

the sub-grade to serve as bedding. The mortar is allowed to harden so that it may permit the mason, to work over the surface without damage to bedding mortar. Immediately before laying tiles, neat cement slurry is spread over the bedding mortar and the tiles are then fixed over the slurry grout. Each tile is gently tapped with a wooden mallet till it is properly bedded and levelled. The joints in the tiles should be as thin as possible and should be in straight lines. After laying, the joints are cleaned off all dirt and mortar to a depth of 2 to 3 mm. with the help of wire brush or trowel and then flush pointed with white or coloured cement to suit the colour of the tiles. The flooring is cured for seven days and thereafter washed before use.

4. P.V.C. Tile Flooring

P.V.C. tiles are now manufactured in variety of shades and design and are being commonly used in residential as well as non-residential buildings. It gives a decorative floor finish which is resilient, smooth and can be cleaned easily. It can be laid over a prepared base which can be of concrete, timber etc.. Prior to laying the tiles, it is necessary to see that the base is perfectly dry and brought to the temperature at which it will be while in use. The layout of the P.V.C. tiles (to the required design/pattern) is marked on the base with the help of guide lines. Adhesive of specified make is thereafter applied on the base and the back of the P.V.C. tiles with the help of a notched trowel. Laying of tile commence when the adhesive has set sufficiently (say within half an hour). After laying, the tiles are pressed suitably with wooden rollers (weighting 5 kg.) to ensure intimate contact with the base. Extra adhesive that oozes out is wiped off and the flooring is finally cleaned with warm soap water before use.

Merits and demerits of tiled flooring.

Merits :

- (i) It is non-absorbent.
- (ii) It is easily repairable in patches.
- (iii) It offers pleasant appearance.
- (iv) It is durable.
- (v) It permits quick laying of floor.
- (vi) It is resistant to wear and has fairly good strength.

Demerits :

- (i) This type of construction is very costly both in initial cost as well as in maintenance.
- (ii) Terrazo tile and glazed tile flooring becomes slippery when wet.

- (iii) PVC tile flooring gets damaged when in contact with burning objects like paper, match stick etc.

127. CEMENT CONCRETE FLOORING

This type of flooring is commonly used both in residential as well as public buildings.

The method of laying cement concrete flooring on ground floor of a building can be broadly divided in the following steps.

(i) **Preparation of sub-base.** The earth filling in plinth is consolidated thoroughly so as to ensure that no loose pockets are left in the whole area. A 10 to 15 cm. thick layer of clean coarse sand is then spread over the whole area. The sand layer is consolidated and dressed to the required level and slope.

(ii) **Laying of base concrete.** The base concrete used under floors may be cement concrete or lime concrete laid to a thickness varying from 7.5 to 10 cm. In case of cement concrete, the mix commonly used is 1:5:10 (1 cement : 5 sand : 10 stone or over burnt brick aggregates 40 mm. nominal size). Lime concrete, if used, should be made up out of 40 mm. nominal size stone/over burnt brick aggregate and 40% mortar comprising of 1 lime : 2 sand/surkhi or 1 lime : 1 surkhi/ash : 1 sand.

The base concrete layer is deposited over the whole area, thoroughly tamped and levelled to a rough surface.

(iii) **Laying the topping.** When the base concrete layer has fully set and hardened, its surface is thoroughly cleaned and the entire area is divided into rectangular or square panels by use of 4 mm. thick glass strips or 5 mm. thick plain asbestos strips. The size of panel is basically governed by the location of floor (exposed or indoor), temperature and other climatic conditions, thickness of topping and proportions of ingredients in concrete mix. etc. In general, the area of one such panel should not preferably be more than 2 sq. m. The surface of base concrete should be made damp and applied with a coat of neat cement slurry prior to laying the topping. The rough finished surface of base concrete coated with cement slurry ensures adequate bond between the base and the topping. The cement concrete topping, normally consisting of 1:2:4 (1 cement : 2 sand : 4 stone aggregate) is then laid in required thickness in one operation in the panels. The concrete is spread evenly by using a straight edge and the surface is thoroughly tamped and floated with wooden floaters till the cream of the mortar comes at top. The surface is then smoothed and finally finished by means of steel trowels. In case glass or plain asbestos strips are not required, the panels are formed by use of wooden or angle iron battens. The battens should have depth equivalent to that of concrete topping. The surface of the battens which is to come in contact with concrete, is coated with raw linseed oil before concreting. Concrete for the topping is then laid in

alternate panels and finished as described above. The battens used for forming panels are removed next day and the topping concrete laid in the alternate panels.

In case the cement concrete flooring is to be laid over R.C.C. slab, it is usual to allow the slab concrete to harden and then lay the flooring. Prior to laying, the slab top is cleaned of all dirt, dust, loose particles, mortar droppings and debris etc. and the flooring laid as described under the sub-head 'laying of topping' above.

In order to prevent the tendency of separation of the cement concrete flooring from the R.C.C. slab, a 20 mm. thick cushioning layer of lime mortar (1 lime : 2 sand/surkhi or lime : 1 surkhi/sand) or 50 to 75 mm. thick lime concrete is sometimes provided between the R.C.C. slab and the cement concrete flooring.

If the working conditions permit, the flooring can also be laid monolithically over the R.C.C. slab while the slab concrete is still green. In this case, the slab concrete is roughened with wire brushes so as to ensure a good bond between the base and the flooring layer. Prior to laying of flooring, the slab surface is cleaned and a coat of cement slurry is applied over it. In this case, any slope required for the floor is given in structural concrete itself.

The flooring should be cured for 10 days before use.

Merits :

- (i) It is non-absorbent and thus it is very useful for water stores.
- (ii) It is durable and hence it is commonly used in kitchens, bathrooms, schools, hospitals, drawing rooms etc.
- (iii) It is smooth and pleasing in appearance.
- (iv) It is economical and has the advantages of costlier types of floors.
- (v) It possesses good wearing properties and can be easily maintained clean.

Demerits :

- (i) Defects in carelessly made floor cannot be rectified, and as such, it requires proper attention while laying.
- (ii) It cannot be satisfactorily repaired by patch work.

12.8. GRANOLITHIC FLOORING

It is a finishing coat provided over the concrete surface to form a hard, resistant to abrasion and durable flooring. Granolithic concrete is composed of cement, sand and specially selected aggregates. The grading of aggregates is very important. Coarse aggregates from basalt or limestone or quartzite are suitably graded from 13 mm. to I.S. Sieve No.

40. The concrete mix is usually of 1:1:2 or 1:1:3. In order to get monolithic construction, the granolithic concrete should be laid before the base concrete has set. The minimum thickness of finishing should be 13 mm. After laying, the surface is tamped and floated with wooden floats and finally smoothed by means of steel trowel.

12.9. TERRAZO FLOORING

On account of its decorative and good wearing properties, this type of flooring is becoming very popular these days and is being commonly provided in offices, schools, hospitals, residential buildings, banks etc. Terrazzo is a concrete surface with special aggregate of marble chips (or other decorative material) mixed with white and/or coloured cement in proportion of 3:1 (three marble chips : one cement). The aggregates are exposed by grinding the surface mechanically or manually. The flooring may be laid in different thicknesses. The construction of 40 mm. thick flooring is described below.

The operations of the preparation of sub-base and laying of base concrete are carried out in similar manner as described earlier in case of cement concrete flooring. The 40 mm. thick flooring will consist of a 6 mm. thick layer of terrazzo topping and 34 mm. thick under layer of cement concrete 1:2:4. Prior to laying flooring, the whole area is divided into suitable panels by use of dividing strips (made from copper, brass, aluminium or glass) of thickness not less than 1.5 mm. and width not less than 25 mm. In order to reduce the risk of cracking, the area of one panel should not exceed two square metre.

The surface of base concrete should be cleaned of all dirt, mortar dropping debris etc. and then wetted with water. Prior to laying the cement concrete under layer, the wet surface of base concrete is smeared with a coat of neat cement slurry to ensure proper bond between the base concrete and flooring.

The concrete under layer is then spread, consolidated, levelled and finished to a slightly rough surface. When the under layer has hardened sufficiently, already prepared plastic terrazzo mixture is laid over the treated under-layer of concrete and compacted thoroughly by tamping or rolling. The terrazzo mixture consists of one part of cement (white or coloured) or a mixture of the two mixed with two to three parts of marble chips with water just sufficient to make it a workable mix. During tamping or rolling, it should be ensured that at least 80% of the finished surface should show exposed marble chip aggregates and if necessary additional marble chips may be added during the process of tamping or rolling to satisfy this condition.

After tamping or rolling, the surface is floated and troweled and left to dry out for 12 to 18 hours. After this period the surface is cured under standing water for 2 days.

Thereafter surface is subject to first grinding by machine by use of carborundum stones of coarse grade (No. 60). The whole surface is then scrubbed using plenty of water. All pores and holes (if any) are then filled with cement grout (using the same coloured cement as in the original mix for terrazzo topping) and the surface coated with neat cement grout of cream like consistency. The surface is again cured for five to seven days and second grinding is carried out by machine by using carborundum stones of fine grade (No. 120). In the similar manner, the surface is cleaned and repaired as before and cured again for a period of 4 to 5 days and subjected to third grinding by machine by using carborundum stones of 320 grit size.

The finished surface is finally worked with dilute oxalic acid solution. The floor is finally polished by floor polishing machine fitted with felt or bessian bobs, till it shines.

12.10. MOSAIC FLOORING

Over the hard base concrete bed, a 5 cm. to 6 cm. thick layer of lime surkhi mortar is spread in a small area. The area taken is such that the flooring can be easily completed in that portion without the mortar getting dry. On this a layer of paste consisting of two parts of sifted slaked lime, one part of powdered marble and one part of puzzolana is laid in thickness not exceeding 3 mm. This surface is left to get dry for four hours. Tiles or marble pieces, cut to the desired shapes, are then hammered on this surface in the desired pattern. The surface is gently rolled by light stone roller about 30 cm. in diameter and 45 to 60 cm in length. Rolling is done till the tile or marble pieces form an even surface and are cemented together properly. The surface is allowed to dry for a day and then polished by rubbing it with pumice stone fitted with long wooden handle. The polished surface is finally allowed to dry for some weeks before use.

12.11. MARBLE FLOORING

Marble flooring is commonly provided in places of worship (temples, churches, mosques, gurudwaras etc.) and in public buildings having rich specifications. In view of high cost of material, use of marble flooring in residential buildings is normally restricted to areas like kitchen, bath room, entrance etc.

The size of marble slabs to be used in flooring depends upon the pattern to be adopted. The slabs for normal works are square or rectangular in shape and their thickness varies from 20 mm to 40 mm. The flooring is laid on prepared sub-grade of concrete or on the R.C.C. floor slab. Prior to laying flooring, the sub-grade is cleaned, wetted and mopped properly. A layer of bedding mortar which can be 1:4 cement mortar (1 cement : 4 coarse sand) or lime mortar (1 lime putty : 1 surkhi : 1 coarse sand) is spread in average thickness of about 20 mm. under the

area of each slab. The marble slab is laid on top of the bedding mortar, pressed and tapped with wooden mallet and brought to the level with the already laid adjoining slabs. The slab is thereafter lifted up and placed aside. The top surface of the bedding mortar is then corrected by adding mortar at hollows. After the bedding mortar is hardened slightly, cement slurry is spread over the same, at the rate of 4.4 kg of cement per sq m. The edges of the slab already laid are then smeared with cement slurry of the same shade as that of the marble slab and the slab to be paved is again placed in position and tapped with wooden mallet till it is properly bedded in level with the adjoining slabs. The joint between two slabs has to be very fine (paper thick). The cement that oozes out of the joint is cleaned. Remaining slabs are also laid in the same manner and the flooring work completed. The paved area is cured for a minimum period of seven days.

12.12. TIMBER FLOORING

In hilly areas, where the climate is damp and wood is easily available, wooden floors prove economical and as such are commonly used. Its use is not extensive in other places. However, they are used for dancing halls, carpentry halls, auditoriums etc. In this type of floor, prevention of dampness is of great importance and hence every precaution is taken to check the dampness from rising above. The entire area of ground below the floor is covered with a 15 cm. layer of

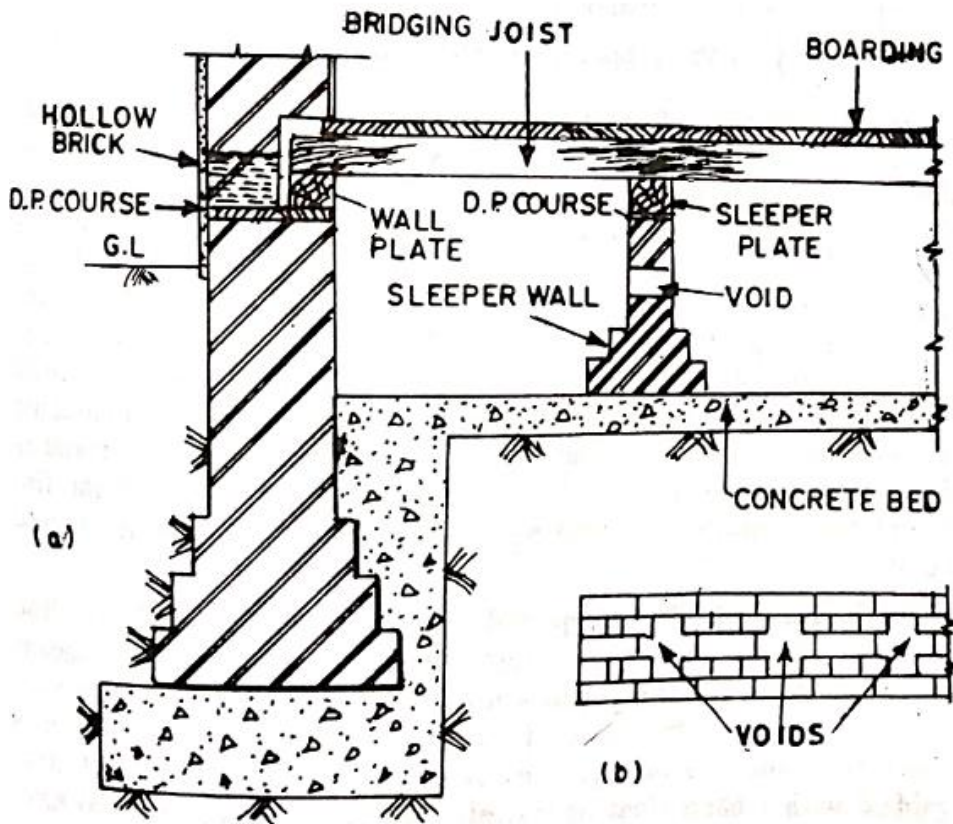


Fig. 121 (a). Section through a timber floor

Fig. 122 (b). Detail showing position of voids in the honey-combed sleeper wall

cement concrete. This layer is called "*site or oversite concrete*". Timber floors essentially consist of boarding supported on timber joists called bridging joists or floor joists which are nailed to wall plates at their ends and supported by intermediate walls called sleeper or dwarf walls, along their length. The sleeper walls are generally 10 cm. thick and are honey-combed. They are intended to reduce the span for the floor joists. The sleeper walls are seldom spaced more than 1.8 m. apart and are honey-combed to enable free circulation of air in the space below the floor. Longitudinal timber members called 'sleeper plates' are fixed on the top of sleeper walls. The floor joists are secured to the sleeper walls by being nailed to the sleeper wall plates. A damp-proof course layer is laid immediately below the wall plates to prevent the rising of dampness. The hollow space between the flooring and the oversite concrete is kept dry and fully ventilated.

12.13. ASPHALT FLOORING

On account of its being dustless, elastic, durable, waterproof, acidproof and attractive in appearance, mastic asphalt flooring is becoming very popular these days. This type of flooring is non-slippery and noiseless too, as such it is recommended for use in factories, loading platforms swimming pools, and terrace floors etc. The construction of floor involves the following operations:

- (i) Preparation of mastic asphalt.
- (ii) Laying of the prepared compost (mastic asphalt)

(i) **Preparation of mastic asphalt.** Asphalt which is generally sold in drums, is broken into pieces and is put into an iron pot known as "Cauldron" and is heated with the fire lighted under it. During the process of heating when melting of asphalts starts, the whole mass is stirred in such a manner that the pieces at the bottom are constantly brought to the surface. When the whole quantity has melted, clean sharp sand or grit is gently added to the molten mass in proportion of 2:1. (two parts of sand or grit : one asphalt). The mixture is constantly stirred till it emits jets of light-brown smoke. At this stage, the mixture or compost is of such a consistency that it drops freely from the stirrer and is considered to be fit for use. The cauldron is then taken off the fire to prevent the compost from getting over-burnt and the mixture is used immediately.

(ii) **Laying of the prepared compost (mastic asphalt).** The compost is poured on the previously prepared concrete bed by means of iron ladle. This is brought to a uniform thickness (which may vary from 13 mm. to 25 mm.) by means of trowels. Before the compost becomes hard, very fine sand in small quantity is sifted over it and the surface is well rubbed with a hand float or trowel. In case, it is necessary to have

a second layer of asphalt, it should be laid before the bottom layer solidifies (no sand being sifted over the bottom layer in that case.). The top layer is then finished in the same manner as described above.

12.14. RUBBER FLOORING

This type of flooring is not common in India but in foreign countries, it is used in residential buildings as well as public buildings like offices, hospitals, school etc. It is noiseless, comfortable, clean and durable. Like linoleum, this type of flooring is manufactured in the form of sheets or tiles in a variety of colours. Its thickness seldom exceeds 10 mm. Rubber sheets or tiles are made by combining at very high temperature pure rubber with cotton fibre, granulated cork, asbestos fibre, other glues and colour pigments to get the designed colour. The rubber tiles are laid by glueing them to a smooth and thoroughly clean and dry base by use of a special adhesive. The base may be of concrete, R.C.C. or wood. It is expensive in its initial cost but it serves as a most durable wearing surface in long run. However, oil or grease renders the floor slippery and it becomes difficult to restore it in good condition.

12.15. LINOLEUM FLOORING

Linoleum is a covering laid over wooden or concrete floors in order to hide the defects of flooring or to enhance its appearance. It is a material manufactured by mixing oxidised linseed oil with powdered cork, wood floor, various type of gums and suitable colouring pigments. The plastic mass thus obtained is pressed in the designed form and dried in ovens. It is finally cured and seasoned. It is available in a variety of colours both in plain and printed form. It is mostly sold in rolls which are 1.8 to 3.66 m. in width and the thickness of the felt seldom exceeds 6 mm.

Linoleum can be laid in the following three ways :

- (i) By spreading the covering loose on dry and smooth floor
- (ii) By pinning down the ends of the loosely laid linoleum covering to the floor below.
- (iii) By fixing the linoleum covering to the floor by use of a special adhesive.

Merits :

Linoleum floor covering has the following advantages :

- (i) It is washable, dustproof and can be easily cleaned with just a swab of damp cloth.
- (ii) It has cushioning effect which gives comfort to the users.
- (iii) It reduces noise effectively.

- (iv) It forms a long-wearing and durable surface if laid and maintained properly.
- (v) It gives a decorative floor finish which looks very attractive.
- (vi) It is economical.

Linoleum floor covering is largely used in residential buildings, offices, schools, hospitals, libraries, restaurants, railway carriages and buses etc. It is, however, not recommended in basement floors.

12.16. ACID-PROOF FLOORING

In places like chemical laboratories and plants, storage battery buildings etc. where acids are used or manufactured, it is necessary that the floor topping should be acid-proof. Asphalt blocks, made by moulding under high pressure a mixture of inert crushed rock aggregate and an acid proof asphalt successfully meet the requirements of an acid-proof flooring. The asphalt blocks are first laid on the hard base and then acid-proof asphalt is uniformly spread over the surface of the block. Before the liquid asphalt hardens, fine sand in small quantity is uniformly spread over it and surface is finished smooth and levelled.

Questions for Review

1. Describe briefly the type of floor used for different types of buildings and state the reasons for their choice. Give detailed specification for coloured Terrazzo flooring.
2. Describe in brief the types of floors that are normally adopted in modern buildings. Explain the advantages and disadvantages of each type. Suggest the type of floor you would recommend for a hospital ward measuring 12 X 12 m.
3. How are the following materials used in construction of floor? Give an idea of the relative cost of each type of flooring in U.P.

(a) Linoleum.	(b) Cork.
(c) Rubber.	(d) Clay tiles.
(e) Marble.	(f) Stone.
(g) Slate	
4. Give the specifications for flooring of a food grain storage godown where trucks of 5 tonne capacity would come in and where the sub-soil water-level is within 1.5 m. of the existing ground level.
- 5: Describe briefly with sketches the type of flooring you would adopt for the following. Justify the selection.
 - (i) Operation theatre in a modern hospital.
 - (ii) Recreation hall of a high-class hotel.
 - (iii) Public latrine.

