

Chapter 9

Flooring, Paving And Dado

9.1 BRICK FLOORING

9.1.1. Bricks

Bricks of specified dimensions and designations shall be used. These shall conform to the Specifications given in Brickwork Chapter. Broken bricks shall not be used in flooring except for closing the line. The bricks shall be laid on edge unless otherwise specified.

9.1.2. Mortar

The mortar used shall be as specified.

9.1.3. Base Concrete

9.1.3.1 Flooring shall be laid on base concrete where so specified. The base concrete shall be provided with the slope required for the flooring. Floors in verandahs, courtyards, kitchens and baths shall have slope ranging from 1:3:6 to 1:4:8 depending upon the locations, as decided by the Engineer.. Floors of water closet portion shall have slope of 1:30 or as decided by the Engineer to drain off washing water. Plinth masonry off-set shall be depressed so as to allow the base concrete to rest on it.

9.1.3.2. If the base consists of lime concrete, it shall be allowed to set for seven days and the Brick on edge flooring shall be laid in the next three days.

9.1.3.3. If the base is of lean cement concrete, the flooring shall commence within 48 hours of the laying of base, failing which, the surface of base shall be roughened with steel wire brushes without disturbing the concrete. Before laying the flooring, the base shall be wetted and smeared with a coat of cement slurry at 2 kg. of cement spread over an area of one sqm. so as to get a good bond between the base and flooring.

9.1.3.4 Where base concrete is not provided, the earth below shall be properly sloped, watered, rammed and consolidated. Before laying the flooring, it shall be moistened.

9.1.4 Soaking of Bricks

Bricks required for flooring shall be adequately soaked in stacks before use, by profusely spraying with clean water at regular intervals for a period of not less than six hours as to keep them wet to the satisfaction of the Engineer.

9.1.5 Laying

9.1.5.1 The bricks shall be laid on the edge in plain, diagonal, herring bone bond, or other pattern as specified or directed by the Engineer.

9.1.5.2 Bricks shall be laid on edge on 12 mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with trowel handle or wooden mallet. Its inside face shall be buttered with mortar, before the next is laid and pressed against it. In Flat Brick flooring, the bricks shall be laid with Frog down.

9.1.5.3 On completion of a portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface of the flooring during laying, shall be frequently checked with a straight edge at least 2m long, so as to obtain a true plane surface with the required slope.

9.1.6 Joints

Bricks shall be so laid that all joints are full of mortar. The thickness of joints shall not exceed 1.0 cm for brick work with bricks of any class designation. All face joints shall be raked to a minimum depth of 15 mm by raking tool during the progress of work when the mortar is still green so as to provide proper key for the plaster or pointing to be done. Where plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. The face of brick work shall be cleaned on the same day on which brick work is laid and all mortar droppings removed promptly.

9.1.7 Curing

Brick work shall be protected from rain by suitable covering when the mortar is green. Masonry work in cement mortar, composite lime mortar, lime mortar (lime of category other than C & D) (Refer Mortar chapter) shall be kept constantly moist on all faces for a minimum period of seven days. Brick work carried out during each day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period. In case of masonry with fat lime mortar, curing shall commence two days after laying of masonry and shall continue for at least seven days thereafter.

9.1.8 Measurements

Length and breadth shall be measured correct to a cm and area as laid shall be calculated in square metres correct to two

places of decimal. Length and breadth shall be measured before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deduction for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm.

Brick flooring when laid in diagonal herring bone bond or other pattern as specified or directed by the Engineer shall be measured separately.

9.1.9 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above, including application of cement slurry on base concrete or RCC slab and cleaning of base. Base concrete shall be paid for separately.

9.1.10 Dry Brick Flooring

All provisions in paras 9.1.1. to 9.1.8. will be applicable subject to following modifications. Bricks need not be soaked. Bricks will be laid on a bed of 12 mm thick mud mortar with plasticity index of 9% to 12% laid to required slope. The joints shall be as fine as possible and not exceeding 5 mm which will be filled with fine sand. No curing is required to be done. Where so specified, Dry Brick flooring can be laid on a bed of dry sand of 25mm average thickness.

9.1.10.1 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

9.2. CEMENT CONCRETE FLOORING

(Note:- For recommended Specifications for different types of Concrete Floors Table 9.1 of Chapter 9 of BIS Handbook of Building Construction Practices may be referred to).

9.2.1. Cement Concrete

Cement concrete of specified mix shall be used and it shall generally conform to the specifications described under Para 3.2. Generally Cement Concrete 1:2:4 (1 Cement; 2 Fine aggregates; 4 coarse aggregate of Graded size 20mm) by volume is used. It can be of richer grade, if required).

9.2.1.1 Cement Concrete flooring, if to be laid directly on ground should be laid on a sub-base comprising of earth filling watered and rammed in 15 cm layers. This shall then be covered with clean coarse sand / ordinary sand well consolidated to a thickness of not less than 10 cm. Sand layer shall be well wetted before laying Concrete for the Sub grade.

9.2.2. Base Concrete or Sub Grade Concrete

9.2.2.1. All provisions in para 9.1.3.1 will apply.

9.2.2.2. If the base consists of lime concrete, it shall be allowed to set for seven days and the flooring shall be laid within the next three days.

9.2.2.3. All provisions in Para 9.1.3.3 will apply.

9.2.2.4. (a) If the cement concrete flooring is to be laid directly on the RCC slab after the slab concrete has set for at least 3 hours the top surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry at 2 kg. of cement per sqm. area applied so as to get a good bond between the base and concrete floor

(b) When however it is possible to lay floor finish immediately within three hours of casting of structural / RCC slab, after ensuring proper bond, a floor finish 15mm thick, in cement concrete 1:2 to 1:3 (cement: stone aggregate of size 4.75mm and below by volume) shall be provided. Cement concrete topping shall be laid and finished monolithic with the structural slab. For this purpose the topping shall be laid immediately after the structural concrete has stiffened enough (but is still green) to allow for the workmen to tread over it by placing planks.

(c) Where required such as for providing proper levels over the RCC Slab, a cushioning layer can be provided of 40mm thickness of Lime / Lean Cement Concrete with brick aggregate of 20mm nominal size. Lime concrete is not to be used where it may come in contact with iron pipes or fittings.

Before laying the cushioning layer, the surface of sub floor shall be thoroughly cleaned of dirt, loose particles and laitance by scrubbing with steel wire brush. The surface shall then be thoroughly cleaned and soaked with water overnight and surplus water removed by mopping immediately before cushioning layer is laid in position. On the clean damp surface of the sub floor, cushioning layer shall be evenly spread between forms, and if necessary thoroughly tamped and levelled.

9.2.3. Protection against dampness

a) The sand layer as required under para 9.2.1.1 above will generally serve the purpose of damp-proofing required for ordinary floors under normal conditions. In more severe conditions where it is expected that the dampness may find its way to the floor in the course of usage, a more effective

damp proof treatment may be given by any of the methods given below which shall be paid for extra.

i) Laying of base concrete in two layers of thickness not less than 75mm each and painting the top of the lower layer with two coats of hot bitumen applied at the rate of 1.5 kg. per sqm. The surface of the lower layer shall be finished smooth while laying the concrete so as to apply the bitumen uniformly. The bitumen shall be applied after the concrete has set and is sufficiently hard.

ii) Sandwitching of water proofing membrane, such as bituminous felt or polyethylene sheet, in the base concrete laid in two layers of thickness 75mm each. The surface of the lower layer shall be finished smooth while laying the concrete so as to provide an even surface thus preventing any damage to the water proofing membrane.

iii) Adding some integral water proofing compound in the concrete mix for the topping.

b) Where it is expected that the dampness may find its way from the surrounding walls, the same shall also be effectively damp-proofed upto atleast 150mm above the level of the base concrete and the damp proof treatment below the floor shall be extended over the walls.

9.2.4. Laying

9.2.4.1 Thickness

The thickness of floor shall be as specified in the description of the item in the Schedule.

9.2.4.2 Panels

Flooring of specified thickness shall be laid in the pattern including the border/or as given in the drawings or as directed by the Engineer. The border panels shall not exceed 450 mm in width and the joints in the border should be in line with panel joints. The panels shall be of uniform size and no dimension of a panel shall exceed 2 m and the area of a panel shall not be more than 2 sqm. Normally Length of a panel should not exceed 1 ½ times its breadth.

9.2.4.3 Laying of flooring with strips

Normally cement concrete flooring shall be laid in one operation using glass/aluminium/PVC/brass strips or any other strips as required as per drawing or instructions of the Engineer, at the junction of two panels. This method ensures uniformity in colour of all the panels and straightness at the junction of the panels. 4 mm thick glass strips or 2 mm aluminium or brass strips shall be fixed with their tops at proper level, giving

required slopes. Cost of providing and fixing strips shall be paid for separately.

Concreting:- Cement concrete shall be placed in the panels and levelled with the help of straight edge and trowel and beaten with a wooden “Thapy’ or mason’s trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given. Beating shall cease as soon as the surface is found covered with a thin layer of cream of mortar. The evenness of the surface shall be tested with straight edge and made true to required slopes. While laying concrete, care shall be taken to see that the strips are not damaged / disturbed by the labourers. The tops of strips shall be visible clearly after finishing with cement slurry.

9.2.4.4 Laying of flooring without strips:-

Laying of cement concrete flooring in alternate panels may be allowed by the Engineer in case strips are not to be provided.

i) Shuttering: The panels shall be bounded by angle iron or flats. The angle iron / flat shall have the same depth as the concrete flooring. These shall be fixed in position with their top at proper level giving required slope. The surface of the angle iron or flats, to come in contact with concrete shall be smeared with soap solution or non-sticking oil (Form oil or raw linseed oil) before concreting. The flooring shall butt against the un plastered masonry wall.

ii) Concreting:- The concreting shall be done in the manner described under para 9.2.4.3. The angle iron / flats used for shuttering, shall be removed on the next day of the laying of cement concrete. The ends thus exposed shall be repaired, if damaged, with cement mortar 1:2 (1 cement: 2 coarse sand) and allowed to set for minimum period of 24 hours. The alternate panels shall then be cleaned of dust, mortar, droppings etc and concrete laid. While laying concrete, care shall be taken to see that the edges of the previously laid panels are not damaged and fresh mortar is not splashed over them. The joints between the panels should come out as fine straight lines.

9.2.5 Finishing

9.2.5.1 The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall

not be permitted. Excessive trowelling shall be avoided.

9.2.5.2 Fresh cement shall be mixed with water to form a thick slurry and spread at the rate of 2 kg of cement per sqm area of flooring while the flooring concrete is still green. The cement slurry shall be finished smooth.

9.2.5.3 The edges of sunk floors shall be finished and rounded with cement mortar 1:2 (1 cement: 2 coarse sand) and finished with a floating coat of neat cement.

9.2.5.4 The junctions of floor with wall plaster, dado or skirting shall be rounded off where so specified.

9.2.5.5 The men engaged on finishing operations shall be provided with raised wooden platform to sit on so as to prevent damage to new work.

9.2.6 Curing

The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies shall be avoided as the colour of the flooring is likely to be affected due to the remnants of cement dust from the bags.

9.2.7 Precautions

Flooring in lavatories and bath room shall be laid only after fixing of water closets and squatting pans and floor traps. Traps shall be plugged while laying the floors and opened after the floors are cured and cleaned. Any damage done to WCs, squatting pans and floor traps during the execution of work shall be made good.

During cold weather, concreting shall not be done when the temperature falls below 4 deg. C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone. During hot weather, precautions shall be taken to see that the temperature of the wet concrete does not exceed 38° C. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer. To facilitate rounding of junction of skirting, dado and floor, the skirting / dado shall be laid along with the border or adjacent panels of floor.

Plastering of all inside walls and ceilings, fixing of door frames and other heavy work shall be completed before laying the floors. The limits with regard to dimensions of panels as specified in para 9.2.4.2 above shall also apply to borders and skirting laid around the floor. The joints in the floor finish

shall extend through the border and the skirting. If the skirting is laid monolithic with the flooring, a border of about 30 cm width shall be provided around the floor. In case the skirting is not monolithic with the floor finish, the width of border shall not exceed 45 cm.

9.2.8. Measurements

Length and breadth shall be measured before laying skirting dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm.

The flooring done either with strips (in one operation) or without strips (in alternate panels) shall be treated as same and measured together.

9.2.9 Rate

The rate shall include the cost of all materials and labour involved in the operations described above including application of cement slurry on RCC slab or on base concrete and including roughening and cleaning the surface but excluding the cost of strips which shall be paid separately under relevant item. Nosing of steps where provided shall be paid for separately in running metre. Nothing extra shall be paid for laying the floor at different levels in the same room or courtyard and for rounding off edges of sunk floors. In case the flooring is laid in alternate panels, nothing extra shall be paid towards the cost of shuttering used for this purpose.

9.2.10 Inspection and Testing:- Adhesion between flooring and the base concrete may be examined by tapping the surface with the end of a rod or a hammer. Hollow sound indicates poor adhesion. Loss of adhesion does not necessarily mean that the floor finish is unsuitable unless it is accompanied by visible lipping of the edges of panels or cracks. Occasionally there may be no lipping but the panel edges may be noticeably higher than the centres of panels. Where the flooring is considered to be unsatisfactory, the topping concrete and any loose concrete in the base concrete shall be cut out and the base concrete keyed sufficiently to allow a sound renewal to be made. The unsatisfactory panels shall be renewed as a whole.

9.2.11 Cement Concrete Flooring, laid in two layers

9.2.11.1 General:- Where a very dense and smooth finish is desired, e.g. in quarters,

hospitals, waiting halls etc the topping may be laid in two layers, i.e. an under-layer and a wearing layer. The specifications for the sub-base, sub-grade, panels, shuttering, curing, precautions, and inspection and testing shall be the same as for "Cement Concrete Flooring, laid in one layer" described under para 9.2 and subsequent sub paras above.

9.2.11.2 Under Layer:- The under-layer shall be cement concrete 1:2:4 by volume. It shall be laid as per specifications for laying the topping under C.C. Flooring (para 9.2.4 above) with the difference that the surface of concrete of this layer shall not be finished smooth but left rough after tamping with the wooden 'thappy' and levelling with a screed board.

9.2.11.3 Wearing layer:- The top 15 mm wearing layer shall be of cement concrete mix 1:2 by volume (1 part cement: 2 parts very fine shingle or grit of size upto 6mm). The mix shall be of consistency stiffer than that of the under layer. It shall be laid over the rough but green surface of the under layer, thoroughly tamped, struck off level and the surface floated with wooden float. The surface shall then be finished smooth as described for "Finishing" under CC Flooring (para 9.2.5) above.

9.2.11.4 Polishing: The wearing layer may be polished, if ordered. The polishing shall be carried out after the floor has completely dried. For polishing, the surface shall be rubbed with medium grain carborundum block till all marks from trowels, scratches, etc are removed. This shall be followed by a similar rubbing with a finer grade of carborundum and finally with a fine hard grain stone so that the surface feels quite smooth to the touch. The final polish shall consist of a mixture of one part bees-wax and 3 parts turpentine, which shall be well rubbed with clean cotton waste into the surface, and all surplus removed. The best result is obtained with a minimum of bees wax and maximum of rubbing. The rubbing must be continued until the floor ceases to be sticky.

9.3 CEMENT CONCRETE FLOORING WITH METALLIC HARDENER TOPPING

9.3.1 General:- (a) Wherever floors are required to withstand heavy wear and tear, it is better to use richer mix of Concrete. Use of a metallic hardener should be resorted to only when justified on the basis of cost. Where metallic hardener topping is used, it shall be 12 mm thick.

(b) The Metallic Hardner compound shall be of approved quality consisting of uniformly graded iron particles, free from non-ferrous metal particles, oil, grease, sand and soluble alkaline compounds. Where so directed by the Engineer it shall be tested as described in **Annexure 9.1.**

9.3.2 Base Concrete

It shall be as specified in para 9.2.2.

9.3.3 Under Layer

Cement concrete flooring of specified thickness and mix shall be laid as under layer (paras 9.2.1. and 9.2.3.). The top surface shall be roughened with brushes while the concrete is still green and the forms shall be kept projecting up 12 mm over the concrete surface, to receive the metallic hardening compound topping.

9.3.4 Topping

This shall consist of 12 mm thick layer of mix 1:2 (1 cement : 2 stone aggregate 6 mm nominal size) by volume or as otherwise specified with which metallic hardening compound is mixed in the ratio of 1:4 (1 metallic concrete hardener : 4 cement) by weight. Metallic hardener shall be dry mixed thoroughly with cement on a clean dry pucca platform. This dry mixture shall be mixed with stone aggregate 6 mm nominal size or as otherwise specified in the ratio of 1:2 (1 cement : 2 stone aggregate) by volume and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete.

The mixture so obtained shall be laid in 12 mm thickness, on cement concrete floor within 2 to 4 hours of its laying. The topping shall be laid true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. After the initial set has started, the surface shall be finished smooth and true to slope with steel floats.

The junction of floor with wall plaster, dado or skirting and finishing operations shall be dealt with as described in para 9.2.5.

The men engaged on finishing operations shall be provided with raised wooden platform to sit on, so as to prevent damage to new work.

9.3.5 Curing etc:- The specifications for curing, precautions to be taken, 'Measurements' and 'Rates' shall be as specified in para 9.2.

9.4 CEMENT PLASTER IN RISERS OF STEPS, SKIRTING, DADO

9.4.1 General:- (a) A band of plaster at the bottom of wall not exceeding 30 cm in height above the floor shall be classified as skirting. It shall be flush with wall plaster or projecting out uniformly by 6 mm from the wall plaster as specified. The work shall be preferably carried out simultaneously with the laying of floor. The corners and junctions with floor shall be finished neatly as specified and shall be rounded off neatly, wherever required upto 25mm radius.

(b) The thickness of the plaster specified for Risers of steps, Skirting or Dado shall be measured exclusive of the thickness of key i.e. grooves or open joints in brick work. The average thickness shall not be less than the specified thickness. The average thickness should be regulated at the time of plastering by keeping suitable gauges of different thicknesses. Extra thickness required in rounding of corners at junctions of wall shall be ignored.

9.4.2 Preparation of Wall Surface

The joints shall be raked out a depth of at least 15 mm in masonry walls. In case of concrete walls, the surfaces shall be roughened by hacking. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

9.4.3 Application

Skirting with specified mortar and to specified thickness shall be laid immediately after the surface is prepared. It shall be laid along with the border of adjacent panels of floor. The joints in skirting shall be kept true and straight in continuation of the line of joints in borders or adjacent panels. The skirting shall be finished smooth and true, with top truly horizontal and joints truly vertical except where otherwise indicated.

9.4.4 Finishing

The finishing of surface shall be done simultaneously with the borders of the adjacent panels of floor. The cement to be applied in the form for slurry for smooth finishing shall be at the rate of 2 kg of cement per litre of water applied per sqm area.

Where skirting is flush with plaster, a groove 10 mm wide and up to 5 mm deep shall be provided in plaster at the junction of skirting with plaster.

9.4.5 Curing

Curing shall be commenced on the next day of plastering when the plaster has hardened sufficiently and shall be continued for a minimum period of 7 days.

9.4.6 Measurements

Length and height shall be measured correct to a cm and its area shall be calculated in sqm. correct to two places of decimals stating the thickness. Length shall be measured as the finished length of skirting. Height shall be measured from the finished level of floor correct to 5 mm.

9.4.7 Rate

Rate shall include the cost of all materials and labour involved in all the operations described above.

9.5 CEMENT PLASTER SKIRTING FINISHED WITH RED OXIDE OF IRON

9.5.1 Under Coat

The under coat of skirting shall be of cement plaster of the thickness and mix described in the item. 'Specifications given under paras 9.5.1 and 9.5.2 shall apply. As regards application, the work shall be carried out in the manner described in para 9.5.3. except that the under coat shall be finished rough with a scratching tool to form a key for the top coat.

9.5.2 Top Coat

Mortar : This shall consist of uniform and smooth layer of plaster of specified thickness and of mix 1 : 3 (1 cement : 3 coarse sand) unless otherwise specified, finished with a floating coat of neat cement. In both plaster and floating coat the ratio specified in the description of item shall be adopted. Normally 3.5 kg. of red oxide of approved quality shall be mixed with 50 kgs of cement. This ratio may, however, be adjusted to the tinge ordered by the Engineer. The red oxide shall be mixed with the cement and then sand added and mixed. The full quantity of dry mortar required for a room shall be prepared in one lot in order to ensure uniform colour. Wet mortar shall be prepared in the usual manner as and when required.

9.5.3 Application : The top coat shall be done the next day after the under coat has been applied. The plaster shall be done to the thickness specified and finished smooth, by application of cement-red oxide mix, at the rate of 1.0 kg. per square metre of surface, the ratio adopted for the mix being the same as that for the plaster. When the surface has hardened sufficiently it shall be brought to a fine polish by use of polishing stones.

9.5.4 Thickness

The thickness of the bottom and top coats shall be as specified. The total thickness of skirting specified is of total thickness of plaster as measured from the un-plastered face of the masonry. Average thickness of the under coat shall not be less than 6 mm and minimum thickness over any portion of the surface shall not be less than 4 mm. The thickness of top coat shall not be less than the thickness specified.

9.5.5 Curing

Curing shall be commenced on the next day of plastering when the plaster has hardened sufficiently and shall be continued for a minimum period of 7 days.

9.5.6 Measurements

Length and height shall be measured correct to a cm and its area shall be calculated in sqm. correct to two places of decimal stating the thickness. Length shall be measured as the finished length of skirting. Height shall be measured from the finished level of floor correct to 5 mm.

9.5.7 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

Where the quantity of red oxide used is different from what is described in the item to get the tinge required by the Engineer, the difference in quantity used will be subject to corresponding adjustment in the rate of the item.

9.6 CEMENT CONCRETE PAVEMENT IN COURTYARD AND TERRACE

9.6.1 General : Specifications described in paras 9.2.1, 9.2.2.1, 9.2.3, 9.2.4, 9.2.6 and 9.2.7 shall hold good as far as applicable except that:

- (i) The panels shall be of uniform size and no dimension of a panel shall exceed 1.25 m and the area of panel should not exceed 1.25 sqm. for the thickness of panels up to 50 mm.
- (ii) Concreting shall be done in alternate panels only and glass strip shall normally not be provided.

9.6.2 Finishing

The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up.

Use of dry cement or cement and sand mix sprinkled on the surface to stiffen the

concrete or to absorb excessive moisture shall not be permitted. Excessive troweling shall be avoided. When the surface becomes fairly stiff, it shall be finished rough with wooden floats or where so specified chequered uniformly by pressing a piece of expanded metal of approved size.

9.6.3 Measurements

Same as in para 9.2.8 except that the volume will be calculated in cum nearest to two decimal places or as laid down in the item.

9.6.4 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above except the base concrete below flooring which shall be paid for separately. Chequering to pattern shall be paid for separately unless otherwise specified.

9.7 TERRAZZO (MARBLE CHIPS) FLOORING LAID IN SITU

9.7.1 Under Layer

Cement concrete is specified mix shall be used and the specifications given under para 9.3.3 shall apply. The panels shall be of uniform size, not exceeding 2 sqm. in area or 2 m in length for inside situations. In exposed situations, the length of any side of the panel shall not be more than 1.25 metres. Cement slurry @ 2.00 kg. per sqm. area shall be applied before laying of under layer over the cement concrete/RCC base. The under layer shall be laid as per specifications for ordinary "Cement Concrete Flooring in one layer" under para 9.2 and subsequent sub-paras above except that the under-layer shall not be left smooth but shall be roughened with 1.5mm deep diagonal lines 7.5cm apart both ways with a scratching tool to form a key for the topping.

9.7.2 Fixing of Strips

4 mm thick glass strips or 2 mm thick PVC strips/aluminium strips/brass strips unless otherwise specified shall be fixed with their top at proper level to required slope. Strips of stone or marble or of any other material of specified thickness can also be used if specifically required. The fixing and laying shall be as specified in para 9.2.4.3. Portions of the bottom edges of the dividing strips may be cut to a height not exceeding 12mm and twisted so as to provide anchorage into the terrazzo finish. The spacing of such cut portions shall not be closer than 30 cm. Alternatively, anchorage

may be provided by fixing 4cm long cross nails through the strips.

9.7.3 Top Layer

9.7.3.1. (a) Terrazzo Mix: The mix for terrazzo topping shall consist of cement with or without pigment, marble powder (Grading Zone IV), marble aggregate (marble chips)

and water., The cement and marble powder shall be mixed in the proportion of three parts of cement to one part marble powder by weight. For every part of cement marble powder mix, the proportion of aggregate by volume shall be as shown in **Table 9.1** below.

TABLE 9.1

Grade No.	Size aggregates (mm)	Proportion of aggregates to binder mix	Minimum thickness of top layer (mm)
00	1-2	1.75:1	6
0	2-4	1.75:1	9
1	4-7	1.75:1	9
2	7-10	1.5:1	12

The marble chips shall be white or pink Makrana, black Bhainslana, Chittoor black, Jaisalmer Yellow, Baroda green, Dehradun white, Chittoor pink, yellow Patam cherala (Andhra Pradesh), grey Gadu (Surat), Chittoor green and yellow and Alwar black or as specified. It shall be hard, sound, dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering. The minimum thickness of the top layer for various sizes of marble aggregates (marble chips) shall be as shown in **Table 9.1**.

Where aggregate of size larger than 10 mm are used, the minimum thickness of topping shall not be less than 1½ times the maximum size of the chips. Where large size chips each as 20 mm or 25 mm are used, they shall be used only with a flat shape and bedded on the flat face so as to keep the minimum thickness of wearing layer.

Before starting the work, the contractor shall get the sample of marble chips approved by the Engineer. The cement to be used shall be ordinary grey cement/ white cement/ cement with admixture of colouring matter of approved quality in the ratio specified in the description of the item to get the required shade as ordered by the Engineer. Colouring materials where specified shall be mixed dry thoroughly with the cement and marble powder and then marble chips added and mixed as specified above. The full quantity of dry mixture of mortar required for a room shall be prepared in a lot in order to ensure a uniform colour. While mixing the aggregates, care shall be taken not to get the

materials into a heap, as this would result in the coarsest chips falling to the edge of the heap and the cement working to the centre at the bottom. The materials shall be kept, as far as possible, in an even layer during mixing. This mixture shall be stored in a dry place and well covered and protected from moisture. The dry mixture shall be mixed with water in the usual way as and when required. The mixed mortar shall be homogenous and stiff and contain just sufficient water to make it workable.

b) Laying:- The terrazzo topping shall be laid while the under layer is still plastic, but has hardened sufficiently to prevent cement from rising to the surface. This is normally achieved between 18 to 24 hours after the under layer has been laid. A cement slurry preferably of the same colour as the topping shall be brushed on the surface immediately before laying is commenced. It shall be laid to a uniform thickness slightly more than that specified in order to get the specified finished thickness after rubbing. The surface shall be rammed in order to consolidate the terrazzo. It is not sufficient just to 'float' lightly as this would cause depressions which have to be filled with mortar. A piece of smooth marble stone of size 15 cm x 15 cm x 2.5cm may be advantageously used for ramming. Following the rammer, a trowel may be used. When using the trowel, the object should be to make the surface level and smooth with as little use of the float as possible, relying upon pressure rather than upon trowelling action to achieve this end. Rolling will be easier than tamping and patting, but a rolled terrazzo is more likely to crack since the rolled surface

would draw the cement to the surface unless the mixture is very dry. The best results will be obtained by tamping combined with a minimum of trowelling. The compaction shall ensure that air bubbles are driven out from the mix. The surface shall be brought true to required level by a straight edge and steel float in such a manner that the maximum amount of marble chips come up and are spread uniformly over the surface and no part of the surface is left without chips.

c) Border and decorative designs:-

Borders and decorative designs shall be laid before the main body of the flooring. They shall be laid and finished in the same manner as flooring, preferably using dividing strips. Where, however, stencils or form work of wood or metal are used instead of dividing strips, they shall be removed before the topping mix commences to harden. The removal shall be effected with as little disturbance to the materials as possible, and any ragged edges left after removal of the stencils or form work shall be rectified with a trowel, care being taken to consolidate the terrazzo to avoid damage to the edges of the design.

The wooden strips or float iron used for shuttering of panels shall normally be removed the next day of the laying of the top layer. The edges shall be checked and made true and straight by chiselling and rubbing down with carborundum stone. The edges of the under-layer shall also be repaired, if necessary, with cement mortar 1:2 (1 cement: 2 coarse sand) and allowed to set for a day. On the next day, the alternate panels shall be cleaned of all dust, mortar, droppings etc. and concrete for the under-layer laid. The process of laying the top terrazzo layer in alternate panels shall then be repeated. Junctions of floor with wall plaster, dado or skirting shall be rounded off neatly, where so required.

9.7.3.2 Polishing, Curing and Finishing

: - Polishing shall normally be done by machine. About 36 hours after laying the top layer, the surface shall be watered and ground evenly with the machine fitted with special rapid cutting grit blocks (carborandum stone) of coarse grade (No. 60) till the marble chips are evenly exposed and the floor is smooth. After the first grinding, the surface shall be thoroughly washed to remove all grinding mud and covered with a grout of cement and colouring matter in same mix and proportion as the topping in order to fill any pin holes that appear. The surface shall be allowed to cure

for 5 to 7 days and rubbed with the machine fitted with fine grit blocks (No. 120). The surface is cleaned and repaired as before and allowed to cure again for 3 to 5 days. Finally the third grinding shall be done with the machine fitted with fine grade grit blocks (No.320) to get even and smooth surface without pin holes. The finished surface should show the marble chips evenly exposed.

Where use of machine for polishing is not feasible or possible, rubbing and polishing shall be done by hand, in the same manner as specified for machine polishing except that carborundum stone of coarse grade (No.60) shall be used for the first rubbing, stone of medium grade (No.80) for second rubbing and stone of fine grade (No.120) for final rubbing and polishing.

After the final polish either by machine or by hand, oxalic acid powder shall be dusted over the surface @ 33 gms per square metre sprinkled with water and rubbed hard with a namdah block (Pad of Woolen rags). The following day, the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean. Curing shall be done by suitable means such as laying moist sawdust or ponding water.

9.7.3.3 Final finishing before occupation:-

Just before the area is occupied, the floor shall be washed clean with dilute oxalic acid solution, dried and rubbed with clean cotton waste. Rubbing shall be continued until the floor ceases to be sticky. In case wax-polished surface is desired, the wax polish shall be sparingly applied with soft linen on the clean and dry surface. This shall then be rubbed thoroughly with clean cotton waste or a polishing machine fitted with felt or hessian bobs. Any surplus wax shall be mopped up and the rubbing shall be continued until the floor ceases to be sticky. Wax polishing shall be done only where specifically ordered by the Engineer. Nothing extra will, however, be paid for the same.

9.7.4 Precautions

Flooring in lavatories and bathrooms shall be laid after fixing of water closets and squatting pans and floor traps. Traps shall be plugged, while laying the floors and opened after the floors are cured and cleaned. Any damage done to WCs, squatting pans and floor traps during the execution of work shall be made good.

During cold weather, concreting shall not be done when the temperature falls below 4°C . The concrete placed shall be protected against frost by suitable coverings. Concrete

damaged by frost shall be removed and work re-done. During hot weather, precautions shall be taken to see that the temperature of wet concrete does not exceed 38°C. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer.

While laying the floor, the joints in flooring shall always coincide with the expansion joints, if any, in the structural slab so that any movement of the base will open joints in the flooring instead of forming uncontrolled cracks. Floor panels should not generally exceed 2 sqm for the under-layer and the topping so as to reduce the risk of cracking. The longer dimension of any panel shall not exceed 2 m.

9.7.5 Measurements

9.7.5.1 Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. The area as laid shall be calculated in sqm. correct to two decimal places.

The thickness of the under layer shall be measured correct to a cm. The thickness of top layer shall not be less than that specified.

No deduction shall be made, nor extra paid for voids not exceeding 0.20 square metre. Deduction for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for laying the floor at different levels in the same room or courtyard.

9.7.5.2 Terrazzo (Marble Chips) flooring laid as floor borders, margins and similar bands up to 30 cm width and on staircase treads shall be measured under the item of terrazzo flooring but extra shall be paid for such work. This extra in the case of staircase treads shall include the cost of forming the nosing also. However, moulded nosing shall be paid extra in running metres except where otherwise stated. Returned moulded ends and angles to mouldings shall be included in the description. Extra shall also be paid for laying flooring in narrow bands not exceeding 7.5 cm in width and such bands shall be measured in running metres for this purpose.

9.7.5.3 Dividing strips inserted in terrazzo to form bays/ patterns shall be described stating the materials, its width and thickness and measured in running metres.

9.7.5.4 Special surface finishes to treads, risers and the ends of concrete steps and the like shall be measured separately and recorded in square metres and shall include form work, if required.

9.7.6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including cleaning of surface of RCC slab or base concrete and application of cement slurry but shall not include the cost of base concrete and cost of providing and fixing strips of glass or aluminium or of any other materials used for making panels, which shall be paid for separately.

9.7.7 Maintenance

Under normal conditions, the flooring may be kept clean by washing periodically with water and occasionally with a dilute solution of oxalic acid after which it shall be mopped down with cold water and dried. Soap in any form shall not be used, as it tends to make the terrazzo dangerously slippery; excessive polishing will have a similar effect. The surface may also be kept free from oil and grease to avoid slipperiness.

9.8 TERRAZZO (MARBLE CHIPS) SKIRTING IN SITU

9.8.1 Under Coat

The under coat of skirting shall be of cement plaster of the thickness and mix described in the item. Specifications given under paras 9.5.1 and 9.5.2. shall apply. As regards application, the work shall be carried out in the manner described in para 9.5.3. except that the under coat shall be finished rough with a scratching tool to form a key for the top coat.

9.8.2 Top Coat or Layer

The specifications as in para 9.7.3. shall hold good as far as applicable and shall include cutting to line and fair finish to top edges of terrazzo and polishing.

9.8.3 Thickness

The thickness of the bottom and top coats shall be as specified. The total thickness of skirting specified is of the total thickness of plaster including top coat as measured from the un-plastered face of the masonry. Average thickness of the under coat shall not be less than 6 mm and minimum thickness over any portion of the surface shall not be less than 4 mm. The thickness of top coat shall not be less than the thickness specified.

9.8.4 Measurements

Length and height shall be measured correct to a cm and its area shall be calculated in sqm. correct to two places of decimal. Length shall be measured as finished length of skirting. Height shall be measured from

the finished level of floor correct to 5 mm where the height of skirting does not exceed 30 cm and when the height exceeds 30 cm, it shall be measured correct to a cm.

9.8.5 Rate

The rates shall include the cost of all materials and labour involved in all the operations described above.

9.9 CRAZY MARBLE FLOORING (FIG.9.1)

9.9.1 Base concrete

Crazy marble stone flooring shall be laid on cement or lime concrete base. The base concrete shall be provided with slope required for the flooring in verandahs and courtyards to drain off washing and rain water. The surface of base shall be roughened with steel wire brushes, without disturbing the concrete, wetted and smeared with a floating coat of cement slurry at 2 kg. of cement per one sqm. area of spread so as to get a good bond between base and flooring.

Before laying the flooring on RCC slabs, the laitance shall be removed, the surface of slab hacked and a coat of cement slurry at 2 kg of cement per sqm. of area shall be applied so as to get a good bond between RCC slab and floor.

9.9.2 Under Layer

The under layer of crazy marble flooring shall be of cement concrete of thickness 25 mm or as specified. The mix shall normally be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm nominal size) by volume unless otherwise specified. It shall conform to the specifications given under para 3.2 of Chapter 3 on 'Cement Concrete'.

9.9.3 Top Layer

The mix of crazy marble stone flooring shall consist of white cement with or without pigment, marble powder, marble chips of 00 Nos. and marble stone pieces and water. The marble stone pieces shall be hard, sound, dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering. Before starting the work the contractor shall get the sample of marble stone approved by the Engineer. The marble stone pieces shall be of sizes as approved by the Engineer but the thickness shall be according to the over all thickness specified which could be achieved when laid over the under layer as specified. Thus for 50 mm thick floor, the thickness of

marble pieces will be 25 mm while for 40 mm thick floor, the thickness will be 15 mm.

The white cement and marble powder shall be mixed in proportion of three parts of cement and one part of marble powder by weight, and the proportion of marble chips to binder mix by volume shall be 7 parts of marble chips to 4 parts of binder mix. The marble chips shall be as specified. It shall be hard, sound, dense and homogeneous in texture. It shall be uniform in colour and free from stains, cracks, decay and weathering.

9.9.4 Laying

A coat of cement slurry at the rate of 2 kg of cement per sqm of area shall be spread and then the marble stone pieces shall be set by hand in such a manner that the top surface of all the set marble stones shall be true to the required level and slopes. After fixing the stones, the cement marble chips mixture shall be filled in between the gaps of laid marble stone pieces. The filled surface then shall be trowelled over, pressed and brought to the level of the laid marble stone pieces.

9.9.5 Polishing, Curing and Finishing

Polishing, Curing and Finishing shall be as described in para 9.7.3.2.

9.9.6 Precautions

Flooring in lavatories and bathrooms shall be laid after fixing of water closets, squatting pans and floor traps. Traps shall be plugged while laying the floors and opened after the floors are cured and cleaned.

9.9.7 Measurements

Length and breadth shall be measured correct to a cm before skirting, dado or wall plaster and it shall be calculated in sqm correct to two decimal places. No deduction shall be made nor extra paid for voids not exceeding 0-20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for laying floor at different levels in the same room or courtyards.

9.9.8 Rate

The rates shall include the cost of all materials and labour involved in all the operations described above including the cost of cleaning of RCC slab surface and applying the cement slurry, but it shall not include the cost of base concrete.

9.10 TERRAZO TILE FLOORING

Note : The specifications below shall be followed as far as they are applicable to Plain Cement Tiles.

9.10.1 Terrazzo Tiles

Terrazzo tiles shall generally conform to IS: 1237. Requirements and methods of testing of tiles are described in **Annexure 9.2**. Unless otherwise specified, the tiles shall be

supplied with initial grinding and grouting of wearing layer.

9.10.1.1 Size

The size of tiles shall be as given in **Table 9.3** or as shown in the drawings or as required by the Engineer. Half tiles for use with the full tiles shall be such as to make two half tiles when joined together, match the dimensions of one full tile.

TABLE 9.3

Length Nominal	Breadth Nominal	Thickness not less than
200mm	200 mm	20 mm
250 mm	250 mm	22 mm
300 mm	300 mm	25 mm

9.10.1.2 Tolerance

Tolerance on length and breadth shall be plus or minus one millimeter, and tolerance on thickness shall be plus 5 mm. The range in variation of dimensions in any one delivery of tiles shall not exceed 1 mm on length and breadth and 3 mm on thickness.

9.10.1.3. The tiles shall be manufactured in a factory under pressure process and subjected to hydraulic pressure of not less than 140 kg per square centimeter and shall be given the initial grinding with machine and grouting of the wearing layer before delivery to site. The wearing layer shall be free from projections, depressions, cracks, holes, cavities and other blemishes. The edges of wearing layer may be rounded.

9.10.1.4. The proportion of cement to aggregate in the backing of tiles shall be not leaner than 1: 3 by weight. Where colouring material is used in the wearing layer, it shall not exceed 10 per cent by weight of cement used in the mix.

9.10.1.5. The finished thickness of the upper layer shall not be less than 5 mm for size of marble chips ranging from the smallest up to 12 mm, and not less than 6 mm for size of marble chips varying from the smallest up to 20 mm.

9.10.2 Laying

9.10.2.1 Base concrete or RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar of specifications as per SOR item prepared in conformity with provisions in relevant para of Chapter 26 on 'Mortar'.

The average thickness of the bedding mortar shall be 20 mm in floors and 12 mm in risers and dado and the thickness at any place shall not be less than 10 mm.

9.10.2.2. cement mortar bedding shall be spread, tamped and corrected to proper levels and allowed to harden for a day before the tiles are set. If cement mortar is laid in bedding the terrazzo tiles, these shall be set immediately after laying the mortar. Over this bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 4.4 kg. of cement per square metre over such an area as would accommodate about twenty tiles. Tiles shall be washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded, and in level with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1.5 mm and in straight lines or to suit the required pattern.

9.10.2.3 The surface of the flooring during laying shall be frequently checked with a straight edge at least 2 metre long, so as to obtain a true surface with the required slope.

9.10.2.4 Where full tiles or half tiles can not be fixed, tiles shall be cut (sawn) from full tiles to the required size and their edges rubbed smooth to ensure a straight and true joint.

9.10.2.5 Tiles which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster, skirting or dado. The junction between wall plaster and tile work shall be finished neatly and without waviness.

9.10.2.6. After the tiles have been laid, surplus cement grout that may have come out of the joints shall be cleared off.

9.10.3 Curing, Polishing and Finishing

9.10.3.1 The day after the tiles are laid, all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shape of the topping of the wearing layer of the tiles. The same cement slurry shall be applied to the entire surface of the tiles as a thin coat with a view to protect the surface from abrasive damage and fill the pin holes that may exist on the surface.

9.10.3.2. The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be ground evenly with machine fitted with coarse grade grit block (No.60). Water shall be used profusely during grinding. After grinding, the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that may appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No.120)

9.10.3.3. The final grinding with machine fitted with the finest grade grit blocks (No.320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor, as ordered by the Engineer. Any joint which may open out after the grinding shall be repaired with Cement grout of matching colour.

9.10.3.4. For small areas or where circumstances so require, hand polishing may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used :

First grinding Coarse grade stone (No. 60)

Second grinding Medium grade (No.80)

Final grinding Fine grade (No.120)

In all other respects, the process shall be similar to that for machine polishing.

9.10.3.5. After the final polish, oxalic acid powder shall be dusted over the surface at the rate of 33 gm per square metre of area sprinkled with water and rubbed hard with a 'namdah' block (pad of woolen rags). The following day the floor shall be wiped with a

moist rag and dried with a soft cloth and finished clean.

9.10.3.6. If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished. The finished floor shall not sound hollow when tapped with a wooden mallet.

9.10.4 Measurements

9.10.4.1. Terrazzo tiles flooring with tiles manufactured from ordinary grey cement without pigment and coloured terrazzo tile flooring shall be measured separately and classified as in para 9.8.5. Terrazzo tile flooring shall be measured as laid in square metre correct to two places of decimal. For length and breadth dimensions correct to a cm before laying skirting, dado or wall plaster shall be taken. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for use of cut tiles nor for laying the floor at different levels in the same room or courtyard.

9.10.4.2 Terrazzo tile flooring laid in floor borders and similar band shall be measured under the item of terrazzo tile flooring. Nothing extra shall be paid in respect of these and similar bands formed of half size or multiples of half size standard tiles or other uncut tiles.

9.10.4.3. Treads of stairs and steps paved with tiles without nosing, shall also be measured under flooring. Moulded nosing shall be paid in running metre except where otherwise stated. Returned moulded ends and angles to mouldings shall be included in the description. Extra shall, however, be paid for such areas where the width of treads does not exceed 30 cm.

9.10.5 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. Where cement mortar bedding is used in place of lime mortar the rate will be adjusted accordingly.

9.10.6 Maintenance : Same as in Para 9.7.7 for Terrazzo flooring laid-in-situ.

9.11 TERRAZZO TILES IN RISERS OF STEPS, SKIRTING AND DADO

9.11.1. General : The terrazzo tiles shall be as specified in para 9.10.1 as far as applicable. The minimum finished thickness of tiles shall, however, be 12 mm. The

finished thickness of the upper layer shall be not less than 5 mm for size of marble chips from the smallest up to 12 mm and not less than 6 mm for size of chips varying from the smallest up to 20 mm. Where the bigger sized chips are used, the tiles shall be not less than 20 mm thick. The requirements of transverse strength tests specified in **Annexure 9.2**, shall not apply when the tiles used are less than 20 mm thick.

9.11.2 Preparation of Surface

The specification for this shall be same as specified in para 9.5.2.

9.11.3 Laying

12 mm thick plaster of cement mortar 1:3 (1 cement : 3 coarse sand) or mix as specified, shall then be applied and allowed to harden. The plaster shall then be roughened with wire brushes or by scratching diagonal lines 2 mm deep at approximately 7.5 cm centers both ways. The back of tiles shall be buttered with a coat of grey cement slurry and edges with grey or white cement slurry with or without pigments to match the shade of tiles and set in the bedding mortar. These shall be tamped and corrected to proper planes and lines. The tiles shall be set in the required pattern and butt jointed. The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated.

The risers of steps, skirting or dado shall rest on the top of the tread or flooring. Where full size tiles cannot be fixed, the tiles shall be cut (sawn) to the required size and their edges rubbed smooth.

9.11.4 Curing, Polishing and Finishing

The specifications as in para 9.10.3. shall hold good as far as applicable. Polishing shall be done only with hand.

9.11.5. Measurements

The thickness of the skirting shall be as stated. Length shall be measured along the finished face of riser, skirting or dado correct to a cm. Height shall be measured from the finished level of tread or floor to the top (the underside of tread in the case of steps). This shall be measured correct to 5 mm in case of risers and skirting not exceeding 30 cm in height. In case of heights more than 30 cms, as in the case of dado and on walls, the height shall be measured correct to a cm and such work shall be paid for separately. The area shall be calculated in square metre, correct to two places of decimal.

Where the height of risers, skirting or dado does not admit of full size or other finished

size tiles and the tiles are to be cut (sawn), nothing extra shall be paid for the same.

9.11.6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. Nothing extra shall be payable for use of cut (sawn) tiles to suit the size of risers, skirting, portions of dado etc.

9.12 CHEQUERED TILE FLOORING

9.12.1 Chequered Tiles

The tiles shall be of nominal size such as 20 x 20 cm, 25 x 25 cm, and 30 x 30 cm or of standard sizes with equal sides. The size of tiles to be used shall be as shown in drawings or as required by the Engineer. The center to center distance of chequers shall not be less than 2.5 cm and not more than 5 cm.

The overall thickness of the tiles shall not be less than 22 mm. The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be cement tiles, or terrazzo tiles as specified in the description of the item. The thickness of the upper layer, measured from the top of the chequers shall not be less than 6 mm.

The terrazzo tiles shall be given the first grinding with machine before delivery to site. The tiles shall conform to the specifications for plain cement concrete or terrazzo tiles in respect of method of manufacture and the mix of the backing and wearing layers.

The relevant paras of IS 13801:1993 for CHEQUERED CEMENT CONCRETE TILES are reproduced below for guidance :

1.1 This standard covers chequered cement concrete flooring tiles.

2. REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3.1 Chequered Tiles

Chequered tiles, cement tiles or terrazzo tiles having grooves on the surface of the tile making it anti-slippery. The area of chequered grooves should not be less than 2 percent of the total surface area of the tile. The chequered groove can be in any shape and length, but the depth of grooves should not be less than 3 mm.

4 MATERIALS

4.1 Cement

Cement used in the manufacture of tiles shall be 33 grade ordinary Portland cement conforming to IS 269:1989 or rapid

hardening Portland cement conforming to IS 8041 : 1990 or white Portland Cement conforming to IS 8042:1989 or Portland pozzolana cement (Fly ash based) conforming to IS 1489 (Part I) : 1991 and Portland pozzolana cement (calcined clay based) conforming to IS 1489 (Part 2) : 1991 or 43 grade ordinary Portland cement conforming to IS 8112 : 1989 or 53 grade ordinary Portland cement conforming to IS 12269 : 1989.

4.2 Aggregates

Aggregates used in the backing layer of tiles shall conform to the requirements of IS 383 :

4.3.2

Pigments	Relevant Indian Standard
a) Black or red or brown pigments	IS 44 : 1991
b) Green pigments	IS 54 : 1988
c) Blue pigments	IS 55 : 1970
	or IS 56 : 1993
	or IS 3574
	(Part 2) : 1996

4.3.3 Colours other than mentioned above may also be used.

4.3.4 The pigments shall not contain zinc compounds organic dyes.

4.3.5 Lead pigments shall not be used unless otherwise specified by the purchaser.

5. MANUFACTURE

5.1 Chequered cement concrete flooring tiles shall be manufactured from a mixture of cement, natural aggregates, and colouring materials where required by pressure process. During manufacture, the tile shall be

1970. For the wearing layer, unless otherwise specified aggregates shall consist of marble chips or any other natural stone chips of similar characteristics and hardness, marble powder or dolomite powder or mixture of the two. Hardners, if required may also be added.

4.3 Pigments

4.3.1 Pigments, synthetic or otherwise, used for colouring tiles shall have durable colour. It shall not contain matters detrimental to concrete and shall according to the colour required be one of the following or their combination:

subjected to a pressure of not less than 14 N/mm².

5.2 The proportion of cement to aggregate in the backing of the tiles shall be not leaner than 1 : 3 by mass.

5.3 Where colouring material is used in the wearing layer, it shall not exceed 10 percent by mass of cement used in the mix.

5.4 On removal from the mould, the tiles shall be kept in moist conditions continuously for such a period that would ensure their conformity to the requirements of this standard. Tiles shall be stored under cover.

6. DIMENSIONS

6.1 The size of chequered cement flooring tiles shall be as follows:

Length	Breadth	Thickness
Mm	mm	mm
200	200	22
250	250	22
300	300	25

Note: The thickness shall be measured as two point situated approximately 50 mm from the ends on the fracture line of the tile that is tested for wet transverse strength. The total thickness is the arithmetic mean of these two measurements.

6.1.1 Half tiles rectangular in shape shall also be available. Half tiles for use with full tiles in the floor shall have dimensions which shall be such as to make two half tiles when joined together, to match with the dimensions of the one full tile.

7. TOLERANCES

7.1 Tolerances on length or breadth of tiles shall be ± 1 mm. In addition, the difference in length of side between the longest side and the shorter side in the sample shall not exceed 1 mm.

7.2 Tolerance on thickness shall ± 5 mm. In addition the difference in thickness between the thickest and the thinnest tile in the sample shall not exceed 3 mm.

7.3 Thickness of Wearing Layer

7.3.1 The thickness of wearing layer measured from the top of the chequers shall not be less than 6 mm.

7.3.2 The thickness of the wearing layer shall be measured at several points along the fracture line of the tile that was tested for wet transverse strength. The arithmetic mean of the two measurements which yielded the lowest value shall be the minimum thickness of the wearing layer.

8. SPECIAL SHAPE AND SIZE

8.1 Shapes and sizes of tiles other than those specified in 6.1 may be manufactured when agreed upon between the supplier and the purchaser but the depth of the grooves shall not be less than 3 mm. The tiles shall also meet all the requirements of the standard.

Note: In rectangular tiles, the requirements for the difference in the length of sides as specified in 7.1 shall be applicable both to the length and width of the tiles.

9. GENERAL QUALITY

9.1 Unless otherwise specified, the tiles shall be supplied with initial grinding and grouting of the upper layer. The upper layer of the tiles shall be free from projections, depressions, cracks (hair cracks not included), holes, cavities and other blemishes. The edges of the tile may be rounded.

10. FINISH

10.1 The colour and texture of the wearing layer shall be uniform throughout its thickness. No appreciable difference in the appearance of the tiles, from the point of view of colour of aggregate, its type and its distribution on the surface of the wearing layer shall be present.

11. PHYSICAL REQUIREMENT

11.0 The tests on tile shall not be carried out earlier than 28 days from the date of manufacture.

11.1 Flatness of the Tile Surface

The tiles when tested according to the procedure laid down in Annex B, the amount of concavity and convexity shall not exceed 1 mm.

11.2 Perpendicularity

When tested in accordance with the procedure laid down in Annex C, the longest gap between the arm of the square and the edge of the tiles shall not exceed 2 percent of the length of the edge.

11.3 Straightness

When tested according to the procedure given in Annex D, the gap between the thread and the plane of the tile shall not exceed 1 percent of the length of the edge.

11.4 Water Absorption

When tested according to the procedure laid down in Annex E, the average percent of water absorption shall not exceed 10.

11.5 Wet Transverse Strength

When tested according to the procedure laid down in Annex F, the average wet transverse strength shall not be less than 2 N/mm².

11.6 Resistance to Wear

When tested in the manner specified in Annex G, the wear shall not exceed the following value:

- a) Average wear 2mm
- b) Wear on individual specimen 2.5 mm

12. MARKING

12.1 Tiles shall be legibly and indelibly marked on the back with the identification of the source of manufacturer.

12.1.1 Each tile may also be marked with the Standard Mark.

13. PACKING

13.1 The tiles shall be packed according to the usual trade practice and adequately protected.

14. SAMPLING AND CRITERION FOR CONFORMITY

14.1 The consignment of chequered cement concrete flooring tiles shall be divided into a number of lots in accordance with 14.1.1. Each lot shall be inspected separately for ascertaining its conformity to the requirements of this specification.

14.1.1 Lot

All the chequered cement concrete flooring tiles in a consignment which are of same type, shape and size and manufactured by a single manufacturer from identical raw materials, under identical conditions of

manufacture shall be grouped together to constitute a single lot.

14.2 The sample of tiles for inspection and testing shall be chosen from a lot at random. For guidance in procedure of random selection IS 4905:1968 may be referred.

14.3 Number of Samples and Criterion for Conformity

For each characteristic the number of sample tiles to be selected from a lot and the criterion for determining the conformity of the lot on the basis of the test results on those samples, shall be in accordance with inspection level 1 in Table 1 and AQL 6.5 percent in Table 3 of IS 2500 (Part I) : 1992.

14.4 If the samples drawn for testing one characteristic can be utilized for testing any other characteristic, without introducing any prejudice in the test results of the latter, it would not be necessary to take fresh samples for the latter characteristics.

9.12.2. Laying etc. : Laying, curing, polishing and finishing shall be as specified in paras 9.10.2 and 9.10.3 except that the polishing of the tiles and the chequer grooves, after laying, may be done by hand. Special care shall be taken to polish the grooves in such a manner as to get a uniform section and to ensure that their finish shall match the finish of flat portion of the tiles. Cement concrete tiles normally do not require polishing but where polishing is required, the same shall be done as described above.

9.12.3 Measurements and Rate

Shall be as specified in paras 9.10.4 and 9.10.5.

9.13. CHEQUERED TILES IN STAIR TREADS (FIG.9.2)

9.13.1. Chequered Tiles

The specifications for tiles shall be specified in para 9.12.1 except in the following respects:

- (1) The length of the tiles including nosing shall be as specified.
- (2) The nosing edge of the tile shall be rounded.
- (3) The minimum thickness of the tile shall be 30 mm or as specified.
- (4) The front portion of the tile for a minimum length of 75 mm from and including the nosing shall have grooves running parallel to the nosing and at centers not

exceeding 25 mm. Beyond that, the tiles shall have the normal chequer pattern.

(5) The nosing shall also have the same wearing layer as the top.

9.13.2. Preparation of Surface and Laying

9.13.2.1. RCC or brick work in treads on which tiles are to be laid shall be cleaned, wetted and mopped. The bedding for tiles shall be with lime mortar of 1:1:1 (1 lime putty: 1 surkhi: 1 coarse sand) or Cement Mortar 1:4 (1 cement:4 coarse sand) or of specified mix. The minimum thickness of bedding mortar at any place shall be 10 mm. Bedding mortar shall be spread, tamped and corrected to proper levels. After laying bedding mortar, neat grey cement slurry of honey like consistency shall be spread over the mortar at the rate of 4.4 kg of cement per square metre of area over each tread. Tiles shall be washed, cleaned and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded and is in level and line with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines. The surface shall be checked with a straight edge during laying to obtain a true surface.

9.13.2.2. The square end of the tile shall, as far as possible butt against the riser face of the concrete or brick tread and in any case shall be embedded under the side wall plaster, skirting or dado and under the riser tile or other finish to a depth of not less than 10 mm.

9.13.2.3. Where full size tiles cannot be fixed, these shall be cut (sawn) to the required size (along the groove of the chequers where the cut edge is exposed) and used. The cut in the case of embedded edges will be neat and true while the cut in the case of exposed edges shall in addition be rubbed smooth to ensure a straight and true joints.

9.13.2.4 After the tiles have been laid surplus cement grout shall be cleaned off.

9.13.3 Curing, Polishing and Finishing

The specifications shall be as described in para 9.10.3. except that polishing of the treads nosing and chequered grooves, after laying, may be done by hand in the same manner as specified under terrazzo tile flooring. Special care shall be taken to polish the nosing and the grooves in such a manner as to get a uniform section for the grooves and the nosing and their finish shall match with the finish of the flat portion of the tiles.

9.13.4 Measurements

Chequered tiles on stair treads shall be measured in square metre correct to two places of decimal. Length shall be measured correct to a cm before laying skirting, dado or wall plaster. Width shall be measured correct to a cm from the outer edge of the nosing, as laid, before providing the riser. In the case of the edge tiles of the landing and wide steps, width shall be measured up to the near edge of the chequered stair tread tiles. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre.

9.13.5 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. Nothing extra shall be payable for cutting the tiles to suit the size of treads and also for nosing.

9.14 GLAZED TILE FLOORING

9.14.1 White Glazed Tiles

The tiles shall be of approved make and shall generally conform to IS: 777. They shall be flat, and true to shape and free from blisters, crazing, chips, wells, crawling or other imperfections detracting from their appearance. The tiles shall be tested as indicated in Appendix of IS: 777.

The tiles shall be square or rectangular of nominal size such as 150 x 150 mm, 100 x 100 mm, 100 x 200 mm or as directed by Engineer. The thickness of the tiles shall be 5 mm, or 6 mm as specified. The length of all four sides shall be measured correct to 0.1 mm and average length or breadth shall not vary more than ± 0.8 mm from specified dimension. The variation of individual dimension from average value of length/breadth shall not exceed ± 0.5 mm. Tolerance in thickness shall be ± 0.4 mm.

Note 1 Where tiles of nominal sizes of 150 x 150 mm or 100 x 100 mm are not available tiles of nominal sizes 152 mm x 152 mm or 108 mm x 108 mm may be allowed to be used with the prior approval of the Engineer.

Note 2 The actual size of the tiles supplied shall be 1 mm less so that with 1 mm joint, the tile when laid shall conform to the nominal size.

The top surface of the tiles shall be glazed and glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5 per cent of the area in order that the tile may adhere

properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only up to 50 per cent of the surface area of the edges.

9.14.2 Coloured Tiles

Only the glaze shall be coloured as specified. The sizes and specifications shall be the same as for the white glazed tiles.

9.14.3 Decorative Tiles

The type and size of the decorative tiles shall be as follows:-

(i) Decorated white back ground tiles.

The size of these tiles shall be 152 x 152 x 6 mm and/or 108 x 108 x 6 mm or of any other approved size.

(ii) Decorated and having coloured background

The sizes of the tiles shall be 152 x 152 x 6 mm and/ or 108 x 108 x 6 mm or of any other approved size.

9.14.4 Preparation of Surface and Laying

9.14.4.1. Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:3 (1 cement : 3 coarse sand) or as specified. The average thickness of the bedding shall be 10 mm while the thickness under any portion of the tiles shall not be less than 5 mm.

9.14.4.2. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place a wooden plank across and squat on it.

9.14.4.3. Over this mortar bedding, grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over such an area as would accommodate about twenty tiles. Tiles shall be soaked in water, washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

9.14.4.4. The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope.

9.14.4.5. Where full size tiles cannot be fixed, these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints.

Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

9.14.4.6 After tiles have been laid surplus cement slurry shall be cleaned off.

9.14.5 Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

9.14.6 Measurements

Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster and the area calculated in square metre correct to two places of decimal. Where coves are used at the junctions, the length and breadth shall be measured between the lower edges of the coves.

No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre.

Areas, where glazed tiles or different types of decorative tiles are used will be measured separately.

9.14.7 Rate

The rate for flooring shall include the cost of all materials and labour involved in all the operations described above. Nothing extra shall be paid for the use of cut (sawn) tiles in the work. Extra over and above the normal rate for white tiles, shall be paid where coloured or any other type of decorative tiles have been used.

9.15 GLAZED TILES IN SKIRTING AND DADO

9.15.1 General

(a) Basic requirements:- The tiles shall be of approved make and shall generally conform to IS: 777. The tiles shall be of earthenware covered by a glaze thoroughly matured and fitted to the body. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

The top surface of the tiles shall be glazed. The underside of the tiles shall not have glaze on more than 5 percent of the area in

order that the tile may adhere properly to the base. The edges of the tiles shall be free from glaze. However, any glaze if unavoidable shall be permissible on only up to 50 percent of the surface area of edges.

The glaze shall be free from welts, chips, craze, specks, crawlings or other imperfections detracting from the appearance when viewed from a distance of one metre. The glaze shall be either glossy or matt as specified. The glaze shall be white in colour except in the case of coloured tiles when colours shall be as specified by the Engineer. There may be more than one colour on a tile.

(b) Dimensions

Glazed earthenware tiles shall be made square or rectangular in sizes such as 149 x 149 mm and 99 x 99 mm or 99 x 199 mm or as specified and shall be straight or cushion edge type.

Half tiles for use as full tiles shall have dimensions which shall be such as to make the half tiles when jointed together (with 1 mm joint) match with dimensions of full tiles. Tiles may be manufactured in sizes other than those specified above.

Note Commonly manufactured sizes include 108 x 108 mm, 152 x 152 mm, 200 x 200 mm, 200 x 150 mm and 200 x 100 mm. The thickness of the tiles shall be 5 mm or 6 mm as specified.

The dimensions of fittings associated with the glazed tiles namely cove base, round edge tile, angles corner cups, ridge and legs, cornices and capping beads shall be of the shape and dimensions as required and the thickness of fittings shall be the same as the thickness of tiles given above.

(c) Tolerances

Facial Dimensions – The lengths of all the four sides of the tile shall be measured to the nearest 0.1 mm. The average value of lengths/breadth shall not vary more than ± 0.8 mm from the above specified dimension.

The variation of individual dimensions from average value of length/breadth shall not exceed ± 0.5 mm. Tolerances on thickness shall be ± 0.4 mm.

(d) Trueness of Shape (Squareness)

Any variation from a right angle in the angle contained by any two adjoining sides shall be limited so that if a builder's steel square is placed against the angle, the distance between the inner edge of the square and the adjacent side of the tile or fitting shall not be more than 0.5 mm per 100 mm run.

(e) Warpage

The tiles when tested for warpage on the edges and on the diagonal as per Appendix – A of IS : 777 shall not have warpage exceeding the value as specified below :

Size of tile (mm)	Warpage (mm)
149 x 149	- 0.4
	+ 0.7
99 x 99	- 0.3
	+ 0.5

(f) Performance Requirements-Water absorption etc.

The average water absorption of the tiles when tested and evaluated in accordance with IS : 777 shall not exceed 20 per cent.

Crazing – Tiles subjected to two cycles of crazing test as per IS : 777 shall not show any sign of crazing.

Impact Resistance: Tiles when tested for impact resistance as per IS : 777 shall remain intact, apart from surface marking.

Chemical Resistance: When tested as per IS : 777, the glazed surface of tiles and/or the fittings having a white or cream coloured glossy glaze shall show no modification.

9.15.2 Preparation of Surfaces

The joints shall be raked out to a depth of at least 15 mm in masonry walls. In case of concrete walls, the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

9.15.3 Laying

12 mm thick plaster of cement mortar 1 : 3 (1 cement : 3 coarse sand) mix or as specified shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at close intervals.

The tiles should be soaked in water, washed clean, and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and jointed. The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed, these shall be cut by sawing to the required size and their edges rubbed smooth.

9.15.4 Curing and Finishing

The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigments if required to match the colour of tiles. The work shall then be kept wet for 7 days.

After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

9.15.5 Measurements

Length shall be measured correct to a cm. Height shall be measured correct to a cm in the case of dado and 5 mm in the case of riser and skirting. The area shall be calculated in square metre, correct to two places of decimal. Length and height shall be measured along the finished face of the skirting or dado including curves where specials such as coves, internal and external angles and beads are used. Where cornices are used the area of dado shall be measured excluding the cornices. Nothing extra will be paid for cutting (sawing) the tiles to sizes.

In addition to payment for areas of skirting and dado, specials such as coves, internal and external angles and beads shall be measured separately and paid for in running metres. Cornices shall also be similarly measured for payment in running metres. Areas where coloured tiles or different types of decorative tiles are used will be measured separately to be paid extra over and above the normal rate for white tiles.

9.15.6 Rates

The rate shall include the cost of all materials and labour involved in all the operations described above. The specials such as coves, internal and external angles and beading shall be measured and paid for separately. The rate shall not include cost of cornices which shall be measured and paid for in running meters separately.

9.16 GLAZED TILE SPECIALS (FIG.9.3)**9.16.1 Specials**

The specials consist of coves, internal and external angles, beads, cornices and the corner pieces.

Coves beads and angles shall be of thickness not less than the thickness of the tiles with which they are used. The size of coves, beads and angles refers to the greatest width of the special measured in a

straight line. The stipulated size of cornices is their height. The lengths of specials shall be 15 cm, 10 cm or other standard size available conforming to the size of tiles available. In other respects the general specifications described in para 9.14.1. shall be applicable.

9.16.2 Preparation:- Preparation of Surface, Laying, Curing and finishing shall be as specified in paras 9.15.2, 9.15.3 and 9.15.4 as far as applicable.

9.16.3 Measurements: Special tiles to form coved internal angles of any radius, rounded external angles, architraves moulding, ceiling ribs, cornices and the like shall each be measured in running metres correct to a cm. Railing members and vertical members shall each be so described. Ends, angles and internal sections shall be enumerated separately.

9.16.4 Rate: It shall include the cost of all materials and labour involved in all the operations described above. Nothing extra shall be paid for corner pieces at junctions of coves, beads, cornices etc., nor for using cut lengths of specials.

9.17 CERAMIC TILE FLOORING

9.17.1 Ceramic Tiles :

9.17.1.1 Definitions, Classifications and characteristics:-

These are covered under IS 13712. Brief particulars gathered from this IS are given below.

i) Definition:- (a) These are made from clays, silica, fluxes, colouring and other mineral raw materials and are used as covering for floors, walls or facades. These are prepared by grinding, sieving, mixing, moistening etc and are shaped by pressing, extruding, casting or other process, usually at room temperature. They are then dried and subsequently fired at a high temperature. Tiles may be glazed, unglazed or engobed and are incombustible and unaffected by light. Depending on degree of vitrification water absorption may vary. A low water absorption tile is called Porcelain tile. An extremely low water absorption tile is called a fully vitrified tile and this may be in a polished or unpolished form.

(b) Extruded Tiles, Pressed Tiles and Cast Tiles are indicated as of Shaping A, B & C respectively.

(c) Sizes : Modular Sizes are based on M= 100mm and can be M, 2M, 3M and 5M and also their multiples. Non modular sizes are those excluding those based on M.

ii) Classification : Ceramic Tiles are divided into groups according to their method of manufacture and their water-absorption.

iii) Water Absorption groups

Pressed Tiles (Shaping B) : For details see 9.18.1.2 (c) below.

a) Tiles of very low and low water absorption (Group I)

Group B 1a – Ceramic Fully Vitrified Tiles

Group B 1b – Ceramic Porcelain tiles

b) Tiles of medium water absorption (Group II)

Group B II – Ceramic Floor tiles

c) Tiles of high water absorption (Group III)

Group B III – Ceramic Wall tiles

9.17.1.2 Pressed Ceramic Tiles :

a) Pressed Ceramic Tiles are covered by Specifications under IS 15622-2006. They cover Pressed Ceramic glazed / unglazed tiles of first quality for use as both floor and wall coverings. This specification is to be read with the following Specifications.

IS : 13630 Pts. 1 to 15:- Ceramic Tiles – Methods of Test

IS : 13712 (under revision):- Ceramic Tiles – Definitions, Classifications, Characteristics and marking.

b) Ceramic Tiles can be of plain type or with Space Lugs as defined in Clause 4.3 of IS Specification. The surface of tiles and associated components can be smooth, profiled wavy, decorated or finished in some other way. They can be unglazed, glossy, matt or semi-matt.

c) Depending on the maximum permitted water absorption the Tiles are grouped as under with their shapes and sizes as per following Tables of IS 15622. Tables 1 to 8 indicate the work or actual size of tiles, joint width, coordinating size (work size + joint width) and thickness of Tile.

GROUP	WATER ABSORPTION (%)	TABLE No. of IS 15622
B III	> 10	1 & 2
B II	> 3 but ≤ 6	3 & 4

B I b	$> 0.08 \text{ but } \leq 3$	5 & 6
B I a	≤ 0.08	7 & 8

d) Tables 9 to 12 of IS 15622 give Dimensional and Surface quality requirements of physical and chemical properties of the four groups.

e) As indicated in Clause 4.4 of IS 15622-2006, Dimensions and tolerances of accessories, for example soap-holder, have not been standardised and left to the manufacturers.

f) The tiles shall be selected of group, size and thickness as required by end user.

9.17.2 Preparation of Surface and Laying

9.17.2.1 Base Concrete or the RCC Slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with Cement Mortar 1:4 (1 Cement: 4 Coarse Sand) or as specified. The average thickness of the bedding shall be 20mm while the thickness under any portion of the tiles should not be less than 10mm.

9.17.2.2 Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

9.17.2.3 Over the mortar bedding, neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg. of cement per Sqm area and tiles set as indicated in Para 9.14.4.3 for Glazed Tiles.

9.17.2.4 Checking of surface shall be done as given in Para 9.14.4.4.

9.17.2.5 Use of cut tiles shall be as given in Para 9.14.4.5.

9.17.2.6 The junction between the wall plaster and tile work shall be finished neatly and without waviness. After the tiles have been laid, surplus cement grout that may have come out of the joints shall be cleaned off.

9.17.3 Pointing and Finishing : The operations shall be carried out on the same lines as described in Para 9.14.5.

9.17.4 Measurements - Provisions in Para 9.14.6 will apply.

9.17.5 Rate

The rate for flooring shall include the cost of all materials and labour involved in all the operations described above. Nothing extra

shall be paid for the use of cut tiles in the work.

9.18 CERAMIC / VITREOUS TILES IN SKIRTING AND DADO

9.18.1 Tiles : Provision in Para 9.17.1 will apply.

9.18.2 Preparation of Surface : The procedure described in Para 9.15.2 for Glazed Tiles will be applicable.

9.18.3 Laying : Procedure described in Para 9.15.3 will be applicable.

9.18.4 Curing and Finishing : Provisions in Para 9.15.4 will apply.

9.18.5 Measurements : Provisions in Para 9.15.5 will apply.

9.18.6 Rate : Provisions in Para 9.15.6 will be applicable.

9.19 MARBLE FLOORING

9.19.1 Marble:-It shall be as specified in Annexure 9.3.

9.19.2 Dressing of Slabs

Every stone shall be cut to the required size and shape, fine chisel dressed on all sides to the full depth so that a straight edge laid along the side of the stone shall be fully in contact with it. The top surface shall also be fine chisel dressed to remove all waviness. In case machine cut slabs are used, fine chisel dressing of machine cut surface need not be done provided a straight edge laid any where along the machine cut surfaces is in contact with every point on it. The sides and top surface of slabs shall be machine rubbed or table rubbed with coarse sand before paving. All angles

and edges of the marble slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slabs shall be 20, 30 and 40 mm or as specified in the description of the item. Tolerance of ± 3 percent shall be allowed for the thickness. In respect of length and breadth of slabs a tolerance of ± 2 percent shall be allowed.

9.19.3 Laying

9.19.3.1. Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar

1 : 4 (1 cement : 4 coarse sand) or with lime mortar (1 lime putty: 1 surkhi : 1 coarse sand) as given in the description of the item.

9.19.3.2. The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12 mm.

9.19.3.3 The slabs shall be laid in the following manner:

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg. of cement per sqm of area. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs as given in the description of the item.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the Engineer.

Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/streaks or as directed by the Engineer.

9.19.3.4. The slabs shall be matched as shown in drawings or as instructed by the Engineer.

9.19.3.5. Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

9.19.4 Curing, Polishing and Finishing

Slight unevenness at the meeting edges of slabs shall then be removed by fine chiseling and finished in the same manner as specified in para 9.10.3. except that cement slurry with or without pigments shall not be applied on the surface before each polishing.

9.19.5 Measurements

Marble stone flooring with different kind of marble shall be measured separately and in square metre correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for laying the floor at different levels in the same room. Steps and treads of stairs paved with marble stone slabs shall also be measured under the item of Marble stone flooring. Extra shall, however, be paid for such areas where the width of treads does not exceed 30 cm. Nosing for treads shall be measured in running metre and paid for extra. The width of treads shall be measured from the outer edge of the nosing, as laid, before providing the riser.

9.19.6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

9.20 MARBLE STONE IN RISERS OF STEPS AND SKIRTING

9.20.1 General:- Marble Stone Slabs and Dressing of Slabs shall be as specified in paras 9.19.1 and 9.19.2 except that the thickness of slabs shall be 30 mm or as laid down in the item. A tolerance of ± 3 mm shall be allowed, unless otherwise specified in the description of the item.

9.20.2 Preparation of Surface

It shall be as specified in para 9.15.2. Where necessary, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in the drawings or as required by the Engineer.

9.20.3 Laying

The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12 mm and at no place the width shall be less than 10 mm. If necessary, the slabs shall be held in position by temporary M.S. hooks fixed into the wall at suitable intervals. The skirting or riser face shall be checked for plane and plumb

and corrected. The joints shall thus be left to harden. Then the rear of the skirting or riser slab shall be packed with cement mortar 1: 3 (1 cement : 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength.

The joints shall be as fine as possible. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers and skirting slab shall be matched as shown in drawings or as instructed by the Engineer.

9.20.4 Curing, Polishing and Finishing

It shall be as specified in para 9.10.3 as far as applicable, except that cement slurry with or without pigment shall not be applied on the surface and polishing shall be done only with hand. The face and top of skirting shall be polished.

9.20.5 Measurements

Length shall be measured along the finished face of riser or skirting, correct to a cm. Height shall be measured from the finished level of tread or floor, to the top (the underside of tread, in the case of steps) correct to 1 mm. The areas shall be calculated in square metre correct to two places of decimal.

Dado and lining of pillars etc., shall be measured as "Marble work in wall lining" if the thickness is up to 25 mm or as "Marble Work" in jambs, walls, columns and other plain work' if the thickness is more.

9.20.6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

9.21 KOTA / CUDDAPPAH / SHAHABAD / TANDUR STONE FLOORING

9.21.1 Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer. Where slabs are

used for treads of steps, the exposed surfaces shall be rough chisel dressed to full depth and cut to uniform thickness.

9.21.2 Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table-rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm or as specified in the description of the item. Tolerance of ± 2 mm shall be allowed for the thickness. In respect of length and breadth of slabs, tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed.

9.21.3 Preparation of Surface and Laying

The specification shall be as described in para.9.18.3 except that the edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab.

9.21.4 Curing, Polishing and Finishing

The specifications shall be as described in para 9.10.3. except that (a) first polishing with coarse grade carborundum stone shall not be done, (b) cement slurry with or without pigment shall not be applied on the surface before polishing.

9.21.5 Measurements and Rate : These shall be as described in paras 9.18.5 and 9.18.6.

9.22 KOTA/ CUDDAPPAH/ SHAHABAD / TANDUR STONE IN RISERS OF STEPS, SKIRTING AND DADO

9.22.1 Stone Slabs:- Stone Slabs and Dressing shall be as specified in paras 9.21.1. and 9.21.2 except that the thickness of the slabs shall be 25 mm or as specified in the description of the item. The slabs may be of uniform size if required.

9.22.2 Preparation:- Preparation of surface shall be as specified in para 9.20.2.

9.22.3. Laying:- Laying shall be as specified in para 9.20.3 except that the joints of the slabs shall be set in grey cement mixed with pigment to match the shade of the slabs.

9.22.4. Curing etc:- Curing, Polishing and Finishing shall be as specified in para

9.20.4 except that first polishing with coarse grade carborundum stone shall not be done.

9.22.5 Measurements

Length shall be measured along the finished face of riser, skirting or dado correct to a cm. Height shall be measured from the finished level of tread of floor to the top (the underside of tread in the case of steps). This shall be measured correct to a mm in the case of risers of steps and skirting and correct to a cm in the case of dado. The area shall be calculated in square metre correct to two places of decimal.

Lining of pillars etc., shall also be measured under this item.

9.22.6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

9.23 RED OR WHITE ROUGH DRESSED SAND STONE FLOORING

9.23.1 Stone Slabs

The slabs shall be red or white as specified in the description of the item. The stone slabs shall be hard, sound, durable and tough, free from cracks, decay and weathering. In case of red sand stone, white patches or streaks shall not be allowed. However, scattered spots up to 10 mm diameter will be permitted. Before starting the work the contractor shall get samples of slabs approved by the Engineer.

The slabs shall be hand or machine cut to the requisite thickness along planes parallel to the natural bed of stone and should be of uniform size if required.

9.23.2 Dressing of Slabs

Every slab shall be cut to the required size and shape, and rough chisel dressed on the top, so that the dressed surface shall not be more than 6 mm from a straight edge when placed on it. The edge of depressions or projections shall be chisel dressed in a slant so that the surface does not have sharp unevenness. The sides shall also be chisel dressed to a minimum depth of 20 mm so that the dressed edge shall at no place be more than 30 mm from a straight edge butted against it. Beyond this depth the sides may be dressed slightly splayed so as to form inverted 'V' shaped joint with adjoining slabs. All angles and edges of the slabs shall be true, square and free from chippings and the surface reasonably true and plane.

Where slabs are used for treads without nosing, the exposed edges shall be rough

chisel dressed to full depth and cut to uniform thickness. The thickness of the slabs after it is dressed shall be 40 mm or as specified in the description of the item with a permissible tolerance of ± 2 mm.

9.23.3 Laying

9.23.3.1. Base concrete on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:5 (1 cement : 5 coarse sand) or with the lime mortar 1:1:1 (1 lime putty: 1 surkhi: 1 coarse sand) or as given in the description of the item.

9.23.3.2. The average thickness of the bedding mortar under the slabs shall be 20 mm and the thickness at any place under the slabs shall not be less than 12 mm.

9.23.3.3 The slab shall be laid in the following manner :

Mortar of specified mix shall be spread under each slab. The slab shall be washed clean before laying. It shall then be laid on top and pressed, so that all hollows underneath get filled and surplus mortar works up through the joints. The top shall be tapped with a wooden mallet and brought to level and close to the adjoining slabs, with thickness of joint not exceeding 5 mm. Subsequent slabs shall be laid in the same manner. After laying each slab surplus mortar on the surface of slabs shall be cleaned off and joints finished flush.

9.23.3.4. In case pointing with other mortar mix is specified, the joint shall be left raked out uniformly and to a depth of not less than 12 mm when the mortar is still green. The pointing shall be cured for a minimum period of 7 days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the Engineer.

9.23.3.5. Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster, skirting or dado. The junction between wall plaster skirting and floor shall be finished neatly and without waviness.

9.23.3.6 The finished floor shall not sound hollow when tapped with wooden mallet.

9.23.3.7 Finishing - Any unevenness existing between the edges of slabs joints shall be removed by chiseling in a slant.

9.23.3.8 Measurements - These shall be as specified in para 9.19.5.

9.23.3.9 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. Where pointing

is to be done, this will be paid extra unless specifically included in the description of the item.

9.24 RED OR WHITE FINE DRESSED SAND STONE FLOORING

9.24.1 Stone Slabs:- Stone slab shall be as specified in para 9.23.1.

9.24.2 Dressing

Every slab shall be cut to the required size and shape and chisel dressed on all sides to a minimum depth of 20 mm. The top and the joints shall be fine tooled so that a straight edge laid along the face is fully in contact with it. In case machine cut stones are used, chisel dressing and fine tooling of machine cut surface need not be done provided a straight edge laid anywhere along the machine cut surface is in contact with every point on it.

The thickness of the slabs after dressing shall be 40 mm or as specified in the description of item with a permissible tolerance of ± 2 mm.

9.24.3 Laying

Shall be as specified in para 9.23.3.

9.24.4. Finishing : In case of chisel dressed stone flooring slight unevenness, if any existing between the edges of slabs at joints shall be removed by chiseling in a slant.

9.24.5 Measurements and Rate:- Measurements and Rate shall be as specified in paras 9.23.5 and 9.23.6.

9.25 RED OR WHITE FINE DRESSED AND RUBBED SAND STONE FLOORING

9.25.1 Stone Slabs:- Stone slabs shall be as specified in para 9.23.1.

9.25.2 Dressing

The specifications for dressing the top surface and the sides shall be as described in para 9.23.2. In addition the dressed top and sides shall be table rubbed with coarse grade carborundum stone before paving, to obtain a perfectly true and smooth surface free from chisel marks. The thickness of the slabs after dressing shall be as specified with a permissible tolerance of ± 2 mm.

9.25.3 Laying

The slabs shall be laid with 3 mm thick or 5 mm thick joints as specified in the description of the item.

Where the joints are to be limited to 3 mm thickness, the slabs shall be laid as specified

in para 9.19.3 except that the bedding mortar shall be as specified in para 9.23.3. and sides of the slabs to be jointed shall be buttered with cement mortar 1:2 (1 cement : 2 stone dust) admixed with pigment to match the shade of the slab. Where the slabs are to be laid with 5 mm thick joints the specifications for laying shall be as described in para 9.23.3.

9.25.4 Finishing:- Finishing shall be as specified in para 9.23.4 except that chisel marks and unevenness shall be removed by rubbing with coarse grade carborundum stone.

9.25.5 Measurements and Rate:- Measurement and Rate shall be as specified in paras 9.23.5 and 9.23.6.

9.26 PVC SHEET/TILES FLOORING

(Note: For PVC Asbestos Floor Tiles also same specifications will apply except that the materials, dimensions, Tolerances, colour finish physical requirements and Tests shall be as per IS 3461).

9.26.1 General:- PVC Flooring material is normally used for covering floor from decorative point of view in residential and non-residential buildings. This material gives a resilient and non-porous surface which can be easily cleaned with a wet cloth as dust and grime do not penetrate the surface. Since even a burning cigarette will damage the neat surface of the PVC sheet, special care should be taken to prevent burning cigarette stumps etc to come in contact with the PVC flooring materials.

It shall be laid on a base that is finished even and smooth such as concrete, metal or timber boarding. Unevenness or undulations in the base will show badly on the surface and are liable to damage the PVC sheet/tiles.

9.26.2 Materials

9.26.2.1. The PVC flooring material shall conform to IS : 3462 . It may be in the form of tiles, sheets or rolls as specified. It shall consist of a thoroughly blended composition of thermoplastic binder, filler and pigments. The thermo plastic binder shall consist substantially of one or both of the following :

- (a) Vinyl chloride polymer
- (b) Vinyl chloride copolymer

The poly-metric material shall be compounded with suitable plasticizers and stabilizers.

Thickness : The preferred thickness of PVC tiles for normal floor covering shall be 1.5, 2.0, 2.5, 3.0 or 4.0 mm.

9.26.2.2. Thickness of PVC sheets shall be measured with micrometer of Ratchet type or a dial gauge graduated to 0.02 mm. The micrometer shall have flat bearing surface of at least 6.5 mm diameter at both contact points.

For sheets and rolls the thickness of the specimen shall be measured at twenty scattered points.

9.26.2.4 Tolerance

(a)	Thickness	± 0.15 mm	
(b)	Width	(i)	300 mm square tiles ± 2 mm
		(ii)	600 mm square tiles ± 0.4 mm
		(iii)	900 mm square tiles ± 0.6 mm
		(iv)	Sheets and rolls ± 0.1 percent

9.26.2.5. Adhesive: Rubber based adhesives are suitable for fixing PVC flooring over concrete, wooden and metal sub-floors. PVA based adhesives may also be used for concrete and wooden sub-floors. PVA based adhesives are not suitable for metallic surfaces and also for locations where there is constant spillage of water.

9.26.3 Preparation of Sub-floors

Before laying PVC sheets/tiles, it is essential to ensure that the base is thoroughly dry and damp proof as evaporation of moisture cannot take place once the PVC flooring is laid. Moisture slowly damages the adhesive resulting in PVC sheet/tiles being separated from the base and curling up. In case of new work a period of 4 to 8 weeks shall be allowed for drying the sub-floor under normal conditions.

Concrete sub-floors on the ground floor shall be laid in two layers. The top surface of the lower layer of concrete shall be painted with two coats of A-90 grade (conforming to IS : 1580) applied at the rate of 1.5 kg/sqm. The top surface of the lower layer shall be finished smooth while laying the concrete so that the bitumen can be applied uniformly. The bitumen shall be applied after the concrete has set and is sufficiently hard. Bitumen felt conforming to IS : 1322 shall be sand-wiched in the sub-floor laid in two layers.

In new concrete floor, the smooth finish required shall be produced by using cement slurry spread on fresh concrete floor and finished smooth. If the concrete floor is old

9.26.2.3. The width of flooring sheets and rolling in continuous length shall be 1000, 1500 and 2000 mm. When supplied in rolls the length of the rolls shall not be less than 10 metres.

The measurement shall be carried out with a traveling microscope or suitable scale graduated to 0.02 mm. Each tile shall be measured for length and width at the three quarter points in each direction.

and surface not even, the surface should be made smooth by first clearing it free of all foreign material and then a layer of cement mortar 1:2 (1 cement : 2 coarse sand) of average thickness of 6 mm shall be applied on the surface finishing the surface smooth. The finished surface shall be cured for 7 days and then allowed to dry thoroughly.

Where it is expected that the dampness may find its way from the surrounding walls, the same shall also be effectively damp-proofed up to at least 150 mm above the level of the sub-floor and the damp-proof treatment below the floor shall be extended over the walls.

9.26.4 Laying and Fixing

9.26.4.1. Prior to laying, the flooring tiles/rolls/sheets shall be brought to the temperature of the area in which it is to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours.

9.26.4.2. Where air-conditioning is installed, the flooring shall not be laid on the sub-floor until the conditioning units have been in operation for at least seven days. During this period the temperature shall neither fall below 20°C nor exceed 30°C. These conditions shall be maintained during laying and for 48 hours, there after.

9.26.4.3. Before commencing the laying operations, the sub-floor shall be examined for evenness and dryness. The sub-floor shall then be cleaned with a dry cloth. The PVC flooring shall not be laid on a sub-floor unless the sub-floor is perfectly dry. Methods

of testing for dryness are specified in **Annexure 9.4.**

9.26.4.4. The layout of the PVC flooring on the sub-floor to be covered should be marked with guidelines. The PVC flooring shall be first laid for trial, without using the adhesive, according to the required layout.

9.26.4.5. The adhesive shall be applied by using a notched trowel (**Figure 9.4**) to the sub-floor and to the back side of the PVC sheet or tile flooring. When set sufficiently for laying, the adhesive will be sticky to touch, but will not mark the fingers. In general, the adhesive will require about half an hour for setting. It should not be left after setting for too long a period as the adhesive properties will be lost owing to dust films and other causes.

9.26.4.6. Care should be taken while laying the flooring under high humidity conditions so that condensation does not take place affecting the adhesive. It is preferable to avoid laying under high humidity conditions.

9.26.4.7 The area of adhesive to be spread at one time on the sub-floor depends entirely upon local circumstances. In case of a small room, adhesive may be spread over the entire area but relatively small areas of tiles/sheets flooring should be treated in a larger room.

9.26.4.8. When the adhesive is just tack free the PVC flooring sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface. After laying the sheet in position, it shall be pressed with suitable roller weighing about 5 kg. to develop proper contact with the sub-floor. The next sheet with its back side applied with the adhesive shall be laid edge to edge with the sheet already laid and fixed in exactly the same manner as the first sheet was fixed. The sheets shall be laid edge to edge so that there is minimum gap between joints.

9.26.4.9. The alignment should be checked after laying of each row of sheet is completed. If the alignment is not perfect, the sheets may be trimmed by using a straight edge.

9.26.4.10. The tiles shall be fixed in exactly the same manner as for the sheets. It is preferable to start laying of the tiles from the center of the area. Care should be taken that the tiles are laid close to each other with minimum gap between joints. The tiles should always be lowered in position and

pressed firmly on to the adhesive. Care should be taken not to slide them as this may result in adhesive being squeezed up between the joints. PVC tiles after laying shall be rolled with a light wooden roller weighing about 5 kg to ensure full contact with the under-layer. Any undulations noticed on the PVC surface shall be rectified by removing and relaying the tiles after thorough cleaning of the underside of the affected tiles. The adhesives applied earlier in such places shall be thoroughly removed by using proper solvents and the surface shall be cleaned to remove the traces of solvents used. Work should be constantly checked against guidelines in order to ensure that all the four edges of adjacent tiles meet accurately.

9.26.4.11. Any adhesive which may squeeze up between sheets or tiles should be wiped off immediately with a wet cloth before the adhesive hardens. If, by chance, adhesive dries up and hardens on the surface of the sheet or tile, it should be removed with a suitable solvent. A solution of one part of commercial butyleacetate and three parts of turpentine oil is a suitable solvent for the purpose.

9.26.4.12. A minimum period of 24 hours shall be given after laying the flooring for developing proper bond of the adhesive. During this period, the flooring shall not be put to service. It is preferable to lay the PVC flooring after completion of plastering, painting and other decorative finish works so as to avoid any accidental damage to the flooring.

9.26.4.13. When the flooring has been securely fixed, it shall be cleaned with a wet cloth soaked in warm soap solution (two spoons of soap in 5 litres of warm water).

9.26.4.14. Where the edges of the PVC sheets or tiles are exposed, as for example, in doorways and on stair treads, it is important to provide protection against damage of flooring materials. Metallic edge strips may be used and should be securely fastened to the sub-floor to protect edges of the flooring.

9.26.5. Precautions in Maintenance

9.26.5.1. PVC flooring subject to normal usage may be kept clean by mopping with soap solution using a clean damp cloth. Water shall not be poured on the PVC flooring for cleaning purpose as the water may tend to seep through the joints and cause the adhesive to fail. To maintain a good wearing surface and a good appearance, the flooring may be periodically

polished. When polish is applied frequently, a thick layer builds up which collects dirt and dust and is tacky to walk on.

9.26.5.2. If the traffic is light, the floor shall be given frequent brushing and regular polishing by an application of new polish every 4 to 6 weeks. Under moderate traffic conditions the floor shall be given an occasional wash with a wet mop but no detergents shall be used so that the polish is not removed.

Application of polish may be done every one to three weeks. PVC flooring should not be over-waxed. When this condition develops, the coatings should be cleared off with white spirit or paraffin and a light even coat of polish applied.

When the PVC flooring has been polished, it will remain bright for a considerable period if dry mop is applied each day. It is this daily 'dry polish' that maintains the glossy surface. After exceptionally heavy traffic PVC flooring should be swept with a hair broom, rubbed with a mop or cloth frequently rinsed in clean water and finally rubbed dry.

9.26.6. Measurements

Length and breadth shall be measured correct to a cm and its area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for providing PVC flooring in borders and margins, irrespective of their width.

9.26.7 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above, except those described in para.9.26.5. The rate does not include the cost of sub-floor or damp proof treatment if any. It also does not include the cost of metallic edge strip to protect edge of flooring. Wherever provided, it shall be paid separately.

9.27 RUBBER FLOORING

9.27.1 General: Rubber flooring and skirting may be laid with rubber sheets, or rubber tiles.

Rubber sheets or tiles may be (i) Plain or Marbled, (ii) Rubbed or fluted, (iii) With fabric backing or fabric insert, (iv) With sponge

rubber backing or (v) With plain rubber backing, as specified. (see **Figure 9.5**)

Rubber flooring shall not be used in situations exposed to direct sunlight or rain as the flooring is likely to deteriorate quickly.

In maintaining rubber flooring, lavish use of water, scrubbing with strongly alkaline soaps and cleaning with rough brushes should be avoided. Rubber flooring made from natural rubber shall not be used in situations where it is likely to come in contact with fats, grease, oil or petrol. To meet such conditions rubber flooring made from certain synthetic rubber will have to be used.

9.27.2 Materials

9.27.2.1. Rubber Tiles: Rubber tiles shall conform in all respect to IS : 809. These shall be of standard sizes, such as 200 x 200 mm, 300 x 300mm or as shown in the drawings or as directed by the Engineer. Where the room length and width are not exact multiples of the size of the tiles, the end rows shall be with cut sizes of tiles. The thickness of the tiles shall be 3.2 mm, 4.8 mm or 6.4 mm as specified in the description of the item, with permissible tolerance of plus 0.8 mm and minus 0.2 mm.

The tiles shall be 'plain' or 'Marbled', unless otherwise specifically described in the item. The colour of the tiles shall be as shown in the drawings or as directed by the Engineer.

Before starting the work, the contractor shall get the samples of rubber tiles approved by the Engineer.

9.27.2.2. Adhesive: The adhesive shall be a rubber adhesive of approved quality of the type and make recommended by the manufacturers of rubber tiles. It shall be got approved by the Engineer. It shall be a rubber solvent preparation with a reasonably short drying time and shall give a tough adhesive film. The surplus adhesive should not be allowed to remain longer than 24 hours.

9.27.3 Laying - Shall generally conform to IS : 1197.

9.27.3.1. Rubber tiles shall be laid to margins and pattern as shown in the drawings or as directed by the Engineer.

9.27.3.2. Rubber flooring may be laid on any base that is finished even and smooth, such as concrete, timber boarding or mastic asphalt. A rough surface makes for poor adhesion of the rubber and its consequent separation from the base in due course.

It is important that the base is thoroughly dry and damp proof as dampness causes failure

of the adhesive, leading to the curling of tiles. Nothing extra shall be paid for the rubber used in sealing the edges at the entrance. Damp proofing of the base can be effected in any of the ways suggested in **Annexure 9.4.**

9.27.3.3. The base shall be smooth, thoroughly clean and dry. Adhesive shall be applied to the base, and to the back and edges of the tiles and allowed to become surface dry. The tiles shall then be firmly pressed and smoothened down with a suitable tool. Weights shall be used to keep the tiles flat if any tendency to curl is noticed. Care shall be taken to ensure that no air pockets are left under the tiles. If any air pocket is left, the tiles shall be removed and re-laid after applying more adhesive on the base and back of tiles and pressed in position. The tile shall be laid with butt joints throughout and the joints shall be very fine.

Coves of wood or metal may be formed to cover or mask the joints between the rubber flooring and the wall facing where so required, but these shall be paid for separately.

9.27.4 Finishing

After laying, any adhesive sticking on the face of the tiles shall be removed immediately, since if allowed to harden, solvent may be required to remove it and this will harm the rubber. The surface shall be cleaned with a mild soap and wet cloth after a week of its laying. After drying, the surface shall be polished with an approved emulsion type polish to give a smooth shining surface.

9.27.5 Measurements

Lengths and breadths of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. No deduction shall be made nor extra paid for any opening in the floor up to 0.20 sqm in area. Deduction for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for borders and margin, irrespective of their width. Nothing extra shall be paid for the use of cut tiles in the work.

9.27.6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above but shall not include the cost of the base or damp proof treatment or the cost of coves.

9.28 STONE SETTS FLOORING

9.28.1 Stone Setts : The stone setts shall be 250mm x 125mm x 100mm or of any other standard size. These shall be of the hardest procurable Granite, Trap or other stone of igneous origin. The stone setts must have a dense and clear section. Those discoloured or distorted with boulder skin or earthy and porous matter or showing signs of decay shall be rejected. All stones must be uniformly rectangular, smooth on the top surface and evenly hammer dressed on the other five sides, and shall be laid flat with the continuous vertical joints not in the direct line of traffic.

9.28.2 Base : Base may consist of dry rammed sand or moorum or dry rammed brick- ballast or stone-ballast or kankar or quarry refuse or lime concrete or cement concrete, as specified by the Engineer. On new embankments which have not fully settled, the base may consist of dry rammed sand or moorum only. The consolidated thickness may be anything from 7 cm to 15 cm depending upon the requirement.

9.28.3 Laying : A layer of 10mm to 20mm sand shall be spread over the base concrete to allow for the irregularities in the stones. The vertical joints shall be 5mm to 10mm, wide which may be later filled in with 1:3 cement sand mortar / bituminous mixed sand unless otherwise ordered. If the stone setts are to be laid dry without jointing, they shall be laid as close to each other as possible with sand spread over the top to work into the services.

9.28.4 Measurements : Work shall be measured in square metres correct to two places of decimal. Length and breadth shall be measured correct to a cm.

9.28.5 Rate : Rate will include labour and materials (except cement) for all the above operations.

{FOR TYPES OF FLOORING RECOMMENDED FOR DIFFERENT LOCATIONS - Annexure 9.5 may be referred to}

ANNEXURE 9.1**ABRASION TEST FOR CONCRETE HARDENING COMPOUNDS****1. Preparation of Sample**

25 mm cylinder shall be prepared in ratio 1: 2 (1 cement : 2 graded stone aggregate 6 mm nominal size) by weight, one each with and without the admixture of concrete hardening compound. The concrete hardening compound shall be used in the proportion by weight of cement as recommended by the firm. The cylinder shall be placed inside a damp box for 24 hours and then cured in water for 27 days. After that, they shall be subject to abrasion test on 'Dorry' Type Avery Abrasion Testing Machine, using Emery Powder No.80 as the abrading medium under the condition given in para 2 below.

2. Conditions of Test

- (a) Area of rubbing surface shall be same in both the cylinders.
- (b) Age of cylinder 28 days
- (c) Duration of Test 60 minutes
- (d) Total distance traversed during rubbing About 2.4 km
- (e) Pressure on rubbing surface 0.04 kg/cm^2

3. Results of Tests

The following observations shall be made in both the cases:-

- (a) Composition of the Test specimen
- (b) Mean thickness rubbed away
- (c) Percentage loss in weight

4. Remarks

Percentage loss in weight in the case of cylinder with concrete hardening compound, should not be more than 40 percent of the percentage loss in the case of cylinder without concrete hardening compound.

ANNEXURE 9.2**TEST REQUIREMENTS AND PROCEDURE FOR TESTING "PRECAST CEMENT CONCRETE / TERRAZZO TILES"****1 Sampling**

The tiles required for carrying out test described below shall be taken by 'random sampling'. Each tile sample shall be marked to identify the consignment from which it was selected.

Minimum quantity of tiles for carrying out the test and frequency of test shall be as specified in the Recommended list of Tests. The number of tiles selected for each test shall be as follows:

- (a) For conformity to requirements on shape and dimensions, wearing layers, and general quality - 12 tiles.
- (b) For wet transverse strength test - 6 tiles
- (c) For resistance to wear test - 6 tiles
- (d) For water absorption test - 6 tiles

NOTE – (a) The tests on the tiles shall not be carried out earlier than 28 days from the date of manufacture.

(2) The tiles selected for (a) may as well after verification of requirements, be used for (b).

2 Wet Transverse Strength Test

Six full size tiles shall be tested for the determination of wet transverse strength. When tested according to the procedure laid down in Appendix 'E' of IS : 1237, the average wet transverse strength shall not be less than 3 N/mm^2 (30 kg/cm^2).

3 Resistance to Wear Test

3.1 Not less than twelve specimens shall be prepared as described in Para -3.2 from the tiles selected in accordance with Para 1. When tested in the manner specified in Paras 3.3.1 to 3.3.4, their average wear shall not exceed 3.5 mm and the wear on any individual specimen shall not exceed 4 mm.

3.2 Preparation of Test Specimens

The test specimens shall be square in shape and of size $7.06 \text{ cm} \times 7.06 \text{ cm}$ (i.e. 50 sq.cm . in area). They shall be sawn off one only from each tile, preferably from the central

part of the tile. The deviation in the length of the specimen shall be within ± 2 percent . The surface to be tested shall be ground smooth and filling removed.

3.3. Apparatus and Accessories

3.3.1. Abrasion Testing Machine

The abrasion test of specimens shall be carried out in a machine conforming essentially to the requirements described in IS : 1237 (Appendix 'F'). The abrasive powder used for the test shall conform to the specification given below:-

The abrasive shall have an aluminium oxide content of not less than 95 percent by weight. The grains shall be of rounded shape and shall generally pass through IS Test Sieve 25 and be retained on IS Test Sieve 20. The combined content of larger grains retained in IS Tests Sieve 25 and of smaller grains whose fineness is not limited, shall not exceed 10 percent. The specific gravity of the grains shall be between 3.9 and 4.1. The grains shall generally have a hardness of 9 in Mohr's scale.

3.3.2. Measuring Instruments

A suitable instrument capable of measurement to an accuracy of 0.01 mm shall be used for determining the change in the thickness of the specimen after abrasion.

3.3.3. Procedure of Test

The specimen shall be dried at 110°C for 24 hours and then weighed to the nearest 0.1 gm. The specimen after initial drying and weighing shall be placed in the thickness measuring apparatus with its wearing

$$t = \frac{10 \times (W_1 - W_2) \times V_1}{W_1 \times A}$$

Where

t = Average loss in thickness, in mm;

W_1 – Initial weight, in gm of the specimen;

W_2 – Final weight, in gm of the abraded specimen;

V_1 . Initial volume, in CC of the specimen and

A = Surface area in sq./ cm. of the specimen.

4 Water Absorption

4.1. At the time of delivery to the site of the work, not less than six full tile specimens, selected in accordance with Para 1 shall be prepared and when tested as described below, their average percentage of water absorption shall not exceed ten.

4.2. Preparation of Specimen

Full size tiles shall be used for this test. They shall be immersed in water for 24 hours, then taken out, wiped dry and tested for water absorption.

surface uppermost and the reading of the measuring instrument taken.

The grinding path of the disc of the abrasion testing machine shall be evenly strewn with 20 gm of the abrasive powder. The specimen shall then be fixed in the holding device with the surface to be ground facing the disc and loaded at the center with 30 kg. The grinding disc shall then be put in motion at a speed of 30- rpm. After every 22 revolutions, the disc shall be stopped, the abraded tile powder and the remainder of the abrasive powder shall be removed from the disc and fresh abrasive powder in quantities of 20 gm applied each time. After 110 revolutions, the specimen shall be turned about the vertical axis through an angle of 90 ° and then the test continued under the same conditions until 220 revolutions have been completed altogether. The disc, the abrasive powder and the specimen shall be kept dry throughout the duration of the test. After the abrasion is over, the specimen shall be reweighed to the nearest 0.1 gm. It shall then be placed in the thickness measuring apparatus once again in the identical manner and the reading taken with the same position and setting of the dial gauge as for the measurement before abrasion.

3.3.4. Determination of Wear

The wear shall be determined from the difference in readings obtained by the measuring instrument before and after the abrasion of the specimen. The value shall be checked up with the average loss in thickness of the specimen obtained by the following formula.

4.3. Procedure of Test

Each tile shall be weighed immediately after saturation and wiping as in Para 4.2. The tile shall be oven dried at a temperature of $65 \pm 1^{\circ}\text{C}$ for a period of 24 hours, cooled to room temperature and reweighed.

4.4. Determination of Water Absorption

The water absorption per cent by weight for each tile shall be determined as follows:

On oven dry basis water absorption per cent by weight $(W_1 - W_2) \times 100$

 W_2

Where

W_1 – Weight in gm of the saturated specimen; and

W_2 . Weight in gm of the oven dried specimen.

The average value for percentage water absorption shall be calculated for the whole number of tiles tested.

ANNEXURE 9.3 MARBLE

1.0 Marble shall be hard, sound, dense and homogeneous in texture with crystalline texture as far as possible. It shall generally be uniform in colour and free from stains, cracks, decay and weathering.

1.0.1 Marbles are metamorphic rocks capable of taking polish, formed from the recrystallization of lime stones or dolomitic lime stones and are distinguished from lime stone by even visibly crystalline nature and non-flaggy stratification.

Note: Marble is a product of nature and hence it is difficult to guarantee uniformity of colour, veining or other characteristics that may be represented in any sample submitted. A sample will indicate only an average of colour, veining and other general texture and specified finish.

1.1 Classification

The marble blocks, slabs and tiles shall be classified broadly in the following two categories:-

- (i) White Marble
- (ii) Coloured Marble such as black, green, pink, brown, grey marble etc.,

(i) White Marble

1.1.1. Plain White Marble

- (a) Makrana first quality White Marble: Plain white marble without streaks available at Chosira pahar Kuwan, Doongri and Bhat.
- (b) Makrana second quality white Marble: White marble having lighter shades or spots

available at Chosira Pahar Kuwan, Doongri and Lodhi Doongri.

(c) Abu White Marble: White marble with blue and grey shades available at Ambaji.

(d) Raj Nagar Marble: It shall be plain white marble with coarse grains predominantly showing mica particles giving reflection in bright light.

1.1.2. Abu Panther Marbles

White marble with irregular blue black spots available in Ambaji.

1.1.3. White Veined Marbles

(a) Makrana Doongri Adanga Marble: Light greyish white having grey and brown veins available at Doongri and Pahar Kuan.

(b) Makrana chak Doongri Marble: White marble having black streaks available at Chak Doongri

(c) Abu White Veined Marble

(d) White marble with grey or black veins available at Ambaji.

(ii) Coloured Marble

1.1.4 Black Marble

1.1.4.1. Plain Black Marble: Black marble sawn along veins locally known as 'Peta Pasu sawing' available at Bhainslana.

1.1.4.2. Black Zebra Marble

(a) Bhainslana Black Zebra Marble: Black marble having grey or white veins available at Bhainslana.

(b) Kishangarh Black Zebra Marble: Black marble having white patches and streaks available at Abu.

(c) Narnaul Black Zebra Marble: Black marble with thin white veins available at Narnaul.

(d) Makrana Dhobi Doongri Zebra Marble: Greyish black marble with white flowery pattern available at Dhobi Doongri.

1.1.5 Green Marble

(a) Baroda Green Marble: Dark Green marble with flowery pattern available at Baroda.

(b) Abu Green Marble: Light green marble with green and/or brown streaks on white ground available at Ambaji.

(c) Falna Green Marble: Green marble with prominent yellowish pattern available at Falna.

(d) Bundi Green Marble: Green marble with pinkish shades available at Umar, (Bundi).

1.1.6. Pink Marble

1.1.6.1. Plain Pink Marble: Pink Marble with light or dark shades available at Makrana and Bar.

1.1.6.2. Pink Adanga Marble

(a) Makrana Pink Adanga Marble: Pink marble with brown or greenish and white

streaks available at Makrana. It has both light and dark shades of pink.

(b) Bar Pink Adanga Marble: Pink marble with green veins available at Bar.

(c) Bundi Pink Adanga Marble: Pink marble with great streaks available at Umar (Bundi).

1.1.7. Grey Marble

(a) Kumari Grey Marble: Grey marble having light blue shades available at Makrana.

(b) Narnaul Brown Marble: Brown marble having teak wood shades available at Narnaul.

1.1.8 Brown Marble

(a) Bar Brown Marble / Brown Marble with light and dark brown shades available at Bar.

(b) Narnaul Brown Marble: Brown marble having teak wood shades available at Narnaul.

1.2. Sizes and Tolerances

The size of marble blacks, slabs and tiles shall be as mentioned in Table below.

TABLE : Sizes of Marble Blocks, Slabs and Tiles

	Length	Width	Thickness
1. Blocks	30 to 250	30 to 100	30 to 90
2. Slabs	70 to 250	30 to 100	2 to 15
3. Tiles	10 to 60	10 to 60	0.8 to 2.4

Notes :

- (1) All dimensions are in centimeter.
- (2) The length and width, of the blocks shall be in multiple of 30 cm.
- (3) Length and width of slab shall be in multiple of 10 cm. And thickness in multiple of 1 cm.
- (4) Tiles shall be square cut and linear dimensions shall be in multiple of 10 cm.
- (5) Only slabs and tiles shall be machine cut and factory made.
- (6) For 8 mm thick tiles, special precautions will be required for fixing them like using special adhesive as per manufacturer's specifications. Such tiles are not suitable for outside veneering work exposed to rains/sun if used in large areas in continuous stretches. For tiles of thickness 20 mm and above cramps may be provided if approved by the Engineer.

Tolerance - Following tolerances shall be allowed in dimension of blocks, slabs and tiles :

Blocks	Tolerance
(a) Length	+ 2 per cent
(b) Width	+ 2 per cent
(c) Thickness	+ 2 per cent
Slabs	
(a) Length	+ 2 per cent
(b) Width	+ 2 per cent

(c) Thickness Tiles	+ 3 per cent
(a) Linear dimension	+ 3 per cent
(b) Thickness	+ 1 per cent

The sizes other than those mentioned above may be provided as directed by the Engineer and nothing extra shall be payable on this account.

ANNEXURE 9.4

DETERMINATION OF SUB-FLOOR DRYNESS

1 General

1.1. Different tests for determining concrete sub-floor dryness are given in this Annexure. It is intended that the first test should be carried out as a preliminary test as it is an approximate method only and while adequate to separate very wet slabs from those which are dry or nearly dry, it will not discriminate satisfactorily between the latter two conditions. Should this preliminary test indicate that the floor is 'dry' confirmatory test should be made by one of the other two procedures given in Paras 3 and 4.

2 Preliminary Test

2.1. Materials

The following materials are required: -

- (a) A sheet of glass about 30 x 30 cm or rubber mat or a sheet of polyethylene (not less than 0.1 mm thick) or the PVC flooring material of about 60 x 60 cm and
- (b) Putty adhesive plasticine or other suitable mastic for sealing the edges of the sheet material.

2.2. Procedure

2.2.1. A sheet of glass rubber or plastic materials shall be placed on the concrete floor slab to be tested and sealed thoroughly around all edges, using the mastic material.

2.2.2. After a period of not less than 24 hours, the covered portion of the concrete slab shall be inspected for signs of dampness. If this area is even slightly darker in colour than the remainder of the slab, the floor shall be considered too wet. A careful inspection is required, as in conditions of good ventilation, the difference in colour may rapidly disappear after the sheet has been lifted.

2.2.3. The test shall be made in several places on the slab, and repeated at regular intervals until no sign of dampness appears. The floor should then be tested at several points by either surface hygrometer method or the electrical resistance method until satisfactory results of floor dryness are obtained before the floor should be considered sufficiently dry.

3 Hygrometer Test

3.1 Apparatus

A hygrometer is so constructed that when sealed to the floor with mastic or by other suitable means, the relative humidity of a small quantity of air confined between the slab and the case of the instrument is measured.

3.2. Procedure

The case of the hygrometer shall be carefully sealed to the slab and left for a period not less than 16 hours. The relative humidity reading shall then be taken.

3.3. Results

The dryness of the concrete slab shall be considered satisfactory for conditions of laying the PVC flooring, if the relative humidity reading does not exceed 70 per cent.

NOTE: The instrument shall be so placed that sunlight does not fall on it, as this may produce a false low reading.

4 Electrical Resistance Test

4.1. Apparatus

The apparatus shall comprise the following:

- (a) Resistance Meter

One, of suitable range to be calibrated in terms of the moisture content of the slab in the range of 4 to 8 percent and having sufficient sensitivity to clearly distinguish changes of 0.5 percent.

ANNEXURE 9.5**TYPE OF FLOORING RECOMMENDED FOR DIFFERENT LOCATIONS**

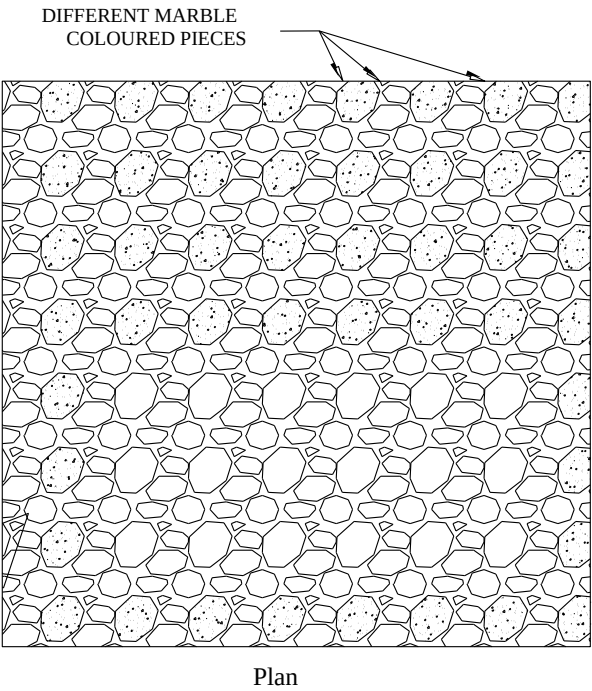
1. Bed Rooms	i) Cement concrete flooring with neat cement finish ii) Terrazzo tiles iii) Terrazzo-in-situ (grey or white) iv) Kota or similar stone v) Marble Crazy flooring
2. Drg.-cum-Dining room	i) White Terrazzo-in-situ flooring ii) Kota or similar stone iii) Marble tiles
3. Office rooms (for general staff)	i) Cement concrete flooring with neat cement finish ii) Terrazzo flooring (grey) iii) Terrazzo tiles
4. Library, Computer rooms	i) PVC flooring
5. Toilet flooring / Kitchen flooring	i) Ceramic tiles / Vitrified tiles ii) Marble tiles or slab iii) Terrazzo tiles iv) Cement Concrete flooring with neat cement finish v) Kota or similar stone vi) Terrazzo in situ flooring
6. Staircase flooring	i) Kota or similar stone ii) Slate stone iii) Terrazzo tiles iv) Cement concrete flooring with neat cement finish v) Marble stone
7. Walkways flooring	i) Plain concrete tiles (precast) ii) Chequered concrete tiles (precast and coloured) iii) Sand stone slab iv) Cement concrete flooring in panels
8. Lobby, Reception Main Lounge flooring in offices	i) Ceramic tiles / Vitrified tiles ii) Terrazzo tiles iii) Kota or similar stone iv) Granite stone
9. Wall cladding, Pillars cladding, Beam cladding in offices in main circulation and reception areas	i) Granite ii) Teak ply
10. Kitchen counter slab	i) Cudappah Black stone ii) Marble slab iii) Granite iv) Cement Concrete flooring with neat cement finish
11. Roof	i) Brick tiles ii) CC Tiles iii) CC flooring in panels iv) Terrazzo tiles

RECOMMENDED LIST OF TESTS ON MATERIALS

Material	Para	Test	Field/ Laboratory Test	Test Proce- dure	Minimum quantity of material for carrying out the test	Frequency of testing
1	2	3	4	5	6	7
Terrazzo Tiles	9:11:1 9:12:1	1. Trans verse strength 2. Water absorption 3. Abras ion test	Laboratory	IS: 1237	5000 Nos. (no testing need be done if total number of tiles of all types of all sizes from all manufacturers used in a work is less than 5000 Nos.)	One test for every 10,000 Nos. or part thereof for each type and size from a single manufacturer. (One test to be done even if the number of terrazzo tiles of any type and size from a single manufacturer is less than 5000 Nos. provided the total number of terrazzo tiles of all types and sizes from all manufacturers used in a work exceeds 5000 Nos.)
White Glazed tiles (for floor & wall)	9:15:1 9:16:1	1. Water absorption 2. Crazi ng test 3. Impact strength 4. Chemical resistant test	Laboratory	IS:777	3000 Nos.	3000 Nos. or part thereof

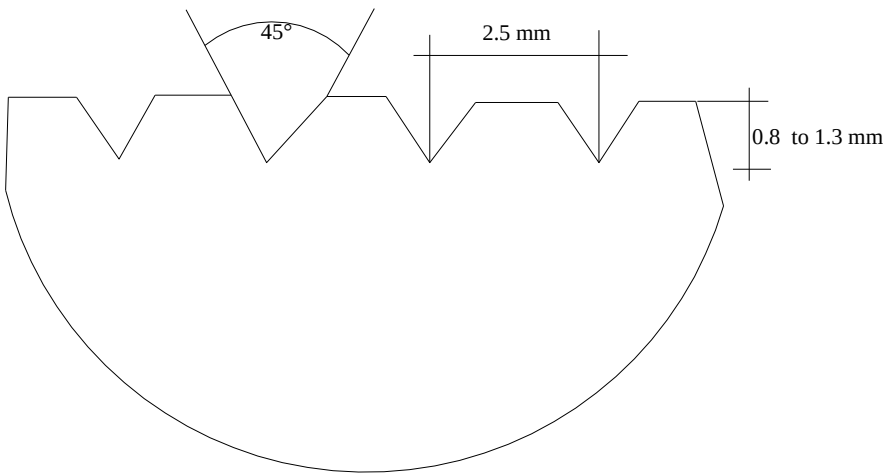
CRAZY MARBLE FLOORING

FIGURE 9.1



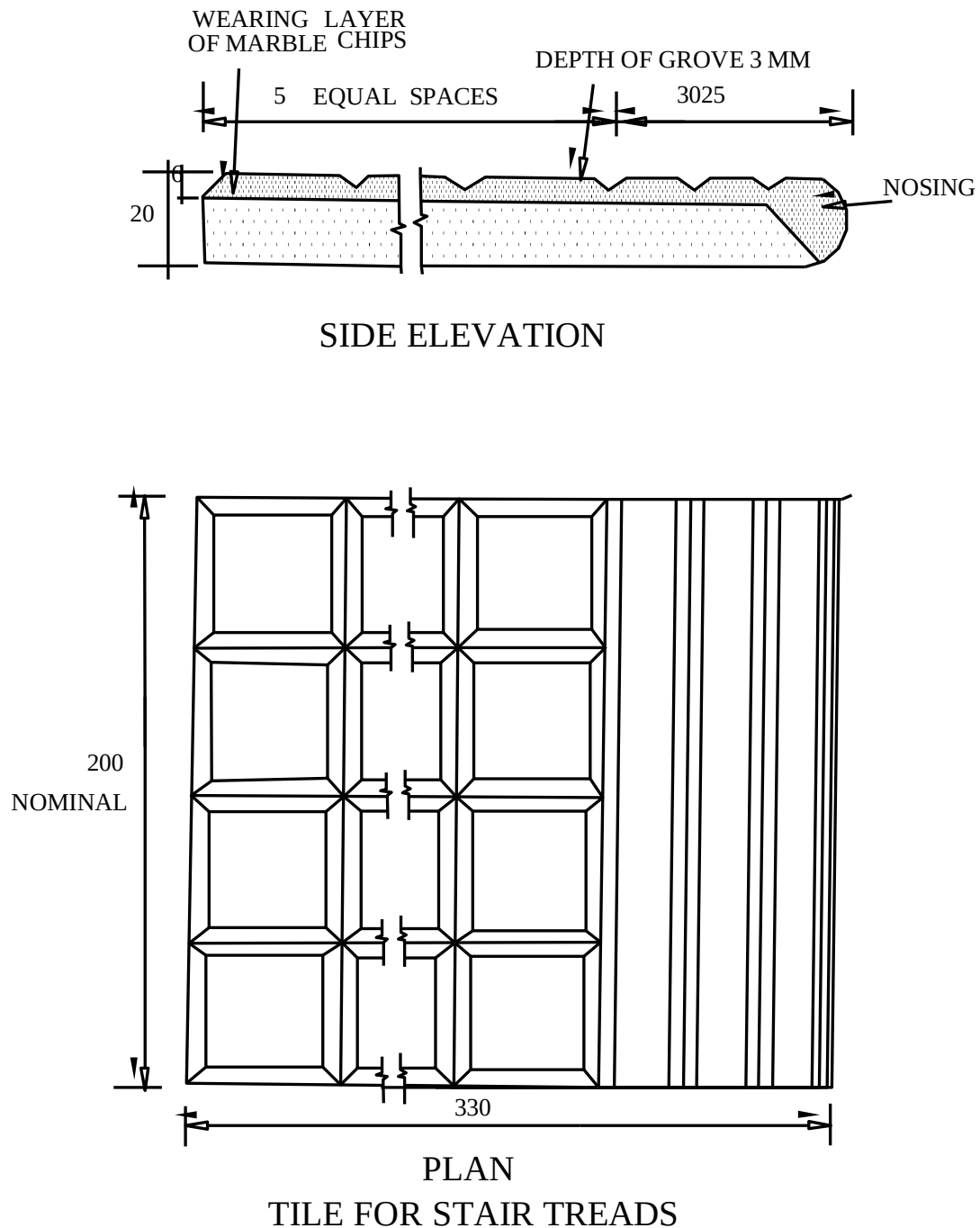
DETAILS OF A TYPICAL NOTCHED TROWEL

FIGURE 9.4



CHEQUERED TILES IN STAIR TREADS

FIGURE 9.2

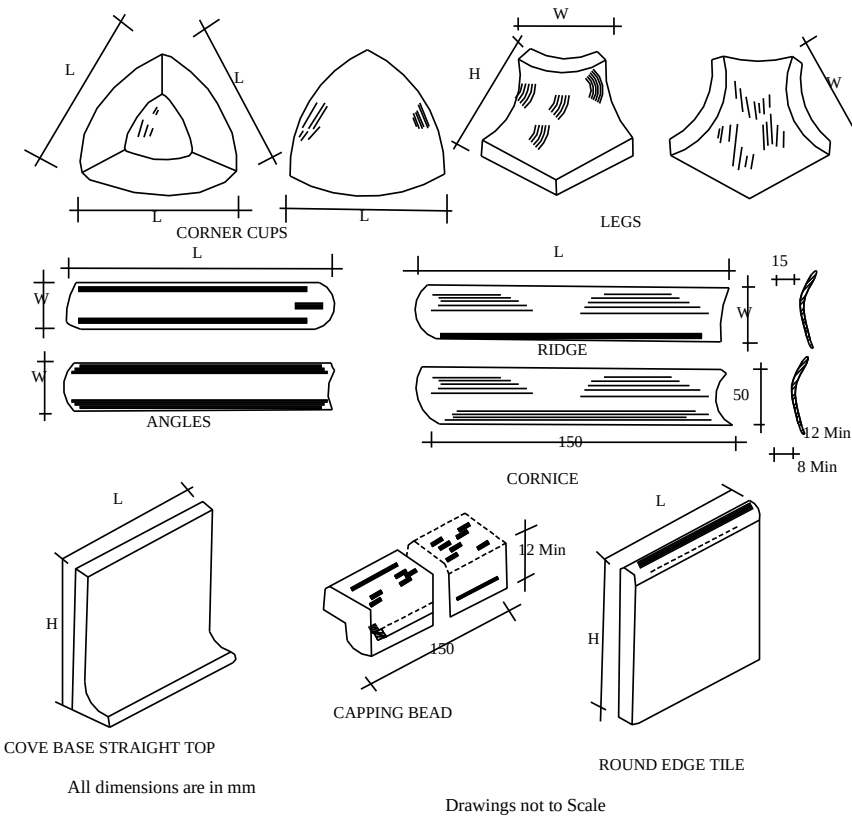


All dimensions are in mm

Drawings not to Scale

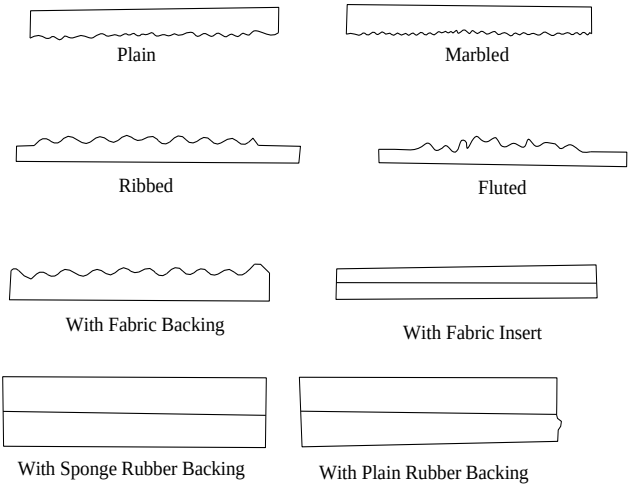
GLAZED EARTHENWARE TILES - SPECIALS

FIGURE 9.3



DIFFERENT TYPES OF RUBBER FLOORING

FIGURE 9.5



DIFFERENT TYPES OF RUBBER FLOORING

Chapter 11

Finishing - Masonry

11.1 GENERAL PLASTER

11.1.1. Scaffolding : For all exposed brick work or tile work in important works, double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

For all other brick work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

In case of special type of brick work, scaffolding shall be got approved from the Engineer in advance.

11.1.2. Preparation of Surface : The joints shall be raked out properly. Chapter on Brick Work and Chapter on Stone Work may be referred to for details. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface, if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

11.1.3 Mortar : The mortar of the specified mix shall be used.

11.1.4 Application of Plaster -

11.1.4.1 Ceiling plaster shall be completed before commencement of wall plaster.

11.1.4.2 Plastering shall be started from the top and worked down towards the floor. All put-log holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 x 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres

intervals over the entire surface to serve as gauges with the help of aluminium /steel straight edges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be beaten with thin strips of bamboo about one metre long to ensure thorough filling of the joints, and then brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and side ways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive troweling or over working the float shall be avoided. During this process, a solution of lime putty shall be applied on the surface to make the later workable.

11.1.4.3 All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

11.1.4.4 When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped, cleaned and wetted with lime putty before plaster is applied to the adjacent areas, to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of wall and not nearer than 15 cm to any corners or arrises. It shall not be closed on the body of the features such as pilasters, bands and cornices, nor at the corners or arrises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. No portion of the surface shall be left out initially to be patched up later on.

11.1.5. Finish : The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not

less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

11.1.6. Thickness : The thickness of the plaster specified shall be measured exclusive of the thickness of key i.e. grooves or open joints in brick work. The average thickness of plaster shall not be less than the specified thickness, (here 12 mm). The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3 mm. The average thickness should be regulated at the time of plastering by keeping suitable thickness gauges. Extra thickness required in dubbing behind rounding of corners at junctions of wall or in plastering of masonry cornices etc. will be ignored.

11.1.7. Curing : Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of seven days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

11.1.8. Precaution : Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer.

i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn by any suitable method in the wall while the plaster is green.

ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

11.1.9 Measurements

11.1.9.1 Length and breadth shall be measured correct to a cm and the area shall

be calculated in square metres correct to two places of decimal.

11.1.9.2 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

11.1.9.3 The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted.

11.1.9.4 The following shall be measured separately from wall plaster.

(a) Plaster bands 30 cm wide and under

(b) Cornice beadings and architraves or architraves moulded wholly in plaster.

(c) Circular work not exceeding 6m in radius.

11.1.9.5. Plaster over masonry pilasters will be measured and paid for as plaster only.

11.1.9.6 A coefficient of 1.63 shall be adopted for the measurement of one side plastering on honey comb work having 6 x 10 cm. opening. Different coefficient will be applied as determined at site for different size of opening and plastered surface.

11.1.9.7 Moulded cornices and coves.

(a) Length shall be measured at the centre of the girth.

(b) Moulded cornices and coves shall be given in square metres the area being arrived at by multiplying length by the girth.

(c) Flat or weathered top to cornices when exceeding 15 cm in width shall not be included in the girth but measured with the general plaster work.

(d) Cornices which are curved in their length shall be measured separately.

11.1.9.8 Exterior plastering at a height greater than 10 metres from average ground level shall be measured separately in each storey height. Patch plastering (in repairs) shall be measured as plastering new work, where the patch exceeds 2.5 sqm extra payment being made for preparing old wall, such as dismantling old plaster, raking out the joints and cleaning the surface. Where the patch does not exceed 2.5 sqm in area it shall be measured under the appropriate item under sub head 'Repairs to Buildings.'

11.1.9.9 Deductions in measurements, for opening etc. will be regulated as follows:

a) No deduction will be made for openings or ends of joists, beams, posts, girders, steps etc. upto 0.5 sqm in area and no additions shall be made either, for the

jamb, soffits and sills of such openings. The above procedure will apply to both faces of wall.

b) Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals, jamb, soffits sills, etc. of these openings.

i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.

ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is unplastered, deduction shall be made from the plaster or pointing on the side of the frame for the doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side. Where widths of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.

iv) Different qualities of plastering referred in this para shall not include '18 mm plastering with terrazzo finish' as given in para 11.1.2 as the method of measurement in the case of the later is different. In such cases where the plaster on the other face consists of a plaster with terrazzo finish method of addition and deductions for the ordinary plaster face shall be regulated as if that face above is plastered and the other is given an entirely different type of non-comparable treatment.

c) For opening exceeding 3 sqm in area, deduction will be made in the measurements for the full opening of the wall treatment on both faces, while at the same time, jamb, sills and soffits will be measured for payment.

In measuring jamb, sills and soffits, deduction shall not be made for the area in contact with frame of doors, windows etc.

11.1.10 Rate : The rate shall include the cost of labour and materials involved in all the operations described above.

11.1.11 Control of Cracks : The main reasons for cracking of plaster are as follows:

i) Quick drying of the mortar due to hot weather and low atmospheric humidity.

ii) When a strong mix has been used on a weak background.

iii) Lack of bond with the background.

iv) Masonry underneath has not undergone initial shrinkage.

v) Lack of proper raking of joints, and

vi) Discontinuity in background, such as change from wall to ceiling, from concrete to brickwork, from clay brickwork to concrete block work etc.

In case of discontinuity in backgrounds, the best treatment would be to separate the two portions by a neat cut through the plaster at the junction. In case of discontinuity from wall to ceiling, a cornice that would permit slight movement without cracking may advantageously be introduced. If it is not proposed to provide a cornice, a straight cut through the plaster or a groove joint at the junction may be provided.

11.2 CEMENT PLASTER

11.2.1 General:- The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

11.2.2 Scaffolding etc.:- Scaffolding and preparation of surface shall be as specified under para 11.1.

11.2.3 Mortar : The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified in Mortar chapter. For external work and under coat work, the fine aggregate shall conform to grading zone IV mentioned in Para 26.1.3.3 or as specified in the item and for finishing coat work the fine aggregate should conform to grading finer than of Grading Zone IV but within grading indicated in Table 26.3 of Para 26.1.3.7. Water Proofing of the Plaster, where so specified, shall be done by the addition of an appropriate brand of cement water proofing compound to the cement used for making the mortar.

11.2.4 Application : The specifications as in para 11.1.4 shall apply except in the following respects :

(a) Beating with thin bamboo strips shall not be done on the cement plaster, and

(b) No lime putty solution shall be applied on the face when finishing.

Further the plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

11.2.5 Thickness

Where the thickness required as per description of the item is 20 mm the average

thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stone work the minimum thickness over the bushings shall be not less than 12 mm.

11.2.6 Curing : Curing shall be started as soon as the plaster has hardened sufficiently and not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

11.2.7 Other Specifications : Specifications, for Finish, Precautions, Measurements and Rate shall be as described under para 11.1.

11.2.8 Control of Cracks : Para 11.1.11 may be referred to.

11.3 CEMENT PLASTER WITH A FLOATING COAT OF NEAT CEMENT

11.3.1 General : The cement plaster shall be 12, 15 or 20 mm thick, finished with a floating coat of neat cement, as described in the item

11.3.2 Other Specifications : Specifications for this item of work shall be same as described in 11.2 except for the additional floating coat which shall be carried out as below.

When the plaster has been brought to a true surface with the wooden straight edge (Para 11.2.4) it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole-surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 2.2 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix. The rest of the specifications described in para 11.2.4 shall apply.

11.4 18 mm CEMENT PLASTER (TWO COATS WORK)

11.4.1 General : The specification for scaffolding and preparation of surface shall be as described in para 11.2.

11.4.2. Mortar : The mix and type of fine aggregate specified in the description of the item shall be used for the respective coats. It

shall be as specified in Mortar chapter. Generally the mix of the finishing coat shall not be richer than the under coat unless otherwise described in item.

Generally coarse sand shall be used for the under coat and fine sand for the finishing coat, unless otherwise specified. For external work and under coat work, the fine aggregate shall conform to grading zone IV. For finishing coat work the fine aggregate conforming to grading finer than that of Zone IV shall be used.

11.4.3 Application

11.4.3.1 The plaster shall be applied in two coats i.e. 12 mm under coat and then 6 mm finishing coat and shall have an average total thickness of not less than 18 mm.

11.4.3.2 12 mm Under Coat: This shall be applied in the manner specified in para 11.2.4 except that when the plaster has been brought to a true surface with a wooden straight edge, the surface shall be left rough and furrowed 2 mm deep with a scratching tool diagonally both ways to form key for the top coat. The scratched lines shall be at not more than 15 cm apart. The surface shall be kept wet till the finishing coat is applied.

11.4.3.3 6mm Finishing Coat : 6 mm finishing coat : The finishing coat shall be applied after the under coat has sufficiently set but not dried and in any case within 48 hours and finished in the manner specified in para 11.2.4.

11.4.4. Other Specifications : Specifications for Curing, Finishing, Precautions, Measurements and Rate shall be as described under para 11.2.

11.5 CEMENT PLASTER ON CEMENT CONCRETE AND REINFORCED CEMENT CONCRETE WORK IN CEILINGS.

11.5.1. Scaffolding : Stage scaffolding shall be provided for the work. This shall be independent of the walls.

11.5.2. Preparation of Surface : Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacing of not more than 5 cm. centres, the pock being made not less than 3 mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned of all oil, grease etc. and well wetted before the plaster is applied.

11.5.3. Mortar : Mortar of the specified mix using the types of sand described in the item shall be used. It shall be as specified in Mortar chapter.

11.5.4. Application : To ensure even thickness and a true surface, gauges of plaster 15 x 15 cm. shall be first applied at not more than 1.5 metre intervals in both directions to serve as guides for the plastering. Surface of these gauged areas shall be truly in the plane of the finished plaster surface. The plaster shall be then applied in a uniform surface to a thickness slightly more than the specified thickness and shall then be brought to true and even surface by working a wooden/aluminum /steel straight edge reaching across the gauges. Finally the surface shall be finished true with a trowel or with wooden float to give a smooth or sandy granular texture as required. Excess troweling or over working of the floats shall be avoided. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

Plastering of ceiling shall not be commenced until the slab above has been finished and centring has been removed. In the case of ceiling of roof slabs, plaster shall not be commenced until the terrace work has been completed. These precautions are necessary in order that the ceiling plaster is not disturbed by the vibrations set up in the above operations.

11.5.5. Finish : The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 metre long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

11.5.6. Thickness : The average thickness of plaster shall be 6 mm or 12mm as specified/ ordered. The minimum thickness over any portion of the surface shall not be less than 10mm for 12mm plaster and 5 mm for 6mm plaster.

11.5.7. Curing : The specifications shall be as detailed in para 11.2.

11.5.8 Precautions : These shall be as described in para 11.1.8.

11.5.9 Measurements

11.5.9.1 Length and breadth shall be measured correct a cm. and area shall be calculated in sqm. correct to two places of

decimal. Dimensions before plastering shall be taken.

11.5.9.2 Thickness of plaster shall be exclusive of the thickness of the key i.e. depth or rock marks and hacking.

11.5.9.3 Plastering on ceiling at height greater than 5 metres above the corresponding floor level shall be so described and shall be measured separately stating the height in stages of 1m or part thereof.

11.5.9.3 Plastering on the sides and soffits of the projected beams of ceiling at a height greater than 5 m above the corresponding floor level shall be measured and added to the quantity measured under para 11.5.9.3.

11.5.9.4 Plastering on spherical and groined ceiling and circular work not exceeding 6m radius, shall be measured and paid for separately.

11.5.9.5 Flowing soffits (Viz. portion under spiral stair case etc.) shall be measured and paid for separately.

11.5.9.6 Ribs and mouldings on ceiling shall be measured as for cornices, deductions being made from the plastering on ceiling in case the width of the moulding exceeds 15 cm.

11.5.9.7. The mode of measurement of exterior plaster and patch plastering (in repairs) shall be as laid down in para 11.1.9.8.

11.5.9.8 Deduction shall not be made for openings or for ends of columns, or columns caps of 0.5 sqm each in area and under. No additions will be made either for the plastering of the sides of such openings. For openings etc. of areas exceeding 0.5 sqm deduction will be made for the full opening but the sides of such openings shall be measured for payment.

11.5.10 Rate

The rate shall include the cost of all labour and materials involved in all the operations described above.

11.9 6MM CEMENT PLASTER FOR SLAB BEARING

11.6.1 General:- Cement plaster shall be 6 mm thick finished with a floating coat of neat cement and thick coat of lime wash on top of walls for bearing of slabs.

11.6.2 Application : The plaster shall be applied over the cleaned and wetted surface of the wall. When the plaster has been brought to a true surface with the wooden straight edge (Para 11.2.4) it shall be

uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix. The rest of the specifications described in para 11.2.4 shall apply.

11.6.3 Lime Wash - This shall be applied in a thick coat after curing the plaster for three days.

11.6.4 Measurements - Length and breadth shall be measured correct to a cm and area worked out in sqm correct to two places of decimal.

11.6.5 Rate - The rate shall include the cost of all labour and materials involved in all the operations described above.

11.10 NEAT CEMENT PUNNING

11.7.1 General : The specifications given for floating coat described in para 11.3.2 shall apply. Quantity of Cement for the floating coat shall be 2.2 kg. per sqm.

11.7.2 Specifications : Specification for scaffolding and curing shall be as described in paras 11.2.2 and 11.2.6 respectively. Specifications for Finish and Precautions shall be as described in paras 11.1.5. and 11.1.8.

11.7.3. Measurements :

11.7.3.1 The measurements for lime punning shall be taken over the finished work. The length and breadth shall be measured correct to a cm. The area shall be calculated in sqm correct to two places of decimal.

11.7.3.2 Punning over Plaster on bands, skirting, coping, cornices, drip courses, string courses etc. shall not be measured separately but only as wall surfaces. In these cases the measurements shall be taken girthed over the above features.

11.7.3.3 Punning over plaster on circular work also, of any radius shall be measured only as wall surfaces, and not separately.

11.7.3.4 Lime punning in patch repairs irrespective of the size of the patch shall be measured as new work, and in this case the rate shall include for cutting the patch to rectangular shape before lime punning.

11.7.3.5 Deductions in measurements for openings shall be regulated generally as described in para 11.1.9.9.

11.7.4. Rate : The rate shall include the cost of all labour and materials involved in all the operations described above.

11.8. ROUGH CAST PLASTER

11.8.1 General - Rough cast finish comprises of a mixture of sand and gravel in specified proportions dashed over a freshly plastered surface.

11.8.2. Scaffolding : Scaffolding shall be done as specified in para 11.1.

11.8.3. Preparation of Surface : The joints shall be raked out, dust and loose mortar shall be brushed out. The surface shall be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

11.8.4. Mortar: Mortar of specified mix using the type of sand described in the item shall be used; Where coarse sand is to be used, the fineness modulus of the sand shall not be less than 2.5.

11.11.5. Applications

11.8.5.1. The plaster base over which rough cast finish is to be applied shall consist of two coats, under layer 12 mm thick and top layer 10 mm.

11.8.5.2 12 mm under layer: This shall be applied in the same manner as specified in para 11.1.4 except that (a) the finishing after the mortar has been brought to a level with the wooden straight edge, shall be done with wooden float only (b) during the process lime putty solution shall not be applied and (c) the surface shall not be beaten with bamboo strips

The surface shall be further roughened by furrowing about 2 mm deep with a scratching tool diagonally both ways to form a key for the finishing coat. The scratched lines shall be at not more than 15 cm apart. The surface shall be kept wet till the finishing coat is applied.

11.8.5.3 Top Layer : The top layer shall be applied a day or two after the under layer has taken initial set. The latter shall not be allowed to dry out, before the top layer is laid on. The mortar used for applying top layer shall be sufficiently plastic and of rich mix 1 : 3 (1 cement : 3 fine sand) or as otherwise specified so that the mix of sand and gravel gets well pitched with the plaster surface. In order to make the base plastic, about 10% of finely ground hydrated lime by volume of cement, shall be added when preparing mortar for the top layer.

11.8.6 Finish : It shall be ensured that the base surface which is to receive rough cast

mixture is in plastic state. The rough cast mixture shall consist of sand or gravel or crushed stone of uniform colour from 2.36 mm to 12.5 mm or as specified and in the proportions as specified accurately to the effect required. The mixture shall be wetted and shall be dashed on the plaster base in plastic state by hand scoop so that the mix gets well pitched into the plaster base. The mix shall again be dashed over the vacant spaces if any so that the surface represents a homogeneous surface of sand mixed with gravel. A sample of rough cast plaster shall be got approved by the Engineer.

11.8.7 Other Specifications : Specification for other details like precautions, measurements and rate shall be as described under para 11.1.

11.8.8 Coloured Finish : For a coloured rough cast finish, a high grade mineral pigment will be mixed with Portland cement or white cement (as the case may be) to obtain the required shade and tint. organic dyes shall not be used, as they are likely to fade.

11.9 PEBBLE DASH FINISH (INSITU WORK)

11.9.1 General : The specification shall be the same as for rough cast plaster, except that the washed pebble or crushed stone graded from 12.5 mm to 6.3 mm or as specified shall be dashed over the plaster base and the vacant spaces if any shall be filled in by pressing pebbles or crushed stone as specified by hand, so that the finished surface represents a homogeneous surface.

11.9.2 Other Specifications : Specifications for scaffolding, preparation of surface, Mortar, Measurements and Rate shall be as described under para 11.8.

11.10 SAND FACED CEMENT PLASTER

11.10.1 Base Coat : The first coat or the base coat should be approximately 12mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows etc. The base coat shall be splashed on to the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this base coat shall be as specified in the respective item of work. The base coat shall be cured for atleast seven days.

11.10.2 Top Coat : The second coat shall be 6mm thick. Before application of the second coat, the base coat shall be evenly dampened. This coat shall be applied from top to bottom in one operation and without joints, finish shall be straight, true and even. The mortar proportion of this coat shall be as specified under the respective item of work. Sand to be used for the second coat and for finishing work shall be as specified in the item description. The second coat shall be finished with sponge. Grooves shall be made as per the drawings.

11.10.3 Curing : The surface shall be kept wet for at least a week

11.10.4 Other Specifications : Specifications for scaffolding, Measurements and Rate shall be as described under Para 11.1.

11.11 WASHED STONE GRIT PLASTER

11.11.1 General:- Scaffolding shall be as specified in para 11.1.1.

11.11.2 Preparation : Preparation of surface shall be as specified in paras 11.1.2 and 11.8.2.

11.11.3. Materials

11.11.3.1 Stone chippings obtained by crushing hard stone shall be free of dust and deleterious material. 10 mm nominal size stone chippings, where specified, shall pass 100% through 12.5 mm sieve and fully retained on 6.3 mm sieve. Stone chippings shall be thoroughly washed with water and sieved before use.

11.11.3.2 Mortar : Cement mortar for under coat and cement mortar to be mixed with stone chippings for top coat shall be as specified in para 11.2.

11.11.4 Application of Plaster

11.11.4.1 12 mm under coat : Under coat of cement mortar 1:4 (1 cement : 4 coarse sand) shall be applied as specified in para 11.2.4 except that the finishing, after the mortar has been brought to level with the wooden straight edge, shall be done with wooden float only. The surface shall be further roughened by furrowing with a scratching tool. Furrowing shall be done diagonally both ways and shall be about 2 mm deep to provide a key for the top coat. The scratched lines shall not be more than 10 cm apart. The surface shall be kept wet till top coat is applied.

11.11.4.2 15 mm top coat : Top coat comprising cement mortar and stone chippings shall have an overall proportion of

1:0.5:2 (1 cement : 0.5 coarse sand : 2 stone chippings 10 mm nominal size) or as specified. The top coat shall be applied a day or two after the under coat has taken the initial set. The surface of the under coat shall be cleaned and a coat of cement slurry at 2 kg of cement per sqm shall be applied before the application of coat. The top coat shall be applied in uniform thickness on the under coat after the application of slurry and sufficiently pressed with wooden float for proper bonding with the under coat. Vacant space, if any shall be filled with the specified mix.

11.11.5 Finish : The top coat of plaster shall be finished to a true and plumb surface. The surface shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds. All the corners, angles and junctions shall be truly vertical or horizontal as the case may be. Rounding or chamfering of corners junctions etc. where required shall be true to template.

Finished surface of the top coat after the mix has taken the initial set, shall be scrubbed and washed with suitable brushes and plain water. Scrubbing and washing shall continue till the stone chippings are sufficiently exposed. Stone chippings which may come out while scrubbing shall be replaced using the specified mortar mix. A sample of the washed stone grit plaster shall be got approved from the Engineer.

11.11.6 Grooves : Grooves of size 15 mm x 15 mm or as specified shall be provided as shown on the drawing or as required by the Engineer. Tapered wooden / metallic battens to match the size and shape of the grooves shall be fixed on the under coat with nails-before the application of the top coat and these shall be removed carefully so that the edges of the panels of top coat are not damaged. Damage, if any, shall be made good by the contractor.

11.11.7 Curing : Curing shall be done as specified in para 11.1.7 except that the dates are not to be marked.

11.11.8 Measurements :

11.11.8.1 Length and breadth shall be measured correct to the nearest cm and the area shall be calculated in sqm correct to two places of decimal.

11.11.8.2. Measurements shall be taken for the work actually done with deductions for all

openings and addition for all jambs soffits and sills. However, no deduction is to be made for the grooves provided as specified in para 11.11.6

11.11.8.3 Washed stone grit plaster on circular surfaces not exceeding 6m radius and on external surfaces at a height greater than 10 m shall be measured separately.

11.11.9 Rate - The rates shall include the cost of all labour and materials involved in all the operations described above except for providing grooves. The length of grooves shall be measured in running metres and paid for separately.

11.13. 18mm PLASTERING WITH TERRAZZO FINISH

11.12.1 Scaffolding : Double scaffolding shall invariably be adopted.

11.12.2 Preparation of Surface : The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence, if any, shall be removed by brushing and scraping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

11.12.3. Mortar

11.12.3.1 The mortar shall be prepared as specified for Terazzo flooring in Flooring Chapter.

11.12.3.2 12 mm under coat : This shall generally consist of cement mortar 1 : 3 (1 cement : 3 coarse sand) unless otherwise specified in the item.

11.12.3.3 6 mm Top Coat : The specifications for Terazzo flooring in Flooring chapter shall hold good as far as applicable.

11.12.4 Applications

11.12.4.1 12 mm under coat: This shall be applied in the manner specified in Terazzo Skirting in Flooring Chapter.

11.12.4.2 6 mm top coat: The top coat shall be applied after the under coat has sufficiently set but not dried, and in any case within 48 hours and finished in the same manner as specified under para 9.9.2 as far as applicable.

11.12.4.3 All corners, arrises, angles and junctions shall be truly vertical or horizontal

as the case may be; arrises shall be carefully and neatly finished and rubbed smooth. Rounding or chamfering corners, arrises, junctions etc. where required shall be true to template and shall be carried out without any extra payment.

11.12.5 Finish : The finished surface shall be smooth, highly polished and absolutely even so that when light from side ways is reflected on it, it does not show any kind of waviness.

11.12.6 Thickness

11.12.6.1 The thickness of the under coat of plaster specified shall be exclusive of the thickness of key. The average thickness of the under coat shall not be less than 12 mm whether the wall treated is of brick or stone. In the case of brick work the minimum thickness over any portion of the surface shall not be less than 10 mm while in the case of stone work, the minimum thickness over the bushing shall not be less than 6 mm.

11.12.6.2 6 mm finishing coat shall be uniformly 6 mm thick over the under coat in the case of both brick and stone masonry.

11.12.7 Curing : Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

11.12.8 Precautions : Any cracks, which appear in the surface and all portions, which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer. In addition care shall be taken that the finish of the rectified work is indistinguishable from the rest of the portions and does not show as a patch.

11.12.9 Measurements

11.12.9.1. Measurements of length and breadth shall be correct to a cm and the area shall be calculated correct to two places of decimal. The measurement of plaster shall be taken between the wall or partition (being the dimension before plastering).

11.12.9.2 Measurement of the work as actually done with all deductions of opening etc., addition of jambs, sills and soffits shall

be taken. However, openings less than 0.50 sqm in area will be ignored.

11.12.9.3 Skirting not exceeding 30 cm in height shall be measured in sqm separately, stating the number of coats, thickness of each coat and whether plain, chamfered or beaded on top.

11.12.9.4 Circular work not exceeding 6 m in radius shall also be separately measured.

11.12.9.5 Moulded cornices and coves shall be measured as follows :

a) Length shall be measured at the centre of the girth.

b) Moulded cornices and coves shall be given in sqm the area being arrived at by multiplying length by the girth.

c) Flat or weathered top to cornices when exceeding 15 cm in width shall not be included in the girth but measured with the general plaster work.

d) Cornices which are curved in their length shall be measured separately.

11.12.10 Rate : The rate shall include the cost of all labour and materials involved in above operations.

11.13 18 mm ARTIFICIAL RED STONE PLASTER

11.14.1 General : The specification for scaffolding and preparation of surface shall be as described in para 11.2.

11.13.2 Mortar

11.13.2.1. 12 mm under coat: Mortar of the mix and type of sand specified in the description of the item shall be used. This shall be generally (1:4) cement mortar using coarse sand, unless described otherwise

11.13.2.2 6 mm finishing coat : This shall consist of cement, marble dust and stone dust in the ratio of 1:1:3 mixed with red oxide at the rate of 15.4 kg per quintal of cement or as determined at site to obtain a shade matching red sand stone. The red oxide used should be of approved make. The colour shall be mixed thoroughly with dry cement and then the mortar shall be mixed in the same manner as ordinary cement mortar, using the pigmented cement and stone dust and marble dust mixture.

11.13.3 Application etc. : Application, Thickness, Curing, Finishing, and Precaution shall be as specified under para 11.4 except that the surface finish shall be neither too rough nor too smooth but should resemble red stone work in texture.

11.13.4. Measurements and Rate : These shall be as specified in paras 11.12.9 and 11.12.10. Lining out plaster in imitation of stone or concrete block walling shall be given in sqm as extra over general plaster work.

11.14 PLAIN BANDS OF CEMENT MORTAR

11.14.1 General :- 'Plain band' is a plaster strip of uniform width not exceeding 30 cm and of uniform thickness, provided for decorative or other purpose flush with, sunk below or projecting beyond, the wall plaster. A flush band is one where due to the difference in mix or shade of the mortar, the band is executed as a separate and distinct operation from the wall plaster.

11.14.2 Thickness : The thickness of a raised band is the thickness of the projection beyond the plane of the wall plaster. In the case of a flush or a sunk band, the thickness will be the thickness of the plaster measured from the untreated wall surface.

11.14.3 Preparation of Surfaces and Application

11.14.3.1 In the case of flush or sunk bands the joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing the scraping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

11.14.3.2. In case of raised band, the surface shall be dealt with as specified in para 11.1.4 except in following respects (a) beating with, thin bamboo strips shall not be done and (b) the lime putty solution shall be applied on the surface when Finishing. The surface of the wall plaster behind the band shall be left rough and furrowed 2 mm deep with a scratching tool, diagonally both ways to form key for the band. No reduction in the rate for the above backing wall plaster shall, however, be made for not finishing the same smooth.

11.14.4 Mortar : Mortar of the mix and type of sand specified in the description of the item shall be used.

11.14.5. Finish : The bands shall be finished exactly to the size as shown-in-the drawings. The horizontal or vertical lines of bands shall be truly parallel and straight and the surfaces shall be finished truly plane and smooth. The lines and surfaces shall be checked with fine threads for straightness, level and accuracy.

11.14.6. Scaffolding, Curing and Precaution : These shall be as described under para 11.2.

11.14.7. Measurements : Length will be measured in running metres correct to a cm. The length shall be taken along the finished face. The width shall not be measured by girth. For width of band 30 cm or below, the width shall be measured in cm correct to 5 mm. The quantity shall be calculated in metre-cm units.

11.14.8 Rate : The rate shall include the cost of all labour and materials involved in all the operations described above. Nothing extra shall be paid for mitres, stops nor for bands on curved surfaces of whatever radius, they may be. The rate is also inclusive of all rounding or chamfering at corners, arrisers, providing grooves at junctions etc.

11.15 MOULDED BANDS OF CEMENT MORTAR (SINGLE COAT WORK)

11.15.1 General:- Moulded band is a plaster strip of uniform width but with varying thickness across its section formed over wall plaster for decorative purposes. The sectional periphery of the band is formed by a combination of straight lines or of curves or of straight lines and curves.

11.15.2. Thickness : The higher thickness stipulated in the description of the item shall refer to the upper limiting thickness of the moulding at its most project portion, measured from the wall plaster.

11.15.3 Surface Preparation : Preparation of Surface, Mortar, Scaffolding, Curing and Precautions shall be as specified under para 11.14.

11.15.4 Application and Finish : Proper templates conforming accurately to the sectional periphery of the moulded band shall be got approved, before use. The finished band shall be true to the template at all sections. The lines of the band shall be truly parallel and straight and surfaces smoothly finished.

11.15.5. Measurements : The width of the band 30 cm or below shall be measured in cm correct to 5 mm and shall be measured

along the sectional periphery of the moulded band, from wall plaster face to wall plaster face. The length shall be measured, in running metres correct to a cm. It shall be taken along the finished face of the band at the centre of its girth. The quantity should be calculated in metre-cm units.

11.15.6 Rate : The rate shall include the cost of all labour and materials involved in all the operations described above. Nothing extra shall be paid for mitres, stops nor for bands on curved surfaces of whatever radius, they may be. The rate is also inclusive of all rounding or chamfering at corners, arrises etc.

11.16. MOULDED BANDS OF CEMENT MORTAR (TWO COAT WORK)

11.16.1 General:- Moulded band is a plaster strip of uniform width but with varying thickness across its section formed over wall plaster for decorative purposes. The sectional periphery of the band is formed by a combination of straight lines or of curves or of straight lines and curves.

11.16.2. Thickness : The higher thickness stipulated for the under coat in the description of the item shall refer to the upper limiting thickness of the under coat of the moulding at its most projected portion from the wall plaster.

The thickness stipulated for the finishing coat is the uniform thickness of the finished peripheral surface of the moulded band from the under coat.

11.16.3 Mortar : The under coat shall consist of cement mortar 1:5 (1 cement : 5 coarse sand) and the top coat shall be of cement mortar 1 : 4 (1 cement : 4 fine sand) unless otherwise specified in the description of item.

11.16.4 Application and finish : Proper templates conforming to the sectional periphery of the moulded band as at the stages of the under coat and the finished final coat shall be made and got approved and used at the proper stages in executing the bands to true and accurate profile. The lines of the bands as finally completed shall be truly parallel and straight and the surfaces smoothly finished.

11.17.5 Other Specifications : All other details shall be as specified under para 11.15.

11.17 CEMENT WATERPROOFING COMPOUND

11.17.1 General : It shall be used for cement mortar for plastering or concrete work.

11.17.2 Water Proofing Compound :

Integral cement water proofing compound conforming to IS: 2645 and of brand and manufacture approved by the Engineer shall be used.

11.17.3 Materials : The contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement and does not run out separately when water is added.

11.17.4 Measurements : It shall be measured by weight.

11.17.5 Rate : The rate shall include the cost of all labour and materials involved in all the operations described above.

11.18. 18mm MUD PLASTER (Two Coats)

11.18.1. Scaffolding : Single scaffolding shall be done as specified under para 11.1.

11.18.2. Preparation of surface : The joints shall be raked out and surface washed of all dust and allowed to dry before plaster is applied.

11.18.3. Mortar : Mud Mortar shall be prepared from good brick earth. This shall be free from grass roots, gravel kankar etc. The earth shall contain no efflorescent salts nor shall it be collected from a locality where there are white ants. The earth shall be reduced to a fine powdered state and mixed with plenty of water in a pit, adding chopped straw at about 33 kg per cum of earth.

The mixture of earth, straw and water shall be allowed to mature for not less than 4 days. During this period it shall be worked up at intervals with foot and/or phawaras so that it is plugged into a homogeneous mixture.

The mortar when ready shall be of such consistency that it will readily slide off the face of trowel but shall not be so wet that the mortar parts into large drops while falling.

11.18.4 Application

Plastering shall be started from the top and worked towards the grounds.

The plaster shall be applied in two coats of 12mm and 6mm thickness. The prepared mixture shall be applied to the surface in a uniform coat of average thickness of 12mm

and then smoothened and made even with a straight edge and with floats. This shall be allowed to set but not to become dry before the second coat is applied. The latter shall be 6mm thick uniform throughout. It shall be finally polished with a trowel after it has been smoothened with wooden floats.

All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be, and shall be carefully and neatly finished. Rounding and chamfering corners, arrises, grooves at junctions etc. where required, shall be done without any extra payments. Such rounding, chamfering and grooving shall be carried out with proper templates or battens to the sizes as required.

11.18.5 Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

11.18.6 Precautions : No curing shall be done. The surface shall be protected from damage till it dries out. Any cracks that open out during drying shall be opened out and thoroughly repaired with mixture of clay and cow dung. Any portions which sound hollow when tapped shall also be redone after cutting out the hollow portions.

11.18.7 Thickness : The average thickness of the finished plaster excluding the key of the joints shall not be less than 18 mm. The minimum thickness of the plaster over any portion of the wall of brick work shall not be less than 15 mm at any point while in the case of stone walls, this shall not be less than 12 mm over the bushings.

11.18.8. Measurements : The specifications for measurement shall be as described in para 11.1.9 except for the following.

All bands and skirtings irrespective of width, moulded beadings, architrave and archivolt bands and circular work of any radius shall be measured and paid for under plastering areas only and not separately.

11.18.9. Rate : The rate shall include the cost of all labour and materials involved in all the operations described above.

11.19. POINTING ON BRICK WORK, TILE WORK AND STONE WORK

11.19.1 General : Pointing shall be of the type shown in **Figure 11.1**. **Figure 5.5** under Chapter 5 Brick work may also be seen. Generally, the floors of rooms and bridges requiring pointing will be flush pointed while all vertical faces of Brick and Stone work will be rule pointed. The work shall however be executed as directed by the Engineer or as shown in the Drawing. The specifications for Cement pointing on Brick flooring and stone slab pavement shall be the same as for Brick work or Stone work detailed below.

11.19.2. Scaffolding : For all exposed brick work or tile work, independent double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong tied together with horizontal pieces over which scaffolding planks shall be fixed. For all other brick work in building, single scaffolding shall be permitted. In such cases, the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width, or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

In case of special type of brickwork, scaffolding shall be got approved from the Engineer in advance.

11.19.3. Preparation of surface : The joints shall be raked out properly. The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall not be less than 12 mm.

For new work, where subsequent pointing is to be done, the raking of joints shall be done during the progress of work, when the mortar is still green. Dust and loose mortar shall be brushed out. The whole surface shall be thoroughly cleaned and efflorescence if any shall be removed by brushing and scraping. The surface shall then be thoroughly washed with water, cleaned and kept wet before pointing is commenced.

In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

11.19.4 Mortar: Mortar of specified mix shall be used. It shall be as specified under Chapter 26. Mortar for pointing may be coloured to match the Brick work or Stone work, if specially ordered.

11.19.5 Application and Finishing

11.19.5.1 The mortar shall be pressed into the raked out joints, with a pointing trowel, either flush, sunk or raised, according to the type of pointing required. The mortar shall not spread over the corner, edges or surface of the masonry. The pointing shall then be finished with the proper tool, in the manner described below:

11.19.5.2 Flush Pointing : The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks, tiles or stones so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and straight edge.

11.19.5.3 Ruled Pointing : The joints shall be initially formed as for flush pointing and then while the mortar is still green, a groove of shape and size as shown in drawings or as instructed, shall be formed by running a forming tool, straight along the centre line of the joints. This operation shall be continued till a smooth and hard surface is obtained. The vertical joints shall also be finished in a similar way. The vertical lines shall make true right angles at their junctions with the horizontal lines and shall not project beyond the same.

11.19.5.4 Cut or Weather Struck Pointing : The mortar shall first be pressed into the joints. The top of the horizontal joints shall then be neatly pressed back about 3 mm or as directed, with the pointing tool so that the joints are sloping from top to bottom. The vertical joints shall be ruled pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles.

11.19.5.5 Raised and Cut Pointing : Raised and cut pointing shall project from the wall facing with the edges cut parallel so as to have a uniformly raised band about 6 mm raised and width 10 mm or more as directed.

11.19.5.6 The superfluous mortar shall then be cut off from the edges of the lines and the surface of the masonry shall also be cleaned off all mortar. The finish shall be such that the pointing is to the exact size and shape required and the edges are straight, neat and clean.

11.19.6 Curing : The pointing shall be kept wet for seven days. During this period it shall be suitably protected from all damages. The

pointing lines shall be truly horizontal and vertical except where the joints are slanting as in rubble random masonry. Lines of joints from different directions should meet neatly at the junctions instead of crossing beyond.

11.19.7 Measurements

11.19.7.1 Length and breadth shall be measured correct to a cm and the area shall be calculated in square metres upto two places of decimal.

11.19.7.2 The various types of pointing for example, struck, keyed, flush, tuck, etc. shall each be measured separately.

11.19.7.3 Pointing on different types of walls, floors, roofs etc. shall each be measured separately. The type and material of the surface to be pointed shall be described.

11.19.7.5 For jambs, soffits, sills etc, for opening not exceeding 0.5 sqm each in area, ends of joists, beams, posts, girders, steps etc not exceeding 0.5 sqm each in area and opening not exceeding 3 sqm each deductions and additions shall be made in the following way, in case of pointing on external face only.

a) No deduction shall be made for ends of joists beams, posts etc. and openings not exceeding 0.5 sqm each, and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.

b) Deductions for openings exceeding 0.5 sqm but not exceeding 3 sqm each shall be made as follows and no additions shall be made for reveals, jambs, soffits, sills, etc. for these openings.

i) When both the faces of the wall are pointed with the same pointing deduction shall be made for one face only.

ii) When two faces of wall are pointed with different pointings or if one face is plastered and other is pointed or plastered, deduction shall be made from the plaster or pointing on the side of frames for doors, windows, etc. on which the width of the reveal is less than that on the other side, but no deduction shall be made from the other side.

iii) Where widths of reveals on both faces of wall are equal, deduction of **50%** of area of opening on each face shall be made from area of pointing or plaster as the case may be.

iv) For opening having door frame equal to projecting beyond thickness of wall, full deduction for opening shall be made from each pointed face of wall.

11.19.7.6 In case of openings of area above 3 sqm each, deduction shall be made for the

openings, but jambs, soffits and sills shall be measured.

11.19.7.7 The following shall be measured separately.

- a) Raking out joints for old work only shall be measured and given in square metres.
- b) Raking out joints of old work built in mud mortar, lime mortar and cement mortar shall each be measured separately.
- c) Raking out joints of different types of old walls, floors etc. shall each be measured separately.
- d) Raking single detached joints as for flashing old work shall be given in running metres.

11.19.8 Rate : The rate shall include the cost of all materials and labour involved in all the operations described above, except that for old work, raking of joints shall be paid for separately. For new work cost of raking of joints is covered by the rate of brickwork/stonework.

11.20 WHITE WASHING WITH LIME

11.20.1. Scaffolding

11.20.1.1 Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface, which is being white washed.

11.20.1.2. For all exposed brick work or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed. In case of special type of brick work, scaffolding shall be got approved from Engineer in advance.

11.20.1.3 Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

11.20.1.4 For white washing the ceiling, proper stage scaffolding shall be erected.

11.20.2 Preparation of Surface: Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings and foreign matter.

In case of old work, all loose particles and scales shall be scrapped off and holes in plaster as well as patches of less than 50 sq cm area shall be filled up with mortar of the same mix. Where so specifically ordered by the Engineer the entire surface of old white wash shall be thoroughly removed by scrapping and this shall be paid for

separately. Where efflorescence is observed the deposits may be brushed clean and washed. The surface shall then be allowed to dry for atleast 48 hours before white washing is done.

11.20.3 Preparation of lime wash

11.20.3.1 The lime wash shall be prepared from fresh stone white lime (Narnaul or Dehradun or similar quality). The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum / fevicol dissolved in hot water, shall be added to each 10 cubic decimeter of the cream. The approximate quantity of water to be added in making the cream will be 5 litres of water to one kg of lime.

11.20.3.2 Indigo (Neel) upto 3 gm per kg of lime dissolved in water, shall then be added and stirred well. Water shall then be added at the rate of about 5 litres per kg. of lime to produce a milky solution.

11.20.4 Application

11.20.4.1 The white wash shall be applied with moonj brushes / ordinary brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

11.20.4.2 Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

11.20.4.3 For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

11.20.4.4 For old work, after the surface has been prepared as described in para 11.20.2 a coat of white wash shall be applied over the patches and repairs. Then a single coat or two or more coats of white wash as stipulated in the description of the item shall be applied over the entire surface. The white washed surface should present a uniform finish through which the plaster patches do not appear. The washing on ceiling should be done prior to that on walls.

11.20.5 Protective Measures: Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashings and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages, if any to furniture or fittings and fixtures shall be recoverable from the contractor.

11.20.6 Measurements

11.20.6.1 Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

11.20.6.2 Measurements for Jambs, Soffits and Fills etc. for openings shall be as described in para 11.1.9.

11.20.6.3 Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area. Corrugated asbestos cement sheet 20%, Semi corrugated asbestos cement sheet 10%

11.20.6.4 Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

11.20.6.5 The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 50 sq. cm. each.

11.20.6.6. Work on old treated surfaces shall be measured separately and so described.

11.20.7. Disinfecting: When lime wash is to be used for disinfecting purpose it should be applied hot, the necessary heat being obtained by placing the quick lime direct into the mixture, and applying the mixture to the walls at once.

11.20.8 Rate: The rate shall include all material and labour involved in all the operations described above.

11.21 WHITE WASHING WITH WHITING

11.21.1 Preparation of mix : Whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form a thin slurry which shall then be screened through a clean coarse cloth. Two kg of gum / fevicol as per manufacturer's recommendations, and 0.4 kg of copper sulphate dissolved separately in hot water shall be added for every cum of the slurry which shall then be diluted with water

to the consistency of milk so as to make a wash ready for use.

11.21.2 Other Specifications : Other specifications described in para 11.20 shall apply in this case also.

11.22 COLOUR WASHING

11.22.1 General : The mineral colours, not affected by lime, shall be added to white wash. Indigo (Neel) shall however, not be added. No colour wash shall be done until a sample of the colour wash of the required tint or shade has been got approved from the Engineer. The colour shall be of even tint or shade over the whole surface. If it is blotchy or otherwise badly applied, it shall be redone by the contractor.

For new work, the priming coat shall be of white wash with lime or with whiting as specified in the description of the item. Two or more coats, shall then be applied on the entire surface till it represents a smooth and uniform finish.

For old work after the surface has been prepared as described in para 11.20.2 a coat of colour wash shall be applied over the patches and repairs. Then a single coat, or two or more coats of colour wash, as stipulated in the description of the item shall be applied over the entire surface. The colour washed surface shall present a uniform finish.

The finished dry surface shall not be powdery and shall not readily come off on the hand when rubbed.

11.22.2 Other Specifications : Other specifications as described under para 11.20 will apply.

11.23 CEMENT WASHING

11.23.1 Material : The wash for cement washing shall be prepared by mixing neat portland cement with water. The quantity of cement to be used will depend upon the shade of the wash required. Normally 1.5 kg of cement for 10 sq. metres of the wall surface should give a good finish. Other specifications as for white-washing shall apply so far as applicable.

11.23.2 Where used : Cement washing is sometimes done on outside surfaces in place of white-washing.

11.23.3 Other Specifications : As under para 11.20

11.24 DRY DISTEMPERING

11.24.1. Materials : Dry distemper of required colour (IS.427) and of approved brand and manufacture shall be used. The shade shall be got approved from the Engineer before application of the distemper. The dry distemper colour as required shall be stirred slowly in clean water using 6 decilitres (0.6 litre) of water per kg of distemper or as specified by the makers. Warm water shall preferably be used. It shall be allowed to stand for at least 30 minutes (or if practicable over night) before use. The mixture shall be well stirred before and during use to maintain an even consistency. Distemper shall not be mixed in larger quantity than is actually required for one day's work.

11.24.2 Preparation of Surface

11.24.2.1 Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth.

11.24.2.2 New plastered surfaces shall be allowed to dry for at least two months, before applying, distemper.

11.24.2.3 In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt, etc.

11.24.2.4 Pitting in plaster shall be made good with plaster of paris mixed with dry distemper of the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

11.24.3 Priming Coat : A priming coat of whiting (see para 11.21) shall be applied over the prepared surface in case of new work, if so stipulated in the description of the item. No white washing coat shall be used as a priming coat for distemper.

The treated surface should be allowed to dry before distemper coat is given.

11.24.4 Application

11.24.4.1 In the case of new work, the treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows an even colour.

11.24.4.2 For old work, the surface prepared as described in para 11.24.2.3 shall be applied one or more coats of distemper till the surface attains an even colour.

11.24.4.3 The application of each coat shall be as follows - The entire surface shall be coated with the mixture uniformly, with proper distemper brushes (ordinary white wash brushes shall not be allowed) in horizontal strokes followed immediately by vertical ones which together shall constitute one coat.

11.24.4.4 The subsequent coats shall be applied only after the previous coat has dried.

11.24.4.5 The finished surface shall be even and uniform and shall show no brush marks.

11.24.4.6 Enough distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

11.24.4.7 After each day's work, the brushes shall be washed in hot water and hung down to dry. Old brushes which are dirty or caked with distemper shall not be used.

11.24.5 Other Specifications:-The specifications in respect of scaffolding, protective measures, measurements and rate shall be as described under para 11.20.

11.25 OIL EMULSION (OIL BOUND) WASHABLE DISTEMPERING

11.25.1 Materials: Oil emulsion (Oil Bound washable distemper (IS.428)) of approved brand and manufacture shall be used. The primer, where used as on new work shall be cement primer or distemper primer as described in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day's work shall be prepared.

The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in the joint custody of the contractor and the Engineer. The empty tins shall not be removed from the site of work, till this item-of work has been completed and passed by the Engineer.

11.25.2 Preparation of the Surface

11.25.2.1 For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered

to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

11.25.2.2 In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

11.25.3 Application

11.25.3.1 Priming Coat : The priming coat shall be with distemper primer or cement primer, as required in the description of the item. The application of the distemper primer shall be as described in para 11.24.4.

Note : If the wall surface plaster has not dried completely, cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied, within six months of the completion of new wall plaster. However, newly plastered surfaces if required to be distempered before a period of six months shall be given a coat of alkali resistant priming paint conforming to IS : 109 and allowed to dry for atleast 48 hours before distempering is commenced. For old work no Primer Coat is necessary.

11.25.3.2 Distemper Coat : For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones, which together constitute one coat. The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade.

For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as are found necessary shall be applied to obtain an even and uniform shade. 15 cm double bristled distemper brushes shall be used. After each day's work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

11.25.4 Other Specifications : The specifications in respect of scaffolding, protective measurements shall be as described under para 11.20.

11.25.5. Rate : The rate shall include the cost of all labour and materials involved in all the above operations (including priming coat) described above.

11.26 CEMENT PRIMER COAT

11.26.1 General : Cement primer coat is used as a base coat on wall finish of cement, lime or lime cement plaster or on asbestos cement surfaces before oil emulsion distemper paints are applied on them. The cement primer is composed of a medium and pigment which are resistant to the alkalis present in the cement, lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil emulsion distemper paints. Cement Primer of approved brand and manufacture shall be used.

Primer coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surfaces. New plaster patches in old work should also be treated with cement primer before applying oil emulsion paints etc.

11.26.2 Preparation of the Surface

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for atleast 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

11.26.2.1 Application : The cement primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire

operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for atleast 48 hours, before oil emulsion paint is applied.

11.26.3 Other Specifications : The Specifications in respect of scaffolding, protective measures, measurements and rate shall be as described under para 11.20.

11.27 CEMENT PAINT

11.27.1 Material

The cement paint shall conform to IS.5410 and be of approved brand and manufacture.

The cement paint shall be brought to the site of work by the contractor in its original container in sealed condition. The material to be brought in at a time shall be adequate to cover the whole work or atleast a fortnight's work. The materials shall be kept in the joint custody of the Contractor and the Engineer. The empties shall not be removed from the site of work till the relevant item of the work has been completed and permission obtained from the Engineer.

11.27.2 Preparation of Surface : For New Work, the surface shall be thoroughly cleaned of all mortar dropping, dirt dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of waterproof cement paint shall be applied over patches after wetting them thoroughly. In the case of old work, all loose pieces and scales shall be removed and the surface shall be scrubbed thoroughly to clear dirt, dust and algae etc by brushing and washing with water. To give an even and smooth surface, sand papering where found necessary shall be used. Holes and pittings in plaster shall be made good by applying cement putty. A coat of water proof cement paint shall be applied over these patches after wetting them thoroughly.

11.27.3 Preparation of mix : Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all

cases the manufacturer's instructions shall be followed meticulously.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

In case of cement paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

11.27.4 Application

11.27.4.1 The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

11.27.4.2 The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

11.27.4.3 For new work, the surface shall be treated with three or more coats of water proof cement paint as found necessary to get a uniform shade.

11.27.4.4 For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

11.27.5 Precaution : Water proof cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

If Water Proof Cement Paint is required to be applied on existing surfaces previously treated with white wash, colour wash etc, the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc., completely. Thereafter a coat of cement primer shall be applied followed by two or more coats of water proof cement paint.

11.27.6 Other Specifications : The specifications in respect of scaffolding, protective measures, measurements and rate shall be as described under para 11.20. The coefficient for cement paint on RCC Jalli

shall be the same as for painting trellis or Jaffri work.

11.28 VINYL PAINTING

11.28.1 Material : Paint of approved brand and manufacture shall be used. In case of new work the surface shall be prepared first to apply paint on outside and inside surface according to directions given by the manufacturer. The paint shall be brought by the supplier in sealed containers for the work in sufficient quantity and shall be kept in the custody of Engineer's representative.

11.28.2 Preparation of Surface : The surface shall be prepared by thorough sand papering. Thereafter putty shall be applied to get a proper and smooth finish of the surface. It is necessary to apply putty made by mixing one part by volume of whiting with one part by volume of paint to bring it down to application consistency with a putty knife. Under no circumstances putty made of any oil or oil based medium shall be used.

11.28.2.1 In case of old work, the surface shall be prepared in the same manner as described in paras 11.24.2.3 and 11.24.2.4.

11.28.3 Application : The first and subsequent coat of paint shall be applied as prescribed by the manufacturer over the prepared surface. The paint shall be applied with brushes in horizontal strokes followed by vertical strokes, which together shall constitute one coat.

11.28.3.1 The second and subsequent coat shall be applied atleast one hour after the first coat has been applied so as to permit proper drying of preceding coat.

11.28.3.2 The paint in first and subsequent coat shall be applied over the prepared surface of old work in the same manner as for new work.

11.28.4 Other Specifications:- The specifications in respect of type of brushes,

scaffoldings, protective measures, measurements and rates shall be as described in relevant paras 11.25.3.2 and 11.20.

11.29 SPECIFICATION FOR GYPSUM BUILDING PLASTER As per IS 2547 Part I - Important paras of the code are reproduced below -

3. CLASSIFICATION

3.1 Gypsum plaster shall be classified as follow:

- a) Plaster of paris,
- b) Retarded hemihydrate gypsum plaster :

Type I – Under coat :

- a) Browning plaster,
- b) Metal lathing plaster,

Type II – Final coat plaster :

- a) Finish plaster,
- b) Board finish plaster,
- c) Anhydrous gypsum plasters are for finishing only, and
- d) Keene's plaster is for finishing only.

Note – Keene's plaster is of the anhydrous type. It is characterized by being more easily brought to a smooth and clean finish associated with gradual set. In this standard Keene's plaster is differentiated from a anhydrous gypsum plaster by a higher standard of purity (CaSO_4 not less than 80 percent) and hardness. The special qualities traditionally with this type of plaster be dealt with at present by any convenient direct test.

4. CHEMICAL REQUIREMENTS

4.1 The chemical composition of the plasters shall be given in Table 1.

TABLE 1 : CHEMICAL COMPOSITION

SL	PARTICULARS	REQUIREMENT				
		Plaster of paris β hemihydrate	Retarded Hemihydrate Gypsum Plaster	Anhydrous Gypsum Plaster	Keene's Plaster	Method of Test
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	SO_3 , percent by mass, Min.	35	35	40	47	See IS : 1288-1982*
ii)	CaO , Percent by mass, Min.	2/3 of SO_3 content	2/3 of SO_3 content	2/3 of SO_3 content	2/3 of SO_3 content	See IS : 1288-1982*
iii)	Soluble magnesium salt, expressed as percentage of MgO ,	0.3	0.3	0.3	0.3	See Appendix-A

	Max.					
iv)	Soluble Sodium salt, expressed as percentage of Na ₂ O, Max.	0.3	0.3	0.3	0.3	See Appendix-A
v)	Loss of ignition, percent by mass	Not greater than 9 and less than 4	Not greater than 9 & less than 4	3.0 Max.	2.0 Max.	See Appendix-B
vi)	Free lime, Min. percent	-	3 #	-	-	See Appendix-C

* Method of test for mineral gypsum and gypsum products (Second Revision)

Applicable to metal lathing plaster.

5. PHYSICAL REQUIREMENTS

5.1 Purity – No material shall be added to gypsum plasters except those which are necessary to control the setting, such as sodium citrate, break-down products of keratin, potassium sulphate, sodium sulphate, alum and zinc sulphate; or working characteristics such as Alkyl-Aryl sulphonate;

or to impart anti-corrosion such as nitrates and nitrites of alkali metals or fungicidal properties.

5.2 Gypsum plaster shall also satisfy the requirements given in Table 2, when tested according to the procedures given in IS : 2542 (Part I) – 1978*.

TABLE 2 PHYSICAL REQUIREMENTS

SL	PARTICULARS	REQUIREMENT			
		Plaster of Paris		Anhydrous Gypsum Plaster	Keene's Plaster
		Type A (short time setting)	Type B (Long time Setting)		
(1)	(2)	(3)	(4)	(5)	(6)
i)	Setting time minutes: a) Plaster sand mixture b) Neat plaster	- 45-120 20-40	- 120-900 60-180	- - 20-360	- - 20-360
ii)	Transverse strength (kg/cm ²) Min.	5	4*	-	-
iii)	Soundness	Set plaster pats shall not show any sign of disintegration, popping or pitting	Set plaster pats shall not show any sign of disintegration, popping or pitting	Set plaster pats shall not show any sign of disintegration, popping or pitting	Set plaster pats shall not show any sign of disintegration, popping or pitting
iv)	Mechanical resistance of set neat plaster	-	# Diameter of the indentation shall not be less than 3 mm and not more than 4.5 mm	Diameter of the indentation shall not be more than 4 mm	Diameter of the indentation shall not be more than 3.5 mm
v)	Residue on 90 µm sieve percentage, Max.	5.0	5.0* (1.0)#	2.0	2.0
vi)	Expansion on setting percentage, Max.	-	0.20 at 24 h □	-	0.5 at 96 h

* Applicable to undercoat plasters only.

Applicable to final coat plasters.

□ Applicable to board finish plasters only.

7. PACKING AND MARKING

7.1 Gypsum plasters shall be dry and free from lumps and shall be suitably packed in watertight bags or containers. The following information shall be marked legibly on each package:

- a) Name of the manufacturer
- b) Class and type of plaster;
- c) Date of manufacture, batch number, if any and
- d) Net mass.

7.2 BIS Certification Marking

The product may also be marked with Standard Mark.

7.2.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made there under. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standard.

Chapter 12

Painting, Polishing And Varnishing

12.1 PAINTING- General

The section on 'Painting' in this chapter covers painting of woodwork, steelwork and masonry/plastered surfaces in building construction work. Painting of steel girder bridges and other railway steel structures like platform shelters, turn tables etc are covered in the Chapter on 'Bridge Works – Superstructure – Steel'.

12.1.1 Materials :

(a) Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Only ready to use paint (Exterior grade) as received from the manufacturer without any admixture shall be used.

(b) If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer shall be used.

(c) Approved paints, oil or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from the Engineer.

(d) (i) Brushes used shall be of the approved type and of the size suitable for the work in hand. For general wood work including doors, sashes etc, a brush 7.5 to 10 cm wide for the larger areas and 5cm wide for the rails would be considered suitable. For flat wall paint, flat brushes of 10 to 15 cm width are also used.

(ii) For Girder works 10 cm to 20 cm may be used.

(iii) For fine work 1.3cm, 2.5cm, 5 cm and 10 cm wide brushes will be useful.

(iv) For dusting large flat surfaces 30 cm to 33.5 cm wide brushes may be used.

12.1.2 Commencing Work : Painting shall not be started until the Engineer has inspected the items of work to be painted, satisfied himself about their proper quality

and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm.

Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work.

The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the paint work being started.

12.1.3 Preparation of Surface : The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer after inspection, before painting is commenced.

12.1.4 Application

12.1.4.1 Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers; when applying also, the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.

12.1.4.2 The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

12.1.4.3 Where so stipulated, the painting shall be done by spraying. Spray machine used may be of (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

12.1.4.4 Spraying should be done only when dry condition prevails. Each coat shall be

allowed to dry out thoroughly and rubbed smooth before the next-coat is applied. This should be facilitated by thorough ventilation. Each coat, except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and cleaned of dust before the next coat is laid.

12.1.4.5 Each coat of paint shall differ slightly in tint from the preceding one so as to make each coat readily distinguishable, the last coat being of the tint required for the finished work.

12.1.4.6 No left over paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

12.1.4.7 No hair marks from the brush or clogging of faint puddles in the corners of panels, angles of mouldings etc. shall be left on the work.

12.1.4.8 In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible, need not be done nor any deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters.

12.1.4.9 On painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

12.1.4.10 The additional specifications for primer and other coats of paints shall be according to the detailed specifications under the respective headings.

12.1.4.11 Generally one coat should be adequate for old work and two coats (excluding priming coat) for new work.

12.1.5 Brushes and containers : After work, the brushes shall be completely cleaned of paint and linseed oil by rinsing with turpentine. A brush in which paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use, shall be kept closed and free from air so that paint does not thicken and also shall be kept safe from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

12.1.6 Measurements

12.1.6.1 The length and breadth shall be measured correct to a cm. The area shall be calculated in sqm (correct to two places of decimal), except where otherwise stated.

12.1.6.2 Small articles not exceeding 10 sq. decimeter (0.1 sqm) of painted surface, where not in conjunction with similar painted work, shall be enumerated.

12.1.6.3 Painting 10 cm in width or in girth and not in conjunction with similar painted work shall be given in running metres and shall include cutting to line where required.

Note : Components of trusses, compound girders, stanchions, lattices and similar work shall, however, be given in sq. metres irrespective of the size or girth of members. Priming coat of painting shall be included in the work of fabrication.

12.1.6.4 In measuring painting, varnishing, oiling etc. of joinery and steel work etc, the coefficients as indicated in **Table 12.1** below shall be used to obtain the area payable. The coefficients shall be applied to the areas measured flat and not girthed.

TABLE 12.1
EQUIVALENT PLAIN AREAS OF UNEVEN SURFACE

SL	Description of work	How Measured	Multiplying coefficients
I	WOOD WORK DOORS, WINDOWS ETC.		
1.	Panelled or framed and braced doors, windows etc.	Measured flat (not girthed) including	1.30 (for each side)
2.	Ledged and battened or ledged, battened and braced doors, windows etc.	Chowkhat or frame. Edge <u>s</u> . Chocks, cleats, etc shall be deemed to be included in the item	
3.	Flush doors etc	-do-	1.20 (for each side)

4.	Part panelled and part glazed or gauzed doors, window etc. (Excluding painting of wire gauze portion)	-do-	1.00 (for each side)
5.	Fully glazed or gauzed doors, windows etc (excluding painting of wire gauze portion)	-do-	0.80 (for each side)
6.	Fully venetianed or louvered doors, windows etc.	-do-	1.80 (for each side)
7.	Trellis (or jaffri) work one way or two way	Measured flat over, no deduction shall be made for open spaces. Supporting members shall not be measured separately	2 (for painting all over)
8.	Carved or enriched work	Measured flat	2 (for each side)
9.	Weather boarding	Measured flat (not girthed) Supporting frame work shall not be measured separately	1.20 (for each side)
10.	Wood Shingle roofing	Measured flat (not girthed)	1.10 (for each side)
11.	Boarding with cover fillets and match boarding	Measured flat (not girthed)	1.05 (for each side)
12.	Tile and slate battening	Measured flat overall. No deductions shall be made for open spaces	0.80 (for painting all over)
II	STEEL WORK DOORS, WINDOWS ETC		
13.	Plain sheeted steel doors or windows	Measured flat (not girthed) including frame edges etc.	1.10 (for each side)
14.	Fully glazed or gauzed steel doors and windows (excluding painting of wire gauze portion)	-do-	0.50 (for each side)
15.	Partly panelled and partly glazed or gauzed doors and windows (excluding painting of wire gauze portion)	-do-	0.80 (for each side)
16.	Corrugated sheeted steel doors or windows	-do-	1.25 (for each side)
17.	Collapsible gates	Measured flat	1.50 (for painting all over)
18.	Rolling shutters of interlocked laths	Measured flat (size of opening) all over; jamb guides, bottom rails and locking arrangement etc. shall be included in the item (top cover shall be measured separately)	1.10 (for each side)
III	GENERAL		
19.	Expanded metal, hard drawn steel wire fabric of approved quality, grill works and gratings in guard bars, balustrades, railing partitions and MS Bars in windows frames	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately	1 (for paint all over)
20.	Open palisade fencing and gates including standards, braces, rails stays etc. in timber or steel	-do- (see note no.12)	1 (for paint all over)
21.	Corrugated iron sheeting in roofs, side cladding etc.	-do- Measured flat (not girthed)	1.14 (for each side)
22.	AC corrugated sheeting in roofs, side cladding etc.	-do-	1.20 (for each side)

23.	AC semi-corrugated sheeting in roofs, side cladding etc. or Nainital pattern using plain sheets	-do-	1.10 (for each side)
24.	Wire gauze shutters including painting of wire gauze	-do-	1.00 (for each side)

Explanatory notes for Table 12.1

- Measurements for doors windows etc., shall be taken flat (and not girthed) over all including chowkats or frames, where provided. Where Chowkats or frames are not provided, the shutter measurements shall be taken.
- Where doors, windows etc., are of composite types other than those included in Table 12.1 the different portions shall be measured separately with their appropriate coefficients, the centre line of the common rail being taken as the dividing line between the two portions.
- The coefficients for doors and windows shall apply irrespective of the size of frames and shutter members.
- In case steel frames are used the area of doors, windows shutters shall be measured flat excluding frames.
- When the two faces of a door, window etc. are to be treated with different specified finishes, measurable under separate items, the edges of frames and shutters shall be treated with the one or the other type of finish as ordered by the Engineer and measurement of this will be deemed to be included in the measurement of the face treated with that finish.
- In the case where shutters are fixed on both faces of the frames the measurement for the door frame and shutter on one face shall be taken in the manner already described, while the additional shutter on the other face will be measured for the shutter only excluding the frame.
- Where shutters are provided with clearance at top or / and bottom each exceeding 15 cm height, such openings shall be deducted from the overall measurements and relevant coefficient shall be applied to obtain the area payable.
- Collapsible gates shall be measured for width from outside to outside of gate in its expanded position and for height from bottom to top of channel verticals. No separate measurements shall be taken for the top and bottom guide rails rollers, fittings etc.
- Rolling shutters of interlocked laths shall be measured for the actual shutter width and the height from bottom of opening to the centre of the shaft. No separate measurements shall be taken for painting guides and other exposed features within or outside the shutter area. The painting of top cover or hood shall, however be measured separately.
- Co-efficients for sliding doors shall be the same as for normal types of doors in the table. Measurements shall be taken outside to outside of shutters, and no separate measurements shall be taken for the painting guide rails, rollers, fittings etc.
- The measurements of guard bars, expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings, when fixed in frame work, painting of which is once measured elsewhere shall be taken exclusive of the frames. In other cases the measurements shall be taken inclusive of the frames.
- For painting open palisade fencing and gates etc., the height shall be measured from the bottom of the lowest rail, if the palisades do not go below it, (or from the lower end of the palisades, if they project below the lowest rail), upto the top of rails or palisades whichever are higher, but not upto the top of standards when the latter are higher than the top rails or the palisades.
- Measurements of painting of doors, windows, collapsible gates, rolling shutters etc., as above shall be deemed to include painting all iron fittings (wire gauze not to be included) in the same or different shade for which no extra will be paid.
- In the case of trellis (or jaffri) work, the measurements shall include the painting of the frame members for which no separate measurement shall be taken. Trellis door or windows shutters shall also be measured under trellis work.
- In the case of asbestos cement corrugated or semi-corrugated sheeting

and iron corrugated sheeting, in roofs, side cladding etc. the work shall be measured flat (not girthed) as fixed.

12.1.6.5 Width of moulded work of all other kinds, as in hand rails, cornices and architraves shall be measured by girth.

12.1.6.6 For trusses, compound girders, stanchions, lattice girders, and similar work, actual areas will be measured in sq. metre and no extra shall be paid for painting on bolt heads, nuts, washers etc. even when they are picked out in a different tint to the adjacent work.

12.1.6.7 Painting of rain water, soil, waste, vent and water pipes etc. shall be measured in running metres of the particular diameter of the pipe concerned. Painting of specials such as bends, heads, branches, junctions, shoes, etc. shall be included in the length and no separate measurements shall be taken for these or for painting brackets, clamps etc.

12.1.6.8 Measurements of wall surfaces and wood and other work not referred to already shall be recorded as per actual.

12.1.6.9 Flag staffs, steel chimneys, aerial masts, spires and other such objects requiring special scaffolding shall be measured separately.

12.1.6.10 The month and year of painting (completion) shall be clearly marked on the steel structure in white or any other colour as specified by the Engineer.

12.1.7 Precautions:

12.1.7.1 All furnitures, fixtures, glazing, floors etc shall be protected by covering and stains, smears, splashings, if any, shall be removed and any damage done shall be made good by the contractor at his cost.

12.1.7.2 The containers of paint, when not in use, shall be kept closed and air tight so that the paint does not thicken and is kept safe from dust.

12.1.7.3 Precautions in using Lead Paints:

- i) White lead, sulphate of lead and all products containing these pigments shall not be used in internal painting of buildings except for priming coat and artistic paintings or fine lining work.
- ii) White lead, sulphate of lead, or products containing these pigments shall not be used in painting operations except in the form of paste or paint ready for use; and measures shall be taken, to prevent danger arising from the application of

paint in the form of spray or from dust caused by dry rubbing down and scraping.

- iii) Paras (i) and (ii) above do not apply to white pigments containing not more than 2% of lead expressed in terms of metallic lead.
- iv) Lead paint and especially white lead, is injurious to those who use it. Entering the pores of the skin, it is absorbed by the system and leads to numbness and a kind of paralysis, and also produces the complaint known as painter's colic. Paint-workers must, therefore, be warned to avoid smearing themselves with paint. As they do not know the difference between the base of one paint and that of another, this warning must apply to all kinds of paint. Any worker found smearing himself with paint after being warned must be sent at once off the work and not re-employed.

12.1.7.4 Where it is necessary to rub down with sand paper, only water proof paper shall be used and the work kept wet. Too much pressure must not be used in rubbing. Slush formed in rubbing shall be frequently washed off with plenty of water.

12.1.8. Rate :

- (a) Rates shall include cost of all labour and materials involved in all the operations described above and in the particular specifications given under the respective items.
- (b) Unless otherwise stipulated, the rates for painting of iron work shall cover the all-inclusive cost of the following:-
 - i) Preparing the surface, except complete removal of existing paint.
 - ii) Providing and applying the prescribed coats of paint.
 - iii) Ladders, scaffolding, cradles, etc as may be necessary upto any height.
 - iv) Other materials and equipment, including scrapers, wire brushes, rust or paint removers, paint-brushes etc.
 - v) Protection of other surfaces and articles from splashes or drops of paint, etc., including moving or covering furniture etc., as may be necessary.
 - vi) Protection of the painted surface till dry.

- vii) Removing any unwanted stain or splash that may have resulted from execution of the work and leaving the premises in a clean state.
- viii) Marking neatly the date of painting according to the instructions of the Engineer's representative.

12.2. PAINTING PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES

12.2.1 Primer

12.2.1.1 The primer for wood work, iron work or plastered surface shall be as specified in the description of item. Priming coat is the first coat applied to fill the pores of wood or any minute inequalities on the surface to be painted. It should adhere firmly to the unpainted surface and provide a suitable ground to receive and hold the next coat. Special care shall be taken of places where decay or corrosion is likely to occur, such as joints in wood or metal and end grains in wood. Hurried priming should be avoided particularly on absorbent surfaces. Priming coat shall have no turpentine as it impairs the firmness of the paint. The rate for priming coat is inclusive of the cost of the

required treatment of the surface including knotting.

12.2.1.2 (a) Primer for Wood work/Aluminium & Iron, Steel Work / Cement Concrete and Plastered Surface shall be as described below in **Table 12.2** or as directed by the Engineer.

b) _____

c) Plastered and Concrete surface should not be painted before lapse of 12 months from the date of Completion of Plastering or Concreting, unless specially permitted in writing by Engineer. This interval is desirable to enable the surface to be completely free from adverse chemical reaction. It should be possible to manage during this period by use of white wash, colour wash, dry distemper or cement paint. If however painting is to be done within 12 months, priming coat shall be of Cement Primer.

(d) Generally for Railway Steel Structures priming coat is made up of One coat Red Lead Paint (IS 102) Or One Coat of Zinc Chromate Paint (IS 104) and one coat of RedOxide-Zinc Chromate Paint (IS 2074) (For New work, these two coats are taken as equivalent to one coat of Red Lead). Or One coat of Bituminous Black Paint (IS 158)

TABLE 12.2

SL	Surfaces	Primer to be used
1.	Wood work (hard and soft wood)	Pink conforming to IS:3536
2.	Resinour wood and plywood	Aluminium primer conforming to IS:3585
3.	(A) Aluminium and light alloys (B) Iron, Steel and Galvanized steel	Zinc Chromate primer conforming to IS:104 Red Oxide Zinc chromate Primer conforming to IS:2074
4.	Cement/ Conc/ RCC/ brick work. Plastered surfaces, asbestos surfaces to receive oil bound distemper or paint finish	Cement Primer conforming to IS:109

12.2.1.3 The primer shall be ready mixed primer of approved brand and manufacture.

12.2.1.4 Where primer for wood work is specified to be mixed at site, it shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.7 kg : 0.7 kg : 1 litre.

12.2.1.5 Where Red Lead primer for steel work is specified to be mixed at site, it shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8 kg : 1 litre : 1 litre.

12.2.1.6 The specifications for the base vehicle and thinner for mixed on site primer shall be as follows:

(a) White Lead : The White lead shall be pure and free from adulterants like barium sulphate and whiting. It shall conform to IS: 103.

(b) Red Lead : This shall be in powder form and shall be pure and free from adulterants like brick dust etc. It shall conform to IS: 102.

(c) Raw Linseed Oil : Raw linseed oil shall be lightly viscous but clear and of yellowish colour with light brown tinge. Its specific gravity at a temperature of 30 degree C shall be between 0.923 and 0.928.

Note : The oil shall be mellow and sweet to the taste with very little smell. The oil shall be of sufficiently matured quality. Oil turbid or thick, with acid and bitter taste and rancid

odour and which remains sticky for a considerable time shall be rejected. The oil shall conform in all respects to IS: 75. The oil shall be of approved brand and manufacture.

(d) *Double boiled linseed oil*: This shall be more viscous than the raw oil, have a deeper colour and specific gravity between 0.931 and 0.945 at a temperature of 30 degree C. It shall dry with a glossy surface. It shall conform in all respects to IS: 77. The oil shall be of approved brand and manufacture.

(e) **Turpentine**: Mineral turpentine i.e. petroleum distillate which has the same rate of evaporation as vegetable turpentine (distillate product of oleoresin of conifers) shall be used. It shall have no grease or other residue when allowed to evaporate. It shall conform to IS: 533.

12.2.1.7 All the above materials shall be of approved manufacture and brought to site in their original packing in sealed condition.

12.2.2 Preparation of surface

12.2.2.1 Wooden surface : a) The wood work to be painted shall be dry and free from moisture. The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. The prepared surface shall be inspected and approved by the Engineer before painting is commenced.

b) **Knotting** : This is done before the application of priming coat to cover all knots in wood to prevent any exudation or resin, or any marks to show through the paint caused by the absorption of the knots. The surface treated for knotting shall be dried before the priming coat of paint is applied. There are three common methods of knotting as described below:-

i) **Lime Knotting**: Knots in deodar or other resinous wood shall be painted over with hot lime and scraped off after 24 hours. The knots are primed with red lead and glue laid hot and one coat of knotting varnish is applied. The surface is then rubbed smooth with pumice stone or sand paper.

ii) **Ordinary size knotting**: This is applied in two coats. The first is made by grinding red lead in water and mixing it with strong glue size used hot. (Dries in about 10 minutes). The second coat consists of red lead ground in oil and thinned with boiled oil and turpentine.

iii) **Patent knotting**: This consists of two coats of a varnish made by dissolving shellac in methylated spirit or naphtha. Knotting may be composed of 250 grams of pure shellac dissolved in 1 litre of methylated spirit and

when thoroughly dissolved, 25 grams of red lead is stirred in.

c) After obtaining approval of Engineer for wood work, the priming coat shall be applied before the wood work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

12.2.2.2 Iron & Steel Surface : All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before priming coat is undertaken.

12.2.2.3 Plastered Surface : The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and when drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations shall be filled up with plaster of paris and rubbed smooth.

12.2.3 Application : The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described in para 12.1.4.

12.2.4 Treatment on Steel for Aggressive Environment

12.2.4.1 A second coat of ready mixed red oxide/ zinc chromate primer or as specified may be applied where considered necessary in aggressive environment such as near Industrial Establishment and Coastal regions where the steel members are prone to corrosion. The second coat (which shall be paid for separately) is to be applied after placing the member in position and just before applying paint. The second coat of primer is not necessary in case of painting with synthetic enamel paint as it is applied over an under coat of ordinary paint.

12.2.4.2 The specifications described under para 12.1 shall hold good so far as they are applicable.

12.3 PAINTING WITH READY MIXED PAINT

12.3.1 General:- Ready mixed paints of approved brand and manufacture and of the required shades shall be used. They shall conform in all respects to the relevant IS Specifications.

12.3.2 Painting on New Surface : The surface which has not been painted earlier, or the paint had been removed by paint remover, burning, caustic soda etc. shall be considered to be new surface.

12.3.2.1 Preparation of Surface

a) **Wood Work :** The surface shall be cleaned and unevenness removed as specified in para 12.2.2.1. Knots if visible, shall be done as described under para 12.2.2.1 (b). Holes and indentations on the surface shall be filled in with glazier's putty or wood putty conforming to IS : 419 and rubbed smooth before Painting is done. The surface should be thoroughly dry before painting.

(b) **Iron And Steel Work :** The priming coat shall have dried up completely before painting is started. Rust and scaling shall be carefully removed by scraping or by brushing with steel wire brushes. All dust and dirt shall be carefully and thoroughly wiped away.

(c) **Plastered surface :** The priming coat shall have dried up completely before painting is started. All dust or dirt that has settled on the priming coat shall be thoroughly wiped away before painting is started.

12.3.2.2. Application : (a) The specifications described in para 12.1.4 shall hold good as far as applicable. The number of coats to be applied will be as stipulated in the item. The painted surface shall present a uniform appearance and glossy finish, free from streaks blisters etc.

(b) **For under coats and finishing coats:-** Either oil paints or bitumastic or aluminium paints of approved brand and manufacture shall be used. Bitumastic paints shall be used where appearance is of secondary consideration. The oil paints may be either synthetic enamels or ready mixed oil paints. Where red colour is acceptable, red oxide of iron paints shall generally be used. The red oxide paint shall be prepared by mixing red oxide, raw linseed oil and boiled linseed oil in the ratio of 4.79 kg : 2 litres : 1 litre.

IS Code references for the various types of Ready mixed paints to be applied as one or more coats as directed by the Engineer are as under.

- Red Oxide Paint (IS 123)
- Aluminium Paint (IS 2339)

- Synthetic Enamel Exterior (IS 2932)
- Enamel Exterior (IS 2933)
- Paint for General Purposes, Battleship grey or other Standard colour (IS 117)
- Bituminous Black Paint (IS 158)
- Bituminous Emulsion Paint
- Coal Tar Black Paint or Tarstil (IS 290)

(c) For Railway Steel Girder Bridges, Specifications indicated in **Annexure 12.1** shall be followed.

12.3.2.3 The specifications described in para 12.1 shall hold good in so far as they are applicable.

12.3.3 Painting on old surface: The surface which has been painted earlier shall be considered to be old surface.

12.3.3.1. Preparation of surface

(a) **Wood work :** If the old paint is sound and firm and its removal is considered unnecessary, the surface shall be rubbed down with pumice stone after it has been cleaned of all smoke and grease by washing with lime and rinsing with water and drying. All dust and loose paint shall be completely removed. The surface shall then be washed with soap and water.

If the old painted surface is blistered or flaked badly old paint shall be completely removed as described in para 12.22 and such removal shall be paid for separately. Holes and cracks if any shall be stopped with glazier's putty or wood putty conforming to IS: 419. Further the painting itself shall be treated as on new surface and paid for, accordingly.

(b) **Iron and Steel Work :** If the old paint is sound and firm and its removal is considered unnecessary, it shall be rubbed with wire brushes and any loosened paint taken off. All dust shall then be thoroughly wiped away. The surface shall then be wiped finally with mineral turpentine to remove grease and perspiration of hand marks etc. and then allowed to dry.

If the old painted surface is in bad condition and blistered and flaked, the old paint shall be completely removed and the surface prepared, as described in para 12.22. Such removal shall be paid for separately. The painting including the priming coat shall be treated as on new work and paid for accordingly.

(c) **Plastered surface :** It shall be as specified for wood work. If before painting, any portion of the wall shows signs of dampness, the causes shall be investigated and the damp surface shall be properly

treated. Such treatment shall be paid for separately. A thin coat of white lead if so required shall be applied on the wet or patchy portion of the surface before painting is undertaken and this shall be paid extra.

12.3.3.2 Application : The specifications described in para 12.1.4 shall hold good as far as applicable. The number of coats to be given shall be as stipulated in the description of the item.

12.3.3.3 The specifications described in 12.1 shall hold good in so far as they are applicable.

12.4 PAINTING READY MIXED PAINT OVER G.S. SHEETS

12.4.1 General : Ready mixed paint, suitable for painting over G.S. sheets, of approved brand and manufacture and of the required shade shall be used. New or weathered G.S. sheets shall be painted with a priming coat of one coat of red oxide zinc chromate paint or as specified. Primer shall be applied before fixing sheets in place.

12.4.2 Preparation of Surface

12.4.2.1 Painting New Surface : The painting of new G.S. sheets shall not usually be done till the sheets have weathered for about a year. When new sheets are to be painted before they have weathered they shall be treated with a mordant solution prepared by mixing 38 gm of copper acetate in a litre of soft water or 13 gm hydrochloric acid in a solution of 13 gm each of copper chloride, copper nitrate and ammonium chloride dissolved in a litre of soft water. This quantity of solution is sufficient for about 235 to 280 sqm of area and is applied for ensuring proper adhesion of paint. The painting with the mordant solution will be paid for separately.

Before painting on new or weathered G.S. sheets, rust patches shall be completely cleaned with coarse emery paper and brush. All grease marks shall also be removed and the surface washed and dried and rusted surface shall be touched with ready mixed paint of red lead.

12.4.2.2 Painting on Old Surface : If the old paint is firm and sound, it shall be cleaned of grease, smoke etc. The surface shall then be rubbed down with sand paper and dusted. Rusty patches shall be cleaned up and touched with red lead.

If the old paint is blistered and flaked, it shall be completely removed as described in 12.22. Such removal shall be paid for

separately and painting shall be treated as on new work.

12.4.3 Application : The number of coats to be applied shall be as in the description of item. In the case of C.G.S. sheets, the crowns of the corrugations shall be painted first and when these get dried the general coat shall be given to ensure uniform finish over the entire surface without the crowns showing signs of thinning. Special attention shall be paid to rivets, bolt heads and welds. If the existing primer appears to be of a poor quality or of inadequate thickness or if there are signs of rusting beneath the paint at numerous places, the whole surface shall be cleaned and reprimed. The second or additional coats shall be applied when the previous coat has dried.

12.4.4 Other Specifications : The specifications described in para 12.1 shall hold good so far as they are applicable.

12.5 PAINTING CAST IRON RAIN WATER, SOIL, WASTE AND VENT PIPES AND FITTINGS

12.5.1 General: The primer shall be prepared at site or shall be of approved brand and manufacture as specified in the item. Paint shall be anti-corrosive bitumastic paint, aluminium paint or other type of paint as specified in the description of the item.

12.5.2 Painting New Surface

12.5.2.1 Preparation of Surface : The surface shall be prepared for priming coat as described in para 12.2.2.2.

12.5.2.2 Application: The number of coats of painting over the priming coat shall be as stipulated in the description of the item. The application of paint over priming coat shall be carried out as specified in para 12.3.

12.5.2.3 Measurements: Measurements will be taken over the finished line of pipe including specials etc. in running metre, correct to a cm. Pipes of different diameters of bore shall be measured and paid for separately. Specials and fittings such as holder bat clamps, plugs etc. will not be measured separately.

12.5.2.4 Rate : The rate shall include the cost of all materials and labour involved in all the operations described above, including painting of all specials and fittings.

12.5.2.5 Specifications described in para 12.1 shall hold good as far as they are applicable.

12.5.3 Painting on old Surface

12.5.3.1 The surface shall be prepared as specified in para 12.3.2.1 (b).

12.5.3.2 The specifications for application shall be as described in para 12.1.4.

12.5.3.3 Measurements, rate and other details shall be as specified in para 12.5.2.

12.6 PAINTING WITH WOOD PRESERVATIVE

12.6.1 General: Oil type wood preservative of specified quality and approved make, conforming to IS : 218 shall be used. Generally, it shall be creosote oil type I or anthracene oil.

12.6.2 Painting on New Surface

12.6.2.1 Preparation of surface : Painting shall be done only when the surface is perfectly dry to permit of good absorption. All dirt, dust or other foreign matter shall be removed from the surface to be painted. All roughness shall be sand papered and cleaned.

12.6.2.2 Application: The preservative shall be applied liberally with a stout brush and not daubed with rags or cotton waste. It shall be applied with a pencil brush at the joints of the wood work. The first coat shall be allowed at least 24 hours to soak in before the second (the final) coat is applied. The second coat shall be applied in the same manner as the first coat. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

12.6.2.3 The specifications described in para 12.1 shall hold good in so far as they are applicable.

12.6.3 Painting on old surface : The work shall be done in the same manner as on new surface except that only one coat shall be done.

12.7 COAL TARRING

12.7.1 General : Coal tar of approved manufacture conforming to IS : 290 shall be used. The tar, to every litre of which 200 gm of unslaked lime has been added, shall be heated till it begins to boil. It must then be taken off the fire and kerosene oil added to it slowly at the rate of one part of kerosene oil to six or more parts by volume and stirred thoroughly. The addition of lime is for preventing the tar from running.

12.7.2 Coal Tarring New Surface

12.7.2.1. Preparation of surface : This shall be done as specified in para 12.2.2 except that sand papering is not necessary. Where

iron work is to be painted it shall be freed from scales and rust before painting.

12.7.2.2. Application : The mixture shall be applied as hot as possible with a brush. The second coat shall be applied only after the first coat has thoroughly dried up. Where possible, the article to be tarred, shall be dipped in the hot mixture for better results. The quantity of tar to be used for the first or second coat shall be not less than 0.16 and 0.12 litre per sqm respectively. Thinning with kerosene oil shall be suitably done to ensure this.

12.7.2.3 The specifications described in 12.1 shall hold good in all other respects, so far as they are applicable.

12.7.3 Coal Tarring old Surface :

The work shall be done in the same manner as specified in para 12.7.2 except that only one coat using 0.12 litre per sqm. area shall be done.

12.7.4 Precautions : Coal tar and bitumen compounds, though not normally considered dangerous, can become so when heated in drums, either due to local boiling of the material at the point of heating or due to the liberation of inflammable gases which catch fire and cause an explosion. Care shall, therefore, be taken to ensure that heating is gradual and spread over a wide area. If due to solidification, material in closed drums is to be heated, the fire shall be kept well away from the open screw cap holes.

12.8 SPRAY PAINTING WITH FLAT WALL PAINT ON NEW SURFACE

12.8.1 General : (a) The work shall include a priming coat of 'Distemping Primer' or 'Cement Primer' as specified in the description of the item. Flat wall paint shall normally be applied on walls 12 months after their completion, in which case Distemper primer will suffice. If the walls are to be painted earlier, the primer coat shall consist of cement primer.

(b) Materials : The primer and the flat wall paint shall be of approved brand and manufacture and of the required shade.

12.8.2 Surface Preparation : The surface shall be prepared as described in Chapter 11.

12.8.3 Application

12.8.3.1 Primer Coat : The specified primer shall be painted or sprayed over the surface in an even and uniform layer.

12.8.3.2 Painting Coats : When the surface is dry, the spray painting with the wall paint

in uniform and even layers will be done to the required number of coats. Each coat shall be allowed to dry overnight and lightly rubbed with very fine grade of sand paper and loose particles brushed off before the next coat is sprayed.

Spraying should be done only when dry condition prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in a uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application. The Air pressure shall not be kept too high as otherwise the paint will fog up and will be wasted

At the end of the job, the spray gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats.

If after the final coat of wall paints, the surface obtained is not upto the mark, further one or more coats as required shall be given after rubbing down the surface and dusting off all loose particles to obtain a smooth and even finish.

If the primer or wall paint gets thickened during the application, it shall be thinned suitably with the thinner recommended by the manufacturer.

Adequate ventilation shall be provided to disperse spray fumes. Fitments and floor shall be protected from the spray

12.8.4 Other Specifications : The specifications described in Para 12.1 shall hold good for all other details as far as applicable.

12.9 SPRAY PAINTING WITH FLAT PAINT ON OLD SURFACE

12.9.1 General : (a) Where the old paint is in sound condition, renewal shall be carried out as described below, otherwise the old paint shall be completely stripped and spray painting shall be carried out as over new work. Such removal shall be paid for separately.

(b) **Materials :** The flat wall paint shall be of approved brand and manufacture and of required shade.

12.9.2. Preparation of Surface : The surface shall be washed to remove dust and dirt. A mild detergent solution like soap water shall be used for washing and the surface shall also be rubbed down lightly with abrasive paper when dry. Any patches

appearing on the surface shall first be touched up with a coat of paint. These shall be allowed to dry and then rubbed down lightly.

12.9.3. Application : The paint shall then be applied with spraying machine in uniform and even layer. A second coat shall be applied if considered necessary by the Engineer but only after the first coat is completely dry and hard.

Spraying should be done only when dry condition prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in uniform sweeping motion. Different air, pressures and fan adjustment shall be tried so as to obtain the best application. The Air pressure shall not be kept too high as otherwise the paint will fog up and will be wasted. At the end of the job, the spray gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they result in variable spray patterns, runs, sags and uneven coats

12.9.4 Other Specification : The specifications described in Para 12.1 shall hold good for all other details, as far as they are

12.10 WALL PAINTING WITH PLASTIC EMULSION PAINT

12.10.1 General : (a) The plastic emulsion paint is not suitable for application on external, wood and iron surface, and surfaces which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel.

(b) **Materials :** Plastic emulsion paint as per IS : 5411 of approved brand and manufacture and of the required shade shall be used.

12.10.2 Painting on new surface

12.10.2.1 Preparation : The wall surface shall be prepared as specified in para 12.1.3.

12.10.2.2 Application : The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush, spray or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from 1 hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary, more coats shall be applied till the surface presents a uniform appearance.

12.10.2.3 Precautions

(a) Old brushes if they are to be used with emulsion paint, should be completely dried of turpentine or oil paints by washing in warm soap water. Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush

b) In the preparation of wall for plastic emulsion no oil base putties shall be used in filling cracks, holes etc

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

12.10.2.4 Other details shall be as specified in para 12.1 as far as they are applicable.

12.10.3 Painting on old surface

12.10.3.1. Preparation of surface : This shall be done, generally as specified in 12.3.3.1 (c) except that the surface before application of paint shall be flattened well to get the proper flat velvety finish after painting.

12.10.3.2 Application : The number of coats to be applied shall be as in description of item. The application shall be as specified in para 12.10.2.2 except that thinning with water shall not normally be required.

12.10.3.3 Other details shall be as specified in para 12.1 as far as applicable.

12.11 PAINTING WITH ENAMEL PAINT

12.11.1 General : Enamel Paint (conforming to IS: 2933) of approved brand and manufacture and of the required colour shall be used. For the under coat, the paint of same quality but of shade to suit that of the top coat shall be used.

12.11.2. Preparation of Surface etc. : Preparation of surface and application shall

be as specified under para 12.3 for painting on new surfaces or old surfaces, as the case may be.

12.11.3 Other Specifications : Other details shall be as specified in para 12.1 as far as applicable.

12.12 PAINTING WITH SYNTHETIC ENAMEL PAINT

12.12.1 General: Synthetic enamel paint (conforming to IS:2932) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary paint of shade to match the top coat as recommended by the same manufacturer as far the top coat shall be used.

12.12.2 Painting on New Surface

12.12.2.1 Preparation of surface shall be as specified in para 12.3.2.1 (a) or (b) as the case may be.

12.12.2.2 Application : The number of coats including the undercoat shall be as stipulated in the item.

(a) Under Coat : One coat of the specified ordinary paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

(b) Top Coat : Top coats of synthetic enamel paint of desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

12.12.2.3. Other details shall be as specified in para 12.1 as far as they are applicable.

12.12.3 Painting on Old Surface

12.12.3.1. Preparation of Surface : Where the existing paint is firm and sound it shall be cleaned of grease, smoke etc. and rubbed with sand paper to remove all loose particles dusted off. All patches and cracks shall then be treated with stopping and filler prepared with the specified paint. The surface shall again be rubbed and made smooth and uniform.

If the old paint is blistered and flaked it will be necessary to completely remove the same as described in para 12.22. Such removal shall be paid for separately and the painting shall be treated as on new surface.

12.12.3.2 Painting : The number of coats as stipulated in the item shall be applied with

synthetic enamel paint. Each coat shall be allowed to dry and rubbed down smooth with very fine wet abrasive paper, to get an even glossy surface. If however, the surface is not satisfactory, additional coats as required shall be applied to get correct finish.

12.12.3.3 Other details shall be as specified in para 12.1 as far as they are applicable.

12.13 PAINTING WITH ALUMINIUM PAINT

12.13.1 General : Aluminium paint shall conform to IS:2339 and of approved brand and manufacture. The paint generally comes in compact dual container with the paste and the medium separately. The two shall be mixed together to proper consistency before use.

12.13.2 Preparation of Surface

12.13.2.1 Steel Work (New Surfaces) : All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

12.13.2.2 C.G.S. Sheets (New Surfaces) : The preparation of surface shall be as specified in 12.4.2.1.

12.13.2.3 Steel work or C.G.S. sheets (Old Surfaces) : The specifications shall be as described in para 12.4.2.2.

12.13.3 Application : The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance.

As aluminium paste is likely to settle in the container, care shall be taken to frequently stir the paint during use. Also the paint shall be applied and laid off quickly, as surface is otherwise not easily finished.

12.13.4 Other Specifications : Other details shall be as specified in para 12.1 as far as they are applicable.

12.14 PAINTING WITH ACID PROOF PAINT

12.14.1 General : Acid proof paint of approved brand and manufacture and of the required shade shall be used.

12.14.2 Preparation of Surface : Preparation of surface and application shall be as specified under 12.3 for new/old surface as the case may be.

12.14.3 Other Specifications : Other details shall, be as specified in para 12.1 as far as they are applicable.

12.15 PAINTING WITH ANTI-CORROSIVE BITUMASTIC PAINT

12.15.1 General : Ready mixed paint conforming to IS 158 shall be of approved brand and manufacture. It shall be black, lead free, acid- alkali- heat- water resistant.

12.15.2 Preparation of Surface etc : Preparation of surface and application shall be as specified in para 12.3 for painting on new or old surfaces as the case may be.

The drying time between consecutive coats however, shall be not less than 3 hours.

12.15.3. Other Specifications : Other details shall be as specified in para 12.1 as far as applicable.

12.16. FLOOR PAINTING

12.16.1 General : Floor paint of approved brand and manufacture and of the required colour shall be used.

12.16.2. Preparation of Surface : All dirt, grease shall be removed from the floor by wiping with rags, soaked in turpentine and scraping where necessary and then washing with warm water containing caustic soda or washing soda in solution. The floor should then be rinsed thoroughly with water and dried. Cracks and holes shall then filled with specified filler as recommended by manufacturer and rubbed smooth.

It should be noted that the painting with floor paints shall not be done over concrete surfaces less than two years old. Old surface shall be prepared as specified in para 12.3.3.1(c).

12.16.3. Application : The number of coats as in description of the item shall be applied. Each coat shall be allowed to dry for not less than 24 hours before the next coat is applied. The flooring should not be brought into use for a week after final coat so that the painted surface can thoroughly harden.

12.16.4. Measurements : Measurements shall be as per actual length and breadth being measured correct to a cm. The details given under para 12.1.6 shall hold good as far as applicable.

12.16.5. Other Specifications : Other details shall be as specified in para 12.1 as far as applicable.

12.17. VARNISHING

12.17.1 General : (a) Ordinary copal varnish or superior quality spray varnish shall be used. The work includes sizing of transparent wood filler.

(b) Materials : Varnish (conforming to IS:347) for the finishing and undercoats shall be of the approved manufacturer.

12.17.2 Varnishing on new Surfaces

12.17.2.1. Preparation of surface : New wood work to be varnished shall have been finished smooth with a carpenter's plane. Knots shall be cut to a slight depth. Cracks and holes shall be cleaned of dust. The knots, cracks etc. shall then be filled in with wood putty made as follows:

On a piece of wood say 20 x 15 cm face and on the side where cross grains appear, a small quantity of glue size shall be poured and the surface scraped with the edge of a fine carpenter's chisel. Very fine wood powder shall be mixed with the glue and the stiff paste thus formed shall be used for the filing.

The fillings when dry shall be rubbed down with a carpenter's file and then the entire surface shall be rubbed down perfectly smooth with medium grained and fine sand paper and wiped with dry clean cloth so that it presents uniform appearance. In no case shall sand paper be rubbed across the grains, as in this case even the finest marks will be visible when the varnishing is applied.

12.17.2.2. Sizing or Transparent Wood Filler Coat : The surface shall then be treated with either glue sizing or with transparent wood filler coat as stipulated in the description of item.

(a) Sizing : When sizing is stipulated, an application of thin clean size shall be applied hot on the surface. When dry, the surface shall be rubbed down smooth with sand paper and cleaned. It shall then be given another application of glue size nearly cold. The sized wood work shall again be rubbed down smoothly with fine sand paper and cleaned. The surface shall be perfectly dry and all dust shall be removed not only from the surface but also from the edges and joints before varnishing is commenced. If the wood work is to be stained, the staining colour shall be mixed with the second coat of the size which must be applied evenly and quickly keeping the colour on the flow.

Any joining up with work already dry will show badly. The object of application of the glue size is to seal the pores in wood to prevent absorption of the oil in the varnish.

Treating oily wood: If the wood work is of an oily nature, a little 'multani mitti' and ochre shall be added to the first coat of size as otherwise varnish will not dry readily. Nothing extra shall be paid for this.

Glue sizing is inadvisable on floors, table tops and other horizontal surfaces likely to carry wet household utensils which are likely to disturb the size coatings and thus expose bare wood. Where glue sizing is omitted to be done, the rate for the work shall be suitably reduced.

(b) Transparent Wood Filler Coat : Where instead of glue sizing, transparent wood filler application is stipulated in the item, then the surface prepared as described in 12.17.2.1 shall be given as application of the filler with brush or rag in such a way that the filler fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours. Then it shall be cut and rubbed with emery paper so that the surface of the wood is laid bare, with the filler only in the pores and crevices of the wood.

12.17.2.3 Application of Varnish : The number of coats to be applied shall be as stipulated in the description of the item.

The undercoat shall be with a flattening varnish. This dries hard and brittle and when cut and rubbed down to produce a smooth surface enhances the gloss of the finishing varnish. The top coat shall be given with stipulated brand of finishing varnish.

The varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. If the work is vertical the varnish shall be crossed and recrossed and then laid off, latter being finished on the upstrokes so that varnish, as it sets, flows down and eliminates brush marks. The above process will constitute one coat. If the surface is horizontal, varnish shall be worked in every direction, with light quick strokes and finish in one definite direction so that it will set without showing brush marks. In handling and applying varnish care should be taken to avoid forming froth or air bubbles. Brushes and containers shall be kept scrupulously clean.

Rubbing down and flattening the surface shall be done after each coat except the final coat, with fine sand paper. The work shall be allowed to dry away from draughts and damp air. The finished surface shall then present a uniform appearance and fine glossy surface free from streaks, blister etc. Any varnish left over in the small container shall not be poured back into the stock tin, as it will render the latter turnout unfit for use. Special

fine haired varnishing brushes shall be used and not ordinary paint brushes. Brushes shall be well worn and perfectly clean. Other details shall be as specified in 12.1 as far as they are applicable.

12.17.3 Varnishing on old Surface

12.17.3.1 Preparation of Surface : If the old varnished surface is firm and sound it shall be cleaned of grease and dirt with turpentine and then rubbed with wet sand paper until the surface is clean and smooth. It shall be dried and wiped clean with a soft cloth. Knots, holes and cracks shall be stopped as specified in para 12.17.2.1 The entire surface shall then be rubbed down smooth with sand paper and wiped clean.

If the old varnished surface is peeled or cracked then it will be necessary to remove the entire varnish as described in para 12.22 and such removal shall be paid for separately outside the rate for varnishing. Further the varnishing itself will have to be done like new work and will be paid for as such.

12.17.3.2. Application : The specification shall be same as described in para 12.17.2.3 as far as applicable except that the coats to be applied will be with the stipulated quality of varnish for finishing coat.

12.17.3.3 Other details shall be as specified in para 12.1 as far as they are applicable.

12.18 FRENCH SPIRIT POLISHING

12.18.1 General:- Pure shellac conforming to IS: 16 varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm of shellac to 1 litre of spirit. Suitable pigment shall be added to get the required shade. Ready made polish conforming to IS: 348 can also be used.

12.18.2 Polishing New Surface

12.18.2.1. Preparation of Surface : The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 Kg of whiting per litre of spirit. The surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

12.18.2.2. Application : The number of coats of polish to be applied shall be as described in the item.

A pad of woolen cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the Wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

12.18.2.3. Measurements, Rate and other details shall be as specified in para 12.1 as far as they are applicable.

12.18.3 Polishing Old Surface

12.18.3.1. Preparation of Surface : If the old polished surface is not much soiled, it shall be cleaned of grease and dirt by rubbing with turpentine and then rubbed with fine sand paper.

If the old polished surface is much soiled, then it will be necessary to remove the entire polish as described in para 12.22 and such removal shall be paid for separately outside the rate of polishing. Further the polishing itself will have to be done like new work and will be paid for as such.

12.18.3.2. Application : The specifications shall be same as described in para 12.18.2.2 as far as applicable.

12.18.3.3. Measurements, Rate and other details shall be as specified in para 12.1 as far as they are applicable.

12.19. OILING WITH LINSEED OIL

12.19.1 General : Raw linseed oil shall be lightly viscous but clear and of yellowish colour with light brown tinge. Its specific gravity at a temperature of 30°C shall be between 0.923 and 0.928. The oil shall be mellow and sweet to the taste with very little smell. Oil shall be clear and free from adulterants, sediment, suspended and other foreign matter. Linseed oil which is turbid or thick, with acid and bitter taste and rancid odour and which remains sticky for a considerable time shall be rejected. The oil shall conform in all respects to IS : 75. The oil shall be of approved brand and manufacture.

12.19.2 Oiling New Surface

12.19.2.1. Preparation of Surface : This shall be done as described in Para 12.17.2.1 except that no sizing will be done on the prepared surface.

12.19.2.2. Application : The number of coats to be applied shall be as stipulated in the description of item. The oil shall be applied freely with brushes (no rags) and spread evenly and smooth until no more oil is absorbed. Each subsequent coat shall be applied after the previous coat is thoroughly dried and in any case not before 24 hours of application of first coat. Work after completion shall not be patchy and sticky to the touch and shall present a uniform appearance.

12.19.2.3. Other details shall be as specified in para 12.1 as far as they are applicable.

12.19.3. Oiling on old Surface

12.19.3.1. Preparation of Surface : The wood work shall be cleaned of all smoke and grease by sand papering or by washing with lime and water. The surface shall then be washed with soap and water and completely dried.

12.19.3.2. The specification for application shall be as described in para 12.19.2.2.

12.19.3.3. Other details shall be as specified in para 12.1 as far as they are applicable.

12.20. BEES WAXING OR POLISHING WITH READY MADE WAX POLISH

12.20.1 General : The polishing shall be done with bees waxing prepared locally or with ready made wax polish of approved brand and manufacture, as stipulated in the description of item. Where bees waxing is to be prepared locally, the following specifications for the same shall apply.

Pure bees wax free from paraffin or stearine adulterants shall be used. Its specific gravity shall be 0.965 to 0.969 and melting point shall be 63 degree C. The polish shall be prepared from a mixture of bees wax, linseed oil, turpentine and varnish in the ratio of 2:1.5:1:0.5 by weight.

The bees wax and boiled linseed oil shall be heated over a slow fire. When the wax is completely dissolved the mixture shall be cooled till it is just warm and turpentine and varnish added to it in the required proportions and the entire mixture shall be well stirred.

12.20.2. Waxing New Surface

12.20.2.1. Preparation of Surface : Preparation of surface shall be as described in para 12.17.2.1 with the exception that knotting, holes and cracks shall be stopped with a mixture of fine saw dust formed of the wood being treated, beaten up with sufficient bees wax to give it cohesion.

12.20.2.2. Application : The polish shall be applied evenly with a clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface is then rubbed continuously for half an hour.

When the surface is quite dry, a second coat shall be applied in the same manner and rubbed continuously for one hour or until the surface is dry. The final coat shall then be applied and rubbed for two hours (more if necessary) until the surface has assumed a uniform gloss and is dry, showing no sign of stickiness. The final polish depends largely on the amount of rubbing which should be continuous and with uniform pressure with frequent changes in the direction.

12.20.2.3. Other details shall be as specified in para 12.1 as far as they are applicable.

12.20.3. Waxing Old Surfaces

12.20.3.1. Preparation of Surface : The wood work shall be cleaned of all smoke and grease by washing with lime water. The surface shall then be washed with soap and completely dried. Then it shall be prepared smooth as specified in Para 12.17.3.1.

12.20.3.2. Application : The polish shall be applied in the manner specified in Para 12.20.2.2. In this case one or two coats shall be applied as necessary to get uniform gloss, instead of three coats in the case of new work.

12.20.3.3. Other details shall be as specified in para 12.1 as far as they are applicable.

12.21. LETTERING WITH PAINT

12.21.1 General : Black Japan paint (conforming to 15:341) or ready mixed paint as ordered by the Engineer shall be used. The paint shall be of approved brand and manufacture. Ordinary ready mixed paint shall be of the shade required by the Engineer.

12.21.2. Lettering on New Surface

12.21.2.1. Application : The letters and figures shall be to the heights and width as ordered by the Engineer. These shall be stenciled or drawn in pencil and got approved before painting. They shall be of uniform size and finished neatly. The edges shall be straight or in pleasant smooth

curves. The thickness of the lettering shall be as approved by the Engineer. Lettering shall be vertical or slanting as required.

Two or more coats of paint shall be applied till uniform colour and glossy finish are obtained.

12.21.2.2. Measurements : Measurements shall be taken in terms of letter cm (the measurement relate to the vertical height of the lettering). The letter heights shall be measured correct to a cm. Dots, dashes, punctuations and other similar marks or lines shall not be measured for payment.

In Devanagari Script Dots & Matras occurring with the letters shall not be measured. Half letter shall be measured as full letter. The height of letters shall be measured excluding the Matras projecting above the head line and matras below the letters.

12.21.2.3. Rate : Rate shall include the cost of all labour and materials involved in the operations described above. The rate per cm height of letter shall hold good irrespective of the width of the letters or figures or the thickness of the lettering. The same rate will apply irrespective of whether black Japan or ready mixed paint of any shade as required is used.

12.21.3. Relettering on Old Surface

12.21.3.1. Painting shall be done over the existing letters and shall accurately follow their lines and curves. One or more coat of paints shall be applied till uniform colour and glossy finish is obtained.

12.21.3.2. Measurements and Rate shall be as specified under para 12.21.2.

12.22 REMOVING OLD PAINT

12.22.1. With Patent Paint Remover

12.22.1.1. Patent paint removers shall consist of volatile organic liquids thickened with waxes and other ingredients to retard the evaporation of the liquid and to enable a substantial layer of remover to be applied to the surface. The paint remover shall be of a brand and manufacture approved by the Engineer. It shall be free from alkaline matter and non-caustic so that it can be handled by workmen without injury. It shall be of non inflammable quality as far as possible.

12.22.1.2. Application: Paint remover shall be used where burning off with blow lamp is not suitable. The paint remover shall be applied liberally with a brush and allowed to remain on the surface for a period depending on the particular brand of remover used and

on the thickness of the paint coating to be removed. When the paint film lifts and wrinkles under the action of the remover it shall be stripped with a sharp instrument. If the film is not thoroughly removed a second coat of remover may be applied if necessary over such patches and then the film thoroughly scrapped.

After the surface has been stripped, it shall be washed down with mineral turpentine to remove all traces of paraffin wax, which forms one of the ingredients of patent paint remover and which if left in place will prevent the paint from drying. The cleaned surface shall be suitably prepared for application of paint or other finish.

12.22.1.3. Precautions : Where the paint remover used is of the inflammable type, suitable precaution against risk of fire shall be taken. Neighbouring painted surfaces which are not to be treated should be properly protected from contact with paint remover.

12.22.1.4. Preparation of Surface : The surface shall then be prepared as described in para 12.2.2.

12.22.1.5. Measurements: Specification under para 12.1.6 shall hold good.

12.22.1.6. Rate: Rate shall include the cost of all labour and materials involved in all operations described above.

12.22.1.7. Other details shall be as specified para 12.1 as far as possible.

12.22.2. With Caustic Soda Solution

12.22.2.1. Application : Caustic soda dissolved with 48 times its volume of water shall be applied to the old paint with a brush and when the paint film lifts and wrinkles it shall be thoroughly scrapped of in the same way as described in para 12.22.1.2. After the surface has been stripped thoroughly, it shall be rinsed with several changes of clean water to remove all traces of, alkali, which if allowed to remain are liable to spoil the new paint applied over it. A little acetic acid or vinegar added to the final change of rinsing water helps to neutralize any remaining alkali.

12.22.2.2. Precautions : Caustic soda as its name implies is a corrosive liquid and care should be taken to see that no liquid spills over the skin or clothing.

12.22.2.3. Preparation of Surface, Measurements, Rate and other details shall be as specified under 12.22.1

12.22.3. With Blow Lamp

12.22.3.1. The paint shall be removed either with a blow lamp or with an airacetylene equipment. The flame shall be allowed to play upon the paint just enough to soften it without charring either the paint or the background. The softened paint shall then be removed with a stripping knife following the flame as it is moved up the surface. Burning off shall begin at the bottom of the vertical surface and shall proceed upwards.

12.22.3.2. Precautions : Removal with blow lamp shall not be done on narrow or carved under cut surfaces or where there is risk of damage to neighbouring materials such as panes in glazed windows.

12.22.3.3. Preparation of surface, Measurements, Rate and other details shall be as described under Para 12.22.1. Neighbouring painted surfaces which are not to be treated should be properly protected from contact with paint remover.

ANNEXURE 12.1

EXTRACTS FROM BIS HAND BOOK ON BUILDING CONSTRUCTION PRACTICES

Schedules for Finishing New Woodwork – Interior

SL	Final Finish Required	Primer (one or Two coats as required)	Undercoat	First Finishing Coat	Second Finishing Coat
i)	Enamel	IS 102: 1962 OR IS 3536:1966 OR IS 3585:1966	IS 133:1993	IS 133: 1993	IS 133:1993
ii)	Oil Gloss	IS 102: 1962 OR IS 3536: 1966 OR IS 3585:1966	IS 3536: 1966	IS 3537: 1966	IS 3537:1966
iii)	Flat	IS 102:1962 OR IS 3536:1966 OR IS 3585:1966	IS 133:1993 OR IS 3539:1966 OR	IS 137:1965 OR IS 3537:1966	IS 137:1965 OR IS 3537:1966
iv)	Varnish	--	IS 524:1983 OR IS 525:1968	IS 337:1975 OR IS 524:1983 OR IS 525:1968	IS 337:1975 OR IS 524:1983 OR IS 525:1968
v)	Grained Work	--	Merging type glaze or stains	Merging type glaze or stains	IS 337:1975 OR IS 524:1983 OR IS 525:1968

- For finishes (i) and (ii) fillers conforming to IS 110: 1983 may be applied after the prime coat as required.
- French polish, when used, shall conform to IS 348:1968.

Schedules for Finishing New Woodwork – Exterior

SL	Final Finish Required	Primer (one or Two coats as required)	Undercoat	First Finishing Coat	Second Finishing Coat
(1)	(2)	(3)	(4)	(5)	(6)
i)	Enamel	IS 102: 1962 OR IS 3536:1966 OR IS 3585:1966	IS 2932:1993 OR IS 2933:1975	IS 2932:1993 OR IS 2933:1975	IS 2932:1993 OR IS 2933:1975
ii)	Oil Gloss	IS 102: 1962 OR IS 3536: 1966 OR IS 3585:1966	IS 3536: 1966	IS 3531:1983 (Alkyd) OR IS 117:1964 OR IS 124 (Part 3):1979 OR IS 127:1962 OR IS 128:1962	IS 3531:1983 (Alkyd) OR IS 117:1964 OR IS 124 (Part 3):1979 OR IS 127:1962 OR IS 128:1962
iii)	Flat	----- Proprietary materials to be used -----			
iv)	Varnish	--	IS 524:1983 OR IS 525:2968	IS 524:1983	IS 524:1983
v)	Grained Work	--	Merging type glaze or stains (see Annex B)	IS 524:1983	IS 524:1983

NOTE : For finishes (I), (ii) and (iii), fillers conforming to IS 110:1983 may be applied after prime coat as required.

Painting Schedules for Ferrous Surface (FOR INTERIORS)

SL	Final Finish Required	Primer	Undercoat	Finishing Coat	Number and Thickness of Coating
i)	Full gloss (enamel gloss)	IS 102:1962 (see Note) IS 207:1964	IS 133:1993 (i) (B) IS 2933:1975 (I) (B,S)	IS 133: 1933 (B) ⁽¹⁾ IS 2933:1975(B,S) ⁽¹⁾	For optimum results, two coats of primer, one under coat, and two finishing coats are recommended. The total film thickness shall be not less than 100 microns.
ii)	Oil gloss	Same as for (I)	IS 133:1993 (B) OR IS144:1950 (S)		Same as for (I)
iii)	Enggshell gloss	IS 102:1962 (see Note)	IS 137:1965	--	Same as for (i)
iv)	Flat	IS 102:1962 (see Note)	IS 137:1965	IS 137:1965	Same as for (I)
v)	Metallic finishes	Same as for (i)	--	IS 2339: 1963 (B) IS 1339:1963(S) OR Bituminous aluminium paints	One coat of primer and two finishing coats; if bituminous aluminium paint is used, three coats will be necessary
vi)	Bitumen	Same as for (i)	--	IS 158:1981	Three coats of bitumen shall be used.

Painting Schedules for Ferrous Surface (FOR EXTERIORS)

SL	Final Finish Required	Primer	Undercoat	Finishing Coat	Number and Thickness of Coating
vii)	Full gloss	IS 102:1962 (see Note)	IS 2933:1975 ¹)	IS 2933:1975 ¹)	For optimum results, two coats of primer, one undercoat and two finishing coats are recommended. The total film thickness shall not be less than 100 micron.
viii)	Oil gloss	Same as for (vii)	--	IS 117:1964 OR IS 128:1962	Same as for (vii)
ix)	Eggshell gloss	--	--	--	--
x)	Flat	IS 102:1962 (see Note)	--	--	
xi)	Metallic finishes	Same as for (vii)	--	IS 2339:1963 OR Bituminous aluminium paint	One coat of primer and two finishing coats; if bituminous aluminium paint is used, three coats will be necessary.

NOTE :

1. Paint primer conforming to IS 102:1962 may be used only where special precautions for drying of the primer coat are taken and where satisfactory drying condition is ensured before application of further coats.
2. Each of these Indian Standard cover both undercoating and finishing paints, and paints appropriate for the function shall be used.
3. (B) is brushing & (S) is spraying.

Chapter 16

Horticulture And Landscaping

16.0 GENERAL

Horticultural operations shall be started on ground previously levelled and dressed to required formation levels and slopes. In case where unsuitable soil is met with, it shall be either removed and replaced or it shall be covered over to a thickness decided by the Engineer with good earth. In the course of excavation or trenching during horticultural operations, any walls, foundations, etc., met with shall not be dismantled without pre-measurement and prior to the written permission of the Engineer.

16.1 MATERIALS

16.1.1 Grass :

- 1) Cynodon Dactylon-Doob, Calcutta, Rajghat Bermuda
- 2) Improved/hybrid strains of Bermuda grass
- 3) Zoyasia grasses.

The grass shall be fresh, free from weed and rank vegetation but having #Rhizome# with sufficient nodes and shall be approved by the Engineer before planting.

16.1.2 Dump Manure:

Dump Manure shall be of well decayed organic or vegetable matter obtained in the dry state from the municipal dump or other similar source approved by the Engineer. The manure shall be free from earth, stone, brick bats or other extraneous stuff.

Manure sieved through sieve of I.S designation 16mm., is generally used for mixing with the excavated soil to be refilled in trenches for shrubbery, rose and vegetable gardens and trees and lawns while that sieved through sieve of I.S. designation 4.75mm. is used for forming lawns for tennis courts, sports etc.

16.1.3. Good Earth :

The soil shall be agricultural soil of loamy nature suitable for gardening free from kanker, Moorum, shingle, rocks, stones, brick-bats, building rubbish and any other foreign matter. The earth shall be free from clods or lumps of sizes bigger than 75 mm in any direction. It shall have P.H. Value ranging between 6 to 8.5.

16.1.4. Oil Cake (Neem/Castor) :

The cake shall be free from husk, dust, grit and any other foreign matter

16.1.5. Sludge :

It shall be obtained from approved sewage

disposal works.

16.2 SUPPLYING AND STACKING OF MATERIALS

16.2.1 Dump Manure : It shall be transported to the site in lorries duly screened through sieve of designators 16mm or 4.75mm as stated. It shall be stacked at site in stacks of not less than 50 cm height and of volume not less than 3 cum.

16.2.1.1 Measurements : Length, breadth and depth of stacks shall be measured correct to a cm. The volume of the stacks shall be reduced by 8% for looseness in stacking to arrive at the net quantity for payment.

16.2.1.2. Rate : The rate shall include the cost of all the labour and material involved in all the operations described above, including carriage within a lead of one Km. the rate shall include royalty and other taxes.

16.2.2. Good Earth

16.2.2.1. The earth shall be stacked at site in stacks not less than 50 cm high and of volume not less than 3.0 cum.

16.2.2.2. Measurements : Length, breadth and height of stacks shall be measured correct to a cm. The volume of the stacks shall be reduced by 20% for voids before payment, unless otherwise described.

16.2.2.3. Rate : The rate shall include the cost of excavating the earth from areas lying at distances not exceeding one Km. from the site, transporting the same at site, breaking of clods and stacking at places indicated. The rate shall also include royalty if payable.

16.2.3. Oil cake

16.2.3.1. (Neem/Castor) :

The cake shall be free from grit and any other foreign matter. It should be undecorticated and pulverised. The material shall be packed in old serviceable gunny bags of 50 kgs capacity approximately. The weight of gunny bag shall be deducted @ 1 kg per bag and payment shall be made for net quantity. The quantity of cake should be got approved by the Engineer before supply.

16.2.3.2. Measurement :

The arrangement for weighing shall be made at site of work by the department. The gunny bags shall be the property of the Railways.

16.2.3.3. Rate : The rate shall include the cost of labour and material involved in all the operations described above, including

carriage upto site of work with all leads and lifts, weighing etc.

16.2.4. **Sludge:**

16.2.4.1. It shall be transported to the site in lorries with efficient arrangement to prevent spilling enroute. It shall be stacked at site in stacks of. not less than 50 cm. height and of volume not less than 3 cum.

16.2.4.2. **Measurement** : Length, breadth and depth of stacks shall be measured correct to a cm. The volume to the stacks shall be reduced by 8% for looseness in stacking, to arrive at the net quantity for payment

16.2.4.3 **Rate:** The rate shall include the cost of all labour and materials involved in all the operations described above including carriage to site upto one km. The rate shall also include royalty, if payable.

16.3 EXCAVATION IN DUMPED STONE OR MALBA, BAJRI PATH AND WATER BOUND MACADAM ROAD

16.3.1 General: As directed by the Engineer, the serviceable and unserviceable material shall be stacked properly. After the unserviceable material is disposed off, the site shall be neatly dressed.

16.3.2. **Measurements** : The relevant portion of earth work shall apply. Excavation in (i) dumped stone of malba (ii) Bajri path and (iii) water bound macadam road shall be measured separately.

16.3.3. **Rate** : The rate shall include the work involved in the operations described above. Nothing extra shall be paid for sorting and stacking the unserviceable and serviceable material, including dressing.

16.4. TRENCHING IN ORDINARY SOIL

16.4.0. **General:** Trenching of soil is done in order to loosen the soil, and turn over and bury the top layer containing weeds etc. in the base and to bring up the lower layers of good earth to form a proper medium for grassing, re-grassing, hedging and shrubbery. Trenching shall be done to the depth ordered by the Engineer. The depth is generally 30 cm. for grassing and 60 cms for regrassing in good soil.

16.4.1. **Dressing of Ground:** The trenched ground shall, after rough dressing, be flooded with water by making small kiaries to enable the soil to settle down. Any local depression unevenness etc. shall be made good by dressing and/or filling with good soil.

16.4.2 **Removal of weeds:** Weeds or other vegetation which appear on the ground are then uprooted and removed and disposed off and paid for separately. The surface when

hard enough is fine dressed. These operations when carried out are, however, payable separately from trenching.

16.4.3. Trenching : Trenching shall consist of the following operations : (Note:- **Figure 16.1** may be referred to).

(1) The whole plot shall be divided into narrow rectangular strips of about 1.5 m. width or as directed by the Engineer.

(2) These strips shall be sub-divided lengthwise into about 1 m. long sections. Such sections shall be excavated serially and excavated soil deposited in the adjacent section preceding it.

(3) In excavation and depositing care shall be taken that the top soil with all previous plant growth including roots, get buried in the bottom layers of trenched area, the dead plants so buried incidentally being formed into humus.

(4) The excavated soil shall be straight away dumped into the adjoining sections so that double handling otherwise involved in dumping the excavated stuff outside and in backfilling in the trenches with leads is practically eliminated.

16.4.4: **Measurements** : Length and breadth of superficial area shall be measured correct to 0.1 metres and depth correct to a cm. Cubical contents shall be calculated in cubic metres, correct to two places of decimal. No deduction shall be made nor extra paid for removing stones, brick bats and other foreign matter met with during excavation upto initial lead of 50m and stacking the same.

16.4.5. **Rate** : The rate shall include the cost of all labour and material involved in the operations described above, with the exceptions noted in paras 16.4.1. and 16.4.2 and 16.4.3. The rate includes cost of all precautionary measures to be taken for protections and supporting all services etc. met with during trenching. It does not include the cost of mixing of earth, sludge/manure.

16.5. ROUGH DRESSING THE TRENCHED GROUND

16.5.0. **General:** Rough dressing the area shall include making kiaries for flooding.

16.5.1. **Procedure:** The trenched ground shall be levelled and rough dressed and if there are any hollows and depressions resulting from subsidence which cannot be so levelled, these shall be filled properly with earth brought from outside to bring the depressed surface to the level of the adjoining land and to remove discontinuity of slope and then rough dressed again. The supply and spreading of soil in such depressions is payable separately. In rough

dressing, the soil at the surface and for 75 mm depth below, shall be broken down to particle size not more than 10 mm in any direction.

16.5.2. Measurements : Length and breadth of superficial area shall be measured correct to 0.1 metres. The area shall be calculated in sqm. correct to two places of decimal.

16.5.3. Rate : The rate shall include the cost of all labour and materials involved in the operations described above.

16.6. SPREADING GOOD EARTH

16.6.1. General: Good earth shall be removed from stacks by head load and spread evenly over the surface to the thickness ordered by the Engineer. It shall be spread with a twisting motion to avoid segregation and to ensure that spreading is uniform over the entire area.

16.6.2 Measurements : The quantity of good earth spread shall be, determined by the difference in the volume of good earth in stacks before and after spreading duly reduced for looseness in stacking by 20% of good earth.

16.6.3. Rate : The rate shall include the cost of all labour and materials involved in all the operations described above, but does not include the cost of the good earth which shall be paid for separately unless specifically described in the item.

16.7. UPROOTING WEEDS FROM TRENCHED AREAS

16.7.1. General: After 10 days and within 15 days of flooding the rough dressed trenched ground with water, the weeds appearing on the ground, shall be rooted out carefully and the rubbish disposed off as directed by the Engineer.

16.7.2. Measurements : Length and breadth shall be measured correct to 0.1 metre. Superficial area of the weeded ground shall be measured for purpose of payment

16.7.3. Rate : The rate shall include the cost of all labour and materials involved in all the operations described above.

16.8. SPREADING SLUDGE/MANURE

The specifications shall be as described in para 16.4 except that the stacks shall be reduced by 8% for looseness.

16.9. FINE DRESSING THE GROUND

16.9.1. General: Slight unevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding

operations, shall be removed by fine dressing the surface to the formation levels of the adjoining land as directed by the Engineer, and by adding suitable quantities of good earth, brought from outside, if necessary. Such supply and spreading of good earth stacked at site is however, payable separately. In fine dressing, the soil at the surface and for 40 mm depth below shall be broken down to particles of size not exceeding 6: mm in any direction.

16.9.2. Measurements : Length and breadth of the dressed ground shall be measured correct to 0.1 metre. The area shall be calculated in sqm. correct to two places of decimal.

16.9.3. Rate : The rate shall include the cost of all labour and materials involved in all the operations described above.

16.10. EXCAVATION AND TRENCHING FOR PREPARATION OF BEDS FOR HEDGE AND SHRUBBERY

16.10.0. General: Beds for hedges and shrubbery are generally prepared to width of 60 cm. to 125 cm. and 2 to 4 metres respectively.

16.10.1. Preparation of Beds: Beds for hedges and shrubbery shall be prepared in the following manner.

The beds shall first be excavated to a depth of 60 cm. and the excavated soil shall be stacked on the sides of the beds. The surface of the excavated bed shall then be trenched to a further depth of 30 cm. in order to loosen the soil, in the manner described in 16.4.3. No Flooding will be done at this stage but the top surface shall be rough dressed and levelled. The excavated soil from the top 60 cm. depth of the bed stacked at the site shall then be thoroughly mixed with sludge or manure in the proportion 8:1 by volume (8 parts of stacked volume of earth after reduction by 20%. to 1 part of stacked volume of sludge or manure after reduction by 8%) or other proportion as described in the item. The mixed earth and manure shall be refilled over the trenched bed, levelled neatly and profusely flooded so that the water reaches even the bottom most layers of the trenched depth of the bed. The surface after full subsidence shall again be refilled with the earth and manure mixture, watered and allowed to settle and finally fine dressed to the level 50 mm to 75 mm below the adjoining ground or as directed by the Engineer. Surplus earth if any, shall be disposed off as directed by the Engineer. Any surplus earth if removed beyond initial lead, shall be paid for separately.

Stones, brick bats and other foreign matter if met with during excavation or trenching shall be removed and stacked within initial lead and lift, such material as is declared unserviceable by the Engineer shall be disposed by spreading and levelling at places ordered by him. If disposal is outside the initial lead and lift, then the transport for the extra leads will be paid for separately. If a large proportion of material unsuitable for the hedging and shrubbery operations is met with and earth from outside is required to be brought in for mixing with manure and filling, the supply and stacking of such earth will be paid for separately.

16.10.2. Measurements : Length, breadth and depth of the pit excavated and trenched shall be measured correct to a cm. The cubical contents shall be calculated in cubic metre correct to two places of decimal.

16.10.3. Rate : The rate shall include the cost of all labour and materials involved in all the operations described above with the exceptions noted in para 16.9.1. The rate shall not include the cost of supplying and stacking sludge or manure unless the same is specifically included in the description of the item.

16.11. MIXING OF GOOD EARTH AND SLUDGE / MANURE

16.11.1. General: The stacked earth shall, before mixing, be broken down to particles of sizes not exceeding 6 mm in any direction. Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the Engineer. The mixing shall be spread as described in para 16.5.1 to the thickness ordered by the Engineer.

16.11.2. Measurements : The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth, sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stacks.

16.11.3. Rate :- The rate shall include the cost of all labour and materials involved in all the operations described above, but does not include the cost of good earth, sludge or manure which shall be paid for separately, unless otherwise described in the item.

16.12. UPROOTING RANK VEGETATION AND WEEDS AND PREPARING THE GROUND FOR PLANTING DOOB GRASS.

16.12.1. General: Initially the area shall be dug up to a depth of 30 cm and weeds and rank vegetation with roots removed therefrom by repeated forking. The whole

area then shall be retrenched to a depth of 60 cm. in the same manner as described in 16.4.3.

Clods of excavated earth shall then be broken upto the size not more than 75 mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from the above operations shall be removed and disposed off in a manner directed by the Engineer, away from the site. The earth shall then be rough dressed and fine dressed as described in para 16.9.1.

16.12.2. Measurements : The length and breadth of uprooted area shall be measured correct to 0.1 metre. The area shall be calculated in sqm correct to two places of decimal.

16.12.3. Rate : The rate shall include the cost of all labour and materials involved in all the operations described above

16.13. GRASSING WITH DOOB GRASS

16.13.0. General: The area from where the grass roots are to be obtained shall be specified by the Engineer at the time of execution of the work and no royalty shall be charged on account from the contractor if it is from within the railway land.

16.13.1 Procedure: The soil shall be suitably moistened and then the operation of planting grass shall be commenced. The grass shall be dibbled at 10 cm, 7.5 cm., 5cm., apart in any direction or other spacing as described in the item. Dead grass and weeds shall not be planted. The contractor shall be responsible for watering and maintenance of levels and the lawn for 30 days or till the grass forms a thick lawn free from weeds and fit for mowing whichever is later. Generally planting in either direction at 15 cm., 10 cm, spacing is done in the case of large open spaces, at 7.5 cm. spacing in residential lawns and at 5 cm, spacing for Tennis Courts and sports ground lawns.

16.13.2. Precautions : During the maintenance period, any irregularities arising in ground levels due to watering or due to trampling by labour, or due to cattle straying thereon, shall be constantly made upto the proper levels with earth as available or brought from outside as necessary. Constant watch shall be maintained to ensure that dead patches are replanted and weeds are removed.

16.13.3. Measurements : Length and breadth of the lawn grassed shall be measured correct to 0.1 metre and the area shall be calculated in square metre correct to

two places of decimal.

16.13.4. Rate : The rate shall include the cost of all labour & materials involved in all the operations described above, excluding supply of the requisite quantity of good earth if so needed for properly maintaining the levels of the lawns.

16.14. RENOVATING LAWNS:

16.14.1. General : The area shall be first weeded out of all undesirable growth. The entire grass shall be scrapped (cheeled) without damaging roots and levels of the grounds. Slight irregularities in surface shall be levelled off and the area shall then be forked so as to aerate the roots of the grass without, however up-rooting them. Specified quantity of sludge or manure shall then be spread uniformly with wooden straight edge (phatti) as directed by the Engineer. The area shall then be slightly sprinkled with water so as to facilitate proper integration of the manure or sludge with the soil and later flooded. The contractor shall be responsible for watering, proper maintenance and tending of the lawn for 30 days or till the grass forms a lawn fit for mowing, whichever is later.

During the above operations, all undesirable growths shall be constantly weeded out and all rubbish removed and disposed off as directed by the Engineer.

16.14.2. Measurements : Length and breadth of the lawn renovated shall be measured correct to 0.1 m. The area shall be calculated in sqm correct to two places of decimal.

16.14.3. Rate: The rate shall include the cost of all labour and T&P (excluding pipe/grass) involved in all the operations described above, including the supply of the requisite quantity of good earth if so needed for proper maintenance of the levels of the lawns. The cost of the sludge or manure shall be measured and paid for separately, unless its supply is specifically included in the description of the item.

16.15. DIGGING HOLES FOR PLANTING TREES

16.15.1. In ordinary soil

16.15.1.1. Holes of circular shape in ordinary soil shall be excavated to the dimensions described in the items and the excavated soil, broken to clods of sizes not exceeding 75 mm in any direction, shall be stacked outside the hole. Stones, bricks bats, unsuitable earth and other rubbish, all roots and other undesirable growth met with during excavation shall be separated out and

unservicable material removed from the site as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the contractor which shall be paid for separately. The tree hole shall be manured with powdered neem/castor oil cake at the specified rate along with farm yard manure or sludge which shall be uniformly mixed with the excavated soil after the manure has been broken down to powder (size of particles not to exceed 6 mm in any direction) in the specified proportion. The mixture shall be filled into the hole upto the level of adjoining ground and then profusely watered to enable the soil to subside. The refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the Engineer.

16.15.1.2 Measurement : Holes shall be enumerated.

16.15.1.3 Rate: The rate shall include the cost of all labour and materials involved in all the operations described above excluding the cost of supplying and stacking the requisite quantity of manure/sludge and oil cake.

16.15.2. In soil other than ordinary soil

16.15.2.1. Where holes are dug in (a) Hard soil (b) Ordinary rock or (c) Hard rock, the above soils occurring independently or in conjunction with each other and/or ordinary soil in any hole, the different excavated soils shall be stacked separately. Excavation in hard rock shall be carried out by chiselling only.

16.15.2.2. The stack measurement of ordinary or hard rock shall be reduced by 50% and of hard soil by 20% to arrive at the excavated volume. These excavations shall be paid for as extras over the rate for holes dug in ordinary soil above, at rates appropriate to the particular soil concerned under earth work chapter.

16.15.2.3. Sufficient quantity of good soil to replace the solid volume of stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth, ordinary and hard stacks shall be brought and stacked at site but the supply and stacking of such earth shall be paid for separately.

16.15.2.4. The useless excavated stuff shall be disposed off by spreading at places ordered by the Engineer. If such places are outside initial lead, carriage for the extra lead shall be paid for separately.

16.15.2.5. The ordinary soil excavated from the hole and the earth brought from outside

shall then be mixed with manure screened through sieve of IS designation 16 mm in the proportion specified in the description of the item and filled into the pit and the same watered and finally dressed as described in para 16.15.1.1.

16.15.2.6. Measurements : The pits shall be enumerated. The volume of excavation in soil other than ordinary soil shall be determined by reducing the stack volume of the relevant soil with the respective percentage deduction for voids specified in para 16.15.2.2.

16.15.2.7. Rate : The rate shall include the cost of labour and material involved in all the operations described above including mixing, refilling, watering dressing etc. but shall not include (a) cost of manure or sludge (b) cost of supplying and stacking good earth for replacement and (c) the cost of carriage beyond initial lead for disposing off useless materials. The excavation other than that of ordinary soil shall be paid for extra over and above the rate of excavation in ordinary soil.

16.16. TREE GUARDS

16.16.1. Circular brick tree guard (Fig. 16.2)

16.16.1.0. The internal diameter shall be 1.25 metre, height above ground level 1.20 metre and depth below ground level 0.20 metre; walls half brick thick.

16.16.1.1. This shall be built of bricks of class designation 7.5. Bricks shall comply with the specifications described in chapter on Brick work. The first two courses from bottom shall be built dry (without mortar) with the bricks laid close to each other, without honey-comb. Subsequent courses upto 0.30 metre from top of tree guard shall be built dry in honey-combed pattern, using 15 bricks in each course, with equal opening in between. Thereafter the top three courses shall be built without honey-combing, in lime surkhi mortar 1:2 (1 lime putty : 2 surkhi) or in cement mortar 1:6 (1 cement 6 fine sand) as directed. In the bottom most 2 courses. and in the top most 3 courses bricks in adjacent courses shall be laid with 10 cm laps. In the honey-combed portion of the work, the vertical edges of bricks in alternate courses shall be in the same line. The laps of bricks on either side of openings shall be equal.

16.16.1.2 Measurements: The tree guard shall be enumerated.

16.16.1.3 Rate: The rate shall include the cost of all labour and materials involved in all the operations described above.

16.16.2. Ornamental circular iron tree guard with bars (Fig. 16.3)

16.16.2.0. The tree guard shall be 50 cm. in diameter.

16.16.2.1. The tree guards shall be formed of (i) 3 Nos. 25 x 25 x 3 mm angle iron verticals 2.00 m. long excluding splayed outward at lower end upto an extent of 10 cms.

(ii) 3 Nos. 25 x 5 mm MS flat rings fixed as per design

(iii) 15 Nos. 1.55 metres long 6 mm dia bars. Each ring shall be in two parts in the ratio of 1 : 2 and their ends shall be turned in radially for a length of 4 cm. at which they are bolted together with 8 mm. dia and 30 mm. long MS bolts and nuts.

The vertical angle irons shall be welded to rings along the circumference with electric plant 15 Nos. bars shall be welded to rings at equal spacing along the circumference of ring. The lower end of the angle iron verticals shall be splayed outwards upto an extent of 10 cm. The lower end of the flat of lower ring shall be at a height of 45 cm. and upper end of the flat of top ring shall be at the height of 2.00 metres. The middle ring shall be in the centre of top and lower ring. The bars shall be welded to rings as shown in the drawing. The entire tree guard shall be given two coats of paint of approved brand and of required shade over a priming coat of ready mixed primer of approved brand. The design of the tree guard shall be as shown in the drawing.

16.16.2.2. Measurements : The tree guard shall be enumerated.

16.16.2.3. Rate : The rates shall include the cost of all labour and materials involved in all the operations described above.

16.16.3. Ornamental circular iron tree guard with welded mesh (Fig. 16.4)

16.16.3.0. The tree guard shall be 50 cm. in diameter.

16.16.3.1. The tree guard shall be formed of :

(i) 3 Nos. 25 x 25 x 3 mm angle iron verticals 2.00 metres long excluding splayed outwards at lower end upto an extent of 10 cms.

(ii) 3 Nos. 25 x 5 mm MS flat rings 50 cm. dia as per design.

(iii) 1.55 m high Welded mesh 50 x 75 mm size of 3 mm thick wire. Each ring of the tree guard shall be in two equal parts and their end shall be turned in radially for a length of 4 cms. at which they shall be bolted together with 8 mm dia, 30 mm long MS bolts and nuts.

The vertical angle iron -shall be welded to rings along the circumference with electric plant. Welded mesh shall be welded to rings in such a way so as to make it sufficiently strong; The lower and of the angle iron

verticals shall be splayed outwards upto an extent of 10 cm. The lower end of the lower rings shall be at 45 cm. height and upper end of the upper ring shall be at 2.00 metre height, the middle ring shall be in the centre of the two. The entire tree guard shall be given two coats of paint of approved brand and of required shade over a priming coat of ready mixed primer of approved brand and manufacture. The design of the tree guards shall be as shown in the drawing.

16.16.3.2. Measurement : The tree guard shall be enumerated.

16.16.3.3. Rate : The rates shall include the cost of all labour and materials involved in all the operations described above.

16.16.4 Ornamental Circular MS flat iron tree guard

16.16.4.0 The Tree Guard shall be 60cm in dia-meter and 2.0m in height

16.16.4.1 The tree guard shall be formed of 8 nos. 25x3mm. MS flat verticals 2.0m long, 4 nos. 25x6mm flat verticals 2.25m , long, and 3 nos. 25x6mm.flat iron rings at top, middle and bottom. Each ring shall be in two semicircular halves with their ends turned out radially for a length of 4 cm, at which they are bolted together with 8mm dia, and 30mm long MS bolts and nuts. The verticals shall be riveted to the rings at equal spacing along the circumference with 6mm. dia rivets, each 25x6mm MS flat verticals being placed after every two 25x3mm. M.S flat verticals. The top ends of all the verticals both 25x3mm. and 25x6mm. shall be cut to form pointed ends at the top and shall be at the same level. The circular rings shall be at 10cm., 1.0m and 1.9m above ground. The bottom 5cm. of the extra 25cm. length of the 25x6mm. M.S flat verticals projecting below the 25x3mm. M.S flat vertical, shall be turned horizontally at right angles , the 4 Nos. 20cm. long legs thus formed being buried below ground. The entire tree guard shall be given two coats of ordinary paint over a priming coat of red lead, the portions buried under ground being painted with bitumastic or

anticorrosive paint before fixing. The tree guard as fixed shall be truly vertical.

16.16.4.2. Measurements: The tree guard shall be enumerated.

Rate: The rate shall include the cost of all labour and materials involved in all the operations described above.

16.16.5 Empty Bitumen/Coal Tar Drum Tree Guard

16.16.5.1. Tree guards shall be made from empty bitumen or coal tar drum supplied free by the Railway. These shall be of 50cm. average diameter and 1.30 metre or 2.0 metre height as specified in the description of the item. The ends of the drums shall be cut and the coal tar or bitumen sticking inside the drum shall be burnt off. The tree guard shall then be fabricated as per design approved by the Engineer. The 1.3/2 metre high tree guard shall have four legs formed of M.S flat sections 30mmx3.0mm of 40cm. length riveted to the tree guard with 6mm dia rivets and projecting sufficiently below for being buried in the ground. Tree guard shall be finished with a coat of coal tar, or two or more coats of ready mixed paint of approved quality and shades after applying a priming coat inside and outside, before fixing.

16.16.5.2. Measurements: The Tree guard shall be enumerated.

16.16.5.3 Rate: The rate shall includes the cost of all labour and materials (except empty bitumen and coal tar drums) involved in all the operations described above.

16.17. EARTHEN POTS

16.17.0. **General:** The earthen pots shall be moulded with good earth. These shall be thoroughly baked without being vitrified, regular in shape and size. All the pots shall be free from visible defects such as cracks, chips, stones and flaws of any kind. The pots shall give a dear ringing sound when struck together or with a light stick.

16.17.1. **Size :** The sizes of the earthen pots are given in table as below :

Size (cms)	Upper dia (cms)	Bottom dia (cms)	Perpendicular height (cms)
30	30	20	30
25	25	15	25
20	20	12	20
15	15	10	15
10	10	6	10
30	30	15	30
25	25	13	25

20	20	10	20
15	15	8	15
10	10	5	10
20	13	8	20
25	20	10	25
30	25	15	30

Upper diameter will be taken from inside and bottom dia. and perpendicular height shall be measured from outside.

16.17.1.1. Tolerance : A margin for variation of 1.5 cm for pots of size 20 cm. and above and a margin of 1 cm. for pots of size 15 cms. and below will be permitted.

16.17.2. Measurements: The pots shall be stacked properly in a countable manner but not in more than 3 layers. The net quantity for payment will be arrived after deducting the broken pots, improperly baked or otherwise damaged in any form assessed by physical appearance etc.

16.17.3. Rate : The rate shall include the cost of all the labour and material required, including carriage to the site of work or the place specified.

16.18 FILLING OF POLYTHENE BAGS/EARTHEN POTS WITH MANURE AND GOOD EARTH AS SPECIFIED.

16.18.1. Mixing : The separately stacked earth and manure or sludge shall before mixing, be broken down to particles or sizes not exceeding 6 mm in any direction. Good earth shall be thoroughly mixed with sludge or manure in specified proportion as directed in the item or as directed by the Engineer.

During the process of preparing the mixture as above and before actual filling in bags/containers etc. required quantity or water should be sprinkled to keep mixture cool & damp.

The polythene bags/containers shall be brought to the site of mixture within 50 m lead and filled with the help of jhaba/hand trowel or any other required tool and instruments. Polythene bags/ containers thus filled in with mixture should be properly pressed & tapped to consolidate the mixture and final level of the mixture should be about 2.6 cm below the top edge of the polythene bags/containers.

The polythene bags /containers thus filled in, shall be arranged in countable manner in

properly prepared beds/ground as directed with in 50 mm lead.

16.18.2 Measurement: In numbers

16.18.3 Rate: The rate shall include the cost of all labour etc involved in all the operations described above, but do not include the cost of good earth, sludge or manure, polythene bags and containers which shall be paid separately unless specifically described in the item.

16.18.3: The rate shall include the cost of all labour etc, involved in all the operations described above, but do not include the cost of good earth, sludge or manure, polythene bags and containers which shall be paid separately unless specifically described in the item.

16.19. BRICK EDGING

16.19.1 General : Bricks of specified class designation shall be used. These shall be laid in one of the following patterns:- (i) Vertical bricks, half brick projecting above ground (ii) Alternate bricks laid horizontally and vertically (iii) Brick inclined at 60 deg. To the horizontal (iv) Brick laid lengthwise with half brick depth.

Trenches of specified width and depth shall first be made along the edging line to accommodate the bricks in one of the above patterns. The bottom of the trench shall be consolidated to form a firm base for the brick edging . Bricks shall be laid true to line and gradient, as directed. The trench shall then be refilled with excavated earth and consolidated by hand packing . The adjacent earth surface shall be then neatly leveled. Surplus earth shall be disposed off by spreading at places directed within 50m lead.

16.19.2 Measurements : In running metres

16.19.3 Rate: The rate shall include the cost of all labour and materials required involved in all the operations described above.

16.20 DEVELOPMENT OF NURSERY AND AFFORESTATION.

16.20.1 **General:** **Annexure 16.1** gives useful details on the following aspects of Horticulture for guidance of the staff engaged in these operations.

- (i) Nursery
- (ii) Method of improving the soil – Manure

- (iii) Manure
- (iv) Planting Trees on road side
- (v) Method of planting Trees on Road side
- (vi) Spacing of Trees
- (vii) Maintenance of trees.

ANNEXURE 16.1

1. NURSERY

The site for nursery should be a level land and of sandy loam soil, and plenty of water should be available. The location of nursery should be convenient for inspection as well as transplantation of plants. The trenches with the width at top as 300mm and bottom width as 200mm and a height of 230 to 300mm should be dug, 1800mm apart or as required as per the requirement of the plant. Berms on both sides of the excavated trench are formed by dumping the excavated soil about 300mm away on both sides of the trench. The berms are used for sowing the seeds. The berms thus formed should be made level prior to sowing is taken up. Normally the work on nursery should be completed before the end of March. In practice the seedlings grow faster over ridges than in beds and even the transplanting would be easy. The seedlings in any nursery is raised from seeds but in case of certain species which do not grow from seeds they will have to be raised from cutting or grafting. The plants should be retained in the nursery till they are sufficiently hard to withstand the planting out operation at the same time they should not be kept for a longer time in the nursery, with the result the roots of the plant will unduly cramp for space.

When the plants are to be carried over long distances for transplanting the earthen ball around the roots should be neatly wrapped with leaves, grass matting or polythene sheets, or the balls may be packed in boxes or baskets with empty space filled by good earth and kept moist by sprinkling water.

The nursery should have a good provision for paths, trenches and fallow. As a matter of fact failure rate of plants can be considered as 25%. Also as per general practice about one third or one fourth area available, should be used in rotation, every year. The actual

size of nursery will mainly depend upon the number of seedlings to be produced, and the age of seeding to be supplied, during the year. The most important factor is the period of keeping the plants in the nursery.

2. METHOD OF IMPROVING THE SOIL – MANURING

Sandy loams and clay loams are fertile and most suitable for the growth of a tree. Every tree or plant needs good depth for the root to develop; however the depth required varies from plant to plant. For example a garden plant just needs 450mm to 900mm depth whereas the fruit trees need about 3500 mm to 4500 mm. Similarly the grain crop would need 1200mm to 1500mm. On the contrary the timber tree would require a depth of 4m to 9m. If no scope is available for the roots to go deep they start spreading side ways.

Stiff clay soil: This type of soil can be improved with mixing of sand, silt from canal, charcoal or brick dust. Lime also can be added. The stiff clay and loose sands are improved by the addition of small quantities of old lime.

Plantation in low laying and water logged areas: A mound of about 900mm dia and 600mm height can be made and plantation done on the mound.

Plantation in Kalar soil: In such soil the planting should not be done directly but pits should be excavated of size 1.00m dia and 1.00m depth and fresh good soil should be filled in the pit to take up the plantation.

Sandy soil: Sheesham stumps of large roots of 300mm to 600mm length can easily be planted in these soils, Kikar and ber also can be easily tried.

3. MANURE

Chemical Manure: This manure is made by the mixture of equal parts of ammonium sulphate and bone meal or super phosphate

of lime. Usually when the plant grows about 150mm height the manure is applied.

Compost: Compost is a mixture of dung and other organic materials and earth. The pit is dug in the ground and sun dried organic matter is placed in the pit covering the same with some earth and lightly watered. This process is repeated till the pit is full.

Cow dung or sheep dung is most useful. The horse dung is less rich in manure. The manure out of dung should never be used fresh but should be thoroughly rotted, otherwise the grubs contained in the manure will attack the plant roots. The dung thus collected should not be exposed to the atmosphere as otherwise we may not be in a position to prevent the escape of valuable gasses. Hence the dung should also be collected in a pit covered with earth, we can also add urine but after diluting the same with a quantity of water four times the quantity of urine. Normally the compost should be about 2 years old but in hot places the compost takes lesser time to mature. The quantity of compost that is used is about 3 to 4 kgs per sqm.

Leaf moulds: This is a best addition to the nursery soil. A pit of 600mm to 900mm depth is dug in a shady place. This pit is filled with fallen leaves of avenue trees particularly at the time when the fruit trees shed their leaves. After a lapse of nearly one to one and half years the leaves thus collected in the pit will be converted into invaluable manure. The decay can be quickened if the pit is thoroughly soaked two or three times during the hot season. The manure will be containing worms and other vermins which should be removed completely before the same is used.

4. PLANTING TREES ON ROAD SIDE

The trees for road side planting should be selected very carefully. The most common and ever green one would be mango or nearly ever green like margosa or neem. The trees should be suitable for the atmospheric condition. Mostly shady trees which do not spread sending large branches should be selected. In short the trees should be fairly hardy and robust and should not be of a variety which grows very fast and ultimately dies fast. Generally the trees that grow about 3m to 4m in a straight direction and spread are most suitable ones. Similarly the roots of the trees should go deep because shallow rooted trees would spoil the pavement as it

would absorb the moisture from the sub-grade.

Trees with thin and small leaves like tamrind or margosa etc. should be preferred as they need less water and with stand the drought very well.

Trees with thick and broad leaves require more moisture and water. Similarly, trees producing valuable fruits or timber or even a babool tree which sheds thorns are not at all suitable one. Certain trees which shed their leaves during the month of April/May should not be preferred at all. One should bear in mind the nature of the road i.e if the road has to run close to the houses just like in a colony etc the thick growing large trees would not be suitable.

It is a common knowledge that in summer the trees dry up the soil almost upto 6% with the result the volume of the sub-grade gets reduced and the pavements crack. Hence in heavy clayey soils the fast growing trees should be planted at least 15m away from the road.

Only mixed planting should be resorted to so that plants flower and bear fruits in different seasons and also the shade of trees take place in different parts of the season. Also by mix planting only some of the trees get uprooted during storms and hale. To serve as an effective land mark, tall growing varieties with straight stem may be planted at selected spots. Planting the trees of divergent habits like banyan, babool and cork etc should be avoided.

5. METHOD OF PLANTING TREES ON ROAD SIDES

The trees on opposite side of the road should be planted in staggered fashion i.e each tree should not come in line with the tree on the opposite side but should be located at middle portion. The planting of the tree should be 2m to 3m away from the edge of the berm. It is mandatory to take particular care that the trees do not interfere with the traffic on the road and the same should be free from off shoot of the branches at least for a height of 3.5m to 4m on high ways and little more on streets in towns. In case the branches grow horizontally they should be cut maintaining a minimum height as 3.5m. The trees should be pruned in such manner that the natural shape is retained. Telephone and telegraph poles should be so fixed that there will not be any interference due to the growth of tree. However, they can

be fixed at least 1.5m outside the road edge or preferably at the boundaries of the road.

A major precaution that should be taken is a tree of less than 3.5m height should not be planted on the road side. It has been observed that most of the failures on the road side planting is due routine use of small seedlings or trees which have not had their roots formed fully before being transplanted from the nursery.

The trees on the south and west sides of a road give most shades hence while widening a road as far as possible these trees should be retained and those in north and east side can be removed.

The planting of trees on road sides is helpful for all types of roads. For Tar/Bitumen roads shielding of direct sun rays prevents licking up of tar and formation of pot holes, because the sun rays have a harmful effect on both tar and bitumen.

Again in case of cement concrete roads the obstruction to direct Sunrays would protect the surface of concrete due to temperature effect. Thus the value of shade due to trees apart from comfort is much more than keeping the road surfaces in good condition.

6. SPACING OF TREES

On an average, tree planting on road sides in our country is about 80 to 90 trees per kilometer. Generally distance between two trees kept at 10m to 15m is suitable.

However, at places where rainfall is less the trees can be planted at 15m apart and fast growing trees are planted in between so that some shade would be available in between. The intermediate trees can be trimmed or cut down once the main trees grow to more than 3.5 to 4m height.

A particular care should be taken while planting the trees on curves so that it does not obstruct the vision. The roots of the trees spread wildly hence no tree should be planted within 6m of any masonry work. The above distance should be increased depending upon the type of tree. The distance may be kept between 20m to 25m as the roots of trees, like pipal, gutar, pikhan and barged grow into the masonry joints and create the damage. The distances that can be maintained for the different types of trees is given below

SL	Name of tree	Safe spacing
1.	Teak	10m to 15m
2.	Pipal	17m to 20m
3.	Neem	8m to 10m
4.	Siris	12mm to 15m
5.	Tamarind or Imli	12m to 15m
6.	Mango	10m to 12m
7.	Jamun	12m to 15m
8.	Mahwa	10m to 15m
9.	Banyan	10m to 15m
10.	Bahera	12m to 18m
11.	Khimi	10m to 12m
12.	Karanj	10m to 12m
13.	Indian Cork	5 m to 8m

Numbering Trees : The trees should be numbered carefully. They should be numbered at a height of 1.25m above the ground level in a specially made space of 150mmx150mm by scraping the bark. Only dry scales should be scrapped without peeling the tree. The numbers should be

written in black colour over the white back ground.

7. MAINTENANCE OF TREES:

In spite of providing all equipments like pipes etc still on an average we will need one mali

to maintain about 2 to 2.5km road side trees. The length will be drastically reduced if the mali has to in addition attend the plantation in the divider portion as well.

Controlling the attack by pests: This can be done by spraying chemicals as follows

- i. Dissolve 50 gms of copper sulphate in a litre of boiling water and this mixture is added to four times the quantity of lime water just before spraying. Spraying this mixture is very effective.
- ii. Boil 100 gms of well dried tobacco leaves in one litre of water for one full hour. Dissolve 25gms of hard soap in this tobacco water, and before use add 6 litres of cold water and this mixture can be sprayed to arrest the pests.

For any tree a parasitic plant is most dangerous. Hence the parasite plant should be removed completely with roots and destroyed. The affected branch or a dead branch should be cut to save the main tree. The cutting or removing a branch should not be done in a haphazard manner. The most systematic method would be as follows:-

The cutting of a branch should not be done by an axe but a cut should be made with a sharp knife/saw close to the affected portion taking care not to leave the stub of amputated branch on the good limb or the tree trunk.

If one has to remove a large heavy branch the same should be done as follows.

The branch should be cut keeping a distance of about 350mm from the trunk. The bark around should be cut with a pruning knife. Then leaving about 300mm space cut the under side with a saw to a distance of half the depth; then cut the remaining portion from top, so that the bark will not be torn off. Small branches can be cut with the pruning knife. The wounds or cuts caused should be protected against moisture or decay and this can be easily done by painting the cut portion with tar. The more systematic method is as follows: Treat the woody portion with a dilute solution of any good wood preservative

or tar and the stripped bark should be treated with a solution of lac in methylated spirit.

Cavity filling: Some times due to careless pruning a cavity gets formed in the trunk and this should not be left untreated. The damage to the tree can be prevented with following method. The dead wood should be scraped very carefully and the hollow portion should be washed thoroughly with a strong solution of permanganate of potash and then fill up the entire gap with cement concrete 1:2:4 well packed and finished neatly till below the level of the bark.

As a matter of fact good maintenance will help prolong the life of a tree. No excavation should be allowed to be done near the tree unless totally unavoidable as it may disturb the roots. The stem should be coal tarred upto 600mm height from the ground at least once in two years. The pruning should be done regularly and wounds if any treated properly.

Pruning a tree: The pruning should be started when the tree is about 2 years old. The pruning will help the growth of a tree in a straight direction and keep it healthy. The best season for pruning is end of cold season or say beginning of the month of March. This is the period when the leaves just appear and the growth in a tree is least active. On the contrary if the pruning is done in summer i.e when the trees are in full growth and the wounds bleed which will not allow the use of tar and bitumen to adhere properly.

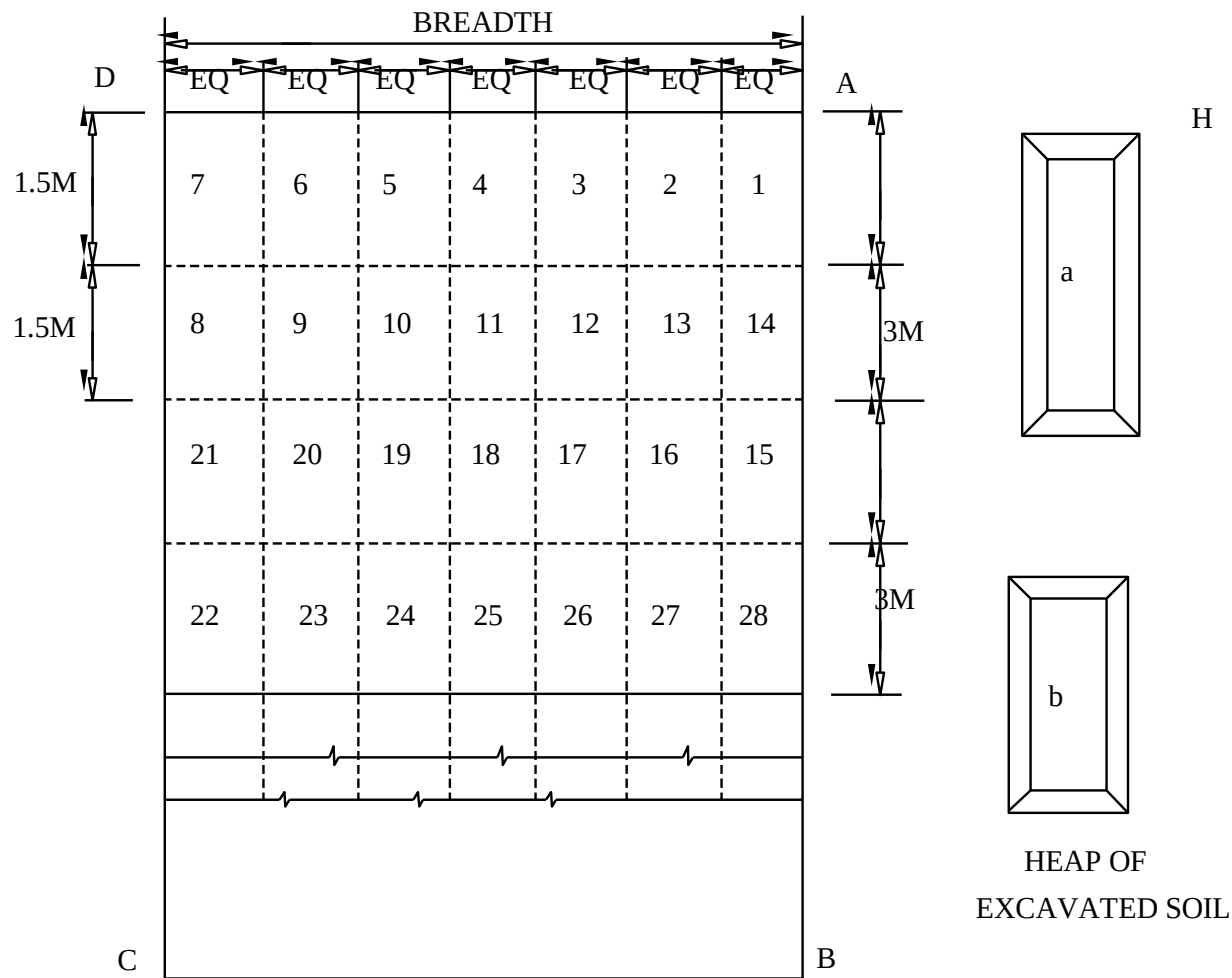
To keep the tree health only two rows or tiers of branches should be removed in a year. Axe should not be used for the purpose of pruning. One can choose the different types of tools as per IS codes.

Weeding: The removal of excessive growth of grass around the tree is called weeding. The grass should be removed with roots.

Felling trees: When a tree is cut a hollow space should be dug around the base and the trunk cut as low down as possible. The hollow portion is then filled properly.

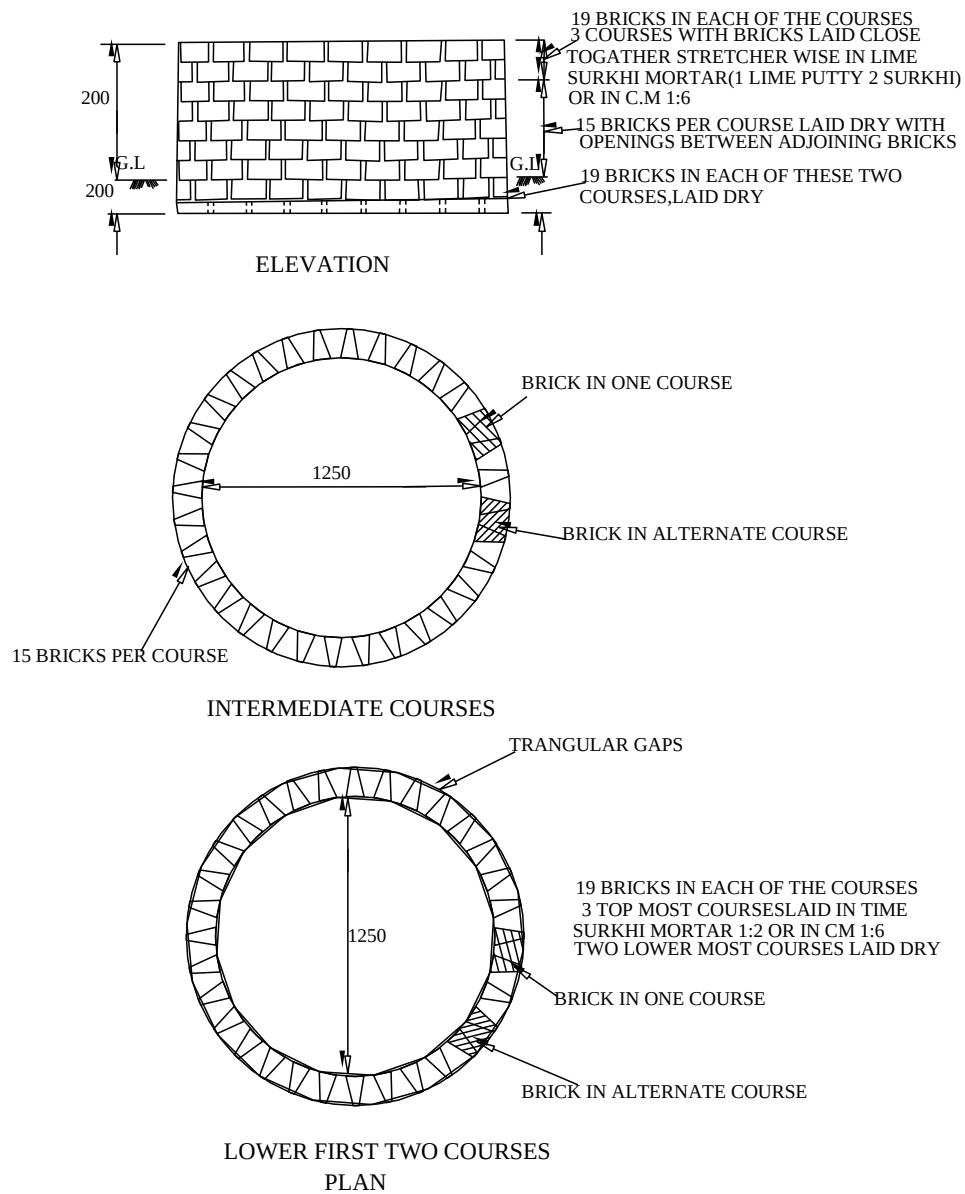
TRENCHING

FIGURE 16.1



BRICK TREE GUARD

FIGURE 16.2

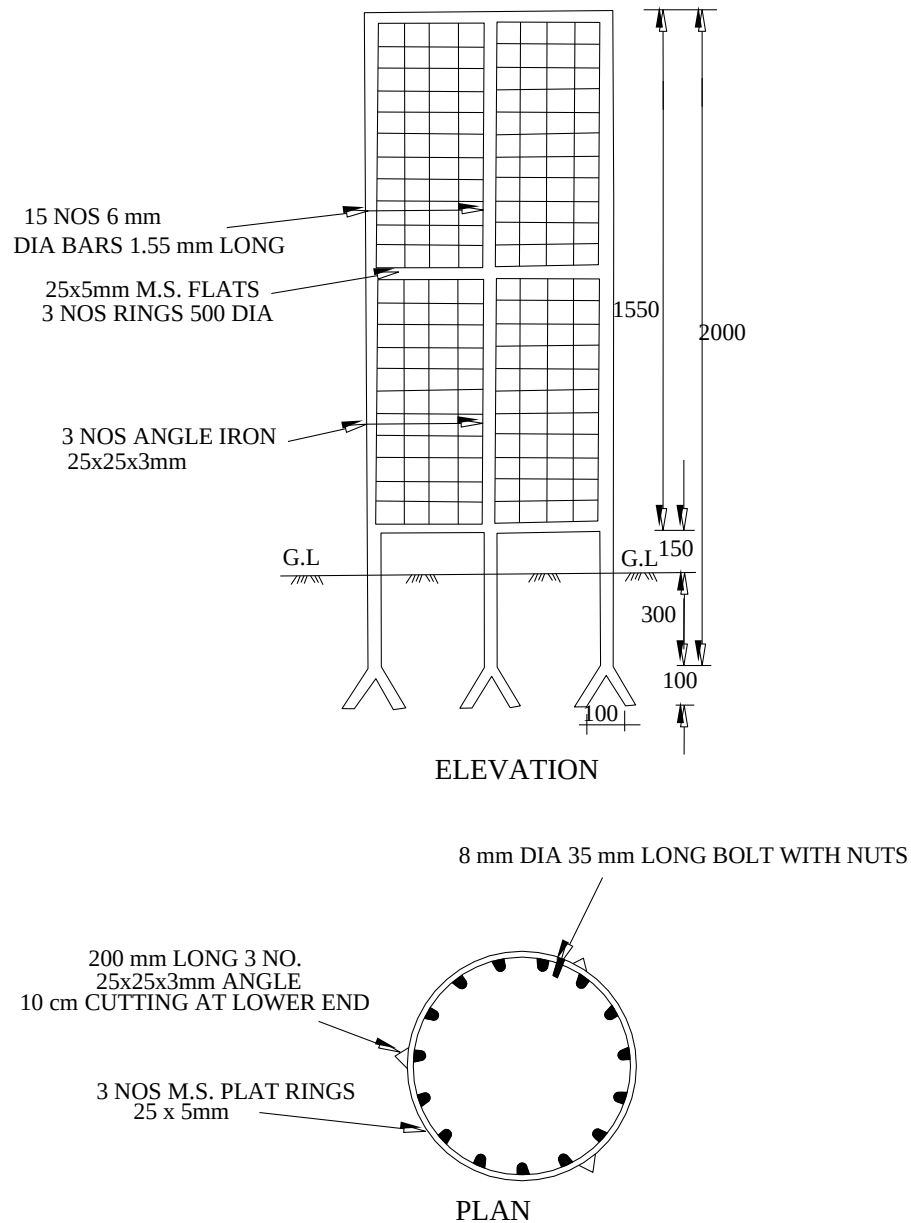


All dimensions are in mm

Drawings not to Scale

ORNAMENTAL TREE GUARD WITH M.S. BARS

FIGURE 16.3

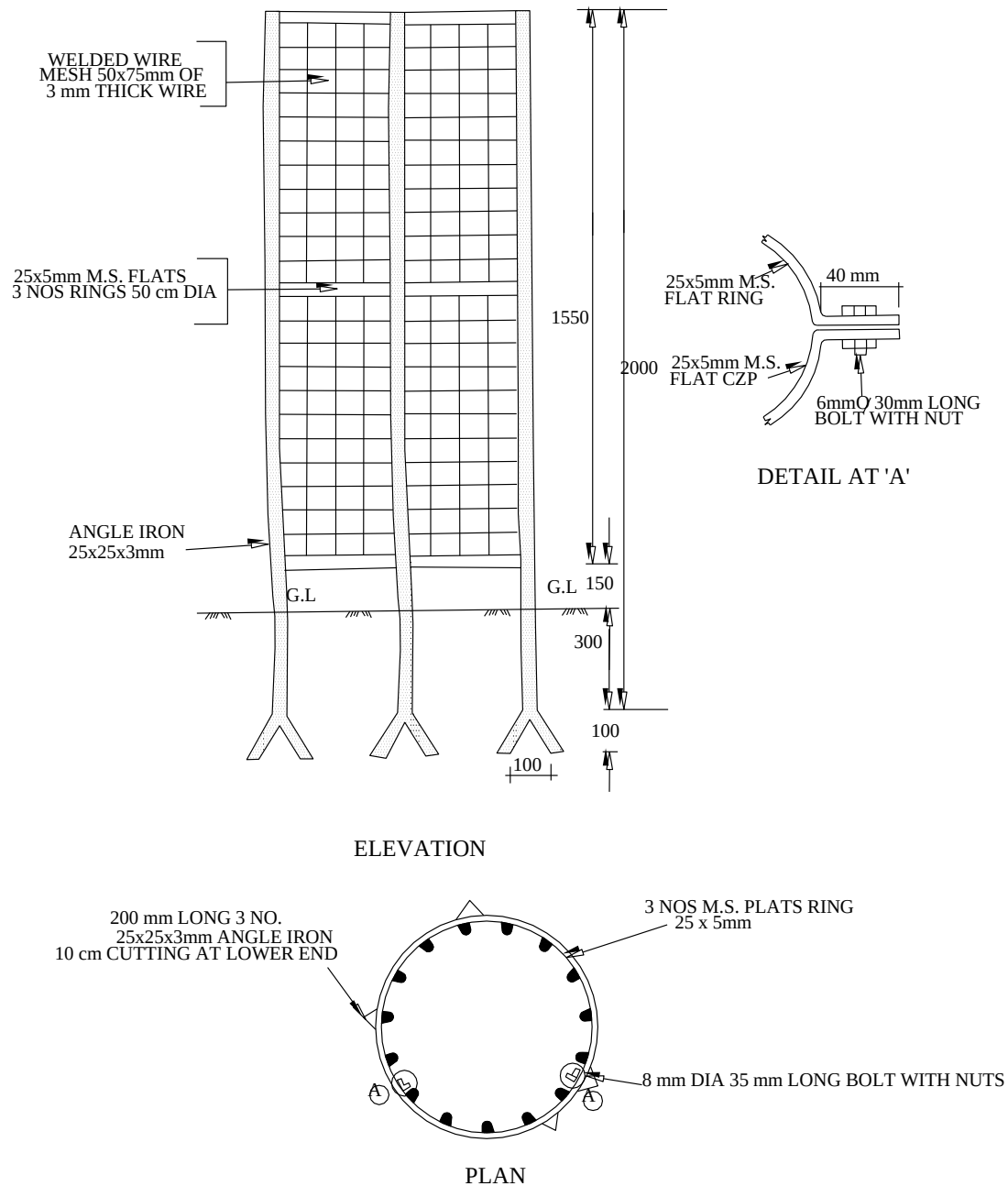


All dimensions are in mm

Drawings not to Scale

ORNAMENTAL TREE GUARD WITH WELDED MESH

FIGURE 16.4



All dimensions are in mm

Drawings not to Scale