केवल कार्यालयीन उपयोग हेतु
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भारत सरकार – रेल मंत्रालय
Government of India – Ministry of Railways

फ्लोरिंग
FLOORING



केमटेक / 2013 / सि / फ्लोरिंग / 1.0
CAMTECH/2013/C/FLOORING/1.0

जनवरी / January – 2013

Indian Railways
Centre for Advanced Maintenance Technology

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फ्लोरिंग

FLOORING

प्राक्कथन

भारतीय रेल, एक प्रमुख संस्थान होने के नाते इसके पास भवनों एवं संरचनाओं की एक विशाल श्रंखला मौजूद है, जिनमें आवासीय एवं कार्यालय भवनों में कई प्रकार की फ्लोरिंग का उपयोग किया जाता है।

इस पुस्तक के द्वारा केमटेक ने फ्लोरिंग के सभी तकनीकी पक्ष जैसे फ्लोरिंग के प्रकार, उनको करने की प्रक्रिया एवं उनके गुण दोश की जानकारी देने का प्रयास किया है।

मुझे उम्मीद है कि यह पुस्तक सिविल अभियॉत्रिकी विभाग के लोगों के लिये जानकारी का महत्वपूर्ण स्त्रोत होगी एवं अत्यंत उपयोगी सिद्ध होगी।

केमटेक, ग्वालियर *(ए. आर. तुपे)*
दिनांक : 31, जनवरी 2013 *कार्यकारी निदेशक*

Foreword

Indian Railways, a premier organisation having vast network of buildings and structures, include office buildings and residential buildings, in which so many types of flooring are used.

Through this hand book, CAMTECH has made an attempt to provide the technical knowledge about the type of flooring, their laying process and also merits and demerits of floorings.

I hope this hand book will prove to be a valuable source of technical knowledge and will be quite helpful to civil engineering personnel in Railways.

CAMTECH/Gwalior ***(A.R Tupe)***
Date: 31, January 2013 ***Executive Director***

भूमिका

भारतीय रेल, एक प्रमुख संस्थान है एवं इसके पास भवनों एवं संरचनाओं की काफी संख्या है। इस पुस्तक को बनाने का उद्दे य फ्लोरिंग की तकनीकी जानकारी को उन सभी लोगों को देना है जो निर्माण एवं मरम्मत के कार्यो में लगे हैं। इस पुस्तक में सामान्यतः रेल्वे में उपयोग होने वाली फ्लोरिंग को लिया गया है। जो कि विभिन्न स्थानों पर की जाती है।

इस पुस्तक को सिविल अभियॉत्रिकी विभाग के लोगों के लिये उपयोगी बनाने की हर संभव कोि ा ा की गई है।

यह पुस्तिका वैधानिक नहीं है, इसमें दी गई जानकारी का उद्धे य केवल मार्गद ार्न है। इसमें दी गई जानकारी, किसी न किसी रूप में संबंधित कोड एवं मेनुअल, एक्ट एवं सर्क्यूलर में उपलब्ध है।

यह पुस्तिका विषय पर उपलब्ध भारतीय रेल कार्य संहिता, इंजीनियरिंग कोड तथा विभिन्न सर्क्यूलर/रिपोर्ट के प्रावधानों तथा रेल्वे बोर्ड, आर. डी. एस. ओ. एवं जोनल रेलों द्वारा जारी निर्दे ाों का स्थान नहीं लेती।

इस पुस्तिका के सुधार हेतु पाठकों के किसी भी सुझाव का हम स्वागत करते हैं।

केमटेक, ग्वालियर *(एस. के. सक्सेना)*
दिनांक 30, जनवरी *2013* *उपनिदेशक/सिविल*

Preface

Indian railways, a big organisation has large number of buildings for its various infrastructural needs vig, service buildings and staff quarters etc. The objective to prepare this handbook on 'Flooring' is to disseminate the technical knowledge for the guidance of civil engineering personnel involved in construction and maintenance field. This book covers most commonly used floorings which are used in Indian Railways on the basis of locations of flooring.

Every effort has been made to make this hand book useful to civil engineering personnel. This handbook is not statutory and contents are only for the purpose of guidance. Most of the data, sketches and information mentioned herein are available in some form or the other in various books or printed matter.

This handbook does not supersede any existing instructions from Railway Board, RDSO & Zonal Railways and the provisions of IRWM, Engineering code, specifications and various circulars/reports on the subject.

We welcome your valuable suggestions for further improvement.

CAMTECH/Gwalior ***(S.K. Saxena)***
Date: 30, January 2013 ***Dy. Director/Civil***

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ISSUE OF CORRECTION SLIPS

इस लघु पुस्तिका के लिये भविष्य में प्रकाशित होने वाली संशोधन पर्चियों को निम्नानुसार संख्यांकित किया जायेगा :

The correction slips to be issued in future for this handbook will be numbered as follows:

केमटेक / 2013 / सि. / फ्लोरिंग / 1.0 / सीएस # XX दिनांक _____

CAMTECH/2013/C/Flooring/1.0/CS # XX date _____

जहॉ "XX" सम्बन्धित संशोधन पर्ची की क्रम संख्या है (01 से प्रारम्भ होकर आगे की ओर)

Where"XX" is the serial number of the concerned correction slip (starting from 01 onwards).

प्रकाशित संशोधन पर्चियॉ
CORRECTION SLIPS ISSUED

क्र.सं. Sr. No.	**प्रकाशन की तारीख Date of issue**	**संशोधित पृष्ठ संख्या तथा मद संख्या Page no. and Item No. modified**	**टिप्पणी Remarks**

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फ्लोरिंग
FLOORING

1.0 सामान्य / GENERAL

Flooring is an important element of a building structure which should have a pleasing appearance and should attract the attention of the people as they enter into the building. Flooring provides support for the occupants, furniture and equipment of a building.

Floors have to serve different purposes in different buildings, such as residential, institutional, industrial, etc. Floors are durable, easy to maintain and suit the budget of the owner. Each type of floor has its own merit and demerits. Following factors should be considered before selecting or deciding the flooring or floor covering.

i) **Initial Cost:** The cost of construction is very important item to select the floor and floor covering.
ii) **Appearance:** Flooring should produce an attractive appearance.
iii) **Cleanliness:** The floor should be non absorbent and capable of being easily and effectively cleaned.
iv) **Durability:** The flooring material should be durable and have sufficient resistance against wear and tear, temperature and chemical action etc.
v) **Resistance against Dampness:** To ensure healthy environment in the building, flooring (especially ground floor) should offer sufficient resistant against the dampness.
vi) **Sound Insulation or (Noiselessness):** As per modern building concepts, a floor should neither create noise nor transmit noise when used.
vii) **Thermal Insulation:** It should be possible to maintain a constant temperature inside the building irrespective of the temperature change outside.
viii) **Smoothness:** Floor or floor covering should exhibit a smooth and even surface, but at the same time, it should not be too slippery.
ix) **Hardness:** It is necessary to use good quality floor covering, free from any form of indentation marks, imprints etc.
x) **Comfort Criteria:** The material of floor covering should be shock absorbing and having good conductive properties. Floor covering gives the comfort to the occupants.
xi) **Fire Resistance:** The material of flooring should have sufficient resistance against the fire to safe guard the life of occupants and their goods.
xii) **Maintenance consideration:** It is always better that the maintenance cost should be as low as possible.

1.1 फ्लोरिंग के अवयव / COMPONENTS OF FLOORING

All the floorings, in general consist of following components:

i) **Base-course or sub-grade:** The purpose of this component is to impart strength and stability to support floor covering and all other superimposed loads. Preparation of sub-base or sub-grade includes the followings.

a) Ground Preparation: First of all, the surface of the ground made up of loose or soft soil should be levelled, well watered and rammed properly.

b) Preparation of Base course: A 15 cm thick layer of broken stones or hard bricks is evenly spread and consolidated on the surface of the ground as prepared above. This sub-base or sub-grade so prepared is also called as hard core. Thereafter, a layer of lime concrete or cement concrete (in specified proportions) about 15 cm thick is laid on the hard core or directly on the surface of ground if made up of good soil. Necessary slope should be maintained to the surface of lime concrete or cement concrete to facilitate the washing down of the finished floor. Usually a slope 1 in 120 to 1 in 240 is sufficient for inside floors and an outward slope of 1 in 36 to 1 in 40 is recommended for bath-rooms and verandas floors.

If the base is of cement concrete, it should be allowed for two days and if that of lime concrete, it should be watered and well rammed and allowed to set for seven days. Where base concrete is not provided, the earth below shall be properly sloped, watered, rammed and consolidated before laying the flooring or floor covering.

ii) **Floor covering or Flooring**: The floor covering over the sub-grade or sub-base is meant to provide a hard, clean, smooth, impervious, durable and attractive surface to the floor.

2.0 फ्लोरिंग के प्रकार / TYPES OF FLOORING

Most commonly used floorings are Brick, Concrete, Stone, Terrazzo, Tile, Rubber, PVC, and Wooden floorings. Some others types flooring are also used like Moorum or Mud, Cork, Asphalt and Magnesite etc. On the basis of material used for flooring or floor covering, it may be divided into the following categories:

- Bricks Flooring
- Concrete Flooring
- Stone Flooring
- Terrazzo (Marble Chips) Flooring
- Crazy Marble Flooring
- Tiles Flooring
- Rubber Flooring
- Plastic or PVC Flooring
- Wood or Timber Flooring
- Mud or Moorum Flooring
- Cork Flooring
- Asphalt Flooring

2.1 ब्रिक फ्लोरिंग / BRICK FLOORING

This type of flooring laid on base concrete or sub-base as prepared earlier is suitable for cheap construction and places where heavy articles are to be stored as in case of ware houses, stores and godowns. It is economical in those areas where stone is scare and well burnt bricks of good quality are readily available. The brick flooring may be laid with bricks laid flat or on edge arranged in herring–bone pattern or set at right angles to the walls.

Bricks on edge is preferred than bricks laid flat, because the former being less liable to cracks under pressure than the latter and also having the higher depth that gives a greater thickness in the former case to resist the moisture penetration.

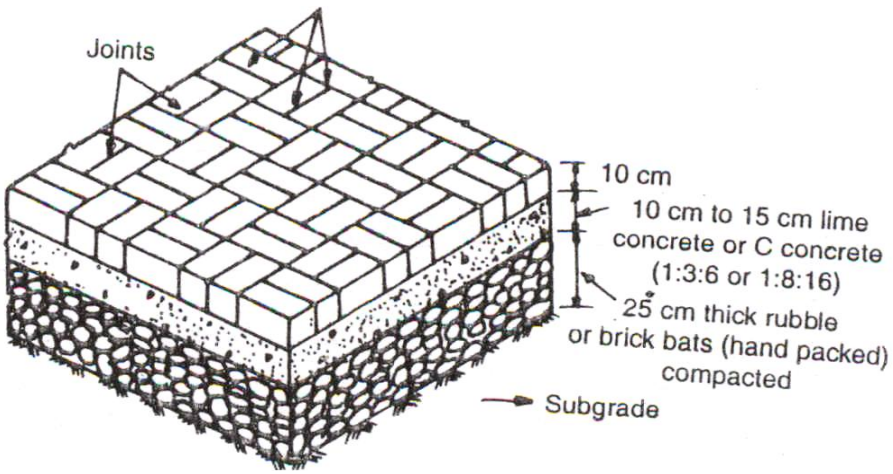
Bricks of specified dimensions and designations shall be used. Normally bricks are available in 19 cms X 9 cms X 9 cms in size. Broken bricks are not preferred to be used in flooring except for closing the line. The bricks are laid on edge unless otherwise specified. The mortar used as per specification.

Soaking of Bricks: The Bricks should be adequately soaked in water for at least 6 hours before use.

Laying: The bricks are laid on the edge in plain, diagonal, herring-bone bond or other pattern as specified or directed by the Engineer. Bricks are laid on edge on 12 mm thick mortar bed and each brick is properly bedded and set home by gentle tapping with trowel handle or wooden mallet. It's inside face is buttered with mortar, before the next is laid and pressed against it. In flat brick flooring, the bricks are laid with frog down. On completion of a portion of flooring, the vertical joints are fully filled from the top with mortar. The surface of the flooring during laying, is checked frequently with a straight edge at least 2 m long, so as to obtain a true plane surface with the required slope.

Joints: Bricks are so laid that all joints are full of mortar. The thickness of joints should not exceed 10 mm for brick work with bricks of any class designation. When the mortar is still green, all face joints should be raked to a minimum depth of 15 mm by raking tool during the progress of work so as to provide proper key for the plaster or pointing to be done. Where plastering or pointing is not required to be done, the joints are struck flush and finished at the time of laying. The face of brick work is to be cleaned on the same day and all mortar droppings is to be removed promptly.

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



Merits: This type of flooring

- gives a durable and sufficiently hard surface.
- provides a non slippery and fire resistant floor surface.
- is cheaper in initial cost and easy in maintenance.

Demerits: Only drawback of this type of flooring is that it is water absorbent.

2.2 सीमेंट कंक्रीट फ्लोरिंग/CEMENT CONCRETE FLOORING

Cement concrete flooring, also known as Indian Patent Stone (IPS) flooring is one of the most common types of flooring provided in houses. It is laid on sub-base comprising of earth filling that is watered and rammed in 15 cm layers. This is covered with clean course sand/ ordinary sand well consolidated to a thickness not less than 10 cm. Sand layer is wetted adequately before laying concrete.

Base concrete is provided with the slope required for flooring. Plinth masonry offsets are depressed so as to allow base concrete to rest on it. If the base consists of lime concrete, it is allowed to set for seven days. If the base is of lean concrete, it is allowed to set for two days. The surface of the base is to be roughened by steel wire brush without disturbing the concrete. Before laying the flooring, the base is adequately wetted and smeared with a coat of cement slurry so as to get a good bond between the base and flooring. After base concrete, the concrete flooring consists of the following operations:

- Laying of top concrete
- Laying of wearing coat or floor finish
- Grinding and polishing
- Curing

After preparation of base concrete, the laying of concrete for topping may be done with the help of panels or without panels depending upon the area of floor. The panels shall be of uniform size, not exceeding 2 Sqm in area or 2 m in length for inside situations. Panels may be framed by using glass, aluminium, PVC brass strips etc.

Normally cement concrete flooring is laid in one operation. Concrete is placed in the panels and levelled with the help of straight edge and trowel and beaten with wooden 'Thappy' or masons trowel. Laying of cement concrete without strips may be allowed. In this case alternate panels may take for flooring. Finishing of the surface is done immediately after the cessation of beating. Surface is left for some time, till moisture disappeared from it.

Fresh cement is mixed with water to form thicker slurry and spread at the rate of 2 kg per Sqm area of flooring while the flooring concrete is still green. The cement slurry is finished smooth. Then curing will be done at least for ten days.

Where a very dense and smooth finish is desire the topping of flooring may be laid in two layers. Under layer is as similar as above, but not finished smooth and kept rough for second wearing layer. Wearing layer consists of 15 mm thick cement concrete mix in 1:2 by volume (1 part cement and 2 part of very fine shingle or grift of size 6 mm). The mix has stiffer consistency than the under layer. The mix is laid over the rough surface of under layer

thoroughly tamped, levelled with the help of wooden float and finished smooth by the cement slurry.

When sometimes floors are required to with stand heavy wear and tear, we can use metallic hardener in topping. The thickness of topping of metallic hardener is 12mm. Metallic hardener topping consists of 12 mm thick layer of mix of 1:4 (1part of metallic hardener and 4 part of cement) by weight and mixed with 1:2 cement mix of 6 mm size and then finished smooth.

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

During cold weather, concreting shall not be done when the temperature falls below 4^0C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone. During hot weather, precautions shall be taken to see that the temperature of the wet concrete does not exceed 38^0C.

Plastering of all inside walls and ceilings, fixing of door frames and other heavy work shall be completed before laying the floors.

Merits: Following are the merits of concrete flooring.

- It is non absorbent and hence offers sufficient resistant to dampness. This is used for water retaining floors as well as stores.
- Possess high durability and hence is employed for floors in kitchens, bath rooms, schools, hospitals, drawings rooms etc.
- This type of flooring provides a smooth, hard, even and pleasing surface.
- It is easily cleaned and has proved over all economical due to less maintenance.
- The concrete being non consumable material, this flooring offers a fire resistant floor, required for fire hazardous buildings.

Demerits:

- The defects once developed in concrete floors whether due to poor workmanship or materials cannot be easily rectified.
- The concrete flooring cannot be satisfactorily repaired by patch work.
- Does not possess very satisfactory insulations properties against the sound and heat.

2.3 स्टोन फ्लोरिंग / STONE FLOORING

Stones are available in plenty across the entire stretch of India. Many of them are suitable for providing floors in residential buildings. Stones used for flooring should be strong and able to withstand abrasion and impact and also give a pleasing appearance. The stone flooring consists of thin slabs of stones laid on concrete bed. Generally Kota, Cuddappah, Shahbad, Tandur, Red, and White Sand stones are used for flooring. Granite may also used.

Stone Slabs: The stone slabs are used as hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. It may be hand or machine cut to the requisite thickness. It is as per colour as specified. Usually the sizes of stone slabs are 30x30 cm, 45x45 cm, and 60x60 cm and thickness varies from 20 to 40 mm. The stone slabs may be square, rectangular. Tolerance of $\pm$2 mm shall be allowed for the thickness. In respect of length and breadth of slabs, tolerance of $\pm$5 mm for hand cut slabs and $\pm$2 mm for machine cut slabs shall be allowed.

Preparation of Surface and Laying: Base concrete or the RCC slab on which the slabs are to be laid is to be cleaned, wetted and mopped. The bedding for the slabs is with cement mortar 1:4 (1 cement : 4 coarse sand) or with lime mortar (1 lime putty: 1 surkhi : 1 coarse sand) or as prescribed in the schedule. The average thickness of the bedding mortar under the slab is 20 mm and the thickness at any place under the slab is not less than 12 mm. The slabs are laid in the following manner:

Mortar of the specified mix is to be spread under the area of each slab, roughly to the average thickness. The stone slabs are washed clean before laying. It is to be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. Slabs then be lifted and laid aside. The top surface of the mortar is corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency is spread over the bedding mortar at the rate of 4.4 kg. Cement per Sqm of area. The edges of the slab already paved are to be buttered with cement.

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

Due care is to be taken to match the grains of slabs which are selected judiciously having uniform pattern of Veins/streaks. Slabs which are fixed in the floor adjoining the wall are entering not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor is to be finished neatly and without waviness.

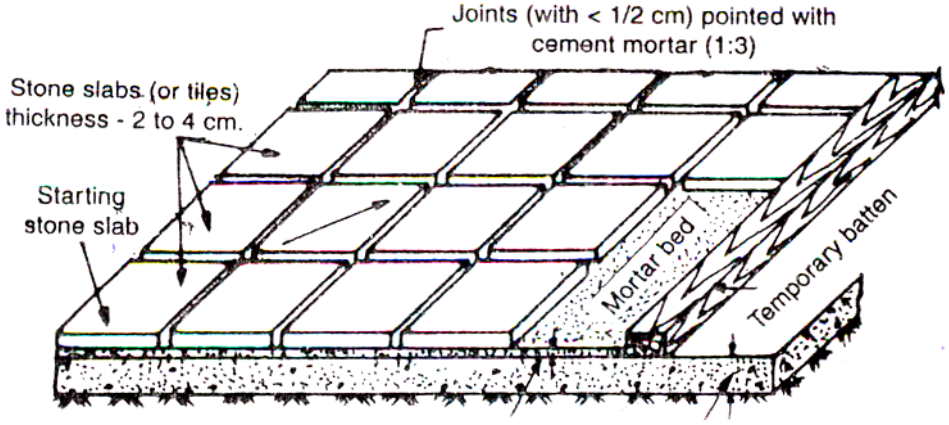
Curing, Polishing and Finishing: The day after the stone slabs are laid, all joints are cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints are then be grouted with grey or white cement mix with or without pigment to match the shape of the topping of the wearing layer of the slabs. The finished floor should not produce sound hollow when tapped with a wooden mallet.

Merits:

- It provides a hard, durable and wear resisting floor surface and such can be used for go downs, stores and workshops. It may be used in residential buildings.
- Construction, repairs and maintenance of this type of flooring is very easy.
- Where the stone slabs are available in abundance, stone flooring can be economical in use.

Demerits:

- As it does not give a pleasing and attractive appearance, so cannot be used in important public buildings.
- Being bad in conductivity, poor in shock absorbing characteristics and not offering perfectly even surface, the use of this type of flooring is not comfortable for living purposes.



STONE FLOORING

2.4 टेराज़ो (मार्बल चिप्स) फ्लोरिंग / TERRAZZO (MARBLE CHIPS) FLOORING

Terrazzo flooring is yet another type of flooring that is commonly used in houses. This type of flooring is provided in the same manner in which cement concrete flooring is provided, except that the top layer consists of terrazzo which is mixture of marble chips. Borders and decorative designs are laid before the main body of the flooring. They are laid and finished in the same manner as flooring, preferably using dividing strips.

After preparation of sub-base or sub-grade, a cement concrete bed of specified thickness and mix is laid as under layer. Generally, concrete of 1:2:4 by volume is used. If required, it can be of richer grade. Cement concrete is placed in the panels and levelled with the help of straight edge and trowel and beaten with a wooden 'Thappy' or masons trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given.

The panels may be framed by fixing of strips of 4 mm thick glass strips or 2 mm thick PVC strips/aluminium strips/brass strips etc. The panels shall be of uniform size, not exceeding 2 Sqm. in area or 2 m in length for inside situations. In exposed situations, the length of any side of the panel shall not be more than 1.25 metres. Cement slurry at the rate of 2 kg per Sqm. area is applied before laying of under layer over the cement concrete/ RCC base.

a) Terrazo Mix: The mix for terrazzo topping consists of cement with or without pigment, marble powder, marble aggregate (marble chips) and water. The cement and marble powder are mixed in the proportion of three parts of cement to one part marble powder by weight. For every part of cement-marble powder mix, the proportion of aggregate by volume and minimum thickness of the top layer of various sizes of marble chips are shown in table:

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

The marble chips are available in so many types like Pink Makrana, Black Bhainslana, Chittoor Black, Jaisalmer Yellow, Baroda Green, Dehradun White, Chittoor Pink, Yellow Patam cherala (Andhra Pradesh), Grey Gadu (Surat), Chittoor Green and Yellow and Alwar Black etc. Chips, which are used in flooring, are hard, sound, dense and homogenous in texture with crystalline and coarse grains. It is uniform in colour and free from stains, cracks, decay and weathering.

If aggregate of larger than 10 mm are used, the minimum thickness of topping should not be less than 1½ times the maximum size of the chips.

Before starting the work, the contractor shall get the sample of marble chips approved by the Engineer. The cement to be used is ordinary grey cement/ white cement/ cement with admixture of colouring matter of approved quality in the ratio specified in the description of the item to get the required shade as ordered by the Engineer.

The full quantity of dry mixture of mortar required for a room is to be prepared in a lot in order to ensure a uniform colour. While mixing the aggregates, care should be taken not to get the materials into a heap, as this would result in the coarsest chips falling to the edge of the heap and the cement working to the centre at the bottom. The materials are kept, as far as possible, in an even layer during mixing. This mixture shall be stored in a dry place and well covered and protected from moisture. The mixed mortar shall be homogenous and stiff and contain just sufficient water to make it workable.

b) Laying: The terrazzo topping is laid while the under layer of concrete is still plastic, but has hardened sufficiently to prevent cement from rising to the surface. This is normally achieved between 18 to 24 hours after the under layer has been laid. A cement slurry preferably of the same colour as the topping is brushed on the surface immediately before laying is commenced. It is laid to a uniform thickness slightly more than that specified in order to get the specified finished thickness after rubbing. The surface is rammed in order to consolidate the terrazo. It is not sufficient just to 'float' lightly as this would cause depressions which have to be filled with mortar. A piece of smooth marble stone of size 15cm x 15cm x 2.5cm may be advantageously used for ramming. Following the rammer, a trowel may be used. When using the trowel, the object should be to make the surface level and smooth with as little use of the float as possible, relying upon pressure rather than upon trowel ling action to achieve this end. Rolling will be easier than tamping and patting, but a rolled terrazo is more likely to crack since the rolled surface would draw the cement to the surface unless the mixture is very dry. The best results will be obtained by tamping combined with a minimum of trowelling. The compaction shall ensure that air bubbles are driven out from the mix. The surface shall be brought true to required level by a straight edge and steel float in such a manner that the maximum amount of marble chips come up and are spread uniformly over the surface and no part of the surface is left without chips.

c) Polishing, Curing and Finishing: Grinding of the surface is then done two or three times, either by hand or grinding machines using carborundom stone. In case of chips, which are loose or come out of the surface, repairing is done with cement grout. The floor is finally polished either by manually or by machines. Normally, polishing is done by machine. After the final polishing, oxalic acid powder is sprinkled with water over the surface @ 33 gms. per sqm. and rubbed hard with a woollen rags pad. Proper curing is being done.

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

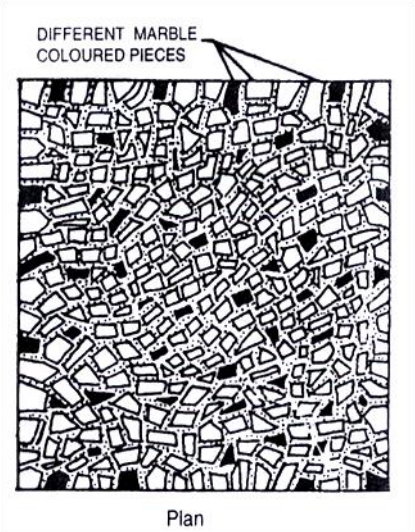
During cold weather, concreting is not done when the temperature falls below 4^0C. The concrete placed is protected against frost by suitable coverings. Concrete damaged by frost is to be removed and work redone. During hot weather, precautions are to be taken to see that the temperature of wet concrete does not exceed 38^0C.

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

2.5 क्रेज़ी मार्बल फ्लोरिंग/CRAZY MARBLE FLOORING

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

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



CRAZY MARBLE FLOORING

Under Layer: The under layer of crazy marble flooring is of cement concrete of thickness 25 mm or as specified. The mix is normally 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 12.5 mm nominal size) by volume unless otherwise specified.

Top Layer: The mix of crazy marble stone flooring consists of white cement with or without pigment, marble powder, marble chips of 00 Nos. and marble stone pieces and water. The marble stone pieces are hard, sound, dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering.

Before starting the work, the sample of marble stone as well as sizes of marble stone pieces should be approved by the Engineer. For 50 mm thick floor, the thickness of marble pieces should be 25 mm while for 40 mm thick floor, the thickness should be 15 mm. The white cement and marble powder are mixed in proportion of three parts of cement and one part of marble powder by weight, and the proportion of marble chips to binder mix by volume shall be 7 parts of marble chips to 4 parts of binder mix.

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

Polishing, Curing and Finishing: Polishing, Curing and finishing is same as in Terrazzo marble chips flooring.

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

2.6 टाइल फ्लोरिंग/TILE FLOORING

In this type of flooring, tiles are used for flooring. Wide range of tiles in various sizes and texture are available in the market. Different types of tiles may be used as per requirement of finishing and the location where they are used. Various types of tiles are available in the market, like terrazzo, chequered tiles, glazed tile, vitrified and PVC tiles. The various sizes and shapes are available. It may be available in the different colours in the market. It is advised that the tiles, which are used in flooring, are to be approved by engineer in charge before laying. Always keep some extra tiles which may be required as and when some of them require replacement.

The method of laying of tiles is similar to stone flooring, but more care and skills are required in the execution of this type of flooring.

Merits:

- It provides a non absorbent, decorative and durable floor surface.
- It permits quick installation or laying of floors.
- Easily repaired in patches.

Demerits:

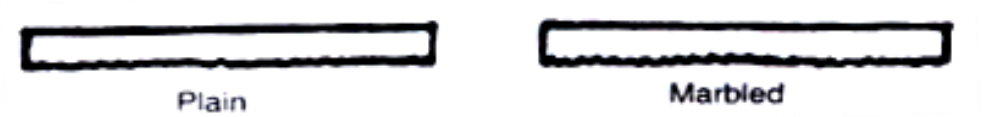
- Tiled flooring is generally costly in initial cost as well as in maintenance cost.
- On becoming wet, it provides a slippery surface.

2.7 रबर फ्लोरिंग / RUBBER FLOORING

Rubber flooring is used to a large extent in public building and industrial buildings because of their good wearing qualities, resiliency and noise insulation. The flooring material is made up of pure rubber mixed with fillers such as cottons fibre, granulated cork or asbestos fibre and the desired colour pigments.

Rubber flooring may be laid on any base that is finished even and smooth, such as concrete, timber boarding or mastic asphalt. **A rough surface provides poor adhesion to the rubber and its consequent separation from the base in due course.** It is important that the base is thoroughly dry and damp proof as dampness causes failure of the adhesive, leading to the curling of tiles.

Rubber tiles conforming to IS: 809 are available in sizes of 200 mm x 200 mm, 300 mm x 300 mm. Where the room length and width are not exact multiples of the size of the tiles, the end rows are to be with cut sizes of tiles. The thickness of the tiles varies from 3.2 mm to 6.4 mm with permissible tolerance of plus 0.8 mm and minus 0.2 mm. Normally, the tiles are 'Plain' or 'Marbled'. The colour of the tiles is as directed by the Engineer. Before starting the work, the contractor should get the samples of rubber tiles duly approved by the Engineer.



The base should be smooth, thoroughly clean and dry. Adhesive should be applied to the base and to the back and edges of the tiles and allowed to become surface dry. The tiles are then firmly pressed and smoothened down with a suitable tool. Weights are used to keep the tiles flat if any tendency to curl is noticed. Care should be taken to ensure that no air pockets are left under the tiles. If any air pocket is left, the tiles are removed and re-laid after applying more adhesive on the base and back of tiles and pressed in position. The tile is laid with butt joints throughout and the joints shall be very fine. Coves of wood or metal may be formed to cover or mask the joints between the rubber flooring and the wall facing where so required.

Adhesive: The adhesive shall be a rubber adhesive of approved quality of the type and make recommended by the manufacturers of rubber tiles. It should be approved by the Engineer. It

should be a rubber solvent preparation with a reasonably short drying time and give a tough adhesive film. The surplus adhesive should not be allowed to remain longer than 24 hours.

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

Merits: It has good wearing qualities, resiliency and noise insulation property.

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

2.8 प्लास्टिक अथवा पी वी सी फ्लोरिंग / PLASTIC OR PVC FLOORING

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

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

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

The poly-metric material is compounded with suitable plasticizers and stabilizers. The preferred thickness of PVC tiles for normal floor covering shall be 1.5, 2.0, 2.5, 3.0 or 4.0 mm. Thickness of PVC sheets shall be measured with micrometer of Ratchet type or a dial gauge graduated to 0.02 mm. The micrometer has flat bearing surface of at least 6.5 mm diameter at both contact points. For sheets and rolls, the thickness of the specimen is measured at twenty scattered points.

The width of flooring sheets and rolling in continuous length shall be 1000, 1500 and 2000 mm. When supplied in rolls the length of the rolls shall not be less than 10 metres. The measurement shall be carried out with a travelling microscope or suitable scale graduated to 0.02 mm. Each tile shall be measured for length and width at the three quarter points in each direction.

Tolerance:

(a) Thickness $\pm$ 0.15 mm
(b) Width

(i) 300 mm square tiles	± 2.0 mm
(ii) 600 mm square tiles	± 0.4 mm
(iii) 900 mm square tiles	± 0.6 mm
(iv) Sheets and rolls	± 0.1 percent

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

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

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

Before commencing the laying operations, the sub-floor is to be examined for evenness and dryness. The sub-floor is then cleaned with a dry cloth. The PVC flooring should not be laid on a sub-floor unless the sub-floor is perfectly dry. The layout of the PVC flooring on the sub-floor to be covered should be marked. The PVC flooring is first laid for trial, without using the adhesive, according to the required layout.

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

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

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

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

Any adhesive which may squeeze up between sheets or tiles is wiped off immediately with a wet cloth before the adhesive hardens. If, by chance, adhesive dries up and hardens on the surface of the sheet or tile, it is removed with a suitable solvent.

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

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

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

Precautions in Maintenance: flooring subject to normal usage may be kept clean by mopping with soap solution using a clean damp cloth. Water is not poured on the PVC flooring for cleaning purpose as the water may tend to seep through the joints and cause the adhesive to fail. To maintain a good wearing surface and a good appearance, the flooring may be periodically polished. When polish is applied frequently, a thick layer builds up which collects dirt and dust and is tacky to walk on.

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

2.9 वूड़न अथवा टिम्बर फ्लोरिंग/WOODEN OR TIMBER FLOORING

Wooden flooring is most commonly used in hilly areas of the country, where temperature are quite low. Wooden flooring may also provide in floors of **high end housing** to give a good appearance. This type of flooring is used in dancing halls, auditorium, badminton halls etc. Wooden flooring can be provided in the following ways;

Strip flooring: This is made up of narrow and thin strips of timber which are jointed each other by tongue and grooved joints. Normally, strips of 60 to 100 mm in width and 20 to 25 mm in thickness are used.

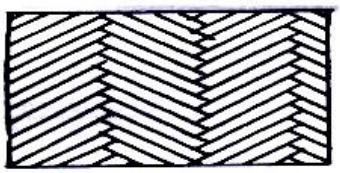
Planked flooring: In this type of flooring, wider planks of 20 cm width are normally used and jointed by tongue and grooved joints.

Wood block flooring: This type of wooden flooring consists of short but thick wood blocks which are laid in suitable designs over a concrete base. Normally, wooden blocks of size 20 to 30 cm x 8 cm and thickness 2 to 4 cm are used.

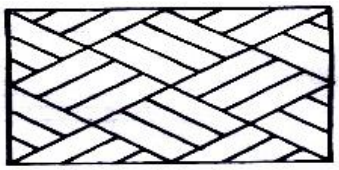
Parquet flooring: This is similar to block flooring except thickness. In this type of flooring 10 mm thick blocks are supported on sub floors. These blocks are laid by means of hot glue in desired pattern and then nailed with panel pins.

Merits: Wooden floors are elastic in nature and possess enough resistant to wear. It is shock observing and maintain good atmospheric temperature condition.

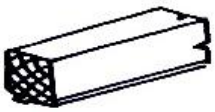
Demerits: This type of flooring is not much used for ground floors. It is easily affected by dampness and termite attack.



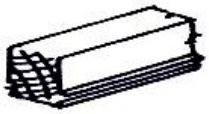
HERRING BONE PATTERN



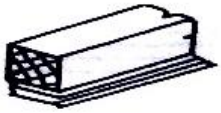
BASKET PATTERN



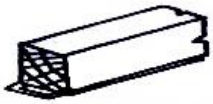
DOVE-TAILED GROOVES ON THE BOTTOM



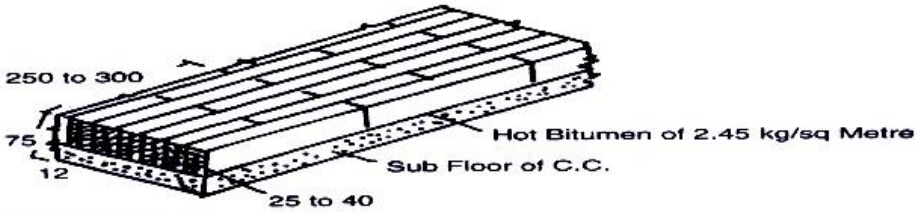
TONGUED AND GROOVED



TONGUES ON THE ENDS



DOVE-TAIL GROOVE ON THE BOTTOM WITH A NARROW BLOCK ALROUND



DRAWING NOT TO SCALE.
ALL DIMENSIONS ARE IN MM

WOOD BLOCK FLOORING

2.10 मड़ अथवा मुरम फ्लोरिंग/MUD OR MOORAM FLOORING

Mud floors are generally used for unimportant buildings, particularly in villages. Mooram or disintegrated rock floors are also used in villages.

Merits:

- Mud and mooram floorings are cheap in initial and maintenance cost.
- They provide a smooth, hard and fairly impervious surface.
- Having good insulation against heat and hence equal temperature in all seasons can be maintained.
- Easy in construction, repair and maintenance.
- They possess sufficiently long life, if properly maintained.

Demerits: For proper maintenance, the floors are required a wash of cement cow-dung, plaster once or twice a week which is objectionable from sanitary considerations.

2.11 क्रॉर्क फ्लोरिंग/CORK FLOORING

Cork flooring is generally used to obtain a noiseless floor as in case of library, churches, radio broad casting stations etc. Natural cork is nothing but the outer work of the cork oak tree, which is used in after manufacturing it in the form of tiles and carpets.

Merits:

- It provides noiseless, warm, non slippery and resilient flooring.
- Its possess good heat insulation qualities.
- This type of flooring should not be used in basement or such other floors which are constantly subjected to dampness.
- It does not offer resistant against fire, being combustible in nature.

2.12 एस्फॉल्ट फ्लोरिंग / ASPHALT FLOORING

Earlier this type of flooring was disliked due to bad smell and ugly appearance particularly in indoor floors. But with the development of technology now, it is possible to have dustless, elastic, durable, water proof and acid proof asphalt flooring. It has a variety of colours, and in different forms such as asphalt tiles, asphalt terrazzo, mastic asphalt, and special asphalt acid proof blocks. Asphalt tiles and terrazzo are used in school and office, shops etc. Mastic asphalt flooring is non slippery and noiseless. Generally, it is used in go-downs, platforms, Factories, etc. Special asphalt blocks are used in chemical laboratories, acid plants, dye houses, etc.

3.0 अनुसंशित फ्लोरिंग / RECOMMENDED FLOORINGS

S.No.	Locations	Recommended Floorings
1.	Bed Rooms	• Cement concrete flooring with neat cement finish • Terrazzo tiles, Terrazzo-in-situ (grey or white) • Kota or similar stone • Marble Crazy flooring
2.	Drg.-cum-Dining room	• White Terrazzo-in-situ flooring • Kota or similar stone • Marble tiles
3.	Office rooms (for general staff)	• Cement concrete flooring with neat cement finish • Terrazzo flooring (grey) • Terrazzo tiles
4.	Toilet flooring / Kitchen flooring	• Ceramic tiles / Vitrified tiles • Marble tiles or slab • Terrazzo tiles • Cement Concrete flooring with neat cement finish • Kota or similar stone • Terrazzo in situ flooring
5.	Staircase flooring	• Kota or similar stone • Slate stone • Terrazzo tiles • Cement concrete flooring with neat cement finish • Marble stone

6.	Walkways flooring	• Plain concrete tiles (precast) • Chequered concrete tiles (precast and coloured) • Sand stone slab • Cement concrete flooring in panels
7.	Lobby, Reception Main Lounge flooring in offices	• Ceramic tiles / Vitrified tiles • Terrazzo tiles • Kota or similar stone • Granite stone
8.	Wall cladding, Pillars cladding, Beam cladding in offices in main circulation	• Granite • Teak ply
9.	Kitchen counter slab	• Cudappah Black stone • Marble slab • Granite • Cement Concrete flooring with neat cement finish
10.	Roof	• Brick tiles • CC Tiles • CC flooring in panels • Terrazzo tiles
11.	Library, Computer rooms	• PVC flooring

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⇒ टिप्पणी / NOTES ⇐

गुणवत्ता नीति

रेलों में यात्री और माल यातायात की बढती माँग को पूरा करने के लिए गुणवत्ता प्रबंध प्रणली में अनुसंधान, डिजाइनों और मानकों में उत्कृष्टता तथा सत्त सुधारों के माध्यम से सांविधिक और नियामक अपेक्षाओं को पूरा करते हुए सुरक्षित, आधुनिक और किफायती रेल प्रौद्योगिकी का विकास करना।

QUALITY POLICY

To develop safe, modern and cost effective Railway technology complying with Statutory and Regulatory requirements, through excellence in Research, Designs & Standards and Continual improvements in Quality Management System to cater to growing demand of passenger and freight traffic on the Railways.

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हमारा उद्देश्य

अनुरक्षण प्रौद्यौगिकी और कार्यप्रणाली को उन्नयन करना तथा उत्पादकता और रेल्वे की परिसम्पत्ति एवं जनशक्ति के निष्पादन में सुधार करना जिससे अन्तर्विषयों में विश्वसनीयता, उपयोगिता और दक्षता प्राप्त की जा सके।

यदि आप इस सन्दर्भ में कोई विचार और सुझाव देना चाहते हों तो कृपया हमें इस पते पर लिखें। :

सम्पर्क सूत्र	:	उप निदेशक (सिविल)
पत्राचार का पता	:	भारतीय रेल उच्च अनुरक्षण प्रौद्योगिकी केन्द्र, महाराजपुर, ग्वालियर (म.प्र.) पिनकोड - **474005**
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Our Objective

To upgrade Maintenance Technologies and Methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability, and Utilisation.

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Fax	**:**	**(0751) – 2470841**
Email	**:**	**dircivilcamtech@gmail.com**