification and drawings are complementary and anything called for in the specification and not shown on the drawings or vice versa, must be considered as appearing in both and hence to be supplied and installed as part of the Contract.

2) Comply with the requirements of the local Plumbing Code.

Drawings

C. A list of Drawings accompanying this Specification Document is given at Appendix B.

Scope of Work

D. The intent of these specifications and of the drawings is to cover and include all of the apparatus, appliances, materials and labour necessary for the proper installation of the plumbing works. Any exceptions to this one properly defined elsewhere in this specification. This shall include but shall not be limited to the following: -

1) Supply and install water supply piping inclusive of all fittings to the proposed building.

2) Supply and install soil, waste and vent systems including connecting water lines to the nearest manhole to the sewage collector system.

3) Supply and install sanitary ware.

Locations

E. All locations are approximately correct but are understood to be subject to modifications as may be found necessary in order to meet structural conditions and the requirements of other equipment installations prior to and/or at the same time of installation.

Co-ordination and Method

A. All roughing-in shall be done from measurement of the actual fixtures or from the manufacturers' brochures giving these specific details. Unless stated otherwise, all pipework above ground shall be concealed within walls, ceiling and plumbing ducts provided and any deviation from this shall be first approved by the Project Manager.

Clean-Outs

B. No clean-out within the building shall be left protruding out of the wall or floor, except where it is concealed behind a sanitary fitting. In all visible locations, clean-out plug shall be recessed and covered by a metal plate. Clean-outs external to the building shall terminate at Grade Level for easy access and properly protected from traffic or otherwise.

Materials Non-Pressure Waste and Soil Pipes

C. Waste and soil pipes up to 100mm diameter internal to the building shall be PVC DWV. (Imperial sizes). PVC pipe shall be installed with all standard PVC fittings using the correct solvent cement for this application.

Cold Water Supply Pipes

D Pipes 25mm to be Grade E PVC. All pipes must withstand test pressure of 150psi on cold water systems.

Venting

E. Venting shall be in accordance with Water and Sewerage Authority regulations and the Isometric Drawing.

Above Ground Support PVC

F. For above ground installation of horizontal runs of PVC pipe, there shall be at least one support hanger located adjacent to the joint. The maximum spacing between hangers shall be 10'-0". For vertical runs of PVC pipe supports shall not be less than every storey height and at the base of the run.

Joints

G. No PVC joints to be made with open flames, heat or sparks. Pipes shall not be flared on site by heat application in order to create a socket joint. A PVC collar shall be used instead.

Fittings

H. All fittings shall be suitable for use with working pressure equal to or better than those applicable to the pipe on which they are installed. For pipes smaller than 3/4" fittings shall be screwed unless otherwise approved. All joints are to be leak-proof.

Adapters

I. Adapters shall be used to join pipe of different type, unless solid sleeves are indicated or approved. Adapters shall have ends for the appropriate type of joint to receive the joining pipe.

Valves and Appurtenances

A. Valve working pressure shall be at least equal to that of the pipe on which they are to be installed. Listed below are the general features required for the various types of valves unless otherwise approved.

Handling and Cutting Pipe

B. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring machined surfaces and abrasion to the pipe coating.

Laying Pipes and Fittings

C. No defective pipe or fitting shall be laid or placed in the piping system and any defective item discovered shall be replaced.

D. Each pipe and fitting shall be cleaned of all debris, dirt, etc., before being laid and shall be kept clean until accepted with the completed work. Pipe fitting shall be laid accurately to the lines and grades indicated as required. Care shall be taken to ensure a good alignment both horizontally and vertically and to give the pipe a firm bearing along its entire length.

Thrust Blocking

E. Joint Restraint devices or thrust blocking must be used for all pressure pipe (including force mains for any change of direction or connection of appliance (e.g. Fire Hydrant). See details given in engineering drawings for information on thrust blocking.

Cutting/Patching, Repairing, etc.

F. All cutting of walls, partitions, floors etc, required for the installation of work called for under this section will be done by the Plumbing Contractor. Cutting of structural members shall not be done without the approval of the Project Manager.

G. All patching will be done by others.

H. Any cutting or patching required in connection with the installation of this work due to errors on the part of the Plumbing Contractor shall be paid for by him.

I. The Contractor shall guarantee that all work and materials found defective during the maintenance period shall be promptly removed and replaced by him without additional cost to the Owner and that all work so replaced shall be in strict accordance with the drawings and this specification.

J. Where such defects occur, the Plumbing Contractor shall be held responsible for all cost incurred in making the defective work good and all damage to finishes caused by such replacements shall be repaired and left in first class condition by the Plumbing Contractor at his own expense.

K. The Plumbing Contractor shall furnish certificates of guarantees from the manufacturer of specialties furnished under this Contract to the effect that they will furnish new parts or apparatus where defects occur due to faulty occur due to faulty manufacture, for the period of one year from date of final acceptance.

Sleeves

A The Plumbing Contractor shall supply all sleeves for openings, etc as required.

B Sleeves shall be delivered to the Supervisory Consultant who shall position these as instructed by the Plumbing Contractor. It shall be the Plumbing Contractor's responsibility to ensure that these are accurately placed and fixed prior to casting.

C. The type of sleeve supplied and the nature of their installation for the particular application shall be as described in these specification and the drawings.

Foundations and Plinths

E The Plumbing Contractor shall supply and position all necessary foundation bolts, and do all final and levelling required by his equipment. Where cork, anti-vibration pads and other such specialties are required below the equipment foundation, they shall be supplied and installed by the Plumbing Contractor.

Licensed Plumber

F Unless otherwise agreed, a licensed plumber shall be in attendance at all time during execution of the Plumbing works. The onus is on the Plumbing Contractor to seek the approval of the Water and Sewerage Authority, periodic inspections and final connections.

Codes, Permits, etc.

G. All materials furnished and work done shall comply with the local Plumbing Code. The Plumbing Contractor shall give all necessary notices, file all plans, obtain all permits and pay all fees or other costs in connections with this work. He shall obtain all certificates of inspection which he shall deliver to the Supervisory Consultant who will distribute copies to all concerned.

Temporary Closure

H. When the pipe laying is not actually in progress, the open ends of pipes shall be closed by temporary water tights plugs or by other approved means.

Cleaning

I. Prior to the pressure and leakage tests, pipe shall be thoroughly cleaned of all dirt, dust, oil grease and other foreign materials. These works shall be done with care to avoid damage to inside coating where applied.

Field Testing

J. Except as otherwise directed, all pipe lines shall be tested. Pipe lines laid in excavation or bedded in concrete shall be tested prior to being covered. The cost involved in providing the necessary materials and apparatus including test plugs, nipples, pumps and labour to prepare and perform the tests is to be borne by the contractor.

Soil, Waste Pipes (Above ground)

K. Water Test. Minimum 10ft head
Maximum 15ft head

Soil Pipes (Buried) Sewer Collector

A. Steel Ball. Mirror Test

Vent Pipes

B. Smoke test.

Water Supply Pipes

C. Pressure system to 1.5 times working pressure and hold without loss for 2 hours.

D. All other testing shall conform to the requirements of the Sanitary Authority or other appropriate authority where applicable and shall be to the satisfaction of the Engineer. All approvals of tests are to be verified in writing.

Adjustments and Cleaning

E. After all fixtures are completely set and connected, the contractor shall adjust the various supply valves, fixtures, fittings, etc., so that the proper delivery of water is obtained at all fixtures. Before work is finally turned over to the owner, the contractor shall make such additional adjustments as may be found necessary to deliver the job in proper working condition.

F. All this time, all fixtures, escutcheons, fittings and nameplates, pipe covering and finishings in general shall be completely gone over by the Plumbing Contractor and left in a finished and neat condition.

a) Clean all parts of the installation exposed to view.

b) Protect from weather and/or oxidation all part of the installation.

c) Provide means of identification of all parts of the installation.

d) Touch up paint of factory finished equipment.

e) Clean, dust, varnish, polish, touch up etc., all of above for final inspection.

As-Installed & Record Drawings

G The Plumbing Contractor shall keep one copy of all drawings, specifications and approved shop drawings of the work in order, available to the Project Manager and to his representatives. As the work progresses, the Plumbing Contractor shall record changes to the project as built.

H. At the completion of the installation and before the final inspection, the Plumbing Contractor shall liase with the Engineer in ensuring the production of an accurate record of "As-Built Drawings".

Maintenance

A. Allow for maintenance of the complete installation to the end of the defects liability period. Maintenance shall include: -

i) Cleaning lubrication and adjustments, etc. of the equipment and accessories in accordance with the Manufacturer's recommendations on a regular basis.

ii) Repair and/or replacement of any part or parts of the installation which may malfunction or prove to be defective whether under the manufacturer's guarantee or not. Repairs are to be made with a minimum of downtime for the equipment.

iii) No charge whatsoever arising out of the maintenance will be accepted by the Owner. Duties, transport and all other costs will be to the Contractor's account.

iv) Project Manager's certification of the maintenance undertaken.

Maintenance Manual

B. Two (2) copies of a Maintenance Manual shall be assembled in plastic covered three-ring binders and delivered to the Project Manager before expiry of the Defects Liability Period.

C. The Manual shall include the following:-

1) Manufacturer's catalogues and shop drawings.

2) All manufacturer's installation and maintenance instructions packed with equipment, electrical and controls wiring diagrams, etc.

3) Lists of spare parts.

4) A copy of these specifications

5) A copy of "As installed & Record Drawings".

6) Manufacturer's test results if such required by equipment specifications.

7) Recommended control settings.

8) Any other information considered useful by the Contractor.

9) System performance, test results and final settings as specified in these specifications.

Tags/Charts/Instructions

D. Provide proper identification of the systems and its components as specified in the relevant technical specifications.

PROPANE GAS INSTALLATIONS

Scope of Work

The intent of these specifications and the drawings is to cover and include all of the apparatus, materials and labor necessary for the proper installation of all propane equipment and piping to provide the building with fully functional systems on completion. This shall include but shall not be limited to the following:-

i. Comply with and obtain approval from the Ministry of Energy for the Propane System.

ii. Supply and install propane storage tanks and manifold.

iii. Provide for the supply and installation of all Propane piping from the storage kiosk to new building. Include for all excavation, backfilling and corrosion protection.

iv. Supply and install all Propane piping internal to building up to bench locations. Include for pressure regulators on all floors and all valves required.

v. Supply and install Propane piping internal to benches including connection to laboratory fixtures.

vi. Purge, test and commission entire Propane system.

vii. Supply and installation of laboratory fixtures. (Equipment Schedule 1)

Installation

Locations

All locations are approximately correct but are understood to be subject to modifications as may be found necessary in order to meet structural conditions and the requirements of other equipment installations prior to and or at the time of installation.

Co-ordination and Method

B. The Process Piping Contractor shall co-ordinate with the contractors on site to ensure that openings in reinforced concrete foundations, frame, walls and floor slabs have been left for his pipe work and he shall be held responsible for fitting his work to the building. All dimensions for purposes of installation shall be taken on site and not from the drawings.

C. All roughing-in shall be done from measurements of the actual fixture or from the manufacturers' brochures giving these specific details. Unless stated otherwise, all pipe work above ground shall be concealed within walls, ceiling and ducts provided and any deviation from this shall be first approved by the Engineer.

Structural Openings

A. It shall be the Process Piping contractors' responsibility to inspect all structural and architectural drawings to insure that all openings required by him in structural walls are marked in the drawings and that the reinforcement was checked by the Structural Engineer. The Process Piping contractor shall supervise the placing of form work for structural openings to insure correct size and proper location. Large openings in non-structural walls requiring lintels shall be marked on the drawings as per the above before the walls are built and all other provisions previously specified shall apply.

Protection

B. All existing pipes, holes, wires, fences, curbings, property line markers and other structures which the Architect decides must be preserved in place without being temporarily or permanently relocated shall be carefully supported and protected from damage.

Cutting and Patching

C. The Process Piping Contractor shall furnish to the Engineer to the sizes and locations of chases and openings in walls partitions etc. before they are built. The Process Piping Contractor shall furnish and install without delay in the execution of the work of other trades the sleeves or boxes in the forms of floor slabs for all his pipes before the floor slabs are poured.

D. The Piping contractor shall do all drilling required for the installation of hangers. All cutting of walls partitions floors etc. required for the installation of work called for under this section will be done by the Process Piping Contractor. Cutting of structural members shall not be done without the approval of the Engineer.

E. All patching will be done by others.

F. Any cutting or patching required in connection with due to errors on the part of the Process Piping Contractor shall be paid for by him.

G. The Process Piping Contractor shall guarantee that all work and materials found defective during the maintenance period shall be promptly removed and replaced by him without additional cost to the Owner and that all work so replaced shall be in strict accordance with the drawings and this specification.

H. Where such defects occur the Process Piping Contractor shall be held responsible for all cost incurred in making the defective work good and all injuries to plaster wood or other finishes caused by such replacements and repaired in first class condition by the Process Piping Contractor or at his own expense.

Guarantees

I. The Piping contraction shall furnish certificates of guarantee from the manufacturer specialties furnished under this contract to the effect that they will furnish new parts or apparatus where defects occur due to faulty manufacture for the period of one year from date of final acceptance.

Sleeves

A. The Process Piping Contractor shall supply all sleeves for openings, etc. as required. Sleeves shall be delivered to the Main Contractor who shall position these as instructed by the Process Piping Contractor. It shall be the Process Piping Contractor responsibility to ensure that these are accurately placed and fixed prior to and during casting.

Excavation and Backfilling

B. The Contractor shall make excavations in such a manner and to such dimensions as will give suitable room for building appurtenant structures and laying and jointing the pipe. He shall place all coffer damming, pumping and draining to render the bottom of the excavations dry and acceptable in all respects. In no case except as provided for hereinafter shall the earth be sloughed, scraped or dug by machinery so near to the finished sub-grade as to result in disturbance below the said sub-grade. The last few inches of the material must be removed with pick and shovel just before placing the pipe, masonry or other structures. Where pipe is to be laid in a gravel bedding or in a concrete cradle, the trench may be excavated by machinery to or just below the designated sub grade provided that the material remaining at the bottom of the trench is not disturbed. Where pipe is to be laid directly on the trench bottom, the lower part of the trench shall not be excavated to the sub grade by machinery but just before the pipe is to be placed the last few inches of the material to be excavated shall be removed by means of hand tools to form a shape bottom true to grade so that the pipe will have a uniform and continuous bearing and support on firm and undisturbed material between joints except for limited areas where the use of slings may have disturbed the bottom. All pipe slopes shall be as indicated on the drawings. All pipework in trenches shall be covered with a sharp sand surround to 150mm.

Pipework Support and Identification

C. All pipework shall be supported in service voids via the use of proprietary pipe clamps and channel supports. All pipework shall be clearly labeled at every floor level.

Drawings

D. A complete drawing list is given.

PROPANE PIPING SPECIFICATION

Standards

E. The Process Piping Contractor is required to comply with the standards set by the Ministry of Energy and carry out work in accordance with NFPA standards (58F).

Material

F. All piping shall be in Schedule 40 Black Steel Pipe with malleable threaded fittings for 50 mm and smaller pipe and welded fittings for pipes greater than 50mm in diameter.

Supports

A. Piping shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping and of adequate strength and quality, and located at proper intervals so that the piping cannot be moved accidentally from the installed position. Gas Piping shall not be supported by other piping. All pipework shall be supported in service voids via the use of proprietary pipe clamps and channel supports. All pipework shall be clearly labeled at every floor level.

B. For horizontal runs of pipework pipe supports shall be placed at not more than 2.5 m for pipes from 12.7mm to 63.5mm diameter.

Workmanship

C. Gas Pipe and Fittings shall be clear and free from cutting burrs and defects in structure or threading and shall be thoroughly brushed, chip and scale blown.

D. Defects in pipe or fittings shall not be repaired. When defective pipes or fittings material shall be replaced.

Installation

E. Pipe section shall be accomplished by means of fittings only.

Corrosion Protection

F. All underground portions of the pipeline must be corrosion protected as follows:

- Outside of pipe must be power brushed to remove all surface rust if any.
- Brush on rust remover solution and wash off.
- Apply two coats of bituminous paint according to manufacturer's instruction.
- Wrap pipe with corrosion resistant asphalt impregnated fabric tape suitable for underground pipe corrosion protection.

Electrical Continuity and Grounding

G. Piping systems shall have electrical continuity and shall be earthed. In no circumstance shall the piping system be used as an earth for electrical installations. All storage vessels are also to be grounded.

Branch Pipe Connection

H. All branch outlet pipes shall be taken from the top or sides of horizontal lines and not from the bottom. Where a branch outlet is placed on a main supply before it is known what size of pipe will be connected to it, the outlet shall be the same size as the line which supplies it.

Valves

A. Valves are to be one quarter turn square head gas cocks with the position of the gate indicated on the head.

Outlets

B. Each outlet, including a valve or cock outlet, shall be securely closed gas tight with a threaded plug or cap immediately after installation and shall be closed until an appliance is attached thereto. Likewise. When an appliance is disconnected from an outlet and the outlet is not to be used again immediately, it shall be securely closed gas tight. In no case shall the outlet be closed with tin caps, wooden plugs, corks or other improvised methods.

Field Testing

C. Before appliances are connected, piping systems shall stand a pressure of at least 15 p.s.i. for a period of not less than 10 minutes without showing any loss of pressure. Pressure shall be measured with a mercury manometer or slope gauge, or an equivalent approved device so calibrated as to be read in increments of not greater than one tenth pound. The source of pressure shall be isolated before the pressure test is made. To test for tightness the pipe may be filled with air or some approved inert gas, but not with any other gas or liquid. Oxygen shall never be used.

Purging

D. After pipework has been checked all piping receiving gas shall be fully purged before use.

INSTALLATION AND COMMISSIONING

Contractors Shop Drawings

E. The Process Piping Contractor shall supply to the Engineer for approval, two (2) copies each of final equipment arrangement and pipework drawings.

F. Drawings shall be of professional quality, fully dimensioned and shall contain all relevant details.

G. Equipment final arrangement shall take into account:-

a. The orientation and connection points of the specific equipment the Process Piping Contractor has undertaken to supply.

b. The most efficient use of the given space and most desirable relative position of individual pieces of equipment.

c. Operational ease and accessibility for inspection and maintenance.

Contractors Shop Drawings (cont'd)

A. Equipment plinths for pumps, air compressors, vacuum pumps shall be accurately located and detailed showing all embedded metal such as holding down bolts, pipes and electrical conduit. The equipment final layout drawings or revisions thereof which are approved by the Engineer shall be given to the Main Contractor for provision of Builders' work items.

B. The Process Piping Contractor shall give to the Main Contractor copies of pipework drawings or revisions thereof which are approved by the Engineer.

C. All of the above to be finalized not later than thirty days after receipt of Consultants Design Drawings.

As Built Drawings

D. The Contractor shall update drawings to affect a complete set of "As-Built" drawings at the end of the project. This updating must be done as the job proceeds since sections of the job will be hidden by other works, e.g. ceilings and wall construction if left for long periods.

Contractors Installation Personnel

E. Apart from installation Technicians and Workmen the Process Piping Contractor shall at all times during the construction of the work have on site a suitably qualified representative of "Project Engineer" status who is fully knowledgeable about the job.

F. This representative must be authorized to act on the Contractor's behalf in matters pertaining to:

a. The co-ordination with other trades.

b. The site instructions given by the Engineer during site inspections.

c. The organization of such test as the Engineer may require.

d. The updating of drawings to "As Built" status.

Equipment Data

G. The Contractor shall supply all manufacturers' literature on start up procedure and testing together with a proposed schedule of tests and commissioning procedures.

Tests

H. The Process Piping Contractor shall carry out at his own cost, all necessary tests and commissioning procedures on components and the whole of the System to the satisfaction of the Engineer.

MAINTENANCE

Documents

A. Information on all operations check and testing should be documented and handed over to the Engineer. Sample operations log sheets shall be provided.

B. Start-up check lists and operations and trouble shooting check lists shall be provided on permanent heat sealed forms so as to be unaffected by handling, water or oils.

C. Lubrication and other schedules should be provided in similar permanent fashion.

Monitoring of System

D. The Contractor shall monitor the plants' performance by periodic checks to be performed at intervals of not more than 2 weeks for the remainder of the twelve (12) months maintenance period.

Correction and Repair

E. Any defect, faulty workmanship or short fall of the equipment (which was not evident during commissioning) to meet the specification shall be corrected by the Contractor free of any cost to the Client. This cost shall include materials and labor.

F. Equipment or parts replacement must not be dependent on whether such parts are covered by manufacturers' standard warranties or guarantees.

G. This maintenance period shall extend twelve (12) months after certification by the Engineer that the equipment is acceptable. This acceptance shall not be unreasonably withheld.

H. The end of this maintenance period shall be documented by the Engineer and copied to the Client.

Service Literature

I. Three (3) copies of all Maintenance Service Literature, Schedules and first twelve (12) months maintenance records to be given to the Client.

Consumables

J. The Process Piping Contractor shall supply as part of his contract all required lubricants, chemicals and filter changes, for the plant for the twelve (12) months' maintenance period.

ELECTRICAL INSTALLATION

General

A. The whole of the work is to be carried out by a Licensed Electrical Contractor, in accordance with the requirement of the Grenada Electricity Services Ltd., the Government Electrical Inspectorate and all relevant By-Laws.

B. Wherever these requirements differ from these specifications, the Contractor shall inform the Engineer so that the differences may be corrected.

Incandescent lamps

C. Incandescent lamps shall be inside frosted 1000 hours, 240 volts and shall be of Westinghouse, G.C.E., Sylvania or equal and similar approved manufacture.

D. All fluorescent fixtures shall be fitted with T12, high quality, rapid start, warm light lamps of Westinghouse, G.C.E., Sylvania or equal and similar approved manufacturer.

E. All ballast shall be of high power factor for operation on lamp's 240v, 50 HB source and shall be equipped with protective thermal devices. Rapid start ballast shall be used for the lamps in the drawings and these shall be sand, rated Group A or better.

F. All fluorescent fixtures to have electronic ballast as described.

i) For Troffers:

G. Ballast shall be high frequency electronic type (20 KHz to 60 KHz), dedicated lamp, rapid start type ballast with less than 10% input current harmonic distortion total, and a crest factor not exceeding 1.4, a power factor greater than 0.95 and efficiency above 95%. Minimum warrants of 5 years.

H. Ballast shall be **ADVANCE MARK V** electronic or similar approved.

I. Lamps to be T-8 with bi-pin base (flexloc) 32 watts each, 2850 Louvers per lamp with colour rendering index (CRI) of 85 and a 3500K lamp colour.

J. The rated lamp life shall be 20 000 hours.

K. Fixtures shall be installed in correct position, true to line and left lean, free from dirt, grease or any casual material tending to mar the finished appearance or interfere with the performance of the fixtures.

L. Fixtures must be stored in dry and protected space suitable of storage of fixtures.

Wiring of lighting equipment

M. All electrical wiring on or within a lighting fixtures shall be neatly arranged without excess wiring. The wiring shall not be exposed to mechanical injury, and arranged so that it is not subjected to the temperatures above which it is approved.

Grounding of lighting equipment

A. Non-current metal parts of lighting fixtures and associated equipment shall be grounded. This shall be accommodated using a ground rod driven into the ground and done is accordance with the relevant authority.

Workmanship

B. Only a high standard of workmanship will be acceptable.

C. The contractor shall be responsible for obtaining the necessary information of any air-conditioning, refrigeration equipment, pumps, hoists and other electrical equipment suppliers as to the requirement for their particular units and to provide such electrical supply and installation, suitable and in accordance with their recommendations and instruction.

Testing

D. The whole of the installation shall be tested for continuing, safety, proper installation materials and workmanship to the satisfaction of the Engineer, the Grenada Electricity Services Ltd. and the Government Electrical Inspectorate. The Certificate of approval forms the relevant utilities Authorities must be obtained and handed over to the Engineer.

PAINTING AND IDENTIFICATION

General

E. The plumbing contractor shall paint and identify all items furnished under their contract as noted in this section.

F. This section gives the requirements for the identification of all mechanical and electrical services installations, the plumbing contractor is to reference this document for all items furnished under the plumbing contract.

G Colours and identification to be according to the American National Standards Institute (ANSI):

H ANSI-A13.1-81- Scheme for the Identification of Piping Systems

Mechanical and Electrical Work Field Painting Schedule

I Field painting of mechanical and electrical work, consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.

J Paint after tests has been completed.

K Omit prime coat from factory prime-coated items.

L Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces.

Mechanical and Electrical Work Field Painting Schedule (cont'd)

A. Color:

Paint colors as specified:

a. White …….. Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.

b. Gray ..... Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces). Water and sewage treatment equipment and sewage ejection equipment.

c. Aluminum Color …… Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment. Steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).

d. Federal Safety Red …….. Exposed fire protection piping hydrants, post indicators, electrical conducts containing fire alarm control wiring and fire alarm equipment.

Identity Painting Schedule

B Identify designated service in accordance with ANSI A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings, piping in accessible pipe spaces, interstitial spaces, and piping behind access panels.

a. Legend may be identity marker options or stencil applied painted on.

b. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12,000mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.\

c. Locate Legends clearly visible from operating position.

d. Use arrow to indicate direction of flow.

e. Identify pipe contents with sufficient additional details such as temperature, pressure and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium and Low Pressure designations as follows:

f. High Pressure – 414kPa (60 psi) and above
g. Medium Pressure – 104 to 413 kPa (15 to 59 psi)
h. Low Pressure – 103 kPa (14 psi) and below
i. Add Fuel oil grade numbers

Identity Painting Schedule (cont'd)

j. Legend name in full or in abbreviated form as follows:

Piping	Color of Exposed Piping	Color of Background	Color of Letters	Legend Abbreviations
Blow-off		Yellow	Black	Blow-off
Boiler Feedwater		Yellow	Black	Bir.Feed
A/C Condenser Water Supply		Green	White	A/C Cond. W. Sup.
A/C Condenser Water Return		Green	White	A.C Cond. W. Ret.
Chilled Water Supply		Green	White	Ch. W. Sup.
Chilled Water Return		Green	White	Ch. W. Ret.
Shop Compressed Air		Yellow	Black	S. Air
Air-Instrument Controls		Green	White	Air-Inst. Cont.
Drain Line		Green	White	Drain
Emergency Shower		Green	White	Emg. Shower
High Pressure Steam		Yellow	Black	H.P. *
High Pressure Condensate Return	Yellow	Black	H. P. Ret. *	
Medium Pressure Steam		Yellow	Black	M. P. Stm. *
Medium Pressure Condensate Return	Yellow	Black	M. P. Ret. *	
Low Pressure Steam		Yellow	Black	L. P. Stm. *
Low Pressure Condensate Return	Yellow	Black	L. P. Ret. *	
High Temperature Water Supply	Yellow	Black	H. Temp. W. Sup.	
High Temperature Water Return	Yellow	Black	H. Temp. W. Ret.	
Hot Water Heating Supply		Yellow	Black	H. W. Htg Sup.
Hot Water Heating Return		Yellow	Black	H. W. Htg. Ret.
Gravity Condensate Return		Yellow	Black	Gravity Cond. Ret.
Pumped Condensate Return		Yellow	Black	Pumped Cond. Ret.
Vacuum Condensate Return		Yellow	Black	Vac. Cond. Ret.
Fuel Oil – Grade		Green	White	Fuel Oil-Grade
Boiler Water Sampling		Yellow	Black	Sample
Chemical Feed		Yellow	Black	Chem.
Continuous Blow Down		Yellow	Black	Cont. B. D.
Condensate Pumped			Black	Cond. –Pump
Pump Recirculating		Yellow	Black	Pump-Recirc.
Vent Line		Yellow	Black	Vent.
Alkali		Yellow	Black	Alk
Bleach		Yellow	Black	Bleach
Detergent		Yellow	Black	Det.
Liquid Supply		Yellow	Black	Liq. Sup.
Reuse Water		Yellow	Black	Reuse Wtr.
Cold Water (Domestic)	White	Green	White	C. W. Dom.

Piping	Color of Exposed Piping	Color of Background	Color of Letters	Legend Abbreviations
Hot Water (Domestic)				
Supply	White	Green	White	H. W. Dom.
Return	White	Yellow	Black	H. W. Dom. Ret.
Tempered Water	White	Yellow	Black	Temp. Wat.
Ice Water				
Supply	White	Green	White	Ice W.
Return	White	Green	White	Ice W. Ret.
Reagent Grade Water		Green	White	RG
Reverse Osmosis		Green	White	RO
Sanitary Waste		Green	White	San. Waste
Sanitary Vent		Green	White	San. Vent
Storm Drainage		Green	White	St. Drain
Pump Drainage		Green	White	Pump Disc.
Chemical Resistant Pipe				
Waste		Yellow	Black	Acid Waste
Vent		Yellow	Black	Acid Vent
Atmospheric Vent		Green	White	ATV
Silver Recovery		Green	White	Sil. Rec.
Oral Evacuation		Green	White	Oral Evac.
Fuel Gas		Yellow	Black	Gas
Fire Protection Water				
Sprinkler		Red	White	Auto. Spr.
Standpipe		Red	White	Stand.
Sprinkler		Red	White	Drain

Protection Clean-up and Touch-up

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.

B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.

C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

RECORD DOCUMENTS

Provision of Record Documents

A The Contractor is to supply as a pre-requisite to Practical Completion of the Engineering Services, comprehensive record documents in uniform indexed bonds sets. The Contractor is advised that great importance will be placed upon the quality, accuracy, clarity and completeness of the record documents and upon their being made available promptly.

B The Contractor is to demonstrate from time to time, as required by the Engineer throughout the execution of the Engineering Services, that adequate and accurate records are being kept such as will ensure the ultimate completeness and accuracy of the record documents and that the record documents are themselves being progressively complied as the work on site proceeds.

C This section gives the requirements for the identification of all mechanical and electrical services installation, the plumbing contractor is to reference this document for all items furnished under the plumbing contract.

D. The following listing of items to be provided includes items for both mechanical and electrical services. The plumbing contractor shall provide documents that pertain to his specific trade.

Scope of Record Documents

E. Record documents are to comprise, all as described in this Specification, the following:

a. Record Drawing and Diagrams
b. Schedules
c. Operating and Maintenance Instructions

F. Three sets of Drawings and Schedules are to be provided and three sets of Operating and maintenance instructions.

G. The record documents are to be adequate for the following purposes:

a. To provide a comprehensive reference source about each installation.

b. To provide a basis for the correct and efficient operation of the installed plant and systems.

c. To serve as an information base and detailed guide for the effective and efficient maintenance of each installation.

d. To make the most economical use of energy when operating each installation.

e. To provide maximum utilization of each installation at minimum cost.

f. To serve as a basis for staff training in the operation and maintenance of each installation.

g. To serve as a basis for safety awareness.

Scope of Record Documents (cont'd)

A. The record documents are to be correlated as that the terminology and the numerical and/or other references used therein are consistent with a similar to those used in the physical identification of component parts of the Engineering Services.

As-Built Drawings and Diagrams

B. The record drawings and diagrams provided by the Contractor are to comprise the documents listed in the following paragraphs, as applicable. All such documents are to clearly be endorsed. AS-BUILT DRAWINGS near to the title block.

C. Drawings or sets of drawings to a scale consistent with that used for the Bid Drawings which are to show the "as fitted" location of the following:

a. The location, including level if buried, of Public Services connections incorporated in the Engineering Services, whether carried out by the Contractor or by the appropriate Authority, together with points of origin and termination, size and material of pipes and cables, line pressure, voltage, and/or other relevant information.

b. The layout, location and extent of all pipes services showing sizes of all pipes together with valves for regulating, isolating, draining, venting and other purposes.

c. Main and sub-main cables showing origin, route, termination size and type of each.

d. Conduits and/or cables for single and three-phase power circuits, lighting circuits and sub-circuits and all miscellaneous services. The drawings are to indicate the origin, route termination and size of each conduit together with the number and size of each cable therein. Further to route of each conduit or cable is to be described, i.e. surface, concealed, in wall chase, in floor screed, cast in-site, above false ceiling etc.

e. Locations of switchboards, distribution boards, switches draw-in boxes, joint boxes etc.

f. The location, identify, size and details of all apparatus served by or associated with each of the various services. (Information with respect to size and details may be presented in schedule form subject to the prior consent of the Engineer.

g. The layout, location and extent of all air ducts, (including those formed in Builders' work or otherwise but forming part of the system) showing all dampers and associated equipment, silencers, grilles, diffusers or other terminal components. Each duct and each terminal component is to be marked with its size and the air quantity flowing, as actually measured after correct regulation of the system, or as computed by the addition of such measured quantities.

h. The location of all test points on water and air systems.

i. The location and identify of each room or space housing plant, machinery and apparatus.

j. Location of all each tapes, earth electrodes and test points.

k. Lighting conductor air terminals, conductors, each electrodes and test clamps.

As-Built Drawings and Diagrams (cont'd)

A. Drawings or sets of drawings to an appropriate scale which are to show the following as installed:

a. The details general arrangement of all boiler houses, switch rooms, machinery spaces, air handling plants, tank rooms and/or other plant or apparatus, including the location, identify, size and details of each piece of apparatus. (Information with respect to size and detail may be presented in schedule form subject to the prior consent of the Engineer.)

b. The details general arrangement of service subways, trenches, ducts, meter rooms, or other special sections of the Engineering Services where, in the opinion of the Engineer, the small scale drawings cannot provide an adequate record.

B. Manufacturers drawings or sets of drawings which are to show:

a. The general arrangement and assembly of component parts of all machines and equipment which may require servicing.

b. The internal wiring of each piece of electrical equipment incorporating the Engineering Services together with physical arrangement drawings, where necessary, to locate and identify the component parts.

c. In conjunction with schedules of location the detail and reference, voltage and wattage of all lighting fittings.

C. Comprehensive diagrams or sets of diagrams which are to show:

a. The principles of the arrangement and operating of each of the various services as related to central plant, other principal components and zoning of distribution etc.

b. The principles of application of automatic controls and instrumentation, presented in combination with item (a) foregoing or separately as agreed with the Engineer.

c. All power and control wiring and/or pneumatic or other control piping including size, type of conductor or pipes used and identifying the terminal points of each.

D. System diagrams, circuit diagrams, wiring diagrams and interconnection diagrams which are to show:

a. How each installation or item of equipment operates.

b. The interconnections between items of equipment, including those provided by others to which the Contractor is required to carry out connection.

c. The size, type and length (to the nearest metre) of each LV cable, together with the measured earth fault loop impedance.

d. The terminal numbering and cable core identification for all alarm and control circuits.

Schedules

A. The Schedules provided by the Contractor are to comprise:

a. Comprehensive schedules illustrating procedures for fault finding and for action in the event of equipment or system failure.

b. Comprehensive schedules of spare parts, lubrications, identification numbers and sources of supply.

Operating and Maintenance Instructions

B. Operating and Maintenance Instructions are to be proved by the Contractor and are to comprise the following, as applicable (all contained in volumes strongly bound in flexible covers and suitable for heavy usage over a long period) written to be read in conjunction with the Record Drawings, Diagrams and Schedules:

a. A general description of the scope, purpose and manner of working of each system or apparatus forming part of the Engineering Services.

b. A detailed description of the scope, purpose and manner of working of each system of automatic controls and/or monitoring instruments.

c. Data on general design parameters and associated normal operating temperatures, pressures etc based on the commissioning activity.

d. Testing and commissioning records clearly cross referenced to system components.

e. Clear and comprehensive instructions for the starting up, running and shut down of each system or apparatus.

f. Clear and comprehensive instructions for dealing with emergency conditions for each system or apparatus.

g. Instructions in respect of any precautionary measures from time to time necessary.

h. Instructions in respect of the care of apparatus normally subject to seasonal disuse.

i. Instructions as to the nature, extent and frequency of servicing necessary properly to maintain the Engineering Service in safe and efficient condition and to the materials to be used for the purpose. This information may be supported in detail, but not replaced by, maintenance instructions provided by the suppliers of particular component apparatus.

j. The names and addresses of suppliers of all major components of the Engineering Services as may potentially be required to obtain spare parts or replacements.

C. Copies of manufacturer's data are to be supplied with respect to the nature, type and method of operation of individual pieces of equipment, together with their detailed maintenance instructions. Such data in the form of individual booklets and the like; is to be indexed and cross referenced to the Operating and Maintenance Instructions and present suitably protected in box files or folders.

PLASTER WORK AND OTHER FLOOR, WALL AND CEILING FINISHINGS

General

Cement, sand, water and plasticiser

A Cement and water shall be as described under "CONCRETE WORK".

B Sand and plasticiser shall be as described under "BLOCKWORK".

FLOORS

Brushed concrete finish

C A brushed concrete finish shall be produced by sweeping the surface of concrete with a bass broom so as to leave visible lines in a roughly parallel configuration on the concrete when it has finally hardened.

Granolithic

D Granolithic shall be composed of two parts of cement to five parts of blue limestone chippings, from an approved source, graded from 6mm down with not more than 20% fine material passing a B.Sc. 200 mesh sieve. The blue limestone chippings shall be angular and free from flaking particles.

E Granolithic shall be floated onto ordinary concrete or screeded bed, to a pattern between dividing strips, within twelve hours of the latter being laid, otherwise the concrete or screeded surface shall be hacked, cleaned and watered and afterwards treated with cement slurry before the paving is laid.

F Immediately after spreading and compacting the topping, tamp surface with a wood float to ensure a level surface and trowel to a smooth finish.

G Where paving is described as one-time or applied "brushed", wash and wire-brush surface to expose the aggregate about one and a half hours after laying, the exact timing being related to the setting of the concrete.

H Where paving is described as "non-skid" the surface shall be ground to expose the aggregate and give a smooth even finish.

I Where paving is described as "polished" the surface shall be ground to expose aggregate and give a smooth even finish and sealed polished with an applied wax polish.

J Two-tone granolithic shall consist of panels each wholly of one of the combinations ordinary grey cement/Guanapo gravel and ordinary grey cement/blue limestone chippings or other combinations listed on the drawings and laid to a consistent pattern.

Tiles

A Ceramic tiles for floors shall conform to B.S. 6431:1983.

B Glazed ceramic tiles for walls shall conform to B.S. 6431:1983.

C Tiles shall be set out so as to avoid or minimise unsightly cutting, to establish the position of movement joints and to maintain straight joints.

D Apply a thin bed of an approved adhesive to a consistent thickness on floors and walls to receive tiles. Fix tiles before any surface drying of the adhesive occurs. After the tiles have been firmly fixed apply grouting material mixed to consistency recommended by the manufacturer to as large an area as can be worked before hardening commences. Work well into joints until they are completely filled and when grout has set, remove surplus and tool joints to required profile. At all exposed edges rounded edge tiles shall be used without mitring corner tiles.

E Tiles shall be fixed by competent tilers approved by the Project Manager.

F The Contractor shall allow in his price for constructing a sample panel for wall and floor tiles, each sample of approximately 16 ft^2, for the approval of the Project Manager. Subsequently, the standard of workmanship approved, shall be the standard by which the works shall be executed.

Beds

G Mix for beds shall be in the proportions of one part of cement to three parts of sand.

H Thoroughly brush clean surfaces to receive beds of all foreign matter. Provide an adequate bond between beds and concrete either by using an approved concrete bonding agent or by well hacking, wetting and applying cement grout immediately prior to laying beds.

I Lay beds to thicknesses and with surface finish as described.

J Fill joints or cracks with an approved plastic material and finish flush with surface.

K Prime chalky or dusty surfaces to receive tiles with a primer recommended by the tile manufacturer.

Levels

L Ensure that the levels of floors and paving within any area and between adjoining areas are constant unless specifically described or shown to be otherwise. Make up for any variations in the thickness of floor and paving finishings and irregularities in the surface of the structural base by adjusting the thickness of the screed as necessary.

Protection

M Protect all premoulded floor finishings from walking or other disturbances for five days after laying.

N Wet all in-situ floor finishings and keep damp for at least seven days after laying by thickly covering with hessian or polythene membrane kept moist by frequent sprinkling with water.

Protection (Cont'd)

A Cover all floors up to the completion of the Works with a temporary covering. On completion of the Works, clean off temporary coverings, remove all stains, mortar splashes, etc., from the floors and leave perfect for handing over.

WALLS

Rendering Work and Backings

Rendering

B Mix rendering of cement and sand, in the proportion of one part cement and five parts sand and lay to the thicknesses described with a plasticiser added in strict accordance with the manufacturer's instructions.

C Proportion materials by measure and not by estimation and proper approved measuring boxes must be provided for this purpose. Make up mix on site in a closeboarded wood platform with upstand edges and thrice turn over mix while water is being added through a rose director and use immediately thereafter.

D Where approved mechanical batch mixers are employed, rotate each batch in the drum at least two minutes and use immediately thereafter.

E Thoroughly wash out all platforms and mixers at the cessation of work each day and as necessary during the working hours.

F Mix only quantities which can be used at once and reject rendering which has begun to set before being required.

G Carefully float all work and finish to the stated thicknesses with surfaces perfectly flat to stand the straight edge every way, free from all cracks, blisters, or after effects and leave perfectly clean.

H "Throw" all rendering and plaster on to the wall and give the minimum of "working" to ensure a plumb and even finish. Use only wood floating unless otherwise described.

I Where possible, complete each section of walling in one operation, but where this is not possible the existing edge shall be well hacked and wetted before recommencing operations. Throughout the whole of the works, order sufficient sand to prevent any variation between the quality and colour of different renderings.

J Allow for preparing and wetting all surfaces prior to commencement of all operations, for any additional thicknesses required in dubbing out and for working round and behind pipes with their connections and fixtures.

Backings

K Mix and apply backing as described under "Beds".

CEILING

Gypsum

A Ceiling materials shall comply with the National Standards as established by the GBS.

Storage and handling of materials

B Store materials in dry conditions. If storing on concrete, boards should be supported by timber platforms. Carry boards on edge to prevent breakage.

Workmanship

C Fix main supporting channels at 410 mm centers using wire ties on plugs and screws to backgrounds as is required. Fix intermediate suspension members to main support with approved plasterboard screws. Fix sheets to suspension system with staggered joints. Joints in sheeting shall be taped with jointing tape and filled with jointing compound.

D The entire surface should be sanded and left smooth for decoration.

Pricing

E. Prices of Floor, Wall and Ceiling Finishings shall include:-

1. All considerations arising from the specification.

2. All preparatory work to the surfaces to be treated.

3. Producing material samples and preparing sample panels of finished work as and when directed by the Project Manager.

GLAZING

General

A Glass shall be obtained from an approved manufacturer and shall conform to B.S. 952 Part 1: 1978. All glass shall be delivered in proper containers with maker's name, guarantee, type of glass and thickness or weight of glass attached to the outside of the containers.

Sheet glass

B Sheet glass shall be selected glazing quality of the weights or thicknesses stated.

C Float glass and plate glass shall be of the thickness stated and be perfectly flat and true.

Wired glass

D Wired glass shall be of the thicknesses stated, be polished Georgian and be perfectly flat and true.

Putty

E Putty for glazing metal frames shall be that supplied or recommended by the metal windows manufacturer.

Glazing

F All float glass louvre blades shall have ground and polished long edges.

G Cut glass to sizes required as measured on site with a clearance on all sizes to allow for flexible 4 mm spacers and bedding blocks all set plumb, square and level in alignment with other work and glazing. Metal frames to have back putty and peg with neat front putty kept below the sight lines. Timber frames to be set and watertight with approved non-hardening electrometric caulking compound.

H Glazed door glass to be set with spacers as above and secured with wash leather or equal strips to prevent rattling.

Mirrors

I Mirrors shall be of selected quality polished plate silvered mirror glass enameled after cutting, polished edges and drilled for chrome plated dome head mirror screws and plastic washers fixing. All mirrors to have 50 mm diameter curved corner as listed on drawings.

Pricing

J Prices for Glazing shall include for all considerations arising from the specification.

PAINTING AND DECORATING

General

All paint shall comply with the GBS11 - 1992 paint.

A All materials used, unless otherwise stated, shall be anti-fungus. Wherever available environmental benign water based paints and primers free from toxic solvents and lead-free will be used.

B Supply paints on site in sealed cans and all mixing etc., shall be in accordance with the manufacturer's instructions. No paint is to be thinned.

C Produce vouchers as and when required by the Engineer to prove to his satisfaction that all materials supplied are genuine and as specified herein.

Preparation and application

D Thoroughly dust and clean down all surfaces to be painted, cut out cracks, stop holes and clean steelwork rust in accordance with approved practice.

E Apply paint by brush, roller or spray with the minimum of dilution.

F Strain the prepared paint free from skins and similar impurities immediately before application.

G Allow to dry and well rub down each coat of paint before the next is applied and no two successive coats shall be to the same tint.

H No paint shall be applied to a damp surface and no external painting shall be carried out during wet weather.

I Remove metal furniture and fittings before painting to general surfaces and afterwards re-fix.

J On no account allow employees to empty washings or painting materials into sanitary fittings or drainage systems, so provide a suitable receptacle outside the building to receive same.

Brand names

K The Generic types of paints which will be allowed for use on this project are:

i.	Emulsion paint	Terpolymer Latex – internally Acrylic Latex – externally
ii.	Oil paint	Long oil modified Alkyd – internally and externally
iii.	High Gloss Enamel	Polyurethane Modified Alkyd
iv.	Emulsion Primer	Terpolymer Latex
v.	Varnish	Polyurethane single pack
vi.	Wood primer	Modified Alkyd
vii.	Metal primer	Polyamide Cored Epoxy

Brand names (cont'd)

Surfaces shall be prepared and paint applied strictly in accordance with the written recommendations of the Manufacturer.

Masonry and hardboard surfaces

A Prepare masonry surfaces for painting by allowing to dry for as long as possible and removing all mortar splashes by rubbing with a pumice or flat stone and thoroughly brushing to remove dust.

B Prime surfaces with one coat of emulsion and allow to dry. Fill all cracks, holes, etc. with patent filler which shall be allowed to set before sanding to a smooth finish before the application of subsequent coats of emulsion paint.

C Surfaces which are selected for a textured finish shall, after preparation as described for general masonry surfaces, be treated with an etching solution in accordance with the manufacturer's recommendation and finished with a single coat of texture emulsion paint.

Woodwork

D Prepare surfaces of woodwork for painting by sanding smooth and cleaning free of dust. Treat knots and resin pockets with one coat of knotting varnish to prevent bleeding and allow to dry. Apply one coat of wood primer and one coat of oil paint after which all cracks, holes, etc., shall be filled with anti-fungus putty, which shall be allowed to set before sanding to a smooth finish before the application of subsequent coats of oil paint.

Metalwork

E Prepare surfaces of metalwork for painting by removing dirt, grease, etc., with an approved solvent and rust and scale by wire-brushing, chipping, etc., allowing to dry.

F Paint metal surfaces with one coat of primer and two coats of oil paint allowing at least one hour drying between coats.

Pricing

G Prices for Painting and Decorating shall include:-

5. All considerations arising from the specification.

6. Varying colours in individual rooms or areas in accordance with the Engineer's colour schemes.

7. Preparing fairly large sample panels of finishing colours as and when directed by the Engineer.

8. All preparatory work to the surfaces to be painted.

PAVING

Standards

A The provision of the latest revised editions of the following British Standards and Civil Engineering Codes of Practice shall be held to be incorporated in this specification unless it is specifically stated otherwise:-

B.S 63	Single sized road stones and chippings
B.S. 594	Rolled Asphalt (hot process)
B.S. 1690	Cold Asphalt
B.S. 598	Sampling and examination of bituminous road mixtures
B.S. 812	Sampling and testing of mineral aggregates, sand and fillers
B.S. 1621	Bitumen macadam with crushed rock or slag aggregate
B.S. 2040	Bitumen macadam with gravel aggregate
C.P. 2003	Earthworks
C.P. 2006	Traffic bearing structures – pavings

Base course

B Gravel for use in bases where described on the drawings shall be natural excavated gravel from an approved source. It shall be unwashed, but free from roots, grass or other vegetable or other deleterious matter. It is important that the fine clay particles inherent in the in-situ gravel beds shall be retained, but any gravel containing soil overburden or mud from overburden or mud deposit shall be rejected and any such deposits shall be removed as a source prior to the excavation of the in-situ gravel.

C The gravel shall conform to the grading analysis given in Table 1, unless otherwise approved by the Engineer.

TABLE 1

Sieve Size	% Passing by Weight
50 mm	100
38 mm	80 – 100
20 mm	60 – 80
10 mm	45 – 65
6 mm	30 – 50
No. 25	10 – 30
No. 200	5 – 15

Bitumen macadam

A Stone used in the bitumen surfacing shall be best quality washed, crushed stone or natural gravel from an approved source. The rock shall be selected and shall be clean and free from geological defects such as decomposition or strata of inferior rocks or shale and shall be free from contamination by overburden, clay, vegetable or other objectionable material. Quarry and crusher sites, loading points and lorries shall be kept clean and the Contractor shall provide a clean base for stockpiling. The crushed rock shall consist of clean, tough durable fragments, free from excess of flaky and elongated particles as defined in B.S. 812.

B The stone for use in wearing courses shall have a maximum size and grading in accordance with the requirements of B.S. 2040, 1960 or 1621 as applicable.

C The stone for use in penetration macadam base courses shall be clean and single sized, passing a 38 mm sieve but retained on a 20 mm sieve.

D Fine aggregate shall be approved clean natural and or crushed rock, in accordance with the requirements of B.S. 1690, 2040 or 1621.

Bitumen

E Bitumen shall be straight run bitumen having a 90/100 penetration at 25°C unless otherwise approved or cutback bitumen of viscosity 100 to 150 seconds to 40°C (Standard Tar Viscometer) unless otherwise approved.

Laying

F Laying shall be in accordance with the relevant section of British Standard C.P. 2006.

G Each course of macadam shall be laid to such a thickness that on completion of compaction its final thickness is specified on the drawings.

H Laying shall not proceed during heavy or continuous rains when material may not adhere or key to the base. Care shall be taken to remove standing water from the base.

I Where tack coat of bitumen penetration is required, care shall be taken not to exceed the specified rates of application. Too much bitumen resulting in ponding on the bottom is not acceptable.

J The roller shall not be less than 100 KN.

Compaction

K The base shall be of the compacted thickness indicated on the drawings. The material shall be laid in layers not exceeding a thickness of 200 mm for gravel and 100 mm for crushed stone, before compaction and shall be thoroughly compacted to the full depth of each layer by either smooth wheel or pneumatic type rollers or vibrating equipment. Compaction shall be carried out to 95% Standard Proctor Density. The roller shall not be less than 100 KN.

Tolerances

A The level of any point on the surface of each of the pavement courses of the paving shall, on completion of compaction, conform to that shown on the drawings within the tolerances stated in Table 2.

Surface of Course	TABLE 2 Tolerance from true surface level	Maximum depression tested with 3000mm straight edge place on the surface parallel to the centre line of the paving
Formation	± 50 mm	-
Base (eg. Pitrun)	± 38 mm	10 mm
Base course (eg. Penetration macadam)	± 6 mm	10 mm
Wearing Course) Hand Laid) Machine Laid)	 ± 12 mm - 6 mm	 6 mm 6 mm

Pricing

B Prices for Paving shall include for all considerations arising from the Specification.

BITUMINOUS PRIME COAT

Description:

A. The work to be performed under this Section consists of applying bituminous prime coat material to a previously prepared aggregate roadbed.

Materials:

B. Bituminous material to be used shall be medium curing liquid bitumen MC-30

Execution:

C. Immediately before applying the bituminous prime coat material, all loose dirt and other objectionable material shall be removed from the surface with a power broom and/ or blower as required. If the Engineer so orders, the surface shall be lightly bladed and rolled immediately prior to the application of bituminous material, in which case brooming or blowing may not be required. When so ordered by the Engineer, a light application of water shall be made just before application of bituminous material.

D. The bituminous material shall be applied by means of a distributor at the temperature and at the rate of 1.5 litres per square meter unless otherwise specified or ordered by the Engineer. The application shall be divided into two applications when necessary to prevent flowing off the surface and additional bituminous material shall be applied where surface conditions indicate it to be necessary. When applied in two or more lanes, there shall be a slight overlap of bituminous material along adjoining edges of lanes.

E. The surface of structures and trees adjacent to the areas being treated shall be protected in such manner as to prevent their being spattered or marred. No bituminous material shall be discharged into a borrow pit or gutter.

F. The distributor shall have pneumatic tyres of such width and number that the load produced on the road surface shall not exceed 100 kgs per centimeter of tyre width, and shall be so designed, equipped, maintained and operated that bituminous material at even heat may be applied uniformly on variable widths of surface up to 4.5 meters at readily determined and controlled rates of from 0.27 to 10 litres per square meter. With uniform pressure and with an allowable variation from any specified rate not to exceed 0.1 litre per square meter. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or calibrated tank and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a separate power unit for the pump and full circulation spray bars, which shall be adjustable laterally and vertically. The spray bars on the position that operation of all sprays are in his full view.

G. Traffic other than that engaged in the pavement construction will not be permitted on the primed surface until it is cured.

H. The contractor shall maintain the primed surface for a minimum of two days before covering it with the surfacing or next course. Any areas containing an excess or deficiency or priming material shall be corrected by the addition of blotter material or bitumen as directed by the Engineer. Prior to the application of the surfacing or next course, any surface breaks shall be patched and all excessive blotter material, dirt and other objectionable materials shall be removed by sweeping.

IMPORTED CRUSHED BLUE METAL AGGREGATE

Description:

A This work shall consist of furnishing, placing and compacting one or more courses of crushed aggregate base material upon a prepared sub-base in accordance with these Specifications and to the lines, grades, thickness and typical cross-sections shown on the Drawings or established by the Engineer.

Materials:

B The aggregate shall consist of crushed angular aggregate free from an excess of flat, elongated, thinly laminated, soft or integrated pieces and free from fragments coated with dirt or other objectionable matter.

C The grading requirements for the aggregate shall conform to the following:-

Sieve Sizes	U.S. Bureau of Standards Sieves % Passing by Weight	
	Min	Max.
37.5 mm	100	-
25 mm	80	100
19.0 mm	70	90
12 mm	55	80
4.75 mm (No. 4)	35	60
2.38 mm (No. 8)	25	50
0.56 mm (No. 30)	12	30
0.075 mm (No. 200)	5	10

D The portion of the material retained on a No. 10 sieve shall be known as coarse aggregate and that portion passing a No. 10 sieve shall be known as filler.

E Unless otherwise approved by the Engineer, coarse aggregate shall have a percentage of wear of not more than 40 at 500 revolutions as determined by the Los Angeles Abrasion Test (AASHTO Designation T96).

F The material passing the 19.0mm sieve shall have a soaked C.B.R. value of not less than 80% when tested at the maximum dry density and optimum moisture content as determined by AASHTO T193.

G For all grading, that portion passing a No. 40 sieve shall be non-plastic or shall have a liquid limit of not more than 25 and a plasticity index of not more than 6.

H At least fifty (50) percent by numerical count of all coarse aggregate particles retained on the No. 4 sieve shall have at least one fractured face or shall be naturally angular with sharp edges. If this requirement cannot be met for a specified crushed aggregate type then the Contractor shall, at no additional charge, crush aggregate to the next smaller size or such intermediate size as the Engineer may direct in order that the crushed aggregate shall meet the requirement.

Workmanship

A The underlying course shall be checked and accepted by this Engineer before placing and spreading operations are started. Any ruts or soft yielding places caused by improper drainage conditions, hauling or any other cause shall be corrected at the Contractor's expense before the base course is placed thereon.

B The aggregate shall be uniformly blended during crushing operations or mixed in a plant. The plant shall blend and mix the materials to meet the specifications and to secure the proper moisture content for compaction.

C The crushed aggregate base material shall be placed on the moistened subgrade in layers of uniform thickness. The maximum depth of a compacted layer shall be 150mm.

D If the total depth of the compacted material is more than 150mm it shall be constructed in two or more layers. In multilayer construction, the base course shall be placed in approximately equal-depth layers. The previously constructed layer should be cleaned of loose and foreign material prior to placing the next layer. The surface of the compacted material shall be kept moist until covered with the next layer.

E Immediately upon completion of the spreading operations, the crushed aggregate shall be thoroughly compacted. The number, type and weight of roller shall be sufficient to compact the material to a density of not less than 95% of the maximum dry density when tested in accordance with AASHTO T-180 (Method D). The moisture content of the material during placing operations shall not be below nor more than 1.5% of the optimum moisture content as determined by AASHTIO T-180 Method D.

F Compaction shall continue until the surface is even and true to the proposed lines and grades within a tolerance of ten millimetres (10mm) above or below the required cross-sectional elevations and to a maximum irregularity not exceeding ten millimetres (10mm) in three metres longitudinally.

G Any specific area of base which, after being compacted, does not form a satisfactory, solid, stable foundation (regardless of test results) shall be removed, replaced and recompacted, to the Engineer's satisfaction, at the Contractor's expense.

IMPORTED PITRUN GRAVEL SUB-BASE

Scope:

A This work shall consist of:

(a) Preparing road subgrade

(b) Furnishing, placing and compacting one or more courses or aggregate sub-base material on the prepared sub-grade.

B All in accordance with these Specifications and in conformity with the lines, grades, thickness and typical cross-sections shown on the Drawings or as established by the Engineer.

Materials:

(a) Aggregate Sub-base:

C The aggregate shall consist of hard durable particles of fragments of stone or gravel and filler of sand or other finely divided mineral matter. Oversize material encountered in deposits from which aggregate is produced shall be removed by screening or shall be crushed to the required size, whichever the Contractor may elect. No particle, larger than 75mm shall be allowed at any time to be compacted within the areas of the pavement.

D The grading requirements for the aggregate shall be the following:

U.S. Bureau of Standard Sieves	% Passing (By Weight)	
Sieve Sizes	**Min**	**Max.**
76.2 mm	100	-
38.1 mm	70	100
19.1 mm	50	95
9.5 mm	40	85
4.76 mm (No. 4)	30	75
2.00 mm (No. 10)	20	60
0.425mm (No. 40)	10	40
0.075mm (No. 200)	5	20

E The portion of material retained on a No. 10 sieve shall be known as coarse aggregate and that portion passing a No. 10 sieve shall be known as filler.

F Unless otherwise approved by the Engineer, coarse aggregate shall have a percentage wear of not more than 50 at 500 revolutions as determined by the Los Angeles Abrasion Test (AASTHO Designation T96).

G The material passing the 19.1mm sieve shall be capable of giving an unsoaked C.B.R. value of 30% when tested in a 152.4 mm mould and compacted at optimum moisture content (the optimum moisture content as determined by AASHTO T180) on five equal layers with fifty-five (55) blows of a 495 kg rammer to each layer.

Materials (cont'd):

(b) Aggregate Sub-base:

A For all gradings that portion passing a No. 40 sieve, shall be non-plastic or shall have a liquid limit of not more than 25 and a plasticity index of not more than 6.

Workmanship:

(a) Road Subgrade Preparation:

B After all required stripping and excavation or embankment has been carried out in areas beneath any proposed roadway, such areas shall be moistened or dried to near optimum moisture, scarified to a depth of 150mm and compacted to at least 95 percent maximum dry density as determined by ASTM D698. If water enters an excavation and disturbs, loosens, or softens this subgrade, the disturbed soils shall be removed and replaced with compacted select native fill or granular material. Final preparation shall be completed to the satisfaction of the Engineer and must be approved prior to placing fill or granular material.

C After the formation of road subgrade is completed, the surface shall be tested for smoothness and accuracy of grade and crown, and if any portions, are found to lack the required smoothness or to fail in accuracy of grade or crown, such portions shall be scarified, re-shaped and re-compacted, and otherwise manipulated as the Engineer may direct until the required uniformity and accuracy is obtained at the Contractor's own expense. The finished surface shall be such that it shall not vary more than ten millimetres (10mm) from a 3 metre straight edge applied to the surface parallel to and at right angles to the centre line.

(b) Aggregate Sub-base:

D No aggregate is to be placed until the subgrade has been prepared, finished and accepted by the Engineer.

E No hauling shall be done or equipment moved over the subgrade when its condition is such that undue distortion results unless the subgrade is protected with adequate plant runways, mats or other satisfactory means.

F Aggregates for sub-base course shall be delivered to the roadbed as uniform mixtures and shall be spread using an approved aggregate spreader. The Engineer may permit end dumping or fly spreading from the tailgate of trucks, provided he is satisfied that the work will be well controlled and segregation will not occur.

G The aggregate sub-base course shall be placed on the prepared subgrade and compacted in layers of thickness not exceeding 150mm compacted or as shown on the Drawings. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed, and each layer shall be of approximately the same compacted thickness within limits defined by the Engineer.

H Compaction of each layer shall continue until a density of not less than 95% of the maximum density determined in accordance with AASHTO T180 Method D has been achieved. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly keyed.

Workmanship (cont'd):

(c) Aggregate Sub-base:

A In place field density determination will be made in accordance with AASHTO T191 (Sand Cone Method) or T238 (Nuclear Methods).

B Subject to the concurrence of the Engineer, the Contractor may water the material as required to aid in attaining the specified density.

C When tested by a crown template, conforming to the typical cross-section shown on the Drawings and a 3-metre straightedge applied at right angles and parallel respectively to the centre-line of the road bed, the variation of the surface from each testing edge between any two contacts with the surface shall at no point exceed 15mm for the crown template and 10mm for the straightedge.

Stockpiling:

D The aggregate shall not be stockpiled within the subgrade before or after excavation. When hauling is done over previously placed material, hauling equipment shall be routed as uniformly as possible over the entire area of previously constructed layers.

Care of Works:

E The aggregate sub-base course shall, after approval in part or in whole, be maintained by the Contractor at his expense.

LANDSCAPING

General

A All plant materials shall be to the size indicated, free from pests and disease and available for inspection prior to the importation to the site.

Topsoil

B Topsoil shall in the first instance be transported from the spoil heaps of excavated topsoil and then imported as good quality free of stones and miscellaneous debris.

Humic material

C Humic material shall be well rotted manure, peat moss, Promix, rotted bagasse, coconut fibre, coffee or rice husks as available.

Inorganic fertilizer

D Inorganic fertilizer for trees shall be NPK mixture preferably 12:12:17:2. It shall be uniform in composition, dry and free flowing. Sulphate ammonia or urea for grassed areas.

Grassed areas

E Remove all stones more than 20 mm diameter, sticks, rubbish and other extraneous matter and rotary cultivate, pulverize and grade the top soil to depth of 200mm. Grassed areas shall be uniform grade throughout without dips and pockets. Place topsoil to maintain the grade of falls of the sub-soil, including swale drains and moulds left by the General Contractor.

F Approved savannah grass shall be planted by approximately 40 mm plugs at 150 mm centres followed by rolling to give a flat planted surface. The area shall be sprayed with an approved insecticide and herbicide treatment against weeds. Fertilize with sulphate of ammonia or urea at appropriate rates.

G The planted grass shall be watered, weeded, and free of bare spots and cut whenever nearing the establishment and maintenance period.

ENVIRONMENTAL PROTECTION MEASURES

Environmental Management Plan (EMP)

Objective

This document is intended to provide guidance for the successful contractor to develop an Environmental Management Plan (EMP) to reduce the adverse impact of construction activities on the environment.

Suggested measures:

- An environmental management system should be in place, as a pre-requisite to preparing an environmental management plan (EMP).
- Prepare an environmental control plan for the whole-of-site plan.
- The plan should implement the risk management action plan; include detailed specifications on site-specific controls.
- Base the measures in the plan on Best Practices.
- Update the plan to meet new risks or where inspections, monitoring or audit reveal that measures are ineffective.
- Update the plan to achieve ongoing improvement.

The EMP should contain all aspects of a project's environmental management, and should be prepared by the contractor before work commences on any construction project.

A maintenance and inspection program should be provided for all control structures and measures. Ongoing surveillance of the site is required to ensure that new risks are identified as they arise. This allows the EMP to be adjusted to ensure that any new risks are adequately managed.

The plan should be updated to address deficiencies identified by the monitoring or audit programme and as new risks are identified through surveillance.

Mitigation Measures

The following are some of the specific mitigation measures to be implemented during this project. Mitigation measures are presented for the following broad environmental and social performance requirements consistent with Best Practices.

ACTIVITY	PERFORMANCE INDICATOR	MITIGATION MEASURES CHECKLIST
Construction Phase	**Air Quality and Ambient Noise Levels**	▪ Enclose the project site prior to commencement of works to limit the impacts of noise and dust emissions. Construction hours: To be discussed and agreed. ▪ Implement dust suppression techniques (e.g. dampening with water) on unpaved access roads/paths during implementation of planned works. ▪ Ensure that vehicles carrying loads with the potential to generate dust are appropriately sheeted/covered. ▪ Situate all soil stockpiles away from site boundaries and sensitive receptors. ▪ Limit vehicle speed to 10-20 km/hr for all vehicles travelling on unpaved roads/paths. ▪ Keep drop height to a minimum when vehicles are offloading soil or other materials that can emit dust. ▪ Maintain work equipment and vehicles in good mechanical condition, guided by the manual for each machine.
	Pollution Prevention, Control and Management	▪ Land clearing and excavation should be limited to periods of dry weather conditions as much as possible to reduce the likelihood that disturbed sediments would be washed into downstream areas. Consult credible weather forecast prior to planning land preparation schedule. ▪ Properly secure all soil onsite to limit erosion and downstream siltation. Separate excavated soil by type to ensure effective reuse. ▪ Reuse excavated soil onsite as much feasible. ▪ Implement the 3R's of Waste Management (Reduce, Reduce and Recycle) as applicable in the management of solid waste generated on site. Green waste should not be taken to Perseverance Landfill; other more suitable uses that benefit from the easily decomposable nature of the waste should be used. ▪ In the event that landfilling of construction waste is needed, use reputable truck drivers/companies to dispose of material at Perseverance Landfill or other sites

ACTIVITY	PERFORMANCE INDICATOR	MITIGATION MEASURES CHECKLIST
		approved by the Grenada Solid Waste Management Authority (GSWMA). Monitor compliance of service provider in delivering this service. ▪ Maintain a record of following to support monitoring activities: ✓ All waste collected; ✓ The number of trucks, including licence plate number that collected waste; ✓ Site at which waste is disposed of; and ✓ At least a telephone number of the place where the material was disposed of. Prevent disposal of all used vehicle oil on the project site.
	Occupational Health and Safety	▪ Maintain the necessary first aid supplies onsite and train and designate at least one person (a designated Safety Manager with previous construction safety experience) to ensure that health and safety measures are in place on the work sites at all times. ▪ Safety Manager/Site Clerk to ensure consistent use Personal Protective Equipment among all site workers, including hard hats, steel toed boots, safety vests, protective gloves. Workers loading the concrete mixers should also wear dust masks. Similarly, ear protection should be worn by all workers who are using machinery which generate noise levels 60dBA and above. Limit working hours for machinery use as advised by the World Health Organization and/or Environmental Protection Agency. ▪ Compliance should be checked, documented and encouraged regularly by Contractors and Consultants on site visits. ▪ Safety Manager to carry out ongoing environmental health and safety (EHS) briefs/training sessions prior to and throughout the construction period to ensure adoption of mitigation measures as included in the ESMP. These sessions should also address matters pertaining to responsible sexual behaviour to limit the opportunities for transactional sex, and the potential for transmission of STIs. ▪ Safety Manager to ensure that emergency numbers are posted in locations that are readily visible by all workers. ▪ Safety Manager to ensure that the work site is free from all sharp objects and slip and fall hazards to prevent

ACTIVITY	PERFORMANCE INDICATOR	MITIGATION MEASURES CHECKLIST
		workers' injuries. Adequate lighting should also be provided if work is undertaken under diminished lighting conditions. ▪ Contractors should use approved scaffolding structures, where necessary to enable workers to safely reach elevated work areas. ▪ Contractor to ensure that the facilities are equipped with adequate fire-fighting equipment for fire protection. The equipment should be properly maintained in good working order and be readily accessible.
	Directly Affected Communities/Businesses	▪ Take every action to ensure equitable employment opportunities for both males and females. ▪ Provide suitable clean changing rooms and toilets on project worksite and maintain aesthetics throughout project lifecycle.
	Landscape and Natural Scenery	▪ Select natural colours and tones for the refurbished building and/or other suitable colour schemes that blend with the general tone in the community and the surrounding landscape.

QUALITY ASSURANCE

D1 Quality System

A. The Contract (including any investigations, design, construction, provision, erection, setting out work, testing and maintenance, whether carried out by the Contractor or a sub-contractor) shall be executed in accordance with a quality system, which satisfies the relevant requirements of BS5750 and the particular requirements of this Specification.

B. The Contractor shall prepare an overall Contractor's Quality Plan describing the quality system to be implemented for the Contract. The Contractor's Quality Plan shall describe in detail the quality management policies, organisation, responsibilities and procedures to be applied, Identifying the applicable requirements of BS 5750.

C. The Contractor's Quality Plan shall be prepared and issued within 4 weeks of award of Contract.

D. The Contractor shall require and verify that sub-contractors comply with the Contractor's Quality Plan.

E. The Contractor shall prepare management and technical procedures supporting or implementing the Contractor's Quality Plan. The procedures shall cover such activities as required by BS 5750.

F. The Contractor shall control quality related activities for key processes to ensure that quality objectives are met. The submission of any item at any stage to the Engineer shall not form part of the direct quality control process and shall not relieve the Contractor of his responsibility for meeting specified requirements. Such submissions shall be regarded as part of the commitment and responsibility of the Contractor to interface with the Engineer to ensure confidence in the output and work.

G. The Contractor shall, in writing:

a) within two weeks of award of Contract appoint a Quality Manager with the Responsibility for and the authority to resolve quality matters.

b) appoint a Quality Representative at each location of work two weeks before work starts at that location.

c) inform the Engineer of the initial appointees on appointment and any subsequent changes.

H. The Contractor shall make available to the Engineer records of internal audits, external audits, management reviews and corrective actions.

D2 Release Certificates

I. The Contractor and his sub-contractors shall only deliver to Site for incorporation in the Works items which comply with contract requirements and have satisfactorily passed all inspections and tests required under the Contract or the Contractor's Quality Plan. Each item shall be accompanied by a Release Certificate in accordance with a set procedure.

HEALTH AND SAFETY

E1 General

A. The Contractor shall appoint a Safety Officer.

B. The Contractor shall be responsible for health and safety on the Site. He shall co-ordinate his own activities and those of his sub-contractors and suppliers to achieve safe and healthy working environments.

C. Not later than two weeks before work is due to start on the Site, the Contractor shall provide the Engineer with a copy of the written Safety Policy which he has prepared under International Standards and which relates to the execution of the Works at the Site.

E2 Safety Plan

D. The Contractor shall prepare a ***Health and Safety Plan*** covering all aspects of the Works and ensure that safety procedures are enforced.

E. The Health and Safety Plan shall be coordinated with other Contractors working on the Site, and other relevant authorities.

F. The Health and Safety Plan shall be submitted to the Engineer within four (4) weeks of the award of Contract, and shall be regularly reviewed and updated.

E3 Site Safety

G. For the duration of activities at or adjacent to the Site the Contractor shall arrange and chair a monthly Site Safety meeting, to which the Engineer or his nominated representative shall be invited.

E4 Substances Hazardous to Health

H. Notwithstanding his general duties under health and safety legislation and regulations, the Contractor shall advise the Engineer in writing of any substances which he proposes to bring onto the Site or incorporate into or use about the Works, or which he discovers existing on the Site, which fall within the Control of the Substances Hazardous to Health Regulations or otherwise require special precautions to be taken.

E5 Employees & Sub-Contractors

I. The contractor shall assume full responsibility and accountability regarding the health and safety of his employees and sub-contractors including any third parties involved in the execution of this contract.

J. Contractor shall comply with Legal Notice 44 of 2002 - Occupational health and Safety Authority Act 2000 and Legal Notice 36 of 2003 - General Provisions for the Health and Safety at Work and the Code of Practice for the Construction Industry (Health and Safety Authority - PT1. 2006), as well as any other legislation, regulations, standards, and / or codes of practice, in effect during the execution of the contract, regarding health and safety issues, as they apply for the contractor's particular operating situation and nature of work activities.

E6 Safe Guarding Existing Buildings and Services

A. During the execution of works, the contractor is to ensure that no damage whatsoever is done to existing building structure or existing services.

B. The contractor is to safeguard the existing buildings using all possible means and methods, such as covering parts of the building which are highly exposed to danger of being damaged from plant and works taking place on site.

E7 Rectification of Damages

C. In case of damage not attributed to any f*orce majeure*, the contractor in all instances will have to make good the necessary repairs at his own expense and as directed by Architect in charge of the site.