# GENERAL

## SCOPE

This specification is to be read in conjunction with the Drawings and Bill of Quantities (BOQ). In the event of any discrepancy, the Specification and Bill of Quantities takes precedence over Drawings.

## Local regulations and standards

Work shall comply with local regulations and local construction standards. Discrepancies between designs and with regulations or standards shall be addressed before work commences.

Structural designs shall be reviewed by a local Engineer to confirm adequacy in relation to local regulations, construction practices, and site conditions.

# SITE

## SITE SELECTION

The site of works shall be selected to avoid risks of flooding, erosion, subsidence, exposure to high winds, contamination of ground water, and other avoidable risks.

## SITE SETOUT

The location of works shall be checked, set-out (marked) and approved before work commences.

## SOIL CONDITIONS AND TESTING

Site soil conditions shall be assessed prior to commencement of works for suitability in relation to structural and hydraulic requirements.

## soakage pits

Sizing of soakage pits, trenches and drain fields depends local site soil infiltration rates and the quantity of wastewater that is expected. Soakage pit dimensions should be determined by on-site soil infiltration tests, considering soil types and infiltration rates noted below.

|  |  |  |
| --- | --- | --- |
|  | Infiltration rate (litres/m2/day) | |
|  | clean water | wastewater |
| Sand | 720-2400 | 33-50 |
| Sandy loam | 480-720 | 24 |
| Silt loam | 240-480 | 18 |
| Clay loam | 120-240 | 8 |
| Clay | 24-120 | Unsuitable |
| *Source: Davis & Lambert (2002) Engineering in Emergencies, 2nd edition. Practical Action Publishing: Warwickshire* | | |

Water collection and usage points should be equipped with adequately designed soakage systems located at least 30 metres away from groundwater sources. A soakage pit base must be at least 1.5m above the highest average groundwater table level.

## prevention of surface or groundwater contamination

Location and construction of water supply related infrastructure must avoid contamination of surface water and groundwater sources. Risks are generally low and related to contamination from water treatment chemicals, water treatment by-products and contamination from wastewater.

# materials

## sand

Sand should be clean, sharp, angular (gritty to touch), clean and free from impurities. River or pit sand should be used rather than sea sand which contains salt and other impurities that affect structural applications. All sands should be washed before use to ensure a clay/silt content of no more than 6%.

A rough field test of sand may be carried out by rubbing a sample of sand between damp hands and noting the extent of discolouration from soil, dust or other impurities.

## water

Water used for construction should be non-saline, and free oils, acids, alkalies and from impurities including soil/mud and organic matter.

## Gravel and aggregate

Gravel and aggregate for concrete and compacted sub-bases shall be clean and free from impurities including soil, dust, and organic material. Aggregates for concrete shall be 12-25mm to minimise crack propagation across load bearing concrete structures and to ensure an adequate covering of steel reinforcement.

## Cement

Ordinary portland cement must be used before the expiry date. Cement should be kept dry and stored at least 15cm above ground to avoid ground moisture. Expired or damaged cement may be indicated by excessive grittiness or lumps of set cement.

## Cement plaster

Cement plaster shall comprise ordinary portland cement, sand and water as specified herein. A cement:sand ratio of 1:4 shall be used unless otherwise noted. Cement plasters shall be applied to a minimum thickness of 1cm unless otherwise noted. After application, plastered surfaces shall be cured (kept moist) for a minimum of 7 days.

Waterproof cement plasters for interior and exterior surfaces of water tank shall comprise 3 layers: 1) 6mm, 1:4, spatter-dash, 2) 10mm, 1:3, rough finish, 3) 10mm, 1:2, smooth float. Each layer shall be applied before the base layer is cured, with the base layer wetted and scratched to ensure proper bonding. Waterproof plasters should be mixed with a waterproofing compound (Sikalite or equivalent) at the dosage specified by the compound manufacturer.

## CEMENT MORTAR

Cement mortar shall comprise Portland cement, sand and water as specified herein. A cement:sand ratio of 1:6 shall be used unless otherwise noted. Cement mortar in brick masonry and stone masonry shall be applied to a minimum thickness of 6-10mm unless otherwise noted. After laying, mortar within brick and stone masonry shall be cured (kept moist) for a minimum of 10 days.

## concrete

### Formwork

Formwork for in-situ poured shall be straight and true with adequate bracing to avoid deformation under the load of poured concrete. Formwork may be constructed of plywood, sawn timber or steel according to local standards and concrete finish (appearance) requirements. Ensure adequate chamfer – around 2cm – at external corners.

Ensure that formwork construction enables removal without damage to concrete. To minimise adhesion of concrete, wet surfaces of formwork that will come in contact with concrete and apply a wash of limewash, linseed oil or soapy water.

### Concrete mix

Concrete shall comprise Portland cement, sand, aggregate, and water as specified herein.

For general structural purposes, a cement:sand:aggregate mix of 1:2:4 (with a minimum cement dosage of 320kg/m3) shall be used unless otherwise noted. For water retaining structures (reservoir walls and bases) a cement:sand:aggregate mix of 1:1.5:3 shall be used unless otherwise noted (1:2:4 is not waterproof)(with a minimum cement dosage of 380kg/m3). For mass concrete applications a cement:sand:aggregate mix of 1:3:6 shall be used unless otherwise noted.

For hand mixing, additional cement should be added in accordance with the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mix | Cement | | Sand  (m3) | Aggregate  (m3) |
| Machine mix  (kg) | Hand mix  (kg) |
| 1 : 1.5 : 3 | 370 | 380 | 0.42 | 0.84 |
| 1 : 2 : 4 | 290 | 300 | 0.45 | 0.90 |
| 1 : 3 : 6 | 190 | 200 | 0.46 | 0.92 |
| *Source: Khanna, P.N. (1982) Indian Civil Engineers Handbook, 8th ed. Engineers Publishers: New Delhi* | | | | |

Ensure that concrete mixtures are not over watered – a bucket slump test of mixed concrete should yield less than ¼ reduction in the slump height.

### Concrete pouring

Each concrete element – e.g., each concrete slab, each section of footing or parapet - shall be cast in a single pour.

### Concrete rodding and curing

Cast concrete should be immediately covered with fabric, plastic sheet, straw, cement bags, sacking or leaves to keep the concrete moist and cool during the curing period. All concrete should be well vibrated or rodded to remove air voids. The concrete shall be cured with frequent watering at least twice daily for at least 10 days before use.

### Concrete finishing

Provide a minimum 1% fall to water collection and drainage surfaces. Provide a rough, non-slip finish to trafficable concrete surfaces, e.g., by brushing the surface during curing.

## Steel reinforcement

Reinforcement bars shall be free from rust and of the correct type and size for concrete construction work (typically a characteristic yield stress of at least 210 N/mm²). Steel reinforcement should be placed as per the designs (typically 7/8 of the slab or wall thickness) to ensure the bars function correctly in tension. All bars should have at least 12mm concrete cover.

## FERRO-CEMENT WIRE MESH

Galvanised wire mesh for ferro-cement should be 0.50-1.00mm diameter with a mesh spacing of 10-20mm. Wire should be galvanised and supplied free of rust, oil or other impurities that may reduce adhesion with cement plaster.

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Fig. 1. Detail section of wire mesh and steel reinforcement configuration for ferro-cement

## Brick masonry

Bricks should be made from clay free of stone or other organic or inorganic impurities. Bricks shall be of a standard, consistent size that conforms with local standards, and shall have plane rectangular faces and right-angled edges. Bricks should be of sufficient strength, with a minimum crushing strength of 125kg/cm2, or to not break when dropped from a height of 1m. Bricks should be fired sufficiently such that, when immersed in water, a brick shall not absorb water more that 20% of its dry weight.

Bricks shall be soaked in water for minimum 15 minutes prior to laying in cement mortar.

Bricks shall be laid in horizontal courses, with brickwork laid in a single day not exceeding 1m height to avoid excessive pressure on newly laid lower courses.

Cement mortar joints should be 6-10mm. A cement : sand mix of 1:6 should be used for masonry mortar unless otherwise noted. Brickwork shall be covered with plastic sheeting or textile and kept wet (cured) for minimum 10 days after laying.

## STONE MASONRY

Stone masonry shall be laid in horizontal courses, with stones laid in a single day not exceeding 1m height to avoid excessive pressure on newly laid lower courses. Stones shall be laid by hand as close as possible with broadest side downwards. Joints and gaps between stones shall be filled with smaller stones.

Cement mortar joints should be 6-10mm. A cement : sand mix of 1:6 should be used for masonry mortar unless otherwise noted. Finished masonry shall be covered with plastic sheeting or textile and kept wet (cured) for minimum 10 days after laying.