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## **DIVISION 5 PAVEMENT WORKS**

### **SECTION 5000 ASPHALT PAVEMENT OF ACCESS ROAD AND MAINTENANCE ROAD**

#### **5001 General**

##### **(1) General**

The section covers materials, workmanship and methods for paving works such as lower sub-grade, upper sub-grade, and asphalt surface course, etc.

Items of work such as lower sub-grade, upper sub-grade, asphalt surface course, and guard railing, shall be in accordance with the provisions stipulated in this section as well as the other applicable sections of the Specifications.

The Contractor shall stake out the work and secure the Engineer's approval of the stake-out before proceeding the construction. If, in the direction of the Engineer, any modification of the line or grade is advisable, either before or after stake-out, the Engineer will issue detailed instructions to the Contractor for such modification and the Contractor shall revise the stake-out for further approval. These requirements shall be met without additional payment.

The gradation, moisture control, density, placing, compaction and asphalt application requirements for the construction of lower and upper sub-grades, asphalt surface course shall be as stipulated herein; however, the Engineer reserves the right to adjust these requirements as he deems best, and in such case no change will be allowed in the unit prices for such work as entered in the Bill of Quantities.

Sufficient templates and straightedges shall be furnished by the Contractor for use in checking the finished surface of the pavement structure. These templates and straightedges shall be submitted to the Engineer for his approval and shall be maintained by the Contractor at all times in a condition to produce the correct cross-sectional profile. They shall be checked at intervals and, if necessary, repaired or adjusted as directed by the Engineer. The furnishing and maintenance of the templates and straightedges will not be paid for directly, but all costs therefor shall be included in the applicable unit prices and prices entered in the Bill of Quantities.

Recommend Practices of the American Concrete Institute (ACI).

##### **(2) Scope of Works**

The Contractor's scope of pavement works shall include services and furnishing of all plant, design, labour, materials, equipment, consumables required for the execution of pavement works.

The Works include, but are not limited to, the following:

- Lower sub-grade
- Upper sub-grade
- Asphalt surface course for pavement
- Concrete curb
- Laterite pavement

**5002 Applicable Codes and Standards**

The asphalt concrete works shall conform to the following codes, standards and specifications or other equivalent codes and standards subject to approval of the Engineer, except as may be amended in this Specification:

The following standards and other publications are referred to in this section:

|      |   |     |   |
|------|---|-----|---|
| ASTM | C | 131 | Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine |
| ASTM | D | 698 | Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort                                    |

**5003 Lower Sub-grade**

After completion of necessary clearing, stripping, excavation and preparation of foundation, the Contractor shall place the lower sub-grade in accordance with the Section 2200 of this specification and the Drawings.

**(1) Material**

Material for lower sub-grade is laterite soil or other approved materials specified as follows:

- Moisture content (Wf) at the place of use : 20 % or less
- No boulders and rock fragments larger than 40 mm
- Free of organic materials

Material for the lower sub-grade shall consist of selected laterite with the following properties:

| Sieve Size       | Percentage Passing (by weight) |
|------------------|--------------------------------|
| 1 1/2" (37.5mm)  | 100                            |
| 1" (25mm)        | 95 -100                        |
| 3/8" (10mm)      | 60 -100                        |
| No.4 (4.76mm)    | 50 -80                         |
| No.10 (2.00mm)   | 40 -70                         |
| No.40 (0.420mm)  | 25 -45                         |
| No.200 (0.074mm) | 8 -25                          |

- a) The fraction passing No. 40 screen shall have a liquid Limit (L. L.) not exceeding 35 %.
- b) Plasticity index (P.I) shall be between 3% and 10%.
- c) The fraction passing through screen No.200 shall not exceed 2/3 of the fraction passing through screen No.40.
- d) Regarding the particle hardness-the loss must not exceed 50 percent when tested by the Los Angeles Abrasion Test (ASTM C131)
- e) The material shall be free from impurities such as roots, grass, organic matter or clay lumps.

## (2) Placing and Compaction

### (a) Placing of Lower Sub-grade

- 1) The fill material for lower sub-grade shall be placed and spread in continuous layers. Layers shall not exceed 200 mm compacted measure in thickness except as approved by the Engineer.
- 2) The surface of the filled layers shall slope transversely at a grade of 5 percents so that surface shall drain freely. The fill shall not be contaminated by other materials and it shall be free of lenses, pockets, streaks or layers that are more pervious and lumps or clods shall be broken down. Where the surface of the fill is considered by the Engineer to be too smooth for proper bonding with next layer, such surface shall be scarified or harrowed as directed immediately prior to the placing of the next layer.
- 3) Where the surface has dried too much for proper bonding, it shall be uniformly sprinkled with water, scarified, harrowed and mixed until the moisture content of the in place material is within the required limits.

If the moisture content of the in place material is higher than the limit required, such fill shall be scarified, harrowed and treated until its moisture content is within required limits or it shall be removed from the fill site where directed by the Engineer.

- 4) The Contractor shall immediately suspend any or all fill placing operations during rain or at anytime the Engineer considers conditions or procedures to be unsatisfactory.

### (b) Compaction Sub-grade

The layer of the lower sub-grade material course shall be compacted by an approved compactor. Water content shall be maintained during the compacting procedure at optimum

value or at the percentage specified by the Engineer. In all places not accessible to compactor, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer is compacted through the full depth to at least 95% of the maximum dry density determined by ASTM D 6988. Compacted lower sub-grade shall have a C.B.R. value not less than 20 percents. Compaction shall be carried out from the edges towards the center of the layer being compacted.

**(3) Measurement and Payment**

Measurement, for payment, of the lower sub-grade will be made on the basis of actual compacted volume in square meter to the design lines, and grades as shown on the drawings or as directed by the Engineer.

Payment for the lower sub-grade will be made at the unit price per square meter, which unit price shall include the cost of all labor, equipment and materials required for hauling to the site, placing, spreading, wetting or drying as required, compacting, shaping, finishing and testing, and all other costs necessary to complete the works.

**5004 Upper Sub-grade**

After completion of the lower sub-grade, the Contractor shall place the macadam sub-grade over the full width of road.

**(1) Material**

Material for the upper sub-grade shall consist of selected macadam soil:

| Sieve Size      | Percentage Passing<br>(by weight) |
|-----------------|-----------------------------------|
| 2" (50mm)       | 100                               |
| 1 1/2" (37.5mm) | 95 to 100                         |
| 3/4" (25mm)     | 50 to 80                          |
| No.4 (4.76mm)   | 15 to 40                          |
| No.10 (2.00mm)  | 5 to 25                           |

**(2) Placing and Compaction**

**(a) Placing of Upper Sub-base**

The Contractor shall carry out the work so as to obtain the true grades, minimize degradation, control the moisture content, and ensure a satisfactory sub-base course. The material, from approved sources, shall be spread in uniform layers of such loose thickness that the finished layer will conform to the specified grading and designate thickness. The materials shall be spread uniformly from spreader boxes, dump boards, moving vehicle, or by other approved methods. The material shall be mixed with blade graders, or other approved equipment in such manner as not to disturb or mix material from the lower subgrade. The upper sub-base material shall then be leveled to the required contour and graded with blade graders. Unsuitable material shall be removed and replaced as directed by the Engineer.

**(b) Layer Thickness**

The compacted thickness of the upper sub-grade shall be as indicated. When a compacted layer of 30 cm or less is prescribed, the material may be placed in a single layer; when a compacted thickness of more than 30 cm is required, no layer shall exceed 15 cm but shall exceed 10 cm when compacted.

**(c) Compaction**

Each layer of the upper sub-grade shall be compacted by an approved roller. Water content shall be maintained during the compacting procedure at optimum value or at the percentage specified by the Engineer. In all places not accessible to rollers, the mixture shall be compacted with mechanical tampers. Compaction shall continue until each layer is compacted through the full depth to at least 95% of the maximum dry density determined by ASTM D 698. Compacted upper sub-grade shall have a C.B.R. value not less than 90 percents. Compaction shall be carried out from the edges towards the center of the layer being compacted.

Any materials found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

The Contractor shall make such adjustments in rolling or finishing procedures as may be directed by the Engineer to obtain true grade to minimize segregation and degradation, to reduce or accelerate loss or gain of water, and to insure a satisfactory upper sub-grade. Any materials found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

**(3) Measurement and Payment**

Measurement, for payment, of the upper sub-grade will be made on the basis of actual compacted volume in square meter to the design lines, and grades as shown on the drawings or as directed by the Engineer.

Payment for the upper sub-grade will be made at the unit price per square meter, which unit price shall include the cost of all labor, equipment and materials required for obtaining the materials, hauling to the site, placing, spreading, wetting or drying as required, compacting, shaping, finishing and testing, and all other costs necessary to complete the works.

**5005 Asphalt Surface Course for Pavement (Hot Mixture Method)**

**(1) General**

This work shall consist of constructing asphalt concrete of one or multiple layers on a previously prime-coated base course as well as providing a bituminous leveling course where necessary as directed by the Engineer.

Prime coat shall be applied at a time when the surface of base course to be treated is dry at the ambient temperature. Asphalt material for the prime coat shall be applied by means of a distributor at the rate or rates directed by the Engineer, at a temperature within the range shown in the Table below.

**Spraying Temperature for Asphalt Prime Coat**

| Type and Grade of Asphalt | Distributor Spraying Temperature, Degrees C |
|---------------------------|---|
| MC-30                     | 30 -90                                      |
| MC-70                     | 50 -100                                     |
| CSS-1                     | 20 -70                                      |
| CSS-1h                    | 20 -70                                      |

**(2) General Composition of the Mixture**

The design of asphalt concrete mixtures shall be undertaken by the Contractor in accordance with the Standard Specifications of the Roads and Bridges Department. The design of mixtures shall be carried out in a materials testing laboratory approved by and under the supervision of the Engineer.

The mixture shall consist of mineral aggregate, filler (1-2% of lime or 2-4% of cement if necessary according to the Engineer) and the asphalt cement. The total mineral aggregate shall have a job mix grading within the limits shown in the Standard Specification of the Roads and Bridges Department. Gradations outside the limit specified shall have the approval of the Engineer. The ratio of total material passing the No.200 sieve to asphalt by weight shall not exceed 1.5 : 1 nor be less than 1 : 1.

In addition to meeting the job mix formula, laboratory samples shall be prepared according to the Marshall method (AASHTO T245-78) using 75 blows to compact the sample. The samples shall be of approved material to the gradation and asphalt content stated and shall have the following characteristics. The Strength Index shall be determined according to the Ontario Vacuum Immersion Marshall Test or the U.S. Army Corps of Engineers-Asphalt Institute Immersion Marshall Test.

- i) Marshall Stability (lbs) not less than 1,500 lb. (680 kg)
- ii) Marshall Flow (0.01 ins) not less than 8 nor greater than 18. (2 mm - 4.5 mm)
- iii) Ratio Marshall Stability (lbs) to Marshall Flow (0.01 ins) shall not be less than 125.
- iv) Air voids in Mix: Wearing 3 - 5%; Binder 4 - 7%
- v) Voids in mineral aggregate: 14 to 20 percent
- vi) Voids filled with asphalt: Wearing 70 - 80%; Binder 65 - 80%
- vii) Strength Index: minimum 75%

The selected job mix shall conform to the guidelines outlined in the Standard Specifications of the Roads and Bridges Department. Asphalt concrete for leveling course shall follow the same mix requirements of the lowest layer of asphalt concrete pavement or overlay (usually binder course) as shown on the drawings or directed by the Engineer.

### **(3) Asphalt Material**

Bituminous materials for asphalt concrete shall be asphalt cement with penetration grades of 60 - 70% or 80 - 100%, unless otherwise directed by the Engineer.

### **(4) Construction Method**

- (a) The temperature of the aggregates shall be so controlled that the temperature of the mixture on being discharged from the mixing plant is between 135° and 175° C. The Contractor shall select the minimum temperature which will ensure the aggregates are properly dried, and which enables him to deliver the mixture to the pavement at or slightly above the required temperature.
- (b) The temperature at which asphalt is fed into the mixer shall be between 0° and 15° C lower than the temperature of the heated aggregates.
- (c) The temperature at which the mixture is spread shall not be less than 130° C, or temperature the Engineer directs so that a proper compaction is obtained.
- (d) The mixture shall be compacted as soon as it will bear the weight of a roller without causing undue lateral displacement of the material. The density of the mixture after compaction shall not be less than 98 percent of the Marshall Density as determined from daily compacted samples. The density shall be checked by 10 cm diameter cores made with an approved core drill.
- (e) The average thickness of the compacted pavement laid in any one day shall not be less than the thickness shown on the drawings. The minimum thickness at any one point shall be no more than 5 mm below the specified thickness.
- (f) The surface of the finished pavement shall be tested for evenness by using a 3.5 meter straightedge. The surface will be considered acceptable providing the deviation from the straightedge, placed either longitudinally or transversely, does not exceed 3 millimeters between two contact points. Pavement surfaces not conforming to this tolerance may be rejected by the Engineer. Rejected areas shall be removed and repaved at the Contractor's own expense.

### **(5) Measurement and Payment**

Asphalt concrete to be used as a surface course, of thickness specified in the drawings, shall be measured on a square meter basis, the dimensions of which shall comprise the thickness and width specified on the typical cross section and the length of completed and accepted construction. Side road intersections, curve widening, fillets and other smaller areas required to be paved shall also be measured on a square meter basis. Pavement thickness shall be within the limit specified in paragraph (4) (e). Additional payment will not be considered for thickness greater than those specified.



Payment for asphalt concrete surface shall be made at the unit price per square meter, which unit price shall include the cost of all material, labor, equipment and tools required for constructing and maintaining the asphalt concrete surface. The unit price shall also include the cost of prime coat and all other materials and operation necessary to complete the work.

#### **5006 Concrete Curb**

##### **(1) Description**

Concrete curb shown on the drawings shall be constructed as detailed on the drawings or directed by the Engineer. Concrete type shall be class C and shall be either pre-cast or cast-in-place with the prior approval of the Engineer.

This work shall also include curb marking of white and yellow paint where shown on the drawings or designated by the Engineer.

##### **(2) Materials**

Bedding material, shall consist of sand, gravel, crushed stone or other approved pervious materials of 1 cm maximum size.

##### **(3) Measurement and Payment**

Measurement and payment for concrete curbs shall be separately made under individual pay items as specified in Division 2 and 3 of the Specifications.

#### **5007 Laterite Pavement**

Laterite pavement shall be placed as detailed on the Drawings or directed by the Engineer. Specifications for laterite pavement shall be referred to the Section 5003 Lower Sub-grade in the Specifications.

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## **DIVISION 6 BUILDING WORKS**

### **SECTION 6000 GENERAL REQUIREMENTS**

#### **6001 General**

This Division shall covers overall technical specification on building construction of El Salaam No. 7 Pumping Station except concrete works.

The concrete works related to El Salaam No. 7 Pumping Station shall follow the specification of Division 3 "Concrete Works", i.e., concrete works, reinforcement, form works, mortar, finishing and other items concerned.

Class G of building concrete shall be applied to the reinforced concrete of the building. Minimum requirement of reinforcement bar of building concrete is 130 kg/m<sup>3</sup> or one percent of concrete cross-sectional area of facilities. Mortar D shall be applied to mortar mixing plan of building works, unless otherwise specified.

## **SECTION 6100 METAL DECKING WORKS**

### **6101 General**

#### **(1) Scope of Works**

This Section covers the requirements for metal decking as formwork for cast-in place concrete roof slab.

The Scope of Works shall include design, manufacture, and delivery to the site and installation required for the Metal Decking Works. The works shall include but not be limited to the following:

- a. All fasteners
- b. Closures, including the following:
  - End closures
  - Side closures
  - Column closures
- c. Reinforcements under metal decking at columns and framed openings, including miscellaneous structural as required for the support of the metal deck at sleeves and unframed openings cut through the deck prior to placing of the concrete.
- d. Other accessories as required

#### **6102 Applicable Codes and Standards**

The codes and standards of the following organizations are specifically applicable to the design, manufacture and testing of the work covered by this Specification:

|      |  |
|------|--|
| AISI | American Iron and Steel Institute          |
| ANSI | American National Standards Institute      |
| ASTM | American Society for Testing and Materials |
| SDI  | Steel Deck Institute. U.S.A                |
| BS   | British Standards                          |
| JIS  | Japan Industrial Standards                 |

#### **6103 Design**

##### **(1) Deck types**

Deck type and size shall be designed and detailed by the Contractor and shall be used only for formwork for cast-in-place concrete. The deck shall be suitable for the span and the construction loads. The Contractor is not allowed to consider the deck as part of reinforcing steel for the concrete roof slab.

## **(2) Welds fasteners and Other Accessories**

Welds, fasteners and other accessories shall be designed and detailed by the Contractor in accordance with the applicable requirements of AISI Specification for the Design of Cold-Formed Steel Structural Members and SDI Design Manual for Composite Decks, Form Decks and Roof Decks, and the requirements of the Specification for Welding in Steel Construction, unless otherwise indicated on the approved shop drawings.

## **(3) Construction Loads**

Decks acting as form work for the Contractor for the wet weight of concrete plus minimum 100 kg/m<sup>2</sup> construction live loads shall design cast-in-place concrete. Sub-Section 6106 (10) indicates the responsibility for temporary supports required for any additional construction loads.

## **6104 Material**

### **(1) Sheet Material**

ASTM A446, Grade A (minimum yield strength 2320 kg per sq. cm) or approved equal.

### **(2) Finish**

Hot-dip galvanized ASTM A525, Coating Designation G60 (minimum) or approved equal.

## **6105 Submittals**

### **(1) Shop Drawings**

Copies of shop drawings showing complete details of fabrication of all metal decking works including plan views, elevations, sections, details and installation methods for this complete scope of works. The shop drawings shall be prepared in conformity with the best modern practice and with due regard to economy in fabrication and erection.

### **(2) Test Reports and Certificate**

The Contractor shall make copies of material certificates, mill test reports and other test reports required by applicable codes or standards available. Those reports shall be submitted on request to the Engineer after completion of the tests.

### **(3) Qualification Reports**

Copies of welding qualification reports, quality control reports, and other reports as specified or required shall be furnished by Contractor to the Engineer, during execution or upon completion of the Work.

#### **(4) As-built Drawings**

As-built drawings shall be submitted upon completing the works.

### **6106 Fabrication and Installation**

#### **(1) General Provision**

Metal decking, including fasteners and all other accessories, shall be fabricated and installed in accordance with the requirements of this Sub-Section, AISI and SDI and other applicable Specifications and Standards, and in strict accordance with manufacturer's printed instructions unless otherwise indicated.

#### **(2) Deck Position**

For cast-in-place concrete roof slabs, metal decks shall be installed in inverted position unless otherwise indicated.

#### **(3) Opening**

No opening through deck shall be cut prior to concrete is placed and hardened.

#### **(4) Arrangement**

Where the span of metal deck for cast-in-place concrete roof slabs is parallel to and directly supported by steel beams, provisions shall be made for full bearing of the rib bottom on steel beams, or the deck shall be cut and side closures provided. If side closures are provided to form a rib bottom, the area of the rib profile so formed shall be at least equal to the area of the deck rib profile.

#### **(5) Alignment**

Metal decking for cast-in-place concrete roof slabs shall be installed so that the rib line up to permit continuity of bottom reinforcing bars.

#### **(6) Closures**

Metal decking form work for cast-in-place concrete roof slabs shall be provided with specific closures, with provisions for reinforcing bars to pass through, and to prevent leakage of concrete during placement at the following locations:

- a. Penetrations through metal decking by structural steel or other members.
- b. Ends or discontinuities of metal decking.
- c. Perimeters of openings and cants in metal decking.
- d. All others as indicated on the shop drawings.



**(7) Ventilation**

For metal decking formwork for cast-in-place concrete roofs only, ventilating clips or suitable openings shall be provided for release of moisture between the concrete and the metal decking.

**(8) Field Cutting for Openings**

Shall be performed by sawing or nipping; the use of flame cutting, welding electrodes or chiseling will not be permitted.

**(9) Fastening**

All metal decks shall be fastened to every supporting structural steel member. Where the ribs of the deck are perpendicular to the supporting steel beams and if the rib spacing of the deck is less than 300 mm, metal deck shall be fastened at the bottom of every other rib. If the rib spacing is 300 mm or more, metal deck shall be fastened at the bottom of every rib.

All ends or butt ends of metal decking shall be fastened to the supporting structural members. The side laps of metal decking shall be fastened at not more than 915 mm on centers. When fusion welds are used for fastening, they shall have diameters of not less than 19 mm and shall be free of sharp points or edges.

Where the ribs of metal deck are parallel to and directly supported by steel beams, the bottom of ribs or side closures shall be fastened to steel beams with 19 mm diameter fusion welds at a maximum of 915 mm on centers. Fasteners and welding shall conform to the requirements of Sub-Section 6103 (2).

**(10) Temporary Supports**

The Contractor shall be responsible for designing, furnishing, installing and removing any temporary supports required to support the additional construction loads resulting from his work, with reference to Sub-Section 6103 (3).

**(11) Field touch-up Painting**

Field cut edges, scratches etc. in metal decks shall be field touch-up painted with one coat of zinc-rich paint comparable with shop galvanizing.

**6107 Quality Assurance/Quality Control (QA/QC)**

The quality assurance/control procedures shall include but not be limited to the following:

- a. Shop drawings
- b. Shop tests and inspection procedures

- c. Cleaning and painting
- d. Packaging and shipping
- e. Installation procedures
- f. Erection checks
- g. Commissioning, testing and cleaning

The quality assurance/control documentation shall include but not be limited to the following:

- h. Material certificates (mill reports)
- i. Welding procedures and inspection reports
- j. Shop tests and inspection reports
- k. All other documentation required by applicable Codes and Standards.

#### **6108 Measurement and Payment**

Measurement for metal decking shall be by square meters of steel structural decking fabricated, furnished and installed as calculated from approved shop drawings. The unit price shall include galvanizing. Such payment is understood to cover all expense in connection with the works, including transportation and storage of the materials as required etc.

## **SECTION 6200 BRICK WORKS AND PLASTERING**

### **6201 General**

#### **(1) Scope of Works**

The Contractor's scope of work shall include shop drawings, working drawings, manufacture, delivery to Site and installation required for Brickwork and Plastering. This specification covers all building brickwork and plastering works. Brick work shall be constructed of units of the types, dimensions and arrangements indicated on the drawings, complete with all materials, accessories and appurtenances as indicated, specified or required, including, among others, the lateral anchoring of the brick work walls to the columns. The works shall include but will not be limited to:

- a. The furnishing and installing all brick units, lintels, pre-cast sills, coping, canopies and beams, and the building-in of all miscellaneous metal items, as applicable.
- b. The furnishing and installation of all anchor bolts, anchors and ties indicated to be embedded in the brickwork unless specifically excluded by the drawings.
- c. The delivery of all required materials and accessories
- d. Temporary protection of the surroundings
- e. Preparation of the surfaces
- f. Execution of all works as described
- g. Removing of rubbish and debris
- h. Removing of surplus materials
- i. Cleaning
- j. Temporary protection of new executed wall finishes
- k. Handing over to the client

#### **6202 Applicable Codes and Standards**

The brick and plastering works shall comply with and be tested in accordance with the latest issues of the following codes and standards:

##### **(1) ASTM Standards**

|       |   |
|-------|---|
| C 5   | Quick lime for structural purposes              |
| C 55  | Concrete building brick                         |
| C 91  | Brick cement                                    |
| C 129 | Non load-bearing concrete brick units           |
| C 144 | Aggregate for brick mortar                      |
| C 145 | Solid load bearing concrete brick units         |
| C 150 | Portland cement                                 |
| C 207 | Hydrated lime for brick purposes                |
| C 331 | Lightweight aggregates for concrete brick units |
| C 404 | Aggregates for brick grout                      |

- C 476 Mortar and grout for reinforced brick
- C 494 Chemical admixtures for concrete

**(2) ACI (American Concrete Institute)**

ACI manual S 31.1 parts 5, concrete brick structures - design and Construction.

**(3) ANSI**

A 42.2 Specifications for Portland cement and Portland cement-lime plastering, exterior (stucco) and interior.

**(4) BS**

- BS 5390 Code of practice for stone brick
- BS 3921 Specification for clay bricks
- BS 187 Specification for calcium silicate (sand lime and flintlime) bricks
- BS 890 Building limes
- BS 1200 Sand for Mortar
- BS 6073 Precast concrete brick units
- BS 12 Cement for mortar (ordinary Portland cement)
- BS 4027 Cement for mortar (sulfate resisting Portland cement)

**(5) Local Standards**

The works shall comply with local Standards where available but shall be in no case of lower quality than the above-mentioned standards indicate.

**6203 Materials**

**(1) General**

The Contractor shall submit manufacturer's product data for each type of brick unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements.

Brick shall be of local manufacture made with cement lime and sand in approved vibrated pressure machines. Bricks shall be cement, sand and lime bricks calcium silicate bricks complying with approved standards. The type and color of the bricks shall be as stated on the shop drawings as approved by the Engineer.

**(2) Cement**

Cement used for mortar shall be ordinary Portland cement complying with BS 12 or equivalent, sulfate resisting Portland cement complying with BS 4027 or equivalent or

brick cement complying with BS 5224 or equivalent as approved by the Engineer.

**(3) Sand for Mortar**

Sand for mortar shall comply with BS 1200 or equivalent and shall be washed sand or natural crushed rock. Sand from a marine source shall not be used.

**(4) Water**

Water for brickwork shall be clean and free from deleterious matter and shall be obtained from a source as approved by the Engineer.

**(5) Admixtures**

Air entraining plasticizing or wetting admixtures shall comply with BS 4887 or equivalent. Retarding admixtures or those containing calcium chloride shall not be used.

**(6) Pointing or Sealing Mastic Compound**

Pointing or mastic sealing compounds shall be polysulphide one part gun grade compounds complying with BS 5215 or equivalent for joint gaps less than 13 mm. For joint gaps above 13 mm up to the maximum of 50 mm the compounds shall be butyl pre-extended strip mastic or knife grade as appropriate.

**(7) Damp-proof Courses**

Damp-proof courses shall comprise bituminous felt in accordance with the requirements of BS 743 Type A or equivalent laid as described therein and at a maximum height of 150 mm above finished ground level.

**(8) Reinforcement, Anchor, Ties**

Bonding ties shall be expanded metal strips or woven mesh as specified on the shop drawings otherwise directed by the Engineer. Wall ties shall comply with approved standards and shall be hot-dip galvanized steel or stainless steel as specified. Metal ties shall be galvanized steel or iron, minimum 4 mm thick and 22 mm wide, minimum length 15 cm. Joint reinforcement shall comply with approved standards width of reinforcement shall match the width of brick/block.

**(9) Pre-formed Joint Filter**

Compressible pre-formed expansion joint filler shall be cork or bitumen impregnated fiber boarding of the thickness specified within a tolerance of +/- 1.5 mm and of such a width that it complies with the specified joint details. The joint materials shall be supplied by approved manufacturers.

**(10) Joint Sealer**

Joint sealer shall be a silicone based sealant complying with approved standards type A and applied in accordance with the manufacturer's recommendations. A sample shall be submitted for approval before incorporation in the Works.

**(11) Metal Lathing, Metal Angle Breads and Plaster Stops**

Metal lathing for plastering shall be plain zinc coated expanded metal complying with approved standards, weighing not less than 1 kg/m<sup>2</sup>. Zinc coated metal angle beads and plaster stops shall be as approved by the Engineer.

**(12) Bonding Agent**

Polyvinyl Acetate (PVAC) Emulsion bonding agent for use in plasterwork shall comply with approved standards.

**(13) Delivery and Storage**

Bricks shall be carefully unloaded and placed on the Site in separate stacks according to strength or of constitution, and marked accordingly. The Contractor shall submit to the Engineer, for his prior approval, details of any handling equipment, which he intends to use in the handling of bricks. The Contractor shall also submit details of his proposed storage facilities.

Cement shall be stored at the Site in bags, sealed by the manufacturers before dispatch in a perfectly dry, watertight shed on a floor raised above ground. Different consignments of cement shall be stacked in such a manner that they may be identified and used in the order of their delivery. Cement stored longer than three months shall be removed from the Site. The Engineer's approval must be obtained should the Contractor intend to store cement at the Site in bulk containers. Cement injuriously affected by dampness or any other causes shall not be used and shall be removed from the Site.

Sand shall be stored, so that it may drain freely, on a hard surface and must be protected from contamination from any source whatsoever: segregated heaps shall be established where differing qualities are in use.

**(14) Sample of Bricks**

The Contractor shall provide samples of bricks for approval. Samples shall be selected in accordance with the requirements of BS 3921 or approved equal. Bricks delivered to the Site shall be equal in all respects to the approved samples with quality assurance maintained. Bricks shall be carefully unloaded and placed on the Site in separate stacks according to strength or of constitution, and marked accordingly.

The Contractor shall submit to the Engineer, for his prior approval, details of any handling equipment, which he intends to use in the handling of bricks. The Contractor shall also submit details of his proposed storage facilities.

## **6204 Technical Requirements**

### **(1) Submittals**

The Contractor shall submit the following to the Engineer for written approval before ordering materials and commencement for the relevant item of finishing work:

- a. Manufacturer's literature, giving a materials description, color charts, details of fixings, preparation of the background and range of accessories together with recommendations for good workmanship practice.
- b. Samples of each type of finish from the manufacturers or Contractor produced range as requested by the Engineer to enable the selection of color, pattern and the like.
- c. Calculations support the design in conformity with this specification.
- d. Certification of test results and label of materials conforming to relevant requirements and standards.

### **(2) Drawings**

- a. All working drawings shall be submitted for approval by the Engineer.
- b. Shop drawings shall provide all information required at site for construction and shall include full details regarding dimensions, recesses, openings, embedded parts, reinforcements, etc.
- c. As-built drawings shall be submitted upon completion of the Work.

## **6205 Workmanship for Brick Works**

### **(1) Laying**

- a. All brickwork shall be set out and built to the respective dimensions, thickness and heights shown on the shop drawings.
- b. All brick units shall be free of dust, dirt and surface moisture when laid.
- c. All walls shall be carried up in a uniform manner and shall be raked back. No tothing will be permitted and no portion raised more than one meter above another at any one time, nor more than sixteen successive courses raised in one day, perpend shall be well "battered" with mortar, with cross joints and collar joints solidly filled.
- d. In no case shall facework be built overhand, unless directed by the Engineer.
- e. Bricks containing a frog shall be laid with the frog uppermost and filled with mortar.
- f. Suitable protection to the top surfaces of unfinished brickwork shall be provided when work is not in progress; and special care taken to prevent any perforations, cavities etc. Becoming filled with water, during periods of rainfall.
- g. Adequate splashboards shall be provided while the work proceeds, and

- from time to time and upon completion, or as directed. The faces of the brickwork shall be brushed free from all mortar particles and the whole left neat and tidy.
- h. No washing down shall be allowed until such time as the joints are fully set. Spirits of salts shall not be used for washing down.
  - i. All temporary holes shall be carefully filled in and made good with matched bricks and mortar pointing.

**(2) Mortar**

Mortar shall be designed as cement mortar, brick cement mortar or air-entrained (elasticized) mortar and graded in accordance with Table 6000-1.

**Table 6000-1 Mortar mixes (proportions by volume)**

| Mortar Grade | Type of Mortar      |               |
|--------------|---------------------|---------------|
|              | Brick cement : Sand | Cement : Sand |
| (i)          | 1:2 1/2             | 1:3           |
| (ii)         | 1:3 1/2             | 1:4           |
| (iii)        | 1:5                 | 1:6           |
| (iv)         | 1:6 1/2             | 1:7           |
| (v)          | 1:7                 | 1:8           |

Designated mortar grades shall be used in accordance with Table 6000-2 for normal weather working

**Table 6000-2 Selection of Mortar Grades**

| Exposure position  | Loam brick | Concrete brick | Sand lime brick |
|--|------------|----------------|-----------------|
| Severe exposure, structural load bearing and work below d.p.c. | (i)        | (ii)           | (iii)           |
| External walls to buildings, cavity walls                      | (iii)      | (iii)          | (iv)            |
| Internal walls and clockwork partitions                        | (iv)       | (iv)           | (v)             |

Mortar generally shall be mixed with suitable mechanical mixers. Small quantities may be mixed by hand with the approval of the Engineer on well-formed watertight banker boards. High shear mixers, roller mortar mills and hand mixing shall not be used for air entrained mortar.

Batched mixes shall be used up within 2 hours of mixing or otherwise shall be discarded. Within which time limits the materials may be reconstituted (knocked up) within small quantities of additional water where required maintaining a practical workability. Volume proportions shall be correctly gauged with purpose made gauge boxes and due allowance made for the bulking of damp sand. During use the batch mixes shall be covered with a damp covering (sacking or similar) to protect against rapid drying out. Ready mixed mortars shall comply with BS 4721 or equivalent and together with site mixed mortars shall not contain retards.



Mortars may only be used with the Engineer's approval, which may be subject to a workability test or other test and may require the use of an approved plasticiser. The Engineer will direct when sulfate resisting Portland cement shall be substituted for ordinary Portland cement. Mortar for pointing shall be composed of cement, sand and plasticizer (the proportions 1: 3). A plasticizer shall be used strictly in accordance with the manufacturer's recommendations.

Sulfate resisting cement shall be used below ground floor slab or damp proof course level and ordinary Portland cement above ground floor slab. Mineral colors shall be added to the mortar where required, in the amount necessary to obtain the desired color and shade.

### **(3) Bonding, Joints and Reinforcement**

Where brick units are combined to make up the thickness of the wall, running bonding shall be used except where otherwise shown on shop drawings, i.e. units laid so that the vertical mortar joints are centered over the unit below. All exposed horizontal mortar joints are to be raked out or pressed back to give a uniform recessed joint of 10 mm minimum. All perpendicular joints are to be pointed or "flushed up" to give a "flush" mortar joint. All joints between bricks shall be as specified and shall be solidly filled to a general thickness of 10 mm and at no point more than 15 mm. Well buttering the end of the brick and then pushing it into position against its neighbor shall fill all cross joints.

Excess mortar burrs formed by the too long shall be brushed or cut off flush with the wall surface. Pointing of mortar joints shall be carried out simultaneously to the progress of the brick work. Mortar joints specified to be caulked shall be raked to a depth of 15 mm. Control joints shall be provided as required, and unless otherwise shown shall be constructed by using either special control-joint units or open-end stretcher units. Grout in control joints shall be raked to a 20 mm depth for sealing at exterior face or walls. Grout in Control joints on other exposed-to-view or painted interior walls or partitions shall be raked to a depth of 6 mm and shall not be sealed.

Rubber or polyvinylchloride control joint keys, which have the capacity to expand and contract, are recommended for control joints. Bond beams shall be continuous across control joints. Design maximum movements in the construction. Bond beams shall be provided when indicated and shall consist of units filled with concrete having strength not less than 175 kg/cm<sup>2</sup> at 28 days. Bond beams shall be broken at expansion joints and, where indicated, at control joints. Dummy control joints shall be formed in the bond beam where bond beam is not broken at control joint.

Expansion joints shall not be less than 25 mm nor more than 40 mm unless otherwise agreed upon. Where specified or ordered by the Engineer, there shall be formed, double ended dovetails for connecting face work to interior work or backing; one dovetail for each half square meter of facing work, as a minimum. The dovetails shall, upon becoming wholly formed, be filled with an approved pattern double dovetail key, which shall be set in

mortar and be completely flushed up, so as to fill up all voids including those surrounding the key. Alternatively, the Contractor may submit, for the Engineer's approval proprietary makes of dovetails, or ties, or a combination of them.

#### **(4) Patching and Cleaning**

- a. Defective joints shall be cut out and repainted with mortar.
- b. Care shall be taken to produce a uniform overall appearance.
- c. Spottiness due to variations either in materials or workmanship will not be accepted.
- d. Following finish pointing, all exposed brick surfaces shall be carefully cleaned and all surface stains removed.
- e. Mortar smears or droppings shall be removed with a steel trowel. Removal shall not be attempted until the smears or droppings have hardened to the extent necessary to prevent additional smearing of the surfaces during removal. Mortar remaining after removal with the trowel shall be removed as much as possible by rubbing with a small piece of block. All surfaces shall then be thoroughly brushed.
- f. All joints between bricks shall be as specified and shall be solidly filled to a general thickness of 10 mm and at no point more than 1.5 mm. Well buttering the end of the brick and then pushing it into position against its neighbor shall fill all cross joints.
- g. Excess mortar burrs formed by the too long shall be brushed or cut off flush with the wall surface.
- h. Pointing of mortar joints shall be carried out simultaneously to the progress of the brick work.
- i. Mortar joints specified have to be caulked shall be raked to a depth of 15 mm.
- j. Control joints shall be provided as required, and unless otherwise shown shall be constructed by using either special control-joint units or open-end stretcher units. Grout in control joints shall be raked to a 20 mm depth for sealing at exterior face or walls. Grout in control joints on other exposed-to-view or painted interior walls or partitions shall be raked to a depth of 6 mm and shall not be sealed.
- k. Rover or polyvinylchloride control joint keys, which have the capacity to expand and contract, are recommended for control joints. Bond beams shall be continuous across control joints. Design maximum movements in the construction.
- l. Bond beams shall be provided when indicated and shall consist of units filled with concrete having strength not less than 175 kg/cm<sup>2</sup> at 28 days. Bond beams shall be broken at expansion joints and, where indicated, at control joints. Dummy control joints shall be formed in the bond beam where bond beam is not broken at control joints.
- m. Expansion joints shall not be less than 25 mm nor more than 40 mm unless otherwise agreed upon.
- n. Where specified or ordered by the Engineer, there shall be formed, double ended dovetails for connecting face work to interior works or backing; one dovetail for each half square meter of facing work, as a minimum.
- o. The dovetails shall, upon becoming wholly formed, be filled with an approved pattern double dovetail key, which shall be set in mortar and be completely flush up, so as to fill up all voids including those surrounding the key.
- p. Alternatively, the Contractor may submit, for the Engineer's approval proprietary makes

of dovetails, or ties, or a combination of them.

**(5) Chipping and Grouting**

Chipping work in concrete or brick structures required for electromechanical installations or other purposes shall be performed where directed by the Engineer. Damages due to chipping work shall be repaired to the satisfaction of the Engineer. Debris shall be removed. Grout for under filing of anchor plates, machine bases, and for filling cavities, bonding members, etc., shall be mechanically mixed for a period of minimum 5 minutes or hand mixed, if permitted by the Engineer.

**(6) Damp-proof Courses**

On walls the damp-proof course shall be lapped at least 100 mm at joints and angles and be bedded on and covered with a bed of mortar. The Contractor shall provide and build in a vertical damp-proof course at jambs of openings in cavity walls and a horizontal damp-proof course above such openings and to parapet walls. Below concrete floors the damp-proof membrane shall be continuous throughout the whole floor area and shall be sealed to the damp course in every adjoining wall or other part of the structure.

**(7) Bed Frames**

All window and door openings shall have ties and lugs built in where required and at completion, point frame with gun grade mastic tested as approved on exposed sides. Where the frames are built in they shall be bedded in the mortar as that used for the walling.

**(8) Lintels**

Lintels for external and internal doors other openings shall be of prefabricated or cast-in-situ type. They shall be flush with brick work wall surfaces and extend at least 20 cm beyond each side of the opening. They shall be of adequate strength and properly reinforced, accordingly to the approved drawings.

Steel frames railings and other built-in items shall be maintained in proper position and bracing for the same shall not be removed until they have been securely anchored in the brick work. Door frames shall be installed in collaboration with the door manufacturer. The cavities between frames and brick shall be completely filled with cement mortar. A caulking space shall be provided between exterior door frames and brick work.

**(9) Protection from Damage**

Exposed brick work and all embedded or built-in items shall be carefully protected from damage until completion of work. Whenever concrete is placed adjacent to previously constructed brick work, the latter shall be adequately protected against splashing of concrete and other damage. Exposed brick walls discolored by paint, mortar or concrete

shall be rebuilt with new material.

Where concrete is poured on top of previously constructed brick, the latter shall be protected from concrete splashing, spilling, and water penetration by placing polyethylene foil or sisal-Kraft paper on top of the brick work and extended down each side of the wall as required for adequate protection. The protective covering shall be neatly trimmed away at face of wall after removal of form work. Surfaces of brick not being worked on shall be properly protected. When rain is imminent and the work discontinued the top of the brick work shall be covered with waterproof means in a manner that will protect the complete work. No load shall be applied on brick the first 24 hours after completion. Brick work damaged after its completion shall be replaced or repaired to the satisfaction of the engineer.

#### **(10) Curing**

Curing shall be accomplished by spraying the brick surfaces with water, twice daily, for a period of 10 days, or as directed by the Engineer or until the plaster is to be applied.

#### **(11) Handling and Storage of Materials**

All brick units shall be handled, hauled and delivered in such a manner that will prevent damage of any kind. Broken, chipped or otherwise damaged blocks will be rejected. Brick units shall be stored on platforms clear off the ground and shall be well protected by covers. Cement and lime shall be stored under cover at a dry place. Aggregates shall be stored so that the inclusion of foreign materials is prevented. Damaged materials shall be replaced at no additional cost. Do not overload structural floors or roof areas when placing and storing materials at these locations.

#### **(12) Clean up**

The premises, where brick work is performed, shall be kept reasonably clean at all times. Debris and empty packing materials shall be removed at least once daily and disposed off. At the completion of the brick work of the brick work in any given building or structure, surplus materials and no longer needed appurtenances shall be cleared out at once. Debris from inside and around the structure shall be cleared away. The inside of the building shall be swept clean with a rough broom.

### **6206 Workmanship for Plastering**

#### **(1) Preparation**

The Contractor shall ascertain the quality of the sub-base on which the finishing works are to be applied. Surfaces to receive plastering shall be brushed to remove all loose particles, laitance efflorescence, etc., and any projecting fins on concrete surface shall be hacked off. Rake out joints of brickwork and hack concrete to provide key. All traces of mould oil shall

be removed from concrete surfaces by scrubbing with water containing detergent and rinsing with fresh sweet water. Surfaces shall be wetted and re-wetted as required to equalize suction before the first coat of plaster is applied. In particular, dense hard concrete surfaces shall be wetted, and re-wetted as required before banding plaster is applied.

## **(2) Cement Plaster**

Cement plaster shall be mixed in the proportion of 1 part cement, 1 part lime to 6 parts sand by volume. The first coat shall be 12 mm thick and finished with uniform rough scratch surface to provide a good bond for the finishing coat. The finishing coat 3 mm thick shall be finished with a steel float.

## **(3) Metal Lathing**

Metal lathing shall be fixed with galvanized steel staples with joints lapped 40 mm and tied with galvanized steel wires. The long way of the mesh shall be at right angles to the supports. The slope of the strands shall be all in one direction which for vertical work shall be inward and downward.

## **(4) Metal Angles Beads and Stops**

Metal angle beads shall be fixed with galvanized nails and plaster dabs at 600 mm centers applied to the wall on either side of the arise and the wings of the metal lathing with fine galvanized wire. Plaster stops shall be fixed in a similar manner. Metal angle beads shall be used on all external angles for internal plaster and on concrete columns, which are to be plaster or render finished. Metal plaster stops shall be fixed at expansion joints and shall be truly plumb and straight.

## **(5) Plaster on Lathing**

Where lathing is plastered it shall be execution in three coats. The first coats, where cement plaster is used shall be of cement plasters mixed in the proportions of 1 part cement, 1 part lime, to 6 parts sand. The first coat shall be 6 mm thick and shall be scratched on the surface in both directions in order to give a good key for the next coat. Care should be taken to ensure that all the voids in the lathing are completely filled. The second and third coats shall be as the first and second coats as described in this Sub-Section (2).

## **(6) Protection, Cleaning and Handling over**

Deliver and lay suitable protection materials in all areas where finishing work shall be done to protect floors and all other surfaces from damage during the work. Remove all rubbish and debris from the site at the end of each day's work. On Completion all surplus material shall be carefully scrubbed off.

## **6207 Quality Control and Testing**

### **(1) General**

The QA/QC procedures shall include the requirements defined in this specification and aspects such as:

- a. Definition of requirements
- b. Compliance with the requirements
- c. Procurement
- d. Packaging and transportation
- e. Control procedures for testing
- f. Tolerances
- g. Inspection checks
- h. Commissioning and testing
- i. Quality assurance / control documentation

Sampling, requirements for inspection, testing and field control of brick and their materials shall be the responsibility of the Contractor. The Engineer approval shall be required for the testing procedures and means. The Engineer shall have free access to the work for the selection of samples and for carrying out tests. The Contractor shall render any assistance necessary for the taking of the samples and for carrying out the tests. If so required, the Contractor shall provide storage and protection for such samples on the site.

### **(2) Sampling and Test**

- a. Samples of each type of bricks, which are intended to be used for the project, shall be submitted to the Engineer for approval.
- b. Additional samples shall be submitted if requested by the Engineer.
- c. All materials used in the works shall be of as good quality as the approved samples.
- d. The selection of the brick units suitable for construction shall be left entirely to the discretion of the Engineer.
- e. Testing for the above requirements shall be in accordance with ASTM C140 "Method of Sampling and Testing Concrete Brick Units" or equivalent and whenever required by the Engineer.

## **6208 Measurement and Payment**

Brick works will be paid per cubic meter of brick walls erected. Plastering will be paid per square meter of plastered surfaces.