

CHAPTER NO. 13

HOISTING AND ROOFING

SPECIFICATION NO. 13.1—Hoisting

1. Hoisting of lintels, battens, beams etc. shall be done carefully in such a manner that no damage to the structural unit is caused. If any damage does occur, the same shall be made good by the contractor. The structural unit, after being hoisted shall be placed at correct position and level specified by the engineer-in-charge. The battens shall be placed at the correct spacing, as ordered.

General.

2. The labour rates for hoisting include the labour charges for hoisting the structural units and placing them in position and also the cost of hoisting equipment such as ropes, hoisting tackle etc. The rates do not include the cost of mortar for placing the units at correct position and level, the same being already included in the rate of brickwork.

Rates.

SPECIFICATION NO. 13.2—Second Class Mud Roofing

Definition.

1. Unless otherwise specified, second class mud roofing shall consist of one layer of tiles 2 inches (5 cm.) thick resting on battens and covered with $1\frac{1}{2}$ inch (6 mm.) thick cement plaster (1 : 4) with two coats of hot bitumen, 1 inch (25 mm.) layer of mud plaster, 4 inches (10 cm.) layer of earth, another 1 inch (25 mm.) layer of mud plaster and finished with leepai.

Materials.

2. The tiles used shall be 12 inches \times 6 inches \times 2 inches (30 \times 15 \times 5 cm) and shall comply with the specification No. 3.6 for brick tiles.

The mortar used with the tiles shall be composed of one part cement to three parts sand and shall comply with the specification No. 2.2 for cement sand mortar.

Laying the battens.

3. The battens shall be of wood or of reinforced concrete of the type and size specified, and shall have properly finished surfaces at the top so as to give an even bearing to the tiles. The battens shall be equally spaced, 12 inches (30 cm.) apart centre to centre, and shall be placed in straight and parallel lines. No battens shall be placed closer than 3 inches (7.5 cm.) to a wall.

Slope to be in battens.

4. The necessary main slope in the roof shall be formed by sloping the beams or battens. Furring timbers shall only be employed where the former method is not practicable. Slope shall be 1 in 10 or any other gradient ordered by the Executive Engineer.

Layer of tiles.

5. Over the battens a layer of 12 inches \times 6 inches \times 2 inches (30 \times 15 \times 2 cm.) tiles shall be laid, with the joints coming over the centre of the battens. Tiles shall be laid by stretching a string so as to get straight parallel lines. All vertical joints shall be as fine as possible and filled with mortar fully without leaving any voids, whatsoever.

Tiles to be bonded with parapet wall.

6. Tiles resting on the walls shall have a bearing of at least $4\frac{1}{2}$ inches (12 cm.) and in no case less than 3 inches (8 cm.) and shall abut closely against the brickwork in the parapet, leaving no voids, wherever possible, the end of the tile shall be bonded into the brickwork.

Cement plaster and bitumen coat.

7. After the tile work has cured, the junction of parapet wall and tile layer shall be rounded off with a cement concrete 1:2:4 gola 4 inch \times 4 inch (10 cm. \times 10 cm.) quadrant and finished smooth. The top surface of the tiles shall be wetted and $\frac{1}{2}$ inch (6 mm.) thick coat of plaster of the same mortar as for tile work spread over it and then carried along the gola and parapet wall up to the drip course. The thickness of plaster coat on the gola and the parapet wall shall, however, be increased to $\frac{3}{4}$ inch (12 mm.). The plaster shall be fully cured for 10 days, allowed to dry completely and then covered with two coats of hot blown bitumen grade 85/25 as

SPECIFICATION NO. 13.2—Second Class Mud Roofing

per specification No. 13.10 at the rate of 54 lbs. per 100 sq. feet (2.75 kg. per sq. metre).

8. A one inch (25 mm.) layer of mud plaster in conformity with specification No. 2.6 shall be laid over the bitumen coat and on this four inches (10 cm.) of silty loamy soil satisfying the requirements of specification No. 6.7 (Earthwork on roofs) shall be well rammed to a density of 1.4 to 1.6. The roof shall then be finished off with another one inch (25 mm.) layer of mud plaster and leeped in the customary manner (Specification No. 15.6 and 15.7). This shall be done before laying the drip course to ensure a close joint next the wall.

Mud Plaster and earth filling.

9. In order to prevent scour, platforms or "Khurras" shall be made as per specification No. 13.14. These shall be made before the earth is laid.

Khurras.

10. On completion of the work, the underside of the tiles shall be washed and neatly pointed flush with lime surkhi mortar of 2 : 3 proportion or cement sand mortar 1 : 2 as per specification No. 15.8 as directed by the Engineer-in-charge.

Pointing underneath.

11. The space over the beams, and between the battens shall be closed in the manner indicated below. Where the wooden battens have been used, the space shall be closed by $\frac{1}{2}$ inch (12 mm.) planks nailed to distance pieces which in turn are nailed to the battens. Where concrete battens have been used, the space shall be filled with 1 : 3 : 6 cement concrete blocks of exact size and laid in place with 1 : 3 cement sand mortar. The filling must equal the battens in height and the outer face must be exactly in line with the edge of the beam.

Filling spaces between battens.

12. The through rate for second class mud roofing covers the following work :—

Rate.

Laying one layer of tiles in mortar as specified. Laying a coat of plaster on tile in mortar as specified with two coats of bitumen painting at the specified rate.

Laying a coat of mud plaster. filling earth and finishing with mud plaster and leepai. Plastering portion of parapet against which mud plaster and earth filling abut, and covering the same with two coats of bitumen painting at the specified rate. Pointing the underside of the tiling, and filling space between battens over the beams.

The labour rate includes the labour charges for above operations, cost of water, tools and plant, scaffolding (both labour and material), cost

SPECIFICATION NO. 13.2 Second Mud Roofing

of soil or earth for mud plaster and earth layer, and cost of clay and cowdung for leepai.

The rates do not include the provision of fixing of battens, or the making of "Khurras", "golas" and rain water outlets.

SPECIFICATION NO. 13.3—Third Class Mud Roofing

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| <p>1. Third class mud roofing is used for temporary structures only and each shall consist of one layer of sirki and sarkanda reeds covered with 1 inch (25 mm.) layer of mud plaster, 4 inch (10 cm.) layer of earth, another 1 inch (25 mm.) layer of mud plaster and finished with leepai.</p> | <p>General.</p> |
| <p>2. Mud plaster shall conform to specification No. 15.6 for mud plaster.</p> | <p>Materials.</p> |
| <p>Sirki and sarkanda reeds shall be new and of the best quality available locally.</p> | |
| <p>3. The battens shall be of wood of type and size specified and shall be placed in straight and parallel lines at specified spacing. No battens shall be placed closer than 3 inch (7.5 cm.) to a wall.</p> | <p>Laying the battens.</p> |
| <p>4. The necessary main slope in the roof shall be formed by sloping the beams or battens. The roof slope shall be at least of 1 in 40 or any other slope specified by the engineer-in-charge.</p> | <p>Slope to be in battens.</p> |
| <p>5. Over the battens, a layer of sirki, which has been soaked in hot creosote shall be laid. On top of sirki, a layer of sarkanda reeds about 2 inch (5 cm.) thick shall be placed without leaving any gaps or voids.</p> | <p>Laying of sirki and sarkanda.</p> |
| <p>6. The laying of mud plaster and earth filling shall be done in the manner specified in para 8 of specification no. 13.2 of "Second Class Mud Roofing".</p> | <p>Mud plaster and earth filling.</p> |
| <p>7. In order to prevent scour, platform and khurras shall be made as per specification no. 13.14. These shall be made before the earth is laid.</p> | <p>Khurras.</p> |
| <p>8. The through rate for third class mud roofing covers the cost of materials, their treatment and labour for placing them in position.</p> | <p>Rate.</p> |
| <p>The labour rate includes the labour charges for above operations, cost of water, scaffolding, earth for mud plaster and earth layer and cost of clay and cow-dung for leepai.</p> | |
| <p>The rates do not include the provision of fixing of battens or the making of khurras and rain-water outlets.</p> | |

**SPECIFICATION NO. 13.4—Precast Cement
Concrete Tile Roofing**

Definition.

1. Precast cement concrete tile roofing shall consist of layer of precast cement concrete tiles 2 inch (5 cm.) thick, resting on reinforced cement concrete battens, covered with $1\frac{1}{2}$ inch (38 mm.) thick screed of 1:4:8 cement concrete, two coats of hot bitumen, one inch (25 mm.) layer of mud plaster, 3 inch (75 mm.) layer of earth, another 1 inch (25 mm.) layer of mud plaster, and finished with leepai.

Materials.

2. The precast cement concrete tiles shall be 24 inches \times 24 inches \times 2 inches (60 \times 60 \times 5 cms.) size and shall be cast in 1:2:4 cement concrete as per specification no. 10.10 for precast cement concrete. Tiles shall be laid in 1:3 cement sand mortar, which shall comply with specification no. 3.6.

Laying the battens.

3. The battens shall be of reinforced concrete of the type and size specified, and shall have properly finished surfaces at the top, so as to give an even bearing to the tiles. The battens shall be equally spaced two feet (0.6 metre) apart centre to centre, and shall be placed in straight and parallel lines. No batten shall be placed closer than 3 inches (7.5 cm.) to a wall.

Slope to be in battens

4. Necessary main slope in the roofs shall be formed by sloping the beams or battens. The slope shall be 1 in 40 or any other gradient ordered by the Executive Engineer.

Laying the tiles.

5. Over the battens, a layer of 24 inches \times 24 inches \times 2 inches (60 \times 60 \times 5 cms.) precast cement concrete tiles shall be laid, with the joints coming over the centre of the battens. Tiles shall be laid by stretching a string so as to get straight parallel lines. All vertical joints shall be as fine as possible and filled with mortar fully without leaving any voids, whatsoever. The mortar in joints shall be fully cured for a week.

Tiles to be bonded parapet walls.

6. Tiles resting on the walls shall have a bearing of at least $4\frac{1}{2}$ inches (12 cms.) and in no case less than 3 inches (8 cms.) and shall abut closely against the brickwork in the parapet, leaving no voids. Wherever possible, the end of the tile shall be bonded into the brickwork.

Cement concrete screed and bitumen coats.

7. On the top of the tiles, $1\frac{1}{2}$ inch (38 mm.) thick screed of 1:4:8 mix cement concrete shall be evenly spread and finished with a float so as to present a smooth surface on the top. The cement concrete shall be fully cured and then covered with two coats of blown bitumen grade 85/25 as per specification no. 13.9 at the rate of 48 lbs. per 100 sq. ft. (2.4 kgs. per sq. metre). The portion of the parapet wall between the tiles and the drip course shall be plastered with $\frac{1}{2}$ inch (12 mm.) thick 1 : 3 cement sand plaster.

**SPECIFICATION NO. 13.4--Precast Cement
Concrete Tile Roofing**

8. The roof shall then be finished with mud and mud plaster as per specification no. 13.2 for Second Class Mud Roofing with the difference that the thickness of mud layer shall be 3 inches (7.5 cms.).

Mud plasters
and earth
filling.

9. On completion of the work, the underside of the tiles shall be washed and neatly pointed with cement sand mortar of 1 : 2 proportion as per specification no. 15.8.

Pointing
underneath.

10. Regarding provision of khurras and filling spaces between battens, specification no. 13.2., for Second Class Mud Roofing shall apply.

Khurras and
filling space
between battens.

11. The through rate for precast cement concrete tiles roofing covers the following work :--

Rate.

Laying one layer of precast cement concrete tiles in cement sand mortar.

Laying a screed of 1:4:8 cement concrete on tiles, with 2 coats of bitumen painting at the specified rate, laying a coat of mud plaster, filling earth and finishing with mud plaster and leepai.

Plastering portion of parapet against which mud plaster and earth filling abut, and painting the same with 2 coats of bitumen.

Pointing the underside of the tiles, and filling space between battens over beams.

The labour rate includes the labour charges for above operations, cost of water, tools and plants, scaffolding (both labour and materials), cost of soil or earth for mud plaster and earth layer and cost of clay and cow-dung for leepai. The rates do not include the provision for fixing of battens or making of khurras and rain water outlets.

SPECIFICATION NO. 13.5—Thatch Roofing

- Definition.** 1. Thatch roofing shall consist of full bamboos tied to the purlins with split bamboo frame on its top. On the bamboo frame shall be placed grass poolas of 2 or 3 layers, as specified.
- Materials.** 2. The bamboos shall have a diameter of $1\frac{1}{2}$ inches ($3\frac{3}{4}$ cms.) and shall comply with the specification no. 3.1. They shall be dipped in crude oil before use. The string used for tying shall be new, stout, good quality munj ban and shall be dipped in coal tar and dried before use.
- Grass poolas shall be best quality grass straw, well selected, fresh, clean and free from thorns, seeds etc. Grass poolas shall consist of straw having stems of 3 feet (1 metre) average length.
- Support.** 3. Full bamboos placed 12 inches (30 cms.) shall be tied to the purlins with tarred moonj ban or tarred string. Split bamboo frame 6 inches (15 cms.) square shall then be laid on the top of the bamboo rafters and shall be sewed down to the purlins and rafters with tarred moonj ban or tarred string.
- Grass Poolas.** 4. The poolas shall be opened out, shaken up lightly and stems of lengths smaller than $2\frac{1}{2}$ feet (0.8 metre) shall be removed by rough combing, with hand rake. The straw shall then be laid into a pile about 3 feet (1 metre) wide and 10 feet (3 metres) or so long, each layer being sprinkled with water as it is distributed over the heap to make the straw damp. Gentle beating with a flat wooden strick as the work proceeds shall be done to consolidate the heap and to loosen the flakes and the rubbish from the stems, as loose material of this kind not only decays quickly but also prevents the easy flow of water off the thatch. When the heap is big enough to contain at least a day's requirement of thatch and the straw has laid in the heap for a few hours, it shall be taken from the side of the heap by grasping the ends of straw in both hands and drawing it out with a vigorous pull commencing at the bottom of the pile where the straw is most tightly packed owing to the pressure resulting from the weight on top. By this method, the straws are cleaned of rubbish and each one comes out straight to lie evenly beside the other. As each handful is drawn clear of the pile, it shall be allowed to fall to ground so that by working from end to the end of the heap, a continuous row of clean straight straw is obtained. These shall be bunched into small poolas in readiness for laying.
- Laying.** 5. These poolas shall be carried to the bamboo frame on the roof with out disarranging the stems and the operation of laying the thatch shall be begun at the eaves upwards. The thick (bottom) end of the 'poolas' shall be kept downwards and the poolas shall be tied tightly with tarred moonj ban to the bamboo frame.

SPECIFICATION NO. 135—Thatch Roofing

'Poolas' shall be placed touching each other with their lengths parallel to the sides of the roof and shall then be opened and spread such that the thickness at the eaves is slightly more than 3 inches (7.5 cms.). It shall then be roughly levelled. As each poola is laid, the edge of the straw already in position shall be slightly lifted up and the new straw shall be pushed underneath an inch or so, in order that adjacent poolas are lapped together and a compact and unbroken joint is made between the two. The straw shall be gently beaten as it is laid and it shall be consolidated into a firm mass.

When the eaves row of 'poolas' has been laid, a bamboo split into half shall be laid on top at about 12 inches (0.3 metre) from the eaves, and parallel to them. This bamboo split shall be tied down with tarred moonj ban pressing the straw under it.

A second row of 'poolas' shall be taken in hand, in exactly the same way, tying each 'poola' of the second row on to a bamboo in the frame below, above the one to which the eaves row of 'poolas' was tied and so on.

The process of laying shall be repeated working upwards towards the ridge till the entire roof is covered, the surface being occasionally beaten gently, consolidated and combed down with hand take to preserve a straight line from top to bottom and to keep each stem in its place. The completed thickness of this covering shall be 3 inches (7.5 cms.).

Every effort shall be made to ensure that the bundles of straw mingle together effectively at the edges as the life of the thatched roof depends very largely on the way the joints are made.

6. The verges of the roof shall be laid with a double thickness of the straw to strengthen the edges and to throw the water away from the gable. A split bamboo shall be tied along the verges also.

Verges.

7. The top of the roof shall be finished off by laying bundles of straw longitudinally along the ridge, these being tied on as before, and being laid in just sufficient thickness to form a substantial (but not bulky) foundation for the crown of the thatch. The apex shall then be covered in by placing the final row of 'poolas' with their centre exactly across the top of the ridge and bending the ends down on either side so that they can be tied to the bamboo foundation. The angle on the top shall not be so acute as to buckle the straw.

Ridge.

8. Second and third layers of 3 inch (7.5 cms.) grass poolas shall be laid in the manner exactly similar to the first layer to produce the required thickness of 6 inches or 9 inches (15 cms. or 22.5 cms.) as specified.

Subsequent layers.

SPECIFICATION NO. 13-5—Thatch Roofing

Finishing.

9. The eaves and verges shall then be trimmed up by cutting the loose ends of the straw off in a straight line with a long scythe by sawing action. The roof when completed shall present a uniform appearance.

Measurement.

10. The finished area of the thatched roof shall be measured for purposes of payment.

Rate.

11. The through rates include the cost of bamboos, grass poles, strings including their wastage, etc. and their preservative treatment, wherever specified, and also the labour charges for fixing them. The labour rates include the cost of labour charges for the above operations. The rates do not include the cost of purlins.

SPECIFICATION NO. 13-6—Corrugated Iron Roofing

1. The corrugated galvanised iron sheets shall be of the gauge specified; if not otherwise specified, the sheets shall be 22—S.W.G. and shall conform to specification no. 3-27 in all respects. Hook, bolts, bitumen and steel washers, nuts and other accessories shall conform to Indian Standard : 730.

Materials.

2. The sheets will rest on horizontal purlins spaced so as to come under the ends, and to give one or two lines of intermediate supports. The roof trusses must be designed for purlin spacing to suit the standard lengths of sheets to avoid unnecessary cutting.

Purlins.

3. Each sheet shall be laid with 6 inches (15 cms.) lap at the end and a lap of 2 corrugations at the side, and laid so as to be turned away from the rainy quarter.

Laps.

4. The sheets shall be laid on the scantlings or purlins to a true plane surface, with the lines of the corrugations truly parallel or normal to the sides of the area to be covered. Each sheet shall be fastened by means of galvanized 'J' or 'L' hook bolts and nuts of not less than 5/16 inch (8 mm.) diameter with limpet washers. The limpet washers may be fitted in conjunction with bitumen washers or alternatively these may be filled with white lead as directed by the engineer-in-charge. The length of hook bolts shall be varied to suit the particular requirements. There shall be at least 3 hook bolts placed at the ridges of corrugations in each sheet on every purlin. Sheets shall be joined together at the laps by galvanized bolts and nuts 1 inch x 1/4 inch (25 mm. x 6mm.) size each with a bitumen washer and a limpet washer. The spacing apart of hook bolts and G.I. bolts shall not exceed 12 inches (30 cms.) in either direction.

Laying and fastening.

5. Holes for hook bolts etc. shall be drilled (not punched) in the ridges of the corrugations from the underside while the sheets are on the ground. All sheets with holes in valleys of corrugations shall be rejected. The holes in the washers shall be of the exact diameter of the hook bolts or G.I. bolts. The nuts shall be tightened from above to give a leak proof covering.

Holes.

6. Ridges and hips shall be covered by special ridge and hip sections. Where allowed by the Executive Engineer, the ridges and hips may be covered with plain, galvanized iron sheeting, 22—S.W.G. laid in lengths, with end and side laps of at least 12 inches (30 cms.). In either case they shall be secured down to purlins and sheets with hook bolts and G.I. bolts as directed.

Ridges and hips.

SPECIFICATION NO. 13-6—Corrugated Iron Roofing

Stopped edges.

7. Corrugated iron sheets shall not be built into gables and parapets, but shall be bent up along the edge, and suitable flashing provided; otherwise a projecting drip course shall be built as part of the parapet, to cover the joint by at least 3 inches (7.5 cms.).

Special fastening against gales.

8. In situations exposed to strong or storm, sheets shall be fastened down just above eaves by continuous lengths of $1\frac{1}{2}$ inches \times $\frac{3}{8}$ inch (28mm. \times 10 mm.) flat iron bars bolted down about every 5 feet (1.5 metres) by $\frac{1}{2}$ inch (12 mm.) bolts built a foot into the wall and secured at the lower end by a 3 inches (7.5 cms.) square washer. The work is not included in the rate and shall be paid at the rate for cold iron work.

Ceiling.

9. Galvanized iron sheeting shall not be ceiled so close to the sheeting so as to leave insufficient room to see the drip, should any leak occur.

Temporary work.

10. When corrugated sheets are used for roofing temporary buildings, no hole shall be made in them but they shall be secured in place by Windle's or other suitable clips.

Rate.

11. The through rate is inclusive of all necessary overlaps and provides for all bolts, nuts, screws, washers and patent or other fasteners required for the proper fixing of the roof. The rate also includes the cost of provision, erection and removal of scaffolding, benching, ladders, templates and tools required for the proper execution and erection of the work. The cost of fixing purlins is not included in the rate.

The labour rate covers the labour charges for the above operations including hoisting.

**SPECIFICATION NO. 13-7—Asbestos Cement
Sheet Roofing**

1. Asbestos cement sheet roofing shall consist of either corrugated sheets (such as Bib Six, Crownit etc.) or semi-corrugated sheets (such as Trafford, Super-thirteen, etc.) as specified. **General.**

2. The Asbestos cement roofing sheets and other fittings shall comply with specification no. 3-50 in all respects. Hook bolts, bitumen and steel washers, nuts and other accessories shall conform to Indian Standard : 730. **Materials.**

3. The sheets shall be laid on the purlins as indicated on the working drawings or as directed by the Engineer-in-charge. The lines of corrugations shall be truly parallel to the sides, of the area to be covered, unless otherwise directed. Purlin spacing shall not exceed 5 feet 6 inches (1.65 metres). **Laying.**

Each sheet shall be laid with a minimum lap of 6 inches (15 cms.) at the ends. For corrugated type of sheets, the side lap shall be half a corrugation, while for semi-corrugated type, it shall be one corrugation. The maximum free overhang at the eaves shall be not more than 15 inches (38 cms.). The sheets shall be laid on the smooth side upwards.

Corrugated sheets shall be laid from left to right starting at the eaves. The first sheet shall be laid uncut but the remaining sheets in the bottom row shall have the top left hand corners cut or "mitred" as described in para 4 below. The sheets in the second and other intermediate rows shall have both the top left hand corner and bottom right hand corner cut, with the exception of first sheet in each row, which shall have only the bottom right hand corner cut, and the last sheet in each row which shall have only the top left hand corner cut. The last or top row sheets shall all have the bottom right hand corner cut with the exception of the last sheet which shall be laid uncut. If the sheets are laid from right to left, the whole procedure shall be reversed. Semi-corrugated sheets shall be laid from right to left starting at the eaves. All semi-corrugated sheets shall have one end marked "Top" on the smooth side of the sheet. This end must always point towards the ridge.

4. The "mitring" described above is done by cutting from a point 6 inches (15 cms.) or (whatever the length of the end lay may be) up the vertical side of the sheets to a point 2 inches (5 cms.) along the horizontal edge for corrugated sheets and to a point $3\frac{1}{2}$ inches (8 cms.) along the horizontal edge for semi-corrugated sheets. This **Mitring.**

**SPECIFICATION NO. 13-7—Asbestos Cement
Sheet Roofing**

will ensure a snug fit where four sheets meet at a lap. The cutting may be done with an ordinary wood saw at site.

Fixing.

5. Sheets shall be fixed to the purlins by means of galvanized hook bolts or crank bolts of approved type and size. The diameter of the bolts shall not be less than 5/16 inch (8 mm.) Each galvanized bolt shall have a bitumen washer and a galvanized washer placed over the sheet before the nut is screwed down from above. One bolt on each purlin in the first crown on each side of the side lap shall be inserted to secure the sheets. Each nut shall be screwed lightly at first. After a dozen or so more sheets are laid, the nut shall be tightened and the joint made leak proof.

Roof boards or roof ladders shall invariably be used by workmen engaged on roofs covered with asbestos cement sheets to avoid damage to sheets and for safety.

Holes for bolts etc. shall be drilled (not punched) in the ridges of the corrugations while the sheets are on the ground. Hole diameter shall be 1/8 inch (3 mm.) greater than bolt diameter.

Expansion joints.

6. In roofs where there is likely to be some movement of the structure due to variations in climatic conditions, expansion joints shall be used in association with the semi-corrugated sheets to permit any such movements being taken up in sympathy with the movement of trusses and purlins. Such joints shall be provided on roof slopes more than 250 ft. (75 metres) in length. These shall be inserted at every 120 ft. to 160 ft. (40 metres to 50 metres) in the length of the slope. Specially manufactured expansion joint pieces available in the market shall be utilized for the purpose. No such joints shall be used in case of corrugated sheets.

**Special fastening
against gales.**

7. In situations exposed to strong winds of storm, sheets shall be fastened down just above the eaves, by continuous lengths of 1½ inches × ⅜ inch (38 mm. × 10 mm.) flat iron bars, bolted down about every 5 feet (1.5 metres) by ½ inch (12 mm.) bolts built a foot (30 cms.) into the wall and secured at the lower end by a 3 inch (7.5 cms.) square washer. The work is not included in the rate and shall be paid at the rate for cold iron work.

Ridges and hips.

8. Ridges of the approved type shall be used. If adjustable ridges used, they shall be fixed in pairs. The spigots and socket of the inner and outer wings shall coincide with the side laps of the sheets. For hips, special pieces shall be used.

SPECIFICATION NO. 13-7—Asbestos Cement
Sheet Roofing

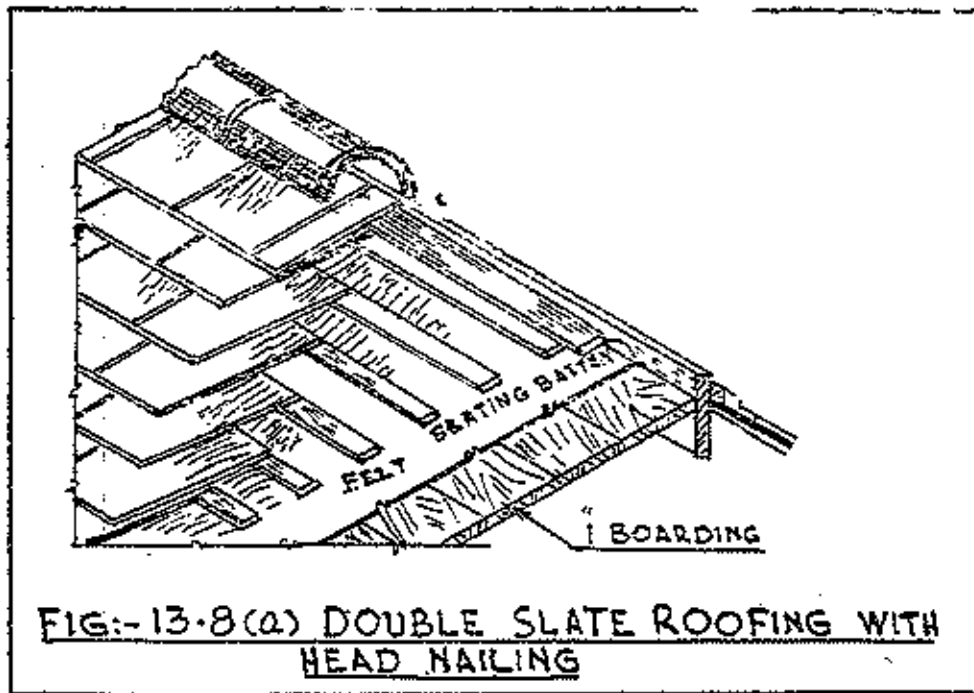
9. The through rates are inclusive of all necessary overlaps and expansion joints and provides for all bolts, nuts, screws, washers and patent or other fasteners required for the proper fixing of the roof. The rate also includes the cost of provision, erection and removals of scaffolding, benching, ladders, templates and tools required for the proper execution and erection of the work. The cost of purlins is not included in the rate. Rate.

The labour rates cover the labour charges for the above operations including hoisting.

SPECIFICATION NO. 13.8—Slate Roofing

General

1. The type of slate roofing to be provided shall be as shown in the drawings or as specified by the Executive Engineer. Generally speaking, slate roofing shall be of two types, namely, single-slate roofing and double-slate roofing. Single slate roofing is suitable for temporary buildings, and shall consist of a single layer of slates, overlapping such other and nailed to the nailing battens resting on roof rafters. Double-slate roofing is suitable for buildings where additional weather protection is desirable. In double slate roofing, nailing battens are fixed at half the spacing of single-slate roofing so that slates, completely overlap each other and there is a double layer of slates as shown in fig. 13.8 (a). If the use of roofing felt has been specified, one inch (2.5 cms.) thick boarding shall be necessary and the slates shall be nailed either direct to the boarding or to the nailing battens fixed over the boarding and felt.



Materials.

2. Slates shall be flat, properly squared to the specified size, with firm sizes and not liable to fracture when holed. They shall be tough, hard, sonorous on being struck, rough to the touch, free from flaws or cracks, non-absorbent, and of uniform thickness. The quarry from which the slates are obtained shall be subject to the approval of the Executive Engineer.

Slating nails shall be of copper or of non-rusting composition approved by the Executive Engineer, Deodar wood shall comply with specification no. 3.15.

SPECIFICATION NO. 13.8—Slate Roofing

Creosote will comply with specification no. 3.37.

Cement concrete for ridges shall comply with specification no. 10.10.

Roofing felt shall be tough and of the quality approved by the Executive Engineer.

PART I—DOUBLE SLATE ROOFING

3. The size of slates given below shall not be laid at pitches flatter than those given against each, nor must the pitch be greatly in excess of that given or undue strain is put upon the nails :— **Sizes and pitches.**

24" × 12" pitch (60 cm. × 30 cm.)	.. 22 degrees
20" × 10" pitch (50 cm. × 25 cm.)	.. 27 degrees
16" × 8" pitch (40 cm. × 20 cm.)	.. 33 degrees

4. When 'head nailing' has been specified by the Executive Engineer, two nails will be used at the head of each slate, placed at a distance of not less than 1 inch (2.5 cm.) from the head and side edges of the slate. In the absence of instructions to the contrary, head nailing will be employed. **Head nailing.**

5. When 'centre nailing' has been specified, two nails shall be used on or near the short axis of the slate, and not more than 1 inch (2.5 cm.) from its long edge. **Centre nailing.**

6. The laps, or the distance by which a slate overlaps the next but one below it, shall in no case be less than 3 inches (75 mm.). **Laps.**

7. All slates shall butt close to each other, with the rough side uppermost. Every nail shall be covered by the covering slate, except in the eaves course. **Placing.**

8. The nails shall be sunk not less than 1 inch (2.5 cm.) into the nailing batten by the board. Heads shall not be driven firmly against the slate but close enough to prevent any appreciable play. **Nailing.**

9. Nailing battens shall be of deodar wood and shall not be of a section less than 1½ inch × 1½ inch (38 mm. × 38 mm.). They shall be correctly spaced to the gauge adopted and firmly nailed to the supporting rafters or to the roof boarding. **Nailing battens.**

10. The roof boarding shall be 1 inch (25 mm.) thick tongue and groov jointed. All boards or battens shall be given 2 coats of hot creosote before slates are fixed. **Roof Boarding.**

SPECIFICATION NO. 13.8—Slate Roofing

Ridges concrete.

11. The top edge of the slates on each side of the ridge shall rest on the ridge plate, the top of which shall be splayed to the roof slope. The slates shall be accurately cut to form a straight and close joint. On the apex formed by the edge of the slates, a roll not less than 3 inches (7.5 cm.) and made of 1 : 2 : 4 cement concrete shall be formed, with its centre coinciding with the apex formed by the slates.

Ridges lead covered.

12. If lead ridging is specified, the slates shall butt against the ridge plate, the top of which will be flush with the top of the slates; lead tacks, 2 inches (50 mm.) wide and 15 inches (38 mm.) long will be nailed across the ridge at 2 feet (60 cm.) centres. A 3-inch (7.5 cm.) diameter ridge roll will then be secured to the ridge plate by double-pointed nails. Over the ridge will be dressed the lead covering resting 6 inches (15 cm.) on the slates on each side and held down by turning up the lead tacks.

Hips.

13. Hips shall be laid on the same manner as the ridge unless it has been specified that these should be concealed.

Concealed Hips.

14. Concealed hips will be covered by lead sheets which have been cut to the length of the slate in use, wide enough to cover at least half the width of a slate, bent over to straddle the hip batten, and fixed in position similarly to a slate. The lead will be covered completely by the upper slate, which must be accurately cut to form a straight and close joint.

PART II—SINGLE SLATE ROOFING

15. Single slate roofing shall be laid in the same manner as double slate roofing excepting that only head nailing shall be employed, centre nailing being not feasible. The head and side laps shall be at least 3 inches (7.5 cms.) and $1\frac{1}{2}$ inches (3.8 cms.) respectively.

Measurement.

16. All work shall be measured net as fixed without any allowance for laps except that openings of area 4 square feet (0.37 sq. m.) and under shall not be deducted. The portions of roof covered by ridge or hip coverings shall be included in the roof measurements. The ridge or hip coverings shall be measured in running feet (metres) and paid for separately.

Rate.

17. The through rates for slate roofing include the cost of slates, nails, ridges, hips etc., preservative treatment and the cost of hoisting and fixing them complete. The labour rates cover the labour charges for the above operations. The rates do not include the cost of boarding or battens, hip or ridge covering which shall be paid for separately. The roofing felt, if specified, shall also be payable extra.

SPECIFICATION NO. 13.9—Paving Roofing with Tiles

1. Wherever mud roofing is subject to wear, or where special protection from the weather is required, or to avoid the necessity of frequent repairs and plastering; the roof should be paved with brick tiles.

When and where necessary.

2. The tiles will be laid directly on the top layer of mud plaster whilst it is still plastic and leepai will be omitted.

Laid direct on mud plaster.

3. The tiles shall be of 9 inch \times 4 $\frac{1}{2}$ inch \times 1 $\frac{1}{2}$ inch (19 \times 9 \times 4 cm.) size and shall comply in every respect with specification no. 3.6 for "Brick Tiles".

Materials.

Cement sand mortar shall comply with specification no. 2.2.

4. Tiles shall be wetted for at least one hour before being laid. No damaged tiles shall be allowed to be used. They shall be laid to a slope of 1 in 40 by stretching a string so as to get straight parallel lines. Tiles shall be laid on mud plaster while it is in a plastic state and shall be tamped into position so as to get an even surface at the top, care being taken that the joints are true and straight. Joints shall not exceed 3/32 inch (2 mm.) in thickness. They shall then be grouted with cement sand mortar of 1 : 4 proportion. The mortar shall be mixed with so much water as to make it into a slurry for ease in grouting. Great care shall be taken that the joints are fully filled with mortar, leaving no voids. The mortar shall be finished flush with tiles.

Laying.

5. After grouting, the top surface shall be cleaned with wet gunny bags, the same day to remove cement sand mortar from surface of tiles, which shall be further cleaned with wire brushes after the mortar has set. The work shall then be cured for 7 days.

Cleaning and curing.

6. The through rates for tile terracing include the cost of tiles, mortars and other materials and laying tiles to proper slope, grouting the joints, cleaning the surface and curing. The labour rates include the labour charges for the above operations and water charges.

Rate.

SPECIFICATION NO. 13.10—Painting Roofs with Bitumen

- Where and when done.**
1. Where specified, first and second class mud roofs ; reinforced concrete and reinforced brick roofs shall be given a coat of bitumen as detailed below. Bitumen painting shall be done on warm sunny days and shall not be carried out in the wet weather conditions.
- Materials.**
2. The bitumen used shall be blown bitumen of grade 85/25 and shall comply with specification no. 3.41 in all respects.
- Preparation of surface**
3. When the surface to be treated is completely dry and smooth, it shall be thoroughly cleaned of all dust and other foreign matter by brushes and gunny bags.
- Application.**
4. The bitumen shall be heated to temperature specified by the manufacturers and maintained at that temperature (temperature being constantly checked with a thermometer). It shall then be poured and spread on the surface in a uniform continuous coating at the specified rate. For very large roofs, use of a spray machine (such as Harris trolley) is recommended to secure even spreading. The surface shall be carefully examined for gaps or pin-holes, which on location shall be carefully filled up with the bitumen. Bitumen shall be applied carefully so that the exposed faces are not disfigured by splashing or spattering the bitumen all over.
- Continue up to drip course.**
5. The coat of bitumen shall be continued at least 6 inches (15 cm.) along the vertical surfaces joining the roof. In case of parapet walls, it shall be continued up to the drip course.
- Rate.**
6. The through rate for applying bitumen on roofs includes the cost of bitumen fuel and other equipment, their carriage to roof and labour for applying the bitumen after cleaning the surface. The labour rate includes the labour charges for above operations, cost of fuel for heating bitumen and carriage of bitumen to roof.

**SPECIFICATION NO. 13.11- Bitumen Felt
Water-Proofing Treatment**

1. Unless otherwise specified, the normal bitumen felt water-proofing treatment on roofs shall consist of the following four courses:— Scope.

- (i) Hot applied bitumen at the rate of 24 lbs. per 100 sq. ft. (1.2 kg. per square metre).
- (ii) Bitumen felt.
- (iii) Hot applied bitumen at the rate of 24 lbs. per 100 sq. ft. (1.2 kg. per square metre).
- (iv) Pea-sized grit at the rate of 2 cft. per 100 sq. ft. (0.006 cubic metre per square metre).

For very severe climatic conditions, a larger number of courses may be necessary and for this purpose Indian Standard: 1346 "Code of Practice for Water Proofing of Roofs with Bitumen Felts" may be referred to for guidance.

2. Bitumen felt shall be hessian base self-finished felt type 3 grade complying with Indian Standard: 1322 Specifications for bitumen felts for water proofing and damp proofing". The weight of bitumen felt shall not be less than 50 lbs. per 12 sq. yard (22.7 kg./per 10 sq. metre) Materials.

Bitumen used for bonding shall be blown-type bitumen grade 85/25 and shall comply with specification no. 3.41 for "Tar and Bitumen".

Cement sand mortar shall comply with specification no. 2.2.

Grit shall comply with specification no. 3.35.

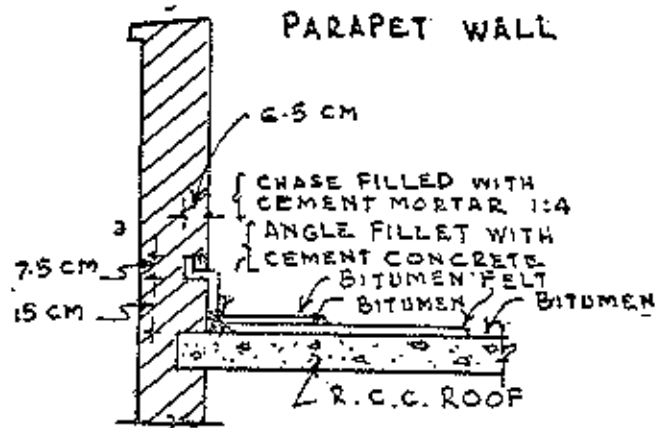
3. The old water-proofing treatment, if any, shall be removed. If the run-off gradient of an existing roof is less than 1 in 120, the roof surface shall be regraded by screeding with cement sand mortar to ensure everywhere a proper gradient of not less than 1 in 120. Preparation of roof surface.

The roof surface shall be thoroughly cleaned with wire brushes and all loose scale, fungus etc. removed. It shall then be dusted off with gunny bags. All cracks in the surface shall be cut to 'V' Section, cleaned and filled up flush with blown bitumen grade 85/25.

4. Drain mouths shall be widened two and a half times the diameter of the drain and rounded with 1:4 cement sand mortar. In case of parapet walls, chimneys etc. 2 inch × 2 inch (5 cm. × 5cm.) flashing grooves or chases shall be made in their vertical faces at a minimum height of 6 inches (15cm.) above the roof level. The horizontal Drain Oulets and parapet walls.

**SPECIFICATION NO. 13.11—Bitumen Felt
Water-Proofing Treatment**

faces of the grooves shall be shaped with 1 : 4 cement mortar as shown in fig. 13.11 (a)



**FIG. 13.11(a) WATER PROOFING TREATMENT OF
JUNCTION ON ROOF & PARAPET WALL**

A 1:2:4 concrete fillet shall also be constructed at the junction between the roof and the vertical face of the parapet wall to facilitate easy application of the treatment.

Laying.

5. After the surface has been prepared and the cement mortar wherever used, has set and dried, the laying shall be started. The felt shall be laid in lengths at right angles to the direction of the run-off gradient commencing at the lowest level and working up to the crest. The felt shall be first cut to the required lengths, brushed, cleaned of dusting materials and laid out flat on the roof. It shall then be rolled up for a distance of half of its length, and bitumen duly heated to the correct working temperature, poured at the roof across the full width of the rolled felt as the latter is steadily rolled out and pressed down. Excess bitumen is squeezed out at the ends and shall be removed as laying proceeds. When the first half of the strip of felt has been bonded to the roof, the other half shall be rolled up and then unrolled on to the hot bitumen in the same way. Minimum overlaps of 1 inch (10 cm.) and 3 inch (7.5 cm.) shall be allowed respectively at the end and the sides of strips of felt. All overlaps shall be firmly bonded with hot bitumen. The felt also shall be carried inside the drain pipes overlapping at least 4 inches (10 cms.).

Surface finish.

6. The felt shall then be painted with bitumen at the rate of 16 lbs. per 100 sq. ft. (0.8 kg. per sq. metre) and covered with pea-sized 3/16 to 1/4 inch (5.8 to 6.4 mm.) gauge grit at the rate of 2 cu. ft. per 100 sq. ft. (3.005 cubic

**SPECIFICATION NO. 13.11—Bitumen Felt
Water-Proofing Treatment**

metre per sq. metre). The grit shall be lightly tamped or rolled as convenient after application. On flashing or on a drain mouth, coarse sand shall be applied instead of grit.

7. Felt shall be laid as flashing, wherever junctions of vertical and horizontal structures occur with a minimum overlap of 4 inches (10 cm.) as shown in fig. 13.11 (a). The lower edge of the flashing shall overlap the felt laid on the flat portion of the roof and the upper edge of the flashing shall be tucked into the groove made in the parapet. The groove shall then be filled up with cement sand mortar 1:4 mix and cured by watering for at least 4 days.

Flashings

8. The superficial area of bitumen felt treatment without overlaps and keying in flashing grooves shall be measured.

Measurement

9. The rate includes the cost of cutting and cementing up of the flashing grooves, but excludes the cost of regrading of existing roof surface or removal of old water proofing treatment, which items shall be paid for separately.

Flashing Rate

SPECIFICATION NO. 13.12—Gutters and Flashings

General.

1. Gutters and flashings shall be made from milled lead weighing 6 lbs. per square foot (29 kgs. per sq. metre) or from 22 S.W.G. (0.70 mm.), galvanized iron sheeting, or as otherwise specified conforming to specification no. 3.27 Gutters shall be laid on 1 inch (25mm.) thick deodar boarding. Gutters shall have a fall of not less than 1 in 100. Where they do not run straight, the slope shall be doubled.

Lead shall be used where great durability is essential and also where the nature of the work requires the sheeting to be laid in a complicated form, or where the flashing has to be laid with many steps, requiring extensive cutting.

Valley gutters.

2. Valley gutters shall be designed to carry the maximum discharge from the roof without flowing over, and shall be constructed wherever possible with a sunk channel or gutter. Valley gutters must not be less than 6 inches (15 cms.) wide at the bottom.

In the case of slate roofs, and also tiled roofs where steel metal valley gutters have been specified, the following minima will apply: the clear width between the edges of the slates or tiles shall not be less than 15 inches (38 mm.) and the sheet shall be carried up not less than the full length of a slate or tile on each side.

Eaves gutters.

3. Eaves gutters shall be provided, semi-circular in shape and twice the diameter of the down pipes.

Flashings.

4. When the edge of a roof sheeting, or of a valley gutter is turned up against a wall, the edge shall be weather proofed with a flashing. The flashing shall be inserted into the brick work or masonry joints to a depth of 2 inches (5cms.) the joints being filled up with 1:3 cement sand mortar. It will be further secured in the joint by means of galvanised iron clips, the bases of which have been let in at least 4 inches (10 cms.) into the masonry. The lower edge of the flashing shall overlap the sheeting below it by at least 4 inches (10 cm.) the edges of the sheeting and flashing being left free for expansion and contraction.

Stepping back flashings.

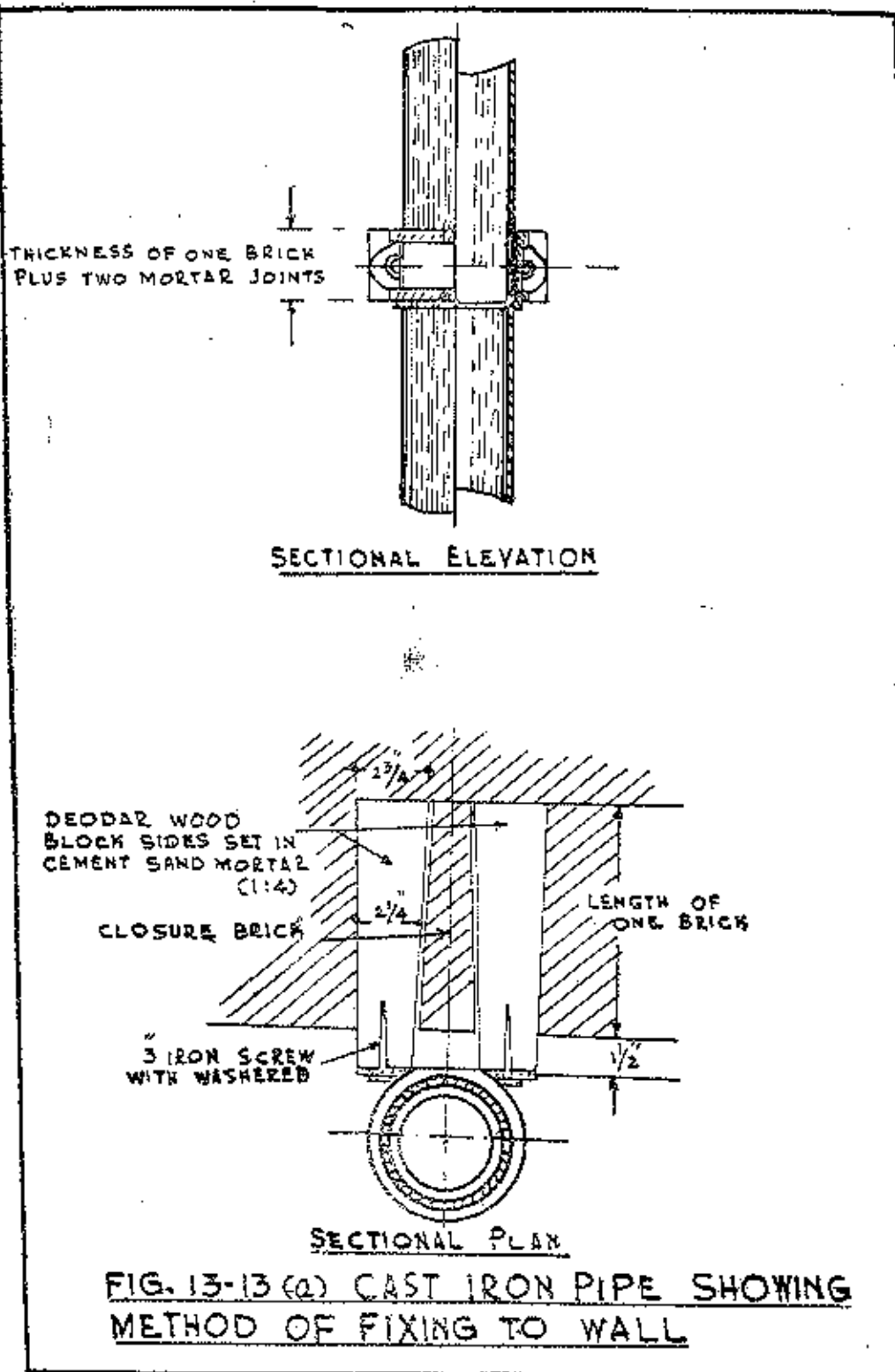
5. Wherever flashing has to be laid at a slope, it shall be stepped at each course of the masonry, the steps being cut back at an angle of not less than 30° to the vertical.

Rate.

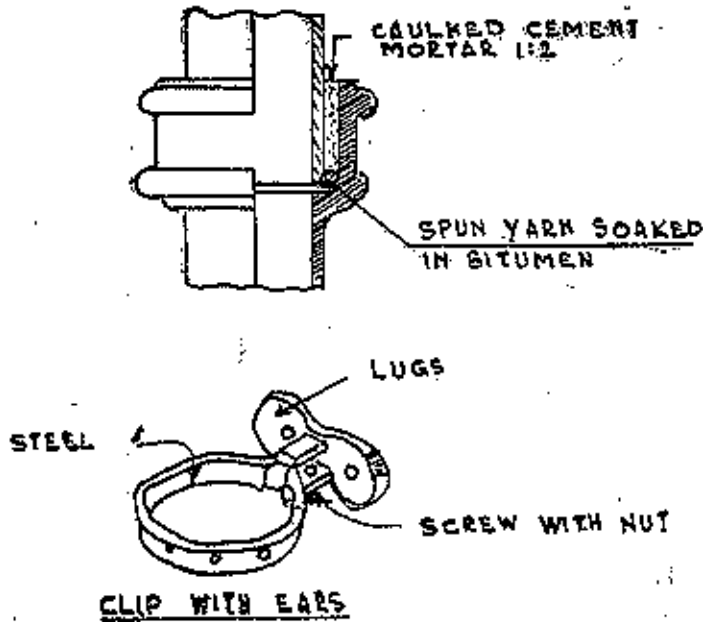
6. Valleys, valley gutters and eaves gutters shall be paid for by length. Flashings will be paid for by superficial area, the rates for stepped and plain work being different. The rate for valleys, gutters and flashings is for completed work fixed in place, including all laps and seams, brackets, slope ends, angles, bolts, nuts, washers, clamps, screws, etc. but does not include the boarding or boxing to which the sheet covering for the valleys or gutters is fixed.

SPECIFICATION NO. 13.13—Fixing Rainwater Pipes

- | | |
|--|---|
| <p>1. Down pipes for rainwater shall be provided to all buildings higher than one storey and wherever specified in single storeyed buildings. The pipes shall either be of the cast iron or asbestos cement. They shall be either fixed on walls or embedded therein as specified or directed by the Engineer-in-charge.</p> | <p>Where required.</p> |
| <p>2. The pipes shall be of the nominal bore specified by the engineer-in-charge. Cast iron and asbestos cement pipes shall conform to specifications nos. 3.54 and 3.50 respectively.</p> | <p>Materials.</p> |
| <p>3. The pipes shall be of such size as to provide one square inch of bore per sixty square feet (one square centimetre of bore per 0.8 square metre) of roof area drained, provided that no pipe shall be less than 3 inches (75mm.) in diameter. The spacing shall be so arranged, depending on the position of openings in the wall, as to be approximately 25 feet (7.5 metre).</p> | <p>Size.</p> |
| <p>4. The cast iron pipes shall be fixed by screwing the lugs to tapered deodar wood blocks as shown in fig. 13.13 (a) on page 356.</p> <p>The wooden blocks shall be fixed in the walls and shall be set with 1:4 cement sand mortar. The blocks must be fixed so as to hold the pipe $1\frac{1}{2}$ inch (38 mm.) from the wall in order to facilitate painting. The pipes and fittings shall be fixed perfectly vertical or along the lines as directed.</p> | <p>Fixing cast iron sheets.</p> |
| <p>5. The asbestos cement pipes shall be fixed in the same manner as cast iron pipes excepting that pipes shall be fixed with holder clamps. The clamps [as shown in fig 13.13 (b)] fit closely round the pipe and have lugs for screwing.</p> | <p>Fixing asbestos cement pipes.</p> |
| <p>6. The pipe shall be embedded in the wall if so specified or directed by the Executive Engineer. The cast iron pipes shall preferably be employed for embedding. Special care shall be taken that the open ends of the pipes are kept closed with gunny bags, so that these are not clogged up inside by mortar drippings. The pipe shall be surrounded by a layer of thick paper before being built in masonry.</p> | <p>Embedding pipes in walls.</p> |
| <p>7. The spigot of the upper cast iron or asbestos cement pipe shall be properly fitted in the socket of the lower pipe, so that there is a uniform annular space for filling with the jointing material. One-third depth of this annular space shall be filled in with spun yarn soaked in blown bitumen grade 85/25 and properly pressed with caulking tool. The remaining two-third depth of the joint shall be</p> | <p>Jointing.</p> |



SPECIFICATION NO. 13.13—Fixing Rainwater Pipes.



**FIG. 13.13 (b) ASBESTOS CEMENT PIPE
SHOWING JOINTING & HOLDER-CLAMPS**

tool and finished smooth at top at an angle of 45 sloping up. This will be cured for a period of seven days by stitching a piece of gunny bag four fold to the pipe and kept moist constantly.

8. The pipes, fittings and the joints shall be tested for leakage. Any defects which come to notice shall be removed to the satisfaction of the engineer-in-charge.

Testing.

9. The pipes shall be measured by length as fixed at site without any allowance for laps.

Measurement.

10. The through rates include the supply of all pipes and fittings, jointing and fixing in place complete. The rates exclude the cost of pipe accessories like head, shoes, bends etc. which shall be paid for separately. The cost of painting the pipes and clamps, etc., if got done, shall also be payable extra. The labour rates include the labour charges for jointing and fixing the pipes.

Rate.

SPECIFICATION NO. 13.14—"Khurras", *Parnalas* and Spouts

Top "Khurras".

1. Top "khurras" shall be 2 feet by 2 feet (60 cm. x 60 cm.) and shall be made of 1:2:4 cement concrete $1\frac{1}{2}$ inch (38 mm.) thick laid on 1:8:16 concrete of 2 inches (5 cms.) average thickness. The outside edge of the khurras shall be flush with the level of the mud plaster or *leepai* and the surface must slope uniformly from there to the outlet, which shall be 2 inches (5 cms.) over than the edges. The concrete shall be sloped 1 to 1 at the sides so as to be overlapped by the earth and mud plaster. The cement concrete shall be continued into the outlet so as to ensure a watertight joint.

Bottom "Khurras"
on a roof.

2. Bottom "khurra" on top of verandah or similar roofs shall be 2 feet x 2 feet (60 cm. x 60 cm.) and shall consist of a $1\frac{1}{2}$ inch (38 mm.) layer of 1:2:4 cement concrete laid on 1:8:16 cement concrete. The surface shall be shaped like a saucer drain, the depth of the saucer being 2 inches (5 cms.) and jointing up with the roof drain described in paragraph 6. The base concrete shall be of a section to give this curved surface and shall be of such thickness that the edges of the khurra are flush with the roof plaster. The rate of bottom khurra on the roof shall be the same as for a top khurra.

Bottom "Khurra"
on ground.

3. Bottom "khurras" when used on the ground, in conjunction with spouts, shall be 4 feet x 2 feet (120 cm. x 60 cm.) and shall consist of brick-on-edge laid in 1:3 cement sand mortar laid on 3 inches (7.5 cms.) of base cement concrete 1:8:16. The top surface of bricks shall be plastered with $\frac{1}{2}$ inch (12 mm.) 1:3 cement sand plaster. In the hills, where bricks are not available, bottom khurras shall consist of 6 inches (15 cm.) thick stone laid in 1:3 cement sand mortar over 3 inches (7.5 cms.) of cement concrete 1:8:16 with $\frac{1}{2}$ inch (12 mm.) thick 1:3 cement sand plaster on top.

"Khassi"
parnalas.

4. "Khassi" *parnalas* shall consist of two fillets of cement plaster raised $1\frac{1}{2}$ inch (38 mm.) and spaced 9 inches (23 cms.) apart clear; the space between being plastered with 1:3 cement sand plaster. The fillets shall be prismatic in section (but with all corners and angles rounded), the inner sides being at right angles to the wall and the outer sides sloping.

"Khassi" *parnalas* shall in no case be made on top of the lime or other plaster on the wall, but made in contact with the brickwork or masonry after raking out the joints.

Spouts.

5. Spouts shall be made of reinforced cement concrete, asbestos cement, cast iron or galvanised iron, as ordered. All spouts shall project at least 15 inches (40 cms.) from the face of the wall and shall

SPECIFICATION NO. 13.14—"Khurras", Parnalas, and Spouts

be built into the wall for a depth at least $13\frac{1}{2}$ inches (35 cms.) Spouts shall be fixed at a slope of not flatter than 1 in 6.

Reinforced cement concrete spouts shall have an open channel $3\frac{1}{2} \times 3\frac{1}{2}$ inches (9cms.x9 cms.) with a semi-circular bottom. The part built into the wall shall be sufficiently thickened to provide adequate support for the overhanging portion. Further they shall have a lip at the lower edge to allow water to drip clear.

Asbestos cement spouts shall consist of 4 inches (10 cms.) internal diameter, asbestos, cement, rain-water pipes cut to required length and shall satisfy the requirements of specification no. 3.50.

Cast iron spouts shall consist of 4 inches (10 cms.) internal diameter cast iron rainwater pipes, cut to required length and shall satisfy the requirements of specification no. 3.54.

Galvanised iron spouts shall be made from $1/16$ inch (1.6 mm.) thick plain galvanised iron sheets which shall conform to specification no. 3.27. The sheets shall be shaped in the form of a trough of 4x2 inches (10x5cm.) section to make spouts of required length.

6. Roof drains shall be provided on verandha and similar roofs to conduct the water, discharged by the "parnalas" of a higher roof to the outlet. They shall run in a straight line from the bottom "khurra" of one roof to the (top) "khurra" for the outlet concerned. The drain shall be saucer shaped in section, the depth being 2 inches (5 cms.). The drains shall be made of 2 inches (5 cms.) thick 1:2:4 cement concrete laid on 1:8:16 cement concrete of a section to give the necessary shape, with edges flush with the roof plaster.

Roof drains.

7. One *parnala* complete shall be provided for every 250 square feet (25 sq. metres) of roof area, and at least one spout shall be provided to a verandha or lower roof for each *parnala* draining on to it. The area drained by one spout shall not be more than 400 square feet (40 sq. metres) including the discharge from the *parnala*.

Number.

SPECIFICATION NO. 13-15—Wooden Plank Ceiling

- General.** 1. Wooden plank ceiling shall consist of wooden planks fixed to the underside of the ceiling joists $2 \times 2\frac{1}{2}$ inches (5 cms. x 6.25 cm.) placed 2 feet (60 cms.) apart and fastened to the underside of the beams of trusses.
- Materials.** 2. Timber shall be of the type specified and shall conform to specification no. 3-15 and para 2 of specification no. 17-1 on "Wood work General".
- Planking.** 3. The planks shall be $\frac{1}{2}$ inch (12 mm.) or $\frac{3}{4}$ inch (20 mm) thick, as specified. They shall be of uniform width not exceeding 6 inches (15 cm.); 3 inches (7.5 cm.) width being preferable. The planks shall be tongue and groove jointed, and planed true on the underside. The edges of the planks may be beaded or bevelled as may be shown on the relevant plans, or as ordered by the Executive Engineer.
- Fixing.** 4. The planks shall be screwed to ceiling joists 2 inch x $2\frac{1}{2}$ inch (5 cm. x 6.25 cm.) placed two feet (60 cms.) apart, and securely spiked to the underside of the tie beams or trusses.
- Joints.** 5. As the planks may swell in damp weather to a small extent, they shall be so fixed that they do not bulge when so swollen, but should, when so swollen, have neat and close joints. When dry, they should not therefore be forced tight against each other before being fixed. The planks shall be laid truly parallel or perpendicular to the walls and fixed with $1\frac{1}{2}$ inch (38 mm.) iron screws, using for every plank two screws at 4 feet (1.2 metre) intervals or on alternate joists, the screws for alternate planks being staggered. Unless otherwise specified, the end joints of planks will be butt joints, and shall come in the centre of the joists. The screws shall be countersunk and screw holes filled with putty or plastic filler.
- Beading.** 6. The ceiling shall be finished with a wooden beading or moulding running around the walls.
- Painting and varnishing.** 7. All planking and moulding shall receive two coats of solignum on upperside and be varnished or painted two coats on underside.
- Measurement.** 8. The plank ceiling shall be measured by net superficial area.
- Rate.** 9. The through rates shall be for complete fixing in place of the ceiling including cost of all materials and wastage, but exclusive of cost of joists, beading, solignum coat and varnishing, which shall be paid for separately. The labour rates include the labour charges for the above for planking.

SPECIFICATION NO. 13-16—Cloth Ceiling

1. Cloth ceiling shall be either of textile cloth or hessian cloth, fixed to a light wooden frame screwed to the underside of tie beams and fixed to wooden blocks let into the walls.

General.

2. The textile cloth shall be either double warped (*dasty*) cloth, weighing 8 ounces per sq. yard (0.27 kgs. per sq. metre). When hessian cloth is used, it shall comply with the specification no. 3.48. Before use, the textile cloth shall be thoroughly washed to free it from chemicals.

Materials.

3. The cloth shall be first damped, stretched and nailed to the light wooden frame. Wooden beading 2 inch X $\frac{1}{2}$ inch (50 mm. X 12 mm.) shall then be screwed through the cloth to the frame to form square or oblong panels, not more than 5 feet (1.5 metres) long.

Fixing.

4. Cloth shall be white-washed or distempered or finished in any manner desired by the Executive Engineer.

Finishing.

5. The cloth ceiling shall be measured by net superficial area.

Measurement.

6. The through rate for cloth ceiling includes the cost of all materials and labour charges for fixing the same. It however does not include the cost and labour for wooden frame, beading and finishing treatment, which shall be paid for separately. The labour rate covers the labour charges for fixing the ceiling in position only.

Rate.

SPECIFICATION NO. 13.17—Plywood Ceiling

- General.** 1. Plywood ceiling shall consist of fixing the plywood panels to a wooden frame so as to make panels of required size and shape.
- Materials.** 2. Plywood shall comply with specification no. 3.16. Unless otherwise specified, plywood shall be 3 ply 4 mm. thick. The thickness shall be suitably increased by the Executive Engineer if the size of the panel is too large.
- Fixing.** 3. The plywood sheets shall be laid truly parallel or perpendicular to the wall and shall be fixed to the battens with 1 inch (25 mm.) iron screws. All joints shall be neat and clean. A gap of $\frac{1}{8}$ inch to $\frac{1}{4}$ inch (3 mm. to 6 mm.), shall be kept between the adjoining edges of the sheets, which shall on no account be forced into position.
- Beading.** 4. All joints in the plywood ceiling shall be covered by beading. Deodar wood beading of a specified size shall be screwed to the battens on the underside of the plywood sheet. The overlap of the beading shall be equal on each of two adjoining sheets. The beading shall be mitred at junctions. The screws fixing the beading shall be staggered along its length, so that each one passes completely through one sheet or the other. The spacing of screws shall not exceed 6 inches (15 cms.).
- Finishing.** 5. The plywood ceiling shall be painted to a specified shade, as per specification no. 16.2 "Painting Woodwork" if so ordered.
- Measurement.** 6. Plywood ceiling shall be paid for net superficial area.
- Rate.** 7. The through rate includes the cost of all materials and fixing the ceiling including all wastage, but excludes the cost of frame work beading and painting which shall be paid for separately.
- The rate given in the common Schedule of Rates includes the cost of 3 ply 4 mm. plywood. If thicker plywood is used, the through rate shall be suitably increased. The labour rate includes the labour charges for fixing the ceiling in position.

SPECIFICATION NO. 13.18—Asbestos Sheet Ceiling

1. Asbestos sheet ceiling shall consist of fixing the asbestos cement boards to a wooden frame. The battens of the wooden frame shall be arranged, so as to make panels of specified size and shape.

General.

2. Asbestos cement boards shall comply with the specification no. 3.50 and shall be either 3/16 inch (4.75 mm.) thickness as specified.

Materials.

3. The boarding shall be laid truly parallel or perpendicular to the walls and shall be fixed to the battens with 1 inch (25 mm.) iron screws. Holes in the boards shall be drilled and on no account be punched. No hole shall be nearer than 1/2 inch (12 mm.), to the edge of the sheet. The boarding shall be butt jointed with screws at 6 inch (15 cm.) intervals at edges and 12 inch (30 cm.) intervals in middle. Screws shall be countersunk and covered by plaster of Paris. A gap of 1/2 inch to 1/4 inch (3 mm. to 6 mm.) shall be kept between the adjoining edges of the sheets. If asbestos cement bevelled edge cover strips are used, 1 inch (25 mm.) flat headed nails may be used instead of screws. Cover strips shall be fixed to battens with screws at 12 inches (30 cm.) centre to centre.

Fixing.

4. The ceiling when completed, shall present a neat and uniform appearance. Care shall be taken to see that asbestos cement boarding is not dirtied during construction. Usually, no finishing treatment of asbestos cement ceiling is needed. The ceiling may, however, be painted to desired shade, as per specification no. 16.4 if so ordered in writing by the Executive Engineer.

Finishing.

5. The asbestos cement ceiling shall be paid for net superficial area.

Measurement.

6. The through rate includes the cost of all materials including wastage and labour for fixing asbestos cement ceiling, but excludes the cost of framework, cover strips and painting, which shall be paid for separately.

Rate.

The rate given in the Schedule of Rates provides for 3/16 inch (4.75 mm.) thick asbestos cement boards. If boards of greater thickness are used on account of design considerations, the through rate shall be increased suitably. The labour rates include the labour charges for fixing the ceiling in position.

SPECIFICATION NO. 13.19—Insulation Board Ceiling

- General.** 1. Insulation board ceiling [shall consist of fixing the insulation board (Celotex, Treetex, Ferrolite etc. etc.) to a wooden frame, so as to make panels of required size and shape.
- Materials.** 2. Insulation boards shall comply with the specification [no. 3.46 and shall be half-inch (12 mm.) thick.
- Fixing.** 3. The boards shall be laid truly parallel or perpendicular to the walls and shall be fixed to the battens with 1 $\frac{1}{2}$ inch (38 mm.) iron screws.
- All joints shall be neat and close. The sheets [shall not be forced up against one another and there shall be a gap of $\frac{1}{8}$ inch to $\frac{3}{4}$ inch (3mm. to 6 mm.) between the edges of the adjoining sheets.
- Beading.** 4. All joints in the insulation board ceiling shall be covered by beading unless otherwise specified. Deodar wood beading 3 inches wide and $\frac{1}{2}$ inch thick (75 and 12 mm.) shall be fixed to the battens with 2 inch (5 cm.) screws on the underside of the boarding.
- The overlap of the beading shall be equal on each of the two adjoining sheets. The beadings shall be mitred at junctions.
- The screws fixing the beading shall be staggered along its length, so that each one is given completely through one sheet or the other.
- The spacing of screws shall not exceed 6 inches (15 cms.).
- Finishing.** 5. Care shall be taken to see that the uniformity of the colour of sheets is not spoilt during fixing operations. The ceiling when completed shall present a neat and uniform appearance. Usually, no finishing treatment of insulation boards ceiling is needed. It may, however, if so desired by the Executive Engineer, painted or distempered to required shades.
- Measurement.** 6. The insulation board ceiling shall be paid for net superficial area.
- Rate.** 7. The through rate includes the cost of $\frac{1}{2}$ inch (12 mm.) thick insulation board and screws and fixing the insulation board ceiling in position. The rate does not include cost of wooden frame, finishing treatment, if any, and beading, which items shall be paid for separately. The labour rate includes labour charges for fixing the insulation board ceiling in position.

SPECIFICATION NO. 13.20—Plaster of Paris Ceiling

1. The plaster of Paris ceiling shall consist of precast plaster of Paris tiles or slabs of $\frac{1}{2}$ inch (12 mm.) thickness, fixed to a deodar wooden frame. In case of flat roofs, the wooden frame shall be suspended from the roof above by means of flat iron strips or mild steel bars of suitable sections, while in case of sloping roofs, the wooden frame shall be directly fixed to the underside of the tie bars of trusses.

General.

2. The deodar wood used for the frame work shall conform to specification no. 3.15.

Materials.

Hessian cloth shall conform to specification no. 3.48.

Plaster of Paris shall be anhydrous gypsum and shall conform to British Standard : 1191.

3. The wooden frame shall consist of main and cross battens of suitable sections, as directed by the engineer-in-charge. The battens shall be arranged so as to make panels of size suitable for fixing the plaster of Paris tiles. The frame work shall be given two coats of creosote before it is covered up with ceiling.

Frame.

4. The slabs of plaster of Paris reinforced with hessian cloth shall be prepared in suitable sizes not greater than $2\frac{1}{2}$ ft. \times $2\frac{1}{2}$ ft. (75 \times 75) cms.

Preparation of Tiles.

Wooden forms $\frac{1}{2}$ inch (12 mm.) thick shall be placed on a truly level and smooth surface, preferably over a glass sheet. The glass sheet or the surface on which form is kept shall be given a thin coat of nonstaining oil to facilitate the removal of the tile. Plaster of Paris shall be evenly spread into the form up to about half the depth and coarse and strong Hessian cloth turned over to form a double layer at edges shall be pressed over the plaster of Paris layer. The form shall then be filled with plaster of Paris, uniformly pressed and wire-cut to even and smooth surface. The tile so moulded shall be allowed to set initially for an hour or so, and then removed from the form and allowed to dry and harden for about a week. A good tile after drying and hardening shall be a ringing sound when struck.

5. The tiles so precast shall be fixed to the cross battens of the ceiling frame with $1\frac{1}{2}$ inch (15 mm.) brass screws at about 8 inch (20 cm.) centres in both the directions. The joints shall be filled with plaster of Paris mortar and finished smooth.

Fixing.

6. The ceiling shall be measured by net superficial area. The variation of minimum thickness of plaster of Paris ceiling from the specified one shall not be more than $\frac{1}{2}$ inch (3 mm.).

Measurement.

SPECIFICATION NO. 13.20--Plaster of Paris Ceiling

Plaster work in
situ.

7. Where so specified plaster work may be done *in situ* on wooden laths instead of using precast tiles. In this type of work, wooden strips or laths 1 inch \times $\frac{1}{2}$ inch (25 mm. \times 6 mm.) of specified wood with $\frac{3}{8}$ inch (10 mm.) gaps in between shall be fixed to the cross battens with flat headed nails at distances not exceeding 18 inches (45 cms.) centres. The strips shall be butt jointed and not overlapped. The joints shall be staggered. Rabbit wire mesh shall then be fixed to the underside of the strips with nails. Plaster of Paris of specified thickness shall be applied to the underside of laths in suitable panels and finished gently to a smooth surface by steel trowels to an approved pattern. The joints shall be finished flush to make the ceiling in one piece or in pattern as approved.

Rate.

8. The through rate for plaster of Paris ceiling shall include the cost of all materials for making and fixing the wooden frame or cradling (including preservative treatment), casting and fixing tiles in position including cost of brass screws and jointing with plaster of Paris mortar and all scaffolding and staging, etc.

The labour rate includes the labour charges for all the above operations and sawing charges.