# New Gun Range

# Fort Prospect

Bermuda

## Annex C
## Specifications

Date: February 24, 2017

Project No. 31-263-76

# TECHNICAL SPECIFICATIONS

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# Part 1. General

## 1.1 Scope of work

A. Additional specific scope information may be given in bidding requirement documents which shall be read in conjunction with the following:

B. The work shall be as defined by the drawings and other contract documents which are intended to provide for and comprise everything necessary for the proper and complete execution of the works, in every part, notwithstanding that every item necessary may not be shown on the drawings nor mentioned in the specification.

C. Work specifically to be excluded will be marked as "not in contract" or a similar designation.

## 1.2 Intention

A. The Contractor shall abide by and comply with the true intention and meaning of the drawings and specifications taken as a whole, and shall not perform any work knowing it involves any errors or omissions, should any exist.

B. Items mentioned in the specification but not shown on the drawings or vice versa, are to be executed as if occurring in both.

C. Should any error or discrepancy appear or should any doubt exist or dispute arise as to the true intention or meaning of the drawings or of the specifications, or should any portion of be obscure or ambiguous, the Contractor shall apply to the Engineer’s Representative who shall provide a correction or explanation thereof.

D. All written or figured dimensions shall supersede scaled dimensions.

## 1.3 The site

A. The site shall be all the area(s) marked on the site plan, designated for the use of the Contractor, and may temporarily include areas within contract limits off site (e.g. for utility lines) as indicated.

B. The site is to be maintained throughout the duration of the contract, and debris and waste should not be allowed to accumulate, but should be removed at regular intervals and disposed of in a lawful manner.

## 1.4 Protection

A. The Contractor shall take all necessary precautions to adequately protect the site, the works, any existing property, landscaping, features or goods stored on the site, and all property surrounding the site, from damage arising out of the works.

B. Any damage arising out of the works should immediately be made good by skilled tradesmen under the employment of the Contractor.

C. Materials and equipment stored on, adjacent to, or offsite, shall be adequately protected from the weather, damage and theft at all times.

## 1.5 Overtime

A. Unless it is otherwise stated in bidding requirement documents, the contract is intended to be performed in normal working hours. Any additional work required to meet contract time limits that the Contractor considers necessary, shall be at his own expense, and shall have the prior written approval of the Engineer's Representative.

## 1.6 Laws, permits and regulations

A. The Contractor shall obtain and pay for all licenses and permits, other than the general Building Control permit, and all fees and charges for connecting outside services. He shall comply with all laws, acts, regulations and code requirements applicable to the work.

B. The Contractor shall notify the relevant officer prior to the permanent covering up of work.

## 1.7 Use of explosives

A. Except as may be specifically authorized in writing by the Engineer's Representative, the Contractor shall not allow the use of explosives on the site.

B. When the use of explosives is authorized, the Contractor will be responsible for obtaining any necessary permits from the Police and any other permits necessary.

## 1.8 Existing conditions

A. The Contractor shall cooperate with the occupants of existing buildings to minimize conflict and to facilitate the Owner's use.

B. The Contractor shall conduct his operations to ensure the least inconvenience to the general public.

C. Information pertaining to existing conditions has been obtained through investigation and has been gathered with reasonable care, but is not warranted, and may be of a schematic nature. The Contractor is to verify all levels and dimensions on site prior to ordering or construction.

D. The Contractor shall be alert to any indication of or evidence of existing conditions not indicated on the drawings. IT the Contractor encounters unexpected existing site conditions, he shall take all necessary precautions to minimize damage, and shall notify the Engineer's Representative immediately, including during the bidding period.

## 1.9 Emergency arrangements

A. The Contractor shall, during the period of the Contract, maintain arrangements whereby he can quickly call out labour outside normal working hours for work required to maintain safety to persons or property. The Contractor shall, prior to commencing the works, supply the

Engineer's Representative with the name, address and telephone number of a contact who shall be responsible for organising emergency work. Such work shall be put in hand immediately upon the request of the Engineer's Representative.

B. Claims for additional time or costs for emergency arrangement will be dealt with under the relevant Section of the contract.

C. Should the Contractor fail to deal with such emergency work as it arises, the Engineer's Representative shall be at liberty to engage others to carry out the work and the Owner may recover the costs attributable thereto from the Contractor.

## 1.10 Noise and nuisance

A. The Contractor shall employ the best practicable means to meet the Public Health Act and the Health and Safety Requirements to minimise the noise and vibration resulting from his operations, and shall have regard to current standards.

B. The Contractor shall ensure that all vehicles, plant and machinery are fitted with effective exhaust silencers, and are operated to minimise noise emissions.

C. Only 'sound reduced' compressors or other approved alternatives are to be used. Any pneumatically operated percussion tools shall be fitted with approved mufflers or silencers which shall be kept in good repair.

D. Any machinery which is in intermittent use shall be shut down in intervening periods of non-use or, where this is impracticable, throttled back to a minimum.

## 1.11 Burning of trash

A. The Contractor shall not bum trash or other material for disposal on or adjacent to the site. All trash and debris shall be removed from site and disposed of lawfully, unless otherwise stated.

## 1.12 Making good

B. The Contractor shall make good all work disturbed to match the existing work, unless directed otherwise by the Engineer's Representative.

# Part 1. General

## 1.1 Definition

A. A unit price is an amount proposed by the Contractor and stipulated in the Schedule of Rates (If requested) as a price per unit of net measurement for a described item of work

B. Unit prices shall be inclusive of all necessary costs of materials, labour, equipment, establishment charges, overheads and fees including all insurances, taxes, freight, duties and other miscellaneous charges.

C. Unit prices are to be for in-place (net) measured quantities and therefore shall include allowances for waste, bulking factors, handling, fixings etc., and shall be for work of a character and quantity envisaged under the contract.

## 1.2 Use

A. Only one unit price shall be given for each item required; add/omit rates for the same item will not be entertained.

B. Unit prices shall be the first option used in valuing variations both additions to, and deductions from, the Contract Sum, by Change Order where the quantities of the work required by the Contract Documents are amended.

C. Where the nature or character of work differs from that described in a Unit price, the Unit price shall form the basis of the valuation.

D. Fair rates shall be used for the valuing of variations where Unit prices are not applicable.

E. Day work or cost / charge shall only be used for valuing variations which are incapable of being measured and priced.

F. The Contractor's unit prices and other cost information will be treated confidentially and used only for the assessment of tenders and for the administration of the contract should the tender be accepted. Schedules will be returned to unsuccessful bidders if requested.

## 1.3 Bills of Quantities

Part 1. Where Bills of Quantities are used, the terms and method of measurement will be defined in the bidding documents

# Part 1 General

## 1.1 Form of application

A. As soon as practicable after being notified of selection for the award of the Contract, the Contractor shall furnish in writing to the Engineer's Representative an itemized cost breakdown of the various trades and sections which comprise the contract, totaled to equal the contract sum: this analysis to be used as a basis for Progress Payment applications.

B. The cost breakdown shall be, and if not objected to by the Engineer's Representative before the first Progress Payment will be deemed to be, a true reflection of the costs (including overhead and fee) to the Contractor of the respective elements in the contract sum.

## 1.2 Frequency of application

A. Payments will be made at the frequency indicated in the Appendix to the Conditions of Contract as indicated on the Bid Form.

## 1.3 Effect of progress certificates

A. The inclusion of any value against an item in a Progress Payment is not of itself conclusive evidence that any work, materials or goods to which it relates are in accordance with the Contract or Specification.

## 1.4 Materials or goods not yet incorporated into the works

A. The Engineer's Representative will only certify payment for materials or goods not yet incorporated into the works that are on or adjacent to the site always provided that the materials or goods are in accordance with the contract, adequately protected from the weather and other casualties, and have not been prematurely delivered to site.

B. Under exceptional circumstances, payment may be made for materials or goods stored off-site. When this is the case such materials or goods, in addition to other requirements, shall be covered by insurance and properly identified as belonging to the project.

C. The Contractor shall furnish original suppliers' (except in-house supply) invoices etc. to substantiate material and shipping costs and customs duties, and payments will be net (i.e. excluding overhead and fee).

## 1.5 Retention

A. The Owner may deduct and retain, an amount calculated as a percentage (at a rate stated in the Appendix to the Conditions of Contract as indicated on the Bid Form) of the total value of work included for payment under the contract.

B. Following the issue of the Certificate of Substantial Completion, the retention percentage deductible shall be reduced to a rate stated in the Appendix to the Conditions of Contract. The reduced rate shall be a minimum dependent on the extent of defective or incomplete work

C. Substantial Completion means the acceptance by the Owner and the Department of Planning and other regulatory agencies of the works as being suitable for occupation, and the approval by the Owner of the Contractor's written list (known as the deficiencies or punch list) of items to be completed during the Warranty Period.

D. During the Warranty Period, retention in excess of the minimum will be released to the Contractor on rectification of defects with the balance due released on Final Payment

## 1.6 Issue of certificate

A. The Engineer’s Representative shall, within 7 days of receiving an application for payment, issue a certificate to the Owner for such amount as he determines to be properly due, stating in writing to the Contractor his reasons for any amounts withheld.

B. No progress payment certificate will be issued for a total amount less than BDA$10,000.00, unless otherwise stated in bidding requirement documents, or as agreed with the Owner.

# Part 1 General

## 1.1 Definition

A. An alternate is an option during the time of bidding. (For product substitutions during the contract see Section 01631).

B. An alternate will be stated on the Bid Form (or revised Bid Form if an alternate is approved by addendum) for an amount to be added to or deducted from the base bid which the Owner may choose to accept

C. An alternate may be either changes to the scope of work, or in products, materials, equipment, systems or installation methods described in the bidding documents.

## 1.2 Policy

A. Contractors shall price the specification and scope of work called for by the bidding documents, and shall only price alternates when they are either called for, or added by addendum.

**B.** Prices for alternates shall include for changes for other work affected**.**

## 1.3 Contractor's request for an alternate

A. A written request to submit an alternate may be made by a contractor during the bidding period, a minimum of ten calendar days prior to the date for receipt of bids.

B. Complete data must be provided with any request, to substantiate compliance with requirements, together with all relevant supporting literature, performance and test data, and samples if applicable.

C. Any approval to allow the pricing of an alternate will be made by addendum to all contractors, and a revised Bid Form issued.

## 1.4 Acceptance of an alternate

Should the Engineer’s Representative approve an alternate for use in the contract, the Contractor shall coordinate related work including that of sub-contractors if applicable, and modify or adjust adjacent work as required to ensure that work affected is complete and fully integrated into the project.

# Part 1 General

## 1.1 Records

A. The Contractor shall maintain all records required by the Contract Documents, including details relating, but not limited to, ground conditions encountered, weather conditions including temperature, relative humidity and precipitation, daily labour return sheets showing the number of operatives (by trade) employed on the site and the activities in which they were engaged, records of visitors to the site and complete accident reports.

## 1.2 Drawings

A. During the course of construction, the Contractor shall maintain an accurate record of all deviations and changes between the works indicated on the drawings and the actual construction on site.

B. Prior to Substantial Completion of the works, the Contractor shall prepare and deliver to the Engineer's Representative, two sets of Record Drawings of all of the work as constructed, including electrical, HVAC and plumbing installations.

C. Record Drawings shall be provided in the form of one set of negatives and one set of prints. For this purpose, transparencies of the original drawings will be furnished by the Engineer's Representative to the Contractor.

D. Should the Contractor fail in his obligation to supply such Record Drawings, the Owner shall have the right to employ the Engineer's Representative or any other competent person to produce the said drawings and to recover the costs of such services from the Contractor. (see also Section 01700 Part 1.3)

## 1.3 Photographs

A. Before commencement of and during the progress of the works, at intervals not exceeding one month, record photographs shall be taken of such subjects as may be reasonably directed by the Engineer's Representative.

B. The negatives and two copies of 8 x 11 and 10 x 11 prints shall be handed to the Engineer's Representative, at which point copyright shall be vested in the Owner. Each print shall be marked on the back with the date of exposure and a brief description of the subject.

C. The Contractor may keep copies of progress photographs for his records, but such copies shall not be used for any purpose whatsoever without the Owner's written consent.

## 1.4 Conduct

A. The Contractor shall treat the details of the Contract Documents as confidential, and shall not publish or disclose them in any trade or technical paper or elsewhere without the prior written consent of the Owner.

B. During the progress of the works the Contractor shall be responsible for the conduct of his workmen, and shall, upon the direction of the Engineer's Representative cease to employ on

the works any person who may, in the opinion of the Engineer's Representative, be incompetent or misconduct himself.

## 1.5 Site superintendent

A. The Contractor shall keep up on the site a competent superintendent, and any instructions given to him by the Engineer's Representative or his representatives shall be deemed to have been given to the Contractor.

## 1.6 Sub-contractors

A. All sub-contractors shall be employed by the Contractor upon terms and conditions consistent with those of the General and Supplementary Conditions of Contract for Construction.

B. The Specification generally avoids delineating responsibility of sub-trades (e.g. with regard to builder's work, interface of mechanical and electrical). The Contractor is responsible for all co-ordination and timing of the work of his sub-contractors. The Contractor shall provide all general and special attendances required and shall be responsible for the satisfactory fulfillment of his sub-contracts.

C. If the Owner has a reasonable objection to any subcontractor proposed by the Contractor, the Contractor shall propose another to whom the Owner has no reasonable objection. If the changing of sub-contractor causes an increase to the bid amount, the increase will only be accepted if the Contractor has acted promptly and responsively, and has provided adequate information for approval.

D. The Contractor shall only use the sub-contractors listed for the work for which they were proposed and accepted, and shall not change the list without the written approval, of the Engineer's Representative.

E. Nominated sub-contractors will be dealt with by the provisions of the Bermuda Supplementary Conditions when necessary.

## 1.7 Suppliers and installation

A. Prior to starting installation of each major component of the work, the Contractor shall hold a pre-installation conference, attended by each entity involved or affected by planned installation, including technical representatives of product manufacturers and others recognized as expert or otherwise capable of influencing success of the installation.

B. The Contractor shall comply with the manufacturer's instructions and recommendations where the extent is more detailed or stringent than requirements contained directly in the Contract Documents.

# Part 2 **Products**

Not applicable.

# Part 3 **Execution**

## 3.1 Anchoring work

A. Work to be fixed in place shall be securely and properly located by measured line and level and isolated from non-compatible materials sufficiently to prevent deterioration.

B. Individual units of work shall be mounted at industry-recognised mounting heights, if not otherwise indicated; uncertainties shall be referred to the Engineer's Representative before proceeding.

## 3.2 Cleaning and protection

A. Installed elements of work shall be cleaned at the time of installation, and provided with sufficient maintenance and protection during construction to ensure freedom from damage and deterioration until the time of Substantial Completion.

# Part 1 General

## 1.1 Utilities and services

A. The Contractor shall make all reasonable enquiries and take all reasonable measures to ascertain locations of, and protect, existing mains, services and utilities, and shall ensure continuity of service to existing buildings.

B. Should any known service passing through the site require adaptation, the Contractor shall carryout such removal, relocation or disconnection as may be required, and shall give sufficient notice to the Engineer's Representative, Owner and others relevant prior to interruption of services.

## 1.2 Setting out and dimensions

A. Upon taking possession of the site, the Contractor shall verify all levels, angles, grades, rises and dimensions shown on the drawings.

B. Should any setting out discrepancies or errors be discovered on the drawings, the Contractor shall immediately inform the Engineer's Representative and cease all work which is directly influenced by such discrepancies or errors pending resolution by the Engineer's Representative

C. The Contractor shall be solely responsible for the accurate setting out of the works and shall employ a qualified surveyor whenever necessary. Any damages which may be incurred as a result of the incorrect setting out of the works shall be the responsibility of the Contractor's

D. The Contractor shall be responsible for the maintenance of all bench marks on the site.

## 1.3 Maintenance of public roads

A. The Contractor shall protect and maintain all existing roads, footpaths and tracks within the site boundary, and keep them in a clean and serviceable condition and make good any damage or soiling prior to handing over the site to the Owner on completion.

B. The Contractor shall be responsible for keeping all roads, footpaths and tracks adjacent to or in the vicinity of the site free from physical damage and mud and other materials deposited by vehicles connected with the works, whether used by the Contractor or not

C. In the event that the Contractor should fail to make good damage or soiling so caused, the Owner shall have the power to employ a separate contractor to repair or cleanse the roads damaged or soiled, and the cost of such works shall be recoverable from the Contractor.

## 1.4 Use and protection of the site and environs

A. The Contractor shall erect temporary barriers, adequate for security and stability, around the construction site for the duration of the contract until Substantial Completion whereupon it shall be removed. The Contractor shall confine his operations (and those of his sub-contractors and suppliers etc.) to within the barriers, except for related off-site work such as roads and utilities which shall be protected in an appropriate manner.

B. The Contractor shall not pollute, nor cause to be polluted, any watercourse, body of water, surface water sewer, or drain discharging into any of these during the progress of the works, by allowing sand, gravel, cement, sewage or other impurities to escape from the works. The Contractor shall take all necessary preventative measures to ensure that such contamination does not occur.

# Part 1 General

## 1.0 Parties to the Contract

A. The "Owner" means the Government of Bermuda, represented by the Minister of Works and Engineering.

B. The "Contractor" means the person or entity (or his heirs or executors) with whom the Owner has entered into a contract or agreement to carry out the works, including his sub-contractors, suppliers and any person acting on his behalf.

## 1.1 Contract Administrator

A. When this Specification is used in conjunction with a contract containing the Bermuda Supplementary Conditions, the 'Contract Administrator' will be selected and stated in the Appendix.

B. The Contract Administrator will normally be "the Engineer's Representative" .The designation "Engineer's Representative" is used throughout the specification to represent the Contract Administrator. When the Contract Administrator is different (i.e. Surveyor or Architect), this will be defined for the particular project.

C. The "Engineer " means the Chief Engineer, the Ministry of Public Works, Post Office Building, 56 Church Street, Hamilton HM 12, PO Box HM 525 Hamilton HMCX,

and

who is a person employed by the Owner and who is lawfully entitled to practice Engineering in the Islands of Bermuda and is registered as an Engineer.

or

his authorised representatives**.**

## 1.2 Terms

A. the "Works" or the "Work" means the construction and services required by the Contract Documents, and includes all labour, materials, equipment and services provided or to be provided to fulfill the Contractor's or his sub-contractors' and suppliers' obligations, or part thereof.

B. "Notice" shall mean written notice.

C. "Approval" shall mean written approval.

D. "Indicated" is used to assist the reader in locating particular information on drawings by notes, graphics or schedules, or written into other portions of contract documents and terms such as "shown", "noted",

E. "scheduled" and "specified" have the same meaning.

F. "Directed, Requested, Approved, Accepted, etc" imply "by the Engineer's Representative", unless otherwise indicated.

G. "Approved by Engineer's Representative" in no case releases the Contractor from the responsibility to fulfill the requirements of the Contract Documents.

H. "Furnish" or "Supply Only" shall include delivery to the site, unloading, unpacking, and similar subsequent requirements prior to installation.

I. "Install" or "Fix Only" includes, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

J. "Provide" means furnish and install complete and ready for intended use.

K. "Remove" means remove from site, unless otherwise stated, and make good where disturbed. K "Bid" means the same as tender.

L. "Sawn" (in carpentry or formwork) means the same as a rough; "wrot" (or wrought) means planed or finished.

M. "Aggregates" are the components of a graded mixture of screenings.

N. 'The Owner" may be referred to in engineering contracts as the Employer.

O. "An Installer" is the operator or entity actually carrying out the installation.

## 1.3 Abbreviations

A. Where abbreviations or acronyms are used in Contract Documents, they mean the recognised name or entity in the building construction industry; uncertainties shall be referred to the Engineer's Representative before proceeding.

Part 1. "N.I.C." means Not in Contract, and indicates work forming part of the overall project, but which is to be carried out by others under a separate contract either prior to, subsequent to or concurrently with the main contract. The Contractor shall not include for work so described.

# Part 1 General

## 1.1 Responsibility

A. It is the Contractor's responsibility to hold all operational site meetings related to the execution of the work (unless it is specifically stated otherwise in bidding requirement documents).

## 1.2 Scope

A. The Contractor shall schedule and administer a pre-construction meeting, as well as periodic progress meetings (minimum fortnightly unless stated otherwise), and specially called meetings as necessary, to include the following:

1. Preparing agenda.
2. Distributing written notice in advance.
3. Making physical arrangements.
4. Presiding at meetings.
5. Recording the minutes including significant proceeding and decisions.
6. Reproducing minutes and copying within three days to all participants (including three copies to the Engineer’s Representative) and to other parties affected.

B. Representatives at meetings of the Contractor, sub-contractors and suppliers shall be qualified and authorised to act on behalf of the entity they represent.

C. The Engineer’s Representative and Owner's representatives may attend meetings to ascertain that work is expedited in accordance with Contract Documents and schedules.

D. The Engineer’s Representative has the right of approval of the minutes.

## 1.3 Pre-construction meeting

A. **The pre-construction** meeting shall be within fifteen days prior to the Contractor commencing site operations, in a central venue convenient to all parties, designated by the Contractor.

B. The following shall be in attendance:

1. The Contractor's representative.
2. The resident Project Representative and/or the Contractor's superintendent.
3. The Owner's representative (optional).
4. The Engineer’s Representative and professional consultants.
5. Major sub-contractors and suppliers.
6. Others as appropriate.

C. The suggested agenda is:

1. Distribute and discuss construction schedules including critical work sequencing.
2. Discuss major equipment deliveries and priorities.
3. Discuss project co-ordination and designation of responsible personnel.
4. Confirm procedures for field decisions, proposal requests, submittals, Change Orders, and applications for payments, and general correspondence handling.

5. Discuss and identify locations of fencing, storage areas, site huts, toilets etc., temporary power, water and telephone, site access, condition of site, spoil banks etc.
6. Arrange the location, time and date of subsequent meetings.

## 1.4 Progress meetings

A. Progress meetings shall be held in the site office of the Contractor.

B. The following shall be in attendance:

1. The resident Project representative and/or the Contractor's superintendent
2. The Engineer’s Representative and his professional consultants as required.
3. Major sub-contractors and suppliers as appropriate to the agenda.
4. Others as appropriate.

C. The suggested agenda is:

1. Review and approve previous minutes.
2. Review of work since previous meeting, including field observations etc.
3. Schedule review: including problems, corrective measures, revisions, off-site fabrication, delivery schedules and co-ordination.
4. Submittal review.
5. Quality control.
6. Pending changes, effect on schedule.
7. Other business.

## 1.5 Engineer’s Representative's option to hold meetings

A. At his discretion the Engineer’s Representative may assume the responsibility for holding site meetings, if he/she considers the Contractor unable to meet, or is deficient in meeting, the requirements of this Section.

# Part 1 **General**

## 1.1 Scope

A. A Construction or Progress Schedule shall be submitted prior to commencing work on site, indicating a time bar for each significant category of work and sequencing times for submittals, and inspections.

B. Status of alternates (if any, see Section 01030) sufficient for distribution to all relevant parties shall be issued promptly after award of the contract.

C. A Schedule of Values in the form of an elemental analysis of the contract sum shall be submitted (see Section 01027) and shall be based on the values in the Bid Form, if provided.

D. Applications for Payment at intervals specified (see Section 01027).

E. Physical samples of mock-ups of materials, equipment or workmanship to establish standards as required by technical sections showing where applicable variations in colour, pattern or texture, average condition and extreme range of variations.

F. The required security, performance bond or indenture submitted prior to the execution of the contract.

G. A copy of each type of insurance policy submitted prior to commencing work on site.

H. Copies of prints of the photographs as required (see Section 01040 Part 1.3).

I. Copies of all warranties, guarantees, operating instructions and the like submitted prior to Substantial Completion.

J. Copies of maintenance instructions, tools and operating manuals required by technical specifications presented prior to Substantial Completion.

K. Copies of the "Certificate of Use and Occupancy" and other Government approvals, (including the Fire Department and Department of Health) submitted prior to the issue of a Certificate of Substantial Completion.

L. Copies of keys for doors, panels, cabinets, valves, equipment etc. submitted upon Substantial Completion.

M. Record Drawings as required (see Sections 01040 and 01070).

N. Shop Drawings

1. Initial submittal: one opaque blue/black line print and one correctable, reproducible transparency. The transparency will be processed and returned. After approval, print the processed transparency for job use and distribution.

2. Final Submittal: after approval, submit 3 prints; if the drawing is required for maintenance manuals submit 5 prints; with final submittal, include additional prints as necessary for job

use and distribution. The Engineer’s Representative will retain 2 prints, and will return the remainder. One print shall be maintained as mark-up copy for Record Drawings.

O. Product Data (facsimiles not acceptable)

**1.** Mark each copy to indicate the actual product to be provided; show selections from among options in the manufacturer's printed product data. Submit 4 copies to Engineer’s Representative; submittal is for information and record purposes only. Where the product data is required for maintenance manuals, submit 2 additional copies which will be returned. Maintain one additional copy at the project site for reference purposes.

**2.** The Contractor shall not proceed with the installation of manufactured products until a copy of the related product data is in the installer's possession on site.

P. Form of payment application

**1.** As soon as practicable after being notified of selection for the award of the Contract, the Contractor shall furnish in writing to the Engineer’s Representative an itemized cost breakdown of the various trades and sections which comprise the contract, totaled to equal the contract sum: this analysis to be used as a basis for Progress Payment applications.

**2.** The cost breakdown shall be, and if not objected to by the Engineer’s Representative before the first Progress Payment will be deemed to be, a true reflection of the costs including overhead and fee) to the Contractor of the respective elements in the contract sum.

# Part 1 General

## 1.1 Environmental Measures

A. Meet or exceed the requirements of all Bermuda environmental legislation and regulations, including all amendments up to project date provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.

# Part 2 Execution

## 2.1 Fires

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

## 2.2 Disposal of Wastes

A. Discharge of solid, liquid or gaseous materials into the surrounding environment will not be permitted. The contractor will be responsible for collection and disposal of all waste materials in accordance with the latest editions of the Ministry of Public Works Waste Management Plan.

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

## 2.3 Work In or Adjacent To Water

A. Works performed in and around water will be carried out in accordance with regulations of Bermuda authorities having jurisdiction.

B. Install temporary enclosures, screens, traps or other devices to prevent any excess concrete or other construction materials, waste materials or debris falling into the water.

C. Remove immediately any solid object inadvertently dropped into the water. On conclusion of construction, dispose of all debris to prevent its entry into the water.

D. Re-fuelling of machinery must take place at a safe distance from the water under methods approved by the Engineer.

## 2.4 Drainage

A. Provide temporary drainage and pumping as necessary to keep site free from water.

B. Do not pump water containing suspended materials into waterways, sewer or drainage systems.

C. Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Bermuda authority requirements.

## 2.5 Environmental Protection

A. When, in opinion of Engineer, negligence of Contractor results in damage or destruction of local flora and or fauna, or other environmental or aesthetic features beyond work areas as shown on contract drawings, the Contractor shall be responsible, at his expense, for complete restoration including replacement to satisfaction of Engineer.

## 2.6 Pollution Control

A. Control emissions from equipment and plant to Bermuda authorities' emission requirements.

B. Prevent extraneous materials from contaminating air, land or water, by vacuum, temporary enclosures, screens, traps or other devices.

C. Spills of deleterious substances should be immediately contained and cleaned up in accordance with provincial regulatory accordance with provincial regulatory requirements. Spills should be reported forthwith to the Engineer.

## 2.7 Storage and Handling of Fuels and Dangerous Fluids

A. Locate fuel storage facility a minimum of 100 m from any water body in an area approved by the Engineer and construct impermeable dykes so that any spillage is contained.

B. Prevent spillage of gasoline, diesel fuel and other oil products into the water and on land. Clean up spills promptly at own cost in accordance with Bermuda regulatory requirements. Report any fuel spills immediately to Engineer.

C. Proper use of primers, grouts, bonding adhesives and other hazardous substances will be undertaken to prevent their entry into the water. Substances are to be stored and mixed on protected surfaces away from site to prevent their entry into waterways and contamination of soils.

D. Collect and dispose of used oil filter cartridges and other products of equipment maintenance at industrial waste facility to satisfaction of Engineer.

# Part 1 General

## 1.1 Definition

**A.** A substitute is a contractor's alternative to a named product, proposed during the contract

## 1.2 Where substitution is not permitted

A. No substitute product will be allowed for the following.

1. For products specified by naming only one product and manufacturer.

B. Under the circumstances in 1.2 A above the Contractor has the option at the time of bidding to request approval of an alternate (see Section 01030), and unless he does so, he shall be deemed to have allowed for a named product.

## 1.3 Where substitution is permitted

A. For products proposed as "equal" or "equivalent", (or similar wording), to named products that have such wording appended; the Contractor shall make a substitution submittal (see Part 1.5 of this Section).

B. For products which the Contractor is unable to procure, or unable to procure in time, for reasons beyond his control; the Contractor shall make a substitution submittal (see Part 1.5 of this Section).

## 1.4 Where substitution is not required

A. For products specified by referenced standard; the Contractor may select products meeting that standard, by any manufacturer but shall prefer a locally available product.

B. For products specified by naming several products or manufacturers; the Contractor may use any of those named which comply with the specification.

## 1.5 Substitution submittals

A. A written request must be made allowing reasonable time for review and reasonable time for ordering should there be approval.

B. Complete data must be provided with any request, to substantiate compliance with requirements, together with all relevant supporting literature, performance and test data, and samples if applicable.

C. The request must state what, if any, effect the substitution has on dimensions, other trades or contracts, scheduling and costs.

## 1.6 Acceptance of a substitute

A. Should the Engineer’s Representative approve a substitute as being equal, for use in the contract, the Contractor shall co-ordinate related work, including that of sub-contractors if applicable, and modify or adjust adjacent work as required to ensure that work affected is complete and fully integrated into the project.

B. Should the Engineer’s Representative approve a substitute that is NOT equal, for use in the contract, the Contractor shall co-ordinate related work, including that of sub-contractors if applicable, and modify or adjust adjacent work as required to ensure that work affected is complete and fully integrated into the project, and any cost saving of the unequal product shall accrue to the Owner.

C. The Engineer’s Representative's response to the contractor's submittal must be made with reasonable promptness and be made in writing.

# Part 1 General

## 1.1 Contractor's procedures at Substantial Completion

A. The Contractor shall comply with the Contract Conditions and complete the following before requesting the Engineer's Representative to inspect the work, or a designated portion of the work, for certification of Substantial Completion:

B. The Contractor shall submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates and similar required documentation for specific units of work, enabling the Owner's unrestricted occupancy and use.

C. The Contractor shall submit record documentation, maintenance manuals, tools, spare parts, keys and similar operational items.

D. The Contractor shall complete final cleaning, and remove temporary facilities and tools.

E. The Contractor shall submit copies of "Certificate of Use and Occupancy" and other Government approvals, including Fire and Health.

## 1.2 Inspection procedures

A. Upon the receipt of the Contractor's request, the Engineer's Representative will either proceed with inspection or advise the Contractor of pre-requisites not fulfilled. Following initial inspection, the Engineer's Representative will either prepare the certificate of Substantial Completion, or advice the Contractor of work which must be performed prior to issuance of the certificate. The Engineer's Representative will repeat the inspection when requested to ensure that the work has been substantially completed. Results of the completed inspection will form the initial "punch-list" for final acceptance.

B. The Engineer's Representative will re-inspect the work upon receipt of the Contractor's notice that, except for the items whose completion has been delayed due to circumstances that are acceptable to the Engineer's Representative, the work has been completed, including punch-list items from earlier inspections and defective work arising during the Warranty Period. Upon completion of re-inspection, and at the end of the Warranty Period, the Engineer's Representative will either recommend final acceptance and final payment, or will advise the Contractor of work not completed or obligations not fulfilled as required for final acceptance. If necessary, this procedure will be repeated.

## 1.3 Record documentation

A. The Contractor shall maintain two complete set of either blue-or black-line prints of the contract drawings and shop drawings for record mark-up purposes throughout the contract time, and mark-up these drawings during the course of the work to show both changes and the actual installation~ in sufficient detail to form a complete record for the Owner's purposes. He shall give particular attention to work which will be concealed and difficult to measure and record later, and work which may require servicing or replacement during the life of the project. He shall require the entities marking prints to sign and date each mark-up,

and shall bind prints into manageable sets, with durable paper covers, appropriately labeled, and shall transfer the information onto an additional set of reproducible transparent drawings.

B. The Contractor shall provide two sets of 3-ring vinyl-covered binders containing required maintenance manuals, properly identified and indexed, including operating and maintenance instructions extended to cover emergencies, spare parts, warranties, inspection procedures, diagrams, safety, security, and similar appropriate data for each system or equipment item.

## 1.4 Final cleaning

A. At the time of project close out, the Contractor shall clean or re-clean the works to the condition expected from a normal, commercial building cleaning and maintenance programme, and complete the following cleaning operations before requesting the Engineer's Representative's inspection for certification of Substantial Completion.

1. Remove non-permanent protection and labels.
2. Polish glass.
3. Clean exposed finishes.
4. Touch-up minor finish damage.
5. Clean or replace mechanical systems filters.
6. Remove debris.
7. Broom-dean unoccupied spaces.
8. Sanitize plumbing and food service facilities, and chlorinate potable water supply system.
9. Clean light fixtures and replace burned-out lamps.
10. Sweep and wash paved areas.
11. Test potable water for contamination not more than 48 hours in advance of Substantial Completion.
12. Wax resilient flooring, vacuum carpeting and wash ceramic tile work.

## 1.5 Repair of defective work

A. Where damage to materials is minor, repair rather than replacement will be acceptable provided the end product is aesthetically and functionally equivalent to adjacent non damaged surfaces as determined by the Engineer's Representative. If unsatisfactory the Engineer's Representative may require that repaired materials be replaced with new.

# Part 1 General

## 1.1 Location

A. The location of selective demolition to the building structure will normally be indicated on the drawings as required to accommodate new construction.

B. Other work such as cutting concrete floors, roof deck and masonry walls for piping and ducts, and for above grade piping, ducts, and conduit will be required where it can be reasonably seen from the respective mechanical, electrical and other drawings that it is required.

## 1.2 Co-ordination

A. This Section shall be read in conjunction with related Sections elsewhere in the Specification.

## 1.3 Schedule

A. The Contractor shall, if requested, submit a schedule indicating the proposed methods and sequence of operations for selective demolition work to the Engineer’s Representative for review prior to commencement' of work, including co-ordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.

B. Where demolition is to be carried out within occupied buildings, the Contractor shall provide a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's site operations, and shall co-operate with the Owner's continuing occupation of portions of the existing building, and with the Owner's partial occupancy of completed new areas.

C. The Contractor shall provide a minimum of 48 hours notice to the Owner of demolition activities which will make an impact on the Owner's normal operations.

## 1.4 Condition of structure

A. The Owner assumes no responsibility for the condition of items or structures to be demolished.

## 1.5 Protection

A. The Contractor shall provide temporary barricades and other forms of protection as required to protect the Owner's personnel and the general public from injury due to selective demolition work.

B. Where applicable, the Contractor shall provide protective measures to provide free and safe passage of the Owner's personnel and the general public to and from occupied areas of the building.

C. Where necessary, the Contractor shall provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of the structure or element to be demolished, and adjacent facilities or work to remain.

D. The Contractor shall protect from damage any existing finish work that is to remain and becomes exposed during demolition operations, including protecting floors with suitable coverings when necessary.

E. The Contractor shall construct temporary dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed, and equip partitions with dustproof doors and security locks if required.

F. The Contractor shall provide temporary weather protection between demolition and removal of existing construction on the exterior surfaces, and the installation of new construction, to ensure that no water leakage or damage occurs to the structure and interior areas of the existing building.

G. The Contractor shall make provision for the continuity of utility services to occupied areas of the site and shall permanently or temporarily cap off or relocate utility service lines as required.

### 1.6 Explosives

A. The use of explosives will not be permitted without the written consent of the Engineer's Representative and without the obtaining of all necessary Government or other permits.

### 1.7 Temporary signage

A. During demolition or alteration work in buildings used by the general public, the Contractor shall provide signs directing building users to necessary services of the facility, in addition to signs apologizing for disruption.

B. Temporary signs shall be produced by a recognized sign maker and shall be in black block letters on a white background painted on 0.75mm (3/4") plywood.

C. Wording on temporary signs shall be approved by the Engineer's Representative.

## Part 2. Products

Not applicable.

## Part 3. Execution

### 3.1 Order of work

A. The Contractor shall perform selective demolition work in a systematic manner (see also Part 1.3 of this Section).

## 3.2 Concrete and masonry

A. Concrete and masonry shall be demolished in small sections, cut at junctions with construction tore main, using a power-driven masonry saw or hand tools where possible and not power-driven impact tools.

B. Debris should be promptly removed to avoid imposing excessive loads on supporting walls, floors and framing, and to avoid blocking egress from the site.

## 3.3 Foundations

A. Foundation walls shall be demolished to a depth of not less than 300mm (12") below existing ground surface.

B. Below-grade concrete slabs shall be broken up and removed where necessary.

C. For interior slabs on grade, removal methods must be used that will not crack or structurally disturb adjacent slabs or partitions, using power saws where possible.

D. Below-grade areas and voids resulting from demolition work shall be completely filled and compacted with approved earth, gravel or sand, free of trash, debris and stones over 15Omm (6") diameter, roots and other organic matter.

## 3.4 Services

A. If unexpected mechanical, electrical or structural elements are encountered, the Contractor shall submit details of such to the Engineer’s Representative.

## 3.5 Asbestos and other hazardous materials

A. If hazardous materials are encountered during demolition or other operations, the Contractor shall cease work in the affected area and submit a report to the Engineer’s Representative; any work in such an area shall comply with applicable regulations concerning removal, handling, protection against exposure and environmental pollution, and disposal.

B. Burning of any removed materials is not permitted on the site.

# Part General

## 1.1 Protection

A. The contractor shall provide the protection necessary to prevent damage to existing properties, and shall protect existing trees and vegetation which are to remain.

## 1.2 Site clearing

**A.** The Contractor shall not perform any clearing operations until receipt of specific instructions in writing to proceed, from the Engineer's Representative. Trees or shrubs outside the excavations or elsewhere which are to remain shall be protected from injury during construction operations.

B. The areas affected by the works shall be cleared of all existing structures, fences, walls, debris, or other garbage as directed by the Engineer's Representative.

C. Underground structures and chambers shall be demolished as directed by the Engineer's Representative, and shall be properly cleaned out and filled solidly with approved material which shall be compacted to the satisfaction of the Engineer's Representative.

D. The Contractor shall remove trees, shrubs, grass and other vegetation, or obstructions interfering with the installation of new construction, to be deposited on site or as specifically indicated. Removal includes digging out stumps and roots completely and backfilling with approved material and compacting to the same density as that of the surrounding soil.

E. Walls or other objectionable matter other than soil shall be removed for a depth of at least 600mm (2') below formation level and within a depth of at least 3OOmm (I') below side slopes. Any parts of structure below these levels shall be cleared out, walls and floors punctured in order to prevent retention of water and the whole filled solidly with approved material and compacted to the satisfaction of the Engineer's Representative.

F. Depressions caused by clearing and grubbing operations shall be filled with satisfactory soil material, unless further excavation or earthwork is indicated.

## 1.3 Stripping topsoil

A. Topsoil is defined as friable clay loam surface soil found in a depth of not less than l00mm (4"). Satisfactory topsoil is reasonably free of subsoil, lumps, stones, and other objects over 50mm (2") diameter, and without weeds, roots, and other objectionable material which on visual examination can be seen to be broken down by agricultural cultivation or is seen to be capable of supporting vegetable growth.
B. Topsoil shall be stripped to whatever depths encountered in a manner to prevent intermingling with underlying sub-soil or other objectionable material.

C. In all cases, topsoil shall be deposited on site for re-use on site where directed; surplus topsoil shall remain the property of the Owner and be stockpiled so as to drain surface water freely and shall be covered to prevent wind-blown dust.

D. The Contractor shall remove heavy growths of grass from areas before stripping.

E. Where trees are indicated to be left standing, topsoil stripping must be stopped a sufficient distance to prevent damage to the main root systems.

## 1.4 Disposal

A. All materials arising from site clearance (excluding topsoil - see Part 1.3.C of this Section) which are surplus to or unsuitable for use in the works shall be disposed of by the Contractor to approved tipping areas or as directed by the Engineer's Representative.

B. The Owner reserves the right of ownership of any Bermuda stone in existing structures or that can be quarried for building blocks. Any additional works in this connection, extra to normal requirements, will be the subject of a Change Order.

# Part 1 General

## 1.1 Scope

A. Work includes, but is not limited, to the following:

**a.** Preparation of the sub-grade for buildings, walks, and pavements.
**b.** All trenches within site lines.
**c.** Excavation and backfilling required in conjunction with underground mechanical and electrical utilities, and buried mechanical and electrical appurtenances.
**d.** Rough grading and excavation to landscaped work, unless otherwise stated.
**e.** Shoring and bracing excavations as required.
**f.** Finish grading

B. Excavation shall be in or through any materials encountered, including pavements and other obstructions visible on the ground, underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered except those classified as hard rock (see Part 1.2 of this Section) or unauthorised excavation. The classifications for earthwork are as Part 1.3 of this Section.

## 1.2 Excavation in rock

A. Apart from that which exists on the surface of the ground, or which can be reasonably assumed to exist from visual or reported data, the Contractor shall assume, for the purposes of bidding, that hard rock (as classified in Part 6.3 D of this Section) does not exist, and that earthwork shall be in suitable or unsuitable material (as classified in part 6.3) B and C of this section) or soft rock.

B. The payment for the removal of rock will be measured and priced as encountered during earthwork and authorised by Change Order.

## 1.3 Classifications

**A.** Topsoil is defined as friable clay loam surface soil found in a depth of not less than 100 mm (4"). Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 50 mm (2") in diameter, and without weeds, roots, and other objectionable material which on visual examination can be seen to be broken down by agricultural cultivation or is seen to be capable of supporting vegetable growth.

B. Suitable material is defined as complying with AS1M 02487 soil classification Groups GW, GP, GM, SM, SW and SP which are acceptable in accordance with the Contract.

C. Unsuitable material shall mean other than suitable material and unless accepted or otherwise instructed by the Engineer's Representative shall include:

a. Peat, logs, stumps, perishable material and soil containing more than 10% organic matter;
b. Salty and gypsiferous soil, containing more than 10% of soluble salts;

c. Clay of liquid limit exceeding 70 and/or plasticity index exceeding 45;
d. Materials having moisture content greater than the maximum permitted for such materials in the Contract unless otherwise permitted by the Engineer's Representative.

D. Hard rock excavation in trenches and open excavations is defined as that which cannot be excavated by means of heavy duty mechanical excavating equipment having a 0.75 to 1.2 cu. yd. bucket, or which cannot be ripped and excavated with heavy construction equipment. Typical of materials classified as rock are boulders 1.2 cu. yd. or more in volume, hard rock, rock in ledges, and rock, hard cementitious aggregate deposits.

E. Unauthorised excavation consists of the removal of materials beyond the indicated sub-grade elevations or dimensions without the approval of the Engineer's Representative. The Contractor responsible for re-filling any unauthorised excavation, as well as any remedial work directed by the Engineer's Representative.

F. Filling o/unauthorised excavation under footings, foundation bases, or retaining walls, shall be with grade 15 concrete to bring elevations to proper position. Elsewhere, the Contractor shall backfill and compact as specified for authorised excavations of same classification, unless otherwise directed by the Engineer's Representative.

## 1.4 Sub-surface data

A. Any report provided on sub-surface conditions is not intended as a representation or warranty of accuracy or continuity between soil bearings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn there from by the Contractor. Data are made available for the convenience of the Contractor.

## 1.5 Existing utilities

A. The Contractor shall locate the existing underground utilities in areas of work. If utilities are to remain, the Contractor shall provide adequate means of support and protection during earthwork and subsequent operations.

B. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, the Contractor shall consult the utility owner immediately for directions, and co-operate with the Owner and utility companies in keeping respective services and facilities in operation. The Contractor shall repair damaged utilities to the satisfaction of the utility owner.

C. Disused soil and surface water drains within 900 mm (3') of formation level, and such larger sewers and culverts at greater depths as the Engineer's Representative specifies, shall be removed and the trenches backfilled with suitable material.

D. Disused drains and pipes which are not to be taken up shall be filled with grade 7 concrete. The Contractor shall allow for breaking into the drain or pipe at suitable intervals between manholes where necessary to ensure that the pipe is completely filled and for any grouting deemed necessary by the Engineer's Representative as a result of this inspection.

E. The Contractor shall provide a minimum of 48-hours' notice to the Engineer's Representative, and must receive written notice to proceed before interrupting any utility.

F. Existing underground utilities indicated to be removed shall be demolished and completely removed from site; the Contractor shall co-ordinate with the utility companies for shut-off of services if lines are active.

## 1.6 Explosives

A. The use of explosives will not be permitted without the written consent of the Engineer's Representative, and will be subject to the obtaining of all required permits.

## 1.7 Protection of persons and property

A. The Contractor must barricade open excavations and post with warning lights.

B. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

# Part 2 Products

## 2.1 Soil material

A. Suitable soil materials are defined as those complying with ASTMD2487 soil classification Groups GW, GP, GM, SM, SW and SP.

B. Sub-base material shall be suitable soil naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.

C. Backfill and fill materials shall be suitable soil materials free of clay, rock or gravel larger than 50 mm (2") in any dimension, debris, and waste, organic and other deleterious matter. D. Excavated or borrow sub-soil shall be free from roots, rock larger than 75 mm (3") in size and building debris and shall be compactable.

D. Fill under landscaped areas shall be free from alkali, salt, petroleum products, and may be from the site only if it conforms to specified requirements.

## 2.2 Granular material for trenches

A. Gravel shall be angular pit run crushed natural stone, free from shale, clay, friable materials, and debris, graded within the following limits: (Metric equivalent to BS 410)

| SIEVE SIZE | % PASSING |
|---|---|
| 1-1/2" | 100 |
| 1" | 95 to 100 |
| 3/4" | 95 to 100 |
| 5/8" | 75 to 100 |
| 3/8" | 55 to 85 |

| | |
|---|---|
| No.4 | 35 to 60 |
| No.16 | 15 to 35 |
| No.40 | 10 to 25 |
| No.200 | 5 to 10 |

B. Pea rock for trenches shall be clean natural stone; free from clay, shale and organic matter; 6mm to 13mm (1/4" to 1/2").

C. Sand for trenches shall be natural sand or sand derived by crushing gravel or stone; free from silt, clay, loam, friable or soluble materials, and organic matter, graded within the following limits:

| SIEVE SIZE | % PASSING |
|---|---|
| No.4 | 95 to 100 |
| No.8 | 60 to 100 |
| No.10 | 30 to 85 |
| No.14 | 10 to 100 |
| No.48 | 15 to 90 |
| No.100 | 0 to 90 |
| No.200 | 0 to 5 |

## 2.3 Granular material for structure foundations

A. Gravel for structure foundations shall be angular pit run crushed natural stone, free from shale, clay, friable materials, and debris, graded within the following limits:
(Metric equivalent is BS 410)

| SIEVE SIZE | % PASSING |
|---|---|
| 2" | 100 |
| 1" | 95 |
| 3/4" | 95 to 100 |
| 5/8" | 75 to 100 |
| 3/8" | 55 to 85 |
| No.4 | 35 to 60 |
| No.16 | 15 to 35 |
| No.40 | 10 to 25 |
| No.200 | 5 to 10 |

B. Pea gravel shall be clean natural stone; free from clay, shale and organic matter; 6mm to 13mm (1/4" to 1/2").

C. Sand for structure foundations shall be natural sand or sand derived by crushing gravel or stone; free from silt, clay, loam, friable or soluble materials, and organic matter, graded within the following limits:

| SIEVE SIZE | % PASSING |
|---|---|

| | |
|---|---|
| No.4 | 100 |
| No.14 | 10 to 100 |
| No.48 | 15 to 90 |
| No.100 | 4 to 90 |
| No.200 | 0 to 5 |

# Part 3 **Execution**

## 3.1 Method of work

A. All excavation shall be carried out in approved and orderly manner.

## 3.2 Levelling

A. The Contractor shall establish and identify the required lines, levels, contours and datum.

B. The Contractor shall maintain bench marks, monuments and other reference points, and shall inform the Engineer's Representative if disturbed or destroyed and shall be responsible for reestablishing.

## 3.3 Grading

A. Grading shall be within contract limits, including adjacent transition areas to new elevations, levels, profiles and contours indicated.

B. Surfaces shall be graded to ensure areas drain away from structures and to prevent ponding of surface drainage. Sub-grade surfaces shall be free from irregular surface changes.

C. Excavations shall be graded to prevent storm water from draining into excavation areas.

D. The top 150 mm (6") of finished grade not covered with hard surfaces or designated otherwise shall be top-soiled.

## 3.4 Excavating foundations

A. The foundation shall be excavated to the depth and sizes shown on the drawings and shall be thoroughly cleaned before being submitted to the Engineer's Representative for approval. The Contractor shall take all necessary precautions to protect approved foundations from sediment run-off, erosion or contamination by other unsuitable material until the works can proceed further.

B. Any localized pockets of poorly cemented rock or soil shall be removed and the foundations shall be probed using a jackhammer drill as instructed by the Engineer's Representative. Drill

penetration rates shall be recorded by the Contractor during probing in order to identify voids and weak stratum.

C. The Contractor shall notify the Engineer's Representative of any voids detected during construction, whether appearing on the surface or hidden beneath a foundation.

## 3.5 Excavating utility trenches

A. The Contractor shall dig trenches to the uniform width required for the particular utility to be installed and sufficiently wide enough to provide working space. The Contractor shall provide a 150 mm to 225 mm (6" to 9") clearance on each side of the pipe or conduit.

B. Trenches for piping are to be carried to a depth which establishes indicated flow lines and invert elevations.

C. Where rock is encountered, excavation shall be carried l50 mm (6") below the required elevation and backfilled with 150 mm (6") layer of crushed stone or gravel prior to installation of the pipe (see also Part 1.2 of this Section).

D. For pipes or conduit 125 mm (5") or less (nominal size) and for flat-bottomed multiple duct conduit units, the Contractor must not excavate beyond indicated depths, and must hand excavate the bottom cut to accurate elevations and support the pipe or conduit on undisturbed soil.

E. For pipes or conduit 150 mm (6") or larger in nominal size, tanks and other mechanical/electrical work indicated to receive granular base, excavation must be to the depth indicated, or if not otherwise indicated, to 150 mm (6") below the bottom of work to be supported.

F. Bottoms of trenches must be graded as indicated, notching under pipe bells to provide solid bearing for the entire body of pipe, making allowances for granular bedding.

G. Trench excavations lower than adjacent walls/ columns shall be backfilled with concrete as follows:

   a. Trenches within 1 m (3'3") of walls/columns shall be backfilled up to the level of the underside of the adjacent foundation.
   b. All other trenches adjacent to walls/columns shall be backfilled until the difference in level to the underside of the adjacent foundation is less than the distance between that foundation and the nearside of the trench.
   c. Concrete backfilling shall have expansion joints at approx. 9 m (30'centres).
   d. The requirement for backfilling trenches with concrete may be waived if, in the opinion of the Engineer's Representative, the nature of the ground makes it unnecessary.

H. Backfilling must not be carried out until tests and inspections have been made and backfilling authorised by the Engineer's Representative. Care must be used in backfilling to avoid damage or displacement of pipe systems. There shall be a laid 150 mm (6") of sand above pipes or conduits prior to general backfilling.

I. For piping or conduit less than 750 mm (2'6") below the surface of roadways, the Contractor shall provide a 150 mm (6") thick concrete base slab support; and after installation and testing of piping or conduit, shall provide a minimum 150 mm (6") thick encasement (sides and top) of concrete prior to backfilling or placement of the roadway sub-base.

## 3.6 Disposal

A. All unsuitable material arising from excavation which is surplus to or unsuitable for use in the works shall be disposed of by the Contractor to an approved spoil area or as directed by the Engineer's Representative.

B. The Owner reserves the right of ownership of any Bermuda stone that can be quarried for building blocks met with during excavation.

## 3.7 Laying and compaction of filling

A. All filling shall be Completed as soon as practicable after deposition. Compaction shall be in accordance with the following table:

| COMPACTION REQUIREMENTS | | D = MAX DEPTH OF COMPACTED LAYER (mm)<br>N = MIN NUMBER OF PASSES | | | | | |
|---|---|---|---|---|---|---|---|
| Type of Compaction Plant | Category | Well Graded Granular Fill Material | | Uniformly Graded Fill Material | | Selected Granular Material for Foundations (Ref c12.3 A) | |
| | Mass per metre width of roll | D | N | D | N | N for D=110mm | N for D=150mm | N for D=250mm |
| Smooth Wheeled Roller | over 2100 kg up to 2700 kg | 125 | 10 | 125 | 10* | | | |
| | over 2700kg up to 5400 kg | 125 | 8 | 125 | 8* | 16 | NS | NS |
| | over 5400 kg | 150 | 8 | NS | | 8 | 16 | NS |
| Vibrating Roller (used in vibrating mode) | Mass per metre width of Vibrating roll | | | | | | | |
| | Over 270kg up to 450kg | 75 | 16 | 150 | 16 | | | |
| | over 450kg up to 700kg | 75 | 12 | 150 | 12 | | | |
| | over 700kg up to 1300kg | 125 | 12 | 150 | 6 | 16 | NS | NS |
| | over 1300kg up to 1800kg | 150 | 8 | 200 | 10* | 6 | 16 | NS |
| | over 1800kg up to 2300kg | 150 | 4 | 225 | 12* | 4 | 6 | 10 |
| | over 2300kg up to 2900kg | 175 | 4 | 250 | 10* | 3 | 5 | 9 |
| | over 2900kg up to 3600kg | 200 | 4 | 275 | 8* | 3 | 5 | 8 |
| | over 3600kg up to 4300kg | 225 | 4 | 300 | 8* | 2 | 4 | 7 |
| | over 4300kg up to 5000kg | 250 | 4 | 300 | 6* | 2 | 4 | 6 |
| | over 5000 kg | 275 | 4 | 300 | 4* | 2 | 3 | 5 |
| Vibrating Plate Compactor | Mass per unit area of base plate | | | | | | | |
| | over 880kg up to 1100kg | NS | | 75 | 6 | | | |
| | over 1100kg up to 1200kg | 75 | 10 | 100 | 6 | | | |
| | over 1200kg up to 1400kg | 75 | 6 | 150 | 6 | | | |
| | over 1400kg up to 1800kg | 125 | 6 | 150 | 4 | 8 | NS | NS |
| | over 1800kg up to 2100kg | 150 | 5 | 200 | 4 | 5 | 8 | NS |
| | over 2100kg | 200 | 5 | 250 | 4 | 3 | 6 | 10 |
| Vibro Tamper | Mass: | | | | | | | |
| | over 50kg up to 65kg | 100 | 3 | 150 | 3 | 4 | 8 | NS |
| | over 65kg up to 75kg | 125 | 3 | 200 | 3 | 3 | 6 | 10 |
| | over75kg | 150 | 3 | 225 | 3 | 2 | 4 | 8 |
| Power Rammer | Mass: | | | | | | | |
| | l00kg up to 500kg | 150 | 6 | | NS | 5 | 8 | NS |
| | over 500kg | 225 | 12 | | NS | 5 | 8 | 12 |
| Dropping Weight Compactor | Mass over 500kg | 600 | 8 | 450 | 8 | NS | NS | NS |
| | Height of drop | 600 | 4 | | NS | NS | NS | NS |
| | 1m up to 2m | | | | | | | |
| | over 2m | | | | | | | |
| | | | | | | | | |
| Note: For items marked *, the rollers shall be towed by track-laying trucks; self-propelled rollers are unsuitable. | | | | | | | | |

B. Variations from the methods of, or equipment for, compaction given in the table, will be permitted only if the Contractor demonstrates at site trials that an equivalent state of compaction is achieved. (See Part 3.8 of this Section for the trial procedure).

C. Earth-moving plant is not acceptable as compaction equipment.

D. No rocks exceeding 150 mm (6") in the longest dimension shall be placed within 300 mm (12") below formation level.

E. Where the maximum particle size exceeds 75 mm (3") the top layer of the filling shall be brought to the required level and profile by a layer of material of consolidated thickness of 50 mm (2") of which the maximum particle size is 25 mm (1").

F. On completion of compaction and preliminary shaping of the upper course of filling, the necessary excavation for all structures which occur in the area and which extend below its surface shall be carefully made so that the surrounding compacted filling remains compacted after completion of the structure.

G. Surplus material arising from the excavation shall be removed from the formation.

H. Any deviation in the finished surface from the correct levels and profiles shall be corrected by loosening and removing or adding material and re-shaping and compacting, but on no account is any further material to be added once the forms for concrete courses have been placed.

I. The Contractor shall apply in writing to the Engineer's Representative for permission, not less than 24 hours before proposing to carry out compaction processes, to enable proper provision for supervision of compaction in the permanent work.

## 3.8 Compaction trials and methods

**A.** The Engineer's Representative may require the Contractor to carry out compaction trials on each layer of filling as described in Part 3.7 of this Section, to be satisfied that the equipment proposed will achieve an adequate degree of compaction without overstressing the layer or underlying layers.

B. The trials shall include field density tests to BS 1377 on each layer except where more than 40% of the fill is retained on a 20mm BS sieve. The trial area shall be built up in layered construction as described in Part 3.7 of this Section. It shall be of sufficient overall size to allow a separate portion to be set aside for trials on each layer of each type of fill material. Each portion shall be not less than 15m (50') long nor narrower than four times the width of the largest item of equipment in use in the trials.

C. The trials shall be carried out on each layer at optimum moisture content and at moisture contents on either side of optimum. Each item of equipment shall be operated at the various loads and speeds recommended by the manufacturers for the type of materials in the layer, and the optimum number of passes at the most satisfactory load speed shall be established.

D. If necessary, thinner layers than the maximum permitted in Part 3.7 of this Section shall be laid to establish the maximum layer thickness at which the stipulated requirement can be consistently achieved.

E. Density tests shall be carried out on each compacted layer except where more than 40% of the fill is retained on an 19 mm (3/4") sieve. The results shall be recorded separately for each fill material and thickness of layer.

F. The recorded densities shall be related to the various types of plant at each load and speed, to the number of passes and to the moisture content of each layer.

G. As a result of the trials the most efficient combination of moisture content, equipment and conditions of operating, to obtain the stipulated requirement is to be agreed, and the compaction process for each filling material and layer will be approved by the Engineer's Representative Until approval has been given, the general laying of fill material required by the Contractor will not be permitted to start.

H. The Engineer's Representative may carry out comparative site density tests in accordance with BS1377 on material which he considers may have been inadequately compacted. If the test results, when compared with the results of tests made on adjacent approved work in similar materials show the state of compaction to be inadequate due to the Contractor's failure to comply with the requirements of the contract. The Contractor shall carry out such remedial works as the Engineer's Representative decides.

I. The table in BS410 at Appendix 2 A1 is ONLY A GUIDE to assist in assessing the compaction requirements. The Contractor will be required to accept the responsibility to compact the filling to the specified requirement

## 3.9 Completion of formation

A. Prior to the completion of the formation all trenches and other cuttings which lie within the construction area shall be filled with the appropriate filling, compacted in layers not exceeding 6" (150mm) to the density appropriate to the area through which they run. The completed formation is to be inspected by the Engineer's Representative and any soil in the exposed natural foundation at formation level which in the opinion of the Engineer's Representative is soft and unsuitable shall be removed and replaced with compacted filling or grade 10 mix mass concrete as directed by the Engineer's Representative.

B. After all weak places have been made good; the formation shall be finally formed to the required lines and profiles and to levels which will result in the finished surface being to the required levels, all to the approval of the Engineer's Representative.

## 3.10 Levelling and raking of topsoil

A. Topsoil shall be fine graded to a smooth even surface. Ridges shall be removed and depressions filled with topsoil.

B. In areas to be sodded / turfed grading shall be 0.25 mm (1") below adjacent pavement or kerb level.

# Part 1 General

## 1.1 Standard specifications

**A. Unless otherwise stated in the Specification the latest edition of the following standard specifications shall apply:**

| | |
|---|---|
| AASHTO T 104-77 | Magnesium Sulphate Soundness Test |
| BS 8110: 1985 | Structural Use of Concrete |
| BS 812: | Testing Aggregates |
| BS 882: 1983 | Aggregates from Natural Sources for Concrete |
| BS 1377: 1990 | Soil Testing |
| BS 12: 1988 | Specification for Portland Cement |
| BS 4027: 1980 | Sulphate-Resisting Cement |
| BS 3148: 1980 | Testing of Water for Concrete |
| BS 4449: 1988 | Carbon Steel Reinforcing Bars for Concrete |
| BS 4482: 1985 | Cold Reduced Steel Wire for Reinforcement for Concrete |
| BS 970: Parts 1&4 | Valve Steels |
| BS 4483: 1985 | Steel Fabric for Reinforcement |
| BS 1521: 1972 | Waterproof Building Paper |
| BS 1881: | Testing concrete |
| BS 8666: 2000 | Reinforcement Bending Dimensions |
| BS 8007: 1987 | Design of Concrete Structures for Retaining Aqueous Liquids |
| BS 1305 | Batch Type Concrete Mixers |
| BS 3963 | Mixing Performance of Concrete Mixers |
| BS 5328 | Concrete |
| BS 146 | Cement |
| BS 729 | Galvanising |

## 1.2 Concrete grades

A. Concrete grades in this specification, e.g. grade 7, 10 etc. are defined in Section 03300.

# Part 2 Products

## 3.1 Materials Generally

A. Materials, articles, samples and test certificates may conform to standards other than the British Standards referred to in this Specification provided the alternative standard is at least equivalent. In the event of a conflict of interpretation between the alternative standard and the British Standard, then the requirements of the British Standard shall prevail.

B. Materials used in the works shall be new, of the qualities and kinds specified herein and equal to approve samples. Delivery shall be made sufficiently in advance to enable further samples

to be taken and tested if required. No materials shall be used until approved, and materials not approved shall be immediately removed from the site.

C. Materials shall be transported, handled and stored on the site or elsewhere in such a manner as to prevent damage, deterioration or contamination.

# Part 1 General

## 1.1 Scope

A. Formwork including all temporary or permanent forms required for forming the concrete, together with all temporary construction required for its support.

## 1.2 Quality assurance

A. Formwork shall be fixed in its correct position and securely braced to withstand, without appreciable displacement; deflection or movement of any kind, the loading from the construction and the movement of persons, materials and plant including any effects of vibrating the concrete.

B. All formwork shall be so constructed that there shall be no loss of material from the concrete, and all joints shall be sufficiently tight to prevent leakage of cement grout and to avoid the formation of fins or other blemishes. After hardening, the concrete shall be in the position and of the shape, dimensions and surface finish described in the contract.

C. When requested by the Engineer Representative, a statement of method and design calculations shall be submitted for approval not less than 7 days prior to any formwork erection.

# Part 2 Products

## 2.1 Surface finishes

A. The surface finishes for formed surfaces shall be as specified on the drawings to the following requirements:

| Type | Quality |
|---|---|
| F1 | This finish shall be obtained by the use of properly designed formwork or moulds of closely jointed sawn boards or sheet ply. The surfaces may be imprinted with the grain of the sawn boards or sheet ply and their joints. In addition, small blemishes caused by entrapped air or water will be accepted, but the surface shall be free from voids, honeycombing and other large blemishes. |
| F2 | This finish shall be obtained by the use of properly designed forms of closely jointed wrought boards or film faced ply. The surfaces may be imprinted with the slight grain of the timber and their joints. Small blemishes caused by entrapped air or water will be accepted, but the surface shall be free from voids, honeycombing and other large blemishes. |
| F3 | The finish shall be achieved only by the use of high quality concrete and by using properly designed forms having a hard, smooth surface. |

The concrete surfaces shall be smooth, with true clean arises. Only very minor surface blemishes will be accepted and there shall be no staining or discoloration from the release agent.

F4 This finish shall be obtained by first producing a type F2 finish on thoroughly compacted high quality concrete, cast in properly designed forms. The surface shall then be improved by carefully removing all fins and other projections, thoroughly washing down and then filling the most noticeable surface blemishes with a cement and fine aggregate paste. Every effort shall be made to match the colour of concrete. The Contractor shall ensure that the finished concrete surface is not permanently stained nor discoloured by the choice of the release agent used.

F5 This finish shall be obtained by first producing a type F3 finish and then, while the concrete is still green, filling all surface blemishes with a fresh, specially prepared cement and fine aggregate paste. Every effort shall be made to match the colour of the concrete. After the concrete has been properly cured, the faces shall be rubbed down to produce a smooth and even surface.

F6 This finish shall be achieved by lining the formwork with the material specified by the Engineer Representative to achieve the specified finish. This material shall leave no stain on the concrete and shall be so jointed and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source through anyone structure. The Contractor shall make good any imperfections in the resulting finish as required by the Engineer Representative. Internal ties and embedded metal parts will only be allowed with the specific approval of the Engineer Representative.

B. The surface finishes for unformed surfaces shall be as specified on the drawings to the following requirements:

Type Quality

| | |
|---|---|
| U1 | The concrete shall be uniformly levelled, tamped or screeded to produce a plain or ridged surface as described on the drawings or elsewhere. No further work shall be applied to the surface unless it is used as the first stage for a Type U2 or U*3* finish. |
| U2 | After the concrete has hardened sufficiently the concrete Type U1 surface shall be floated by hand to produce a uniform surface free from screed marks. |
| U3 | When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, a Type U1 surface shall be power-floated and power-towelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks. |
| U4 | The concrete shall be finished to U3 level and then brushed to produce permanent non-slip ridges. |

C. Any remedial treatment to surfaces shall be agreed with the Engineer Representative following inspection immediately after removing the form work and shall be carried out without delay.

D. Any concrete, the surface of which has been treated before being inspected by the Engineer Representative, shall be liable to rejection.

E. In no cases shall any concrete finishes be of a lower standard than the minimum specified in A or B above.

# Part 3 **Execution**

## 3.1 Preparation

A. The inside surfaces of forms shall, except for permanent formwork, be coated with an approved material to prevent adhesion of the concrete. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not come into contact with the reinforcement. The same release agent shall be used for all concrete surfaces which will be visible on completion of the works.

B. Immediately before concreting, all forms shall be thoroughly cleaned out. Openings for inspection of the inside of the formwork and for the escape of water used for washing out shall be formed so that they can be conveniently closed before placing the concrete.

C. Before placing the concrete, bolts and fixings shall be in position, and cores and other devices used for forming openings, holes, pockets, recesses and other cavities shall be fixed to the formwork No holes shall be cut in any concrete unless approved by the Engineer Representative.

D. Vertical props shall be supported on wedges, or other measures shall be taken whereby the props can be gently lowered vertically when commencing to remove the formwork. Props for an upper story shall be placed directly over those in the story immediately below and the lower prop shall bear on work sufficiently strong to carry the load.

E. Before any concrete is placed, all formwork shall be inspected and approved by the Engineer Representative who must be notified by the Contractor 24 hours prior to concreting. Approval does not relieve the Contractor of the responsibility for the structural adequacy of formwork and supports.

## 3.2 Installation

A. Connections shall be constructed to permit easy removal of the formwork and shall be either nailed, screwed, bolted, clamped, wired or otherwise secured to be strong enough to retain the correct shape during consolidation of the concrete.

B. Where internal metal ties are permitted, they or their removable parts shall be extracted without damage to the concrete and the remaining holes filled with dry-pack. No permanently embedded metal parts shall have less than 50 mm (2") cover to the finished concrete surface or 75 mm (3") cover where the structure is water retaining or exposed to sea-water.

C. If the formwork for a column is erected to the full height of the column, one side shall be left open and shall be built-up in sections as placing of the concrete proceeds.

D. Forms for beams, slabs and similar members shall be designed and constructed so that the sides may be removed without disturbing the soffit shutters or supports thereto.

E. Where concrete is to be placed directly against an un-excavated surface, the Contractor shall seal the face of the excavation to ensure that no water required for the hydration of the cement is drawn out of the concrete mix. The method of sealing the face of the excavation shall be subject to the approval of the Engineer Representative. Approval does not relieve the Contractor of the responsibility for the adequacy of the method.

## 3.3 Removal

A. The Engineer Representative shall be informed in advance when the Contractor intends to strike any Formwork.

B. Formwork shall be constructed so that the side forms of members can be removed without disturbing the soffit forms, and if props are to be left in place when the soffit forms are removed, such props shall not be disturbed during striking.

C. Formwork shall be removed by gradual easing without jarring or damage to the concrete. Formwork shall be removed only in the presence of a competent supervisor when the concrete has attained sufficient strength.

D. Where it is intended that formwork is to be reused it shall be cleaned and made good to the satisfaction of the Engineer Representative.

## 3.5 Removal times

A. The time at which the formwork is struck shall be the Contractor's responsibility, but the minimum periods between concreting and the removal of forms shall be as follows:

| Type of Formwork | Minimum Period before striking |
|---|---|
| Vertical formwork to columns, walls, and large beams | 12 hours |
| Soffit formwork to slabs | 4 days |
| Props to slabs | 10 days |
| Soffit formwork to beams | 10 days |
| Props to beams | 14 days |

B. Notwithstanding any approval given by the Engineer Representative, the Contractor shall be held responsible for, and shall make good any damage arising from the removal or premature removal of the formwork.

# Part 1 General

## 1.1 Galvanising

A. After being cut and/ or bent to the dimensions shown on the drawings or given in the bar schedules, all bar reinforcement and steel fabric unless indicated otherwise on the drawings shall be prepared and hot-dip galvanised in accordance with the requirements of BS 729 with a chromatin post-treatment. The temperature of the molten zinc bath shall not exceed 500"C. soft and needs iron tying wire shall also be hot-dip galvanised and similarly treated. Steel reinforcement shall be clean, free from loose rust and mill-scale at the time of galvanising. Unless instructed otherwise by the Architect, reinforcement shall not be straightened nor bent after galvanising.

B. Steel bars to be used for reinforcement supports and spacers shall be hot-dip galvanised and treated in accordance with BS 729 as above. With the prior approval of the Engineer Representative the Contractor may cut and bend this steel on site provided 2 coats of an approved metallic zinc-rich paint is applied to the cut end of the steel and to those areas where damage occurs to the galvanising coating.

# Part 2 Products

## 2.1 Reinforcing steel

A. Steel used for concrete reinforcement shall comply with the following British Standard Specifications:

| BS | Bar Description |
|---|---|
| 4449 | Carbon Steel Bars for the Reinforcement of Concrete |
| 4483 | Steel fabric for the Reinforcement of Concrete |

B. Reinforcement shall have the following minimum specified characteristic strengths:

Hot rolled mild steel bars 250N/ $mm^2$

High yield steel bars 410N/ $mm^2$

C. High yield steel reinforcement shall be Type 2 deformed bars.

## 2.2 Colour coding reinforcing steel

A. The supplier shall colour code wire weld metric fabric in accordance with the following chart.

| MESH TYPE | Cross-Sectional Area | | Type | Colour Code |
|---|---|---|---|---|
| | $mm^2/m$ | $mm^2/m$ | | |
| | Main wires | Transverse wires | | |
| Square Mesh Fabric | 393 | 393 | A 393 | Black |
| | 252 | 252 | A 252 | Yellow |
| | 193 | 193 | A 193 | Brown |
| | 142 | 142 | A142 | Purple |
| | 98 | 98 | A98 | Orange |
| | | | | |
| Structural Fabric | 1131 | 252 | B1l31 | Blue |
| | 785 | 252 | B785 | Green |
| | 503 | 252 | B503 | Red |
| | 385 | 193 | B385 | White |
| | 283 | 193 | B283 | White, Black and White |
| | 196 | 193 | BI96 | Yellow, Brown and Yellow |
| Wrapping Fabric | 98 | 98 | D98 | |
| | 49 | 49 | D49 | |

Conversion factor: 1 mm2/m = 0.000472 in2/ft.

B. The colour code markings shall be applied on opposite end bars of each sheet of fabric. The mark shall cover at least a 150 mm (6") length of bar.

## 2.3 Storage of reinforcement

A. The Contractor shall pay particular attention to the conditions of transport, shipment and storage to avoid contamination by chlorides. Reinforcement shall be stored under a waterproof shelter and supported above the surface of the ground or any water lying on the ground. Any damage which occurs to the galvanised coating in the course of transit or fixing in the works shall be renovated by the application of an approved metallic zinc-rich paint as instructed by the Engineer Representative.

## 2.4 Condition prior to fixing

A. At the time of fixing in position and concreting, all reinforcement shall be free from pitting, loose rust, mill-scale, paint, oil, grease, adhering earth, salts or any other material that may impair the bond with the concrete, or that may cause corrosion of the reinforcement or disintegration of the concrete.

B. Prior to concrete placement all reinforcement fixed in place shall be washed down with fresh water.

## 2.5 Concrete cover blocks

C. Concrete cover blocks shall be as small as possible consistent with their purpose and of a shape acceptable to the Engineer Representative. They shall be designed and fixed so that they will not overturn when the concrete is placed. They shall be made of concrete with 10 mm (3/8") maximum aggregate size and the mix proportions shall be such as to produce the same strength as that of adjacent concrete.

D. Proprietary plastic cover supports may be used with the approval of the Engineer Represenative.

## 2.6 Fibre reinforcement

A. Fibre reinforcement shall be added to the concrete mix only in the locations specified on the drawings.

B. Concrete engineered reinforcing fibres shall be polyproplylene, collated, fibrillated fibres from Fibermesh Company, 4019 Industry Drive, Chattanooga, TN 37416, U.SA or equal approved.

C. Only fibres designed and manufactured specifically for use in concrete from virgin polypropylene and so certified by the manufacturer shall be used.

D. Reinforcing fibres shall be used in strict accordance with the manufacturer's recommendations, including the type and amount.

E. The addition of fibre does not relieve the Contractor from the responsibility of achieving adequate compaction and strength.

# Part 4 Execution

## 4.1 Fixing reinforcement

A. The number, size, form and position of all members of the reinforcement shall be in accordance with the drawings, and bar bending schedules if provided.

B. Reinforcement shall be accurately fixed and by approved means maintained in the position described on the drawings and elsewhere. Bars intended to be in contact at passing points shall be securely wired together at all such points with #16 gauge galvanised annealed soft iron tying wire and the ends of the tying wire shall be turned into the main body of the concrete. Spliced bars shall be placed in contact and wired to provide consistent cover.

C. Links and the like shall tightly embrace the bars with which they are intended to be in contact and shall be securely wired.

D. All steel fabric shall be lapped two meshes unless otherwise shown on the drawings and be bound securely to the supporting bars with galvanised soft-iron wire of #16 S.W.G.

E. Reinforcement projecting from work being concreted or already concreted shall not be bent out of its correct position for any reason.

F. The vertical distances required between successive layers of bars in beams and similar members shall be maintained by the provision of steel spacer bars inserted at such intervals that the main bars do not perceptibly sag between adjacent spacer bars. The diameter of such spacer bars shall be the greatest of the following:

1. the maximum size of coarse aggregate plus 6mm (1/4");
2. the diameter of the largest bar being spaced;
3. 25mm (1").

G. No concreting shall be carried out until the reinforcement has been inspected and approved by the Engineer Representative. The Contractor shall notify the Engineer Representative when the reinforcement is fixed in position as soon as it is final, but at least 24 hours prior to concreting.

H. No adjustment of reinforcement is permitted after concrete placement has commenced.

## 4.2 Cutting and bending

A. Bars shall not be cut nor bent on site without the prior approval of the Engineer Representative; cutting and bending where permitted shall be in accordance with BS 8666.

B. Neither the diameter nor the length of a bar shall be less than the diameter or length described in the bar schedule or elsewhere.

C. The Contractor shall be responsible for checking and verifying the accuracy of the bar bending schedules, if provided, and reinforcement details prior to cutting and bending reinforcement.

D. Bars shall be bent cold by machine or other approved means producing a gradual and even motion. Bars incorrectly bent shall not be re-bent and incorporated in the works and no reinforcement shall be bent when in position in the works, whether or not it is partially embedded in hardened concrete.

E. Bends shall comply with the dimensions given in the bending schedule. Dimensions of bent bars and internal dimensions of links and the like shall not exceed the dimensions given on the bar schedule and elsewhere. Unless described otherwise, bending dimensions shall conform to BS 8666.

F. The internal radii of bends shall be not less than 3 times the diameter of the bar for bars not greater than 19 mm (3/4") and 4 times the diameter for bars over 19 mm (3/4").

## 4.3 Welding reinforcement

A. Reinforcement in structures shall not be welded except where permitted in the Contract. All welding procedures shall be subject to the prior approval of the Engineer Representative in writing.

## 4.4 Support to reinforcement

A. The distribution and design of reinforcement supports shall be to the approval of the Engineer Representative. No support may be removed during concreting operations.

## 4.5 Cover to reinforcement

A. The cover of concrete to the reinforcement does not include any applied finish, and shall be as described on the drawings. Cover shall be provided and maintained within a tolerance of 3 mm (+ 1/8") by means of pre-manufactured bar spacers. The use of pieces of block, stone, wood, metal or porous tile will not be allowed for this purpose.

B. Where concrete cover to reinforcement is not described on the drawings it shall be in accordance with the following:

| Condition | Cover |
|---|---|
| Completely protected against weather and aggressive conditions, except for a brief period of exposure to normal weather conditions during construction. | 38 mm (11/ 2") |
| Exposed to driving rain, alternate wetting and drying, subject to heavy condensation of corrosive fumes and concrete continuously under water. | 50 mm (2") |
| Exposed to sea water or marsh water with abrasion. Cast against and permanently exposed to earth. | 75 mm (3") |
| Exposed ends of bars in a beam, slab or the like. | Twice the bar diameter or 50mm (2") whichever is greater |

## 4.6 Laps and joints

A. Laps and joints shall be made only by the methods specified, for the length specified and at the positions shown on the drawings unless otherwise approved by the Engineer Representative.

B. Unless specified otherwise on the drawings, all laps in bars shall be a minimum of 50 bar diameters.

# Part 1 General

## 1.1 Codes and standards

A. All concrete work shall be in accordance with the British Standard Code of Practice BS 8110.

## 1.2 Testing and sampling

A. The Contractor shall be responsible for providing qualified personnel and site equipment for all testing and sampling of concrete as instructed by the Engineer Representative.

B. Compliance with the specified characteristic compressive strength of the concrete shall be judged by tests made on 150mm (6") cubes at an age of 28 days in accordance with BS 1881. Where the Contractor requires an early indication of the strength of the concrete, additional cubes may be taken and tested at 7 days at the option of the Contractor, and these results shall also be forwarded to the Engineer Representative.

C. The tests will require the preparation of 4 cubes, each made from a single sample taken from a randomly selected batch of concrete. Cubes shall be labeled A, B, C, D, for any particular sample and in a numerical order for the number of samples. A test result is defined as the mean compressive strength of two cubes tested at 28 days.

i.e. Test result X = (Comp strength cube A+ Comp strength cube B)/2

Test result Y = (Comp strength cube C+ Comp strength cube D)/2

D. The samples, where practicable, should 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. The samples shall be taken as representative, but not ones taken at the beginning or end of the discharge.

E. The number, frequency and location of tests shall be decided by the Architect, but the maximum quantity of concrete that four consecutive test results shall represent shall be limited to 13 $yd^3$ (10 $m^3$).

F. Compliance with the specified characteristic compressive strength shall be assumed if the following conditions are met:

**1.** the average strength determined from any group of four consecutive test results exceeds the specified characteristic strength by:

a) 3 N/mm for concretes of grade 20 and above, or,
b) 2 N/mm for concretes of grade 7, 10 and 15.

**2.** the strength determined from any test result is not less than the specified characteristic strength minus:

a) 3 N/mm for concretes of grade 20 and above, or,

b) 2 N/mm for concretes of grade 7, 10 and 15.

If only one test result fails to meet the second requirements then that test result may be considered to represent only the particular batch of concrete from which that test was taken provided the average strength of the group satisfies the first requirement.

If more than one test result in a group fails to meet the second requirement or if the average strength of any group of four consecutive test results fails to meet the first requirement then all the concrete represented by all such samples shall be deemed not to comply with the strength requirements.

G. All test cubes shall be labeled as described herein, and shall, approximately 24 hours after casting, be transported to the Ministry of Public Works Quarry for curing and testing. Test results shall be forwarded to the Architect.

H. The Engineer Representative may require the testing of additional cubes for special purposes including the time at which to strike formwork and the strength of concrete under hot weather conditions. These additional cubes shall be made and tested in accordance with BS 1881, but the methods of sampling shall be varied to suit the purpose for which they are required. Sampling where possible shall be at the point of placing and the cubes shall be stored so far as possible under the same conditions as the concrete in members to which they relate. The extra cubes shall be clearly identified at the time of making and shall not be used as part of the normal quality control or compliance procedures.

I. The cement content of any batch of concrete shall be not less than the specified minimum value minus 5% of that value, not more than the specified maximum value plus 5% of that value, unless otherwise approved by the Architect.

J. On every- batch of concrete the workability shall be measured by either the standard slump test or the compacting factor test all in accordance with BS 1881 and shall be within the following limits:

| 1. Slump Test | | |
|---|---|---|
| | Specified Value | Tolerance |
| | 10mm (3/8”) | +35mm (+ 1 3/8”) |
| | | -10mm (- 3/8”) |
| | 25mm (1") | +35mm (+ 1 3/8”) |
| | | -25mm (-1") |
| | 50mm (2") | +35mm (± 1 3/8”) |
| | 75mm (3") and over | ± (1/3 specified slump + 10mm (3/8”) |
| | | |
| 2. Compaction Factor Test | | |
| | ± 0.03 where the required value is 0.90 or more; | |
| | ± 0.04 where the required value is less than 0.90 but more than 0.8; | |
| | + 0.05 where the required value is 0.8 or less. | |

The slump shall be sampled in accordance with BS 1881: Part 102. If the concrete is delivered in a mixing or agitation truck the slump is measured in a sample obtained from the initial discharge. There shall be allowed a discharge of approximately 0.4 $yd^3$ (0.3$m^3$) of concrete (which shall not be placed until a satisfactory- test is achieved) and then the sample shall be taken.

If the first test result fails to meet the specified limits a second set of results shall be tested. Two failures constitute a rejection of that batch of concrete.

K. Any additional tests required by the Engineer Representative to comply with this specification as a result of failure of routine tests shall be performed at the expense of the Contractor.

Reports of each test taken shall be supplied to the Engineer Representative and shall contain the following:

1. Name of project and the position of placement.
2. Name of supplier.
3. Date and time of delivery- to site.
4. Time from sampling to commencement of test.
5. Form of slump, whether true, shear or collapse.
6. Measured true slump.
7. Name of person carrying out test.

L. Should any of the results of the specified works tests be unsatisfactory, the Engineer Representative may take one of the following actions:

1. Reject the work and instruct replacement of the unsatisfactory work
2. Instruct the Contractor to carry out additional tests and/or works to ensure the soundness of the work

M. The Contractor shall note that the target strength for the concrete mix design shall be substantially greater (in the order of 10 $N/mm^2$) than the specified characteristic compressive strength. To ensure that no more than 5% of the concrete falls below this value the Engineer Representative may instruct the contractor to take one or both of the following steps in the event of test cubes failing to meet the required standard:

1. Alter his methods of making concrete and control quality to reduce variability;
2. Alter the proportions of the concrete mix to increase the compressive strength.

## 1.3 Load tests of structures or parts of structures

A. The Engineer Representative shall instruct the Contractor to make a loading test on the works if in the opinion of the Engineer Representative such a test is necessary. The test shall be in accordance with BS 8110, and shall be carried out as soon as possible after the expiry of 28 days from the time of placing the concrete.

B. The test loads to be applied shall be specified by the Engineer Representative and shall be equal to the characteristic imposed load and shall be maintained in place for 24 hours. If any

of the final dead load is not in position on the structure, compensating loads shall be added as directed.

C. During the tests, struts and bracing strong enough to support the whole load should be placed in position leaving a gap under the members to be tested, and adequate precautions should be taken to safeguard persons in the vicinity of the structure.

D. Measurements of deflection and crack width shall be taken immediately after the application of load, at the end of the 24 hour loaded period, after removal of the load and after a 24 hour recovery period.

E. The maximum permissible deflection measured immediately after application of the test load shall be as specified by the Engineer Representative, which for members spanning between two supports shall be not more than 1/500 of the effective span.

F. If, within 24 hours of the removal of the test load the part of the works under test does not show a recovery of at least 85% of the maximum deflection shown during the 24 hours under load, the loading shall be repeated. The structure shall be considered to have failed to pass the test if the recovery after the second loading is not at least 85% of the maximum deflection shown during the second loading.

G. If the result of any test is not satisfactory, the Engineer Representative shall instruct that the part of the works concerned shall be taken down or cut out and reconstructed to comply with the Specification, or that other measures shall be taken as directed. The Contractor shall conduct the test and shall take down or cut out and reconstruct the defective work or shall execute remedial measures as directed.

H. On completion of the works, including plastering if required, all water retaining structures constructed shall be tested for water tightness with potable water in accordance with BS 8007. After the expiry of a minimum 28 days from completion of the tank, all inlets and outlets shall be sealed and the tank slowly filled with fresh water. When filled, the water shall stand for 7 days to allow for absorption. At the end of7 days, the tank shall be deemed to be water tight if the total drop in surface level does not exceed 13mm (*112")* in 7 days.

I. If the structure does not satisfy the conditions of the test, and the daily drop in water level continues, the period of test may be extended for a further 7 days at the discretion of the Engineer Representative. The Contractor shall execute any remedial measures as required by the Engineer Representative.

# Part **Products**

## 2.1 Cement

A. Unless otherwise noted, cement shall comply with BS 12 and BS 146 or equal approved.

B. Neither masonry cement nor high alumina cement shall be used in structural concrete.

C. All cement shall be fresh when delivered to the site, and unless delivered in bulk, shall be in the original sealed bags or drums of the manufacturers. It shall be stored in a suitable

weatherproof building of ample size, with raised floors giving adequate protection against the effects of moisture from any source. Manufacturers' certificates shall be submitted to the Engineer Representative on request.

D. Cements of different types shall not be mixed and consignments shall be used in the order of delivery.

E. Cements shall be delivered in quantities that ensure there is neither suspension nor interruption of the work of concreting at any time.

F. If in the opinion of the Engineer Representative any cement has become injuriously affected by damp or other causes, it shall at once be removed from the site. All cement shall remain stored at the sole responsibility of the Contractor.

## 2.2 Aggregates

A. Generally:

**1**. Materials used as aggregate shall be obtained from a source known to produce aggregates satisfactory for concrete and shall be chemically inert, strong, hard, durable, of limited porosity, and free from adhering coatings, clay lumps, residues and organic or other impurities that may cause corrosion of the reinforcement or may impair the strength or durability of the concrete. Aggregates shall be natural gravels or crushed stone complying with BS 882 or as specified by the Engineer Representative.

B. Fine aggregate:

**1.** Fine aggregate shall be natural sand, excluding beach sand, or sand derived by crushing gravel or stone. It shall be clean, sharp, free from coagulated lumps without any admixtures of clay or other foreign matter.
**2.** Sand derived from stone unsuitable for coarse aggregate shall not be used as fine aggregate.
**3.** The grading of fine aggregate shall be such that not more than 10% shall exceed 5mm (3/ 16"). For a natural sand or crushed gravel not more than 10%, and for crushed stone not more than 20% shall pass BS sieve No. 100. Between these limits the grading shall conform to the grading for either Zones 1, 2 or 3 (BS 882) or Zone 4 if so instructed.

C. Coarse aggregate

**1.** Coarse aggregate shall be crushed or uncrushed gravel or crushed stone. It shall be clean and free from any clay admixtures and other foreign matter. The pieces shall be angular, or, except for concrete surfaces subject to abrasion, rounded in shape and shall have granular or crystalline or smooth (but no glossy), non-powdery surfaces. Friable, flaky and laminated pieces, mica and shale shall only be present in such quantities that do affect adversely the strength and durability of the concrete.
**2.** After 24 hours immersion in water, a previously dried sample of the coarse aggregates shall not have gained in weight more than 10% or not more than 5% if for use in impermeable construction.

3. The grading of coarse aggregate is such that not more than 5% is larger than 19 mm (3/4”) and not more than 10% is smaller than 5 mm (3/16”) and not less than 25% nor more than 55% is smaller than 10 mm (3/8”).

D. All-in aggregate

1. All-in aggregate shall only be used for concrete grade 15 or below, unless the Engineer Representative gives written approval otherwise. All-in aggregate shall comply in all respects except grading with the requirements for fine and coarse aggregates, and except for grading tests shall be separated into two groups: material smaller than 5 mm (3/ 16”) and material of 5 mm (3/16") and over. These materials shall be considered as fine and coarse aggregates respectively.
2. The grading of all-in aggregate shall be such that not more than 5% shall exceed 38 mm (1- 1/2") and not more than 6% shall pass B.S. sieve No. 100, and not less than 45% nor more than 75% is smaller than 19 mm (3/4”) and not less than 25% or more than 45% is smaller than 5 mm (3/16).

E. Storage of aggregates

1. Aggregates shall be handled and stored to minimise segregation and contamination. They shall be stored to size separately on hard standings or timber platforms, and kept clean and well drained and free from surface water in order that the materials are not be contaminated before use.

F. Testing of aggregates

1. Aggregates shall be tested in accordance with BS 812 and the results of such tests shall comply with the requirements of B, C, D, & E the percentages being by weight.

## 2.3 Water

A. Water shall be potable, clean, fresh and free from organic and inorganic matter in solution or suspension in the concrete. Water shall be obtained from an approved source and must not be obtained from a well, excavation, underground source or the sea.

B. Only water of approved quality shall be used for washing out formwork, curing concrete and similar purposes. Water for making concrete shall be tested in accordance with BS 3148.

## 2.4 Admixtures

A. Suitable admixtures may only be used in structural concrete mixes with the prior approval of the Engineer Representative. The amount added and the method of use shall be to the strict instructions of the manufacturer and the approval of the Engineer Representative.

## 2.5 Building paper

A. Building paper shall comply with BS 1521.

# Part 3 Execution

## 3.1 Concrete grades

A. The concrete grade designations are given in Table C.1 below:

| Grade | Characteristic strength | | Lowest grade for compliance with use |
|---|---|---|---|
| | $N/mm^2$ | psi | |
| 7 | 7.0 | 1015 | Blinding concrete |
| 10 | 10.0 | 1450 | Mass concrete |
| 15 | 15.0 | 2175 | Plain, unreinforced concrete |
| 20 | 20.0 | 2900 | Reinforced concrete |
| 25 | 25.0 | 3625 | Marine concrete |
| | | | |

TABLE C. 1- CONCRETE GRADE DESIGNATIONS

B. The characteristic strength of concrete is that 28 day cube strength below which not more than 5% of the test results may be expected to fall.

## 3.2 Quality of concrete mixes

A. For the specified grade of concrete the Contractor shall design the mix in accordance with BS 8110 and within the limits indicated in Table C.2 below:

| Grade | Max. size aggregate | Min. cement content | Max. free W/C ratio | Characteristic strength (150mm cube) |
|---|---|---|---|---|
| | mm (in) | $kg/m^3$ (pcy) | by weight | $N/mm^2$ (psi) |
| 7 | 14 (9/16) | 290 (490) | 0.55 | 7 (1015) |
| 10 | 20 (3/4) | 330 (557) | 0.55 | 10 (1450) |
| 15 | 20 (3/4) | 330 (557) | 0.55 | 15 (2175) |
| 20 | 20 (3/4) | 340 (574) | 0.50 | 20 (2900) |
| 25 | 20 (3/4) | 360 (607) | 0.50 | 25 (3625) |

TABLE C. 2 -CONCRETE MIXES

B. The cement content of the mix shall not exceed 500 kg/m3 (844 pcy), without the approval of the Engineer Representative.

C. The total chloride content of the concrete mix shall not exceed 0.35% of chloride ion by weight of cement for concrete made with ordinary Portland cement. The chloride content shall be measured in accordance with BS 1881.

D. The total sulphate content of the mix shall not exceed 4.0% of sulphur trioxide by weight of cement. The sulphate content shall be measured in accordance with BS 1881.

E. The Contractor shall demonstrate to the Engineer Representative satisfaction that the proposed mix will develop the required strength prior to the commencement of concreting, by either submitting a history of test results for the mix or by carrying out trial mixes in accordance with Part 3.4. G, H and I of this Section.

## 3.3 Workability

A. The workability of the fresh concrete should be such that the concrete is suitable for the conditions of handling and placing so that after compaction it surrounds all reinforcement and fills the formwork, subject to the approval of the Engineer Representative.

B. The workability of the mix may be improved by the use of an admixture if approved by the Engineer Representative.

## 3.4 Batching and mixing

A. The weighing and water-dispensing mechanisms shall be maintained in good order. Their accuracy shall be maintained within the tolerances described in BS 1305 and checked against accurate weights and volumes when required by the Engineer Representative.

B. The weights of cement and each size of aggregate as indicated by the mechanisms employed shall be within a tolerance of ±2% of the respective weights per batch agreed by the Engineer Representative. The weights of the fine and coarse aggregates shall be adjusted to allow for the free water contained in them. The water added to the mix shall be reduced by the quantity of free water contained in the fine and coarse aggregates, which shall be determined by the Contractor by a method approved by the Engineer Representative immediately before mixing begins, and further as the Engineer Representative requires.

C. Concrete shall be mixed in a batch type mixer manufactured in accordance with BS 1305 or in a batch type mixer that has been tested in accordance with BS 3963 and has a mixing performance within the limits of Table 6 of BS 1305.

D. The cement and aggregates shall be thoroughly mixed in the required proportions and the water shall not be admitted to the drum of the mixer until all the cement and aggregate constituting the batch are in the drum. Mixing shall continue until the concrete is uniform

in colour and for not less than two minutes after all the materials and water is in the drum. The entire contents of the drum shall be discharged before the materials for the succeeding batch are fed into the drum. No partly set or re-tamped concrete shall be used. Partly set or excessively wet concrete shall not be used on the works and shall be immediately removed.

E. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before any fresh concrete is mixed. Unless otherwise agreed by the Engineer Representative, the first batch of concrete through the mixer shall then contain only two-thirds of the normal quantity of coarse aggregate. Mixing equipment shall be thoroughly cleaned before changing types of cement.

F. During hot weather the Contractor shall ensure that the constituent materials of the concrete are sufficiently cool to prevent the concrete from stiffening in the interval between its discharge from the mixer and compaction in its final position.

G. Trial mixes: where trial mixes are required, three separate batches of concrete shall be made using materials likely to be typical of the proposed supply and preferably under full scale production conditions. If circumstances make this inconvenient, the batches may be mixed in a laboratory unless this is specifically precluded by the Engineer Representative. Sampling and testing should be in accordance with BS 1881 and BS 5328.

H. The workability of each of the trial batches should be determined and three cubes made from each batch for test at 28 days. A further three cubes from each batch shall be made for testing at an earlier age if required. The trial mix proportions should be approved if the average strength of the nine cubes tested at 28 days exceeds the specified characteristic strength by 10 $N/mm^2$ or the nine tests at an earlier age indicate that is likely to be exceeded by this amount

I. During production the Engineer Representative may require trial mixes to be made before a substantial change is made in the materials or in the proportions of the materials to be used.

## 3.5 Ready-mixed concrete

A. Ready mixed concrete as defined in BS 5328, batched off the site, may be used only with the agreement of the Architect and shall comply with all requirements of the Specification and Contract.

B. The concrete shall be carried in purpose made agitators operating continuously, or truck mixers. The concrete shall be compacted and in its final position within 11/2 hours of the introduction of cement to the aggregates, unless a longer time is agreed by the Engineer Representative. The time of such introduction shall be recorded on the Delivery Note together with the weight of the constituents of each mix, water/cement ratio strength admixtures and any other pertinent information. The following information shall be added to the delivery ticket on site; the time of completion of discharge; the location in the works of the batch of concrete, and the quantity of any water added to the mix on site and the

name of authorizing officer. Copies of all Delivery Notes for each day's work are to be bound and delivered to the Engineer Representative to form part of his site records.

C. When truck mixed concrete is used, no water may be added to the mix at the site, without the express approval of the Engineer Representative, and in no circumstances shall water be added in transit.

D. Mixing shall continue for not less than 100 revolutions at a rate of not less than 7 revolutions per minute.

E. Any ready-mix truck containing concrete which has been rejected by the Engineer Representative for whatever reason shall be removed from the site and deposited elsewhere. Under no circumstances will any addition of material such as cement, aggregate or water and remixing of the original batch be allowed.

## 3.6 Transporting concrete

A. Concrete shall be transported in such a manner as to avoid the contamination, segregation or loss of constituent materials. The method of transporting shall be subject to the approval of the Engineer Representative.

## 3.7 Placement of concrete

A. Mixing and distributing equipment shall be clean before commencing mixing and distribution of the concrete and such equipment shall be kept free from set concrete. The method of placing concrete shall be to the approval of the Engineer Representative.

B. Before proceeding to place the concrete, the formwork shall be realigned, if necessary, and all formwork, and reinforcement contained in it, shall be clean and free from standing water.

C. Concrete shall not be placed in any part of the structure until the approval of the Engineer Representative has been given. A minimum of 24 hours' notice shall be given prior to any concrete placement.

D. If concreting is not started within 24 hours of approval being given, approval shall again be obtained from the Engineer Representative. Concreting shall then proceed continuously over the area between construction joints or to the approved extent. If stopping of concrete placing is unavoidable elsewhere, a construction joint shall be formed where the work stopped. Fresh concrete shall not be placed against in-situ concrete which has been in position for more than 30 minutes unless a construction joint is formed in accordance with Part 3.10. of this Section. When in-situ concrete has been placed for more than 4 hours no further concrete shall be placed against it for a further 20 hours.

E. Concrete, when deposited, shall have a temperature of not less than 41 ° F (5° C) and no more than 86° F (30° C). It shall be compacted in its final position within 30 minutes of discharge from the mixer.

F. Except where otherwise agreed by the Engineer Representative, concrete shall be placed in a single operation to the fun thickness of slabs, beams and similar members. Concrete shall be placed directly in its permanent position and shall not be worked along the forms to that position.

G. Concrete shall not be dropped into place from a height exceeding 1.0m (3'). When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. In general, trunking or chutes shall not be more than 20° from vertical.

H. Should the Contractor require placing concrete by pumping he shall first obtain permission from the Engineer Representative and shall submit complete details of the proposal for approval.

I. All cement slurry and other material used to lubricate pump pipes shall be run to waste and not deposited in the works.

J. Should continuous pumping of concrete be suspended, all concrete remaining in the pump and pipes for longer than 30 minutes shall be run to waste and not deposited in the works.

K. No concrete shall be placed in flowing water. Underwater concrete shall be placed in position by tremies, or by pipeline from the mixer. Full details of the method proposed shall be submitted to the Engineer Representative and his approval obtained before placing begins. Where the concrete is placed by a tremie, its size and method of operation shall be in accordance with (U.K.) Civil Engineering Code of Practice, "Foundations". Forms shall be provided in all faces of concrete placed between tides, the top face being closed immediately after completion of placing and before subsequent submersion. During and after concreting underwater, pumping or dewatering operations in the immediate vicinity shall be suspended until the Engineer Representative permits them to be continued.

## 3.8 Effects of the weather

A. During hot weather the Contractor shall ensure that the constituent materials of the concrete are sufficiently cool to prevent the concrete from stiffening in the interval between its discharge from the mixer and compaction in its final position. Alternatively the Contractor may incorporate in a mix a plasticiser of a make and in a proportion which has been shown by laboratory tests and full scale trial to be to the satisfaction of the Engineer Representative, to eliminate detrimental effects of high temperature without introducing any other detrimental effect, and for which he takes full responsibility in these two respects.

B. The following may be used to keep the temperature of concrete below the above limitations:

1. Chilling of concrete water by heat exchange coils or by addition of broken ice, provided that the water is free from ice at the time of entry into the mixer;
2. Cooling of coarse aggregate by watering, provided that the water content of the aggregate so cooled is uniform;

3. Reclaiming of aggregate from stockpiles by the tunnel method to avoid using the surface layer of the stockpile, with shade and wind protection of conveyor elevating to batching plant;
4. Night work provided that 1,2 and 3 are proved inadequate or unsatisfactory in their results and provided also that the Engineer Representative has no other reason for refusing permission for night work and subject to Section 01010 Part 1.5.

C. The Engineer Representative shall have the power to order the suspension of concrete production and/or laying when the shade temperature exceeds 86°F (30°C) if he is not satisfied that the precautions being taken or intended by the Contractor are adequate to:

1. Prevent the temperature of the concrete rising above 86° F (30° C) or;
2. Avoid any detrimental effect in the use of a plasticiser. This power of the Engineer Representative shall not relieve the Contractor of his responsibilities.

D. Concrete shall not be laid during heavy or prolonged rain. Suitable protection shall be readily available to protect the concrete after placement during adverse weather conditions.

## 3.9 Compaction

A. All concrete shall be compacted to produce a dense homogenous mass. Unless otherwise agreed by the Engineer Representative, it shall be compacted with the assistance of immersion (poker) vibrators. Vibration shall continue until all the air bubbles have dispersed and the tone of the vibrator becomes constant and in a manner that does not promote segregation. Sufficient vibrators in serviceable condition shall be on site so that spare equipment is always available in the event of breakdowns.

B. Immersion vibrators shall be capable of producing not less than 10,000 cycles per minute, and in the opinion of the Engineer Representative be of suitable diameter to deliver an effective radius of action.

C. Vibration shall not be applied by way of the reinforcement and contact with all reinforcement and inserts shall be avoided, so far as is practicable.

D. Concrete shall not be subjected to vibration between 2 and 24 hours after compaction.

## 3.10 Construction joints

A. Construction joints shall be square and shall be vertical or horizontal, as required, except that in an inclined or curved member the joint shall be at right angles to the axis of the member.

B. The position and detail of any construction joints not described in the contract shall be subject to the approval of the Engineer Representative, and shall be arranged to minimise the possibility of the occurrence of shrinkage cracks.

C. Construction joints not shown on the drawings and elsewhere shall with the approval of the Engineer Representative be in accordance with the following:-

**1.** A joint shall be formed horizontally at the top of a foundation and 7 5mm (3") below the lowest soffit of the beams meeting at the head of a column. A joint shall be formed in the rib of a large "T" or "L" beam 25 mm (1") below the soffit of the slab. Concrete in a haunch or a splay on a beam or a brace, and in the head of a column where beams meet, shall be placed without a joint at the same time as that in the beam or beams and brace. Concrete in the splay at the junction of a wall and a slab shall be placed without a joint at the same time as that in the slab. Concrete in an up-stand, or starter, at the bottom of a wall or at the bottom of a lift of a column shall, if so shown on the drawings, be placed at the same time as the slab or other work from which the up-stand projects.

**2.** Concrete in a beam shall be placed without a joint, but if the provision of a joint is unavoidable, the joints shall be vertical and within the middle third of a span. A joint in a slab shall be vertical and parallel to the principal reinforcement.

D. The upper surface of lifts of concrete walls and columns shall be horizontal and if the formwork extends above the joint on the exposed face it shall be cleaned of adhering concrete before the next lift is placed. The concrete placed immediately above a horizontal construction joint shall contain only two-thirds the normal quantity of coarse aggregate, shall not be the first batch through the mixer, and shall be thoroughly compacted and worked against the existing concrete.

E. Where sections of the work are carried out in lifts, the reinforcement projecting above the lift being cast shall be adequately supported to prevent movement of the bars during the casting and setting of the concrete.

F. All laitance, loose material and cement paste shall be removed by wire brushing while the concrete is still green, to expose, but not dislodge, the coarse aggregate, and no further roughening shall then be required. Where this is not possible, it shall be removed by mechanical means without damaging the aggregates, provided the concrete has been in position for more than 24 hours. The roughened surface shall then be washed with clean water and 1:1 slurry of cement and concretes and shall, wherever possible, be well worked in immediately before the fresh concrete is placed.

## 3.19 Structure joints

A. Expansion joints, contraction joints, hinges or other permanent structure joints shall be provided in the positions and of the form described in the drawings or elsewhere in the documents.

## 3.20 Protection of concrete

A. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion, deleterious groundwater, mixing with earth or other

materials, flotation and other influences that may impair the strength and durability of the concrete.

## 3.21 Finish to floor slabs

A. All areas of internal floor slabs shall be power-floated and power -toweled to provide a durable and smooth surface, unless otherwise indicated on the drawings.

B. Power-toweling shall not be started until surface moisture has evaporated and the concrete is firm enough to take the weight of the machine. Sufficient machines shall be provided to ensure that the whole of the area laid is finished before the concrete becomes unworkable.

C. The tolerance on surface regularity shall be 3mm (1/8") under a 3m (10') straight edge. Notwithstanding this requirement, the slabs shall be finished to provide a surface which is visually smooth to the satisfaction of the Engineer Representative.

## 3.22 Lintels

A. Unless otherwise stated, lintels shall be a minimum of 200mm (8") deep and shall have a minimum bearing of 200mm (8") on each side of the opening below them and shall be reinforced as follows:

| WIDTH | CLEAR SPAN | | |
|---|---|---|---|
| | Up to 4ft (1.2m) | 4ft - 6ft (1.2m to 1.8m) | 6ft- 8ft (1.8m to 2.4m) |
| 100mm (4") | 1x16mm Bottom | n.a. | n.a. |
| 150mm (6") | 2x10mm Bottom | n.a. | n.a. |
| 200mm (8") | 2x12mm Bottom | 2x12mm Bottom | 2x12mm Bottom<br>2x10mm Top |
| 250mm (10") | 2x12mm Bottom | 2x12mm Bottom | 2x16mm Bottom<br>2x10mm Top |
| 300mm (12") | 2x12mm Bottom | 2x12mm Bottom | 2x16mm Bottom<br>2x10mm Top |

B. The ends of the bottom reinforcement bar shall be hooked and 8mm diameter stirrups at 150mm (6") centres shall be provided for spans over 1.8m (6ft).

C. These lintels are to be used only when the block work height over the opening is greater than or equal to the opening width. Where additional loads from floors, roofs, beams, etc., are within this height, purpose designed lintels are to be used.

## 3.23 Early loading

A. Concrete shall at no time be subjected to loading, including its own weight, which will produce a compressive stress in it exceeding 1/3 of the compressive strength at the time of loading.

B. The strength of the concrete and the stresses produced by the loads shall be assessed only by the Engineer Representative Materials and plant shall not be stacked on any newly constructed floor without the permission of the Engineer Representative.

C. If the imposition of a load is anticipated, which in the opinion of the Engineer Representative exceeds the design load, props shall be provided in an approved manner after removal of the formwork and before the imposition of the load. Props for an upper storey shall be placed directly over those in the storey immediately below and the lowest prop shall bear on work sufficiently strong to carry the load.

## 3.24 Equipment loading

A. If it is proposed to use climbing tower cranes, or any type of plant or equipment which places any load on the reinforced concrete structure, then the Contractor shall submit full details of such plant or equipment to the Engineer Representative for approval before installation.

B. The loads from such plant or equipment shall be imposed on completed sections of the structure where the concrete has attained the minimum 28-day crushing strength.

C. If necessary and acceptable, the Engineer Representative may agree to strengthen the structure to take loadings imposed by plant or equipment. The Contractor shall be responsible for reinstating all damage caused.

## 3.25 Fixtures, indentations and voids

A. No openings, chases, holes or voids other than those indicated on the drawings shall be formed in the concrete without the approval of the Engineer Representative.

B. Details of any fixtures to be permanently built into the concrete shall be submitted to the Architect for his approval. Fixing lugs, Lewis bolts; timber plugs and all other fixtures must comply with the requirements of the Engineer Representative and must be of a character and size to avoid any weakening or chemical contamination of the structural concrete.

# Part 1 General

## 1.1 Curing generally

A. Notwithstanding the provision for special sequences of casting as directed by the Engineer Representative, the Contractor shall at all times ensure proper curing of the works.

B. Immediately after compaction, concrete shall be protected from the sun, wind and rain, and be prevented from drying out by one of the following methods for a period of at least 4 days.
   1. Water spraying or ponding
   2. Wet coverings of hessian or sand.
   3. Covering with waterproof paper or polythene sheet
   4. Applying an approved coloured curing compound in strict accordance with the manufacturer's instructions.

C. If the concrete being cured is exposed to the sun, the curing compound shall be a proprietary product containing white pigment or be an aluminised compound. The curing compound shall be kept clear of any construction joint surfaces and be compatible with floor finishes, adhesives for tiles, etc.

# Part 1 General

## 1.1 Precast members

A. A detailed method statement, drawings and method of manufacture shall be submitted to the Engineer Representative for approval two weeks before work is started. When the method has been approved no changes shall be made without the consent of the Engineer Representative.

B. The Contractor shall inform the Engineer Representative before commencement of manufacture and casting of each type of member.

C. A copy of all 28 day cube test results relating to members cast off the site shall be sent to the Engineer Representative as soon as they become available. Where the Engineer Representative requires tests to be carried out, no members to which the tests relate shall be dispatched to the site until the tests have been satisfactorily completed.

D. Members shall be lifted or supported only at points shown on the drawings or approved by the Engineer Representative and shall be handled and placed without impact.

# Part 1 General

## 1.1 Standards

A. Unless otherwise stated in the Specification, the current editions of the following standard shall apply:

| | |
|---|---|
| BS5628 | Structural Use of Masonry |
| BS12 | Specification for Portland Cement |
| BS4027 | Sulphate-Resisting Cement |
| BS 1200:1976 | Building Sands from Natural Sources |
| BS 890: 1972 | Building Limes |
| BS4887 | Mortar Admixtures |
| BS 4482:1985 | Cold Reduced Steel *Wire* for Reinforcement of Concrete |
| BS 6515:1984 | Polythene Damp Proof Courses for Masonry |
| BS 729:1971 | Hot Dip Galvanised coatings on Iron and Steel Articles |
| BS 8666:2000 | Carbon Steel Reinforcing Bars for Concrete |
| BS 4360:1990 | Wieldable Structural Steel |
| BS 4483:1985 | Steel Fabric for the Reinforcement of Concrete |
| BS5075 | Concrete Admixtures |
| BS 4551:1980 | Testing Mortars, Screeds and Plasters |
| BS 4254:1983 | Two-Part Polysulphide Based Sealants |
| ASTMC90 | Concrete Masonry Units |

# Part 2 Products

## 3.1 Mortar

A. Mortar shall be to BS 5628, and be specified by designation (i) through (iv). Materials for mortar shall be accurately measured by volume and thoroughly mixed to secure an approved plastic working mortar. Care should be exercised in mixing and the mortar shall have an approved water/cement ratio.

B. Mortar shall be mixed from cement to BS 12 or BS 4027, sand to BS 1200 Grade G and lime to BS 890. Water shall be clean and free from harmful material. Attention should be paid to note 4 of Table 15 and Clause 32.3 of BS 5628, Part 3 with reference to workability and good adhesion.

C. Mortar made with masonry cement may be used as an alternative, with the approval of the Engineer's Representative.

## 3.2 Mortar Testing

A. Mortar testing, if deemed necessary by the Engineer's Representative, will be in accordance with BS 5628 Part 1 Appendix Al (as follows):

B. At least six weeks before the masonry construction is started six specimens of the required shape shall be made, stored and tested in accordance with the procedures given in BS 4551.1bree specimens shall be tested at seven days and should achieve a strength exceeding two-thirds of the 28 days compressive strength. If less, then the tests shall be repeated using more suitable sand or an increase in the cement to sand ratio until the seven days and 28 day results reach the required compressive strength.

C. During construction, site tests using six samples of the same size as used in the preliminary tests shall be made for every 1615 sq. ft (150 sq. m.) of blockwork built. Three samples shall be tested at seven days and the average strength should exceed two thirds of the 28 day compressive strength. The remaining three samples shall be tested at 28 days and the average strength shall exceed the value shown for site tests. The testing shall be carried out by an approved testing laboratory.

D. In the event of the 28 day sample failing to meet the requirements, the Contractor shall, if required by the Engineer's Representative, take down and rebuild the work affected. In the event of the seven day strengths failing to exceed the required strength the Contractor may elect to continue work at his own risk while awaiting the results of the 28 day tests or take down the work affected.

## 3.3 Admixtures

A. Admixtures shall not be used without the Engineer's Representative's prior written permission. Plasticisers shall conform to the requirements of BS 4887 and shall be used only with written approval of the Engineer's Representative.

# Part 4 Execution

## 4.1 Mortar mixes

A. Mortar mixes shall be to be to BS 5628: Part 1: 1978.

| Mortar Designation | Cement: Lime: Sand by Volume | Cement: Sand W/approved Plasticiser | 28 Day Mean Compressive strengths (N/mm2) | |
|---|---|---|---|---|
| | | | Lab Samples | Site Tests |
| (i) | 1: 0-1/4: 3 | | 16.0 | 11.0 |
| (ii) | 1:1/2:4 | 1:3 | 6.5 | 4.5 |
| (iii) | 1:1:5 | 1:5 | 3.6 | 2.5 |
| (iv) | 1:2:8 | 1:7 | 1.5 | 1.0 |
| | | | | |

## 4.2 Jointing

A. All horizontal and vertical joints in blockwork shall be 10mm (3/8") thick and must be completely filled with mortar.

B. The joints of fair-faced blockwork shall be tooled to the required profile when the mortar is "thumb print" hard. Blockwork having an applied finish other than paint shall have joints stuck flush.

C. The joint finish for a wall to be left with natural finish or painted shall be of the "bucket handle" (keyed) type.

# Part 1 General

## 1.1 Scope

A. The Contractor shall provide all labour, materials, services, tools and equipment required to complete all masonry and related work, as shown on the drawings and as herein specified, including but not limited to the following:

a) All load bearing concrete block walls.
b) All non-load bearing concrete block walls.
c) Building in of all anchors, clamps, ties and other fastenings required for the proper anchorage of masonry work to the work of other trades.
d) Building in of flashing where required to be built into masonry, including the preparation of a proper bed for the flashing and damp-proofing.
e) Building in of windows and doors.
f) Co-operation with the contractors for the various mechanical systems, (if any), including the preparation of all masonry for the proper reception of such systems including the building in of sleeves, inserts and other fittings as required.
g) Formation of, or cutting of, all slots, groove channels, or chases as indicated or required. The masons shall consult the various trades requiring such facilities in advance so that there will be a minimum of cutting afterwards.
h) Furnishing of all scaffolding plant and equipment required for the proper erection of all masonry.

## 1.2 Layout

A. Building and axis lines and a datum level shall be established as shown on the drawings, as should other lines and levels, including those for footings and floor levels.

B. As soon as the exterior walls are started the line may be inspected by the Engineer's Representative, at his discretion, after which the walls shall be checked by the Contractor for plumb at regular intervals. Inspection by the Engineer's Representative does not imply approval for correct setting out.

## 1.3 Standards

A. All masonry work shall be in accordance with British Standard BS 5628: Parts 1-3: 1985 - Use of Masonry.

## 1.4 Testing

A. Ten blocks of each size and strength per 1000 or part thereof shall be required for testing. Five shall be used for dimensional checks and be kept available for subsequent tests. Five shall be tested for compressive strength and shall be deemed to comply if the average compressive strength exceeds that specified and the lowest crushing strength of any individual block shall not be less than 80% of the required strength. In addition, the manufacturer shall operate a quality control scheme and make test results

available to show that not more than 2.5% fall below the allowable compressive strength as specified.

B. Details of the quality control scheme shall be submitted to the Engineer's Representative for approval prior to the commencement of construction and approval of the block manufacturer. Blockwork testing shall be carried out by an approved independent testing agency.

## 1.5 Dimensional tolerances

A. The tolerances of the five blocks tested for dimensional deviations shall be within the following (given in metric for accuracy):

Length +3mm, -5mm
Height +3mm, -5mm
Thickness +2mm, -2mm average
+4mm, -4mm at any individual point

## 1.6 Rejected material

A. Blocks which are damaged or do not comply with the requirements of the Specification shall be deemed rejected and shall be removed from site immediately. Any block that the Engineer's Representative shall judge inferior to the relevant approved sample shall be deemed rejected.

# Part 2 Products

## 2.1 Masonry units

A. The masonry units shall be cellular hollow or solid concrete blocks of approved manufacture and comply with the requirements of ASIM C90 Type 1 Concrete Masonry Units and shall be manufactured using Ordinary Portland Cement.

B. The masonry units shall be of one of the following nominal sizes (mm):

| Length | Height | Width | |
|---|---|---|---|
| 395 (15 5/8) | 195 (7 5/8) | 295 | 12" Block |
| 395 | 195 | 245 | 10" Block |
| 395 | 195 | 194 | 8" Block |
| 395 | 195 | 143 | 6" Block |
| 395 | 195 | 92 | 4" Block |

C. The hollow load bearing units (unless otherwise indicated on the drawings) shall be in accordance with Tables M1 and M2:

Table M1

| **Strength and Absorption Requirements**<br>*Note: to prevent water penetration, protective coating should be applied to the exterior face of basement walls and, when required, on the face of exterior walls above grade.* | | | | |
|---|---|---|---|---|
| Compressive strength<br>Min. PSI (MPa) Average Net Area | | Weight Classification<br>Oven Dry weight of concrete, LB/FT3 | | |
| Average of 3 units | Individual unit | Light weight<br>Less *than 105 (1682)* | Medium weight<br>*105 to less than 125*<br>*(1682 – 2002)* | Normal weight<br>125<br>(2002 or more) |
| 1900 (13.1) | 1700 (11.7) | 18 (288) | 15 (240) | 13 (208) |
| *Water Absorption, max, lb/ft3 (kg/m3) (Average of 3 Units)* | | | | |

Table M2

| **Moisture Content Requirements for Type 1 Units**<br>*Moisture Content max,* % of *total Absorption*<br>*(Average 0/3 Units)* | | | |
|---|---|---|---|
| Linear Shrinkage,% | Humidity Conditions at Site or Point of Use | | |
| | Humid | Intermediate | Arid |
| 0.08 or less | 45 | 40 | 35 |
| From 0.03 to 0.045 | 40 | 35 | 30 |
| 0.045 to 0.065, max | 35 | 30 | 25 |

D. The blocks shall be of the close texture type capable of accepting a paint finish, unless otherwise indicated.

## 2.2 Certificate of compliance

A. The manufacturer shall supply the Engineer's Representative with a certificate of compliance with the Specification.

## 2.3 Damp-proof courses

A. Damp-proof courses, where indicated, shall comply with BS 6515 and shall be laid on an even mortar bed free from projections which may puncture the material. They shall be laid over the whole of the walls for the full thickness at a minimum height of 150mm (6") above finished ground level.

## 2.4 Ties

A. Galvanised steel strip ties shall be provided at joint locations indicated on the drawings. Strips shall comprise low carbon steel BS 4360, Grade 43 Hot-dip galvanised complying with BS 729. Minimum mass of coating shall be 940 g/ sq. m. including both sides. De-bonding coating shall be a single coat of black bitumastic paint.

## Part 3 Execution

### 3.1 Workmanship

A. All blockwork shall be laid with a 1/2 lap stretcher bond in level beds of uniform 10mm (3/8") thickness, unless otherwise indicated on the drawings. All blockwork shall be straight, level, plumb and uniform in plane with all joints, horizontal and vertical filled with mortar unless otherwise indicated. Any wall deviating from this standard shall be removed and rebuilt.

B. Walls shall be accurately fitted at all openings. Anchors for door frames are to be built in; such anchors shall be provided by the Contractor for doors.

C. All sections of walling where lintels or beams bear, all corners, window and door jambs and junctions of cross walls shall be formed in blocks filled with concrete down to the footing. Care must be taken to ensure that the blocks are filled solid and the concrete compacted in the voids, as each course rises. All cells shall be thoroughly cleaned before filling. The grout shall be of 20 $N/mm^2$ the minimum characteristic compressive strength.

D. Block walls which are to be left with natural finish or fair faced shall be carefully laid with all surfaces flush and joints tooled (see section 04100 Part 3.2).

E. All loose mortar shall be removed from wall surfaces as the work progresses.

F. All concrete blockwork of exterior wall s and interior partitions perpendicular to exterior walls shall be attached to any structural frame with approved galvanised masonry anchors. If there is no separate frame, interior block walls shall be mechanically interlocked with exterior walls.

G. All anchors, ties and similar items in connection with walls, furring and partitions shall be built in as the work progresses and spaces solidly filled with masonry.

H. Loose lintels shall be set in proper locations as the walls are carried up.

I. Unfinished work shall be stepped back to permit jointing of new work. Before connecting new work to work previously built, the old work shall be swept clean, all loose mortar and other matter removed and surfaces thoroughly wetted.

J. All bearing places, flashing, sleeves, louvres, etc., shall be built in as the work progresses and particular care shall be taken that flashings are bedded in and covered with mortar. Ends of lintels and similar items shall be set solidly bedded in mortar.

K. Where shown on the mechanical drawings, or as directed, the Contractor shall build in sleeves in block masonry for the passage of pipes, conduits, etc., and for access, building around work after it is in place, and grouting or caulking to secure a tight joint. Sleeves for mechanical trades are described under the relevant Sections.

L. Any broken or cracked concrete blocks or otherwise defective masonry shall be removed and replaced with proper work.

M. Walls of buildings shall be carried up simultaneously to be well bonded at comers, and in no case is a wall or section of wall to be built more than 6 courses ahead of an adjoining wall.

N. Concrete blocks shall be cut with masonry saws to produce clean, straight edges.

## 3.2 Tolerances

A. The block walls shall be within 6mm (1/4") of their correct positions as shown on the drawings and within 6mm (1/4") of their correct level relative to datum level. Surfaces exposed in the finished work shall not depart by more than 4mm (3/16") from a 1.2m (4') straight edge placed anywhere on the surface.

## 3.3 Lintels

A. Lintels may be precast concrete and should not bear on short lengths of cut block (see Section 03300 Part 3.14 for details of reinforced concrete lintels over openings).

## 3.4 Forming of chases and holes

A. Sleeves, chases and holes shall as far as possible, be provided during erection of the blockwork Chasing of completed walls or the formation of holes shall only be carried out with written approval and only with a tool designed to cut the blocks cleanly. No horizontal or diagonal chases shall be permitted. There shall be at least 225mm (9") between chases and door jambs.

B. Horizontal pipes and conduit embedded (i.e. not chased) in blockwork shall be concrete encased.

## 3.5 Rate of laying

A. The maximum height of blockwork that may be built in a day shall be 4'8" (7 courses).

## 3.6 Compressible filler boards

A. Compressible filler boards shall be placed in the locations indicated on the drawings. Unless otherwise indicated on the drawings the type of filler board shall be to the approval of the Engineer’s Representative.

## 3.7 Joints with concrete or steelwork

A. Unless noted otherwise on the drawings all blockwork in contact with vertical concrete elements shall be tied to them using a suitable galvanised steel tie system approved by the Engineer’s Representative. Toothed blockwork may be considered

as an acceptable alternative by the Engineer's Representative. Ties shall be positioned vertically in alternate courses and centrally in each blockwork skin abutting the concrete member.

B. Where any opening restricts the length of blockwork abutting a vertical concrete element to a dimension less than 600 mm (2') the ties shall be positioned in each mortar course of the blockwork.

C. Unless noted otherwise on the drawings, all blockwork in contact with concrete casing to structural steel elements shall be tied to them as specified in Parts 3.7 A and B of this Section.

D. Where steelwork is encased, the method of securing the blockwork to the steel elements shall be subject to the approval of the Engineer's Representative.

## 3.8 Anchors

A. Anchors shall be provided wherever necessary for the bonding and tying of the work.

## 3.9 Wall Plugs

A. Suitable bolts, metal wall plugs and other approved metal fastenings shall be provided for securing wood nails or other works to block concrete or tile walls.

## 3.10 Cleaning block walls

A. Special care shall be taken when setting block walls to prevent mortar droppings from remaining on the walls.

B. Upon completion, all walls shall be cleaned of all mortar droppings, dirt, efflorescence and other foreign matter leaving the wall smooth and clean throughout.

## 3.11 Cutting and patching

A. The Contractor shall drill, cut and patch masonry as required by the other trades. All other trades shall be consulted in advance and provisions made for the installation of their work to avoid unnecessary cutting and patching.

B. Where the Contractor, without the consent of the Engineer's Representative installs masonry before sleeve inserts and similar utilities have been properly located, any cutting and additional patching, repairing and pointing up caused thereby shall be included herein .

# Part 1 General

## 1.1 Scope

A. Blockwork shall be reinforced in the locations indicated on the drawings and accurately fixed in the positions indicated.

B. The minimum clearance to block cells shall be 19mm (3/4"); the minimum lap lengths of bars under shall be 50 bar diameters unless otherwise indicated.

# Part 2 Products

## 2.1 Reinforcing steel

A. Reinforcing steel including bed joint reinforcement shall comply with the following British Standards:

BS 8666: 2000 Carbon Steel Reinforcing Bars for Concrete
BS 4482: 1985 Cold Reduced Steel Wife for Reinforcement for Concrete
BS 4483: 1985 Steel Fabric for Reinforcement

B. Reinforcement shall be galvanised after manufacture in accordance with BS 729.

## 2.2 Concrete

A. Unless specified otherwise on the drawings concrete infill for blockwork shall be grade 20 minimum 28 days characteristic compressive strength.

## 2.3 Aggregate

A. The maximum size of aggregate shall not exceed 50% of the specified cover to reinforcement.

## 2.4 Admixtures

A. Construction admixtures in accordance with BS 5075: Part 1 may be used with the prior approval of the Engineer’s Representative.

# Part 3 Execution

## 3.1 Slump

A. The slump of all mixes shall be appropriate to the size and configuration to be filled but shall be between 75mm (3") and 175mm (7") for unplasticised mixes.

## 3.2 Mix and method of placement

A. Details of the infill concrete mix and method of placement shall be agreed with the Engineer's Representative prior to the start of construction.

B. Unless otherwise shown on the drawings, all filled block shall have two bars of 6mm (1/4") horizontal masonry reinforcement correctly laid in bed joints at 600 mm (2') vertically. Bars shall be laid in the flanges of blocks and not through the centre of cells. The minimum lap length shall be 300 mm (12"). Any proposal to substitute purpose manufactured masonry reinforcement with an alternative shall require the approval of the Engineer's Representative.

C. Block is to be filled in maximum 5 course lifts with all block fill rodded thoroughly.

D. Cavities, cells or voids in blockwork shall be thoroughly cleaned before placing grout or infill.

E. Concrete infill shall be placed to within 50 mm (2") of the level of the last course laid.

F. Care shall be taken to ensure that adequate lap length is maintained in vertical reinforcing after a lift.

# Part 1 General

## 1.1 Definition

A. All stone shall be Bermuda stone unless otherwise stated.

B. This Section shall be read in conjunction with related Sections including those for water, sand and cement contained elsewhere in the Specification.

## 1.2 Sample panel

A. Prior to construction, a control sample of minimum dimension 1500 mm x 1500 mm (4'-8" x 4'-8") shall be prepared for the Engineer's Representative's approval.

# Part 2 Products

## 2.1 Bermuda stone

A. Bermuda stone shall be freshly cut and squared native stone of good texture, unless otherwise stated, and be uniformly dense without earth streaks and other stains, and free from cracks and sand holes.

B. Bermuda stone for a project shall be obtained from a single quarry and be consistent in colour, range and texture.

## 2.2 Mortar

A. Stone shall be laid in a 1:3:8 cement: lime: sand mortar.

B. Where used as a facing, stone shall be laid with stainless steel twist type cavity wall ties at 2.5 per sq. yd. to the inner blockwork leaf.

C. Mortar plasticiser conforming to BS 4887 may be substituted for lime.

# Part 3 Execution

## 3.1 Bond

A. Stone shall be built plumb to lines with all courses level; half lap stretcher bond shall be used for all stonework, unless otherwise indicated on the drawings.

## 3.2 Jointing

A. A uniform joint size must be maintained.

B. All joints must be raked out 19 mm (3/4") before mortar sets, keeping the face of the stone clean.

C. After mortar sets, the Contractor shall wet rake joints and pack solidly with pointing mortar, unless otherwise specified.

D. Joints shall be tooled slightly concave, unless otherwise indicated on the drawings.

## 3.3 Cleaning

A. Stonework shall be kept clean of all mortar deposits and excess mortar.

B. Stonework shall be cleaned within six days of placement with clean water and stiff bristle brushes.