



NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT (NAVDCP)

ENHANCED RICE PROCESSING AND MARKETING AT SIRIWO

PROJECT DETAILED SPECIFICATIONS

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VOL. 1

SECTION 1

GENERAL AND SPECIFIC SPECIFICATIONS

ENHANCED RICE PROCESSING AND MARKETING AT SIRIWO PROJECT

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GENERAL AND SPECIFIC CONDITIONS

SPECIFICATIONS: GENERAL

PART I: GENERAL

1.1 MATERIALS GENERALLY

All materials used on the works shall be new and of the qualities and kinds specified herein and equal to approve samples. Deliveries shall be made sufficiently in advance to enable samples to be taken and tested if required. No materials shall be used until approved and all materials which are not approved or which are damaged, contaminated or have deteriorated in any way or do not comply in any way with the requirements of this specification shall be rejected and shall be immediately removed from the site at the Contractor's expense.

The Contractor shall provide at his own risk and cost where directed on the site weather proof lock-up sheds (Site store) and make good damaged or disturbed surfaces upon completion to the satisfaction of the Project Manager Nominated Sub-Contractors are to be made liable for the cost of any storage accommodation provided especially for their use.

Means of access to the Site shall be agreed prior to commencement of the work and Contractor must allow for building any necessary temporary access roads for the transport of the materials, plant and workmen as may be required for the complete execution of the works including the provision of temporary culverts, crossings, bridges, or any other means of gaining access to the Site. Upon completion of the works, the Contractor shall remove such temporary access roads; temporary culverts, bridges, etc., and make good and reinstate all works and surfaces disturbed to the satisfaction of the PROJECT MANAGER

1.2 MATERIALS FOR WHICH THERE IS A KENYA BUREAU OF STANDARDS SPECIFICATION

All materials used in the works for which Kenya Bureau of Standards Specification has been published shall conform with the latest edition thereof in every way. The Architect reserves the right to demand that the Contractor shall obtain at his own expense a certificate in respect of any materials to state that it is in accordance with the Kenyan Bureau of Standard Specification.

1.3 SAMPLES

The Contractor shall furnish for approval, with reasonable promptness all samples of materials and workmanship required by the Architect. The Architect shall check and approve such samples for conformance with the design concept of the works and for compliance with the information given in the Contract Documents. The work shall be in accordance with approved samples.

- a) All material samples shall be delivered to the Architect's office with all charges in connection therewith paid by the Contractor.
- b) Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Architect, one for office use and one for the site.
- c) Samples shall be furnished so as not to delay fabrication, allowing the Architect reasonable time for consideration of the sample submitted.

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- d) Each sample shall be properly labelled with the name and quality of the material, manufacturers name, name of the project, the Contractor's name and the date of submission and the specification number to which the sample refers.

1.4 MEASURING AND TESTING EQUIPMENT

The Contractor shall provide the following equipment for carrying out measuring and control tests on the site and maintain in full working order:

- a) Straight edges 2 meters and 4 meters long for testing the accuracy of the finished concrete.
- b) A glass graduated cylinder for use in the silt test of organic impurities in the sand.
- c) Slump test apparatus.
- d) 150 mm steel cube moulds with base plates and tamping rod to B.S. 1881.
- e) Two 30-meter steel tapes.
- f) One dumpy or quickset level and staff
- g) Micrometer

1.5 WATER HARVESTING

- 1. The contractor shall supply and install an approved PVC water tank, complete with base and accessories, as specified.
- 2. The tank shall be manufactured from food-grade PVC material, suitable for storing potable water.
- 3. The tank shall be designed and manufactured to withstand the specified environmental conditions and loads.
- 4. The contractor shall ensure that the tank is installed in accordance with the manufacturer's instructions and relevant standards.
- 5. The tank shall be tested for leaks and defects before commissioning.

1.6 PROJECT SIGNBOARD

- 1. The contractor shall erect the signboard at a location approved by the Engineer
- 2. The signboard shall be installed securely to withstand wind and weather conditions
- 3. The contractor shall maintain the signboard throughout the contract period
- 4. The signboard shall be cleaned and repainted as necessary to maintain its appearance
- 5. The contractor shall submit the signboard design and content to the Engineer for approval before fabrication
- 6. The Engineer shall inspect the signboard for compliance and approve its installation

1.7 HOARDING, SITE SECURITY AND WORK PROTECTION

The Contractor shall provide, erect, and maintain a site hoarding enclosing the Site or such parts of the Works as are under construction, as directed by the Project Manager. The hoarding shall be a minimum height of 2400 mm and shall consist of iron sheets securely fixed to timber posts of minimum size 100 × 50 mm, firmly embedded and secured at centres not exceeding 1800 mm.

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The hoarding shall be stiffened with two horizontal timber rails of minimum size 75 × 50 mm throughout its length.

The total length of hoarding shall be approximately five hundred (500) metres or as directed by the Project Manager. The hoarding shall be erected in a neat, stable, and workmanlike manner, capable of withstanding wind loads and normal site conditions, and shall be maintained in good condition for the duration of the Works.

In addition, the Contractor shall take all necessary precautions for the safe custody and protection of the Works, materials, plant, equipment, the public, and the Employer's property on and adjacent to the Site. Adequate warning signs, lighting, and barriers shall be provided where necessary to ensure safety and security.

Upon completion of the Works or when no longer required, the hoarding shall be removed, and all disturbed surfaces shall be reinstated to their original condition or as directed by the Project Manager. The cost of providing, maintaining, and removing the hoarding and associated security measures shall be deemed to be included in the Contract Rates, and no additional payment shall be made.

The Contractor shall provide and maintain adequate security measures to protect the works, materials, equipment, and workers throughout the contract period. This includes, but is not limited to:

1. Site Security:
 - Deploy security personnel to guard the site 24/7.
 - Install fencing, gates, and barriers to prevent unauthorized access.
2. Access Control:
 - Implement a site access control system to monitor and regulate entry and exit.
 - Ensure all personnel on site wear identification badges.
3. Asset Protection:
 - Secure valuable materials and equipment, especially at night and during off-days.
 - Store materials in designated, secure areas.
4. Worker Safety:
 - Provide security training to workers on site security protocols.
 - Ensure workers are aware of emergency contact numbers and procedures.
5. Risk Management:
 - Conduct regular risk assessments and update security measures accordingly.
 - Notify the Engineer of any security breaches or incidents.

The Contractor shall be responsible for any losses or damages due to inadequate security. No additional payment will be made for security measures, and the Contractor shall include these costs in their overall bid price.

1.8 UTILITIES PROVISION

The Contractor shall provide and manage utilities as required for the works:

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a. Water Supply

The Contractor shall arrange and pay for connection to the nearest suitable water main. They shall install and maintain temporary water tanks, meters, and piping as required. The Contractor shall meter and pay for all water used for the works. If the mains supply is insufficient, the Contractor shall make arrangements for augmenting the water supply at their own cost.

b. Electric Light and Power

The Contractor shall arrange and pay for electric light and power required for the works. This includes installing and maintaining temporary electrical installations, including lighting and power connections.

c. General Requirements

The Contractor shall clear away temporary installations when no longer required and make good to the satisfaction of the Engineer. They shall pay all charges, including consumption charges, connection fees, and disconnection fees. Nominated Sub-contractors shall be liable for the cost of water and electricity used and installations provided for their own use. The Contractor shall ensure that all temporary installations are safe and comply with relevant regulations and standards.

Clean and flush all gutters, rainwater and waste pipes, manholes and drains, wash (except where such treatment might cause damage) and clean all floors, sanitary fittings, glass inside and outside and any other parts of the works and remove all marks, blemishes, stains and defects from joinery, fittings and decorated surfaces generally, polish door furniture and bright parts of metalwork and leave the whole of the buildings watertight, clean, perfect and fit for occupation to the approval of the Project Manager.

1.9 SITE RESTORATION

The Contractor shall remove all temporary works, rubbish, debris and surplus materials from the site as they accumulate and upon completion of the works, remove and clear away all plant, equipment, rubbish, unused materials and stains and leave in a clean and tidy state to the reasonable satisfaction of the Project Manager.

PART 2: SITE CLEARANCE, EXCAVATION AND EARTHWORKS

2.0 GENERAL

2.1 ARCHITECT OR ENGINEER

Where the word 'Engineer' is used in these descriptions of Materials and Workmanship, it shall in all appropriate cases be used and construed as the Structural Engineer. For this purpose, the Engineer shall be deemed vested with the duties of and be the representative of the Architect.

2.2 DISCREPANCIES IN DESCRIPTIONS

The drawings take precedence over the bills of quantities.

2.3 TEST AND SAMPLES

Unless otherwise described in the Bills of Quantities, the Contractor will be responsible for all the costs involved in testing materials as described hereinafter. He will also be responsible for all the costs involved in supplying samples of materials or workmanship as required hereinafter to the satisfaction of the Engineer. The cost of replacing materials fixed or placed in position which do not comply with the required test results or approved samples shall be borne solely by the contractor. Samples of materials shall be submitted as soon as possible after the Contract is let. No deliveries in bulk shall be made until the samples are approved by the Engineer.

2.4 SITE CLEARANCE

Site clearance shall include the cutting down of all trees, stumps, bushes, vegetation and rubbish, burning the debris arising in approved locations, and carting remaining material to a tip provided by the Contractor.

2.5 GRUBBING

Grubbing up roots etc. shall include the following and disposal shall be as described under the foregoing clause:

1. Stumps and roots of large trees shall be completely removed
2. Stumps and roots of small trees, bushes or other vegetation shall be completely removed to a depth of at least 600 mm below formation.
3. Smaller stumps and roots of vegetation up to 25 mm thick shall be completely removed to a depth of 230 mm below formation.
4. Fine roots shall be removed to as great depth as is practicable by hand.

Except where the area of grubbing is to be excavated, all resulting holes shall be filled up solid with approved material compacted to the same relative density as the surrounding material.

2.6 EXCAVATION

The Contractor is advised to visit the site and ascertain the nature of the ground to be excavated and he shall price accordingly and no claim will be allowed for want of knowledge in this respect.

Rates for excavation shall include for excavation in soil, earth, black cotton, sandy soil, murrum, tuff, soft rock, boulders or whatever other subsoil is encountered, except hard rock as defined below. Allow for all necessary planking, strutting, shoring and temporary supports to the sides of excavations for ground slab, column bases/pads, foundations and related works, to maintain the stability of the excavation and ensure the safety of operatives, adjacent structures and services, all in accordance with the Engineer's instructions. Planking and strutting shall be of adequate strength and properly installed, maintained and adjusted as excavation proceeds, and shall be removed on completion of the works or as directed, without disturbing the permanent works. Allow for the removal and control of general surface water, including rainwater, seepage and runoff, by pumping, bailing, temporary drains or other approved methods, to keep excavations dry and suitable for construction at all times.

All costs for planking, strutting, dewatering, maintenance and final removal shall be deemed to be included in the Contractor's rates.

2.7 HARD ROCK

Any rock or other hard materials encountered in excavating to the required depths which in the opinion of the Architect or Engineer can only be removed by wedges, compressed air or other special plant, or explosives shall be paid for as per the contractor's Bill of Quantities and the price shall include for trimming and levelling. No blasting will be allowed without prior written permission from the Engineer and relevant Government Authority. Material which can be removed by pick or traxcavator, ripper or similar mechanical plant will not be classed as rock.

- a) The foundation trenches and column bases shall be excavated to the widths and depths of the concrete foundations shown on the drawings or to such widths and depths as the Engineer may instruct after examination of the excavations. Quantities of all excavations shall be measured and valued by the Quantity Surveyor and any difference between such measurements and the measurements herein given shall be dealt with as a variation to the Contract.

If, however, the Contractor excavates to any greater depths than shown in the drawings or as instructed by the Engineer, then he shall at his own expense fill in such extra depth of excavation with concrete as specified for the foundations to the satisfaction of the Engineer. The Contractor shall not be paid for the cost of any excavation executed deeper or wider than shown on the drawings or instructed by the Engineer nor for the cost of back filling such excavation or disposing of surplus.

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- b) The Contractor shall report to the Engineer when secure bottoms have been obtained to the excavations and are ready to receive the foundation concrete. Any concrete or other work put in before the excavations have been inspected and approved by the Engineer shall, if so directed, be removed and new work substituted in accordance with the specification after excavations have been approved, all at the Contractor's expense.
- c) The bottoms of all foundation trenches and column bases shall be trimmed square and level. The Contractor shall form such steps on bottoms of foundation trenches as the Engineer may consider necessary in such positions and to such depths as he may direct.

2.8 SURPLUS SOIL DISPOSAL

Excavated material not required for subsequent refilling shall be removed to areas off site which shall be approved by the Architect.

2.9 TOP SOIL FOR SPREADING

Where required in the Bills of Quantities, top soil required for subsequent spreading over finished work shall be especially selected and shall be dumped in special heaps as indicated by the Architect. Such top soil shall be reasonably free from vegetation to the satisfaction of the Architect, and shall be compacted as little as possible in the heaps.

2.10 FILLING UNDER SURFACE BEDS IN BUILDINGS

i. Murram filling

Murram for filling as base course shall be from an approved source and of the highest quality. It shall be laid in layers not less than 150 mm thick and not greater than 230 mm thick prior to compaction. Water will be applied to O.M.C. and each layer will be thoroughly compacted by at least 8 passes of a 10 tonne smooth wheeled roller or a 2 tonne vibrating roller until all movement ceases and 100% C.B.R. is obtained.

ii. Hardcore filling

Hardcore filling shall be crushed rock, broken brick, broken concrete or other approved hard granular materials broken to pass not greater than a 150 mm ring or to be 75% of the finished thickness of the layers being compacted whichever is the less and graded so that it can be easily and thoroughly compacted by rolling. The filling is to be laid in layers each of a consolidated thickness not exceeding 230 mm.

Where rolling by 10 tonne smooth wheeled roller or 2 tonne vibrating roller is impossible, compaction shall be by hand or mechanical tampers. Each layer shall be compacted by at least 8 passes of the roller.

The top surface of the hardcore shall be levelled or graded to falls as required and blinded with similar material broken to 25 mm gauge and surfaced with stone dust and well wetted before consolidation by the roller. The surface so obtained shall be to the Engineer's approval.

2.11 MATERIALS FOUND IN EXCAVATIONS

All materials classified as rock may, if approved by the Architect or Engineer be used as hardcore filling and the measured quantities of imported filling will be adjusted accordingly; all rock so used must be broken to the required size as before described before being used.

No sand, aggregate, murrum or other material found in the excavations is to be used in the works without the written permission of the Architect.

2.12 FILLING OBTAINED FROM THE EXCAVATIONS

Filling obtained from surplus excavated materials is to be free from all weeds, roots, vegetable soil or other unstable materials and is to be filled in layers each of not more than 230 mm finished thickness. Each layer to be well wetted and consolidated as described herein.

2.13 INSECTICIDE TREATMENT

Where described, the top surface of filling shall be treated with Pesticide or equal and approved to be applied and approved firm and in accordance with the manufacturer's instructions and subject to a ten year guarantee to the satisfaction of the Architect.

2.14 POLYTHENE SHEETING

Polythene sheeting shall be produced by an approved manufacturer. Joints in sheeting shall be treble folded with a 150 mm fold and taped at 300 mm intervals with 50 mm wide back plastic adhesive tapes. The sheeting shall not be stretched but shall be laid with sufficient wrinkles to permit shrinkage up to 15%.

The Contractor shall ensure that the membrane is not pierced during buying, laying and concreting.

SPECIFICATIONS: CONCRETE

PART 3: CONCRETE WORK

3.1 CODES OF PRACTICE

All workmanship, materials, tests and performances in connection with reinforced concrete shall be in conformity with the latest edition of the British Standard for concrete works (B.S 8110 parts 1 & 2, BS 8004, B.S 8007) and any other approved Local and International Standards. Where inconsistency exists between these preambles and these Standards, the Contractor shall notify the Engineer in good time for his Clarification as to which of the two shall prevail. Such clarification shall not have cost implications on the Contract.

Provide, mix, place, compact, finish, and cure in-situ reinforced concrete Class 25 using 20mm aggregates to all elements shown on the drawings and as directed by the Project Engineer. Concrete shall be produced using approved cement, clean sand, and well-graded aggregates, mixed mechanically and placed only after inspection and approval of formwork and reinforcement.

Provide and cast 200mm thick reinforced concrete ground slabs on approved prepared bases. Concrete shall be vibrated, levelled, and finished to the specified levels and falls.

Provide and cast reinforced concrete column bases/pads, stub columns up to dwarf wall height, strip footings, and ground beams to the specified dimensions. All concrete shall be placed in approved formwork, thoroughly compacted by vibration, and finished true to line, level, and plumb.

Provide and cast reinforced concrete access ramps 5.2m wide, finished with rough concrete screeding to provide a non-slip surface and constructed to the required gradients and levels.

Provide all necessary formwork, planking, strutting, and supports to maintain correct alignment and stability during concreting. Formwork shall be removed only after concrete has achieved sufficient strength and with the approval of the Project Engineer.

Allow for control and removal of surface water from excavations and concrete works at all times to prevent damage or contamination of concrete.

GENERAL AND SPECIFIC CONDITIONS

All concrete shall be properly cured and protected against adverse weather and premature loading. The works shall be executed in accordance with approved drawings, relevant standards, and to the satisfaction of the Project Engineer.

3.2 SUPERVISION

A competent person approved by the Engineer shall be employed by the Contractor whose duty will be to supervise all stages in the preparation and placing of the concrete. All cubes shall be made and site tests carried out under his direct supervision, in consultation with the Engineer.

As and when required by the Engineer the Contractor shall prepare and submit, before commencing the work, a time-chart (additional to the general programme) detailing the various operations for concrete works.

3.3 CONTRACTOR'S PLANT, EQUIPMENT AND CONSTRUCTION PROCEDURES

Not less than 30 days prior to the installation of the Contractor's plant and equipment for processing, handling, transportation, storing and placing concrete, the Contractor shall submit drawings for approval by the Engineer, showing proposed general plant arrangement, together with a general description of the equipment he proposes to use.

After completion of installation, the operation of the plant and equipment shall be subject to the approval of the Engineer.

Where these Preambles, the Bills of Quantities or the Drawings require specific procedures to be followed, such requirements are not to be construed as prohibiting use by the Contractor of alternative procedures providing these have been approved by the Engineer in advance.

Approval of plant and equipment or their operation, or of any construction procedure, shall not operate to waive or modify any provision or requirements contained in the Preambles governing the quality of the materials of the finished work.

3.4 LEVELS AND FOUNDATIONS

The foundations of the Works shall be carried down to depths as may be directed by the Engineer and they must be cut as nearly to the size of the concrete as possible and the vacant spaces between the concrete and the solid ground excepting where otherwise shown must be carefully filled in as directed by the Engineer.

All temporary timber shall be removed but should any timber be left in or should any other work be done beyond that specified, it will be at the Contractor's own cost.

The contractor to provide and construct foundation walling in rough-dressed natural stone masonry bedded and jointed in cement–sand mortar of approved mix ratio.

GENERAL AND SPECIFIC CONDITIONS

Walls shall be 200mm thick, built true to line, level, and plumb, with stones properly selected, shaped, and laid with full mortar beds and vertical joints fully filled. Face stones shall be neatly arranged to produce a uniform and stable wall.

Provide and install 20-gauge hoop iron wall ties at every alternate course, continuous along the length of the wall, lapped adequately at joints and embedded fully in mortar to ensure proper reinforcement and bonding.

All masonry shall be properly cured, kept damp for the specified period, and protected from damage until adequately set. The completed work shall be to the approval of the Project Engineer/Architect and in accordance with the drawings and relevant standards.

3.5 MATERIALS GENERALLY

All materials which have been damaged, contaminated or have deteriorated or do not comply in any way with the requirements of these Preambles shall be rejected and shall be removed immediately from the Site at the Contractor's own expense. No materials shall be stored or stacked on suspended floors without the Engineer's prior approval.

3.6 SAMPLES AND TESTING

The Contractor shall provide on the site, equipment, staff and labour for carrying out the sampling and testing and shall carry out any or all of these tests at such times and with such frequency as may be requested by the Engineer.

All equipment shall be calibrated and checked from time to time by the relevant Government authority and/or as the Engineer may direct.

The Contractor shall provide all samples required by the Engineer as soon as possible after the contract is let. No deliveries in bulk shall be made until the samples are approved by the Engineer. All condemned material shall be removed from the site within 24 hours.

Frequency of tests and number of samples required shall be governed by the results of previous tests, the quality of materials revealed during the tests and the uniformity of that quality. Should it become evident that the quality of concrete is deteriorating, the Engineer may require additional samples to be taken and test cubes to be made and tested to determine the cause.

3.7 CEMENT

Cement unless otherwise specified shall be ordinary Portland Cement of a brand and source approved by the Engineer and shall comply with the requirements of B.S. 12. A manufacturer's certificate of test in accordance with B.S 12 shall be supplied for each consignment delivered to the Site.

Should the Contractor require to use cement of Rapid Hardening variety, he shall submit his proposals to the Engineer along with any cost implications on the project for his approval. Any

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additional cost that may be caused by the use of Rapid Hardening cement shall be borne by the Contractor.

Cement may be delivered to the Site either in bags or in bulk.

If delivered in bags each bag shall be properly sealed and marked with the manufacturer's name and on the Site is to be stored in weatherproof shed of adequate dimensions with a raised floor. Each consignment shall be kept separate and marked so that it may be used in the sequence in which it is received. Any bag found to contain cement which has set or partly set, shall be completely discarded and not used in the works. Bags shall not be stored in stacks more than 2.0 meters in height.

No cement which has been kept on site in bags for more than 3 months shall be used in works.

If delivered in bulk the cement shall be stored in a weather proof silo either provided by the cement supplier or by the Contractor but in either case the silo shall be to the approval of the Engineer.

3.8 SAND

Sand used for concrete shall be clean, well graded siliceous sand of good sharp hard quality equal to samples which shall be deposited with and approved by the Engineer. The sand shall be free from lumps of stone, earth, loam, dust, salt organic matter and other deleterious substances, sieved and washed with clean water unless directed otherwise by the Engineer.

3.9 AGGREGATE

Aggregates shall conform with the requirement of B.S. 882 and all the proposed sources, types and grading test results of all aggregates are to be approved in all respects by the Engineer before work commences.

The grading of aggregates shall be one within the limits set out in B.S. 882 and as later specified and the grading, once approved, shall be adhered to throughout the Works and not varied without the approval of the Engineer. Fine aggregates shall be clean, coarse, siliceous sand of good, sharp, hard quality and shall be free from lumps of stone, earth, loam dust, salt, organic matter and any other deleterious substances. It shall be graded within the limits of Zone 1 and 2 of Table 2 of B.S. 882.

Coarse aggregate shall be good, hard, clean, approved blacktrap or similar stone, free from dust, decomposed stone, clay, weather matter, foreign substances or friable thin elongated or laminated pieces. It shall be graded within the limits of Table 1 of B.S. 882 for its respective nominal size.

If in the opinion of the Engineer the aggregate meets with the above requirements but is dirty or adulterated in any manner it shall be screened and/or washed with clean water at the Contractor's expense.

GENERAL AND SPECIFIC CONDITIONS

Aggregate shall be delivered to the Site in their prescribed sizes or gradings and shall be stock-piled on paved areas to boarded platforms in separate units to avoid intermixing. On no account shall premixed coarse aggregates be brought to the batching plant. On no account shall aggregates be stock-piled on the ground.

The Engineer shall be entitled to require a Certificate from an approved testing laboratory in connection with each source of fine and coarse aggregates (including sand) showing that materials comply with the specification. Samples shall be subjected to such tests and at frequencies as determined by the Engineer. All such testing shall be carried out at the Contractor's expense.

3.10 WATER

The water used for mixing concrete shall be from an approved source, clean, fresh, and free from harmful matter and comply with the requirements of B.S. 3148.

3.11 ADMIXTURES

Before approval for the use of a proprietary admixture is given, the Contractor shall satisfy the Engineer as to its suitability for the work and its compatibility with the cement it is intended to complement.

3.12 EXPANSION JOINT FILLERS

Expansion joint filler shall be an approved filler.

3.13 JOINT SEALANT

Sealants shall be polysulphide based "Pli-astic" or Seelastic" applied in accordance with the manufacturer's printed instructions and prices shall include for temporary battens or fillets and afterwards withdrawing to form grooves as necessary.

"Seelastic" shall be applied by gun and where more than 12 mm deep shall include filling with loose packing yarn to within 12 mm from outer face.

On no account shall soft board materials be used as joint fillers.

3.14 CONCRETE MIXES

All structural concrete shall consist of laboratory designed mixes. The weights of cement, fine, coarse aggregates and water (and plasticiser where required) to be used in the designed concrete mixes shall be those giving one cubic metre of mixed concrete. Each design mix (for each class of structural concrete) shall be submitted to the Engineer along with at least 8 laboratory test results (4 No. 7 days and 4 No. 28 days) for his approval. The design mixes and the accompanying test results shall be sent in their original form directly to the Engineer with a copy

to the Contractor. No photocopies shall be accepted. Once approved these design mixes shall be used in preliminary stage of works.

Only the 28-day test results shall form the basis of assessment for the preliminary and works cube results but the Engineer may use the 7-day test results to determine the quality of concreting at his discretion.

3.15 STRUCTURAL CONCRETE STRENGTHS AT PRELIMINARY WORKS STAGE

For the purpose of this Contract, Structural concrete shall mean concrete for which the specified characteristic cube strength is equal to or higher than 20N/mm².

The concrete mix shall be designed to attain a mean strength greater than the characteristic strength by at least the current margin. The current margin shall be taken as the smaller of the value resulting from (1) or (2) below.

1. For at least 40 separate batches of concrete of identical proportions of similar materials produced over a period of between 5 days and 60 days using the same plant under similar supervision and procedures. Current Margin = 1.64 times the standard deviation but not less than 7.5N/mm².
2. For cube tests on at least 100 batches as described in (1) produced over a period not exceeding 12 months.

Current Margin = 1.64 times the standard deviation but not less than 3.75N/mm² for concrete grade 20 and above.

Where there is insufficient data to satisfy (1) and (2), the current margin for the initial mix design shall be taken as 10N/mm² until sufficient data is available.

Testing of concrete at preliminary stage shall continue until the Engineer is fully satisfied that the concrete mix has met all the requirements outlined in this section.

Structural concrete shall satisfy the above requirements for the characteristic strength at 28 days shown in the table below.

The strength at 7 days shall only be indicative and unless the Engineer otherwise agrees, it shall not form the basis of approval for design mixes.

3.16 QUALITY CONTROL AT WORKS STAGE

Once the concrete mix is accepted from preliminary to works stage, the principal basis of control shall be analysis of the cube test results at 28 days.

Cube test results shall be examined individually in 10 consecutive sets of four. The standard deviation and mean strength of each set shall be calculated.

GENERAL AND SPECIFIC CONDITIONS

The concrete mix proportions shall only be acceptable if all of the following requirements are complied with:

- a. Not more than two results in 40 are less than the characteristic crushing strength.
- b. No value of the average for any set of four results shall be less than the characteristic strength plus one-half of the current margin.
- c. When 40 No. have been obtained and the mean strength and standard deviation are calculated, the mean strength minus 1.64 times the standard deviation shall be greater than the characteristic strength.

Where the results do not conform to the above requirements the following action shall be taken:

- Adjustments to the mix to obtain strength required.
- In the case where any result is less than 85% of the characteristic strength the structural implications shall be determined and any necessary remedial action carried out shall be at the Contractor's costs.

3.17 PROPORTIONS OF CONCRETE WORKS

All structural concrete shall be proportioned in weight using weigh batching machines of an approved type (to B.S. 1305) and shall be properly maintained and checked for accuracy to the requirements of Factories Inspectorate and at such intervals as required by the law and/or as Engineer shall direct.

3.18 CEMENT

The quantity of cement shall be measured by weight. Where delivered in bags, each batch of concrete is to contain one or more bags of cement in accordance with the proportions specified.

Where batching is by volume, approved gauge boxes of such a size as will give the correct proportions shall be used, and full account shall be taken of bulking due to high moisture content.

3.19 READY-MIXED CONCRETE

Where the Contractor desires to use ready-mixed concrete prepared outside the site, he shall submit a written request to the Engineer for his approval. In his request, the Contractor shall attach a detailed proposal showing the logistics of carrying out such an exercise.

The Engineer shall give his written consent only after satisfying himself with the adequacy of the Contractor's proposals as far as specifications and logistics are concerned.

The Engineer may demand particular conditions be fulfilled before granting the permission (A sample of "Delivery Ticket" for ready-mix concrete as attached at the back of this specification).

3.20 PHYSICAL BARRIER FOR WATERPROOFING

Where specified, physical barriers shall consist of the following:

Mastic Asphalt

This shall be laid in layers of maximum thickness of 10 mm each. The Materials and workmanship shall comply to CP 102:1973. Rubber-Membrane

This shall consist of preformed laminated membrane comprising an elastomeric self- adhesive rubber/bitumen compound and robust polythene sheet such as Bituthene 1000. The membrane shall be stored, handled and laid onto the elements to be protected strictly in accordance with the manufacturers specifications and under the supervision of one of their approved representatives all to CP 102:1973. Special precautions shall be taken at the interface of this material and mastic asphalt. Only approved water bars shall be incorporated in the structural concrete works and these shall be provided in the positions indicated on the drawings or at other alternative positions approved by the Engineer.

Waterbars

Joints shall be heat welded in accordance with the manufacturer's instructions and where the waterbar is to be fixed vertically, metal clips as manufactured by the supplier of the waterbar or of other approved design shall be provided to suspend the waterbar from the reinforcement.

Where waterproof concrete is used the Contractor shall adhere strictly to the position and type of construction joints as detailed on the drawings. Any deviation from this procedure or the provision of additional construction joints will require the prior approval of the Engineer and any additional waterbar so required will be at the Contractor's expense.

Formwork shall be designed with sufficient timber forms and blocking pieces to support the waterbar and to ensure that it is not displaced during concreting. In the case of horizontal joints in vertical walling and similar members the formwork shall be so constructed as to permit the starter or upstand concrete surrounding the lower half of the waterbar to be poured in the same operation as the slab or other concrete from which it springs. Formwork to walls or similar members where waterbar is positioned at the base of the lift shall have sufficient inspection openings not less than 300 mm square at approximately 15 mm to 300 mm above the level of the waterbar to permit checking that the waterbar is correctly positioned and not displaced during concreting.

Through-bolts or ties will not be permitted in liquid retaining structure or in retaining walls. The Contractor shall use only such bolts or ties as are capable of being removed in part so that the portion remaining embedded in the concrete shall be between the specified thickness of cover to the reinforcement.

No concreting will be permitted to portions where upstand starters form an integral part until the formwork to the starter has been fixed and approved. No through holes shall be permitted in basement retaining walls.

The Contractor shall provide the following furniture and equipment for setting up his laboratory to be used in carrying out control tests on the site.

3.21 WORK CUBE TESTS

Work cubes are to be made at intervals as required by the Engineer and the Contractor shall provide a continuous record of the concrete work. The cubes shall be made in approved 100 or 150 mm moulds as required by the Engineer in strict accordance with the Code of Practice.

At least four cubes shall be made on each occasion, from different batches, the concrete being taken from the point of deposit.

Frequency of the tests and the number of samples required will be governed by the results of the previous tests, the quality of the materials revealed during the tests, and the uniformity of the quality. Should it become evident that the quality of the concrete is deteriorating the Engineer may require additional samples to be taken and test cubes to be made and tested to determine the cause.

Cubes shall be forwarded, carriage paid to an approved Testing Laboratory in time to be tested two at 7 days and two at 28 days. No cube shall be dispatched within 3 days of casting.

Authentic copies of all Work Test results shall be forwarded to the Engineer directly from the testing laboratory and one shall be retained on the site. The test certificate shall indicate all properties as required by B.S. 1881.

If the strengths required above are not attained and maintained throughout the carrying out of the Contract, the Contractor will be required to increase the proportion of cement and/or substitute better aggregates so as to give concrete which does comply with the requirements of the contract. The Contractor may be required to remove and replace at his own cost any concrete which fails to attain the required strength as ascertained by Work Cube Test.

The Contractor must allow in his rates for concrete test cubes for all expenses in connection with the preparation and conveyance to the Testing Laboratory and testing of test cubes and no claim in respect of his failure to do so will be entertained.

3.22 MIXING OF CONCRETE

The concrete shall be mixed only in approved power driven weigh batch mixers of a type and capacity suitable for the work. The batching plant shall have a reserve capacity of at least 30% over and above the expected maximum demand.

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The weigh batch mixer shall be equipped with an accurate water measuring device. All materials shall be thoroughly mixed dry before the water is added and the mixing of each batch shall continue for a period of not less than two minutes after the water has been added and until there is a uniform distribution of the materials and the mass is uniform in colour.

The entire contents of the mixed drum shall be discharged before recharging. The volume of mixed materials shall not exceed the rated capacity of the mixer. Whenever the mixer is started, 10% extra cement shall be added to the first batch and no extra payment will be made on this account.

As a check on concrete consistency slump tests shall be carried out in accordance with

B.S. 1881. The Contractor shall provide the necessary apparatus and allow for the cost of such test.

The slump of the concrete made with the specified water content, using dry materials, shall be determined and the water to be added under wet conditions shall be so reduced as to give approximately the same slump.

3.23 TRANSPORTING CONCRETE

The concrete shall be mixed as near to the place where it is required as is practicable, and only as much as is required for a specified section of the work shall be mixed at one time, such section to be commenced and finished in one operation without delay.

All concrete must be efficiently handled and used in the Works within twenty (20) minutes of mixing. It shall be discharged from the mixer direct either into receptacles or barrows and shall be distributed by means which do not cause separation or otherwise impair the quality of the concrete. Approved mechanical means of handling will be encouraged, but the use of chutes for placing concrete is subject to the prior approval of the Engineer.

Where approval is obtained for concrete to be conveyed by chutes, these shall have a slope (not exceeding 1 vertical to 2 horizontal) such as to ensure a continuous flow of concrete.

Additional water shall not be introduced to assist the flow.

Where approval is obtained for pumping the concrete, the pump manufacturer's recommendations shall be followed. The pumps used shall be of adequate capacity and power to ensure delivery of a continuous supply. The Contractor shall provide adequate alternative arrangements for transporting concrete including standby pumps in case of breakdown of the pumping equipment.

No relaxation of these specification on pumped concrete will be permitted. In particular, attention shall be paid to the proper grading of aggregates to prevent bleeding and/or segregation during pumping operations.

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The inclusion of mixtures to improve the flow characteristics of the concrete will only be permitted where it can be shown that they do not adversely affect the concrete.

Proper bridging arrangements for traffic over reinforcement shall be provided so that the reinforcement is not distorted, damaged or displaced.

3.24 PLACING CONCRETE

No concrete shall be placed before approval by the Engineer's representative.

Any accumulation of set concrete on the reinforcement shall be removed by wire brushing before further concrete is placed.

Care shall be taken that the concrete is not disturbed or subjected to vibrations and shocks during the setting period.

Mixing machines, platforms and barrows shall be clean before commencing mixing and be cleaned on every cessation of the work.

Where concrete is laid on hardcore or other absorbent materials, the base shall be suitable and sufficiently wetted before the concrete is deposited.

Concrete shall be placed from a height not exceeding 1.5 m directly into its permanent position and shall not be worked along the shutters to that position. Unless otherwise approved, concrete shall be placed in a single operation to the full thickness of slabs, beams and similar members, and shall be placed in horizontal layers not exceeding 1.5 m deep in walls and similar members.

Concrete in columns may be placed to a height of 4.0 m with careful placing and vibration and satisfactory results. Where the height of the column exceeds 4.0 m suitable openings must be left in the shutters so that this maximum lift is not exceeded. The bottom 500 mm must first be thoroughly compacted before more concrete is added as the vibrator is gradually withdrawn.

Tops of lifts in walls and columns shall be finished level and well compacted so that minimal preparation of the next lift is required.

Concrete shall be placed continuously until completion of the part of the work between construction joints as specified hereinafter.

If stopping of concreting is unavoidable elsewhere, a construction joint shall be made where the work is topped. A record of all such joints must be made by the contractor and a copy supplied to the Engineer.

3.25 WET WEATHER CONCRETING

Concreting during periods of constant rain shall not be permitted unless aggregate stockpiles, mixers and transporting equipment and the areas to be concreted are adequately covered.

3.26 HOT WEATHER CONCRETING

Concreting shall not be permitted if its temperature at placing is in excess of 38°C. In order to maintain the temperature of the concrete below this value the following precautions shall be taken wholly or in part as instructed by the Engineer:

- a) All aggregate stockpiles, water lines and tanks as well as the mixer shall be protected from the direct rays of the sun.
- b) Coarse aggregate shall be cooled by constant watering where possible.
- c) Mixing water shall be cooled by the addition of ice to the storage tanks where necessary.
- d) Rapid-hardening cement shall not be used.
- e) Where the above precautions are inadequate, concreting shall be carried out during the cooler parts of the day or night as may be directed by the Engineer.

When the air temperature is above 20°C loss of mixing water by evaporation shall be considered in arriving at the amount of water to be added to the mix. In order to maintain the water/cement ratio within permissible limits, an approved water-reducing agent shall be included in the mix.

The maximum water/cement ratio may be increased with the Engineer's permission during mixing, but on no account shall water be added to concrete directly or indirectly once it has left the mixer.

In order to reduce premature drying of the concrete during transporting and placing, all chutes, formwork and reinforcement shall be cooled by watering when possible, or shall otherwise be protected from the direct rays of the sun. Any water so used shall be removed by jetting with compressed air before placing the concrete in close contact.

As soon as possible after concreting, the formwork shall be stripped and the surface of the concrete shall be treated in accordance with the requirements stated elsewhere.

Where drying winds are encountered, wind shields shall be positioned as directed by the Engineer to protect exposed surfaces of the curing concrete.

3.27 CONTINUOUS POUR IN CONCRETE

Where the Contractor desires to use continuous concreting method in large sections (rafts and walls), he shall submit a written request to the Engineer for approval. In the request he shall attach details which shall include but not be limited to the following:

- Total amount of concrete to be placed in the shift
- Stock of approved concrete materials on site
- Capacity of the batching plant
- Number and type of truck mixers to be deployed for the exercise and movement logistics
- Number of skilled and other manpower to be deployed for exercise in shifts.
- Number and capacity of plant to be used in placing concrete (pumps, vibrators, buckets, etc.)

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- Method(s) of monitor and dealing with the heat of hydration
- Details of protection against rain and floodwaters and how to cope with it.

The Engineer shall consider the above details and other parameters (e.g. weather, satisfactory records of cube test results, availability of adequate working section where reinforcement placement and the necessary formwork have been approved etc.) before making his decision. The Engineer may order that additional concrete cube moulds be made available as well as arrangements be made for cube crushing with an approved laboratory to cope with the increased demand.

The Engineer may order that the concreting works be stopped immediately if in his opinion the quality of the works is threatened for whatever reason.

3.28 SPECIAL NO-FINES CONCRETE

No-fines concrete for use in subsoil drainage shall consist of a 1:8 cement/aggregates mix by volume. Aggregate shall be 20 mm to 10 mm graded with no more than 5% passing the 10 mm sieve. Only sufficient water shall be added to ensure complete coating of the aggregate. One half of this water shall be placed into the mixer first, after which the aggregate and cement shall be admitted. After partial mixing, the balance of the water shall be added until a consistency of mix is achieved.

Preliminary tests shall be carried out on the site to prove the suitability of the finished concrete and adjustments made to the proportions and/or grading as may be required by the Engineer.

3.29 COMPACTION AND VIBRATION

At all times during which concrete is being placed, the Contractor shall provide adequate trained and experienced labour to ensure that the concrete is compacted in the forms to the satisfaction of the Engineer.

The Contractor shall ensure that he has at least 30% backup/reserve capacity over and above the maximum expected demand.

Concrete shall not be placed at a rate greater than will permit satisfactory compaction nor to a depth greater than 450 mm before it is compacted.

During and immediately after placing, the concrete shall be thoroughly compacted by means of continuous vibration.

Care shall be taken to fill every part of the forms, to work the concrete under and around the reinforcement without displacing it and to avoid disturbing recently placed concrete which has begun to set.

Any water accumulating on the surface of newly placed concrete shall be removed and no further concrete shall be placed thereon until such water is removed. Internal vibrators shall have a

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frequency of not less than 7,000 cycles per minute and shall have a rotation eccentric weight of at least 0.75 kg with an eccentricity of not more than 15 mm. Such vibrators shall visibly affect the concrete within a radius of 250 mm from the vibrator.

Internal vibrators shall not be inserted between layers of reinforcement less than one and one half times the diameter of the vibrators apart. Contact between vibrators and reinforcement and vibrators and formwork shall be avoided.

Internal vibrators shall be inserted vertically into the concrete wherever possible at not more than 500 mm centers and shall constantly be moved from place to place. No internal vibrator shall be permitted to remain in any one position for more than ten seconds and it shall be withdrawn very slowly from the concrete.

In consolidating each layer of concrete the vibrating head shall be allowed to penetrate and re-vibrate the concrete in the upper portion of the underlying layer. In the area where newly placed concrete in each layer joins previously placed concrete, more than usual vibration shall be performed, the vibrator penetrating deeply at close intervals along these contacts. Layers of concrete shall not be placed until layers previously placed have been vibrated thoroughly as specified.

Vibrators shall not be used to move concrete from place to place in the formwork.

At least one internal vibrator shall be operated for every four cubic meters of concrete placed per hour and at least one spare vibrator for every three shall be maintained on site in case of breakdown during concreting operations.

External formwork vibrators shall be of the high frequency low amplitude type applied with the principal direction of vibration in the horizontal plane. They shall be attached directly to the forms at not more than 1.200 M centers.

In addition to internal and external vibration, the upper surface of suspended floor slabs shall be levelled with a tamping or vibrating screed prior to finishing.

Vibrating elements shall be of the low frequency high amplitude type operating at a speed of not less than 3,000 r.p.m.

3.30 CONSTRUCTION JOINTS

Construction joints shall be permitted only at the positions predetermined on the drawings or as instructed on the Site by the Engineer. In general, they shall be perpendicular to the lines of principal stresses and shall be located at points of minimum shear, viz. vertical at, or near, midspans of slabs, ribs and beams.

The position of construction joints, when not shown on the Drawings or otherwise required by this specification, shall be decided on site having regard to the plant and labour made available by the Contractor for the manufacture, placing and compaction of the concrete as well as its

curing, the climatic conditions prevailing at the time of concreting, the nature and size of the formwork and conditions of operations of the work. The Contractor shall submit his proposals to the Engineer for his approval before commencing the work.

Suspended concrete slabs are generally to be cast using alternate bay construction in bays not exceeding 15 m in length. No two adjacent bays are to be cast within a minimum period of 48 hours of each other. The joints between adjacent bays are to be in positions agreed with the Engineer.

Under no circumstances shall concrete be allowed to tail-off, but it shall be deposited against stopping-off boards.

Before placing new concrete against concrete already hardened, the face of the old concrete shall be thoroughly hacked, roughened, and cleaned, and laitance and loose material removed therefrom, and immediately before placing the new concrete the surface shall be saturated with water and covered with a coat of mortar at least 25 mm in thickness composed of cement and fine aggregate in the proportions used in the concrete.

3.31 CURING AND PROTECTION

Care must be taken that no concrete is allowed to become prematurely dry and the fresh concrete must be carefully protected within two hours of placing from rain, sun and wind by means of at least three layers of Hessian sacking, white polythene sheeting, or other approved means. This protective layer and the concrete itself must be kept continuously wet for at least seven days after the concrete has been placed. The Contractor must allow for the complete coverage of all fresh concrete for a period of 7 days. Hessian or white polythene sheeting shall be in the maximum widths obtainable and shall be secured against wind. The Contractor will not be permitted to use old cement bags, clear or any other colour polythene sheets, hessian or other material in small pieces.

Concrete in foundations and other underground work shall be protected from admixture with the falling earth after placing.

Traffic or loading must not be allowed on the concrete until the concrete is sufficiently matured, and in no case shall traffic or loading be of such magnitude as to cause deflection or other movement in the formwork or damage to the concrete members. Where directed by the Engineer props may be required to be left in position under slabs and other members for greater periods than those specified hereafter.

3.32 FAULTY CONCRETE

Any concrete which fails to comply with these Preambles, or which shows signs of setting before it is placed shall be taken out and removed from the Site. Where concrete is found to be defective after it has set, the concrete shall be cut out and replaced in accordance with the Engineer's instructions. On no account shall any faulty, honeycombed, or otherwise defective concrete be repaired or patched until the Engineer has made inspection and issued instructions for the repair.

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On the Engineer's instruction, the contractor shall cut out and replace any concrete in any part of the structure if in the Engineer's opinion: -

- a) The concrete does not conform to the specification, or
- b) Deleterious materials or materials which are likely to produce harmful effects have been included in the concrete, or
- c) The honeycombed or damaged surfaces are too extensive, or
- d) The finished concrete sizes are not in accordance with the drawings within permissible tolerances, or
- e) The setting-out is incorrect, or
- f) The steel cover has not been maintained, or
- g) The protection, including curing of the concrete during the construction was inadequate resulting in damage, or
- h) Undue deformation of or damage to the works has taken place due to inadequate shuttering or to premature traffic or to excessive loading, or
- i) Any combination of the above points has taken place resulting in unsatisfactory work.

The whole of the cost, whatsoever (including time lost) which may be occasioned by the need to remove faulty concrete shall be borne by the Contractor.

3.33 LOADING TESTS

The Engineer may direct that a loading test be made on the works or any part thereof if he deems such a test to be necessary for one or more of the following reasons:

- a) Failure of "Site cubes" to attain the strength requirements.
- b) Premature removal of formwork
- c) Overloading of structure during construction
- d) Improper compaction of concrete
- e) Any other circumstances attributable to alleged negligence on the part of the Contractor which in the opinion of the Engineer may result in the structure being of less than the required strength.

The loading test ordered solely or in part for reasons (a) to (e) shall be made at the Contractor's own cost.

Loading tests shall be carried out in accordance with the requirements of B.S. 8110.

If the results of the test are not satisfactory, the Engineer will direct that the part of the work concerned be taken down or removed and reconstructed to comply with the Specification or that such other remedial measures as he may think fit be taken to make the work acceptable and the Contractor shall carry out such work at his own cost.

The Engineer may also instruct the Contractor before a loading test takes place to take out cylindrical core specimens from the structures concerned and have them tested. The cutting equipment and the method of doing the work shall be to the Engineer's approval. The specimens

shall be dealt with in accordance with B.S. 1881. Prior to testing, the specimens shall be available for examination by the Engineer. If the cores are ordered to be taken solely or in part for reasons (a) to (e) above, the work involved and the testing shall be made at the Contractor's own cost.

No extensions of time shall be granted for any delays or disruption of work caused by these tests.

3.34 STEEL REINFORCEMENT

The steel reinforcement shall comply with the latest requirements of the following British Standards:

Hot rolled M.S for the reinforcement of concrete B.S. 4449 Hot rolled H.Y. steel for the reinforcement of concrete B.S. 4449

Cold worked H.Y. steel for the reinforcement of concrete B.S. 4461 Hard drawn steel wire B.S. 4482

Generally high yield, hi-rib rebars (425 & 460 N/mm²) shall be used for main reinforcement and mild steel round bars, (250 N/mm²) for links and ductility for special elements where specified. In addition, where so detailed, mild steel deformed bars shall also be used.

The Contractor shall submit a test certificate of the rollings. Reinforcement shall be stored on racks above ground level in covered waterproof sheds to keep away rain water. The sheds shall be well drained to prevent deterioration or contamination from any cause. All reinforcement shall be free from loose mill scale or rust, grease, paint or other substances likely to reduce the bond between the steel and concrete.

3.35 FABRIC REINFORCEMENT

Fabric reinforcement shall be electrically cross-welded steel wire mesh reinforcement to

B.S. 4483, and of the size and weight specified and made of wire to B.S. 4482.

3.36 FIXING STEEL REINFORCEMENT

Reinforcement shall be accurately bent to the shapes and dimensions shown on the Drawings and Schedules and in accordance with B.S. 4466 and B.S. 8110. Reinforcement must be cut and bent cold and no welded joints will be permitted unless so detailed or directed by the Engineer.

Reinforcement shall be accurately placed in position as shown on the drawings, and before and during concreting, shall be secured against displacement by using No. 18. S.W.G. annealed binding wire or suitable clips at intersections, and shall be supported by concrete or metal supports, spacers or metal hangers to ensure the correct position and cover. No part of binding wire shall protrude into the specified nominal cover.

No concreting shall be commenced until the Engineer has inspected the reinforcement in position and until his approval has been obtained. The Contractor shall give two clear day notice of his intention to concrete to the Engineer. Approval forms shall be submitted in duplicates. (A sample of the format of the Approval form is attached at the back of this specification).

The Contractor is responsible for maintaining the reinforcement in its correct position, according to the drawings, before and during concreting. During concreting a competent steel fixer must be in attendance on the concretors to adjust and correct the positions of any reinforcement which may be displaced. The vibrators are not to come into contact with the reinforcement.

Where required to support and retain the reinforcement in its correct position, the Contractor shall provide templates, stools or other supports at his own cost.

Unless permitted by the Engineer, welding of bar reinforcement at intersections or for the joining of bars is prohibited. Where permission is granted, welding shall be carried out in accordance with the recommendations of the Institute of welding for the welding of reinforcement bars.

The Contractor shall provide on-site facilities for cutting and bending reinforcement whether he is ordering his reinforcement bent or not and shall ensure that a token amount of straight bar of each diameter is available on site for bending as and when directed by the Engineer in order that minor modifications may be implemented on site without prior notice.

Bar bending schedules shall be issued to the Contractor at least a month in advance of the actual physical requirement in site. The Contractor is responsible for verifying that he has in his possession the required schedules to meet his programme and shall give the Engineer at least 3 weeks' notice for any schedules that he requires.

3.37 SPLICES AND SCREWED COUPLERS

Where specified in the works, splices and screwed couplers shall be CCI systems type or similar approved and shall be for reinforcement bar sizes 16, 20, 25 and 32. The relevant certificates of performance shall be submitted to the Engineer for approval. The Engineer may order additional relevant tests be carried out through the Contractor from time to time as a measure of continuous monitoring of quality and performance.

3.38 POSITION AND CORRECTNESS OF REINFORCEMENT

The Contractor shall draw the Engineer's attention in good time if any discrepancies between details on drawings and bar bending schedules occur. Irrespective of whether any inspection and/or approval of the fixing of the reinforcement has been carried out as above, it shall be the Contractor's sole responsibility to ensure that the reinforcement complies with the details on the drawings or bending schedules and is fixed exactly in position shown therein and in position to give prescribed cover.

The Contractor will be held entirely responsible for any failing or defect in any portion of the reinforced concrete structure and including any consequent delay, claims, third party claims, etc.,

where it is shown that the reinforcement has been incorrectly positioned or is incorrect in size or quantity with respect to the detailed drawings or bending schedules.

3.39 SPACER BLOCKS

Spacing blocks of approved size and shape made of concrete similar to that used in the surrounding construction and fixed to the reinforcement or formwork by No. 18 S.W.G. wires set into the spacer blocks or other approved means shall be provided where necessary to ensure that the requisite cover is obtained. The Contractor is to include for providing sufficient such spacer blocks in his prices for steel reinforcement where such supplier has been nominated. Where composite blocks or other forms of rib construction are used, spacer blocks are to be provided as shown on the drawings. These will generally consist of concrete blocks as described above made to fit the width of the rib less 3 mm to tolerance and with single or double grooves (depending on the number of the reinforcement bars used per rib) in the top surface with wire ties at each groove.

The Engineer may direct that special types of spacers (e.g. preformed plastic types) be used in the whole or part of the works, if in his opinion the concrete spacers are not to the required standard.

3.40 NOMINAL CONCRETE COVER TO REINFORCEMENT

Unless otherwise directed the nominal concrete cover to steel reinforcing bars (including links and distribution) in any face shall be:

Foundations against earth face 75 mm

Foundation against blinding 50 mm

Columns (main bars) 40 mm

Beams (main bars) 30 mm or diameter of main bar

Slabs and stairs 20 mm

Wall (main bars) 40 mm

The tolerance on placing of bars achieve nominal cover is ± 5 mm

3.41 FIXING FABRIC REINFORCEMENT

The fabric shall be free from scale, rust, grease or other substances likely to reduce the bond between the steel and the concrete and shall be laid with minimum 300 mm laps and bound with No 18. S.W.G. annealed iron wire.

3.42 PROJECTING REINFORCEMENT

Where reinforcement projects from a concreted section of the structure and this reinforcement is expected to remain exposed for some time, it is to be coated with a cement grout to prevent rust staining on the finished concrete. This grout is to be brushed off the reinforcement prior to the continuation of concreting.

3.43 SECURITY REINFORCEMENT

Spiral

Spiral reinforcement where specified in the works shall be chubb spiral, Aegamesh or similar approved. It shall consist of steel bars of at least 15 mm diameter forming a mattress with pitches not exceeding 125 mm, and shall be delivered to the site in preformed 2 row mattress cages of exact and specified dimensions and incorporating appropriate spacer bars to maintain mattress rigidity. When assembled, the cages shall define the outline of the elements to be protected including allowance for openings. The assembling in the works shall be carried out under the supervision of the supplier's approved representative.

These shall be chubb tangbars, John Tann bars, Tord bars or similar approved. They shall be made from 3 mm thick mild steel plates cut into strips running off a central cord. They shall be transported to the site in flat condition where they shall be twisted into spirals. The twisting and laying of the units shall be carried out under the supervision of the supplier's approved representative.

3.44 FIXTURES AND INDENTATIONS IN CONCRETE

No openings, chases, holes or other voids shall be formed in the concrete without the prior approval of the Engineer. Details of any fixtures to be permanently built into the concrete including the proposed positions of all conduits 25 mm and over in diameter shall be submitted to the Engineer for his approval before being placed.

3.45 CHASES, HOLES, ETC IN CONCRETE

The Contractor shall be responsible for the co-ordination with the Electrical and other sub-contractors for incorporating electrical conduits, pipes, fixing blocks, chases, holes and the like in concrete members as required and must ensure that adequate notice is given to such sub-contractors informing them when concreting members incorporating the above are to be poured. The Contractor shall submit full details of these items to the Engineer for approval before the work is put in hand. All fixing blocks, chases, holes, etc, to be left in the concrete shall be accurately set out and cast with the concrete.

3.46 POSITION OF ELECTRICAL CONDUIT

Unless otherwise instructed by the Engineer all electrical conduits to be positioned within the reinforced concrete shall be fixed inside the steel cages of beams and between the top and bottom steel layers in slabs and similar members.

The proposed position of all conduits 25 mm and over in diameter which are to be enclosed in the concrete shall be shown accurately on a plan to be submitted to the Engineer whose approval shall be obtained before any such conduit is placed.

3.47 FORMWORK

The method and system of formwork which the contractor proposes to use shall be approved by the Engineer before construction commences. Formwork shall be substantially and rigidly constructed of timber, steel, plastic, precast concrete or other approved material.

All timber for formwork shall be good, sound, clean, sawn, well-seasoned timber free from warps and loose knots and of scantlings sufficiently strong for their purpose.

3.48 CONSTRUCTION OF FORMWORK

All formwork shall be of sufficient thickness and with joints close enough to prevent undue leakage of liquid from the concrete

and fixed to proper alignment, level and plumb and supported on sufficiently strong bearers, shores, braces, plates, etc, properly held together by bolts or other fastenings to prevent displacement, vibration or movement by the weight of materials, men and plant on same and so wedged and clamped as to permit easing and removal of the formwork without jarring the concrete. Where formwork is supported on previously constructed portions of the reinforced concrete structural frame, the contractor shall by consultation with the Engineer ensure that the supporting concrete structure is capable of carrying the load and/or sufficiently propped from lower floors or portions of the frame to permit the load to be temporarily carried during construction.

Soffits for beams and slabs of spans greater than 10 m shall be erected with an upward camber of 5 mm for each 3.0 m of horizontal span or as directed by the Engineer, without reducing the depth of the element.

Great care shall be taken to make and maintain all joints in the formwork as tight as possible, to prevent the leakage of grout during vibration.

All faulty joints shall be caulked to the Engineer's approval before concreting.

The formwork shall be sufficiently rigid to ensure that no distortion or bulging occurs under the effects of vibration. If at any time the formwork is insufficiently rigid or in any way defective the Contractor shall strengthen or improve such formwork as the Engineer may direct.

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The Contractor's attention is drawn to the various surface textures and applied finishes required and the faces of formwork next to the concrete must be of such material and construction and be sufficiently true to provide a concrete surface which will in each particular case permit the specified surface treatment or applied finish.

All surfaces which will be in contact with concrete shall be oiled or greased to prevent adhesion of mortar. Oil or grease shall be of a non-staining mineral type applied as a thin film before the reinforcement is placed. Surplus moisture shall be removed from the forms prior to placing of the concrete. Great care shall be taken to avoid oiling or greasing the reinforcement.

Temporary openings shall be provided at the base of columns, wall and beam forms and at any other points where necessary to facilitate cleaning and inspection immediately before the pouring of concrete. Before the concrete is placed the shuttering shall be trued- up and any water accumulated therein shall be removed. All saw-dust, chips, nails and other debris shall be washed out or otherwise removed from within the formwork. The reinforcement shall then be inspected for accuracy of fixing. Immediately before placing the concrete the formwork shall be well wetted and inspection openings shall be closed. Cement slurry shall be applied to previously casted concrete as necessary to allow for adequate bonding. The erection, easing, striking and removing of all formwork must be done under the personal supervision of a competent foreman, and any damage occurring through faulty formwork or its incorrect removal shall be made good by the Contractor at his own expense.

After removal of formwork, all projections, fins, etc., on the concrete surface shall be chipped off, made good to the requirements of the Engineer. Any voids or honeycombing shall be treated as described under "Faulty Concrete".

3.49 STRIPPING FORMWORK

All formwork shall be removed without undue vibration or shock and without damage to the Concrete. No formwork shall be removed without the prior consent of the Engineer. The Contractor shall notify the Engineer of his intended removal of any formwork at least two days in advance. The minimum periods that shall elapse between the placing of the concrete and the striking of the formwork will be as follows:

Beam sides, wall and columns (unloaded) 2 days

Slab soffits (props left under) 3 days

Beam soffits (props left under) 7 days

Removal of props to: (partly subject to 7 days concrete cube strength being satisfactory) Slabs 10 days

Beams 14 days

Cantilever beams and slabs 28 days

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In continuous spanning slabs or beams, no span shall be de-propped until the adjoining spans have been cast and cured for the specified periods.

Stripping and re-propping will not be permitted. The striking times indicated herein are for normal conditions and shall be adjusted if:

- a) The span of the structural member under consideration exceeds 6.0 m for beam. An additional period of one day for each 500 mm of additional span shall then be allowed
- b) The dead load of the structural member under consideration forms a large proportion of the total design load.
- c) The setting of the concrete has been retarded for any reason.
- d) Any combination of the above points and other consideration which would call for such a precaution to be taken.

In any case, props shall be left in place in the lower two consecutive floors over which construction loads are expected to be supported.

3.50 SURFACE FINISHES

Fair Face Finish

Where fair face finish is specified the concrete shall be brought to a perfectly true smooth and even surface by rubbing with carborundum stone dipped in cement grout. Such work must be commenced within one hour of removing the formwork and be actively and rapidly pursued until completed, the object being to complete the finish as soon as possible after the removal of the shuttering. On no account may such work be postponed to a later stage in the Contract. Fair face surfaces shall be clean, smooth, even true to form and free from all board marks, joint marks, honeycombing, pitting etc. The Contractor is permitted at his own expense to provide smooth lining to the forms which will achieve the required finish without rubbing down. All rubbed down work must be lightly washed with plain cold water at the completion of the Contract, and not before the cement grout used in the finish is at least four weeks old after initial mixing.

Wrought Lined Formwork

The shuttering shall be constructed of wrought tongued and grooved boarding, plywood or blockboard lined with approved laminated plastic sheeting to produce a concrete surface with truly flat surface completely free from all air bubbles, joint marks, honeycomb and other pitting and blemishes to the approval of the Engineer. Should the Contractor desire to use alternative materials he should submit his proposals to the Engineer for approval. Should the Contractor fail to obtain approval and the Engineer subsequently rejects the work, the Contractor will at his own expense carry out all work necessary to attain the approval of the same.

Tamped Finish

Areas so specified shall be finished at the time of casting with a tamped finish to the Engineer's approval produced by an edge board. Board marks are to be made to a true pattern and will

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generally be at right angles to the traffic flow. Haphazard or diagonal tamping will not be accepted.

Board Marked Finish

Where so directed or measured the finish shall be that of a board marked pattern panels, the boards shall be arranged vertically and of widths and sizes all as detailed on the drawings. All exposed concrete will be left unpainted and therefore every care and attention shall be paid to obtain a satisfactory visual appearance and that maintenance of the same throughout the building operation. The finished surfaces shall be free from blow holes, hungry patches and other blemishes, and a sample panel is to be provided and approved by the Engineer before work commences. Unless otherwise specified, the formwork shall be rip sawn softwood to the Engineer's approval and shall have a sufficiently strong grain to impart a corresponding pattern on the concrete surface. Unless otherwise approved it shall have four uses only and shall be carefully cleaned from adhering grout after each use. It shall be lightly oiled with an approved non-staining mould oil.

Vertical Ribbed Finish

Unless otherwise specified, vertical ribbed finish to walls shall comprise 50 x 50 mm concrete projections at 450 mm centres cast vertically on the face of wall. All surfaces are to be as described under "Wrought Formwork".

Diagonal Ribbed Finish

Unless otherwise specified, diagonal ribbed finish to walls shall comprise 50 x 25 mm deep concrete projections at 100 mm centres cast at 45 degree angle to the vertical on face of wall. All surfaces are to be as described under "Wrought Formwork".

Chisel Dressed Finish

Where specified a chisel dressed finish is to be carried out on any grade of concrete but not until it is at least 30 days old. The surfaces are to be fully chisel dressed to remove a maximum of 12 mm (average 9 mm) of the surface to expose the aggregate without excessive cracking or breaking thereof.

Where the drawings show details of arises of columns, beams etc., these are to be preformed with timber fillets set in the formwork, and care must be taken in working up to those to preserve a clean line. For vertical surfaces of walls and columns, particular care must be taken to remove all sharp projections. For beam soffits this requirement is not necessary.

All chisel dressed surfaces are to have the margins chisel dressed by hand for a minimum width of 75 mm commencing from the fillet edge. Thereafter mechanical chisel dressing may be used but the Contractor must ensure that a uniform texture and even

plain surface is achieved. The use of pointed steel tools for both hand and mechanical chisel dressing is essential. Upon completion the surfaces are to be thoroughly wire brushed and washed down and protected during the course of construction from damage, dirt, cement grout etc.

3.51 PRECAST CONCRETE

General

Unless otherwise approved by the Engineer, all precast concrete construction shall be carried out on the Site and shall conform to requirements given elsewhere in these preambles.

The maximum size of coarse aggregate in precast concrete shall not exceed 20 mm except for thickness less than 75 mm where it shall not exceed 10 mm.

The compacting of precast concrete shall conform with requirements given elsewhere in these preambles except for thin slabs where use of immersion type vibrators is not practicable. The concrete in these slabs may be consolidated on a vibrating table or by any other methods approved by the Engineer. Steam curing of precast concrete will be permitted. The procedure for steam curing shall be subject to the approval of the Engineer.

The precast work shall be made under cover and shall remain under the same for seven days. During this period and for a further seven days the concrete shall be shielded by sacking or other approved materials kept constantly wet. It shall then be stacked in the open for at least a further seven days to season before being set in position. Where steam curing is used these times may be reduced subject to the approval of the Engineer.

Precast concrete units shall be constructed in individual forms. The method of handling the precast concrete units after casting, during curing and during transport and erection shall be subject to the approval of the Engineer, providing that such approval shall not relieve the Contractor of responsibility for damage to precast concrete units resulting from careless handling.

Repair of damage to the precast concrete units, except for minor abrasions of the edges which will not impair the installation and/or appearance of the units will not be permitted and the damaged units shall be replaced by the Contractor at his own expense.

Except where precast work is described as "fair face" or as having "exposed aggregate" or terrazzo finish the moulds shall be made of suitable strong sawn timber true in form to the shapes required. Unless otherwise described faces are to be left rough from the sawn moulds.

Where precast work is described as "fair face" the moulds are to be made of metal or are to have metal or plywood linings or are to be other approved moulds which will produce a smooth dense fair face to the finished concrete suitable to receive a painted finish direct and free from all shutter marks, holes, pinnacles, etc. In his prices for such precast work the Contractor shall include for all rubbing down to produce the finish required, to the satisfaction and approval of

the Engineer. Where precast work is to have an "exposed aggregate" or terrazzo finish the moulds shall be constructed to the requirements given for moulds for "finished fair" work. The method of achieving the exposed aggregate finish shall be "aggregate transfer" or other approved method.

3.52 PRECAST CONCRETE CLADDING UNITS

These shall be cast to the general details shown on the drawings. The Contractor shall submit working/shop drawings for each type of the cladding panels to the Engineer for approval before he commences casting operations.

The panels shall be cast in special yards and shall be cured adequately before being hoisted into position in the structure, taking care that no parts are broken in the process. The units shall then be joined together with insitu concrete and flexibly connected to the top and bottom beams to allow for limited movement of the combined unit.

The precast units shall be installed to the lines, grades and dimensions shown on the drawings or as directed by the Engineer.

3.53 HOLLOW BLOCK SUSPENDED CONSTRUCTION (COMPOSITE FLOOR SLAB)

Concrete hollow blocks for use in the composite floor slabs shall be of the standard sizes required or as shown on the drawings and are to be of adequate strength to support the concrete during placing and consolidation by vibration. Blocks are to be manufactured in accordance with the procedure specified in B.S. 6073 and to be of a mix not weaker than 1:4:8 cement: sand: stone using maximum 10 mm size aggregate.

Concrete blocks are to be cured for at least 28 days before use on the site. During the first seven days of curing, blocks are to be kept permanently damp and protected from exposure to sun and wind.

Concrete blocks are to be well wetted before the pouring of cement.

Hollow clay filler blocks for use in the composite floor slabs are to be of the sizes shown on the drawings and to be of adequate strength to support the concrete during placing and consolidation by vibration. They shall be obtained from an approved manufacturer. Before any orders are placed, at least 6 sample clay blocks shall be provided for the approval of the Engineer. Any clay blocks subsequently delivered to site which in the opinion of the Engineer are not of equal standard to the approved samples shall be rejected.

Rejected blocks shall immediately be removed from the site and shall not be used in the works. Clay blocks are to be fully cured before delivery or use on site.

Clay blocks are to be well wetted before pouring of concrete.

3.54 COMPOSITE FLOOR CONSTRUCTION

The hollow block floor construction is generally to be as shown on the Engineer's Drawings.

Care shall be taken in placing blocks to ensure that they are set out in accordance with the details shown on the Drawings and that they run truly in line without encroaching on the width of the insitu ribs.

The open ends of hollow blocks, if adjacent to concrete to be placed insitu are to be plugged or stopped to prevent the concrete from flowing into the void and the Contractor is to include for this in his prices.

The Contractor should note that slip tiles are not to be used to the Soffits of ribs and he is to take this into consideration in pricing the items of formwork to the soffit of hollow block floor construction. Before concreting is carried out the blocks are to be thoroughly wetted.

Care should be taken during concreting that the width of ribs between the rows of blocks and the solid insitu concrete shown on the Drawings adjacent to supporting beams is not encroached upon by the blocks.

It is essential that the concrete topping be poured at the same time as the ribs between hollow blocks.

Reinforcement shall be positioned accurately with required cover in accordance with the Drawings and using the particular spacing blocks with wire ties as previously described. Spacer blocks shall be provided in ribs at not more than 1.2 m Centres. Care must be taken during concreting that the reinforcement is not displaced.

Where holes or services occur, the necessary holes or pockets shall be accommodated by the replacing of a hollow block by insitu concrete or the widening of a rib all in accordance with the Engineer's instructions.

Prices for such holes through hollow block construction are to include the rearrangement or substitution of the hollow block with solid concrete in addition to the actual formation of the hole.

3.55 CONCRETE SURFACE BEDS AND BLINDING

Before placing concrete and where specified or shown on the Drawings a layer of 1000 gauge polythene or diothene sheeting shall be laid on the blinding above the hard-core filling. Blinding concrete shall consist of in-situ mass concrete Class 15 made with 19 mm nominal size coarse aggregate, mixed, placed, and finished in accordance with the relevant standards and the Engineer's instructions. A 50 mm thick blinding layer shall be laid on approved, well-prepared, and compacted formation surfaces under strip foundations and under column bases/pad foundations. Blinding shall be placed immediately after inspection and approval of excavations to protect the formation from contamination, moisture ingress, and disturbance. No blinding concrete shall be placed on soft, waterlogged, or disturbed ground. All surplus concrete, laitance,

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and debris shall be removed, and the surface kept clean prior to subsequent works. Curing shall be carried out using approved methods to prevent rapid moisture loss and cracking. All blinding works shall be executed to the satisfaction of the Engineer.

The concrete shall be placed as soon as possible after being mixed. In transporting the concrete, adequate precautions shall be taken to avoid damage to the prepared base. The concreting shall be spread to such a thickness that when compacted it shall have the finished thickness as specified or shown on the Drawings. A layer of concrete 25 mm less than the finished thickness shall first be spread and struck off at the correct level to receive the top fabric reinforcement.

The top layer shall then be added. Not more than 30 minutes shall elapse between spreading the bottom layer and the start of compaction of the top layer. The Contractor shall be responsible for maintaining the reinforcement in its correct position during the placing and compaction of the concrete. The compaction and finishing of the concrete shall be effected by immersion vibrators and a hand or mechanical tamper weighing not less than 10 kg per meter run and having a tamping edge shored with a steel strip 75 mm wide fixed to a tamper by countersunk screws. Immersion vibrator with "spade" attachments will be permitted. Compaction shall be continued until a dense, scaled surface finish is achieved. Over- compaction causing an excessive amount of fines to be brought to the surface shall be avoided.

The surface of the concrete shall be finished to the surface texture specified to the levels, falls and crossfalls, as directed or shown on the Drawings and shall be subject to the following tolerances:

- The level shall be within + or - 6 mm of the levels specified.
- The falls shall be within 10% of the falls specified.
- The smoothness shall be such that departures from a 3 m straight edge laid in any direction shall not exceed 3 mm.
- Minor irregularities shall be made good by the use of a steel float but in no circumstances shall mortar be used to make good the surface.

As soon as the surface has been finished, it shall be protected against too-rapid drying by means of damp Hessian, white polythene sheeting or other approved means placed carefully on the surface and kept damp and in position for 7 days and the concrete shall be kept wet for a further 21 days. The most critical period is the first 48 hours after placing and curing during that time shall be very thorough.

The Contractor is to obtain the Engineer's approval to the material and method he proposes to use for curing and no concreting will be permitted until sufficient such material is on site.

Forms shall not be removed from freshly placed concrete until it is at least 24 hours old. Care shall be taken that in their removal no damage is done to the concrete, but should any damage occur the Contractor shall be responsible for making it good.

3.56 EXPANSION JOINTS IN CONCRETE SURFACE BEDS

Expansion joints shall be positioned and constructed as shown on the drawings. The joints in the surface beds shall be absolutely square and true to line and position.

All joints in surface beds shall be formed to the patterns and shapes to coincide exactly with the joints in the surface finish or as otherwise indicated on the drawings. Formwork shall be manufactured from steel of heavy angle section and be to the Engineer's approval. The Contractor shall submit drawings of the forms he intends to use and obtain the Engineer's approval before fabrication. Panels shall be poured in alternate bays as agreed with the Engineer. No construction joints other than those indicated on the Drawings shall be submitted.

3.57 NOTES CONCERNING MEASUREMENT AND PRICING

Prices for concrete shall include for mixing and depositing as described or indicated and for hoisting and depositing at the various levels required throughout the building, and shall also include for forming or hacking a satisfactory key for all faces receiving asphalt and plaster work. Prices for slab shall also include for levelling off the surfaces as described under "Compaction", and all temporary formwork to form construction joints at bay edges.

Prices for reinforced concrete shall, in addition, include for filling into between or on formwork and thoroughly compacting between and around rods or fabric reinforcement and for forming all additional construction joints between varying mixes. Where described as vibrated, prices must include for fully vibrating as described.

Prices for formwork shall include for extra materials at joints, extra labour and waste for narrow widths, small quantities, over laps, passing at angles, straight cutting and waste, splayed edges, notching, etc., and for fixing at the various levels including battens, struts, and supports and for bolting, wedging, easing, striking and removal. Prices for linear items such as boxing shall include for angles and ends.

Prices for steel rod reinforcement shall include for cutting to lengths and all labour in bending and cranking, forming hooked ends handling, hoisting and fixing in position and for providing all necessary tying wire and supports. Prices for fabric reinforcement shall include for all straight cutting and waste, handling, hoisting and fixing in position, providing all necessary tying wire and supports and all extra material in laps.

Prices for all precast concrete shall include for all moulds, finishing as described, handling reinforcement, hoisting and fixing at the required levels, bedding, jointing and pointing in cement and sand (1:5) mortar also for casting or cutting to the exact lengths required and any waste resulting from such cutting.

Prices for expansion joints shall include for cutting to size all temporary supports, and prices for expansion joint sealers shall include all temporary battens or fillets required to form the necessary grooves.

Prices for suspended hollow tile composite floor and roof slabs must be "all inclusive" to include for concrete hollow tiles, insitu ribs, concrete topping, concrete filling to open ends of hollow concrete tiles.

3.58 SITE BOOKS AND STANDARDS

Instructions to be Recorded

The Contractor shall provide and keep permanently on the site a numbered triplicate book wherein the Contractor shall record all instructions relating to concrete work issued by the Engineer or the Engineer's representative. One copy of every entry therein shall be sent to the Engineer on the same day as the entry is made.

Site Diary

The Contractor shall provide and keep permanently on the site a continuous entry diary wherein the Contractor shall record details of shuttering, placing of reinforcement, concreting and curing operations, striking of shuttering, making good and daily temperature and weather conditions. This diary shall always be available for inspection by the Engineer's representative.

SPECIFICATIONS: WALLING

PART 4: WALLING

MATERIALS

4.1 CEMENT

Cement used for making mortar shall be as described in "Concrete work".

4.2 LIME

The lime for making mortar shall be obtained from an approved source and shall comply with B.S. 890 Class A for non-hydraulic lime. The lime to be run to putty in an approved lined pit or container. The water to be first run into the pit or container and the lime to be added until it is completely submerged, stirred vigorously until all lumps are disintegrated and shall be kept constantly covered with water and regularly stirred for at least four weeks. The resulting milk-

lime then to be run through a fine sieve and run into a pit or other container and kept clean and moist for not less than two weeks before being used in the works.

4.3 SAND

Sand used for making mortar shall be clean, well graded siliceous sand of good sharp hard quality equal to samples which shall be deposited with and approved by the Architect. It shall be free from lumps of stone, earth, loam, dust, salt, organic matter and other deleterious substances, passed through a fine sieve and washed with clean water if so directed by the Architect.

4.4 WATER

Shall be as described in "Concrete Work".

4.5 CONCRETE BLOCKS

Concrete blocks shall comply with the requirements of B.S. 2028, 1384 except where amended or extended by the following clause. Blocks shall have square arrises and corners. For fair-faced work damage to arrises and corners shall not exceed the removal of 6 mm of the blocks depth or thickness.

Concrete blocks shall have a minimum crushing strength of 3.5 N/mm² except when below the damp course level or in contact with soil when they shall have a minimum crushing strength of 7N/mm², unless noted otherwise on drawings. Hollow concrete blocks shall not be used below the damp course level or in contact with soil.

Concrete blocks used for external walls shall be Class A and for internal load bearing walls they shall be at least Class B.

Class 'C' blocks shall only be used for non-load bearing partitions.

No precast blocks shall be incorporated into the works unless approved by the Architect. The delivery of precast blocks from which samples tested do not comply with this specification shall be deemed defective. Any work constructed with blocks from which samples tested do not comply with this specification shall be deemed to be defective.

From every 1,000 precast concrete blocks delivered to site, ten block samples shall be provided for testing. The precast block samples shall be selected in accordance with B.S. 2028, 1364. Samples of precast concrete blocks for testing shall be tested for the following properties in accordance with the methods given in B.S. 2028, 1364 and the test results shall comply with the requirements of B.S. 2018, 1364 except where amended by this specification.

- a) Drying shrinkage
- b) Compressive strength or transverse breaking load (as applicable).
- c) Wetting expansion
- d) Density

GENERAL AND SPECIFIC CONDITIONS

- e) Dimensional Tolerance
- f) Cavity size

Test only applicable for concrete blocks made with clinker aggregate.

Blocks shall also be tested to determine the suction rate. The test shall consist of weighing the block, placing in a tray of water such that only 3 mm of the block side is immersed for a period of sixty seconds $\pm$ 2 seconds; quickly wiping off excess water and reweighing. The suction rate is the increase in weight due to water absorbed and shall not exceed 2 kg/m²/minute. Blocks which have suction rate exceeding 2Kg/m²/minute may be used if the Contractor uses an approved water reactive additive in the mortar or can show that the blocks are wetted such that the blocks will have a suction rate not exceeding 2Kg/m²/ minute for a period of 24 hours from being laid and provided the blocks comply with all other requirements.

Concrete blocks shall be stacked on prepared dry areas free of clinker, ashes and sulphate bearing strata. Blocks of different strengths shall be stacked separately and clearly marked to differentiate the strengths.

Blocks shall not be used for a minimum of 7 days after manufacture and shall not be loaded for at least 14 days after laying. For the first 7 days after manufacture, blocks shall be cured by maintaining in a damp condition, e.g. covering with polythene sheeting after wetting blocks.

4.6 HOLLOW CLAY BLOCKS

Hollow clay partition blocks shall comply with the provisions of B.S. 1190 Section 1 and are to be hard, well burnt true to size and shape and with sharp arises and keyed faces and joints and are to be obtained from an approved manufacturer and to be equal in every respect to a sample to be deposited with and approved by the Architect.

Blocks are to be 190 mm high (to give 200 mm course height including the joint) and of the thickness given herein. Cutting of blocks is to be avoided wherever possible and full use is to be made of quarter, half and three quarter blocks and blocks with conduit recesses.

4.7 LOUVRE BLOCK WALLING

- a) To be precast concrete mix 1:1:5:3 or 25 N/mm² (12 mm aggregate) but with 10 mm finished fair on all exposed surfaces, built in cement and sand (1:5) mortar with straight horizontal and vertical joints to flush pointed both sides.
- b) Each block to be size 200 mm x 400 mm x 200 mm high and consisting of two ends each 200 mm x 200 mm x 50 mm thick joined with a 50 mm thick twice cranked louvre with top end of louvre projecting 40 mm above top of block.

4.8 STONE

All stone shall comply with the requirements of CP 121.202 for masonry and rubble walls respectively except where amended or extended by the following clauses.

GENERAL AND SPECIFIC CONDITIONS

Unless otherwise noted, all masonry walls shall be coursed squared rubble walling with mortar joints.

The size of stones for rubble walling shall be such that the length of stone does not exceed three times its height. For course squared rubble walls blocks shall not exceed 300 mm in height and shall be not less than 150 mm in height.

Where snecked rubble walls are specified, the snecks shall not be less than 100 mm square on the exposed face.

Stone for masonry shall have a minimum compressive strength of 10 N/mm². (Stone shall not be required to be tested to failure). The density of stone for masonry shall be not less than 230 kg/m³

The drying shrinkage of stone shall not exceed 0.05%.

Samples of stone provided for testing shall be tested for the following in accordance with the methods given in B.S. 2028, 1364 and the test results shall comply with the requirements of this specification.

- a) Compressive strength
- b) Density
- c) Drying shrinkage

The colour and texture of stone shall be uniform and consistent. Prior to delivering any stone to site, the Contractor shall supply the Architect with a sample of stone in order that he may approve the colour and texture. The Contractor shall ensure that sufficient suitable stone is available for the whole of the project prior to ordering the stone.

Where cast stone including stone described as artificial stone, reconstructed stone, etc is specified the stone shall comply with the requirements of B.S. 1217.

Masonry shall be of stone, having no irregular faces and only the back face if not visible shall be left as from the saw.

Prior to ordering dry stone the Contractor shall demonstrate that the stone is durable. This may be done by supplying details of buildings constructed with stone from the same quarry and which has been exposed to the same environmental condition for at least ten years.

The maximum projection from the face of stone for rubble walls shall be 20 mm beyond the specified face of the wall.

The Contractor shall provide six samples of stone measuring 150 mm x 150 mm for testing prior to delivering any stone to site. As work proceeds the Contractor shall provide six samples 150 mm x 150 mm x 150 mm for testing from every 300 m² of work.

All stone shall be stacked on prepared dry area free of clinker, ashes and sulphate bearing strata.

4.9 MULTI-COLOURING STONE WALLING

Stone for multi-coloured stone walling shall have at least three distinct colours but shall in any case be to the approval of the Architect. A sample panel of walling shall be built and on approval of the Architect will be the minimum standard for the works.

4.10 FIRE BRICKS

Clay fire bricks shall be obtained from an approved source and shall be hard, sound, square and clean, well burnt and in respect of size shall comply with B.S. 3921: 1974 Section 2.

4.11 WALL REINFORCEMENT

Where described walls and partitions shall be reinforced with a 25 mm wide strip of No. 20 S.W.G. hoop iron built into alternate horizontal joints in the wall centre. The reinforcement shall be lapped and hooked at running joints, angles and intersections and carried at least 115 mm into abutting walls at junctions.

4.12 WALL TIES

To be 3 mm diameter galvanized mild steel wire twisted butterfly wall ties.

4.13 DAMP-PROOF COURSES

The bituminous felt sheeting for damp-proof courses shall be hessian based bituminous felt complying with B.S. 743 type 4A weighing not less than 3.85 kgs per square meters. The sheeting is to be lapped 150 mm at running joints and the full width of walls at angles.

WORKMANSHIP

4.14 CEMENT MORTAR

Mortar described as cement mortar 1:4 shall be composed of 1 cubic metre (1498 kgs) of Portland Cement and 4 cubic meters of sand. Other mixes such as 1:3, 1:5 etc. shall be similarly construed.

4.15 MIXING OF MORTAR

The constituent materials shall be measured separately when dry in specially prepared gauge boxes of sizes to give the proportions specified without consolidation of the contents by ramming and shaking. The mortar shall be mixed in an approved power-driven mixer for not less than two minutes per batch and using the minimum quantity of water necessary to obtain a working consistency. The mixer shall be used as close as practicable to the works and mortar and shall be

used within 30 minutes of mixing. No partially or wholly set mortar will be allowed to be used or re-mixed.

4.16 GENERAL CONSTRUCTION

a) Setting out

The Contractor shall provide proper setting out rods and set out all work on some for course, openings, heights etc., and shall build the walls, piers etc., to the widths, depths and heights indicated on the Drawings and as directed by the Architect.

b) Building in Wood Frames

Openings for doors, ventilators etc., are to be set out and left unbuilt until the wooden frames have been fixed in position.

c) Building in Metal Windows and Doors

Openings for metal frames are to be wide enough for the frames to fit without being forced into position. Build the lugs into the joints of the walling and fill in the space between the walling and frame with cement mortar well tamped into the channel of the frames and point all round externally.

d) Building in Metal Windows and Doors

All frames must be set plumb and level and free from twist.

e) Walls to Receive Plaster & Similar Finishes

All faces of walls to be plastered etc., to have all projections dressed off and joints raked out as key.

4.17 BUILDING WALLING

a) Laying and Jointing

All blocks shall be well wetted before being laid and the top of walling where left off shall be well wetted before commencing building. Walls to be kept wet three days after building. All walls throughout the works shall be carried up evenly in 200 mm courses except where courses of less depth are required to bring walling up to level of floors, windows and the like and where otherwise described, no part being allowed to be carried up more than one metre higher at one time than any other part and in such cases the joining shall be made in long steps so as to prevent cracks arising and all walls shall be levelled round at each stage. Not more than 3 metre height of wall shall be laid in any one day.

GENERAL AND SPECIFIC CONDITIONS

Blocks shall be bedded and jointed in cement mortar as described with beds and joints 10 mm thick, all flushed up and grouted solid as the work proceeds.

b) Bonding

The blocks shall be properly bonded together and in such manner that no vertical joint in any one course shall be within 115 mm of a similar joint in the courses immediately above and below. All walling of 300 mm thickness or less shall be built in single thickness of blocks. Walling exceeding 300 mm in thickness shall be built with through bonders not more than 1070 mm apart in each course as directed by the Architect. Alternate courses of walling at all angles and intersections shall be carried through the full thickness of the adjoining wall. All perpend, reveals and other angles of the walling shall be built strictly true and square.

c) Tolerance

All courses of walls shall be level with a maximum deviation of ± 3 mm in any one metre length and a maximum overall deviation of 10 mm for length of wall exceeding 3 meters. Walls shall be plumb with a maximum deviation of ± 3 mm in any metre height of wall with a maximum deviation of ± 10 mm in the total height of the wall of any storey.

All corners of walls which are shown as being at right angles shall be square with a maximum deviation of 3 in 1000. All walls shall be straight with a maximum deviation of ± 3 mm in any one metre length and a maximum overall deviation of 10 mm in any length exceeding 3 meters.

d) Tolerance

All bed and vertical joints shall be an average of 10 mm thick with a maximum deviation of ± 3 mm of blockwork, and stone rubble walls, joints for stone masonry walls shall be 6 mm ± 1 mm thick.

e) Curing

All walls shall be maintained in a damp condition for at least 24 hours after laying. Walls under construction shall be dampened by applying water with a brush and no hosing directly on to the wall shall be permitted. When work ceases on any section of wall polythene or hessian shall be draped over the wall for at least 24 hours. If hessian is used, it shall be maintained continuously wet.

f) Cavities

Cavity walls shall be of the overall thickness shown on the drawings.

Cavities above ground level between leaves of block or masonry shall be free of mortar droppings or other debris. The Contractor shall take proper precautions to prevent mortar or debris entering the cavity.

Cavities below ground level shall be filled with mortar for cavities up to 75 mm wide and for cavities over 75 mm wide filling shall be concrete mix 1:3:6. Cavities shall be filled such that there is maximum of three times the thickness of the thinner leaf of the wall filled with wet mortar or concrete unless the wall is continuously supported for the depth.

g) Backfilling

Earth backfilling against walls shall be carried out such that the level of the backfill is always equal on each side of the wall.

When a wall has filling material on one side only to a fill width of more than three times the wall thickness, the wall shall be continuously supported during backfilling.

Backfilling shall not be carried out until at least seven days have elapsed since the laying of the blocks or stone.

4.18 REINFORCED WALLS

Steel reinforcing bars in walls shall be carefully placed and spacers used to ensure that a minimum of 20 mm cover is given to the reinforcement unless otherwise specified.

Horizontal reinforcement in mortar joints shall be laid such that the reinforcement is not in contact with the blocks or stone.

4.19 WALL TIES

Wall ties shall be provided to connect walls to steel or Concrete columns and beams to connect two unbonded leaves of wall.

Wall ties shall be provided at 450 mm centres both vertically and 900 mm centres horizontally and shall be staggered when used to connect two leaves of unbonded wall. Wall ties shall be embedded into each material by a minimum of 50 mm.

SPECIFICATIONS: ROOFING

5.1 BOX PROFILE AND CORRUGATED GALVANIZED IRON (CGI) SHEETING

Roofing

Roofing and wall cladding shall be 28 Gauge (28G) IT5 box-profiled steel sheets, factory roll-formed with uniform corrugations, free from defects, warping, or surface damage.

Sheets shall be hot-dip galvanized or pre-painted as specified. Material shall comply with relevant KS / ISO / ASTM standards for structural roofing sheets.

Approved make: Galsheet or equal and approved

Fixing and Fasteners

The roofing and wall sheets shall be securely fixed to the supporting steel purlins using:

Galvanized J-bolts complete with nuts and washers.

Neoprene/rubber washers to ensure watertight fixing and prevent leakage. Fixings shall be corrosion-resistant and suitable for external exposure.

Fixing spacing shall be in accordance with manufacturer's recommendations and engineer's approval.

Supporting Structure (Purlins)

Roofing sheets shall be fixed onto Z-purlins of size: $100 \times 75 \times 2.0$ mm Z-section steel purlins

Purlins shall be fabricated from mild steel sections, straight, true to line, and securely fixed to the main structural frame. All steel purlins shall be hot-dip galvanized or treated with approved anti-corrosion paint.

Galvanized mild steel corrugated sheeting (GCI) shall be in accordance with B.S 3083, not less than 0.56 mm (24swg) with sheets free from twist or buckle. Galvanizing must be clean, free from surface defects, and firmly bonded to the steel. Ridges, valleys, flushings and the like, of the same profile and quality with the roofing sheets shall be provided.

Galvanized mild steel ridges and valleys shall be not less than 0.56 mm (24swg) thick, of a profile to suit the specified construction, and not less than 300 mm wide.

Fixings must be of a size and pattern to suit the roof and the sheets being fixed and must be approved by the sheet manufacturer. Bolts, screws and nails must be supplied complete with plastic washers. All fixing bolts and screws must be fitted with approved plastic washers for the profile of the sheeting in use. Steel hook bolts and nuts shall comply with

B.S 1494. Cadmium or zinc plated steel roofing screws shall comply with B.S 1494, galvanized and gimlet pointed.

Roofing sheets and accessories shall be fixed in accordance with the manufacturer's recommendations to make the whole system sound and watertight.

Sheeting shall be laid with end laps of not less than 150 mm and one and a half corrugation side laps. Sheets shall be laid with open joint side laps to face away from the prevailing wind.

Eaves and end laps shall be fixed with two fixings per sheet width. Fixing at intermediate supports, where no lap occurs, shall be with one fixing per sheet width.

5.2 GUTTERS

Provide and install 26 gauge galvanized iron boxed gutters of size: 150 × 100 × 150 mm boxed section fabricated from hot-dip galvanized steel sheets, free from defects and distortion. Straight joints shall be soldier-jointed and fully sealed to ensure watertightness.

Fixing: Gutters shall be fixed using galvanized metal brackets. Brackets to be spaced at maximum 1000 mm centers. Gutters shall be laid to a true line and with adequate fall towards outlets. All steel surfaces shall receive one coat of approved primer paint before installation. Extra over the boxed gutter rate for the following accessories; Closed ends, properly sealed and fixed. Spigot outlets, securely fixed and sealed to the gutter.

Provide and fix 75 mm diameter galvanized iron downpipes: Fabricated from galvanized steel of approved thickness fixed vertically to walls or structural members using galvanized holder bats or brackets joints to be properly formed and sealed.

Extra over downpipe rate for: Swan neck bends horse-shoe ends, properly shaped and securely fixed.

Water Storage Tank: Supply, deliver, and install 10,000 litres approved PVC water storage tank, complete with all necessary accessories.

Tank Requirements: Tank shall be manufactured from UV-stabilized, food-grade PVC of approved make and quality suitable for potable water storage. Colour and model to be approved by the Engineer

Base: Tank shall be installed on a properly constructed reinforced concrete base. Base to be level, stable, and sized to manufacturer's recommendations

Accessories: Inlet connection from rainwater downpipes, Outlet valve and fittings, Overflow pipe, and lockable cover. All necessary connectors and fittings for a complete and functional installation.

Workmanship and Compliance: All works shall comply with relevant Kenyan Standards and manufacturer's instructions. Installation shall be carried out by experienced personnel. All materials and workmanship shall be subject to approval by the Project Engineer / Architect.

Measurement and Rates: Gutters and downpipes shall be measured in linear metres (m). Accessories shall be measured as extra over items (No.). Water tank shall be measured as number (No.).

Rates shall include supply, fixing, labor, tools, and all incidental costs required for completion.

5.3 SHINGLES

Shingles shall be 400 mm long nominally and red Canadian cedar fixed with copper nails to timber battens with 125 mm laps.

5.4 PROMENADE TILES

Promenade tiling will be executed by an approved specialist sub-contractor. The tiles shall be manufactured by TAC Construction Materials (Turner and Newell PLC) or by other equal and approved. The tiles shall be fixed by galvanized steel hooks to the manufacturer's specifications.

5.5 ASPHALT ROOFING

Asphalt roofing will be executed by an approved specialist roofing sub-contractor. Before any application of roofing, the Contractor is to ensure all roof surfaces are thoroughly cleaned by sweeping.

Roofing asphalt shall be to B.S 988/1966 Table 3 Column 111 Tropical Mastic asphalt laid in two coats to a total thickness of 20 mm on and including black sheathing felt and vertical surfaces local grey stone chippings or pre-cast concrete paving slabs as necessary.

The first layer of asphalt to be fully bonded to the Sheathing felt and the second layer to be laid with a 75 mm joint to the first layer.

At all junctions of covering with parapet walls, kerbs, eaves, gutters etc., the asphalt is to be turned up a minimum of 150 mm with an angle fillet at the junction with the roof and splayed at the top and tucked 25 mm into groove and pointed in cement and sand mortar.

Precast concrete tiles are to be 300 mm x 300 mm x 25 mm thick, interlocking, finished fair on exposed face and bedded in bitumen and pointed in cement mortar.

5.6 ALUMINIUM FLUSHING

Aluminium flushings shall be formed out of 22-gauge super purity aluminium with natural mill finish to B.S 1470. Where flushings are built into joints or rucked into grooves, the minimum depth is to be 25 mm and they are to be secured by folded aluminium wedges at 450 mm centres and pointed in cement mortar (1:3).

5.7 ROOF SCREEDS GENERALLY

Roof screeds are to be laid to a minimum fall and cross fall of 27 mm in 3.0 meters with a minimum thickness of 19 mm at rainwater outlets and are to be finished to the entire satisfaction of the sub-contractor executing the roofing.

5.8 CEMENT AND SAND ROOF SCREEDS

The roof screeds shall be formed of cement and sand (1:3). The screeds shall be laid in bays, square where possible, of maximum 10 square meters. Each bay shall be formed between stop boards of the correct height and cut on each side to indicate the slope required in the roofing. The screed shall be trowelled with a wood float to true and accurate falls or cross falls up to the stop boards. A 10 mm wide gap shall be left between each screed bay for the full depth of the screed.

The screeds shall be allowed to cure thoroughly to attain maximum shrinkage. Any cracks which will appear due to shrinkage shall be made good.

The screed joints shall then be covered with a 200 mm wide strip of building paper not bonded to the screed joint and well lapped at angles and junctions before the application of the roof covering.

5.9 LIGHTWEIGHT ROOF SCREEDS

Lightweight roof screeds shall be composed of bases of cement, sand and pumice (1:4:8) finished with a 12 mm cement and sand (1:5) topping laid whilst the base is still green and trowelled smooth to the satisfaction of the Architect.

The screeds are to be laid as described in cement and sand roof screeds.

5.10 P.V.C RAINWATER PIPES

P.V.C rainwater pipes and fittings are to comply with B.S 4576 with rubber ring seal joints.

Pipes are to be fixed to the structure with P.V.C holderbats or brackets built-in or plugged and screwed at maximum 2-meter centers.

Bends, swan necks, discharge chutes and fittings generally are to be fixed where necessary to facilitate the flow of water.

Rainwater outlets shall be PVC suitable for the roof finish in which they occur with domical PVC grating.

5.11 COMPLETION OF THE WORKS

On completion of the works, the Contractor shall clear away, ensure that rainwater outlets are clear and generally leave the roof area in a clean and watertight condition to the satisfaction of the Architect.

5.12 PROTECTION

The Contractor is to take all necessary precaution to protect the finished works and must ensure that no damage occurs to the footing until completion of the works.

5.13 PRECAST CONCRETE INTERLOCKING TILES

Precast concrete tiles shall conform to the general standards of precast concrete units as before described in the specifications for concrete. The tiles shall be fixed in accordance with the manufacturer's specifications with a 90 mm end lap and 50 mm side lap. Ridge cappings and hip cappings shall be bedded and jointed in colored cement and sand (1:3) mortar to match the color of the tiles.

SPECIFICATIONS: CARPENTRY & JOINERY

PART 6: CARPENTRY AND JOINERY

6.1 GENERAL

All woodwork shall be carried out in accordance with the drawings and the principles of first class joinery construction. Unless specifically stated otherwise, sizes shown on drawings are finished sizes and the Contractor must allow for wrot faces.

MATERIALS

6.2 QUALITIES OF TIMBER

- a) The qualities of timber stated hereinafter are in accordance with the latest KENYA Government Grading Rules.
- b) All timber described as Prime Grade is to be First Grade (Grade II).
- c) All timber described as Selected Grade is to be Second Grade (Grade II).
- d) All hardwood is to be Prime Grade (Grade I).

- e) All timber for permanent work in the building shall before use be approved by the Architect for quality in accordance with the foregoing specification for its respective grade. Any timber not so approved by the Architect shall be removed from the site forthwith.

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6.3 MISCELLANEOUS MATERIALS

- a. Tapered timber pellets for filling screw holes must be cut across the grain and shall be of the colour and grain being plugged.
- b. Metal fixing devices must be fully rust-proofed. Cramps, brackets, plugs, bolts etc. must be of a type, make and pattern approved by the Architect.
- c. Adhesives must be suitable for use in the local conditions and be compatible with the materials with which they are in contact.

6.4 NAILS AND SCREWS

Nails shall comply with B.S. 1201, screws shall comply with B.S. 1494 and bolts shall comply with B.S. 916.

6.5 TOLERANCES

The method of construction must accommodate tolerances as shown on the drawings and allow for ensuring that repetitive units can be accurately located in relation to grid lines and that tolerances do not accumulate.

Reasonable tolerance shall be provided at all junctions between joinery and the building carcass, whether of masonry or frame construction, so that any irregularities or movement may be adequately compensated.

6.6 JOINTING

- a. Where the use of bolts and washers is specified the holes are to be bored from both sides of the timber and to be a diameter $D + D/16$ where D is the diameter of the bolt. Nuts must be brought up tight but care is to be taken to avoid crushing of the timber under the washers.
- b. Joints in joinery must be as specified or detailed and so designed and secured as to resist or compensate for any stresses to which they may be subjected. All nails, sprigs etc. are to be punched and puttied.
- c. Loose joints are to be made where provision must be made for shrinkage, glued joints where shrinkage need not be considered and where sealed joints are required. All glued joints shall be cross-tongued or otherwise reinforced.
- d. Glues for load bearing joints or where conditions may be damp must be of the resin type. For non-load bearing joints, or where dry conditions can be guaranteed, resin or organic glues may be used.

6.7 FRAME WORK

The word "framed" shall mean and include all the best known methods of jointing woodwork together by mortice, tenon, dovetail or other methods and for forming all necessary stops, mitres or mason's mitres in members which are moulded, rebated etc.

6.8 PLUGGING

Plugging and fixing to walls in all trades shall be executed by "Rawl plugging" or similar approved proprietary methods all in accordance with the manufacturer's printed instructions. Hacking of holes and filling with timber plugs will not be permitted under any circumstances.

6.26 SOFTWOOD

Fixing shall be by means of non-rusting screws with counter sunk heads to proprietary plugs or grounds. Nailing will not be permitted.

Sections shall be neatly and accurately cut so as to avoid splitting of the wood.

SPECIFICATIONS: STRUCTURAL STEEL-WORK

PART 7: STRUCTURAL STEEL – WORK

7.1 APPROVED SUB-CONTRACTOR

The whole of the structural steelwork is to be executed by a specialist sub-contractor who is to specifically be approved by the Engineer and the Contractor and will be required to make arrangements for the execution of this work and bear all expenses incurred. No change in the rates inserted by the Contractor in these Bills of Quantities will be allowed.

7.2 ARCHITECT/ENGINEER

For the purpose of the steel structure, the Structural Engineer shall be deemed vested with the duties of and be the representative of the Architect.

7.3 QUALITY OF MATERIAL AND WORKMANSHIP

The quality of all materials and workmanship used in the execution of the works shall comply with the requirements of current relevant British Standards and Codes of Practice, including all the amendments

7.4 BRITISH STANDARDS AND CODES OF PRACTICE

B.S 4360 Weld able Structural Steels

GENERAL AND SPECIFIC CONDITIONS

B.S 449 The use of Structural Steel in Building, (incorporating B.S Code of Practice C.P 113 including Addendum No. 1)

B.S 4 (Part 1) Hot rolled sections

B.S 4 (Part 2) Hot rolled hollow sections

B.S 938 General requirements for the metal arc welding of Structural Steel Tubes to B.S 1717, (B.S 938 will be considered to apply to the requirements for welding of hot rolled hollow sections to B.S 4 Part 2).

B.S 1775 Steel tubes for Mechanical, Structural and General Engineering Purposes.

B.S 1856 General requirements for the metal arc welding of Mild Steel.

B.S 639 Covered Electrodes for the metal arc welding of Mild Steel.

B.S 2008 Protection of Iron and Steel Structured from Corrosion.

7.5 TESTS

The Engineer may at any time require any materials to be tested in accordance with the requirements listed above. The cost of all successful tests shall be borne by the Employer. The Contractor shall, if required by the Engineer, promptly supply at his own expense test pieces. The costs of tests of materials failing to comply with these standards shall be borne by the Contractor. If in the opinion of the Engineer, faulty material and/or workmanship has been used in the works, the Contractor may be directed to dismantle and cut out the parts concerned and remove them for examination and testing. The cost of dismantling, cutting out and making good to the approval of the Engineer shall be borne by the Contractor.

7.6 FABRICATION

Provide, fabricate, supply, and erect H/I-section steel columns, beams, and roof support members complete, all in accordance with the Structural Engineer's drawings, details, and specifications.

All steel members shall be of approved structural steel grade, accurately cut, drilled, welded, and assembled in a competent fabrication workshop. Fabrication and erection tolerances shall comply with relevant standards. Bolts, nuts, washers, welds, and connection plates shall be of approved quality and strength.

Prior to fabrication, the Contractor shall prepare detailed workshop fabrication drawings for all steel works under this Contract and submit two (2) sets for review and approval by the Structural Engineer/Project Engineer. The submission shall include drawings, member schedules, connection details, material specifications, samples where required, and progress photographs. Fabrication shall not commence until written approval is obtained.

GENERAL AND SPECIFIC CONDITIONS

All steel surfaces shall be cleaned, free from rust, oil, scale, and mill residues, and treated with two (2) coats of approved chromate primer paint applied in accordance with the manufacturer's instructions. Touch-up painting shall be carried out after erection where necessary.

Erection shall be carried out by skilled personnel using approved methods, ensuring correct alignment, plumb, and stability at all stages. Temporary supports shall be provided as required. All works shall be completed to the satisfaction and approval of the Structural Engineer/Project Engineer.

The standard of work and the general procedure to be followed during fabrication shall be in accordance with B.S 449. The Contractor must ascertain all dimensions on site prior to commencement of fabrication.

- a) Cutting & Bending: All members, plates, brackets etc. shall be neatly and accurately sheared, sawn or profiled to the required shape as shown on the drawings. Where steel is oxy-cut to shape, care shall be taken to preserve the full finished sizes required. If members or plates are bent or set, the bends or sets shall be correctly made to the radii or angles specified without leaving hammer marks. The materials may be heated to permit this. Material that has been heated should be annealed to approval.
- b) Punching & Drilling: Holes for black bolts shall be drilled or punched 2 mm larger in diameter than the bolt size. Holes for high tensile friction grip bolts shall be drilled or sub punched and reamed to 2 mm larger in diameter than the specified bolt size. All drilled holes shall be parallel sides and shall be drilled by axle of holes perpendicular to the surfaces. Badly drilled holes shall either be reamed out to approval and larger bolts fitted or otherwise as directed. All rough arises shall be ground off. Holes for bolts in material thicker than 15 mm must be drilled. When holes are drilled in one operation through two or more thickness of material, the parts shall be separated after drilling and all burrs (rough edges) removed before assembly. Holes for bolts shall not be formed by a gas cutting process. Holes formed or enlarged by oxy-cutting will not be accepted and must be filled to approval by electric welding and re-filling.
- c) Bolting: All bolts used shall be of such length that at least one thread is exposed beyond the nut after the nut has been tightened. Where a nut or bolt head would bear on an inclined surface, a beveled washer of the correct shape shall be interposed between the two surfaces. Beveled washers shall not be allowed to get out of position during fabrication and erection and for this purpose may be spot welded to the steel surface.

Bolting:

Beveled washers for use with high tensile bolts shall not be welded.

- a. Black Bolts, Nuts and Washers. Black bolts shall comply with the requirements of B.S 916. (B.S.W Threads) or B.S 2708 (U.N.C. Threads) as appropriate.
- b. Close Tolerance Bolts. Close tolerance bolts shall conform to B.S 916 or B.S 2708
- c. High Tensile Bolts. High tensile bolts shall conform to B.S 1768.

GENERAL AND SPECIFIC CONDITIONS

- d. High Strength Friction Grip Bolts
 - General grade bolts to B.S 3139 Part 1
 - Load indicating bolts manufactured by G.K.N Ltd. or any other approved manufacturer.
 - High tensile bolts to B.S 1768.
- e. Rawl Bolts. Rawl bolts shall be those manufactured by Rawlplug Company Ltd. or any other approved manufacturer.
- f. Washers. Plain and tapered washers to B.S 3410. Spring washers to B.S 1802. Washers for high strength friction grip bolts shall be appropriate to the type and quality of bolt specified.
- g. Rivets. The steel used for rivets shall be in accordance with B.S 4360 and in the case of high tensile steel rivets shall be so manufactured so that they can be driven and the heads formed and the physical properties not impaired.
- h. Pressed Steel Sections. Pressed or cold rolled steel purlins and girders shall be to the sizes indicated on the drawings and shall be formed from approved steel strip with a minimum yield strength of 175 N/mm².
- i. Pressed Steel Sections. The sections shall be manufactured straight and free from twist. The tolerance away from straightness shall not be greater than 2 mm for every 2000 mm in length along any folded edge.
- j. Electric Welding. All welding shall be carried out in strict accordance with the requirements of B.S 1856 and B.S 2624 as appropriate and electrodes shall comply with B.S 639. Fusion faces shall be free from irregularities such as tears, fins, etc. which would interfere with the deposition of weld metal. Fusion faces shall be smooth and uniform and shall be free from loose scale, slag, rust, grease, paint and other deleterious material. All welds shall be of approved type and finished size as specified. Welding shall be carried out in such sequence that results in minimum distortion of the welded parts. Preparation of edges for welding shall be carried out by planing or machine flame cutting. Manual flame cutting will not be permitted. Parts to be welded shall be maintained in their correct relative positions during welding, preferably by jigs. Multi-run welds shall be carried out with each run closely following the previous run but allowing sufficient time for the proper removal of slag. The Contractor shall ensure that each run is inspected and any unsatisfactory weld cut and remade to approval. Welds in material 25 mm or greater in thickness shall be made by the Argon arc or similar approved process and special precautions shall be taken to prevent weld cracking. Unless otherwise stated, the minimum size of fillet shall be 6 mm. On completion, welds shall present a smooth and regular finish. Weld metal shall be solid throughout with complete fusion between weld metal and parent metal and between successful runs throughout the joint. Defects shall be cut out and made good to approval in sound weld metal.
- k. Electric Welding. The external faces of butt welds are to be ground smooth on completion to the approval of the Engineer.

7.7 SHOP AND FIELD CONNECTIONS

- a) Rolled Sections

All shop connections shall be electric welded or bolted with high tensile bolts.

GENERAL AND SPECIFIC CONDITIONS

No bolts used shall be less than 12 mm diameter and no weld less than 40 mm in length. At least two bolts shall be used in connections transmitting loads unless otherwise indicated by the Engineer.

No weld of length less than four times the nominal fillet size shall be deemed capable of carrying load.

Beam to column connections not detailed shall be on 'Standard' top and bottom cleat connections with the load carried on the bottom cleat. Standard web connections shall be used for connecting beams to beams.

Field connections shall be as detailed, i.e. bolted with high tensile or black bolts in drilled holes. Black bolts in punched holes will only be permitted for connections carrying a designed load or for connections to timber members.

b) Structural Hollow Sections

Hollow sections shall be connected by electric welding unless specified otherwise.

The designs of welds shall be in accordance with Clauses 53 and 54 and Appendix of B.S 449.

Butt welds in tension members shall not be permitted unless the prior approval of the Engineer in writing has first been obtained.

Butt welds where permitted shall be made with the fusion surfaces of the ends of each member properly prepared and the member properly aligned.

7.8 ASSEMBLY

a) Trusses and Portal Frames

Trusses and portal frames shall be carefully set out to the dimensions shown in the drawings.

Where it is required that trusses be cambered, such camber shall be provided by bending the bottom chord to an arc of a circle.

Notwithstanding any dimensioned spacing of purlin cleats, the Contractor shall ensure that purlin cleat spacing is satisfactory for the available stock lengths of roof sheeting. However, the Engineer's approval must first be obtained before any alteration is made in purlin spacing or sheeting sizes.

Splices in portal and other frames shall be made where shown on the details or where directed by the Engineer.

b) Boxed Members

GENERAL AND SPECIFIC CONDITIONS

Abutting edges of boxed members shall be connected and sealed with a continuous weld to exclude the entrance of moisture. Where specified, such welds shall be ground flush, to approval.

c) Shop Assembly

Assembly of the units in the shop prior to transporting to the Site must be inspected by the Engineer prior to painting. The assembled work shall be laid out in the shop or yard such that all parts are accessible for inspection or testing.

The Contractor shall furnish all facilities for inspection and testing of the works and must notify the Engineer on every occasion materials are ready for inspection.

d) Marking

All members of the structures to be site assembled shall be marked in accordance with the site details and marking plans submitted to the Engineer for approval.

7.9 ERECTION

a) Site Dimensions

Erection shall not commence unless and until accurate site dimensions have been taken by the Contractor. No claims will be considered should site dimensions differ from those on the drawings. Any modifications in the structural steel required in order to comply with site dimensions shall be made on the ground to the Engineer's approval before erection is commenced.

b) Safety

All erection shall be carried out by competent and experienced personnel and the Contractor shall take every care to safeguard members of the public, workmen and adjoining property against injury and/or damage. The Contractor shall be held responsible for all damage caused to the structure, workmen or other property during erection.

All gear used shall be adequate strength and shall comply with all current regulations.

During erection, the work shall at all times be adequately bolted, guyed and/or braced to make the structure secure.

c) Storage and Handling

Steel members shall be stored, handled and erected in such a manner that no member shall be subjected to excessive stresses which could have adverse effects on the properties of the steel. If, in the opinion of the Engineer, the steelwork has been subjected to such treatment, the Contractor shall remove the member from site and replace it at his own expense.

GENERAL AND SPECIFIC CONDITIONS

d) Erection Notes

No member or part of a member which has been bent or distorted shall be erected in that condition. All straightening shall be done on the ground.

Stanchions shall be wedged to line and level on steel or cast iron wedges and checked by the Engineer. After acceptance, stanchion bases shall be grouted to approval before wedges are removed. Unless otherwise shown on the drawing, all stanchions shall be left truly vertical and correct to line and level. Beams, girders, etc. shall be erected level, unless otherwise shown, and correctly positioned.

Trusses and open web joists shall be carefully handled at all times and during erection shall be lifted at such points and in such a manner that will preclude any possibility of damage from excessive stresses.

Packing plates, shims, washers or similar adjusting pieces found necessary to accommodate tolerance in structural site dimensions shall be provided and fixed to the approval of the Engineer.

Immediately after erection, each truss shall be made secure by purlins, bracing or guys to the approval of the Engineer. Bracing shall be fixed in position as soon as dependent portion of the work is completed.

e) Tightening and Testing High Tensile Friction Grip Bolt

Before assembly, the contact surfaces, including those adjacent to the washers, shall be descaled and be free from dirt, oil, loose scale, burrs, paint (except priming paint), pits and other defects that would prevent proper seating of the parts.

Bolts shall be fixed with approved hardened flat or tapered washers as required between the bolt and nut and the softer mild steel.

When bearing faces of the bolted part have a slope of more than 1 in 20 with respect to a plane normal to the bolt axis, square smooth beveled washers shall be used to compensate for the lack of parallelism.

All bolts shall be tightened by the 'Turn of Nut' method. This method shall generally be specified in B.S 3259 and as approved by the Engineer to achieve a minimum tension equal to the roof load.

f) Grouting

Unless otherwise detailed on the drawing, a space of not less than 40 mm shall be provided between undersides of column base plates and footings and between beams and roof truss bearings and concrete pads.

GENERAL AND SPECIFIC CONDITIONS

After each column, beam or roof truss has been wedged up to a line and level and fixed in position to approval, the space between footing and pad and underside of column base plate or steel member shall be grouted with a mixture of one part of Portland cement and one part of approved washed sand (1:1)

The Portland Cement and sand shall be thoroughly mixed together with sufficient water to produce a mixture of damp earth consistency and shall be used within 20 minutes of mixing. The caulking mixture shall be packed tightly into the space between base plate and foundation and protected from damage until it sets.

7.10 PAINTING

a) Paints

All paints are to be obtained from suppliers approved in writing by the Engineer.

Paints are to be delivered to the site or to the Contractor's fabrication site in the original containers as supplied by the manufacturer with seals unbroken and are to be used in strict accordance with the manufacturer's specifications.

Manufacturer's representatives are to be free to visit the site and inspect the materials for laboratory analysis.

Paints are not to be thinned unless instructed by the Engineer. No external painting is to be carried out during rain or when rain is likely to occur before the paint has had time to dry. All surfaces are to be dry and free from moisture during painting.

b) Preparation for Painting

All structural steel shall be thoroughly scraped and wire brushed to remove mill scale and rust. Dirt, grease and oil shall be washed off with white spirit and the steel allowed to dry.

c) Application

A first coat of Red Lead Graphite Primer or other approved primer shall be applied after fabrication of the works has been completed. A minimum of 24 hours shall elapse before the steel is moved from its position before the painting has been completed.

After delivery to site the steel shall be carefully examined and all areas where the priming coat has been damaged and/or where rust has developed shall be washed with white spirit and wire brushed as necessary and a further priming coat as for the first coat applied to completely cover the damaged areas.

During erection, surfaces of steel which are to be in contact shall be painted with one further coat of primer as previously described and the surfaces brought together whilst the paint is wet.

GENERAL AND SPECIFIC CONDITIONS

After erection, paint a second and finishing coat of 'Oil Company Aluminium Paint 360/36' or other finishing paint of standard as for steelwork. Welds shall not be painted over until they have been deslagged, inspected and approved.

Steel purlins and side rails shall generally be painted as for steelwork when the following specification shall be used.

1st Coat – Red Oxide Zinc Chromate Primer other approved primer.

2nd Coat – Robbialac 'Oil Company Aluminium Paint 360/36' or other equal and approved aluminium paint.

The interior of mild steel gutters shall be prepared as previously described and painted with two coats of Robbialac Epilac Coal Tar Epoxy Paint or other approved paint.

7.11 PRICES, MEASUREMENTS AND PAYMENTS

Prices quoted by the Contractor shall be based on the calculated weights of steel and shall include for manufacture, painting and supply, all as described in the Bills of Quantities, specified and shown on the drawings, including the cost of delivery to the site or other agreed place or places and the supply of all bolts, rivets plugs, gussets, cleats, to complete the erection of the works.

Prices shall include for erection, (all labour, scaffolding and other erection equipment necessary) and cover the cost of additional prime coat painting as previously specified. The prices shall also include for lining up, levelling and plumbing but not for grouting up of the bases.

The basis for payment for steelwork shall be the calculated steel weights of the structure. Any variation from the original design on which the tender was based, which results in either an increase or decrease in weight of the structure as completed, shall result in appropriate additions to or deductions from the submitted tender totals.

Any written instruction from the Engineer which may result in additional work over and above that for which the Contractor quoted will be considered as extras and shall be paid for on the basis of additional steel weights.

SPECIFICATIONS: METALWORK

PART 8: METALWORK MATERIALS

8.1 GENERALLY

All materials shall be the best of their respective kinds free from defects and all work is to be carried out in the most workmanlike manner and strictly as directed by the Architect. The materials in all stages of transportation, handling and stacking shall be kept clean and prevented from injury by breaking, bending or distortion and weather action.

8.2 MILD STEEL

Mild steel shall comply with B.S 15

8.3 HOLLOW SECTION TUBING

Square and rectangular hollow section tubing shall be hot rolled mild steel in accordance with Grade 43 C of B.S 4360.

8.4 BOLTS, NUTS AND WASHERS

These shall be fabricated from materials which comply with B.S 15 and each manufactured item shall comply with the appropriate B.S.

8.5 GALVANIZED SHEET METAL

To be No. 24 SWG of approved manufacture to B.S 2989 of best quality mild steel sheets cold rolled close annealed patent, flattened and hot dipped galvanized.

8.6 ALUMINIUM

Aluminium shall be extruded sections with an anodized finish, either natural or coloured, to give a 25-micron minimum depth to European norm EWAA.

The Contractor shall submit with each item or batch of items delivered, test certificates or such other documentary evidence as the Architect shall require that the anodizing depth specified has been achieved.

8.7 STAINLESS STEEL

Stainless steel tube shall be Austenic steel to B.S 3014 comparable to B.S 1449 type 316 S16.

8.8 METAL DOOR FRAMES

Metal door frames are to be in steel to comply with B.S 1245 of profile to suit the wall thickness.

Door frames are to be provided with the following:

- a) Two priming coats of paint.
- b) Fixing lugs for building into walls.
- c) Three galvanized steel hinges per door.
- d) Adjustable lock strike plate.
- e) Two shock absorber buffers.

8.9 STEEL WINDOWS

Steel windows shall be manufactured from section conforming with B.S 990 of heavy duty sections of the metric W20 range of approved manufacture and design approved by the Architect.

After manufacture and before delivery to site, steel windows are to be hot galvanized by dipping in a bath of molten zinc or painted with one coat primer.

8.10 ALUMINIUM WINDOWS

Aluminium windows are to be designed, manufactured and fixed in accordance with the relevant British Standards summarised below:

Where windows are described as “Black Anodised” then the final finish shall be black anodic oxidation coating to grade AA25 (or above) or B.S 1615.

Fixing, assembling, bedding frames and painting shall be executed as described for ‘Fixing of Steel Windows’.

8.11 WELDING

All welding is to be in accordance with the requirements of B.S 1856 and 938 and the electrodes shall comply with B.S 639.

GENERAL AND SPECIFIC CONDITIONS

Fusion faces shall be free from irregularities which could interfere with the welding material. These faces shall also be free from any deleterious material such as rust, grease and paint.

All welds shall be of the specified finish sizes and the sequence of the welding shall be carried out in a manner that will give minimum distortion to the welded parts.

Edges of all welding parts will be maintained in their correct position.

Welds shall be carried out with each run closely following the one prior with sufficient time between to allow for removal of slag.

Each run of weld is to be inspected and the sub-contractor shall ensure that unsatisfactory welds are cut out or remade to the required standard.

The minimum size of filled weld shall be 6 mm.

All completed welds shall have a regular and smooth surface. The weld material shall be solid with complete fusion throughout the weld and to the faircut metals.

Any defects shall be cut out or made good to approval. External faces of butt welds to be ground smooth.

8.12 PAINTING

All steel is to be wire brushed and any loose scale, dirt or grease shall be removed before any painting is commenced. One coat of red oxide primer type A to B.S 2523 shall be applied at the shop.

Any damage to the priming paint shall be made good to the Architect's satisfaction.

8.13 FIXING OF STEEL WINDOWS

Fixing of metal windows shall include for assembling and fixing, including screwing to sub-frames or cutting mortices for lugs in concrete or walling and running with cement mortar (1:4), bedding frames in similar mortar, pointing in mastic, bedding sills, transoms and mullions in mastic, making good finishes around both sides and fixing, oiling and adjusting all fittings and frames.

SPECIFICATIONS: FINISHES

PART 9: FINISHES GENERAL

9.1 OTHER SPECIFICATIONS

All other specifications of this contract where applicable are deemed to apply equally to the finishings specifications.

9.2 SAMPLES

The Contractor shall prepare at his own cost sample areas of the paving, plastering and rendering as directed until the quality, texture and finish required is obtained and approved by the Architect after which all work executed shall conform with the respective approved samples.

9.3 FINISHED THICKNESSES

The thicknesses of the floor finishes quoted in this section of the specification shall be the minimum requirements.

Suspended floors shall have a constant structural thickness and have level top surfaces. The finished floor surface will equally have a constant level and any adjustment needed to achieve this effect with the varying floor finish materials is to be made in the screeds beneath the same.

Slabs bearing on the ground may be cast to varying levels and be of constant thickness with varying formation levels, or have varying thicknesses at the option of the Contractor. This stipulation in no way relieves the Contractor of the requirements of the specification for structural works.

Finishing Works

Lime gauged plaster as described shall be applied to internal wall surfaces, comprising 12mm thick gauged plaster of cement, sand and lime, mixed in approved proportions and finished smooth with a float, true to line, plumb and free from cracks or defects. Vertical and horizontal wall pointing shall be carried out to external surfaces of protective walls, with joints neatly

raked, cleaned and pointed, and bituminous paint applied to keys, all to the Architect's approval. Prepare and apply three coats of approved emulsion paint to plastered wall surfaces, including surface preparation, priming and finishing coats to achieve an even and uniform finish.

Floor Finishes (Internal):

Provide and lay 30mm thick cement/sand floor screed backing to receive terrazzo and other floor finishes, laid to appropriate falls and cross-falls and finished level, smooth and well compacted. Apply 33mm thick polished terrazzo finish, including approved plastic dividing strips fixed at approved intervals, using approved terrazzo mix, ground and polished smooth and finished to appropriate falls and cross-falls. Extra over for carborundum insert where specified, neatly incorporated into the terrazzo finish.

Floor Finishes (External – Ramps)

Externally to ramps, provide and lay 40mm thick two-coat hardened/rich concrete screed, incorporating one layer of chicken wire reinforcement, with mix consisting of quarry dust, sand and cement in approved proportions. The screed shall be laid to appropriate falls and cross-falls, finished smooth, properly jointed, and completed to the satisfaction of the Architect.

9.4 MATERIALS GENERALLY

All materials shall be of high quality, obtained from manufacturer's to be approved by the Architect.

Cement, sand and water shall be as described under Concrete Work and Blockwork.

9.5 BONDING

Bonding compounds, etc. for use in applying plaster and similar finishes direct to surface without the use of backings or screeds are only to be used if approved by the Architect and are to be used strictly in accordance with the manufacturer's printed instructions.

9.6 CHASES, OPENINGS AND HOLES

All chases, holes and the like which were not formed in the concrete or walling shall be cut and all service pipes shall be and plaster work is commenced. In no circumstances will the fixed and all holes and chases filled with mortar before paving Contractor be permitted to cut chases, holes and the like in Finished paving or plasterwork.

The term plastering refers to the operation internally and rendering to the same operation externally but for ease of reference the term plastering has generally been used in this specification to describe both operations.

9.7 MIXES

The method of measuring and mixing plaster shall be as laid down under Concrete work and the proportions and minimum thickness of finished plaster shall be in accordance with the following:

Item of Work Mix Minimum Thickness and Finish

Internal Plaster 1 part cement

$\frac{1}{4}$ part lime 4 parts sand 17 mm finish to walls ceilings.

Wood float finish unless otherwise specified.

External Render 1 part cement

4 parts sand 12 mm finish in two coats

Tyrolean finish Ditto 7 mm finished thickness in two coats on 10 mm Plastered backing

To obtain greater plasticity a small quantity of lime may be added to the mixes for external plastering at the Architect's discretion but in any case this is not to exceed $\frac{1}{4}$ part lime to 1 part cement.

With regard to the lime mortars gauged with cement, the addition just before use, of the cement to small quantities of the lime/sand mix shall preferably take place in a mechanical mixer and mixing shall continue for such time as will ensure uniform distribution of materials and uniform colour and consistency.

It is important to note that the quantity of water used shall be carefully controlled. Plaster may be mixed either in a mechanical mixing machine or by hand.

Hand mixed plaster shall first be mixed in the dry state being turned over at least three times. The required amount of water should then be added and the mix again turned over three times or until such time as the mass is uniform in colour and homogeneous.

The plaster shall be completely used within thirty minutes of mixing and hardened plaster shall not be remixed but removed from the site.

9.8 PREPARATION OF SURFACES FOR PLASTER ETC.

Irregularities in the surfaces to be plastered or rendered shall be filled with mortar, without lime, twenty-four hours before plastering is commenced. Joints in blockwork, etc. are to be well raked out before plastering to form a good key. Smooth concrete surfaces to be plastered shall be treated with an approved proprietary bonding agent or hacked to provide an adequate key for the plaster.

GENERAL AND SPECIFIC CONDITIONS

All surfaces to be plastered or rendered shall be clean and free from dust, loose mortar and all traces of salts.

All surfaces shall be thoroughly sprayed with water and all free water allowed to disappear before plaster is applied.

As far as practical, plastering shall not be commenced until all mechanical and electrical services, conduits, pipes and fixtures have been installed.

Before plastering is commenced all junctions between differing materials shall be reinforced. This shall apply where walls join columns and beams, particularly where flush and similar situations where cracks are likely to develop and as directed by the Architect. The reinforcement shall consist of a strip of galvanized wire mesh 'Expamet' or equal approved 15 cm wide which shall be plugged, nailed or stapled as required at intervals not exceeding 45 mm at both edges. The surfaces to which such mesh shall be applied shall be painted with one coat bituminous paint prior to fixing the mesh.

9.9 APPLICATION OF PLASTER AND RENDER

After preparation of the surfaces a key coat of cement slurry shall be applied to the wetted surface to be plastered. When this coat is dry the plaster coat shall be applied, by means of a trowel, between screeds laid, ruled and plumbed as necessary. This coat which shall be to the required thickness shall be allowed to set hard and then cured as described.

Surfaces are to be finished with a wood or steel float to a smooth flat surface free from all marks.

Tyrolean finish shall be applied with an approved machine to give a finish of even texture and thickness. The sprayed finish shall be applied in two separate coats allowing time for drying between coats.

Application in one continuous operation to build up a thick layer will not be permitted. The total finished thickness of the two sprayed coats shall be not less than 7 mm. The sprayed finish shall not be applied until all repairs and making good to the undercoat are completed. Any plaster which adheres to pipes, doors, windows and the like shall be carefully removed before it has set. Curing shall take place after the application of the second coat. The finished surface shall be wither 'rough textured' or 'Pressed' finish as directed by the Architect. Where coloured tyrolean is required this shall be obtained by the addition to the mix of an approved colour pigment.

All plastering and rendering shall be executed in a neat workmanlike manner. All faces except circular work shall be true and flat and angles shall be straight and level or plumb. Plastering shall be neatly made good around pipes or fittings. Angles shall be rounded to 7 mm radius.

All tools, implements, vessels and surfaces shall be at all times kept scrupulously clean and strict precautions shall be taken to prevent the plaster or other materials from being contaminated by pieces of partially set material which would tend to retard or accelerate the setting time.

Bituminous Painting to Rendered Plinth

The contractor to prepare and apply two (2) coats of first-grade bituminous paint to all rendered plinth surfaces as shown on the drawings or as directed by the Architect/Engineer.

Rendered surfaces shall be sound, clean, dry, and free from dust, loose material, grease, and laitance before application. Any defects in the render shall be made good and allowed to cure prior to painting.

The first coat shall be applied evenly as a priming coat and allowed to dry thoroughly before the second coat is applied to achieve a continuous, uniform protective finish. Application shall strictly follow the manufacturer's instructions regarding coverage and drying times.

All work shall be executed to the approval of the Engineer and in accordance with the relevant standards.

9.10 CURING OF PLASTER

Each coat of plaster is to be maintained in a moist condition for at least three days after it has developed enough strength not to be damaged by water.

9.11 ANGLE BEADS

Where required by the Architect, salient external angles of plastered walls shall be protected with galvanized mild steel angle beads complying with B.S. 1247 profile C3.

They shall be securely plugged, nailed or stapled as required at intervals not exceeding 450 mm at both edges.

9.12 PLASTER STOPS

Where shown on details, plasterwork shall be stopped against "Expamet" galvanized steel plaster stop, reference 575 which shall be securely nailed to walls in the positions indicated on the drawings.

Stops shall be neatly and closely fitted together at corners and it is important that they are secured to walls through all holes provided.

9.13 CEMENT AND SAND SCREEDS

Screeds shall be mixed and formed as described.

9.14 SURFACE HARDENERS

Floor hardeners shall comprise an approved type guaranteed by the makers to produce a hard dense concrete with high abrasive resistance, impervious to the penetration of heavy oils, acid or alkali solutions and to be used strictly in accordance with the maker's instructions.

The first dressing of sodium silicate for granolithic flooring shall be one part of sodium silicate to six parts of water by volume.

Subsequent dressings shall be composed of one part of sodium silicate to four parts of water by volume, for all surface. The two liquids shall be well mixed together, sprayed over the flooring and spread evenly with a mop or soft brush, any excess being wiped off and the flooring allowed to dry for at least 24 hours after each dressing. After final drying floors shall be washed with clean water.

9.15 RATES OF IN-SITU WORK

The rates for in-situ work shall include for raking out joints of blockwork or bonding coat or spraying cement slurry on new concrete surfaces to form key, for work in narrow widths, small and isolated areas, rounded arises, fair and chamfered edges, for making good and working around pipes, brackets etc. and for all other incidental labours.

Rates shall also include for masking before the application of spray finishes work executed overhead, temporary rules, supports, screeds and templates.

9.16 TILE, SLAB AND BLOCK FINISHING

Vinyl asbestos floor tiles shall comply with B.S. 3270 of an approved manufacturer to patterns as directed by the Architect. Adhesives are to be as recommended by the manufacturer in writing and approved by the Architect.

The tiles are to be laid and bedded direct in adhesive on to a cement and sand bed to make up the total paving thickness.

The cement and sand screed is to be finished with a steel trowel to a perfectly smooth surface before the application of the mastic and tiling.

On completion the vinyl asbestos tiles are to be sealed and polished with wax all in accordance with the manufacturer's printed instructions.

9.17 RUBBER STUDED FLOOR TILES

Rubber studded floor tiles are to be of approved manufacture and shall have the following specifications:

- a) Tile size 500 x 500 mm

- b) Thickness 4 mm
- c) Weight 5.84 kg. per M3
- d) Hardness IRHD80 + or - 5
- e) Breaking load 70 kg. Per mm3
- f) Extension of break 200 g
- g) Effect of burning to be slight localised change of colour only.
- h) Brasion under load of 0.5 kg. 300 mm3
- i) Colour black or brown

Adhesives are to be polychloroprene as approved by the manufacturer and the Architect.

9.18 LINOLEUM

Linoleum sheets shall be:

- a) Manufactured by Krommenie Linoleum, N.V. Nederlandsche Linoleum Fabriek, krommenie, Holland or equal and approved.
- b) 3.2 mm thick
- c) In accordance with B.S. 810
- d) Smooth, uniform and free from indentations or protrusions.

9.19 CLAY TILE PAVING

Clay tile pavings are to be in 150 mm x 150 mm tiles obtained from an approved manufacturer and are to be laid on prepared screeds. The tiles are to be bedded in cement and sand (1:4) with straight joints in each direction. Upon completion grout in cement and wash and clean down. Tiles are to be cut with an electric tile cutting saw.

9.20 GLAZED WALL TILES

Glazed wall tiles shall be in accordance with B.S. 1281 and shall be 150 x 150 x 7 mm tiles from the standard colour range with cushion edges. Wall tiling shall be carried out in accordance with C.P. 212.

9.21 THERMOPLASTIC TILES

Thermoplastic tiles shall be:

- a) In conformity to B.S. 2592
- b) Size 300 x 300 x 3 mm thick

9.22 CERAMIC TILES

Ceramic tiles shall be:

GENERAL AND SPECIFIC CONDITIONS

- a) Manufactured by Daniel Platt & Sons Limited, Brownhills Tileries, Tunstall, Stoke-on-Trent, ST7 4NY, England or equal approved.
- b) Weigh 1000 kgs. per 29 square meters
- c) 10 mm Thick
- d) Fixed in accordance with Code of Practice CP 202: 1972 and AMD 3271 June 1980.

9.23 PRECAST TERRAZZO TILE PAVING.

Terrazzo tile pavings are to be in sizes as specified x 25 mm thick bedded on cement mortar screeds and jointed and pointed in white cement. The tiles are to be laid with straight joints in both directions and cleaned down on completion. Tiles are to be cut with an electric cutting saw.

The mix of the terrazzo for tiles is to be as described under "Insitu Terrazzo Pavings".

9.24 PRECAST CONCRETE PAVING SLABS

To be all in accordance with B.S. 378. The slabs are to be of the sizes given herein and bedded, jointed and pointed in cement lime mortar (1:2:9).

9.25 RATES

The rates for tile, slab and block finishings shall include for rounded edge tiles and angles, cutting and fitting up to boundaries and around pipes, brackets, etc. and waste for work in narrow widths, small and isolated areas and for all other incidental labours.

SPECIFICATIONS: GLAZING

PART 10: GLAZING MATERIALS

10.1 GENERAL

Glass used for glazing and for mirrors shall be best quality clear glass free from visible defects so as to afford uninterrupted vision and deflection as appropriate and without obvious distortion.

10.2 PUTTY

- a) The putty for glazing to wood sashes is to be linseed oil putty all as B.S 544.
- b) The putty for glazing to metal windows is to be gold size metal window putty specially designed for tropical use, or patent mastic putty if approved by the Architect.
- c) All putty shall be delivered on site in the original manufacturer's sealed cans or drums and used direct therefrom with the addition only of pure linseed oil necessary. No mineral or other oils may be used in the putty except genuine linseed oil.

WORKMANSHIP

10.3 GENERAL

Glazing of all types and in all locations shall be carefully executed by artisans skilled in this type of work and in conformance with the recommendations of CP 152. Glazing shall be carefully fitted so that it is not subject pressure and stresses imposed by being an oversized fit within the framing.

10.4 MEASUREMENTS

Each element (door, window, etc.) to receive glass shall be accurately measured to ensure a perfect fit subsequently.

10.5 DAMAGE

All glass shall be checked before installation to ensure that defective glass is not installed. Notwithstanding that, if in the opinion of the Architect any installed glazing is defective, it shall be removed and replaced free of charge to the satisfaction of the Architect.

10.6 CLEANING

All window glazed panels and mirrors shall be cleaned both inside and outside immediately prior to handing over of the building to the satisfaction of the Architect.

SPECIFICATIONS: PAINTING AND DECORATING

PART 11: PAINTING AND DECORATING MATERIALS

11.1 MANUFACTURERS

Except where stated all materials shall be obtained from approved manufacturers. The Contractor shall state the name and address of the manufacturer whose materials he proposes to use. Once approval has been given the Contractor shall not obtain materials from other sources without the prior written agreement of the Architect.

11.2 GENERAL

Each succeeding coat of priming, undercoating and finishing (pigment) or clear coating shall be sufficiently different in colour as to be readily distinguishable.

All primers and paint in one system upon a particular surface shall be obtained from the same manufacturer.

The mixing of paints, etc. of different brands before or during application will not be permitted.

11.3 EMULSION PAINTS

Emulsion paints shall be matt or satin finish vinyl emulsion paint.

The first (mist) coat shall be thinned in accordance with the manufacturer's instructions.

11.4 GLOSS PAINT

Gloss paints shall be hard gloss finish oil paint.

11.5 LEAD BASED PAINTS

The use of lead based paints will not be permitted.

11.6 CLEAR FINISHES

Clear finishes internally shall be clear polyurethane varnish (one pack)

11.7 PRIMERS AND UNDERCOATS

Unless otherwise specified, primers and undercoats shall be of the type recommended by the manufacturer of the finishing coats specified for a particular surface. Primer for external bare metalwork surfaces shall comply with B.S 2523.

11.8 KNOTTING

Shellac knotting shall comply with B.S 1336

11.9 WHITE SPIRIT

The white spirit shall comply with B.S 245.

11.10 TIMBER STAIN

Timber stain shall be oil based pigmented stain. The application of this material shall be strictly in accordance with the manufacturers written instructions. Tint and degree of application shall be to the approval of the Architect.

11.11 STOPPING

The stopping shall be as follows:

- a) Plaster work shall be plaster based filler.
- b) Concrete and brickwork shall be similar material to the background and finished in a similar texture.
- c) Internal woodwork, plywood and blockboard shall be putty complying with B.S 544.
- d) External woodwork shall be white lead paste complying with B.S 2029.
- e) Internal clear wood finishes: the stopping shall be that recommended by the lacquer manufacturer.

11.12 FILLERS

The fillers for internal joinery shall be the type recommended by the paint manufacturer for use with this type of paint or lacquer.

Stoppers and fillers shall be tinted to match the undercoat, and shall be compatible with both undercoats and primers.

All materials shall be used strictly in accordance with the manufacturer's instructions.

11.13 TEXTURED COATING

Textured coating is to be of proprietary manufacture approved by the Architect, of an approved colour.

GENERAL AND SPECIFIC CONDITIONS

Technical information concerning the coating is to be submitted to the Architect before ordering but the minimum qualities of the coating are to be as follows:

- a) Suitable for application internally and externally to plastered, rendered, concrete, block, stone, brick, asbestos and timber surfaces.
- b) Minimum durability of 10 years even in exposed surfaces.
- c) Maintenance fee.
- d) Built-in mould resistant fungicide.

11.14 GENERAL WORKMANSHIP

Workmanship generally shall be carried out in accordance with CP 231, unless otherwise specified.

Before painting is commenced, floors shall be swept and washed over, surfaces to be painted shall be cleaned before applying paint as specified and all precautions taken to keep down dust whilst work is in progress.

No paint shall be applied to surfaces structurally or superficially damp, and all surfaces must be ascertained to be free from condensation, efflorescence, etc. before the application of each coat.

No painting shall be carried out externally during humid, rainy, damp, foggy or freezing conditions where surfaces have attained excessively high temperatures or during dust storms.

No new, primed or undercoated woodwork and metalwork shall be left in an exposed or unsuitable situation for an undue period before completing the process.

No dilution of paint materials shall be allowed except strictly as detailed by the manufacturer's own direction, either on the containers or their literature, with the special permission of the Architect. For external work, dilution of paints will not be allowed whatsoever. For internal work, where permitted by the Architect, undercoats may be thinned by the addition of not more than 5% thinners. Gloss finish shall not be thinned at all.

Metal fittings such as ironmongery etc. not required to be painted shall first be fitted and then removed before the preparatory processes are commenced. When all painting is completed, the fittings shall be cleaned as necessary and re-fixed in position.

11.15 BRUSHWORK

Unless otherwise specified, all primers and paints shall be brush applied. Written permission must be obtained from the Architect if an alternative method of application is to be used.

11.16 STOPPING AND FILLING

Unless otherwise specified by the manufacturer, all primers and undercoats shall be stopped flush and rubbed down to a smooth surface with an abrasive paper and all dust removed before each succeeding coat is applied. Care shall be taken to avoid burnishing (make shine) of the surface.

11.17 STIRRING

Unless otherwise stated by the paint manufacturer, all paint materials shall be thoroughly mixed and/or stirred before and during use and suitably strained as and when necessary.

11.18 INSPECTION

No priming coats shall be applied until the surfaces have been inspected and the preparatory work has been approved by the Architect. No undercoats or finishing coats shall be applied until the previous coat has been similarly inspected and approved.

11.19 PAINT APPLICATION

Each coat of paint shall be so applied as to produce a film of uniform thickness. All paint shall be applied in accordance with the manufacturer's instructions. Special attention shall be given to ensure that all surfaces including edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of adjacent painted surfaces.

11.20 DRYING

All coats shall be thoroughly dried before succeeding coats are applied. Allow a minimum of 24 hours between applications on any one surface, unless otherwise stated by the manufacturer.

11.21 UNPRIMED WOODWORK

Unprimed woodwork scheduled to be painted shall be rubbed down with abrasive paper and dusted off. Care shall be taken to prevent burnishing of the surface. All knots and resinous areas shall be coated with two coats of knotting. Pitch on large, open unseasoned knots and all other beads or steaks of pitch shall be scraped off, or if still soft, shall be removed with white spirit before applying the knotting. Apply one coat of priming to all surface, two coats to all end grain, to be subsequently painted. Backs of all wood frames in contact with concrete, brickwork, blockwork and metalwork or similar material shall be primed before fixing. After priming all joints, holes, cracks shall be stopped and filled, rubbed down and dusted off.

11.22 PRIMED WOODWORK

Woodwork delivered primed shall be lightly rubbed down with abrasive paper and dusted off. Touch up bare areas with a similar priming including open grained ends. After touch priming all joints, holes, cracks and open grained ends shall be stopped and filled, rubbed and dusted off.

11.23 PLYWOOD AND BLOCKBOARD

Edges of exterior plywood and blockboard shall be sealed with two coats of aluminium primer and the backs treated with a lead primer.

11.24 CLEAR FINISHED WOODWORK

All woodwork scheduled to receive a clear finish shall be well sanded with the grain removing all dirt etc. to give as smooth a surface as possible. Resinous timber shall be swabbed (mopped) down with white spirit and dried thoroughly. Split or end grain shall be filled with suitable filler recommended by the lacquer manufacturer, in accordance with their instructions and of the appropriate shade.

11.25 BARE METALWORK

Bare metalwork shall be thoroughly cleaned of all dirt, grease, rust and scale by means of chipping, scraping and wire brushing, particular attention should be given to the cleaning of welded, brazed and soldered joints. Wash down with white spirit and dry with clean rags. Apply a coat of metal primer immediately the cleaned surfaces have been approved by the Architect.

11.26 GALVANIZED METALWORK

Galvanized metalwork scheduled for painting shall be thoroughly cleaned of dirt, grease dusted and washed down with white spirit and wiped dry with clean rags. Any minor areas of rust shall be removed by wire brushing and spot primed with a zinc rich primer. Apply at least one coat of calcium plumbate primer to all surfaces subsequently to be painted.

11.27 PRIMED METALWORK

If the priming coat of pre-primed metalwork has suffered damage in transit, or during erection on site, the affected areas shall be cleaned off by wire brushing, abrading and dusting off, the bared patches touched up with a primer of a similar type to that already applied.

11.28 COPPER

Copper scheduled for painting shall be lightly abraded with emery cloth, washed with white spirit and wiped dry with clean rags. Apply a coat of the primer immediately the cleaned surfaces have been approved.

11.29 BRICKWORK, CONCRETE ETC.

All brickwork, blockwork, concrete, rendered and plaster surfaces scheduled to be painted shall be brushed down, all holes and cracks filled, all projections such as plaster or mortar splashes etc. removed to leave a suitable dust free surface. All traces of mould oil shall be removed from concrete surfaces by scrubbing with water, detergent and rinsing with clean water. All these

surfaces shall be thoroughly dry before any primer and paints are applied. Apply a coat of alkali resisting primer where surfaces are to be finished with oil paints or alkalyd resin type emulsion.

Asbestos cement surfaces scheduled for painting shall be brushed down to remove powdery deposits and a coat of alkali resisting primer applied where such surfaces are to be finished with oil paints or alkalyd resin type emulsion.

11.30 COLOURS

The colours will be selected by the Architect from the paint manufacturer's standard colour range.

11.31 TOXIC WASH

Concrete, blockwork, plaster and timber surfaces which are to be painted shall be washed down prior to painting with a toxic wash applied by brush or spray. A second wash shall be applied two days after the first wash. The surfaces shall be allowed to dry out completely before application of paint.

11.32 PROTECTION

Proper care must be taken to protect surfaces while still wet by use of screens and wet paint signs where necessary.

11.33 DAMAGE

Care must be taken when preparing surfaces, or painting etc. not to stain or damage other work. Dust sheets and covers to the satisfaction of the Architect shall be used to protect adjacent work. Any such stains or damage shall be removed and made good at the Contractor's expense.

11.34 CLEANLINESS

All brushes, tools, pails, kettles and equipment shall be clean and free from foreign matter. They shall be thoroughly cleaned after use and before being used for different colours, types or classes of material. Painting shall not be carried out in the vicinity of other operations that may cause dust. Waste liquids, oil soaked rags etc. shall be removed from the building each day. Waste liquids shall not be thrown down in any sanitary fittings or drains.

11.35 PERFORMANCE

If, while the work is in progress, the paint appears to be faulty, such as consistency of colour, drying time, or quality of finish, the work shall be stopped at once and the manufacturer consulted.

GENERAL AND SPECIFIC CONDITIONS

The manufacturers of the materials shall be given every facility for inspecting the work during progress in order to ascertain that the materials are being used in accordance with their directions, and to take samples of their products from the site if they so desire for tests.

The finishing coats of the various paints or surface finishings shall be free from sags, brush marks, runs, wrinkling, dust, bare or starved patches, variations in colour and texture, and other blemishes.

When the work has been completed, the finished surfaces shall not be inferior in quality. Colour and finish to the samples approved by the Architect and imperfections in manufacture shall not be apparent through these finished surfaces.

In the event that the Architect is not satisfied that the quality of finish does not comply with the required standards and/or the sample panel, the Contractor will be required to repaint at his own expense, such work to the satisfaction of the Architect. If in the opinion of the Architect it is necessary to remove completely the unsatisfactory paintwork, this shall also be done under the direction of the Architect and at the expense of the Contractor.

11.36 PACKAGING, DELIVERY AND STORAGE

All paints and surface coatings shall be delivered in sound, sealed containers, labelled clearly by the manufacturers, the label or decorated container must state the following:

- a) The type of product.
- b) The brand name and colour
- c) The use for which it is intended
- d) The manufacturer's batch number
- e) The B.S number if applicable
- f) All labels shall be printed - containers bearing type written labels will not be acceptable.

Materials shall be stored under cover in accordance with the manufacturer's instructions and with local fire and safety regulations. The store itself must be maintained at a temperature of not less than 50 degrees F (10degrees C) and must not be subjected to extreme changes of temperature.

The batch deliveries are to be dated and used strictly in order of delivery.

11.37 VINYL EMULSION PAINT

Surfaces to be painted shall receive one mist coat followed by two final coats of vinyl emulsion paint.

11.38 GLOSS FINISH PAINT

Surfaces to be painted shall be primed then painted with two undercoats followed by one coat gloss finish paint.

11.39 CLEAR POLYURETHANE VARNISH

Surfaces to be clear varnished shall be treated with two coats polyurethane varnish.

11.40 TEXTURED COATING

The manufacturer's instructions concerning application of the coating are to be strictly followed under the direction of the Architect.

All surfaces to receive textured coatings are to be clean and dry with surfaces scraped and brushed before application of the coating. Application of the coating is to be with textured roller fibre brush as directed by the Architect with a minimum spreading capacity of 1 kilogramme per square metre. Under no circumstances is the coating to be thinned.

SPECIFICATIONS: CIVIL WORKS SITE CLEARANCE

PART 12: SITE CLEARANCE

12.1 CLEARING SITE

The Contractor shall remove all obstructions, grub up and remove trees, hedges bushes and shrubs and clear the site of the works at such time and to the extent required by the Engineer, but not otherwise, the materials so obtained shall so far as suitable be reserved and stacked for further use; all rubbish and material unsuitable for use shall be destroyed or removed from the site.

Where top soil has to be excavated, this shall be removed and stacked on site. After completion of construction, it shall be spread over the disturbed ground, any surplus being disposed of as directed by the Engineer.

12.2 VEGETATION

No allowance will be made for the cutting and removal of crops, grass weeds and similar vegetation. The cost of all such work will be held to be included in the rates entered in the Bills of Quantities for excavation.

12.3 BUSHES AND SMALL TREES

All bushes and small trees, the main stem of which is less than 300 mm girth at 1 meter above ground level shall be uprooted (unless otherwise directed by the Engineer) and burnt or otherwise disposed of as directed by the Engineer.

12.4 HEDGES

Where directed by the Engineer, hedges shall be uprooted and disposed of by burning.

12.5 GRUBBING UP ROOTS

Stumps and tree roots shall, unless otherwise directed, be grubbed up, blasted, burnt or removed and disposed of in approved dumps to be provided by the Contractor. Where directed by the Engineer, the holes resulting from grubbing up shall be filled with approved materials, which shall be deposited and compacted in layers not exceeding 225 mm loose depth, to the same dry density as that of the adjoining soil.

12.6 UNDERGROUND CHAMBERS, ETC. TO BE CLEANED

Demolition of pits, septic tanks, walls and cesspools shall be to a depth of 1 metre below formation level and the remainder shall be properly cleaned out and filled with approved materials, which shall be deposited and compacted in layers not exceeding 225 mm loose depth to the same dry density as that of the adjoining soil. Soil and surface water drains, lying within the site of the works, shall, where directed by the Engineer, be sealed off and all other services

satisfactorily severed and sealed to the satisfaction of the appropriate authorities and/or owners. Disused soil and surface water drains within 1 metre of formation level shall be required by the Engineer to be removed and trenches shall be backfilled.

12.7 WEED CONTROL

The Contractor shall take all necessary precautions against the growth on the site of weeds and remove them as necessary throughout the period of works and maintenance.

The formation level and finished surface of base of all footways and elsewhere as directed shall be sprayed with an approved persistent total herbicide at the rate recommended by the manufacturer. The application shall be by an even spray in a high volume of water at about 0.07 to 0.11 litres per sq.m. After this application the footways shall receive at least two further waterings before the surface is sealed.

12.8 PROTECTIVE FENCING OF TREES

The Contractor shall provide, maintain and remove on completion of the Works all temporary Works including roadways, sleeper tracks and stagings etc., over roads, footpaths, suitable in every respect to carry all plant required for the work or for providing access or for any other purpose.

Details of Temporary Works shall be submitted in advance to the Engineer for his approval and the approval shall not relieve the Contractor of complete responsibility for their safety and satisfactory operation.

SPECIFICATIONS: ELECTRICAL WORKS

PART 13: ELECTRICAL WORKS

13.1 SCOPE OF ELECTRICAL WORKS

The electrical works shall include the complete supply, installation, testing, commissioning, and handing over of all electrical installations for the house. This shall cover lighting installations, power outlets, switches, distribution boards, earthing and bonding systems, external electrical works where applicable, and any other electrical components required to deliver a safe, functional, and compliant electrical installation. All works shall be executed in a professional manner and to the satisfaction of the Project Engineer/Architect.

13.2 STANDARDS AND REGULATIONS

All electrical installations shall comply with the requirements of the Kenya Bureau of Standards (KEBS), the IET Wiring Regulations (BS 7671) or equivalent approved standards, regulations of the local electricity supply authority, and all applicable statutory and safety regulations. Where differences occur between standards, the most stringent requirement shall apply.

13.3 MATERIALS AND WORKMANSHIP

All materials, fittings, cables, conduits, accessories, and equipment used for the electrical works shall be new, unused, and of approved quality from reputable manufacturers. No substandard, counterfeit, or damaged materials shall be permitted on site, and any rejected materials shall be removed at the contractor's cost.

13.4 QUALIFIED PERSONNEL

Electrical works shall be carried out by qualified, competent, and licensed electricians registered with the relevant authorities. Upon request, the contractor shall submit proof of qualifications, licenses, and registrations to the Project Engineer/Architect.

13.5 DRAWINGS AND COORDINATION

The contractor shall strictly follow the approved electrical drawings and details. Proper coordination with architectural, structural, plumbing, mechanical, and other services shall be ensured to avoid clashes and rework. Any discrepancies, omissions, or conflicts in the drawings shall be reported to the Project Engineer/Architect for clarification before execution.

13.6 CONDUITS AND WIRING

All wiring shall be carried out using copper conductors of the specified sizes and insulation ratings. Wiring shall be run in heavy-duty PVC conduits concealed within walls, floors, and ceilings unless otherwise approved. Conduits shall be neatly aligned, securely fixed, and installed prior to plastering. No joints shall be permitted within conduits, and all joints shall be made only in approved junction boxes.

13.7 SWITCHES, SOCKET OUTLETS, AND ACCESSORIES

Switches, socket outlets, and electrical accessories shall be of approved type, rating, and finish. Socket outlets shall be properly earthed and installed at approved heights. All accessories shall be firmly fixed, properly aligned, and flush with finished wall surfaces.

The contractor shall supply, install and commission a 6-way 100A SPN consumer unit, flush mounted, complete with 100A SPN integral isolator, lockable cover, busbars, neutral and earth bars, internal wiring, fixings and all necessary accessories, excluding MCBs, all to approved make or equivalent. Provide and install the following MCBs to suit the consumer unit, of approved manufacture or equivalent: 10A single-pole (SP) MCB, 32A single-pole (SP) MCB, and blanking plate to cover unused ways, all correctly rated, securely fixed, tested and commissioned in accordance with the relevant electrical standards.

13.8 ELECTRICAL AND LIGHTING INSTALLATIONS

Lighting points shall be installed strictly in accordance with the drawings or as directed by the Project Engineer/Architect. Light fittings shall be installed only after completion of ceiling works and final painting. Energy-efficient lighting fittings shall be used unless otherwise specified.

13.9 DISTRIBUTION BOARD

A main distribution board shall be installed at an approved and easily accessible location. The distribution board shall be complete with a main isolator, miniature circuit breakers, residual current devices, and clearly labeled circuits. Circuit loading shall be balanced and designed to comply with applicable standards.

13.10 LIGHTENING PROTECTION, EARTHING AND BONDING

A complete earthing and bonding system shall be provided in accordance with approved standards. Earth electrodes shall be installed to achieve acceptable earth resistance values. All metallic parts, electrical equipment, socket outlets, and distribution boards shall be effectively bonded to earth to ensure safety.

Supply, install, test and commission a complete lightning protection system comprising 25mm × 3mm copper tape down conductors, including approved copper saddles fixed at 1500mm intervals, and effective bonding to water tanks and all other exposed metallic roof elements, all in accordance with the relevant standards and as specified. Provide and install copper air terminations (lightning arrestors) complete with base clamps and all necessary fixing materials, securely mounted at approved locations and heights. Provide and install test clamps to allow for inspection and testing of the system. The entire installation shall be electrically continuous, mechanically secure, properly bonded, and tested to the satisfaction of the Engineer.

13.11 EXTERNAL ELECTRICAL WORKS

External electrical installations, where applicable, shall be adequately protected against weather, moisture, and mechanical damage. All outdoor fittings shall be weatherproof and suitably rated for external use.

The Sub Contractor shall supply, install, connect and test the electric power installation as detailed on the contract drawings. Work under this section shall include:

- a) Single phase general purpose power outlets in office and basement areas.
- b) Single and 3 phase power outlets for specialist mechanical equipment such as lifts and water booster pumps.

All electrical installations shall comply with the requirements of the Kenya Bureau of Standards (KEBS), the IET Wiring Regulations (BS 7671) or equivalent approved standards, regulations of the local electricity supply authority, and all applicable statutory and safety regulations. Where differences occur between standards, the most stringent requirement shall apply.

13.12 TESTING, INSPECTION, AND COMMISSIONING

Upon completion of the electrical works, the contractor shall carry out insulation resistance tests, continuity tests, polarity tests, and earth resistance tests in the presence of the Project Engineer/Architect. Any defects identified shall be rectified at no additional cost. The installation shall not be energized without written approval.

13.13 AS-BUILT DRAWINGS AND HANDOVER

The contractor shall submit as-built drawings showing the final electrical installation layout together with test certificates, operating manuals, and warranties. These documents shall form part of the final handover to the Client.

13.14 MEASUREMENT AND PAYMENT

Electrical works shall be measured and paid for in accordance with the Bills of Quantities. No additional payment shall be made for works executed without prior approval of the Project Engineer/Architect.

13.15 FIRE EXTINGUISHER

GENERAL

The particular specification details the requirements for the supply and installation and commissioning of the Portable Fire Extinguishers and Boosted Hose Reel System. The Sub-contractor shall include for all appurtenances and appliances not necessarily called for in this specification or shown on the contract drawings but which are necessary for the completion and satisfactory functioning of the works.

PORTABLE CARBON DIOXIDE FIRE EXTINGUISHERS

These shall be portable carbon dioxide fire extinguishers and shall comply with B.S. EN 3/BS 1449 and B.S. 1004. The body of extinguisher shall be a seamless steel cylinder manufactured to one of the following British Standards; B.S. 401 or B.S. 1288. The filling ratio shall comply with B.S. 5355 with valve fittings for compressed gas cylinders to B.S.341. Where a hose is fitted it shall be flexible and have a minimum working pressure of 206.85 bar (3000 p.s.i.).

The hose is not to be under internal pressure until the extinguisher is operated. The nozzle shall be manufactured of brass gunmetal, aluminium or stainless steel and may be fitted with a suitable valve for temporarily stopping the discharge if such means are not incorporated in the operating head.

The discharge horn shall be designed and constructed so as to direct the discharge and limit the entrainment of air.

WATER/CO2 EXTINGUISHERS

These shall be 9-litre water filled CO2 cartridge operated portable fire extinguishers and shall comply with B.S. EN 3/BS 1449 and to the requirements of B.S.1004. Unless manufactured with stainless steel, bodies shall have all internal surfaces completely coated with either a lead tin, lead alloy or zinc applied by hot dipping. There shall be no visibly uncoated areas.

SPECIFICATIONS: SOLAR PHOTOVOLTAIC (PV) SYSTEM

PART 14: SOLARIZATION

14.1 SOLAR PV SYSTEM – GENERAL SCOPE

The contractor shall design, supply, install, test, commission, and hand over a complete Solar Photovoltaic (PV) power generation system integrated with the building electrical installation. The system shall operate in hybrid mode incorporating solar PV, grid power, battery storage, and standby generator supply. All works shall be executed in accordance with the approved drawings, specifications, Bills of Quantities, and to the satisfaction of the Project Engineer/Architect.

The contractor shall identify and label various components upon completion of works.

14.2 SOLAR PV DESIGN, DRAWINGS, AND DOCUMENTATION

The contractor shall prepare detailed working drawings for the Solar PV system, including array layout, inverter configuration, single-line diagrams, mounting details, cable routing, earthing, and protection schematics. Three (3) sets of drawings shall be submitted for approval prior to installation. The contractor shall also submit technical data sheets, brochures, product schedules, samples, and progressive site photographs for approval.

14.3 SOLAR PV MODULES

The Solar PV modules shall be 550W mono-crystalline panels of approximate size (1722 × 1134 × 30) mm or approved equivalent. Panels shall be supplied complete with factory-fitted junction boxes and integral 4.0mm² DC cables. All modules shall comply with applicable IEC standards and be installed strictly in accordance with the manufacturer's recommendations.

14.4 MOUNTING STRUCTURES

Solar panels shall be mounted on roof-mounted aluminium support structures complete with rails, clamps, fasteners, and accessories suitable for 550W modules. The mounting system shall be designed to withstand local wind loads and environmental conditions. Any roof penetrations shall be properly sealed to prevent water ingress and damage to roofing finishes.

14.5 INVERTER SYSTEM

The contractor shall supply and install a 50kW, 48V hybrid inverter charger or approved equivalent, subject to approval by the Project Engineer/Architect. The inverter shall be capable of managing solar PV input, battery charging, grid supply, and generator input, complete with internal protections, monitoring, and communication interfaces.

14.6 DC AND AC CABLING

The contractor shall supply and install all necessary DC and AC power cables, interconnecting cables between panels, combiner boxes, inverters, batteries, and consumer distribution boards.

All cables shall be of appropriate size, rating, insulation type, and shall be neatly routed, adequately supported, and mechanically protected in accordance with approved drawings.

14.7 EARTHING AND BONDING

A complete earthing system shall be provided for both DC and AC installations. Earthing shall comprise 25mm² PVC insulated copper conductors connecting solar module frames, inverter, and associated equipment to copper earth electrodes measuring 1200mm long by 15mm diameter. Earth electrodes shall be enclosed in concrete inspection chambers of minimum size 300 × 300 × 200 mm with removable covers.

14.8 PROTECTION, SWITCHING, AND CONTROL DEVICES

The contractor shall supply and install to the satisfaction of the engineer, a Solar PV system complete with all necessary protection and control devices including but not limited to:

- 1000V DC Surge Protection Devices rated at 40kA
- 20A DC fuses or MCBs complete with enclosures
- Eight-input DC combiner boxes
- 250A two-pole DC battery disconnectors complete with fuses
- 63A single-pole MCBs complete with enclosures
- 100A four-way distribution board
- 400A four-pole Automatic Transfer Switch

All protection devices shall be properly rated, clearly labelled, and easily accessible for operation and maintenance.

14.9 DISTRIBUTION AND SYSTEM INTEGRATION

The contractor shall supply and install a 10mm² three-core armoured cable for connection between the building main distribution board and the solar power room. Integration of solar, grid, and generator supplies shall ensure safe and automatic changeover without back-feeding or operational conflicts.

14.10 MONITORING AND CONTROL SYSTEM

A complete system control and monitoring device shall be supplied and installed to enable real-time monitoring of power generation, energy consumption, battery status, and system alarms. All associated cabling and accessories shall be included.

14.11 GENERATOR SUPPLY AND INTEGRATION

The contractor shall supply and install a 50kVA standby generator complete with all accessories, control panel, mounting base, exhaust system, fuel system, and protective cage. The generator shall be fully integrated with the inverter and Automatic Transfer Switch for seamless operation.

14.12 SITE RESTORATION

The Contractor shall remove all temporary works, rubbish, debris and surplus materials from the site as they accumulate and upon completion of the works, remove and clear away all plant, equipment, rubbish, unused materials and stains and leave in a clean and tidy state to the reasonable satisfaction of the Project Manager.

14.13 TESTING, COMMISSIONING, COMPLETION AND TRAINING

The contractor shall carry out full testing and commissioning of the Solar PV, inverter, battery, and generator systems. All systems shall be demonstrated to operate satisfactorily under all modes. Any defects shall be rectified before final acceptance and handover. The contractor upon completion of works shall train the identified personnel responsible for operation, repair, and maintenance on various components of the system.