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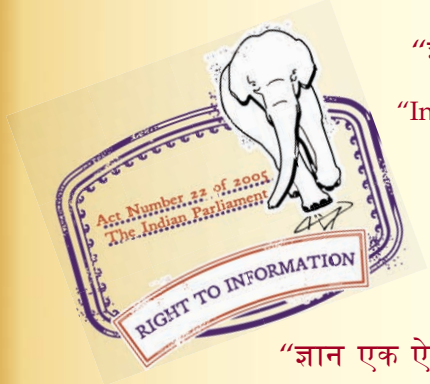

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CODE OF PRACTICE FOR FLAT ROOF FINISH : MUD *PHUSKA*

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CODE OF PRACTICE FOR FLAT ROOF FINISH : MUD *PHUSKA*

(Second Revision)

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Indian Standard

CODE OF PRACTICE FOR FLAT ROOF FINISH : MUD *PHUSKA*

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 31 October 1980, after the draft finalized by the Building Construction Practices Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Mud *PHUSKA* is a common type of insulating course in the roof used in hot dry regions of the country, such as in the states of Punjab, Uttar Pradesh and other regions where the rainfall is not heavy. Its use is cheap, reasonably durable and adds enough therma insulation for maintaining relatively comfortable temperature in the interior. In laying the roof, however, there are several important details of workmanship which, if neglected, will considerably reduce the efficacy of the roof. This standard is intended to serve as a guide in the work of laying mud *PHUSKA* in flat roofs.

0.3 This standard was first published in 1962 and subsequently revised in 1967. The present revision has been taken up to incorporate the improvements found necessary during usage of the standard and in the light of comments and suggestions received from various organizations. In this revision, the requirement of soil for the preparation of mud *PHUSKA* and mud plaster has been modified so that a reasonable cohesive soil could be obtained. The binding and reinforcing ingredients which are actually used in practice for the preparation of mud plaster has been spelt out and the method of preparation of 'leeping' plaster has been dealt in detail. The revision also specifies the minimum compacted thickness of *PHUSKA*.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers the laying of mud *PHUSKA* with or without bricktiling, on a flat roof surface.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Flat Roof — A practically level roof surface with a small slope for the purpose of drainage, the slope generally not exceeding 1 in 10; the term is used in contrast with 'pitched or sloped roof'.

2.2 Mud *PHUSKA* — An insulating medium in roof finish of a layer of compacted soil underlying another layer of soil mixed with building material such as cowdung and fibrous reinforcing ingredient such as wheat straw.

2.3 Roof Finish — The top part of the roof which contributes protection and durability to it, without itself being a structural or supporting element in the roof.

2.4 Sub-floor — The supporting part of the roof underneath the roof finish.

2.5 Burnt Clay Pozzolana — An artificial pozzolana obtained by burning clay under specified condition and grinding to a specified degree of fineness (*see* IS : 1344-1959*).

3. NECESSARY INFORMATION

3.1 For efficient planning and construction of the roof finish, detailed information in regard to the following are necessary:

a) Area of roof to be finished;

b) Levels to which the roof should be finished and direction of the slope of the finish for facilitating drainge including details of parapet walls; and

c) Waterproofing and similar other supplementary treatments to be used below the mud *PHUSKA* medium.

3.2 All the information stated in **3.1** shall be made available to those who are responsible for finishing the roof before the work is started. Necessary drawings and instructions for preparatory work shall also be given.

*Specification for burnt clay pozzolana (*first revision*).

3.3 Arrangements shall also be made for the proper exchange of information amongst all, concerned with the execution of the roofing work to ensure proper co-ordination.

4. DESIGN CONSIDERATIONS

4.1 Protection Against Water Penetration

4.1.1 Mud *PHUSKA* layer by itself may not be sufficiently waterproof for the roof and it may be necessary to provide beneath it a waterproofing layer or membrane to be effective in this respect. Care shall also be exercised while doing the roof finish work to compact the mud *PHUSKA* layer to the maximum density (*see* **8.1**).

4.1.2 The slope of the terrace shall be such as to drain off promptly all rain-water falling on the roof surface well before the water begins to seep through cracks, if any, into the mud *PHUSKA* layer. The slope shall not be less than 1 in 40. If it is not possible to give all the slope by the mud *PHUSKA* layer, part of the slope required for roof drainage may be given in the sub-floor itself.

4.1.3 Rain-water pipes to be provided for roof drainage shall be determined in accordance with the intensity and duration of the rainfall in the area. The cross-sectional area of flow of the rain-water pipe shall be not less than 1/5000 of the roof area drained, and the pipe shall in no case be less than 100 mm diameter.

4.2 Durability — Mud *PHUSKA* will be suitable in hot dry regions where the rainfall is not heavy and extremely hot temperature occur during the summer. The durability of the mud *PHUSKA* layer depends on how the protective surface, namely, the mud plaster or the brick tiles layer as the case may be, are maintained free of cracks. When the cracks develop in the mud plaster, or when the joints of brick tile layer get dislodged, water will find its way to the mud *PHUSKA* layer through seepage. Regular maintenance is necessary to fill up cracks so as to extend the life of the finish.

4.2.1 In areas where there is no rainfall and there is very little variation in temperature, and where clay of good quality is used for mud *PHUSKA* paving with tiles may not be necessary over the mud *PHUSKA* layer. Paving finish will, however, be necessary where the roof is used for living and sleeping purposes and also if additional durability and thermal insulation is required.

5. MATERIAL

5.1 Soil for Mud *PHUSKA* — The soil for mud *PHUSKA* shall be free from gravel and coarse sand (of particle size greater than 2 mm),

vegetable matter and fine *KANKAR* particles. The coarse material shall not exceed 25 percent by mass. The soil shall also be free from harmful and efflorescent salts. The plasticity index of the soil shall be between 10 to 15 percent.

NOTE 1 — Generally soil suitable for brick making is suitable for mud *PHUSKA* also.

NOTE 2 — Soils collected from localities afflicted by white ants may not be suitable.

NOTE 3 — The above plasticity index will indicate a reasonable cohesive soil.

5.2 Soil for Mud Plaster and Mud Mortar—The soil shall be free from vegetable roots, gravel and coarse sand of particle size greater than 2 mm. The coarse material shall not exceed 10 percent by mass. The soil shall also be free from harmful and efflorescent salts. The plasticity index of the soil shall be between 10 to 15 percent.

5.3 Mud Plaster—The mud plaster shall be prepared from soil conforming to **5.2**. The dry soil shall be reduced to fine powder and mixed with water in a pit, adding wheat straw 6 percent by mass and cowdung 12 percent by mass. The mixture shall be allowed to rot for a period of not less than 7 days. During this period, it shall be pugged manually using spades if necessary to get a homogeneous mass free from lumps and clods.

NOTE — The wheat straw used may be of any size since it would be broken to small size during the rotting period.

5.3.1 The consistency of the mortar shall be adjusted by taking it in a trowel and observing how it slides off the face of the trowel. The mortar shall readily slide off, but at the same time shall not be so wet as to part into large drops before falling. Alternatively, slump test may be performed in accordance with the procedure laid down in IS : 1199-1959*. The slump should be about 70 mm.

5.4 Cut-Back Bitumen — Cut-back bitumen shall be prepared by adding 20 parts of kerosene oil and 1 part of paraffin wax to 80 parts of 80/100 bitumen melted on gentle fire. The mixture shall be worked to a homogeneous mass.

5.5 Mud Mortar — Mud mortar used as bedding under brick tile layer shall be prepared in the same manner as mud plaster (*see* **5.3**) but without any addition of fibrous reinforcing material and binding material. The mud mortar may be used immediately without any rotting period.

5.5.1 The mortar shall be mixed with 2 percent of bitumen cut back (*see* **5.4**) by mass of dry soil and worked to a homogeneous mass.

*Methods of sampling and analysis of concrete.

5.6 *'LEEPING'* Plaster (*GOBRI LEEPING*) — This shall be prepared by mixing soil with equal volume of cowdung and adding the required quantity of water to make a thin paste. The soil used shall be free from coarse sand and gravel. The mixture shall then be worked to a homogeneous mass. Five percent of cut back bitumen by mass of dry soil may be added to improve upon the waterproofing characteristics.

5.7 Brick Tiles — These shall conform to the requirements given in IS : 2690 (Part I) - 1975* or IS : 2690 (Part II) - 1975†.

5.8 Cement — This shall conform to either IS : 269 - 1976‡ or IS : 455 - 1976§ or IS : 1489 - 1976‖.

5.9 Sand or Fine Aggregate — These shall conform to IS : 2116-1980¶.

5.10 Burnt Clay Pozzolana — This shall conform to IS : 1344-1968**.

5.11 Cement Mortar for Grouting — Cement mortar for grouting shall consist of one part of cement and three parts of sand by volume or any richer mortar as may be required in special circumstances. The mortar shall be prepared as laid down in IS : 2250 - 1965††. Wherever ordinary cement is used, it will be preferable to add burnt clay pozzolana in suitable proportions depending upon its pozzolanic activity.

6. PROGRAMMING OF WORK IN RELATION TO FLAT ROOF FINISH

6.1 All preliminary operations such as finishing of services that affect the schedule of commencement and completion of the roof work, shall be completed.

6.2 The sub-floor shall be finished to a reasonably even surface and to the required level.

6.3 Before the finishing work is started, all points of level for the finished roof surface shall be marked out. Wherever slopes in finished floors are desired, points of level and outlets shall be correctly marked and outlet openings made beforehand.

6.4 Protection Against Dampness — Wherever it is feared or suspected that moisture may percolate to the top of the sub-floor during any time of the year, the same shall be treated as explained in the relevant Indian Standards on waterproofing and damp-proofing to prevent such conditions. Where water is likely to percolate from the side walls, the roof surface shall also be properly waterproofed against the wall up to a level of at least 150 mm above the sub-floor.

*Specification for burnt clay flat terracing tiles : Part I Machine made (*first revision*).
†Specification for burnt clay flat terracing tiles : Part II Hand made (*first revision*).
‡Specification for ordinary and low heat portland cement (*third revision*).
§Specification for portland slag cement (*third revision*).
‖Specification for portland pozzolana cement (*second revision*).
¶Specification for sand for masonry mortars (*first revision*).
**Specification for burnt clay pozzolana (*first revision*).
††Code of practice for preparation and use of masonry mortars.

7. LAYING OF MUD *PHUSKA*

7.1 Preparation — The soil as defined in **5.1** shall be stacked in required quantities in about 300 mm high stacks over a level ground and the top surface divided into suitable compartments of convenient size by bunding. The estimated quantity of water corresponding to optimum moisture content shall be added about 12 hours before the use and allowed to soak. The stacks of soil shall then be worked up with spades and hands to ensure proper distribution of moisture at the time the soil is to be used.

NOTE — Generally soil of this type will require an optimum moisture of about 145l/m³. A practical way of determining the moisture content of soil suitable for giving good compaction is that the soil should contain that much quantity of moisture, which when a handful of soil is moulded with hand to the shape of a ball, it shall just retain its form. If the soil on moulding cannot retain its shape of a ball, moisture content is inadequate. On the other hand, if the ball can be plastically deformed on pressing with hand, the moisture content is on the higher side.

7.2 Laying — The mud *PHUSKA* prepared as in **7.1** shall be carried to the surface to be covered and laid in loose thickness not greater than 150 mm. The surface shall then be brought to the proper slope. It shall then be rammed manually with wooden rammers and *THAPPIES* so as to obtain maximum density. Normally a mud *PHUSKA* layer laid to a compacted thickness of not less than 100 mm is considered adequate.

7.3 The surface shall be allowed to dry for a period of not less than 24 hours. If any cracks appear, these shall be filled with a grout of the binder material that is used in the *LEEPING* (usually *GOBRI*).

8. APPLYING MUD PLASTER

8.1 After laying the mud *PHUSKA*, mud plaster prepared as specified in **5.3** shall be laid to a total thickness of not less than 25 mm over the surface. The plaster may be applied in a single coat or two coats of 15 mm and 10 mm, the latter being preferable. After the application, the coat of plaster shall be allowed to dry. If any hair cracks open out they shall be filled with a grout as in **7.3**. The surface shall be checked once more for slope and evenness with a straight edge and spirit-level and made up wherever necessary by application of the plaster.

8.2 When the surface of the mud plaster coating has dried a thin coat of *LEEPING* plaster as specified in **5.6** shall be applied to a thickness of not less than 3 mm. The surface shall be allowed to dry. When hair cracks appear they shall be filled as described in **7.3**. The *LEEPING* shall be finished with the trowel or float.

9. PAVING WITH BRICK-TILES

9.0 This paving finish will be necessary where the roof is used for living and sleeping purposes and also if additional durability and thermal insulation is required. Tiled paving finish shall be laid down directly over the mud plaster and no *LEEPING* will be necessary.

9.1 The brick tiles shall be laid flat on a thin layer of mud mortar. The mud mortar shall be as specified in **5.5**. The mud mortar shall be used to the minimum extent to give a level surface. The tiles shall be laid close to each other and the thickness of joints shall not be less than 6 mm and not more than 15 mm. It shall be ensured while laying the tiles that the mud mortar rises vertically in the joints to a height of about 15 mm. The brick-tile work shall be allowed to dry for a period of 24 hours before grouting of the joints. Care shall be taken at the time of grouting the joints not to displace the tiles laid in position on the roof finish.

9.2 When the brick-tile work has dried, the joints shall be grouted with cement-sand mortar as in **5.10**. It shall be ensured that the joints are filled completely by the mortar. The mortar shall be allowed to set for a minimum period of 12 hours before further pointing of the joints which need to be done only if necessary. Before pointing, the grouted joint shall first be brushed clean with a soft brush.

9.3 The completed brick-tile surface shall be checked for evenness and slope by means of straight edge and spirit level.

10. CURING

10.1 The surface of the finished roof shall be kept wet for a period of not less than 7 days.

11. TREATMENT AT JUNCTION BETWEEN THE ROOF FINISH AND PARAPETS

11.1 The details shall conform to the requirements laid down in the relevant Indian Standards on waterproofing of flat roofs in buildings.

12. INSPECTION

12.1 The inspection of the roof shall be done at least in the following stages:

a) Before spreading of the mud *PHUSKA* layer,
b) On completion of mud *PHUSKA* layer finish,
c) On completion of mud plaster finish, and
d) On completion of brick-tile layer finish.

13. MAINTENANCE AND REPAIRS

13.1 Annual maintenance is only required in the case of roofing where finish with *GOBRI LEEPING*. In such cases, the roof shall be inspected a month before the monsoon and *GOBRI LEEPING* provided where necessary. After the monsoon, the roof should again be inspected, the grass removed and provided with *GOBRI LEEPING*.

(*Continued from page* 2)

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