

**Construction of Fifty Housing
Units in the Kalinago Territory**

EDF/11/SRBC/WRK/9

Technical Specifications

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1. PRELIMINARIES

1.1. LOCATION OF THE WORKS

The works are to be executed within four (4) hamlets of the Kalinago Territory, in the Parish of Saint David, Commonwealth of Dominica. The works are to be undertaken at the locations shown on the location plans and set out in accordance with the site plans. The four (4) hamlets comprise Crayfish River, Salybia, St Cyr and Mahaut River.

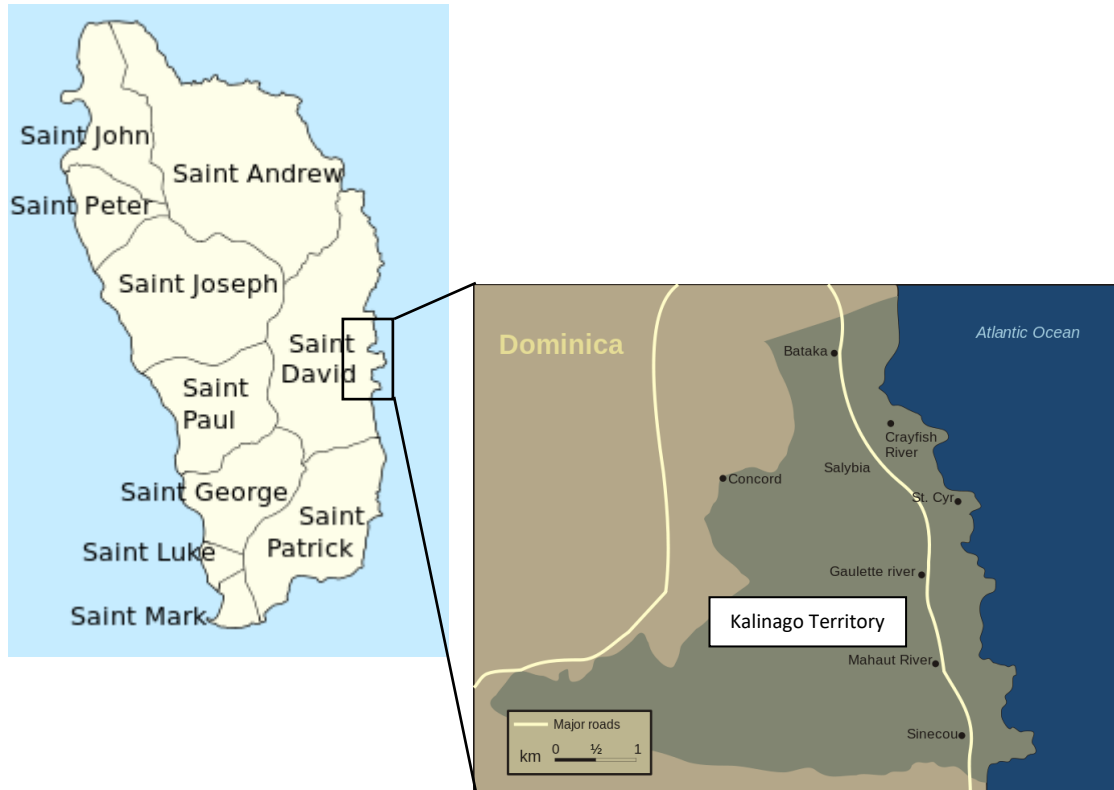


Figure 1 - Map of Dominica and Kalinago Territory (Source: wikipedia.org)

1.2. SCOPE OF WORKS

The works comprise the construction of two (2) bedroom and three (3) bedroom resilient houses for six (6) Kalinago Beneficiaries. Most of the houses are to be constructed at the sites traditionally occupied by each Beneficiary. Traditional methods of construction are envisaged for the erection of all houses.

Structural Framing

The roof is split into a sloping reinforced concrete slab to the rear and a reinforced concrete framed gable to the front. The roof is supported by reinforced masonry walls with structural stability provided via uninterrupted shear panels within each elevation. The ground floor slab is suspended and spans onto reinforced concrete beams. Due to the diversity of the site topography across the various sites, the

ground floor beams are either capping beams for reinforced masonry on strip footings, or spanning beams supported on columns and pad footings with tie beams.

Civil Works

For sites on sloping land, benching earthworks and retaining walls are to be constructed where indicated.

MEP Works

The plumbing works include the installation of cold and hot water lines to kitchen and bathroom fixtures and external installation of a hose bib. For some remote sites, plumbing lines are to be installed from the house to the DOWASCO water main.

Electrical works include the installation of lighting and socket fixtures and fittings in all rooms and external lighting at corners and entrances, all in accordance with code requirements for the Commonwealth of Dominica.

Non-Structural Elements

The non-structural fixtures include internal and external doors, windows with sills, kitchen cabinets, bedroom closets, pantry shelves, patio balustrades, blockwork access steps or RC ramps as specified.

1.3. STANDARDS

1.3.1. Compliance

Where there is a requirement in this specification for compliance with any part of a standard or other technical specification, that requirement may be met by compliance with any local, regional or international standard or code of practice, provided that the relevant standard imposes an equivalent level of performance and safety provided for by the stated Standard or technical specification.

1.4. QUALITY MANAGEMENT

The Contractor shall develop and implement a quality management system for the duration of the works and ensure compliance by all site personnel. The management system shall make allowance for the performance and recording of the following:

- Control of documents and records;
- Procurement of goods and services in compliance with these specifications;
- Procurement of supervisory and site resources with adequate skills and services for the delivery of the project;
- Planning and execution of internal quality audits and quality control inspections by the Supervisor;
- Planning and performance of tests in accordance with these specifications;
- Control of non-conformances and performance of corrective works;
- Protection of completed works.

1.4.1. Supply of Quality Records

For works, goods or materials, the Contractor shall make available copies of all quality records to the Supervisor and/or the Contracting Authority, where requested in these Specifications and specifically tabulated in Appendix B. Where information and documentation regarding works, goods or materials is required to be submitted to the Supervisor and/or the Contracting Authority for acceptance, the Contractor shall submit such documentation in a timescale to meet the requirements of the Contractor's programme of works. The Contractor shall liaise with the Supervisor and/or the Contracting Authority to ensure that adequate time is allocated for the Supervisor and/or the Contracting Authority to undertake the required assessments for acceptance.

The Contractor shall require any member of the Contractor's supply chain to make available such quality records when requested.

1.4.2. Non-Conforming Product or Service

The Contractor shall report any non-conforming product/service to the Supervisor and/or the Contracting Authority and shall require any member of the Contractor's supply chain to immediately report any non-conforming product/service to the Contractor. The Contractor shall immediately pass these reports to the Supervisor, and undertake no further related work until remedial or other measures have been undertaken.

1.4.3. Goods and Materials

The Contractor shall provide the Supervisor and/or the Contracting Authority with details of the suppliers from whom he proposes to purchase the goods and materials necessary for the execution of the works prior to their inclusion in the works.

1.4.4. Sampling and Testing

The Contractor, at the discretion of the Supervisor, shall provide samples of goods and materials as described in Appendix A and shall deliver these to the Supervisor. These samples shall be supplied in sufficient time for them to be tested or examined for acceptability by the Supervisor, taking into account the programme for the works.

Production samples shall be delivered in a condition which is representative of the material's state for the purpose of the test.

The Contractor shall provide the Supervisor and/or the Contracting Authority with details of the Testing Agency chosen for the performance of all tests tabulated in Appendix B, prior to the execution of the works. The performance of these tests shall remain at the discretion of the Supervisor.

1.5. HISTORIC FEATURES AND ARTIFACTS

Where in the performance of the works – particularly site clearance and excavation – the Contractor encounters any item which may be of historical relevance, the Supervisor and/or the Contracting Authority shall be immediately notified. Any items discovered shall remain in place until instruction is issued by the Supervisor.

1.6. VEHICULAR SITE ACCESS

Where required, access roads to each site will be constructed in advance of the works. The Contractor shall comply with Section 3.1.8 in this regard.

1.7. SITE OFFICES AND MATERIAL LAY DOWN AREAS

The Contractor is responsible for the selection and location of site offices and material lay down areas as set out in the tender documentation. Permission for the use of the lands in the Kalinago Territory is issued by the Kalinago Council.

Site offices shall have adequate accommodation for site supervisors, in accordance with the labour laws of the Commonwealth of Dominica. Site offices shall include the following:

- Facilities for site workers to shelter, change and eat;
- Ablution facilities with toilets in sufficient quantity for the number of site personnel and sub-contractors, and clean water for washing up and drinking;
- First aid kits and details of the nearest health facility in the event of emergencies.

1.8. SITE ADMINISTRATION

The Contractor shall ensure that management systems are in place for the execution of his business. The following are required:

- Record keeping and filing system – (e.g. timesheets, daywork records, drawing registers, correspondence with the Supervisor and/or the Contracting Authority and staff);
- Site diary and site photographs;
- Means of communication with the Supervisor and/or the Contracting Authority and the site operatives;
- Management and security of stores.

1.9. EXISTING GROUND LEVELS

The Contractor shall satisfy himself that the existing ground levels as shown on the drawings are correct. Should the Contractor wish to dispute any levels he shall submit to the Supervisor and/or the Contracting Authority a schedule of the position of the levels considered to be in error and a set of revised levels. The existing ground relevant to the disputed levels shall not be disturbed before the correct levels are determined.

1.10. SETTING OUT

Approval for the development of each site is contingent on the inspection and approval of the setting-out of all septic tanks and soakaways by the Environmental Health Department. The Contractor shall, upon award of the Contract, immediately notify the Supervisor and/or the Contracting Authority and the Environmental Health Department of the timeline for setting out at each site, and shall provide firm dates to each party for the inspection of proposed septic tank and soakaway positions. The Contractor shall programme the works and communicate effectively so as not to cause unnecessary delays to the execution of the Works.

The Contractor shall, within 3 weeks of the date for commencement of the works, carry out the following a check of the co-ordinates and levels of all ground markers and benchmarks shown on the site plans and advise the Supervisor and/or the Contracting Authority of any discrepancies.

The Contractor shall keep updated schedules and drawings of all bench marks used in the setting out and shall make these available to the Supervisor and/or the Contracting Authority when required.

The Contractor shall ensure that where necessary, in order to maintain his programme, lines and levels are set out in such time as to enable statutory undertakers' apparatus and other publicly or privately owned services or supplies to be installed, altered or removed.

1.11. PRIVATELY AND PUBLICLY OWNED SERVICES OR SUPPLIES

1.11.1. Requirements

The Contractor is required to coordinate the installation of service connections for potable water and electricity for the project.

1.11.2. Protection

The Contractor shall satisfy himself as to the exact position of buried services and other publicly and privately owned services or supplies affected by the works and shall take all measures required by the relevant agency for the support and full protection of all such services or supplies.

1.11.3. Installation or Alteration of Service

Where services or supplies affected by the works are subject to alteration, removal or addition, the Contractor shall be responsible for all arrangements with the owners and/or their agents for the execution and phasing of such works in accordance with his programme.

1.11.4. Interruption of Services

No services or supplies shall be interrupted without the written consent of the appropriate authority or owner, and the Contractor shall provide a satisfactory alternative before interrupting any existing service or supply.

Disconnected apparatus shall be removed by the Contractor only with the prior consent of the utility provider concerned.

1.12. HEALTH, SAFETY AND THE ENVIRONMENT

1.12.1. Health and Safety of Workers and Visitors to the Site

The Contractor shall establish a culture of safety at the site. The site shall be maintained in a reasonably clean and orderly manner, and site personnel shall be discouraged from taking unnecessary risks.

The Contractor shall implement adequate measures to protect the site personnel, members of the public and persons visiting the site from risks arising from the hazards defined therein.

The Contractor shall be mindful of the proximity of the sites to existing residences and businesses, and implement reasonable methods of exclusion for unauthorised visitors, particularly children and the elderly.

Where exclusion is not feasible, the Contractor shall perform risk assessments and implement adequate mitigation methods to minimise or eliminate the risk for each hazard identified. Risk assessments shall consider both authorised and unauthorised visitors to the site.

The Contractor shall ensure that all site personnel and visitors to the site are supplied with personal protective equipment which is suitable for the tasks to be

performed. As a minimum, operatives shall be issued with hard-hats, gloves, protective eyewear and safety boots or shoes.

1.12.2. Working Adjacent to Roadways

If required, permission for road or lane closures for the execution of the works shall be obtained from the Traffic Department of the Commonwealth of Dominica Police Force. In such instances, traffic information signs shall be sited to advise motorists but shall not be placed where they may distract.

The Contractor shall plan, design, programme, provide, implement, maintain and remove all traffic safety and traffic management measures necessary for the completion of the works.

1.12.3. Environmental Protection

The Contractor shall conduct environmental risk assessments for the site, identify mitigation methods for each risk and ensure compliance with the mitigation methods by all site personnel.

The Contractor shall implement practical and effective measures to reduce noise, dust and vibration and avoid land and water pollution. Measure shall include but are not limited to the following:

Parameter	Mitigation Measure
Noise	<p>Construction noise shall be limited to the working hours set out below.</p> <p>During operations the engine covers of generators, air compressors and other powered mechanical equipment shall be closed, and equipment placed as far away from residential areas as possible.</p> <p>Delivery of materials shall be limited to working hours.</p>
Air Quality	<p>Demolition debris shall be kept in controlled areas and sprayed with water mist to reduce debris dust.</p> <p>An optimum moisture content for access road base materials and aggregates stored on site shall be maintained.</p> <p>Construction materials (especially aggregates) which are stored on site shall be covered with geotextile or plastic if there is risk of air pollution.</p> <p>Covered haulage vehicles shall be used to transport all construction and spoil materials.</p>

Parameter	Mitigation Measure
	<p>The surrounding environment (sidewalks, roads) shall be kept free of debris to minimize dust.</p> <p>Open burning of construction / waste material at the site is strictly prohibited.</p> <p>Excessive idling of construction vehicles at sites shall be discouraged.</p> <p>Appropriately sized vehicles shall be used for assigned tasks.</p>
Waste Management	<p>Adequate sanitation and garbage disposal facilities for site personnel shall be provided and maintained in accordance with the regulations/guidance of the Environmental Health Division and the Dominica Solid Waste Management Corporation.</p> <p>Waste collection and disposal pathways shall be identified for all major waste types.</p> <p>Inert construction and demolition wastes shall be separated from general refuse, organic, liquid and chemical wastes.</p> <p>With permission from the Supervisor and/or the Contracting Authority and the Kalinago Council, the contractor may establish temporary stockpile sites for inert waste before final disposal at the landfill in Roseau.</p> <p>Disposal of site waste into watercourses is strictly prohibited.</p>
Hazardous Materials	<p>If asbestos is located on the project site it shall be marked clearly as hazardous material and disposed of in accordance with the requirements of the Environmental Health Division and the Dominica Solid Waste Management Corporation.</p> <p>Chemicals, petroleum products, liquid wastes and toxic substances shall be stored on site in safe containers and in a manner to prevent spillage and leaching and disposed of in accordance with the requirements of the Environmental Health Division and the Dominica Solid Waste Management Corporation.</p>
Land and watercourses	<p>Refuelling of site vehicles shall occur on banded concrete or on a surface which prevents leaching of spills.</p>

Parameter	Mitigation Measure
	<p>Existing drainage systems shall be kept clear of site debris.</p> <p>Site offices and material stockpiles shall be located at a distance from watercourses and drainage systems.</p> <p>Portable toilets or septic systems shall be provided for the use of site personnel.</p>

The Kalinago Council has approved the following three (3) sites for the disposal of waste. These sites shall not be used for the disposal of liquids, chemicals, petroleum products, food and biological material. Prior to the start of construction, the Contractor shall advise the Supervisor and/or the Contracting Authority of the intended use of the disposal site.

The type of waste permitted for disposal at each site is restricted. Use of these sites and the exact location for disposal shall be approved by the Supervisor and/or the Contracting Authority only if the following conditions are implemented:

- Touna Concord Playing Field
 1. Only excavated soil shall be disposed of at this site. The site shall be properly levelled and drainage reinstated prior to closure once soil disposal is complete.
 2. No other material, including concrete, galvanise, wood, etc. should be disposed of in this area. The soil shall be levelled within the designated area as disposal occurs.
 3. The Contractor shall establish and demarcate a specific route of movement by heavy equipment to prevent destruction of the field and as a safety measure for people traversing the field.
- Old Salybia Primary School Playing Field
 1. Only excavated soil shall be disposed of at this site. The site shall be properly levelled and drainage reinstated prior to closure once soil disposal is complete.
 2. For use of this site, the Contractor shall establish proper site access with adequate site preparation. The Contractor shall create / prepare layovers along the adjacent road to allow for vehicles to pull over in order to prevent traffic issues. Traffic management, including the use of flag people shall be established.
 3. The Contractor shall coordinate use of the field with the Kalinago Council and the Church.
- Gaulette River Playing Field

1. The site is suitable for the disposal of excavated soil and inert construction material only. All material shall be covered with soil on completion of disposal and drainage reinstated.
2. Disposal shall not occur if there is activity on the playing field.
3. The Contractor shall establish and demarcate a route for movement of vehicles, heavy machinery and equipment to the left of the entrance to the field to prevent rutting of the main playing field area. No maneuvering shall be done outside of the demarcated area.
4. Traffic management shall be established within the designated areas and for vehicles entering and leaving the site.
5. The Contractor shall coordinate disposal with other contractors using the site.

Unless agreed otherwise with the Supervisor, the Contractor shall be restricted to the following hours of working:

Monday to Friday – 07:30hrs to 16:00hrs

1.13. AS INSTALLED AND RECORD DRAWINGS

The Contractor shall keep one copy of all drawings, specifications and approved Shop Drawings of the work in good order, available to the Supervisor and/or the Contracting Authority and to his/her representatives.

As the work progresses, the Contractor shall record changes to all areas of the project as built.

If the Contractor defaults in this procedure, then the Supervisor and/or the Contracting Authority may make the necessary arrangements for effecting the above at the Contractor's cost.

2. SPECIFICATION FOR SITE CLEARANCE

2.1. CLEARING

The Contractor shall demolish, break up and remove buildings and structures as indicated on the drawings as well as any superficial obstructions on the site in the way of or otherwise affected by the permanent works.

The area of the Works shall be cleared of any material or obstructions which in the opinion of the Supervisor and/or the Contracting Authority would adversely affect the uniformity or stability of the fills or foundations. All topsoil shall be removed to expose sound formations as determined by the Supervisor.

Underground structures, chambers and foundations shall be demolished to a depth of 6 inches below ground level, properly cleaned out and filled.

Holes shall be made in any structures retained below ground and which are liable to form a barrier to water.

The ends of existing drains and sewers no longer required because of alterations to the drainage layout shall be sealed.

Blasting for site clearance and demolition is expressly forbidden.

The treatment of any hazardous materials encountered in site clearance shall comply with the laws of the Commonwealth of Dominica.

2.2. DEMOLITIONS

All demolition work shall be carried out in conformity with the requirements of British Standards BS 6187 and BSCP 94.

For the avoidance of doubt, the Contractor shall first ascertain whether structures identified for demolition are to be retained on site for future use by the Beneficiary. In this case, demolition works shall be conducted in a manner which preserves the functionality of the structure.

2.3. DISPOSAL OF MATERIALS

After the clearance provided for above, the Supervisor and/or the Contracting Authority may order the excavation and removal of any material deemed unsuitable for supporting the fills or foundations to be placed thereon, and subsequent replacement by suitable approved fill material.

All materials arising from site clearance which are not required, which are unacceptable for use in the permanent works or which are not classified under

Clause 1.5 shall become the property of the Contractor and shall be disposed of by him as set out in Section 1 – Preliminaries and in accordance with the laws of the Commonwealth of Dominica.

3. SPECIFICATION FOR EXCAVATIONS AND GRANULAR FILL

3.1. GENERAL

3.1.1.Safety

The Contractor shall provide adequate timbering and pumping to prevent collapse of any earth cuts where appropriate and shall be entirely responsible for the excavations and any damage caused by them to other parts of the Works.

Excavations are to be left exposed for as short a time as possible, and the Contractor shall erect and maintain all necessary barricades and covers around the excavations for the protection of the public and workmen employed on the site and shall be responsible for any damage to persons or property due to any operations connected with his work. He shall provide and maintain adequate support to adjoining property and structures to safeguard life, limb and property.

3.1.2.Records

The Contractor shall supply those records in his possession that may be required by the Supervisor, including record drawings of works as executed.

3.1.3.Datum

The datum level will be given by the Supervisor and/or the Contracting Authority at the commencement of the Contract. The Contractor shall establish a Bench Mark on Site and shall agree the location, construction and level of this Bench Mark with the Supervisor. All levels required for the construction of the Works shall be referred to this Bench Mark.

3.1.4.Level

Immediately before any section of the Works is commenced, all necessary levels shall be taken and agreed with the Supervisor.

3.1.5.Assistance to the Supervisor

The Contractor shall provide assistance to the Supervisor and/or the Contracting Authority including chainmen, tradesmen, labourers, surveying instruments and other apparatus that may be required in connection with the Supervisor's duties.

3.1.6.Existing Services

The Contractor is to execute the Works in such a manner that he does not damage or interfere with existing services which are located on, under or in proximity to the Site. Excavations within 24" to either side of existing utility lines are to be done by hand.

Attention is drawn to the presence of water, electrical, and communication services which may be near the works and will continue to be operational throughout the duration of the works.

The Contractor is responsible for locating and protecting all existing services within the site. Damage to existing services caused by the Contractor shall be made good at his own expense. He is to lend any assistance needed by the utility companies in the repair of such damaged lines.

3.1.7. Temporary Disruption of Services

All watercourses, drains and pipes temporarily cut through or disturbed by the execution of the Works are to be restored so that the water flowing in them may continue to flow in a full and free manner as it did before the disturbance.

3.1.8. Restoration of Roads, etc.

The Contractor is to ensure that damage to any public or private roads, footpaths and tracks used by any vehicles or plant proceeding to or from the Site shall be kept to a minimum and he shall be responsible for all repairs necessary to restore such roads, tracks or footpaths to the satisfaction of the Supervisor.

3.2. EXCAVATIONS

3.2.1. Lines and Levels

All excavation shall be carried out to the lines and levels shown on the Drawings or to such lines and levels as the Supervisor and/or the Contracting Authority may direct.

3.2.2. Excavation beyond Line and Levels

If for any cause whatsoever excavations are carried out beyond their true line and level other than at the direction of the Supervisor, the Contractor shall make good to the required line and level with approved material and in such a manner as the Supervisor and/or the Contracting Authority may direct.

3.2.3. Excavation alongside Existing Roads

Excavations alongside existing roads shall be carried sufficiently into the existing roads to expose the full thickness of the existing road structure. The extent of this excavation must be approved by the Supervisor and/or the Contracting Authority before any fill is placed.

3.2.4. Shoring

The Contractor is to provide all timbering, pumping and other supports to the sides of excavations that may be necessary and shall be responsible for any injuries which may occur to anyone working on the project as a result of inadequate shoring of excavation.

3.2.5. Foundations

The excavations for all foundations shall be inspected by the Supervisor and/or the Contracting Authority before any concrete is placed and the Contractor shall give the Supervisor and/or the Contracting Authority forty-eight (48) hours' notice that such an inspection will be required.

3.2.6. Protection

Excavations are to be protected from weather and any work damaged by weather is to be repaired by the Contractor.

3.2.7. Excavated Material

The Contractor may use for the construction of the works, any of the materials excavated which the Supervisor and/or the Contracting Authority may determine to be fit for such use.

3.2.8. Re-use of Material

Excavated material from the Works selected by the Supervisor and/or the Contracting Authority for re-use shall be placed in its final position or may be stacked on Site as directed by the Supervisor.

3.2.9. Material Unfit for Use

Soil unfit for re-use shall be removed from the site.

3.2.10. Backfilling

Excavations shall not be backfilled before they have been inspected by the Supervisor. They shall be backfilled with approved material compacted in 10" layers to the satisfaction of the Supervisor.

3.3. BORROW PITS AND QUARRIES

The sites of borrow pits and quarries must be approved by the Supervisor and/or the Contracting Authority before any operations commence. Borrow pits shall be kept in a tidy state and where possible they shall be self-draining.

Before opening up any quarry the Supervisor and/or the Contracting Authority shall be supplied with an adequate number of borehole logs and details of test pits or

other information required to satisfy that the selected site of sites may be expected to provide stone of the required quality and quantity for the works.

The quarries shall be run in a safe manner and on completion of the Works they shall be left in a tidy state with all loose rock on the face barred down. No rock shall be left overhanging except with the approval of the Project Supervisor. All quarries shall be worked in such a manner that they do not constitute a danger to health or a nuisance to the neighbourhood, either during the operation of the quarries or after completion of the works.

Explosives shall not be used except in the presence of the Police. The use, transport and storage of all explosives in magazines shall be subject to their approval and shall be to the satisfaction of the Supervisor. Safety men shall be provided for the protection of the public and others during blasting operations.

Where blasting is permitted it shall be carried out strictly in accordance with arrangements previously agreed in writing by the Supervisor.

3.4. FILL MATERIAL

3.4.1. Supply

The Contractor shall ensure that sufficient quantities of each material for the whole of the works are available.

3.4.2. Samples

Samples of all types of fill materials together with the results of laboratory tests specified will be supplied by the Contractor to the Supervisor and/or the Contracting Authority, prior to bringing bulk supplies onto the Site.

3.4.3. Approval

No material will be used until it has been approved by the Supervisor. All fill incorporated into the Works shall be from approved sources and in general, shall conform to the provisions of these specifications except as may be otherwise modified by the Supervisor and/or the Contracting Authority to adjust for local geological conditions. All proposed sources of supply are the responsibility of the Contractor and shall be subject to sampling and testing by the Supervisor and/or the Contracting Authority to gain approval.

When approved, the Contractor shall not change the source of supply of such materials without the written authorisation of the Supervisor. Approval of the source shall not preclude subsequent rejection of materials at the Site of the Works should such materials, in the opinion of the Supervisor, not be representative of previously approved samples.

3.4.4. Material Delivery

The Contractor shall supply to the Supervisor and/or the Contracting Authority or the representatives on Site, a copy of all delivery notes in respect of all materials delivered to the Site for incorporation into the Works. Such delivery notes shall state the type, exact quantity and sources of the material delivered, the date of delivery, truck identification and project description.

In the event of non-compliance with any of the above requirements, the materials in question will not be accepted on the Site. Delivery notes shall be supplied to the Supervisor and/or the Contracting Authority or their representatives at the time of delivery of the materials to the Site.

3.4.5. Preliminary Tests

Before any fill or foundations forming part of the permanent works is placed, the Contractor shall conduct the specified tests and obtain the approval of the Supervisor and/or the Contracting Authority that the underlying layer is satisfactory.

3.4.6. Inspections

The whole of the material used in the Works will be subject to inspection and tests, as set out in these specifications, from time to time as the work proceeds. The cost of such inspection and tests including the provision and use of equipment shall be borne by the Contractor.

3.4.7. Substandard Material

If the results of any test show that any sample does not conform to the requirements of this specification, such results will be final, subject to possible additional tests at the discretion of the Supervisor and the whole consignment will be rejected as unfit for use and must be removed from the site.

3.4.8. Fill Under Slabs

Fill for use under slabs, within a minimum of 12", where described on the drawings, shall be 2" down crusher run or naturally-occurring, well graded crushed rock/granular material, and shall be from an approved source. It shall be unwashed, but free from roots, grass and other vegetable or deleterious matter. The fill shall conform to the following grading:

<i>Sieve Size</i>	<i>Percentage by Weight Passing Square Mesh</i>
2"	100
1"	65 - 85
3/8"	35 - 70
No 4	30 - 60
No 10	20 - 45
No 40	12 - 25

No 200	6 - 12
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Fill for use at a depth of greater than 12" below the underside of slabs on grade shall be well graded granular sand or gravel, meeting the requirements of ASTM D2487. The following properties shall be determined after testing as per Clause 3.13.

D₁₀ The size such that 10% of particles are smaller

D₃₀ The size such that 30% of particles are smaller

D₆₀ The size such that 60% of particles are smaller

$C_u = D_{60}/D_{10}$ = coefficient of uniformity

$C_c = D_{30}^2/D_{60}D_{10}$ = coefficient of curvature

The value of C_c shall be between 1 and 3, and the value of C_u shall exceed 4. It is probable that material excavated from the layer of generally light brown to light grey silty sands and gravel, at about 4' below the original ground level, might satisfy this specification, subject to testing.

3.4.9. Transporting

In order to prevent segregation in the handling and spreading of fill material, its moisture content shall be adjusted and controlled within a range of suitable values during movement.

3.4.10. Placing

The fill material shall be laid in layers not exceeding a thickness of 9" generally or 6" below slabs before compaction and shall be thoroughly compacted to the full depth of each layer. The spreading and compaction of subsequent layers shall not take place until each layer has been inspected and approved by the Supervisor's Representative.

3.4.11. Compaction under Slabs

Compaction of the fill under slabs shall be carried out to a minimum density of 95% of the Modified Proctor maximum dry density.

3.4.12. Watering

The Contractor is to allow for watering where necessary and for delays, which may occur to allow the soil to dry out to an appropriate moisture content. Any soft areas that may develop during compaction shall be removed and replaced to the satisfaction of the Supervisor.

3.4.13. Laboratory Tests

Three dry and three wet Particle-Size Analyses according to ASTM methods D421, D422 and D2217 shall be carried out on each type of granular fill material that the Contractor proposes to use. Three Modified Proctor tests according to ASTM

method D1557 shall also be carried out on each type of material prior to its use on the site. Each type of fill material will then be classified according to ASTM method D2487. The results of all tests shall be sent to the Supervisor and/or the Contracting Authority as soon as they are available.

3.4.14. Field Testing

Tests shall be carried out by the Contractor in the field to determine the in-situ density and moisture content of the fill. The sand-cone method to ASTM D1556 or the nuclear density method to ASTM D2950 or to ASTM D2922 will be used.

3.4.15. Frequency of Testing

A minimum of one test shall be carried out for every 270 sq. feet of each layer of fill placed and compacted under floor slabs, elsewhere the frequency may be increased to every 1,076 sq. feet of each layer.

3.4.16. Test Results

If the results of the tests above indicate that the fill has been compacted as specified, then no further tests will be required. Fill which fails to meet the requirements of this specification will be further compacted until satisfactory results are obtained.

3.5. TARRISH FOR ROADWORKS

3.5.1. Granular Sub-Base Course

Tarrish fill for the sub-base course shall consist of material obtained from approved sources provided by the Contractor and shall be naturally occurring well graded gravel or crushed rock, free from roots, grass and other vegetable or deleterious substances.

All material shall pass the 37.5 mm sieve.

The material passing the No. 36 BS sieve shall have a liquid limit of not more than 25 and a plasticity index less than 7.

When compacted to the minimum acceptable field density of 90% Modified Proctor maximum dry density, the CBR value shall not be less than 25% at the equilibrium moisture content which in the opinion of the Supervisor and/or the Contracting Authority will obtain after completion of the Works.

3.5.2. Granular Base Course

The crusher run tarish base course shall conform to the following gradation:

BS sieve size	Percentage Passing			
	37.5mm (1½")	20mm (¾")	10mm (¾")	5mm (3/16")
37.5mm (1½")	100			
20mm (¾")	80 - 100	100		
10mm (3/8")	55 - 80	80 - 100	100	
5mm (3/16")	40 - 60	50 - 75	80 - 100	100
2.36mm (No.7)	30 - 50	35 - 60	50 - 80	80 - 100
1.18mm (No.14)	--	--	40 - 65	50 - 80
600 um (No.25)	15 - 30	15 - 35	--	30 - 60
300 um (No.52)	--	-	20 - 40	20 - 45
75 um (No.200)	5 - 15	5 - 15	10 - 25	10 - 25

Crusher run shall not be brought onto the site until the required tests have been carried out and the Supervisor's approval has been obtained regarding the type and source of the material.

After the final rolling and just prior to the placing of the bituminous layers, the surface of the crusher run shall be inspected and approved by the Supervisor. Dusty surfaces will be broomed to expose the aggregate and improve the bond between the bituminous and granular base courses.

The tarish material shall have a liquid limit not less than 25% and a Plasticity Index not greater than 6%.

The tarish material when compacted to the minimum acceptable field density of 95% the Modified Proctor maximum dry density, the CBR value shall not be less than 80%.

3.5.3. Transporting

In order to prevent segregation in the handling and spreading of material, its moisture content shall be adjusted and controlled within a range of suitable values during movement.

3.5.4. Placing

The fill material shall be laid in layers not exceeding a thickness of 250mm before compaction and shall be thoroughly compacted to the full depth of each layer.

3.5.5. Acceptance

All fill incorporated into the Works shall be from approved local sources and in general, shall conform to the provisions of these specifications except as may be otherwise modified by the Supervisor and/or the Contracting Authority to adjust for local geological conditions. All proposed sources of supply are the responsibility of the Contractor and shall be subject to sampling and testing by the Supervisor and/or the Contracting Authority to gain approval. When approved, the Contractor shall not change the source of supply of such materials without the written authorisation of the Supervisor. Approval of the source shall not preclude subsequent rejection of

materials at the Site of the Works should such materials, in the opinion of the Supervisor, not be representative of the previously approved samples.

3.5.6. Materials Delivery Notes

The Contractor shall supply to the Supervisor and/or the Contracting Authority on the Site of the Works, a copy of all delivery notes in respect of all materials delivered to the Site for incorporation into the Works. Such delivery notes shall state the type, exact quantity and sources of the material delivered, the date of delivery, truck identification number and project description.

In the event of non-compliance with any of the above requirements, the material in question will not be accepted on the site. Delivery notes shall be supplied to the Supervisor and/or the Contracting Authority at the time of delivery of the materials to the Site.

3.5.7. Tests Before Construction

Samples of all types of fill materials together with the results of laboratory tests specified will be supplied by the Contractor to the Supervisor and/or the Contracting Authority prior to bringing bulk supplies onto the site.

No material will be used until it has been approved by the Supervisor.

Before any material forming part of the permanent works is placed, the contractor will conduct the specified tests and obtain the agreement of the Supervisor and/or the Contracting Authority that the underlying layer is satisfactory.

The whole of the material used in the works will be subject to inspection and tests as the Supervisor and/or the Contracting Authority may direct from time to time as the work proceeds.

If the results of any test shows that any sample does not conform to the requirements of this specification, such results will be final, subject to possible additional tests at the discretion of the Supervisor, and the whole consignment will be rejected.

Three dry and three wet Particle-Size Analyses according to ASTM methods D421, D422 and D2217 will be carried out on each type of granular fill material that the Contractor proposes to use. Three Modified Proctor tests according to ASTM method D1557 will also be carried out on each type of material. Each material will then be classified according to ASTM method D2487. The results of all tests will be sent to the Supervisor and/or the Contracting Authority as soon as they are available. These results will conform to the requirements of this specification unless notified otherwise in writing by the Supervisor.

3.5.8. Tests During Construction

Tests will be carried out by the Contractor in the field to determine the in-situ density and moisture content of the fill. The Sand Cone method to ASTM DF1556, the Nuclear Density method to ASTM D2950 or ASTM D2922, or other method approved by the Supervisor and/or the Contracting Authority will be used. A minimum of one test will be done on each layer of material or as directed by the Supervisor.

A minimum of one test will be carried out for every one hundred square metres of each layer of fill placed and compacted.

Compaction of the sub-base course material shall be carried out to a minimum density of 90% of the Modified Proctor maximum dry density. Compaction of the base course material shall be carried out to a minimum density of 95% of the Modified Proctor maximum dry density.

3.5.9. Workmanship

The levels of the sub-grade fill will be checked during construction. These levels shall conform to the following tolerances:

<u>Surface</u>	<u>Tolerance (mm)</u>
Formation (bottom of excavation)	+ 0 - 50
Granular Sub-base Course	+ 0 - 30
Granular Base Course	+ 5 - 10

4. SPECIFICATION FOR REINFORCED CONCRETE

4.1. GENERAL

No artifice or any new process is required to achieve the standard of concrete requested for this project. The Contractor is asked simply to confine himself to a strict adherence to the rules governing the art of his profession. The Contractor must make rigid watertight formwork, fix the reinforcement carefully, use a concrete which always conforms to that chosen by the Supervisor, and place it with care, avoiding any segregation on its way to the point of placing.

Concrete shall be made with cement, fine aggregate, coarse aggregate and water. No other agent or ingredient shall be added to the concrete without the prior approval of the Supervisor. The Contractor shall ensure that the use of any such approved additive will not adversely affect the works. Admixtures, when used, shall supplement the basic properties of the concrete mix, rather than replace any of the basic ingredients.

4.1.1. Responsibility

No approval or acceptance by the Supervisor and/or the Contracting Authority or their representatives shall in any way relieve the Contractor of his responsibility for the quality of materials and the standard of workmanship in the finished works, and for the strength and durability of the finished concrete works.

4.1.2. Reinforced Concrete

The reinforced concrete works have been designed generally in accordance with the recommendations contained in the British Standard Structural Use of Concrete BS 8110 Part 1:1997. The Works are to comply with the recommendation made in Sections 6 and 7 of BS8110 Part 1, whether referred to or not, unless specifically excluded or modified hereafter.

4.1.3. Unreinforced Concrete

Un-reinforced concrete works shall comply with all the relevant requirements for reinforced concrete.

4.2. MATERIALS, MACHINES, MEN

4.2.1. General

All materials used in the Works shall comply in all respects with the current issue of the relevant British Standard except for any deviations specifically authorised in subsequent clauses of this specification.

4.2.2.Cements

The cement shall be Portland cement complying with BS12 or ASTM C 150.

All cement shall be delivered in the original sealed containers of the manufacturer. No re-bagged cement will be permitted to be brought on to the site.

4.2.3.Aggregates

Fine aggregate shall comply in all respects with BS 882 and shall consist of well-graded coarse sand or crushed rock fines, mainly passing a 3/16" test sieve as defined therein.

The coarse aggregate shall comply in all respects with BS 882 and shall consist of natural gravel crushed stone with grading of nominal size 3/16" to 3/4" for reinforced concrete. The grading between the stated limits shall be such as to produce a dense concrete of a consistency that will work readily into position without segregation and without the use of an excessive water content.

4.2.4.Water

The water to be used in the Works shall be clean and free from all harmful matter in suspension or solution. Only potable water from the mains may be used. Tanks and pipelines carrying the mixing water should be buried, insulated, shaded or painted white to maintain the water at the lowest practicable temperature.

4.2.5.Reinforcement

Reinforcing steel bars shall comply with BS 4449:1998 British Standard Specification for carbon steel bars for the reinforcement of concrete.

Welded steel fabric shall comply with the recommendations of BS 4483 for "Steel Fabric for the Reinforcement of Concrete". All mesh shall be purchased from the manufacturers as flat sheets.

4.2.6.Storage

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

Aggregates shall be stored on hard clean platforms with adequate dividing walls, or in approved containers to prevent mixing of different types of aggregate.

Stockpiles should be shaded from the sun or kept cool by sprinkling.

4.2.7.Plant and Equipment

All plant and equipment used shall be maintained in good working order at all times. It shall be of sufficient capacity to produce and handle effectively the concrete of the

particular quality selected without undue variations and without contamination of the concrete by lubricants or other harmful material. Where necessary, duplicate equipment shall be available.

Mixers, chutes, belts, hoppers, pump lines and other equipment for handling concrete shall be shaded, painted white or covered with wet hessian to reduce the effect of the sun's heat.

4.2.8.Labour

The Contractor shall employ sufficient skilled and unskilled workers (especially from the Kalinago Territory) under trained and experienced supervision, to ensure the degree of skill necessary to produce the quality of workmanship demanded.

4.3. TESTS

4.3.1.General

Before the commencement of the Contract, the Contractor shall submit to the Supervisor and/or the Contracting Authority for his approval, the name of the Testing Authority he proposes to employ.

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

The Contractor shall maintain all testing equipment on Site in proper working order to the satisfaction of the Supervisor.

4.3.2.Cements

The manufacturer's certificate of tests including compressive strength tests, carried out in accordance with ASTM C 150 for Portland cement or BS 12 for ordinary and rapid-hardening Portland cement, shall be supplied to the Supervisor and/or the Contracting Authority, if requested.

4.3.3.Aggregates

Samples of all aggregates shall be submitted to the Supervisor and/or the Contracting Authority for approval before the commencement of the work.

After the approval of samples of the aggregates by the Supervisor, the samples will be retained by the Supervisor and/or the Contracting Authority for comparison with all subsequent deliveries. Any delivery that in the opinion of the Supervisor and/or the Contracting Authority is not in accordance with the standard of the samples

previously supplied by the Contractor shall be rejected as unfit for use in the Works and shall forthwith be removed from the Site by the Contractor.

If the Supervisor and or The Contracting Authority considers it necessary to carry out grading tests on the aggregates, the Contractor shall arrange and expedite the necessary tests in accordance with ASTM C 136.

4.3.4. Mixing Plant

Weigh-batching plant shall be checked in the presence of the Supervisor. The checking shall be carried out with approved weights provided by the Contractor for this purpose.

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

If any fault in the mixing plant is detected by these tests or otherwise, the fault shall be rectified to the satisfaction of the Supervisor before any further use is made of the equipment.

4.3.5. Concrete Tests

Concrete test cubes shall be made, cured and tested and the results recorded, in accordance with the recommendations of BS 1881 unless specifically modified in subsequent clauses on the specification.

The test specimens shall be 4" or 6" cubes, made in steel moulds of approved design. The test cubes shall be taken from typical batches of concrete as directed by and in the presence of the Supervisor, without prior notice.

The test cubes shall be properly packed, suitably labelled and sent by the Contractor to the Approved Testing Authority.

Slump tests or compaction factor tests of the mixed concrete shall be carried out each day of concreting and the results recorded and kept on the Site.

4.3.6. Load Tests

Load tests of completed parts of the structure may be called for by the Supervisor and/or the Contracting Authority at any time.

The test procedure and the standard of acceptance will be specified by the Supervisor.

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

4.4. CONCRETE

4.4.1. General

For structural concrete mixes, made with ordinary Portland cement, the 7-day works strength shall be as specified on the structural drawings.

4.4.2. Mix Proportions

Mix proportions shall be designed by the Contractor for each structural concrete mix specified.

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

4.4.3. Mix Constituents

The maximum water-soluble chloride and sulphate in the concrete mixes shall not exceed the limits of BS 8110 for cement complying with BS 12 or the limits of ACI 318 for cement complying with ASTM C 150.

4.4.4. Preliminary Strength

Preliminary strength cube tests shall be carried out to check the calculated proportions for each structural concrete mix at least 7 days before the commencement of concreting.

The strength of cubes taken from trial mixes, shall reach at 4 days the strengths required for working mixes at 7 days.

Results of all preliminary tests shall be sent to the Supervisor and/or the Contracting Authority as soon as they are available.

4.4.5. Works Strength

Works strength cube tests shall be carried out during the Contract period for each mix used.

For each mix, a sample of the concrete shall be taken and 6 cubes from the sample for every 40 cubic yards of concrete placed of each mix, provided that samples shall be taken at least twice weekly for each mix used in each week.

Each set of three cubes tested at 7 days shall be accepted as satisfactory if the crushing strengths of all three cubes are greater than the specified strength for that mix or if the average strength of the three cubes is greater than the specified strength and the difference between the greatest and the least is not more than 20% of that average.

4.4.6. Works Test Failure

If any set of 7-day cube test results falls below the specified strength, the Supervisor and/or the Contracting Authority shall be notified immediately and the cause of the failure investigated. The Contractor shall immediately inform the Supervisor and/or the Contracting Authority in writing of the course of action he proposes to take to remedy this situation. However, such action shall only be instituted after the approval of the Supervisor and/or the Contracting Authority has been given.

The Supervisor and/or the Contracting Authority may at their discretion, order that compression tests be carried out at 28 days on the second set of three cubes. Provided that the 28-day strengths are satisfactory, the Supervisor and/or the Contracting Authority may decide to permit the use of concrete which has not attained the specified 7-day strengths. The Contractor is, however, directed to the fact that the 7-day cube strength as stated on the contract drawings is the specification criterion for assessing the strength of the concrete.

The extent of the area of the structure affected shall be as defined by the Supervisor.

4.4.7. Site Control

For all concrete grades, the quantities of cement and aggregates in the mix shall be measured separately by weight with approved weigh-batching plant.

Where the cement is delivered to the site in bags, each batch of mixed concrete shall be proportioned to use an integral number of complete bags.

The water-cement ratio determined in the calculation of proportions for each mix shall be controlled by direct measurement, and due allowance shall be made for water content of the aggregate.

The slump test or compaction factor test shall be used as a guide to the workability of the mixed concrete.

The permissible range of slump is 4" maximum and 1" minimum.

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

4.4.8. Ready-Mixed Concrete

Ready-mixed concrete may be used, subject to the joint prior approval of the Supervisor. The concrete shall be transported to the site in approved containers, and shall be continuously agitated until it is placed in its final position.

The concrete shall comply with this specification except that the preliminary strength tests may be waived at the Supervisor's discretion.

The supply and delivery of ready-mixed concrete shall comply with the recommendations of BS 5328. However, where a truck, mixer or agitator is used for transporting concrete, the discharge shall be complete within 1¼ hours after the introduction of the mixing water to the cement and aggregates, unless a longer period is authorized by the Supervisor. The time of introduction shall be recorded on the delivery note.

No additional water shall be added to ready-mixed concrete on site. Samples for works tests shall be taken as the concrete is placed in its final position.

5. SPECIFICATION FOR FORMWORK

5.1. GENERAL

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

5.2. MORTICES, HOLES, CHASES IN CONCRETE

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

The Contractor shall obtain from all sub-contractors, complete information of their requirements regarding conduits, pipes, fixing blocks or boxes, chases, holes and any other items to be cast or formed in the concrete members.

He shall also ensure that sub-contractor requirements relating to concrete members are approved by the Supervisor and/or the Contracting Authority before work is commenced.

5.3. PROPPING

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

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

5.4. BEAM AND SLAB FORMWORK

Unless otherwise detailed on the drawings the formwork of all beams and slabs shall be constructed with an upward camber giving rise at mid-span of 1/8" for each 10' of span.

5.5. FINAL PREPARATION

The internal faces of the formwork may be coated, subject to the Supervisor's approval, with a preparation to prevent adhesion of the concrete to the forms, provided that this preparation shall not be allowed to touch the reinforcement.

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

Each section of the formwork to structural members shall be inspected and passed by the representative of the Supervisor immediately before the concrete is placed in that section.

Forms (and reinforcing steel) shall be sprinkled with water just before the concrete is placed to cool the surface and surrounding air and increase its relative humidity. Prior to placing the concrete there shall be no standing water or puddles on the forms.

5.6. WROUGHT FORMWORK

Wrought formwork shall be formed from plywood with taped joints.

5.7. CONSTRUCTION JOINTS & EXPANSION JOINTS

5.7.1. Position of Construction Joints

The Contractor shall ensure that all construction joints are arranged to minimise the effect of shrinkage of the concrete. Generally, the distance between construction joints shall not exceed 30ft.

- The positions of all joints shall be agreed with the Supervisor and/or the Contracting Authority before work is commenced.
- Construction joints shall be located preferably in areas of compressive stresses.
- Concrete placing shall be carried out continuously between consecutive construction joints.

5.7.2. Treatment of Construction Joints

The treatment of vertical and horizontal joints shall be agreed with the Supervisor.

All construction joints shall be hacked and all laitance and honey-combed concrete removed from the contact face before the adjacent section is concreted. All loose material shall be removed from the contact face immediately after hacking has been completed.

When work is to be resumed at a construction joint, it shall be swept clean.

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

Horizontal joint surfaces shall be well-brushed with a wet hand-brush and washed off with a spray of water 30 minutes to 1 hour after casting to expose the aggregate and to provide a key for the next lift. Before the formwork for the next lift is placed, the exposed aggregate surface should be well scrubbed to remove all laitance and loose material. No mortar shall be placed on the treated surface prior to placing the next lift of concrete.

5.8. REINFORCEMENT

5.8.1.General

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

Before the bars are cut to length, the Contractor must check that reinforcement schedules are provided for each part of the structure sufficiently in advance of his concreting programme and advise the Supervisor and/or the Contracting Authority if this is not the case.

All reinforcement shall be ordered as metric sizes and will generally be described as follows:

Description on Drawings	Diameter (mm)	Mass /ft (lb)
T8-00	8	0.265
T10-00	10	0.414
T12-00	12	0.597
T16-00	16	1.061
T20-00	20	1.657
T25-00	25	2.590
T32-00	32	4.242

5.8.2.Bending

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

The minimum diameter of former to be used when bending high tensile bars shall be six times the bar diameter except for links, stirrups, and ties. These shall fit tightly around the bars at their corners.

5.8.3.Cleaning

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

5.8.4.Placing

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

The concrete cover to the reinforcement detailed on the drawings shall be maintained by use of methods approved by the Supervisor. Plastic spacers shall be used wherever applicable.

The Contractor shall supply and fix all necessary chairs required to maintain the reinforcement in the correct position. The spacing of chairs and the diameter of bars used in their manufacture shall be agreed with the Supervisor.

All laps of fabric and all intersections of bars shall be securely connected with malleable iron wire of suitable size or by any other approved method.

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

The minimum concrete cover to reinforcement shall be as specified on the structural drawings.

The placing and fixing of all reinforcement between successive construction joints shall be completed, inspected and approved by the Supervisor and/or the Contracting Authority, before the concreting of that section of the structure begins. The Contractor shall give the Supervisor and/or the Contracting Authority forty-eight (48) hours' notice of the times for these inspections.

5.8.5.Welding

Welding of steel reinforcement is not generally required. No welding of reinforcement shall be put in hand without the written permission of the Supervisor.

5.8.6. Projecting Reinforcement

All projecting reinforcement shall be suitably treated to prevent rust-staining of the finished concrete surfaces without affecting the bond resistance of the bar.

5.9. CONCRETING

5.9.1. Mixing

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

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

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

5.9.2. Transporting

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

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

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

5.9.3. Placing

The concrete shall be deposited in the forms as nearly as possible in its final position. Concrete shall be placed while still sufficiently plastic for adequate compaction. The Contractor shall keep on site a complete record of the works showing the time and date when concrete is placed in each part of the works. This record shall be available at all times for inspection by the Supervisor.

5.9.4. Compacting

Concrete shall be thoroughly compacted during placing and shall be carefully worked around all reinforcement and embedded fixtures and into the sides and corners of the formwork, eliminating all air or stone pockets which may cause honey-combing, pitting or planes of weakness.

Unless otherwise specified, all structural concrete shall be compacted by the use of suitable mechanical vibrators. Wherever possible internal vibrators shall be used.

Mechanical vibrators shall be operated by competent workmen. The use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at many points from 18" to 30" apart.

Internal vibrators shall be kept away from the faces of exposed concrete members.

Where surface mortar is to be the basis of the finish, the coarse aggregate shall be worked back from the forms with a suitable tool so as to bring a full surface of mortar against the form, without the formation of excessive surface voids.

5.9.5. Finishing of Slabs

The Contractor shall finish concrete slabs that are to receive ceramic tile by steel trowel and fine broom-finish, wood float finish or mechanical scarification.

The maximum permissible variation in the plane or slope shall be $\frac{1}{4}$ " in 10 feet (6mm in 3m) from the required plane when measured with a straight edge.

The Contractor shall properly cure slabs without using liquid curing compounds or other coatings which may prevent bonding of tile setting materials to slabs.

5.9.6. Curing

All surfaces of freshly placed structural concrete shall be completely covered with hessian or other approved material and kept constantly wet for seventy-two (72) hours after placing.

Curing membranes may also be used subject to the approval of the Supervisor.

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

5.10. STRIKING OF FORMWORK

5.10.1. General

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

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

Before the formwork is removed from any structural member, the Contractor shall ensure that the concrete in that member has attained sufficient strength for striking to proceed.

5.11. FINISHING WORK TO CONCRETE FACES

5.11.1. General

After removal of the formwork, no treatment of any kind other than that required for curing the concrete, shall be applied to the concrete faces until they have been inspected by the Supervisor.

5.11.2. Exposed Concrete Faces

Unless otherwise specified, all concrete faces to be exposed in the finished works shall be left as struck.

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

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

Any finished work which the Supervisor and/or the Contracting Authority shall judge inferior in any respect to the standard of the relevant approved sample or which is subjected to subsequent damage or surface staining shall be rejected and treated as defective work.

5.12. STANDARD OF WORKMANSHIP

5.12.1. Working Tolerance

Unless otherwise indicated on the drawings, the setting out dimensions and levels of the finished works shall be within the maximum tolerance given below:

<i>Width</i>	
Up to 10'	±1/4"
10' to 15'	± 3/8"
15' to 20'	± 1/2"
Additional for every subsequent 10'	± 1/4"

Cross Section (each direction)

Up to 20"	± 1/4"
20" to 30"	± 3/8"

Additional for every subsequent 10" ± 1/8"

Straightness or bow (deviation from intended line)

Up to 10'	±1/4"
10' to 20'	±3/8"
20' to 40'	±1/2"

Additional for every subsequent 20' ±1/4"

Squareness

When considering the squareness of a corner, the longer of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in its distance from a perpendicular so that the difference between the greatest and the shortest dimensions exceeds:

Length of shorter side

Up to and including 4'	1/4"
Over 4' but less than 6'	3/8"
6' and over	1/2"

For the purpose of this requirement any error due to the lack of straightness shall be ignored; squareness shall be measured with respect to the straight lines which are most nearly parallel with the features being checked.

When the nominal angle is other than 90°, the included angle between check lines shall be varied accordingly.

Twist

Any corner shall not be more than the deviation stated from the plane containing the other three corners.

Up to 2' wide and up to 20' in length	1/4"
Up to 2' wide and for any length	1/2"

Flatness

The maximum deviation from 5' straight edge placed in any position on a nominally plane surface should not exceed 1/4".

5.12.2. Defective Work

Wherever in the opinion of the Supervisor, any of the finished works, or the materials or workmanship in any part of the Works, does not comply with all the relevant requirements of this specification, that part of the Works shall be classed as defective work.

All work classed as defective work shall be cut out and removed from the works and replaced to the satisfaction of the Supervisor.

The extent of the work to be removed and the methods to be used in the removal and replacement of this work shall be in accordance with the Supervisor's directions. In all cases cutting out of defective concrete work shall be carried back to a satisfactory construction joint before the replacement of the defective work and any other work thereby affected is commenced.

6. SPECIFICATION FOR CONCRETE BLOCKWORK

6.1. CONCRETE BLOCKS

6.1.1. Dimensions

Blocks shall be 2-core hollow concrete blocks of approved overall dimension. Minimum face shell and web thickness shall be as follows:

Nominal Width	Face Shell Thickness	Web Thickness	Equivalent Web Thickness
6"	1"	1"	2¼" per lin ft
8"	1¼"	1"	2¼" per lin ft
12"	1¼"	1 1/8"	2 ½" per lin ft

Note: Equivalent web thickness is the sum of the measured thicknesses of all the webs in the unit times 12 divided by the length of the unit.

No overall dimension shall differ by more than $\pm 1/8$ " from the specified standard dimensions.

6.1.2. Manufacture

Blocks shall be manufactured from dense natural aggregates complying with ASTM C150 or BS 12 with a mix not richer than one part by volume of cement to six parts of combined fine and coarse aggregate.

The drying shrinkage of the blocks shall be determined in accordance with BS 6073 and the average value for three specimens shall not exceed 0.04%.

6.1.3. Strength

The compressive strength of the blocks shall be determined in accordance with the method of testing laid down in BS 6073 or ASTM C140. Minimum compressive strengths for walls shown on the structural drawings shall be as follows:

On average gross area:

Average of 5 units	500psi
Individual unit	400psi

On average net area:

Average of 5 units	1000psi
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Individual unit 800psi

All blocks shall be sound and free from cracks or other defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction.

6.1.4. Testing

Testing of blocks shall be carried out by a Testing Authority approved by the Supervisor. No less than 3 blocks shall be tested from each consignment of 200 blocks arriving on site. The procedure for selecting these blocks shall be as directed by the Supervisor. Results of tests should be communicated to the Supervisor and/or the Contracting Authority as soon as these are available and no blocks from any consignment may be used without the Supervisor's permission.

6.2. MORTAR

6.2.1. Mix Proportions

Mortar shall consist of one part by volume of normal Portland Cement to ASTM C 150 or BS 12 to three parts by volume of natural sand to BS 1200 with or without one quarter part by volume of lime complying with the recommendation of either clause 8.001 or 8.002 of BS 890.

Alternative equivalent mortar mixes utilising masonry cement or proprietary additives may be used subject to the approval of the Supervisor.

6.3. REINFORCEMENT

6.3.1. Vertical Reinforcement

All vertical steel reinforcement shall be to BS 4449:1998.

Loadbearing Blockwalls

Vertical reinforcement in loadbearing blockwalls shall be detailed as on the structural drawings.

6.3.2. Horizontal Reinforcement

All horizontal reinforcement shall be approved by the Supervisor and/or the Contracting Authority and laid in the horizontal joints of the blockwork.

Loadbearing Blockwalls

Horizontal reinforcement in loadbearing blockwalls shall be as detailed on the structural drawings.

Non-Loadbearing Blockwalls

Horizontal reinforcement in non-loadbearing blockwalls shall be as detailed on the drawings.

6.3.3. Corners and Junctions

All blockwork junctions, openings and corners shall be reinforced as detailed on the structural drawings.

6.4. CONCRETE FILLING TO BLOCKWORK

6.4.1. General

Concrete filling to blockwork shall consist of a coarse grout of fluid consistency that can be poured or pumped with segregation.

Grout shall have a minimum strength of 2000 psi at 7 days, or as shown on the drawings, and the minimum ratio of cement, sand and aggregate shall be 1 part cement to 3 parts sand to 2 parts pea gravel by weight. The maximum size of the gravel aggregate shall be 3/8" unless otherwise indicated on the drawings.

6.5. WORKMANSHIP

6.5.1. General

Blocks should be laid dry or wetted only as necessary to adjust suction on faces in contact with mortar.

Blocks shall be laid in true and regular courses in half bond.

Walls and partitions shall be bonded to each other at angles and junctions, and closer blocks used at ends, jambs and junctions.

Blocks are to be cut neatly.

6.5.2. Joints

Horizontal and vertical mortar joints are to be of an average thickness of 3/8" exclusive of any key in the jointing surfaces of the blocks.

All joints are to be finished flush unless described otherwise in the drawings and/or specification.

Horizontal and vertical mortar joints shall have full mortar coverage on the face shells and on all webs.

Vertical head joints shall be buttered well before the blocks are placed together, and these joints shall be shoved tightly so that the mortar bonds well to both units.

Where blocks are to be concrete filled, care is to be taken to avoid mortar dropping into the cavities and all projecting mortar is to be removed.

6.5.3. Chasing

No horizontal chases for services will be permitted in walls. Vertical chases or openings are only to be formed with the approval of the Supervisor.

6.5.4. Mixing of Mortar

Mortar shall be mixed in an approved mechanical mixer for not less than three minutes. Mortar may be re-tempered with water where it has dried out but not used more than 1½ hours from the initial mixing time.

6.5.5. Reinforcement

Foundation dowel bars shall not be cranked more than 1 in 6 to correct misalignment.

Splices shall be a minimum of 25 diameters and bars shall be wired together.

Vertical bars shall be held in position at top and bottom and at intervals not exceeding 192 diameters and shall have a minimum clearance of ½" from masonry.

The longitudinal bars horizontal reinforcement shall be completely embedded in mortar or concrete. Reinforced mortar joints shall be at least twice the thickness of the reinforcement.

Horizontal wire reinforcement shall be lapped at least 6" at splices and shall contain at least one cross wire of each piece of reinforcement in the lapped distance.

6.5.6. Erection of Loadbearing Blockwalls

The following procedure shall be carried out for the erection of loadbearing blockwalls.

1. Blockwork shall be constructed to a height of 4'-8" approximately or less.

2. Holes shall be made in one face only of the blocks at the bottoms of the voids to be filled.
3. Each void to be filled shall be cleaned out thoroughly by rodding or other approved means and the debris, etc., removed from the holes at the base of the voids.
4. The holes shall then be formed in order to retain the grout.
5. The vertical reinforcement as scheduled shall then be inserted into the voids.
6. Grout as specified shall then be poured into each void to be filled. The pour shall be stopped 1.5" below the top of a course to form a key at the joints.

7. SPECIFICATION FOR STRUCTURAL TIMBER

7.1. GENERAL

The General Conditions accompanying these specifications shall be read by this contractor and each sub-contractor, as they form part of the contract and agreement. The section of General Conditions headed "Scope of Work" defines, in general, the extent of the work included in all sub-contracts.

7.2. SCOPE OF WORK

The work under this contract shall include all labour, materials and appliances necessary to construct all timber joists, rafters, angles, roof boarding and all fixings as detailed on the Supervisor's drawings.

7.3. MATERIAL

Pitch pine shall be *Pinus palustris*, *P elliotti* or *P caribaea* of mature growth free from gross defects, air seasoned and having a minimum density of 720kg/m³ at 25% moisture content. All timber shall be free from splits, wane, rot, fungus, decay or infestation.

7.4. TOLERANCES

All timber shall be sawn to the sections given on the drawings. Permissible tolerance on cross section dimensions will be +6mm and -3mm with no allowance for wane.

7.5. STANDARDS

The following British Standards shall apply in so far as they refer:

ISO Metric Black Hexagon Bolts, Screws and Nuts	BS 4190
Wire nails and cut nails for building purposes	BS 1202
Wood screws	BS 1210
Workmanship and Maintenance	BSCP 112
Preservative Treatment for Constructional Timber	BSCP 98

7.6. NAILS

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

7.7. SCREWS

All screws shall be stainless steel.

7.8. BOLT HOLES

Bolt holes should be large enough to permit easy access for the bolt but may not exceed $D+D/16$ or $D+1.5\text{mm}$, whichever is the larger, where D is the bolt diameter.

7.9. EXCESSIVE MOISTURE

Care should be taken in fabrication to avoid excessive wetting or drying of the timber.

7.10. FIXINGS

All fixings, plates, shoes, rods or straps on the drawing shall be neatly formed using mild steel plate or bars drilled and welded as necessary. Prior to erection all mild steel components shall be ball-shot or sand-blast cleaned to the approval of the Supervisor and/or the Contracting Authority followed by an application of 76 microns of Metalife Metallic Zinc from Belzona Molecular Metalife Ltd, Harrogate HG1 4AY, North Yorkshire, England or equivalent. The Manufacturer's instructions shall be strictly adhered to for the steelwork preparation and protective application. All surfaces in contact with the timber shall be painted a further two coats of bituminous paint.

7.11. TREATMENT

Treat all structural timber against termite attack with an approved preservative.

8. SPECIFICATION FOR PLUMBING

8.1. SUB-CONTRACTORS

The Contractor may sub-contract part or all of the plumbing and drainage works. Where a plumbing sub-contractor is employed, the Contractor shall remain responsible for the execution of the works in accordance with these Specifications.

8.2. GENERAL

The General conditions shall apply to all works in this section and shall be carefully read and adhered to by the Contractor and Plumbing Sub-Contractor.

The Contractor shall ascertain the requirements of the Dominica Water and Sewerage Authority's (DOWASCO) regulations and all relevant bye-laws, and conform thereto but give the Supervisor and/or the Contracting Authority notice of any difference between those requirements and those specified.

The whole of the plumbing and drainage installations shall be carried out by licensed craftsmen to the satisfaction of the Supervisor and/or the Contracting Authority and DOWASCO. All fittings shall be properly stored and protected and shall be left clean and in perfect working condition.

8.3. SITE VISITS

The Contractor shall ensure that any Plumbing Sub-Contractor thoroughly examines the site, location, connections and any system that may affect or tie-in with the works of these specifications and drawings. No additional payment shall be allowed for work resulting from conditions which would have been evident upon a thorough examination.

The site shall be made available for any Plumbing Sub-Contractor's use in accordance with the Contractor's Programme and the Plumbing Sub-Contractor is to work with the Contractor and the other Contractor(s) in organising and arranging the works.

8.4. SCOPE OF WORKS

The intent of the specification and drawings is to cover and include all of the apparatus, appliances, materials and labour necessary to operate effectively. The operating conditions for the plumbing equipment as herein specified including:

- Hot and cold water services, distribution mains, pumps and branches including connections to and from storage tank, gutters and rainwater harvesting tank.

- Soil, waste and venting system, branches, stacks and building drain street connections and sanitary fixtures.

All equipment not specifically mentioned, but necessary for the complete installation shall be furnished and installed by the Plumbing Sub-Contractor.

The Contractor shall install all equipment in strict accordance with the drawings and specifications. They mutually explain and illustrate each other.

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

8.5. CO-OPERATION

Every reasonable effort shall be made by the Contractor to assist any Sub-Contractors in the installation of their work, by finishing his work at such a time so as not to interfere with other work on the building.

The Contractor shall keep on the work during its progress a competent Superintendent and any necessary Assistants, all satisfactory to the Supervisor. The Superintendent shall not be changed, except with the consent of the Supervisor, unless the Superintendent proves to be unsatisfactory to the Contractor or ceases to be in his employ. The Superintendent shall represent the Contractor in his absence and any directions on minor matters given to him shall be held to be given in proper and correct terms to the Contractor.

8.6. CODE, PERMITS, ETC

All materials furnished, and work done shall comply with the International Plumbing Code. The Contractor shall give all necessary notices, file all plans, obtain all permits and pay fees or other costs in connection with his work and shall obtain all Certificates of Inspection, which he shall deliver to the Supervisor.

8.7. TESTS

The entire sanitary system including all drainage, vent and leader lines shall be tested before all such work is concealed and fixtures have been set in accordance with the requirements of the Environmental Health Department.

It may be tested in its entirety or in sections with at least a three-metre head of water. If the test shows defects or leaks, they shall be corrected and the test repeated until the system is water tight.

The entire water supply system shall be tested to the satisfaction of the Supervisor and/or the Contracting Authority and the Environmental Health Department before all such work is concealed and fixtures have been set. It shall be tested with air and proved tight with a constant pressure of 150 PSI maintained for 30 minutes without further addition of air.

After all fixtures are completely set and connected; the Contractor shall adjust the various supply valves, fixtures fittings, etc. so that the proper delivery of water is obtained at all fixtures. Before work is finally completed the Contractor shall make additional adjustments as may be found necessary to leave the job in proper working conditions.

At this time, all fixtures, escutcheons, fittings and nameplates, pipe coverings and finishes in general, shall be double checked by the Contractor and left in a finished and neat condition.

All other tests required by the owner or authorities having jurisdiction shall be made in a manner required by them.

8.8. CUTTING, PATCHING, REPAIRS, ETC

The Contractor shall furnish the Supervisor and/or the Contracting Authority with the sizes and locations of chases and openings in walls, partitions, etc before they are built. The Plumbing Sub- Contractor shall furnish and install, without delay in the execution of the work of other trades, sleeves or boxes in the forms of floor slabs for all his pipes before the slabs are poured.

The Contractor shall do all drilling required for the installation of hangers.

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

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

The Contractor shall guarantee that all work and materials which show defects within one year from the date of acceptance shall be promptly removed and replaced by him without additional cost to the Supervisor and/or the Contracting Authority and that all work so replaced shall be in strict accordance with the drawings and specifications.

Where such defects do occur, the Contractor shall be held responsible for all costs incurred in making the defective work good and all injuries to plaster, wood or other finish caused by such replacement and repairs of defective work shall be replaced in first class condition by the Contractor at his own expense.

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

8.9. EXCAVATION AND BACKFILLING

Excavate so that pipe trenches are straight lines at the required depths, widths and gradients. Thoroughly ram and consolidate trench bottom to the satisfaction of the Supervisor and/or the Contracting Authority before any drain is laid.

Lay drains to minimum fall of 1:40 except where otherwise stated or shown.

Keep drains free from earth, debris, superfluous cement and other obstructions during laying and until the completion of the contract. Drains shall be handed over in clean condition.

Lay pipes with sockets leading up hill and rest on solid and even foundations for the full length of the barrel.

The Contractor shall do all excavation and backfilling necessary to the installation of his work, including the patching and repairing of pavements, shall perform all sheeting and shoring required to perform and protect excavations and to safeguard employees and shall remove from the premises all rubbish and surplus earth occasioned thereby. Trenches shall not be backfilled until the facilities therein have been tested and passed in accordance with procedures described in connection with the particular work and have been accepted as tight. Exercise care when filling trenches, etc in order not to disturb the pipes and fill with selected excavated material and carefully ram and consolidate in layers not exceeding 225 mm thick. Make up depressions on the surface as necessary and leave to the satisfaction of the Supervisor.

8.10. PAINTING

All machinery and equipment that is shipped with a factory finish shall be touched up to repair all damage to the finish.

All exposed lines, hangers and supports shall be cleaned, primed and painted with two coats of paint.

8.11. SLEEVES AND PLATES

Furnish and install pipe sleeves for all lines passing through floors, walls, partitions, roof and foundations. The annular space between the pipe and sleeve shall be caulked and made water tight.

All exposed branch connections to plumbing fixtures shall be provided with chromium escutcheons.

8.12. MATERIALS FOR PLUMBING AND DRAINAGE

8.12.1. PVC Pipes & Fittings

PVC soil and waste pipes and fittings shall comply with BS.4514. PVC water supply pipes and fittings shall comply with BS.4346 Part 1 and BS. 3505. Fittings shall be of solvent-weldable type. PVC drain pipes and fittings shall comply with BS. 3506 Class B.

8.12.2. Polypropylene Pipes and Fittings

Polypropylene waste pipes and fittings shall comply with BS. 5254

8.12.3. Traps

Traps shall comply with BS. 3943.

8.12.4. Bends and Tees

All bends shall be easy sweep bends or easy right-angle bends. No elbows shall be used on rainwater or sanitation pipes. All tees shall be pitcher tees.

8.12.5. Brass Work

Brass stop valves and draw off taps shall be of screw down pattern complying with BS.1010 Part 2. Brass draining taps shall comply with BS. 2879. Brass body ball valves shall be of piston type complying with BS. 1212 Part 1.

8.12.6. Manhole Covers

Manhole covers and frames shall comply with BS. 497.

8.12.7. Jointing Materials

Jointing and caulking compounds, cements, gaskets, washers and other jointing materials shall be of the types recommended by the manufacturer of the pipes being fitted.

8.13. PLUMBING AND DRAINAGE WORKMANSHIP

8.13.1. Pipe Work Generally

Pipes shall be in the maximum lengths possible to avoid unnecessary jointing. The Contractor shall allow in his price for all straight couplings between lengths of pipes.

8.13.2. Falls of Pipe

Pipes shall be fixed to sufficient falls to prevent air locks and to enable the system to be drained through the draw-offs and drainage taps provided.

8.13.3. Cutting of Pipes

Pipe ends shall be cut clean and square, using equipment appropriate to the material.

8.13.4. Jointing Material

Jointing Material must not be allowed to project into the bore of pipes, fittings or appliances.

8.13.5. Sanitary Appliances

Fix sanitary appliances in accordance with the manufacturer's recommendations, using fastenings supplied by the manufacturer. Retain protective coverings until practical completion. Do not use appliances for preparing materials or for washing tools.

8.13.6. Trenches for Pipes

The bottom of trenches shall be graded and compacted to the correct falls. Over excavation shall be filled to the correct level with concrete or granular material as instructed by the Supervisor. Backfill shall be carried out using the material specified in layers not exceeding 12" thick.

8.13.7. Pipes Insulation

Were specified; insulation should be fully glued together and securely duct taped. Thermal insulation should be Armaflex for 1" wall thickness and pipe noise insulation should be from Acoustical Surfaces, Inc. or approved equivalent.

8.13.8. Defects

Each pipe shall be carefully examined on arrival and any defective pipe shall not be used and shall be set aside and clearly marked.

8.13.9. Taps and Stopcocks

Bib and Pillar taps and stopcocks shall conform to BS 1010:1959.

8.13.10. Make Good

Include in tender for fixing all pipes, fittings, sanitary appliances, etc and for making good the surfaces to which they are affixed including forming all holes, chases, etc.

8.13.11. Builder's Works In Connection

The materials and workmanship required for general builder's work in connection with these installations shall be in so far as they are applicable, all as described under the various section headings.

9. SPECIFICATION FOR PIPES & PIPEWORK FOR DRAINAGE

9.1. TRENCH EXCAVATION

The excavation is to be carried out to the lines shown on the drawings or to such other dimensions the Supervisor and/or the Contracting Authority shall supply. The bottom and sides of all excavations shall be trimmed so that pipes can be bedded without filling and the sides tapered in such a way that the horizontal dimensions of the top of the excavation exceed those of the bottom by at least 2". Should the excavations be taken below the required level, the difference in level shall be made up in material and in a manner as directed by the Supervisor.

Trenches shall be excavated to the lines required and to levels that will allow for the pipe wall thickness and bedding thickness, and to widths that will allow proper and efficient jointing to be carried out in clean and dry conditions. Trench bottoms shall be compacted by ramming before any pipes are laid.

The trench excavation and filling in shall be so executed that all walls, roads, sewers, drains, pipes, cables, structures, places and things shall be reasonably secure against risk of subsidence or injury and shall be carried out to the satisfaction of the authorities concerned.

Where trenches pass from a footway to a roadway or at other positions where a change of level is necessary, the bottom of the trench shall rise or fall gradually. The rate of rise or fall shall be approved.

Unless otherwise agreed, provision shall be made during excavation and until restoration has been completed, for reasonable access of persons and vehicles to property or places.

9.1.1. Excavated Material

The materials excavated from each trench shall be so placed so as to prevent any security risk, or nuisance or damage to adjacent ditches, drains, fences, gateways and other property or things. Excavated material shall be stacked so as to avoid undue interference with traffic. Where, owing to traffic or for reasons of safety or other considerations, this is not permissible, the excavated material shall be removed from the Site and, if necessary, returned for refilling the trench on completion of laying; surplus material shall be disposed of by and at the cost of the Contractor.

9.1.2. Timber Left and Built In

Where required for the security of the Works or adjacent buildings or structures, timber installed for the support of trenches, joint bays, headings, tunnels, etc., shall not be withdrawn but shall be left in position.

9.1.3. Inspection

All excavations shall be inspected by the Supervisor and/or the Contracting Authority before any pipe and/or concrete is placed and the contractor shall give the Supervisor and/or the Contracting Authority at least 48 hours' notice that such an inspection will be required.

9.2. PIPE WORK

The Contractor shall construct pipelines, drains, and the like to the lines and levels required. He shall provide the materials in accordance with the specifications.

The types of pipes proposed for each system shall be approved by the Supervisor. All pipework shall be installed strictly in accordance with the manufacturer's instructions.

Exposed PVC pipe is to be coated with two layers of exterior water based latex paint to protect the pipe from UV oxidation.

9.2.1. PVC pipes

PVC pipes for gravity sewers and effluent pipe shall have solvent elastomeric ring joints and shall conform to BS 4660 or ASTM D3034 or approved equal.

9.3. SOAKAWAYS AND SEPTIC TANKS

Soakaways and septic tanks shall be provided as set out on the site plans and constructed in accordance with the civil works drawing.

9.4. LAYING AND JOINTING PIPES – GENERAL

At all times a minimum cover of 1' shall be maintained to the top of pipes, except under trafficked areas where the cover shall be 2' unless the pipes are to be surrounded with concrete, when the cover may be reduced. Where pipes pass under roads, they shall have a 6" thick concrete surround made of 1:3:6 concrete.

All pipe systems shall be laid to true and even falls. The Contractor shall supply and fix in all pipe runs, all necessary bends, tees, tapers, valves, hydrants and other specials and shall carry out all necessary cutting, coring, drilling holes, jointing and connecting to new and existing work.

All joints shall be made in accordance with the manufacturer's instructions and recommendations, and with BS 8301 and BS 6700. Surplus joint material shall be removed from inside and outside pipes where necessary. Joints or gaskets of natural rubber will not be approved. After laying and jointing the pipes they shall be tested.

9.4.1. Bedding and Surrounding Pipes

Pipes generally, unless bedded on concrete, shall be bedded on a layer of sand 6" thick under the barrel of the pipe. The pipes shall first be checked to ensure that there are no stones or other obstructions inside and then laid in the trench so that they bed evenly throughout their whole length.

Where indicated or ordered, pipes shall be bedded and surrounded with concrete 6" thick. Concrete surrounds in the vicinity of joints shall not be placed until the pipes have been tested and approved by the Supervisor.

All points at which lateral thrust will be experienced, such as at tees and bends shall be secured with concrete thrust blocks.

9.4.2. Backfilling

Backfilling shall not be commenced until the relevant length of pipe has been approved by the Supervisor. Where pipes are not surrounded by concrete, they shall be backfilled with approved sand to a thickness of 6" over the pipe barrel and then with approved material, which shall exclude sharp or excessively heavy material. Backfilling shall continue in layers not exceeding 12" thick. Material shall be compacted to the Supervisor's approval.

Where the trench bottom is excavated in rock then the rock shall be excavated 6" deeper, and 6" of fine granular material shall be put down to form a bed for the pipes.

Backfill to pipes that are surrounded by concrete shall be of approved material devoid of heavy stones.

All backfill shall be thoroughly compacted in layers to a density appropriate to the material through which the pipeline runs.

9.4.3. Testing

All foul drains shall be tested for water tightness in accordance with BS 8301. The Contractor shall provide all equipment, anchors and the like necessary for testing and shall carry out all tests to the satisfaction of the Supervisor.

During the testing the backfilling of the trenches shall be complete except that the joints of the pipe and fitting shall remain exposed for visual inspection. Upon satisfactory completion of the test the remainder of the backfilling shall be undertaken in the same way as described in Clause 5 above.

9.5. RODDING DRAINAGE PIPELINES

Provision is to be made for rodding all pipelines. For this purpose, manholes for buried pipelines shall be not greater than 330' apart. Pipelines above ground level shall have access plates on each bend or junction. Each rainwater down pipe is to have an access plate 30" above ground level.

9.6. TRENCHES UNDER ROADS

All trenches for services, drains and the like, in or adjacent to the roads or surfaced areas shall be completed, backfilled and compacted before the sub-base is laid. The Contractor shall satisfy the Supervisor and/or the Contracting Authority as to the proper consolidation of all backfilling in trenches. Any subsidence shall be made good and tested to the Supervisor's satisfaction. Damage to the road or surfaced area foundation due to subsidence of trench filling shall be made good at the Contractor's expense. The material employed shall be non-plastic and to the Supervisor's satisfaction.

The bottoms of all trenches shall be trimmed to grade and level and thoroughly consolidated by ramming before any bedding is placed or pipes laid.

Material less than 12" above the top of the pipes shall be thoroughly compacted in layers of selected fine material not exceeding 6" using hand rammers.

Material more than 12" above the tops of pipes and all material around and over manholes etc, shall be compacted in layers by power operated rammers so that a minimum of 95% of Modified Proctor maximum dry density of the material is achieved throughout.

Where in the opinion of the Supervisor and/or the Contracting Authority backfilling is unsatisfactory, it shall be removed and replaced in accordance with the Specification.

The requirements of this clause shall apply outside the road pavement for a distance of 8' from each kerb line.

10. SPECIFICATION FOR ELECTRICAL WORKS

10.1. SUB-CONTRACTORS

The Contractor may sub-contract part or all of the electrical works. Where an electrical sub-contractor is employed, the Contractor shall remain responsible for the execution of the works in accordance with these Specifications.

10.2. GENERAL

The electrical installation shall be carried out in accordance with the "Requirements for Electrical Installations", IET Wiring Regulations (17th Edition 2011) published by the Institution of Engineering and Technology and BSI (UK), hereinafter referred to as the I.E.T. Regulations, also relevant in accordance with the American NEC, e.g. article 333 and in accordance with the local Electricity Supply Regulations.

The Contractor shall provide any small item of work not specifically called for but required to complete the intended installations.

Builders' work which is considered normal for the trade may be included in any Sub-Contract.

The Contractor shall allow for co-coordinating his work with the installation of the ceilings. for correctly fixing surface mounted light fixtures onto the ceilings. Ceiling heights shall in general be as indicated on drawings but exact ceiling heights shall be agreed at the time of installation.

For all holes and openings in structural concrete work, the Contractor shall submit the necessary information and drawings to the Supervisor and/or the Contracting Authority in sufficient time for review.

In all other materials, the Contractor shall make his holes and arrangements necessary for fixing and routing his own installations.

The drawings show general location of electrical items, the exact locations of items shall be to the approval of the Supervisor, and shall reflect symmetry and aesthetics, throughout.

Any doubt as to the full intent of the drawings or Specifications shall be resolved by the Contractor prior to completion of the Tender.

Notwithstanding any dimensions which may be given on the drawings, the Contractor shall check, at his own expense, all dimensions required for the manufacture of any materials or products.

The Contractor shall refer any such discrepancies to the Supervisor and/or the Contracting Authority before assuming a particular interpretation.

The Supervisor and/or the Contracting Authority reserves the right to approve the quality of material and workmanship, to call for any test which they deem necessary during the progress of the work and a complete test on each system as specified elsewhere in this document at the completion of the works.

10.3. SITE VISITS

The Contractor shall require any Electrical Sub-Contractor to visit the site and make himself thoroughly acquainted with all matters affecting the price, particularly in respect of, but not limited to, access, storage area, and security as no claims shall be allowed for him not having done so.

The Contractor shall require any Electrical Sub-Contractor to thoroughly examine the site, location, connections and any system that may affect or tie-in with the works of these specifications and drawings. No additional payment shall be allowed for work resulting from conditions which would have been evident upon a thorough examination.

10.4. ISOLATORS

Isolators shall be of the appropriate voltage rating and shall be clearly marked with their "current ratings".

The isolators shall be of 4 pole, 3 pole or 2 pole type as appropriate.

The isolators shall be of the quick break type.

Isolators shall be supplied complete with the corresponding HRC fuse links whenever specified.

10.5. DISTRIBUTION BOARDS

All switchgear, distribution panels, distribution boards, circuit breakers, cable and earthing system provided for these services shall be consistent with the design and manufacture of similar equipment detailed under relevant clauses in these specifications.

The supply of these services shall be distributed through distribution boards fitted with miniature circuit breakers or residual circuit breaker with overcurrent protection device. All distribution boards shall have spare ways and due allowance made for future extension facilities.

All distribution boards shall be single phase or three phase as specified elsewhere with neutral bar and main switch, incomer circuit breaker or switch. These shall be of an approved manufacturer.

Distribution boards shall be of the flush or surface pattern as specified elsewhere in heavy sheet-steel cases of the 600-volt range with miniature circuit breakers.

On all three phase distribution boards the number of neutral and earth terminals to be provided shall be the same as the total number of single-phase ways in the board.

The outer doors of all distribution boards shall be lockable either by means of a barrel type lock with detachable key and inner doors or by means of a modified door fixing screw.

Ample clearance shall be provided between live parts and the sheet-steel protection to allow cables to be brought to their respective terminals in a neat and workmanlike manner.

To separate opposite poles, a fillet of hard incombustible insulated material shall be provided of sufficient depth to reach the inside of the door.

The Electrical Sub-Contractor shall supply and install the distribution boards complete with miniature circuit breakers, and residual circuit breakers with overcurrent protection as on drawings. These shall be of an approved manufacturer.

10.6. CONDUIT

The whole of the various installations described for the building shall be carried out in medium gauge PVC conduit unless otherwise specified. No conduit less than 20 mm diameter will be permitted.

Where metal EMT conduit is specified, it shall be supported by approved supports spaced at 5-foot intervals. The necessary accessories and fittings for the proper installation of the EMT conduit shall be installed where required as per international norms.

Conduit runs or drops shall be recessed into walls or slabs or concealed in voids.

Horizontal and diagonal runs of flush conduits on structural or partition walls will not be permitted. All flush conduit shall drop or rise vertically to their respective points.

The ends of the conduit shall butt solidly in all couplings. Where they terminate in fuse-switches, distribution boards, switch and outlet boxes, trunking etc., they shall be connected thereto by means of appropriate PVC adaptors.

PVC conduit not exceeding 25 mm in diameter may be bent cold by means of the appropriate spring with larger sizes of conduit, only factory-made bends shall be utilised.

A 90° bend shall have an inner radius of not less than five times the outside diameter of the tube.

All bends shall be made on site to suit conditions and not more than two right angle bends will be permitted without the interposition of a draw box. No tees and elbows, either of inspection or solid type will be permitted.

Care shall be taken to prevent ingress of water, dirt, rubbish and concrete grout into the conduit system during erection. The Contractor shall provide PVC tube ends, or flexible covers to protect open ends. Joints between conduits and conduit fittings shall be water tight and shall be made by means of solvent adhesive in an approved manner. Care shall be taken to ensure that the conduit runs are clean and free from damp and grease and in particular dust, mould and oil.

Conduit in ceiling cavities shall be supported independent of the suspended ceilings. All conduits shall be securely fixed to the slab or structural member of the ceilings (not lay loose over the ceilings). Conduit boxes shall be fixed to the structure of the building independently of the conduit.

Where surface conduit is required, it shall be fixed by means of distance saddles. Saddles shall be fixed on each side of every bend at 300 mm maximum from the point on intersection of the centre lines of the conduits. Vertical conduit runs shall have saddles at 300 mm maximum from their point of emergence from floor or ceilings. All saddles shall be fixed consistent with the requirements of appropriate spacing and appearance.

All conduit accessories, switch boxes socket outlet boxes and all associated apparatus used in the conduit installation of metal type must be galvanised.

Recessed conduit buried in concrete grout or plaster shall permit a full 7 mm minimum depth of cover over its entire length.

Particular care shall be taken when setting out conduit runs to outlet points where they are fitted to desks, counters, kitchen fittings, etc. The Contractor shall ascertain exact details of desks, counters, kitchen fittings construction and or locations in order that all conduit work shall wherever possible be concealed.

All conduit systems shall be erected completely with all conduit accessories connected. It shall then be offered for inspection and approved by the Supervisor and/or the Contracting Authority before any cables are installed and before any concrete pouring or screeding operations.

Where conduits are laid on floor slabs etc., the Contractor shall arrange for a competent person to be in attendance whilst the concrete screeding operation is being carried out, in order to avoid damage being caused to the conduits, and also to ensure that the conduits are in sound condition, and are properly and efficiently maintained during this installation period.

Additional protection, such as kick-boards, barriers, etc., shall be provided at any point where PVC conduits and trunking are likely to suffer mechanical damage.

The 415/240 Volt general power system, computer/telephone system and Fire System shall have individual conduit systems reserved exclusively for their cables.

Galvanised draw wires or other approved types shall be provided where conduits are to be wired on completion or to be wired by others.

The computer system, telephone system, CATV system shall share the same conduit System.

10.7. FLEXIBLE CONDUIT

Connections to any motors or machinery run in conduit shall be made using an appropriate length of watertight flexible conduit from the isolator. The conduit shall be of an approved type and manufacturer.

Flexible conduits shall be terminated with couplings and connections from the conduit manufacturer, specially made for that purpose.

10.8. TRUNKING

Trunking body and lids shall be extruded from high impact, self-extinguishing rigid PVC complete with all trunking accessories. Colour of trunking to be approved.

Where metal trunking is specified, it shall be supported by approved supports, spaced at 5-foot intervals. The required fittings shall be used in the installation as per international norms.

10.9. CABLE AND CONDUCTORS

All cables shall be of the standard high conductivity copper type. PVC or XLPE insulated only, and PVC-sheathed cables shall be 600/1000 volt grade to BS

6004:1969. Single wire armoured cable shall be 600/1000 volt grade to BS 5467:1969, and all cables shall carry the BASEC seal of approval.

All cables shall be delivered to site on reels, with seals and labels intact and shall be of one manufacturer throughout the installation.

The cables shall be installed direct from the reels and any cables which have become kinky, twisted or damaged in any way, shall be rejected. The installation shall be wired on the loop-in system i.e. wiring shall terminate at definite points and no intermediate connections or joints shall be permitted. Cables shall not pass through or terminate in lighting fittings.

Where it is necessary to make direct connection between the hard wiring and the flexible cord, this shall be done by means of screw type conical wire connectors.

The terminations shall be suitable for the type of terminals provided and shall be either compression lugs of appropriate size or eyelet or crimped type cable terminations, all of a reputable manufacturer. Shake proof washers shall be used where connection to vibrating equipment is made.

Under no circumstances shall cable cores be larger than terminal holes. For all single connections, they shall be double or twisted back on themselves and pinching screws shall not be permitted to cut the conductors. Cables shall be firmly twisted together before the connection is made. In no circumstances shall cable be trapped under plain washers as a termination.

All cables shall be coloured in accordance with the I.E.E. Regulations.

Only two cables shall generally be bunched together at one terminal. In exceptional cases three cables may be bunched together at one terminal as given on site, but this must meet the approval of the Supervisor.

10.10. LIGHTING

The lighting system shall provide adequate illumination of all parts of the contract area.

Lighting apparatus shall be of top quality, designed to ensure satisfactory operation and service life under all reasonable variations of load, frequency, voltage, and temperature.

10.11. LIGHTING FITTINGS

All light fixtures shown and listed elsewhere in this document shall be provided and installed. The installation of light fixtures shall include all necessary assembling, wiring and erection, and putting to work.

Fluorescent light fixtures shall be complete with rapid start control gear and bi-pin lamp holders, except where otherwise specified.

LED lights and fixtures must be approved by the Supervisor.

The fixture shall be of the High P.F. type.

All emergency lights shall be self-contained, 3-hour type fittings. The finish shall be ordered to match ceiling or wall finishes as approved by the Supervisor.

All lighting luminaires shall be suitable for power supplied specified with a + 10% variation in voltage.

10.12. LIGHTING SWITCHES

Lighting switches shall be rocker operated, of 240-volt rating, with at least 6 amps rating as specified on drawings.

All lighting switches shall be as Crabtree Electrical Industries Ltd.'s or approved equivalent. All switches shall be of an approved colour.

Switches shall be one way, two way or intermediate as required and generally where mounted together they shall be fitted in one box.

Galvanised switch boxes shall be fitted with earth terminals.

No more than one phase shall be connected in a switch assembly.

10.13. SOCKET OUTLETS

Socket outlets shall be of 240-volt range, 13-amp switch type, with rocker operated switch mechanism for the 240-volt system, and as approved for the 240-volt system.

Socket outlets for 240-volt general power shall be of standard 3-pin type. Socket outlets shall normally be of switched type, unless stated otherwise.

Socket outlet boxes shall be galvanised and fitted with earth terminals.

All socket outlets shall be provided with appropriate and approved type plugs and shall be of 2 gang type unless specified otherwise.

All 240-volt socket outlets shall be as Crabtree Electrical Industries Ltd.'s or an approved manufacturer of an approved colour. Any 110V socket outlets shall be of similar manufacturer and colour, and of the 15A 127V American Standard socket outlet.

10.14. BONDING AND EARTHING

Great care is to be taken in bonding and earthing the installation and tests are to be carried out as the work progresses to check the electrical continuity of metal work and earth continuity conductors.

The Contractor shall be responsible for the bonding and earthing of all exposed metal work structural or otherwise, and of the metalwork of any gas or water services, to the earthing termination at the intake position, in accordance with IET Regulations.

Earth continuity conductors shall not be less than 6mm sq. copper cable-insulated, and must be coloured.

10.15. GREEN / YELLOW

Where an earth electrode is required, it shall take the form of copper clad steel rods 20mm x 2440mm driven into the ground at a spacing not less than 2.5 m. The number of rods driven shall be determined according to the soil resistivity at the site to give an earth resistance not exceeding 5 ohms.

The Electrical Sub-Contractor shall measure earth resistance with an earth megger tester to ascertain that earth resistance are well within specified values in the presence of the Supervisor.

Concrete Inspection Covers shall be provided over every earth electrode and a means shall be provided for disconnecting the bonding cable from every electrode.

Connection between electrodes shall be carried out in bare stranded copper conductor of a size approved by the Supervisor.

Connection to the Electrode System from the main earth bar on distribution panels shall be carried out in insulated single core copper conductor coloured green/yellow of the specified size.

The earthing system shall be discussed with the Supervisor and/or the Contracting Authority and shall be to his approval.

10.16. CIRCUIT / EQUIPMENT IDENTIFICATION

At each distribution board a circuit list shall be supplied and installed on the distribution board door. The list shall state the type and location of fixtures on a particular circuit. The circuit labelling shall be typed on heavy quality plain paper laminated between clear plastic sheets.

On the cover of each three-phase distribution board and isolator, red-white lamacoid labels, with 8 mm high characters "415 volts" shall be fixed. On the covers of all isolators 45 mm x 20 mm lamacoid labels shall be fitted with 5 mm high characters giving details of service position.

The Contractor shall identify wiring with permanent identifying markings by number on both ends of the phase conductors and other circuit wiring.

The Contractor shall maintain phase sequence and colour coding throughout.

The Contractor shall use colour coded wires in control and communication cables, matched throughout the system.

The Contractor shall identify electrical equipment with nameplates and labels to Specifications.

10.17. TESTING AND COMMISSIONING

Continuity and insulation tests shall be carried out during the installation.

Before the works are taken over by the Supervisor, the Contractor shall conduct and pay for all tests specified including tests of:

- All grounding systems
- Earth loop impedance
- Equipment insulation
- Bonding
- Polarity
- Phase sequence
- Continuity and insulation resistance tests on entire insulation
- Protective devices
- Lighting
- Loading
- Signal circuits and systems

The Contractor shall carry out the tests in the presence of the Supervisor.

The Contractor shall provide instruments, meters, equipment and personnel required to conduct the necessary tests during and at conclusion of project.

The Contractor shall submit test results to the Supervisor and/or the Contracting Authority within three (3) days after these tests are conducted.

The Contractor shall give to the Supervisor, in writing, 10 days' notice of the date after which tests on completion, will commence. Unless otherwise agreed, the tests shall take place within 5 days of the said date on such day as the Supervisor and/or the Contracting Authority shall, in writing, notify the Contractor.

The Contractor shall repeat within a reasonable time, the appropriate tests on any portion of the works which had failed to pass the said tests and bear all reasonable expenses to which the Supervisor and/or the Contracting Authority may be put by the repetition of the tests.

The Electrical Sub-Contractor shall carry out the tests in the following sequence:

- I. Visual Inspection
- II. Continuity of branch circuit conductors
- III. Continuity of protective (grounding) conduction.
- IV. Earth electrode resistance
- V. Insulation resistance - use 1000 V megger.
- VI. Insulation of site-built and factory- built assemblies
- VII. Protection by electrical operation
- VIII. Insulation of non-conducting floors walls
- IX. Polarity
- X. Earth fault impedance
- XI. Earth leakage protective device
- XII. Phase sequence
- XIII. Prospective short circuit current to terminal and intermediate equipment.
- XIV. Load Balance:
- XV. Submit, at completion of work, a report listing all phases, and neutral currents on relevant panel boards operating under normal load. State hour and date on which load was measured and voltage at time of test.

10.18. WARRANTY & SERVICE

The Contractor shall replace or repair without cost to the owner, any and all parts in the entire system covered by this specification, due to faulty workmanship, design or materials, for a period of one year from the date of acceptance of the system.

10.19. CERTIFICATES FROM GOVERNMENT AGENCIES

The Contractor shall submit to the Supervisor and/or the Contracting Authority the appropriate Certificates of Acceptance/Approval from the relevant Government Agencies on completion of the works.

10.20. OPERATION AND TEMPORARY SERVICES

Power or Service cannot be interrupted without the Supervisor's written approval. Any power interruption necessary for change-over must be applied for at least 48 hours ahead of time.

10.21. CERTIFICATE OF PRACTICAL COMPLETION

When the Contractor has demonstrated to the Supervisor and/or the Contracting Authority complete satisfaction that the works are operating as intended within the design limits and tolerances of the manufactured items, the Supervisor and/or the Contracting Authority shall issue a Certificate of Practical Completion subject to the clearance of any outstanding items or defects within 14 days of the date of the certificate.

Responsibility for the operation will pass from the Contractor to the Supervisor and/or the Contracting Authority or as otherwise agreed with the Supervisor as soon as all the items have been cleared to the Supervisor's satisfaction.

10.22. CERTIFICATE OF MAKING GOOD DEFECTS

The Contractor shall carry out a thorough detailed examination of the installation between the eleventh and twelfth month of the defects liability period and shall put right any outstanding defects.

On completion of such works and on agreement that the Conditions of Contract and Specifications have been met, the Supervisor and/or the Contracting Authority will issue a Certificate of Making Good Defects.

10.23. MANUALS AND DRAWINGS

The Contractor shall supply the following documents along with the as-built drawings specified in Section 1.

- 2 Copies - installations Manual and Electrical Wiring Diagrams
- 2 Copies - Parts Manual
- 2 Copies - Operations and Maintenance Manual

10.24. WARRANTY OF INSTALLATION

All equipment shall be warrantied for a minimum period of 12 months from the date of commissioning.

11. SPECIFICATION FOR FIXTURES AND FINISHES

11.1. PAINT FINISHES

11.1.1. Materials

Materials shall be as described on the drawings.

The Contractor shall deliver all painting materials to the work site in original containers with seals and labels intact. Containers shall not be opened until after they have been inspected by the Supervisor.

Prepared material shall be used without cutting or diluting except as specified herein or as directed by manufacturer and approved by the Supervisor.

11.1.2. Workmanship

All work shall be done by qualified painters in a neat and workmanlike manner. All work which shows carelessness or lack of skill in execution or is defective due to any other cause will be rejected. Such work shall be redone to the satisfaction of the Supervisor and/or the Contracting Authority prior to acceptance of work.

11.1.3. Application

Unless specified otherwise, paint shall be applied by brush or spray.

Paint shall be applied only on thoroughly clean and dry surfaces, unless specified otherwise. Paint shall not be applied in extreme heat, cold, damp or humid weather, or in dust- or smoke-laden air.

Paint materials shall be kept sealed or covered when not in use. Oily rags or waste shall be kept in covered containers and disposed of at frequent intervals.

If brushes are used, they shall have sufficient body and length of bristle to spread paint in a uniform coat. Rollers shall be lint free. Paint shall be evenly spread and thoroughly brushed out and no residual brush marks shall remain. On surfaces which are inaccessible for brushing, paint shall be applied by spray or other means as approved by the Project Supervisor.

If a spray method is used, the operator shall be thoroughly qualified in use of the equipment required. Air compressors employed in spray painting shall be equipped with suitable trapping devices to keep water, oil, and other impurities from entering air lines. Runs, sags, thin areas, or other imperfections in the paint coat shall be considered as cause for rejection and the Contractor shall be required to make all necessary corrections to the satisfaction of the Supervisor.

11.1.4. Paint Systems – Concrete and Rendered Blockwalls

Cement render or concrete shall be aged to at least 3 weeks before the application of the paint system.

Blockwalls and concrete shall be rubbed with a flat stone to remove pitted elements.

All surface defects shall be repaired to the approval of the Supervisor. Cracks shall be filled with filler or caulk and surfaces shall be cured for a minimum of seven (7) days thereafter.

Surfaces shall be cleaned with a commercial cleaner to remove all grease, oil, and chemical residues and thoroughly rinsed with water.

Primer	1 coat concrete primer applied at a rate of no less than 300 sq ft / gallon to fully cover the surface, or in accordance with the manufacturer's recommendation.
Finish Coat – Interior Walls and Ceilings	2 coats of interior flat emulsion in the colour specified on the drawings.
Finish Coat – Exterior Walls and Ceilings	2 coats of exterior flat emulsion in the colour specified on the drawings.

Minimum drying time between prime coat and finish coat shall conform to the manufacturer's recommendations.

11.1.5. Paint Systems – Interior Doors, Kitchen Cabinets and Closets

All surface defects shall be repaired to the approval of the Supervisor, and surfaces shall be cured a minimum of seven (7) days thereafter.

All grease, oil, and chemical residues shall be thoroughly removed.

Primer	1 coat of approved primer applied at a rate of no less than 300 sq ft / gallon or in accordance with the manufacturer's recommendation.
Finish Coat	2 coats of gloss emulsion in the colour specified on the drawings or as specified by the Supervisor and/or the Contracting Authority.

Minimum drying time between prime coat and finish coats shall conform to the manufacturer's recommendations.

11.1.6. Paint Systems –External Doors

All surface defects shall be repaired to the approval of the Supervisor, and surfaces shall be cured a minimum of seven (7) days thereafter. All grease, oil, and chemical residues shall be thoroughly removed.

Primer	2 coat of wood primer applied at a rate of no less than 250 sq ft / gallon or in accordance with the manufacturer's recommendation.
Finish Coat	2 coats of gloss enamel in the colour specified on the drawings

Minimum drying time between prime coat and finish coats shall conform to the manufacturer's recommendations.

11.1.7. Protection

The Contractor shall protect freshly painted or epoxied surfaces from accumulation of dust, dirt, water, or other foreign materials, whatever the cause or source. Any damaged surfaces shall be wiped clean, sanded, or stripped to a clean, dry condition and recoated to satisfaction of the Supervisor.

The Contractor shall protect all parts of the work site during his operation. Tarps and cloths shall be placed where required to protect floors and equipment from spatter and droppings. Electrical fixtures, hardware, glass, and all other items not to be painted or epoxied shall be removed, covered, or otherwise protected during coating operations.

The Contractor shall clean or otherwise restore any surfaces which are painted or epoxied as a result of the Contractor's failure to provide proper protection and said restoration shall be performed to the satisfaction of the Supervisor.

11.2. TEXTURED WALL AND CEILING FINISHES**11.2.1. Materials**

The Contractor shall deliver all materials to the work site in original containers with seals and labels intact. Containers shall not be opened until after they have been inspected by the Supervisor.

All internal surfaces shall be primed with a concrete primer prior to the application of paint or textured finishes.

The materials shall be painted or Toweltex textured finish or Trowel Plastic textured finish, or similar approved, of grade and colour specified on the drawings.

The prepared material shall be used without cutting or diluting except as specified herein or as directed by the manufacturer and approved by the Supervisor.

11.2.2. Workmanship

All work shall be done by qualified operatives in a neat and workmanlike manner. All work which shows carelessness or lack of skill in execution or is defective due to any other cause will be rejected. Said work shall be redone to the satisfaction of the Supervisor and/or the Contracting Authority prior to acceptance of work.

11.2.3. Application

All cracks, crevices, depressions and surface defects shall be rectified to a specification approved by the Supervisor and/or the Contracting Authority and shall be cured to a minimum of seven (7) days thereafter. Surfaces shall then be cleaned with steam or with a commercial cleaner to remove any grease, oil, and chemical residues and then thoroughly rinsed with water.

The surfaces shall be dry and cool. Materials shall not be applied to walls under direct sunlight.

The Contractor shall first apply one even coat of Trowel Plastic Multi-Surface Primer, or similar approved, to the walls and ceilings, followed by one coat of Trowel Plastic or similar approved.

Materials shall be kept sealed or covered when not in use in a shaded area.

11.3. TILING

11.3.1. General Requirements: Sub-Surfaces and Preparations by Other

The Contractor shall ensure that all work in or behind tiles shall be installed before tile work is started, including but not limited to door frames and electrical installations.

The slab surface or masonry walls shall be sound, well cured, dimensionally stable, and free of cracks. Any damage, or loose or uneven areas must be repaired, patched and levelled to meet the requirements of these Specifications. Repair methodologies shall be submitted for approval by the Supervisor and/or the Contracting Authority prior to commencement of repairs.

Where the substrate does not comply with the Specification for Reinforced Concrete, it may be prepared for direct application of mortar and tile by mechanically scarifying to completely expose uncontaminated backing surface, to ensure that tiles installed have enough bond strength.

Floor Deflection

Floor areas shall not have a deflection greater than 1/360 of the span when tested per ASTM C627. Make allowance for live load and all dead load, including weight of tile and setting bed.

Wall Verticality

The plane of wall surfaces to receive ceramic tile shall be plumb, level and true with square corners, with variations not exceeding ¼" in 10 feet (6mm in 3m) from the required plane.

11.3.2. Workmanship, Cutting and Fitting

The Contractor shall centre and balance areas of tile, if possible.

An excessive number of cuts shall not be made. Usually, no cuts smaller than half size shall be made. Make all cuts on the outer edges of the floor area.

Edges shall be smooth cut. Tiles shall be installed without jagged or flaked edges.

The splitting of tile is expressly prohibited, except where no alternative is possible.

The Contractor shall maintain the heights of tilework in full courses to the nearest obtainable dimension where the heights are given in feet and inches and are not required to fill vertical spaces exactly.

11.3.3. Materials

- Ceramic tiles shall conform to ANSI A137.1. All tiles shall be Standard Grade.
- Dry set mortar shall comply with ANSI A118.1.
- Water for use in the installation shall be clean and potable.
- Tile grout shall comply with ANSI A118.6 or ANSI A118.7.
- Dry-set mortars which are labelled for use with particular types of tiles such as wall tile, ceramic tile, mosaic tile, paver tile or quarry tile are required to pass only the requirements of those tiles and shall be used to set only the types of tile for which they are intended.
- Tiles shall be graded and containers grade-marked in accordance with requirements and minimum grade specification established in ANSI A137.1.
- Types, sizes, colours, patterns, trim shapes, finishes and required characteristics of all tiles shall be as designated on the drawings.
- Packaged materials shall be delivered and stored in original unopened containers with labels intact until time of use. Materials shall be stored and handled in a manner to prevent damage or contamination by water or foreign matter. The packaging label shall indicate the necessary directions for application, instructions for storage, instructions for proper use and expiry date.

- Samples of materials for approval, as they are designated in the project specification, shall be submitted before delivery of material to the project site. Installed materials shall match approved samples within normal industry standards.

11.3.4. Installation

Ceramic tiles shall be installed in accordance with ANSI A108.5 – *Ceramic Tile Installed with Dry-Set or Latex-Portland Cement Mortar*.

Mixing Mortars

Mix dry-set mortars in accordance with the following directions, unless manufacturer's instructions differ:

- Add dry ingredients to recommended amount of water. Mix slowly and thoroughly and let mortar stand for 15 minutes, then remix. Do not speed mix. Do not add water, additional mortar or other ingredients after slaking period.
- Mortar consistency shall be such that when applied with the recommended notched trowel to the backing, the ridges formed in the mortar shall not flow or slump.
- During use, remix mortar occasionally. Additional water or fresh materials shall not be added after initial mixing.
- Mortar shall not be used after initial set.

Method of Installation of Tiles on Walls and Floors.

- Clean surface thoroughly. Dampen if very dry but do not saturate.
- Apply mortar with the flat side of the trowel over an area no greater than can be covered with tile before the mortar skins over.
- Using a notched trowel, of type recommended by the manufacturer, comb mortar to obtain even setting bed without scaping wall or floor.
- Cover surface uniformly with no bare spots and with sufficient mortar to ensure a minimum mortar thickness of 3/32" (2mm) between tile and wall after tile has been beaten into place.
- Tiles shall not be applied to skinned-over mortar.
- Glazed wall tiles shall not be soaked.
- Press tiles into freshly combed mortar, ensuring mortar contact while maintaining joint alignment and spacing. Keep an adequate joint depth open for grouting. Joints shall be in accordance with the tile manufacturer's instructions.
- Average contact area shall be not less than 80%, except on exterior or shower installations where contact area shall be 95% when not less than 3 tiles or tile assemblies are removed for inspection. The 80% or 95% coverage shall be sufficiently distributed to give full support of the tile.

11.3.5. Protection of Tiled Areas

- The Contractor shall close all spaces in which tile is being set, to traffic and other work. The space shall remain closed until tile is firmly set and for at least 72 hours after mortar installation.
- The Contractor shall not permit walking on or working on newly tiled floors, without using adequate protection of the tiled surface.

11.3.6. Grouting

- Install and cure grout in accordance with ANSI A108.10 *Installation of grout*.
- Before grouting, all tiles must be firmly set, all paper and glue removed from face of mounted tiles and all spacers, strings, ropes and pegs removed.
- All foreign material and job site debris shall be removed from the open joints before grouting. Remove excessive mortar in the open grout joints.
- Grouting shall be performed at temperatures no greater than 38°C.
- Machine mixing of grout is preferred to assure a uniform blend. To prevent trapping air bubbles into the prepared grout, use a slow speed mixer.
- Slake for 15 minutes.
- Use caution when grouting glazed ceramic tiles to prevent scratching or damaging the surface of the tile.
- Dampen dry joints prior to grouting, but do not leave puddles of water in the joints.
- Keep an adequate joint depth open for grouting. Force a maximum amount of grout into the joints.
- All grout joints shall be uniformly finished.

11.3.7. Cleaning

- The tiles shall be cleaned upon completion of setting and grouting.
- The Contractor shall comply with the Manufacturer's recommendations for cleaning of tile after grouting.
- Final cleaning shall be done by finishing or polishing with a terry cloth or similar pad.
- Acid or acid cleaners shall not be used to clean glazed tile.

11.4. JOINERY AND CABINETS

11.4.1. Material

Timber shall be thoroughly seasoned and matured, sound, straight, free from warp, sapwood, signs of rot, shakes, large and loose knots, worm holes, waness, defects, high resin content and shall be sawn square and true on all four sides.

Joinery quality timber shall be well seasoned and free from any defects.

The moisture content of timber after kiln drying and air seasoning shall not exceed 6% for timber used internally and 8% for timber used externally.

Preservatives for timber shall be pressure or immersion impregnated.

Timber may contain sound or tight knots on any surface provided that the mean diameter of any one knot does not exceed 20 mm and the knot nowhere occupies more than one sixth of the width of the surface. Samples of each of the approved hardwoods shall be kept on site, stored in such a manner that the colour shall not be affected by sunlight.

All hardwood subsequently used in the Works shall be of the same quality and colour as the approved samples.

Joinery timber shall be of sufficient size and strength for its specific function.

Warping of timber must not exceed the limits set down in BS 4978 or BS EN 14081: Parts 1- 3 for softwood or BS 5756 for hardwood.

Plywood shall comply with BS 5268.

Plywood for external applications or in contact with external surfaces, shall comply with BS EN 314: Part 2, and be equal in quality to class 3.

Plywood for internal applications shall comply with BS EN 313: Part 1, and Part 2 and be equal in quality to Grade 2, Type MR.

Plywood shall be free from end joints (including scarf joints in veneers), overlaps in core veneers, dead knots, patches and plugs, open defects, depressions due to defects in core, insect attack (except isolated pinwork holes through face veneers only), fungal attack and from discolorations differing from that normally associated with species.

Face veneer shall be hard and durable, capable of being finished to a smooth surface and be equal to an approved sample.

Marine plywood shall be manufactured from timber species selected for suitable density, bending strength, impact resistance and surface finishing characteristics.

11.4.2. Workmanship

Framed softwood in carpentry work shall be properly jointed and held together with glue and steel screws or steel nails.

Fixing of hardwood joinery for external applications shall be by means of stainless steel screws unless otherwise specified.

Screw heads in work to be painted shall be properly countersunk and stopped.

Carpentry shall be set to required levels and lines, with members plumb, true to line, cut, and fitted to other construction, scribed and coped as needed for accurate fit.

11.4.3. Protection

All installed joinery products shall be protected until completion of the project.

The Contractor shall ensure that doors, drawers etc., work easily and shall make all necessary adjustments before handing over and during the maintenance period.

Carpentry work, which does not form an essential part of the structural fabric, shall not be executed nor brought onto site until required, unless the Contractor can show that such materials will be adequately stored and protected

APPENDIX A – Quality Samples and Documents

The material samples and information required by this Specification shall be submitted to the Supervisor and/or the Contracting Authority prior to the execution (A) or as a prerequisite for completion (B) of the relevant area of work as indicated below:

Clause		Description
1.8	A	Timeline for completion of setting out works. (Also to be supplied to the Environmental Health Division).
3.3.2	A	Materials used for fill
4.3.2	A	Manufacturer's certificates of test
4.3.3	A	Aggregate samples
8.2.4	A	Roof sheeting fixing details
9.7	A	Plumbing - size and location of chases and openings
11.20	B	Certificates from Government Agencies
12.3	A	Tile, cement and grout samples
13.4.1	A	Samples of hardwood and softwood for joinery

APPENDIX B – Quality Records

The quality records required by this Specification shall be submitted to the Supervisor and/or the Contracting Authority as indicated below. The Supervisor and/or the Contracting Authority reserve the right to request other quality records set out in these Specifications:

Category A:	Records required in advance of commencement of a construction activity. These records will be considered by the Supervisor and/or the Contracting Authority prior to granting approval. Approval of such records constitutes a Supervisor's hold point.*
Category B:	Records required during the course of an activity to demonstrate compliance. Submission of these records constitutes a Contractor's hold point.
Category C:	Certificates required from third parties, suppliers, and specialist manufacturers. These certificates shall be provided before a product is deemed to have been received.
Category D:	Records required on completion of an activity.

Excavations and Granular Fill

Category	Clause	Description
A	3.3.4	Material delivery notes
A	3.3.5	Preliminary tests
A	3.3.13	Laboratory tests
B	3.3.14	Field tests
A	3.5.6	Material delivery notes
A	3.5.7	Tests before construction
A	3.5.83	Tests during construction

Reinforced Concrete

Category	Clause	Description
A	4.3.1	Names of testing authorities
A	4.3.3	Grading tests on aggregates
C	4.3.5	Concrete cube tests, slump tests and compaction factor tests
	4.3.6	Load tests
A	4.4.4	Preliminary strength cube tests
C	4.4.5	Works strength cube tests
B	4.4.8	Ready mixed concrete (delivery note with time of introduction)

		of water)
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Formwork

Category	Clause	Description
D	5.9.3	Date and time of concrete placing

Concrete Blockwork

Category	Clause	Description
C	6.1.4	Testing of blocks

Structural Timber

Category	Clause	Description
A	7.10	Evidence of termite treatment of wood and plywood

Structural Steelwork

Category	Clause	Description
A	8.2.4	Roof sheeting fixing detail proposal

Plumbing

Category	Clause	Description
C	9.7	Tests for leaks in sanitary systems
C	9.7	Tests for leaks in water supply system

Electrical Works

Category	Clause	Description
B	11.14	Bonding and Earthing
A	11.15	Earth Resistance
B	11.17	Testing and Commissioning
D	11.20	Certificate of acceptance from Government Agency

