## Section 5

## Specifications

## CONTENTS

## 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:

| | | |
|---|---|---|
| ACI | - | American concrete Institute |
| GBS | - | Grenada Bureau of Standards |
| ACI MCP | - | ACI manual of concrete Practice |

### 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

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

H. 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.

I. 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.

J. 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**

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

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

| | | |
|---|---|---|
| $m^3$ - | Cubic Metre | cy |
| $m^2$ - | Square Metre | sy |
| m - | Linear Metre | y |
| mm- | Millimetre | ft |
| cm - | Centimetre | |
| g - | Gram | lbs |
| Tonne - | Metric tonne | |
| Nr. - | Number | |
| Kg - | Kilogramme | |
| Hr - | Hour | |

C. 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.

D. 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.

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

F. 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**

G. 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**

H. 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 deemed 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

I. 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 a new position 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**

J. 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-washering 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.

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.

## EXCAVATION AND EARTH WORK

### 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.

**Approval of bottoms (cont'd)**

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.

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.

## 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.

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.

**Reinforcement (cont'd)**

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"

L. 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" |

M. 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.

N. 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

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

P. 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**

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

E. 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.

F. 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.

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

H. 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**

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

**TESTS**

**General**

J. 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.

K. 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.

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

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

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

A. 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.

B. 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.

**TESTS ….General (cont'd)**

C. 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.

D. 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**

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

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

G. 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.

H. 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.

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

J. 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**

K. 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.

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

A. 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**

B. 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.

**Concrete tests (cont'd)**

C. 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.

D. 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.

E. 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**

F. 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**

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

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

I. 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**

A. 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.

B. 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**

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

**Mix proportions (cont'd)**

D. 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$^2$ |

E. 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.
(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**

I. 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.

J. 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.

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

L. 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.

A. 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.

B. 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.

C. 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.

D. 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**

E. 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.

F. 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.

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

H. 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**

I. 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.

J. 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.

K. 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**

A. 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.

B. 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.

**REINFORCEMENT**

**General**

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

D. 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.

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

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

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

**Bending**

H. 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.

i. 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**

A. 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**

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

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

D. 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.

E. 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.

F. 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.

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

**Welding**

H. 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.

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

**Formwork**

J. 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.

K. 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.

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

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

B. 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**

C. 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.

D. 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.

E. 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.

F. 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**

G. 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.

H. 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.

I. 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**

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

K. 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**

A. 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.

B. 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.

C. 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**

D. 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.

E. 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.

F. 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.

G. 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**

H. 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%.

I. 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.

J. Obtain approval for use 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.

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

**Mixing**

L. 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.

A. 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.

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

**Transporting**

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

D. 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.

E. 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**

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

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

H. 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**

I. 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**

J. 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.

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

L. 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**

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

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

**Record of temperatures**

C 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**

D 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 |

## MASONRY

### General

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

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 gauge, 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 3,000 psi in 28 days and met ACI 530.1.

E. Fill all foundation block cells with concrete or 3,000 psi - 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 re-tempered 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.

I. 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.

A. 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.

B. 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.

C. Thoroughly wet clay blocks before laying.

D. 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**

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

F. Grout shall consist of concrete mix 21N/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.

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

H. 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.

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".

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

**Reinforcement**

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

D. 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.

E. 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.

F. 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.

G. 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**

H. 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.

I. 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**

A. 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.

## 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**

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

**Nails**

A. 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.

## PLUMBING INSTALLATION

### General

A. The whole of the plumbing and installation shall comply with the requirements of the National Water and Sewerage Authority (NAWASA) (and shall be to the satisfaction of the Engineer and Health Authority.

### Compliance and Codes

B. Compliance with the Specifications

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 Section 6 in Bidding Documents.

### Scope of works

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 wares.

### 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

F. 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

A. 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**

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

**Cold water supply pipes**

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

**Venting**

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

**Above ground support pvc**

E. 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**

F. No P.V.C. 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**

G. 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 ¾" fittings shall be screwed unless otherwise approved. All joints to be leak-proof.

**Adapters**

H. 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**

I. 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**

A. 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**

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

C. 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**

D. 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.

**Cutting/patching repairing etc.**

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**

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

A. 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.

B. 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**

C. 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**

D. 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.**

E. 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**

F. 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**

G. 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**

H. 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)

I. 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 to be verified in writing.

E. **Lavatory basins**

Basins shall conform to BS 488 or similar. They shall be heavy duty grade vitreous china white glazed inside and out, complete with chromium plated traps, plug and chain stay, 1 1.2" dia. Supported on porcelain enamelled cast iron built-in cantilever brackets so that the front rim shall be at a height of 30" above finishes floor level.

F. **W.C suite**

Bowls (Pans) shall conform to BS 1213 or similar and shall be heavy duty grade vitreous china white inside and out. They shall be fitted with gunmetal screws to hardwood or fibre let into the floor.

**Flushing cistern** shall conform to BS 1225 or similar and shall be vitreous china, uniform in colour with the bowls, having chromium pasted, brass level handle and brass flushing mechanism.

Unless otherwise specified, cisterns shall have 2 gals. capacity with brass of approved plastic siphon.

**Ball valves** shall conform to BS 1212 or similar and approved with spherical copper or plastic floats fitted with copper alloy corrosion-resistant inerts to carry the thread.

**Overflows** shall be provided to each cistern. They shall be ¾" dia. pipes taken single and projected 6' through external walls where practicable, or as shown or directed.

**Flush pipes** shall conform to BS 1125k or similar and connected to the pan with an approved prefabricated flush pipe connector and shall be adjusted so that they empty completely after each flush. They shall not be less than 1½" internal diameter and shall be of white porcelain enamelled steel or plastic.

G. **Traps**

All sanitary appliances shall be fitted with self-cleansing traps before being connected to the waste or soil system. Traps shall be made of corrosion resistant material and shall be the same diameter ads the waste pipe to which they are connected. Traps must have an adequate water seal (1 ½" minimum) while at the same time having minimum water capacity. Provision must be made wherever necessary, for preventing the breaking of the trap seals by an efficient system of trap ventilation.

**Plastic pipes, fittings and accessories**

A. PVC (unplasticised Polyvinyl Chloride) pipes shall conform to BS 3505 similar having a minimum wall thickness of 0.125" and fittings shall have a minimum wall thickness of 0.135". Traps shall comply with BS 3943 or similar. Where made bends are necessary this shall be done by inserting a bending spring into the pipe or by filling the pipe with sand, heating the pipe with hot air to $266^{o}$ F and bending over a former to the radius required. The pipe shall be allowed to cool naturally while fully supported. Joints shall be solvent welded spigot and socket, or moulded fittings of approved manufacturer, rubber ring type joint or compression joints in accordance with BS 864 or similar.

**Valves**

B. Valves, cocks, tap etc., shall be full way and comply with BS 1010 or similar.

**Testing**

C. The contractor shall be required from time to time the suit the progress of the work, air-test the plumbing and internal drainage in sections to the satisfaction of the engineer before any work is covered.

D. At completion of the work, all soil pipes, branches, ventilation pipes and waste pipes and other parts of the internal drains directly connected to the sewage system controlled by the National Water and sewage Authority shall be subjected to any tests required to satisfy the engineer and/or the above mentioned authority.

**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 cost 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.

## 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:

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.

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

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.

The rated lamp life shall be 20 000 hours.

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.

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

### Wiring of lighting equipment

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**

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**

Only a high standard of workmanship will be acceptable.

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**

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.

## PLASTERWORK AND OTHER FLOOR, WALL AND CEILING FINISHING

### 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.

### 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 $16ft^2$, 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.

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.

**Workmanship**

**Laying tiles**

Non-skid ceramic tiles and clay tiles shall be laid on an approved grout with appropriate falls toward the waste outside or as directed. Joints between tiles shall be filled with grouted cement mortar to produce flush finish.

Vinyl tiles shall be laid using an appropriate adhesive to be used in strict accordance with manufacturer's specifications. Vinyl tiles shall be warmed immediately before laying where undulations in the floor might occur such that the materials may become flexible.

**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 hole 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".

## 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.

### Compatibility of Materials

D. Undercoats and finishing coats for any single application must be obtained from the same manufacturer. One maker's finishing coat must not be applied over another maker's undercoat and vice versa.

### Storage

E. All materials must be kept protected in a dry, clean storage. Group materials of similar colour and type together as such as is possible.

### Preparation and application

F. Thoroughly dust and clean down all surfaces to be painted, cut out cracks, stop holes and clean steelwork rust in accordance with approved practice.

G. Apply paint by brush, roller or spray with the minimum of dilution.

H. Strain the prepared paint free from skins and similar impurities immediately before application.

I. 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.

J. No paint shall be applied to a damp surface and no external painting shall be carried out during wet weather.

K. Remove metal furniture and fittings before painting to general surfaces and afterwards re-fix.

L. 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

A. the Generic types of paints which will be allowed for use on this project are:

| | | |
|---|---|---|
| i. | Emulsion paint: | Terpolymer Latex – internally<br>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 |

B. Surfaces shall be prepared and paint applied strictly in accordance with the written recommendations of the Manufacturer.

**Masonry and hardboard surfaces**

C 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.

D 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.

E 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**

F 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**

G 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.

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

**Preparation of existing decorated surfaces**

A. Previously painted surfaces which are to be redecorated shall be prepared as follows:-

a. Woodwork shall be washed and rubbed down with waterproof paper. Stop all holes and cracks nail holes etc. with hand stopping, prime all bare parts and bring forward worn parts with additional undercoats.

b. Burn off where required to obtain an even surface.

c. Iron and Steelwork shall be stripped of all loose and defective paint, dust and dirt by scrapping or wire brushing. Paint bare metal with one coat of an approval primer.

d. Rendered or Plastered Surfaces of concrete work, and fair face blockwork shall be brushed down and stopped, required or renewed as necessary before the undercoat is applied. Painted surface must be washed off and flattened before redecoration.

**Stirring**

B. The contents of all cans and containers of all material must be properly and thoroughly stirred before and during use and shall be suitably strained as and when necessary.

**Damage surfaces**

C. All damages painted or other surfaces must be touched up before hand over.

**Varnishing**

D. Woodwork for varnishing shall be sanded and cleaned free of dust. All holes, crakes, etc. filed with plastic wood filler to match the colour of the wood and sand to a smooth finish. Varnish shall be applied and allowed to stand for at least 24 hours before application of a successive coat. Each coat shall be rubbed down with a very fine sandpaper before application of another coat.

**Brush work**

E. Unless otherwise described, all application shall be by brush or roller. Permission must be granted by the Engineer for the use of spray application.

**Protection of wet surfaces**

F. Adequate care must be taken in order to protect newly decorated surfaces from blemish. Screens and signs showing "wet pin" may be used.

**Ironmongery**

G. All bolts, latches, hinges, locks, etc. must be removed from decoration and replaced afterwards taking care not to blemish the decoration surface.

**Cleaning on completion**

A. All floors shall be washed clean of paint splashes marks on painted surface shall be touched up and splashes on gross, ironmongery or anywhere visible at any time shall be cleaned to the satisfaction of the engineer.

**Pricing**

B. 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.