

**QUALITY ASSURANCE & QUALITY CONTROL**  
**FOR**  
**DESIGN & CONSTRUCTION**

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## **1.0 EXCAVATION FOR FOUNDATIONS & TRENCHES**

To provide guidelines for all types of excavation to conform to the grades, lines and dimensions.

- a) Excavation shall be done in accordance with the line and depth indicated in the drawings or as directed by the Engineer.
- b) The set out for excavation shall be carried out according to the drawings to proper line and level.
- c) A reference Benchmark shall be established close to the site which shall be so located so as to avoid damage due to equipment movement or its impact.
- d) The temporary Benchmark transferred shall be double checked and shall be got approved by an Engineer.
- e) If the excavation depth is more than 1.2 m, care should be taken to avoid slippage of side slopes, depending on the type of soil, by providing shoring and shuttering or by casing the slopes.
- f) The commencement of excavation shall be done using approved Company equipment and as per the plan notified to the Engineer.
- g) If rock is encountered, SIC shall notify the Engineer for decision for further excavation.
- h) In case water table is encountered at any stage of excavation, SIC shall notify the Engineer in this regard and await further instructions.
- i) Excavated material suitable for use as backfill shall be deposited and stacked in storage piles at points convenient for re-handling of material during backfilling.
- j) The method of excavation within 3 m of any existing structure shall be with proper supporting arrangement so as not to endanger the existing structure. Before starting such excavation, proposals for the method of excavation shall be made and got approved from Engineer.
- k) Prior to the start of excavation, the following shall be ensured:
  - i) Joint measurement of net levels of ground along with Engineer shall be taken for assessing.
  - ii) Availability of excavation permits as per municipal bylaws.
  - iii) Check for any underground service lines and verification/clearance from the consultant shall have to be obtained.
  - iv) Fence the area with hoarding as required under local byelaws.

- v) Provide barricades & safety ribbons around the excavated area to prevent entry of unauthorized people and accidents. Caution night lamps shall be provided for excavations in open areas.
- vi) Excavated material unsuitable for reuse shall be carted away to municipal dumping ground with proper documentation like trip sheet and issue and receipt vouchers.
- vii) Protection for any underground services must be taken as per the instructions of the Engineer.
- viii) Whenever underground water table is met, dewatering must be resorted to, in consultation with the Engineer to keep the excavated working space clean and dry.
- ix) Sign boards indicating excavation work shall be erected when working in open (unfenced) areas.

## **2.0 CUT AND FILL, EMBANKMENT FORMATION**

To provide guidelines for the Site personnel for maintaining a uniform and consistent Cut and Fill, Embankment Formation conforming to quality standards.

1. Where ever required, the site shall be cleared from all rubbish, loose soil, trees, stumps, bushes and other growing vegetation so as to have hard base.
2. The setting out shall be carried out according to the drawings to proper line and level using accurate levelling instruments i.e., Compass, Theodolite, etc. The grid levels of the existing ground shall be taken with respect to the Benchmark.
3. A reference Benchmark shall be established close to the site which shall be so located so as to avoid damage due to equipment movement or its impact.
4. The temporary Benchmark transferred shall be double checked and shall be got approved by Engineer using RFI.
5. Prior to the beginning of grading a trial pit must be excavated to the required depth to get a fair idea of the strata.
6. After taking grid levels, the same shall be plotted on a drawing and areas for cutting and levelling shall be clearly demarcated based on requirements.
7. The top soil of the filling area shall be removed to a minimum depth of 10 ~ 15 cm or to the extent of loose soil. So as to have a suitable hard base free from roots, vegetation.
8. Excavated material suitable for use as embankment material already deposited in storage piles at points convenient for rehandling of the material may be

deposited on the embankment positions at convenient layer over watered and compacted sub base.

9. No Filling shall be done without the approval of the Engineer. All material intended to be used for filling shall be free from all organic and deleterious matter. It shall be tested (Particle size distribution and standard Proctor Test) and got approved from the Engineer.
10. Fill material shall be free from large lumps, wood or other extraneous material.
11. The approved material for filling shall be free of any appreciable amount of gravel or stone particles more than 40 cm in size and of such gradation as to permit thorough compaction.
12. The parameters required for Standard Proctor's Density Tests for the cut material as well as imported material from other quarries shall be determined if the material is intended to be used for filling.
13. The filling shall be commenced in uniform layers from the lowest part/point.
14. The width of layers shall be extra for about 45 cm width on either side when measured across the cross section to have required density at the edges of embankment. After formation of embankment, the extra 45 cm has to be removed by gently without disturbing the side embankment. So as to have the entire embankment a uniform Proctor Density.
15. The formation shall be built up in layers as specified at its Optimum Moisture Content to achieve the Specified Compaction percentage.
16. Compaction shall be carried out using approved vibratory rollers.
17. When necessary, each layer before being compacted shall be processed as required to bring the moisture content sufficiently close to optimum to make possible its compaction to the required density. The material shall have uniform moisture content through the entire layer of material to be compacted.
18. Each layer of material shall be compacted uniformly by use of three-wheeled power rollers, vibrator, rollers or other approved type compactors like plate compactors. Sheep foot compactors depending upon the type of soils proposed for embankment.
19. The rolling shall be done in a longitudinal direction along the embankment and shall generally begin at the outer edges and progress towards the center in such a manner that each section receives equal compacting effect.
20. The equipment deployed for compaction shall be capable of achieving the specified degrees of compaction.

21. The compaction shall be done progressively from one side with each succeeding pass uniformly overlapping the previous pass.
22. In the case of soil raft or compaction of large areas, a test patch has to be conducted to ascertain the number of rollers required to achieve the desired compaction.
23. Maximum dry density and optimum moisture content of soil shall be determined by one of the methods described in ASTM D1557 - 70 (AASHTO T180-74) commonly known as the Standard Proctor Test. Any comparison shall achieve the compaction to the extent so as to give minimum required percentage of maximum density as per specifications.
24. At the time of compacting areas where high density is required, fill material and the surface on which it is placed shall be within the specified range of moisture content. In case the material is soft or too wet, it shall be spread out and allowed to dry sufficiently prior to compaction.
25. Prior to the start of grading, the following shall be ensured:
  - i) Availability of work order as per municipal bylaws.
  - ii) Joint measurement of spot level along with Engineer.
  - iii) Check for any underground service lines and verification/clearance from the consultant.
  - iv) Fence the area with hoarding as required under local byelaws.

### **3.0 PLAIN CEMENT CONCRETE**

To have guidelines on execution of Plain Cement Concrete of various grades in levelling course through site mixed concrete or Ready Mixed Concrete.

#### **A) Site Mixed Plain Cement Concrete**

1. The design mix meant to be used in site mix should be studied in detail. Prior to use of the mix in actual work, trials needs to be carried out and 7 day compressive strength shall be ascertained.
2. The cubes tested for 7 days compressive strength should indicate values above the 7 day target mean strength of the design mix. In case the cubes fail to achieve these criteria, the concrete mix shall be redesigned.
3. The weight mix of aggregates shall be converted into volume mix based on box sizes of 30 x 30 x 30 cm. The coarse and fine aggregate shall be converted into volumes required for each 50 kg bag of cement based on their densities.

4. The water requirement for each 50 kg bag of cement mix shall be arrived at from the designed water-cement ratio.
5. Initially we may start with wooden boxes for measurement of aggregates. Subsequently we shall convert into steel boxes fabricated for this purpose after a specified lead time.
6. The boxes used for measuring shall be marked by paint for the aggregate type it is to be used with the following letters on two vertical sides of the box.
  1. Sand – “S”
  2. 10 mm – “10”
  3. 20 mm – “20”
7. The height of the aggregate to be filled inside the box shall be marked with paint on the inside vertical faces of the box at 4 locations.
8. The measured aggregate for each mix shall be transferred into a wheel barrel which shall transport the aggregates into the hopper of the concrete mixer.
9. Water shall be put inside the rotating drum using the 5 litre bucket clearly marked with the quantum required.
10. All the aggregates and cement, 1 bag, will be collected in the hopper of the mixer which will convey the same using the lever and rope hoisting arrangement into the mixer drum for mixing.
11. The mixing time for each mix shall be maintained at 3 minutes.
12. The conveying of cement and aggregates from hopper to the drum shall be controlled in such a way that the maximum mixing time does not exceed 5 minutes for each mix.
13. After the completion of mixing, the concrete contents shall be delivered into a dumper or wheel barrow which will transport the concrete to the placing site.
14. Usual quality control tests like slump, temperature shall be carried out prior to placement of mix in forms.

**B) Ready Mix Plain Cement Concrete**

1. Vendors/Suppliers for Ready Mix Concrete shall be short listed and design mix to be obtained.
2. Design mix should be studied in detail.
3. Trial mix shall be organized and witnessed along with representatives of consultants/clients.

4. Vendors of RMC should be preferably finalized with the one with ISO 9000 series accreditation.
5. The production and batching of concrete shall be as per the procedure adopted by the Ready supplier and duly approved by Company/Consultant/ Client.
6. The transportation of batched pre-mixed concrete should be preferably through transit mixers.
7. The pre-mix concrete shall be produced with approved quantum of admixtures and retarders (if, required) to delay setting times.
8. On arrival of the mix at site, an initial check should be organized by the Foreman on the quantum received, time of despatch, arrival time etc. to check on the workability and the specifications.
9. The delivery note shall be checked by the Foreman to confirm the grade, water cement ratio and quantity.
10. The transit mixer drum shall be rotated for 2 minutes at high speed to ensure uniform mixing of concrete before pouring.
11. The Foreman shall ensure the readiness of the site to receive concrete including approval from client/consultant in the pour card prior to ordering the concrete.
12. The concrete slump and temperature shall be checked for conformity with the design mix prior to the pour.

**C) Concrete Placement**

1. The foreman shall ensure that the formwork is tightly constructed and the jars in contact with concrete are free from foreign matter.
2. Method of placing of concrete shall be programmed in advance and discussed with the consultant's representative for concurrence.
3. All plant and equipment used in placing of concrete shall be kept fully maintained and in clean condition free from hardened concrete and deleterious matter.
4. After pouring, the surface of the pour shall be trowelled to provide surface and slope as per the design. Two hours after the pour, water shall be sprinkled and surface to be kept wet using soaked gunny bags to prevent shrinkage cracks.
5. As soon as exposed concrete surfaces can accept further curing procedures (after one day of casting), they shall be covered by an approved curing membrane or ponding by fresh water shall be resorted to.
6. The minimum curing period shall be three days for all Plain Cement Concrete, unless otherwise instructed.



7. The stripping time for shuttering shall be one day unless otherwise instructed by the Engineer.

#### **4.0 REINFORCED CEMENT CONCRETE**

To provide guidelines to Site Personnel for Quality Assurance and Control in casting of Reinforced Concrete Structural Members.

##### **A. Staging**

1. The areas where an elevated slab has to be cast should first be surveyed for deciding the type of staging system to be adopted.
2. The ground must be surveyed and if need be, compacted with good earth to avoid settlement of staging at the time of loading and concrete pour.
3. The hydrostatic pressure that is likely to be exerted on ground by the props due to the weight of concrete must be evaluated and action must be taken.
4. The decision on the type of staging shall necessarily depend on the height of the slab from ground level.
5. Generally, a system of props and spans are used in the company for elevated slab castings. Wherever, the height requirements of the building exceeds the maximum permissible elevations of the extent staging systems, incremental height increases must be done by the use of solid blocks, steel cribs or by the use of both in combination.
6. For safety purposes, it is essential that individual props are fastened to one another.
7. Erection of props should be carefully done to avoid any accidents.
8. As far as possible, electric wires should not be pulled in between the erected props.
9. The area where the props are being erected should be cordoned off using caution tapes to prevent any unauthorized access.
10. The Props shall be erected to the proper level from the initial stage itself so as to avoid major alignment and level adjustments to forms and props just before actual pour.

##### **B. Shuttering**

1. For shuttering purposes, 12mm plywood is generally used for normal slab and footings and beam works. For fabrication of shuttering of deep beams (depth > 500mm) and column boxes, 18mm plywood shall be used.

2. Formwork for concrete shall be tightly constructed using good quality fair faced plywood, true to shape and dimension prescribed in the working drawings.
3. Faces of shuttering in contact with concrete shall be free from adhering grout, projecting nails, splits and other defects.
4. Shuttering oil shall be used to clean the shuttering and for easy stripping of formwork. However, excess use of mould oil should be discouraged.
5. Joints of shuttering shall be made to ensure zero loss of fine material or cement grouts during the placing and consolidation of concrete. Slurry leakage from shuttering should be controlled by all means.
6. When reinforcement is passing through a formwork, care shall be taken to ensure a close fitting joint against the steel rods so as to avoid loss of cement grout.
7. Connections shall be constructed to permit easy removal of concrete and shall be either nailed, screwed, bolted, clipped, clamped, wired or secured otherwise so as to be strong enough to retain the correct shape during pour.
8. Bolt holes used for securing formwork shall be made good after stripping.
9. When the film of shuttering ply gets worn of due to repetitive use, the form shall be remade utilizing the other face of the plywood.
10. Wooden runners should be nailed to the form at suitable intervals so as to avoid face outs due to bulging of plywood.
11. The wood used for making runners to the formwork should be straight and well seasoned.

### **C. Reinforcement Work**

1. Bars shall be bent cold by machine or by other approved means as per BS 4466.
2. Prior to the start of bar bending work for each structural member, bar bending schedule must be made and got approved from the Consultant.
3. The bar bending schedule should conform to the working drawings provided in the contract.
4. For kinks the bar bending pattern should conform to the prescribed standards of radius and angles of bend.
5. All reinforcement shall be cut to the specified lengths made truly straight or bend to specified shape before it is fixed.
6. The length of right angle bends should be equal to 4 times the diameter of bar.
7. Bar splices shall be made in the reinforcement by lapping bars for a length of 42 times the diameter of the bar or as specified.

8. Bar splices shall be securely fastened together.
9. All end hooks shall have an overall length and width equal to 4 times the diameter of the bar or as specified.
10. Reinforcement shall be accurately positioned as shown on Engineer's drawing rigidly supported and wrapped together to prevent displacement during concreting.
11. Cover blocks shall be placed along with tying of reinforcement so that subsequent insertion is avoided.
12. Cover blocks shall be made of desirably the same concrete mix or grade and cured sufficiently before usage at work spot.
13. Link bars shall tightly embrace the bars with which they are intended to be in contact and shall be securely bound.
14. The reinforcement used in rebar work shall be tested to conform to the prescribed specifications. It shall be free from rust or pitting.
15. SIC shall check the steel for its dimensional accuracy and weight per unit length on receipt.
16. Prior to the pour of concrete, the SIC shall measure the reinforcement work jointly with Consultant representative in Measurement Book/Sheet for records.

**D. Concrete Pour**

Concrete production and placement shall conform to QC-MS-02 for site mix concrete and QC-MS-03 for ready mix concrete.

**E. Formwork Removal**

1. Unless otherwise stated, formworks shall be removed for each concrete member as specified in QC-MS-02 and QC-MS-03.
2. The curing period shall be a minimum of 7 days for all reinforced concrete structural members.
3. Alternate methods of curing can be adopted after the approval of Engineer and cost benefit analysis. The alternate methods include:
  - a. Application of curing compound subject to manufacturer's specification.
  - b. Resin based curing membrane in accordance with manufacturer's instruction.
4. Removal of formwork shall be carefully done without shock or vibrations to the concrete.

5. The minimum stripping time shall be as follows.
  - a. Foundation Sides – 1 day
  - b. Columns – 1 day
  - c. Beams – 2 days for sides & 7 days for soffits.
  - d. Slabs – 7 days
6. Wherever plastering is to be carried out hacking of concrete to a depth of 2 mm to be ensured after de-shuttering.

## **5.0 STORAGE OF CEMENT**

To provide guidelines for storage of cement bags at site in accordance with specifications and standards.

1. Cement bags shall be stored in raised platform about 150mm above ground level and 300mm away from walls.
2. Flooring of storage area shall be damp proof.
3. Ventilators in the storage area shall be as minimum as possible in size and number to reduce circulation of air.
4. Water shall not enter in store through doors and windows.
5. To avoid loss in strength due to storage, first in/first out system shall be followed.
6. Maximum of 10 bags shall be stored in each stack. The bags shall be placed in headers and stretchers, i.e. alternatively lengthwise and crosswise.
7. Receipt date of cement shall be displayed on slate for that particular stack.
8. Storekeeper shall go through the documents to confirm regarding validity of supply.
9. If storekeeper is not sure about the supply/quality of the cement, he shall inform the site-in-charge for details regarding supply/quantity of material.
10. Cement issue register shall be maintained by the storekeeper on daily basis. He shall record the number of cement bags per issue slip and also return of bags if any and actual consumption.
11. All cement delivered to the site shall be accompanied by manufacturers test certificate showing compliance with the appropriate standards.

## **6.0 PLASTERING**

To provide guidelines for all types of plastering both externally and internally to walls and exposed surfaces to conform to the grades, lines and dimensions.

1. The cement, water and sand shall comply with relevant specification of contract documents.
2. Metal accessories like expanded metal lathing, nails, plaster stop, angle beads shall conform to the specifications.
3. Mix proportions of mortar shall be as per the specifications and shall follow the methodology of mixing adopted for mortar for hollow block - QA-MS-08.
4. Plastering shall be made good up to metal or wood frames and skirting and around pipes or fittings.
5. Surfaces of undercoats shall be well scratched to provide a key for finishing coats.
6. All tools implements vessels and surfaces shall at all times be kept clean and strict precautions shall be taken to prevent the plaster or other materials from being contaminated by pieces of partially set material.
7. All surfaces to be plastered shall be made free from dust, grease, loose mortar etc.
8. Mortar joints in Block work shall be raked out to a depth of 15 mm.
9. Smooth or greasy cone surfaces shall be roughened by hacking.
10. All surfaces to be plastered shall be dashed with a mixture of cement and sand to form a key.
11. All surfaces shall be thoroughly sprayed with potable water and all free water is allowed to disappear before plaster is applied.
12. Before plastering is commenced, joints between different materials like joints between concrete and block work shall be reinforced with expanded metal lathing of specified width by nailing it to the block work or concrete. The reinforcement shall be fixed in such a way that is embedded completely in the undercoat of plaster.
13. The plastered surface of the wall shall be plumbed and straight from one end to other end. Plaster buttons shall be fixed at suitable intervals to indicate the thickness of the top surface line of the plaster.
14. After the preparation of surfaces as above, the undercoat shall be applied to the required thickness between screeds laid, ruled and plumbed.
15. When nearly set, the surface of the undercoat shall be scratched and cured before the finish coat is applied. This is where the plastering is to be done in two coats.

16. The finishing coat shall be applied to the required thickness by means of laying on trowel and finish to give the required surface.
17. Plaster shall be kept moist by sprinkling with water at regular intervals for a period of seven days.
18. The type of mix and thickness of plaster for each location shall be as indicated in drawings or as agreed to Engineer.
19. Any plaster of more than 12mm in thickness shall be applied in 2 coats.
20. For external plaster, the rendering shall be in 2 coats. Plaster buttons, expanded metal lath shall be fixed and rush coat applied as in the case of internal plaster. The wall shall be wetted before the application of first coat. The second coat shall be applied after the first coat has dried completely. All other procedures and methodology of internal plaster shall hold good for external render/plaster as well.

## **7.0 PAINTING**

To act as procedural methods for the execution of Painting Works at Construction Sites.

1. The following information shall be collected from the Specification, MAS, etc. before commencing the work.
  - a) Details of surface preparation to be done
  - b) Method of application, whether Hand brush, Roller brush, Ordinary spray, Airless spray, etc.
  - c) Sequences of coats, drying time for each coat, any curing is required.
  - d) Mixing ratios and type of thinner to be used
  - e) Temperature and Humidity limits
  - f) Shelf life and pot life of the product
2. Painting works shall commence only after the specified curing of the surface is completed
3. Painting activities for walls shall commence only after completing all the painting activities for the ceiling, i.e., top to bottom sequence to be followed.
4. Patch up plastering around switch boxes, conduit chasing, inserts shall be completed before commencing of the painting activities.
5. Fixing of floor skirting and the subsequent patch up plastering shall be completed before the commencement of the wall painting activities.

6. All types of wet grinding and buffing to the floor finish shall be completed before the final coat of the wall painting.
7. All painting activities except final coat shall be completed prior to fixing of switch box tops and pull box tops.
8. Fixing of M & E installations like fans, lamps, panel boards, etc. shall be fixed after the final coat is completed.
9. All installations which are likely to be fixed before the completion of the painting activities shall be protected from paint spills using polythene sheets and masking tapes.
10. Provision of Ample ventilation to the painting area, mask and gloves to the painting workers, etc. shall be adhered.
11. Smoking shall be prohibited and chances of electric sparks shall be ruled out where inflammable paint materials are being used.
12. As soon as a new lot of paint arrives at Store, a sample test patch is painted using the same and compared to be colour of the previous lots to ensure matching of colours.
13. Painting shall commence only after erection of proper stagings and platforms.

## **8.0 REINFORCEMENT STEEL**

The contractor shall procure Mild Steel (MS) Reinforcement Bars, High Yield Strength Deformed Bars (HYSD) Bars, Rods and Structural Steel, etc., required for the works, only from the main or secondary producers, manufacturing steel to the prescribed specification of Bureau of Indian Standards or equivalent and licensed to affix ISI or other equivalent certifications marks and acceptable to the Engineer-in-charge. Necessary test certificates for each consignment are to be produced to Engineer-in-charge before use on works. The original bills of procurement should be submitted to the Engineer-in-charge for making payment of the item.

The Diameter & weight of steel should be as follows:

| <b>Sl. No.</b> | <b>Diameter of Rod</b> | <b>Sectional weight in kg / RMT</b> |
|----------------|------------------------|-------------------------------------|
| 1.             | 08 mm                  | 0.39                                |
| 2.             | 10 mm                  | 0.62                                |
| 3.             | 12 mm                  | 0.89                                |
| 4.             | 14 mm                  | 1.21                                |
| 5.             | 16 mm                  | 1.58                                |
| 6.             | 18 mm                  | 2.00                                |

| Sl. No. | Diameter of Rod | Sectional weight in kg / RMT |
|---------|-----------------|------------------------------|
| 7.      | 20 mm           | 2.47                         |
| 8.      | 22 mm           | 2.98                         |
| 9.      | 25 mm           | 3.85                         |
| 10.     | 28 mm           | 4.83                         |
| 11.     | 32 mm           | 6.31                         |
| 12.     | 33 mm           | 6.71                         |
| 13.     | 36 mm           | 7.99                         |
| 14.     | 40 mm           | 9.86                         |
| 15.     | 42 mm           | 10.88                        |

Note: - **If any rods other than those diameters specified above are procured the weights shall be as per standard steel tables.**

Reinforcement shall be free from pitting due to corrosion and free from loose rust, mill scale, paint, oil, grease, adhering earth etc. The over laps in the reinforcement shall be as per IS : 456 – 2000 wastage in steel will be at the cost of contractor.

The contractor shall procure MS and HYSD rods required for the works, only from the main manufacturing steel units to the prescribed specification of Bureau of Indian Standards or equivalent and licensed to affix to ISI or other equivalent certifications, marks and acceptable to the Engineer-in-charge. The contractor should obtain and furnish from suppliers of steel, necessary ISI test certificate for every consignment of steel, before use on work.

Mild Steel Bars shall conform to Grade I of IS : 432.

High Yield Steel Strength deformed Bars shall conform to IS : 786 Binding wire shall conform to IS : 280.

Erected and secured reinforcement after fabrication shall be inspected and approved by the Engineer prior to placement of concrete.

## **9.0 STRUCTURAL STEEL**

1. Design Calculations & Drawing details.
2. Fabrication & Erection of Steel Structures shall be as per drawings.
3. Consumables like suitable electrodes (Megnarac / Advani make or any IS make), Industrial Gas etc., are to be used.
4. Painting of trusses with approved quality paints with one shop coat of Zinc Chromate should be applied before erecting have to be taken up.



5. Work to be done in accordance with statutory safety provisions and not exposing the employees or property to unacceptable risk. Safety rules shall be followed and contractors are accountable for compliance.
6. One shall be solely responsible for the safety & security of all the men & machinery employed by you on the job. You shall take necessary insurance coverage for the same, besides adhering the safe construction practices.
7. Obtain all necessary insurance coverage like CAR, Workmen Compensation, Public Liability besides Medical Insurance and Personal Accident Insurance for all the workmen engaged by him on the said contract works.
8. The material shall be procured, conveyed and unloaded and kept on your safe custody at the location shown by us in the Facility.

#### **10.0 TILING WORKS IN FLOORS AND WALLS**

To act as procedural methods for the laying and fixing of all types of flooring and wall tiling and to confirm with the required specifications and quality.

1. The following information shall be collected from the Specification, MAS and shop drawing before the commencement of the tiling work.
  - a) Details of the Services pipes, conduits etc. which are to be concealed under the proposed tiling work.
  - b) Layout pattern, colour, alignment etc. for the tiling works to be carried out.
  - c) Width of the gap to be maintained between the tiles.
  - d) Availability of the proper cutting tools for the tile being used.
  - e) Finish details for the corner tiles of walls (whether to insert corner tiles or to travel the edges, etc).
2. The SIC shall check whether all the concealed works and insert works are completed before the commencement of the tiling works.
3. Splatter coat and first coat of plastering shall be completed before commencing the wall tiling.
4. Floor tiling shall conform to the required slope as per shop drawings/requirement.
5. Unless otherwise specified in the layout details tiling shall be done so that length of the cut piece as the left extreme shall be same as that of the right extreme. Cut piece size of lesser than half the tile shall be avoided.
6. Tile size of spacers used shall conform to the specification.
7. Tiles shall be dry laid over plain floor for inspection of the uniformity of colour shade as well as dimension within a lot and between different lots prior to actual usage.

## 11.0 QUALITY CONTROL MANUAL

### Walls

| Sl. No. | Characteristics    | Specification  | Measuring Equipment / Method | Sample size-frequency | Details of Inspection | Acceptance Criteria  | Responsibility | Action incase of non-conformity | Responsibility |
|---------|--------------------|--|------------------------------|-----------------------|-----------------------|----------------------|----------------|---------------------------------|----------------|
| 1.      | Cracks             | Not allowed  | Visual                       | 100-5%                | Check visually        | As per specification | Site In charge | Dismantle and rework            | Site in charge |
| 2.      | Dampness / Leakage | Not allowed  | Visual                       | 100-5%                | Check visually        | As per specification | Site In charge | Dismantle and rework            | Site in charge |
| 3.      | Finishing          | Local Projection shall not exceed 2 mm & local depression 1.2 mm | Visual                       | 100-5%                | Check visually        | As per specification | Site In charge | Dismantle and rework            | Site in charge |

### FLOORING

| Sl. No. | Characteristics            | Specification               | Measuring Equipment / Method | Sample size-Frequency | Details of Inspection                                | Acceptance Criteria            | Responsibility | Action incase of non-conformity | Responsibility      |
|---------|----------------------------|-----------------------------|------------------------------|-----------------------|--|--------------------------------|----------------|---------------------------------|---------------------|
| 1.      | Level                      | 5 mm                        | Measuring tape               | 100-5%                | Mark Lobby on door frame & check with measuring tape | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
| 2.      | Line (Flooring / Skirting) | As per Architecture drawing | Visual                       | 100-5%                | Check Visually                                       | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
| 3.      | Cracks                     | Not allowed                 | Visual                       | 100-5%                | Check Visually                                       | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
| 4.      | Gap Filling                | Cement Grout                | Visual                       | 100-5%                | Check Visually                                       | As per specification /         | Site In charge | Fill with grout                 | Project coordinator |

| Sl. No. | Characteristics             | Specification               | Measuring Equipment / Method | Sample size-Frequency | Details of Inspection | Acceptance Criteria            | Responsibility | Action incase of non-conformity | Responsibility      |
|---------|-----------------------------|-----------------------------|------------------------------|-----------------------|-----------------------|--------------------------------|----------------|---------------------------------|---------------------|
|         |                             |                             |                              |                       |                       | drawing                        |                |                                 |                     |
| 5.      | Voids                       | No Hollow Sound             | Coin                         | 100-5%                | Check Visually        | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
| 6.      | Slope (Bath / WC / Balcony) | As per Architecture drawing | Level Tube                   | 100-5%                | Check Visually        | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
|         | <b>PLATFORM</b>             |                             |                              |                       |                       |                                |                |                                 |                     |
| 7.      | Height                      | As per Architecture drawing | Measuring tape               | 100-5%                | Check Dimensions      | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
| 8.      | Slope                       | As per Architecture drawing | Level Tube                   | 100-5%                | Check with level tube | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
| 9.      | Leakage                     | No leakage is allowed       | Visual                       | 100-5%                | Visual                | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |
| 10.     | Umbra Patti                 | As per Architecture drawing | Measuring tape               | 100-5%                | Check Dimensions      | As per specification / drawing | Site In charge | Remove & rework                 | Project coordinator |

## WINDOWS

| Sl. No. | Characteristics                 | Specification       | Measuring Equipment / Method | Sample size-Frequency | Details of Inspection | Acceptance Criteria  | Responsibility | Action incase of non-conformity | Responsibility      |
|---------|---------------------------------|---------------------|------------------------------|-----------------------|-----------------------|----------------------|----------------|---------------------------------|---------------------|
| 1.      | Locks                           | Smooth in operation | Visual                       | 100-5%                | Locking & unlocking   | As per specification | Site In charge | Reject                          | Project coordinator |
| 2.      | Closing & opening               | Smooth in operation | Visual                       | 100-5%                | Locking & unlocking   | As per specification | Site In charge | Reject                          | Project coordinator |
| 3.      | Gap between window frame & wall | No gap is allowed   | Visual                       | 100-5%                | Check Visually        | As per specification | Site In charge | Remove and rework               | Project coordinator |

## Doors

| Sl. No. | Characteristics                    | Specification              | Measuring Equipment / Method | Sample size-Frequency | Details of Inspection | Acceptance Criteria  | Responsibility | Action incase of non-conformity | Responsibility |
|---------|------------------------------------|----------------------------|------------------------------|-----------------------|-----------------------|----------------------|----------------|---------------------------------|----------------|
| 1.      | Closing & opening                  | Operation should be smooth | Visual                       | 100%-5%               | Check visually        | As per specification | Site In charge | Reject                          | Site In charge |
| 2.      | Gap between window frame & wall    | No gap is allowed          | Visual                       | 100%-5%               | Check visually        | As per specification | Site In charge | Remove & rework                 | Site In charge |
| 3.      | Gap between window frame & shutter | No gap is allowed          | Visual                       | 100%-5%               | Check visually        | As per specification | Site In charge | Remove & rework                 | Site In charge |
| 4.      | Painting                           | Shade should be uniform    | Visual                       | 100%-5%               | Check visually        | As per specification | Site In charge | Remove & rework                 | Site In charge |
| 5.      | Fitting                            | As per P.O                 | Visual                       | 100%-5%               | Check visually        | As per specification | Site In charge | Remove & rework                 | Site In charge |
| 6.      | Moulding patti / Beading patti     | As per P.O                 | Visual                       | 100%-5%               | Check visually        | As per specification | Site In charge | Remove & rework                 | Site In charge |

## PLUMBING & SANITATION

| Sl. No. | Characteristics                         | Specification  | Measuring Equipment / Method | Sample size-Frequency | Details of Inspection                  | Acceptance Criteria     | Responsibility | Action incase of non-conformity                                     | Responsibility      |
|---------|---|--|------------------------------|-----------------------|--|-------------------------|----------------|---|---------------------|
| 1.      | Fixing & height of all fixture from FFL | Ti should be as per plumbing layout                    | Measuring tape               | 100-5%                | Check with respect to plumbing drawing | As per plumbing drawing | Site In charge | Remove & rework   | Project coordinator |
| 2.      | Leakage from taps & other fixtures      | No leakage   | Visual                       | 100-5%                | Check visually                         | No leakage              | Site In charge | Remove & fix new fittings or repair fittings                        | Site In charge      |
| 3.      | Pressure at all taps                    | Pressure should be equal at all taps                   | Visual                       | 100-5%                | Check visually                         | Equal at all taps       | Site In charge | Check for any obstructions in plumbing lines & change layout        | Site In charge      |
| 4.      | Functioning of stop cock                | Smooth functioning                                     | Visual                       | 100-5%                | Check by opening & closing the spindle | Smooth functioning      | Site In charge | Remove the defective stop coke                                      | Site In charge      |
| 5.      | Cleaning of WC trap                     | It should be clean & clear of sand and other particles | Visual                       | 100-5%                | Check visually                         | If P-trap is clean      | Site In charge | Clean thoroughly fill obstruction removed with chemical or manually | Site In charge      |

## 12.0 TESTING OF WORKS & MATERIALS

- a) All materials used and works done shall be subject to approval of the Engineer.
- b) The contractor shall arrange sufficiently in advance to test materials and portions of works in order to prove their soundness and efficiency if required, including samples and supporting test results from the approved laboratory and other documentary evidence from the manufacturer. Wherever applicable and indicate the types of materials and their respective sources. The delivery of materials at site shall commence only after the approval of the quality, grading and sources of the materials by the Engineer.
- c) The quality of all materials approved shall be maintained throughout the period of construction and periodical tests shall be carried out to ensure that it is maintained. The contractor shall conduct tests at work site / approved laboratories and shall maintain test reports at site for cement, coarse aggregates, fine aggregates, water, steel, bricks and concrete at the following frequency: -

| <b>Sl. No.</b> | <b>Description of Material</b>  | <b>Frequency of Test</b>                                  | <b>Allowable Limits</b>  |
|----------------|---|---|--|
| 1.             | Cement (IS : 8112 – 1989)   |   |  |
|                | a) Fineness   | One for each source of supply in a month                  | Shall not be less than 3500 sq.cm / gm   |
|                | b) Setting Time   | One for each source of supply in a month                  | Initial setting time shall not be less than 30 minutes and final setting time shall not be more than 60 minutes.   |
|                | c) Soundness  | One for each source of supply in a month                  | Expansion (un-aerated) shall be not more than 10 mm by "Le Chatelier" method; if it fails, expansion of aerated sample shall be not more than 5 mm.                  |
|                | d) Compressive Strength of Cement Mortar cubes 1 : 3 (1 Cement : 3 Standard Sand) by mass | One for each source of supply in a month                  | Compressive Strength for 7 days shall not be less than 330 kg / cm <sup>2</sup> and Compressive Strength for 28 days shall not be less than 430 kg / cm <sup>2</sup> |
| 2.             | Coarse Aggregate : (IS383 – 1970)   |   |  |
|                | a) Gradation  | One test for 15 cum or at least on the day of concrete if | <b>40 mm Metal</b><br><b>a) Sieve Analysis:</b>  |

| <b>Sl. No.</b> | <b>Description of Material</b> | <b>Frequency of Test</b>  | <b>Allowable Limits</b>   |
|----------------|--------------------------------|---|---|
|                |                                | concrete quantity is less than 15 cum.                                    | 63 mm – 100%<br>40 mm – 85 to 100%<br>20 mm – 0 to 2%<br>10 mm – 0.5%<br>b) <b>Flakiness Index:</b> Shall be less than 30% by weight<br><b>20 mm Metal.</b><br><b>a) Sieve Analysis:</b><br>40 mm – 100<br>20 mm – 95 to 100%<br>10 mm – 25 to 55%<br>4.75 mm – 0 to 10%<br>b) <b>Flakiness Index:</b> Shall be less than 25% |
|                | b) Aggregate Impact value      | Once for each source of supply or when ever change in texture is noticed. | Aggregate impact value : 20 – 40 mm (IS 2386 – 1963)  |
| 3.             | Fine Aggregate (IS 383 – 1970) |   |   |
|                | a) Gradation Concrete          | for One test for every 15 cum   | Fineness modules : Fine sand limit 2.2 to 2.6   |
|                | b) Gradation Masonry           | for At least once on the day of work                                      | Medium sand limit 2.6 to 2.9  |
|                | c) Gradation Finishing         | for At least once on the day of work                                      | Coarse Sand Limit 2.9 to 3.2  |
|                | d) Bulk age                    | Three for each day of work i.e., morning noon and evening                 |   |
|                | e) Silt Content                | At least once on the day of work  | Silt Content : shall be less than 4% by weight  |
| 4.             | Water: Chemical Test           | One Test for each source  | The pH value of water shall not be less than 6.   |
| 5.             | Steel : F2415 (IS 1786 – 1985) |   |   |
|                | a) 0.2% proof stress           | One for each source of supply   | 4150 kg / cm <sup>2</sup> (minimum)   |

| <b>Sl. No.</b> | <b>Description of Material</b> | <b>Frequency of Test</b>   | <b>Allowable Limits</b>   |
|----------------|--------------------------------|--|---|
|                |                                | and once in six months for fresh supply  |   |
|                | b) Elongation                  | One for each source of supply and once in six months for fresh supply  | Percentage of Elongation 14.5% minimum  |
|                | c) Tensile Strength            | One for each source of supply and once in six months for fresh supply  | Ultimate Tensile Strength 4900 kg/cm <sup>2</sup> (Minimum)   |
| 6.             | Bricks : (IS : 1077 – 1976)    |  |   |
|                | a) Compressive Strength        | One for each source of supply and once in two months when change in texture is noticed   | Shall not be less than 40 kg / cm <sup>2</sup>  |
|                | b) Water absorption            | One for each source of supply and once in two months when change in texture is noticed   | Shall not be greater than 20% by weight   |
| 7.             | Concrete : (IS 456 : 2000)     |  |   |
|                | a) Cube Strength               | Frequency of Testing as per clause 15.2 of IS 456 – 2000 for example 6 cube specimens, 3 each for 7 days & 28 days strength for every 15 cum. Cube shall be prepared, cured and tested in accordance with the requirement of IS 516. | a) Compressive Strength (7 days)<br>M 15 – 100 kg / cm <sup>2</sup><br>M 20 – 135 kg / cm <sup>2</sup><br>b) Compressive Strength (28 days)<br>M 15 – 150 kg / cm <sup>2</sup><br>M 20 – 200 kg / cm <sup>2</sup> |
|                | b) Slump                       | Thrice in a day of concrete in morning, noon & evening   | a) Foundation footing 10 to 25 mm<br>b) Column beams and slabs 25 to 40 mm (with nominal reinforcement)<br>c) Beams, slabs – 40 to 50 mm (with congested reinforcement)   |