भारतीय मानक
Indian Standard

IS 16777 : 2019

पेवर ब्लॉक को बिछाना — रीति संहिता

Laying of Paver Blocks — Code of Practice

ICS 93.080.20

भारतीय मानक ब्यूरो
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Price Group 8

Flooring, Wall Finishing and Roofing Sectional Committee, CED 05

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring, Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

Interlocking concrete block pavement has been extensively used in a number of countries for quite some time. This standard gives recommendations for the laying of interlocking concrete paving blocks intended for roads, industrial areas and other paved surfaces subjected to all categories of static and vehicular loading and pedestrian traffic. This standard has been formulated for laying of such interlocking concrete block pavements, giving suggested procedures for laying practices and patterns for different requirements and situations of applications, construction practices, and for their use.

The composition of the Committee responsible for formulation of the standard is given in Annex A.

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 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of specified value in this standard.

Indian Standard

LAYING OF PAVER BLOCKS — CODE OF PRACTICE

1 SCOPE

This standard covers laying of interlocking concrete paver blocks intended for roads, industrial areas and other paved surfaces subjected to all categories of static and vehicular loading and pedestrian traffic. This standard also covers recommendations for drainage and maintenance of such pavements.

2 REFERENCE

The standard listed below contains provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

IS No.	*Title*
15658 : 2006	Precast concrete blocks for paving — Specification

3 TERMINOLOGY

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

3.1 Arris — Part of a block where two faces meet, which can be bevelled, rounded, chamfered or splayed.

3.2 Aspect Ratio — The ratio of length to thickness of a paver block.

3.3 Backing Layer — Layer of concrete on the lower face of a two-layer paver block, made of material same as or different from that used in the wearing layer of the block.

3.4 Basket Weave or Parquet — A laying pattern where two or more pavers are placed side-by-side. Adjacent pavers are placed side-by-side, but turned 90° and alternated 90° throughout the pattern.

3.5 Base Course — A material of designed thickness placed on a sub-base or a sub-grade to support a surface course. A base course can be compacted aggregate, cement or asphalt stabilized aggregate, asphalt or concrete.

3.6 Bed Face — That surface of a paver block which, when paved, comes in direct contact with the bedding material.

3.7 Bedding Sand — A layer of coarse, clean sand that is screeded smooth for bedding the pavers. The sand can be natural or manufactured, that is, crushed from larger rocks, and should conform to the grading requirements.

3.8 California Bearing Ratio (CBR) — The ratio expressed in percentage of force per unit area required to penetrate a soil mass with a circular plunger of 50 mm diameter at the rate of 1.25 mm/min to that required for corresponding penetration in a standard material. The ratio is usually determined for penetration of 2.5 and 5 mm. Where the ratio at 5 mm is consistently higher than that at 2.5 mm, the ratio at 5 mm is used.

3.9 Chamfer — A 45° bevelled edge around the top of a paver unit usually 2-6 mm wide. It allows water to drain from the surface, facilitates snow removal, helps prevent edge chipping, and delineates the individual paving units.

3.10 Colour — Appearance of a paver block due to pigment used in concrete, other than natural cement colour.

3.11 Complementary Product — A precast usually of the shape of part of a block, used for fitting into gaps remaining in a block-paved area, for complete coverage of paved surface.

3.12 Crown — The slightly convex shape of a road cross-section. It is beneficial to surface drainage and interlock.

3.13 Deflection — The temporary movement of a pavement structure due to traffic loads.

3.14 Deformation — A change in the shape of the pavement.

3.15 Equivalent Single Axle Loads (ESALs) — Summation of equivalent single axle loads (100 kN) to combine mixed traffic to a design traffic load for the design period.

3.16 Edge Paver — A paving unit that is made with a straight, flush side, or cut straight for placement against an edge restraint.

3.17 Edge Restraint — Device that serves to prevent lateral movement of paving units and to prevent loss of the laying course material.

3.18 Face Mix or Hard Facing — The application of a thin layer of fine aggregate and cement to the top surface of a concrete paver. The layer is often coloured and is used to provide a more intensive appearance, greater abrasion resistance, or provide a base for a textured finish.

3.19 False Joints/Grooves — Regularly shaped depressions on the wearing layer of a paver block.

3.20 Format — Work dimensions of a paver block, specified in the order of overall length, overall width and thickness.

3.21 Half Stone — A half of a paver.

3.22 Hard Edges — A field of pavers that is restrained against a visible edge restraint or curve, thus visually reinforcing the edge of pavement.

3.23 Herringbone Pattern — A pattern where joints are no longer than the length of one and one-half pavers. Herringbone patterns can be 45° or 90° depending on the orientation of the joints with respect to the direction of the traffic.

3.24 Interlocking/ Dentated/ Inter-connected Paver Blocks — Cement concrete paver blocks, which key into one another on some or all vertical faces, when paved in any pattern.

3.25 Interlocking Mechanism — The mechanism, which allows adjacently paved blocks to key into one another and facilitate the sharing of shear, bending and thrust forces between adjacent blocks in a paved system.

3.26 Intermediate Restraint — Device that is used to provide restraint of paving units at intervals of the paving surface.

3.27 Joint Sand — Sand applied to fill the joints between paving units.

3.28 Joint Sand Stabiliser — Liquid penetrating or dry mix applied or materials that provide early stabilization of joint sand.

3.29 Joint Spacing — The distance between pavers subsequently filled with joint sand.

3.30 Joint Width — Distance between adjacent paving units or units and restraint.

3.31 Lean Concrete — Concrete of low cement content (150 kg/m^3 of concrete) used as a structural base material or as flow able fill in utility trenches.

3.32 Length — Shortest distance between farthest opposite vertical faces of a parallelepiped enclosing a paver block, excluding the dimensions due to any spacer nibs.

3.33 Layer or Cluster — A group of paver manufactured in a laying pattern, generally placed by mechanical equipment.

3.34 Laying Face — Working edge of the surface course to which paving unit are being placed.

3.35 Laying Course — Layer of sand on which paving units are bedded.

3.36 Laying Pattern — The sequence of placing pavers such that the installed units create a repetitive geometry. Laying patterns may be selected for their visual or structural benefits.

3.37 Moisture Content — The percentage by weight of water contained in the pore space of soil, sand or base, with respect to the weight of the solid material.

3.38 Multicoloured Paver (Colour Blend) — A paver with two or more colours. The appearance is usually variegated.

3.39 Pavement Structure — A combination of sub-base, base course, and surface course placed on a sub-grade to support the traffic load and distribute it to the roadbed.

3.40 Paver Block — Solid, un-reinforced pre-cast cement concrete paving units used in the surface course of pavements, with minimum horizontal cross-section of 50 mm from any edge in any direction, having aspect ratio not more than four, except for complementary products.

3.41 Permeable Interlocking Pavement — Concrete pavers with wide joints (10 mm to 30 mm) or a pattern that creates openings in which rainfall can infiltrate. The openings can be filled with aggregate or topsoil and grass. The pavers are typically placed on an open-graded aggregate base, which stores runoff.

3.42 Plan Area — Horizontal area bounded by the vertical faces of a paver block, excluding the area due to any spacer nibs.

3.43 Plate Compactor — A mechanical device required for making compacted or stabilized layers according to provisions of applicable specifications.

3.44 Pumping — The ejection of saturated bedding and joint sand, through joints or cracks or along edges of pavers when a load is applied.

3.45 Road Base or Base Course — One or more layers of material placed above the sub-base that constitutes a structural element of a flexible or composite pavement.

3.46 Running or Stretcher Bond — A laying pattern with continuous joint lines in one direction and pavers are staggered from one row to the next.

3.47 Side Face — That face of a paver block which is generally in the vertical direction when paved and which faces adjacent block.

3.48 Skid Resistance — Resistance to relative movement between a vehicle tyre and the trafficked surface of a pavement.

3.49 Soft Edges — A field of pavers with no visible edge restraint that meets grass or other vegetation, thus giving a soft appearance to the edge.

3.50 Stack Bond — A laying pattern in which the joints in both directions are continuous.

3.51 Sub-base — One or more layers of material placed immediately above the sub-grade.

3.52 Sub-grade — The soil upon which the pavement structure and shoulders are constructed.

3.53 Spacer Nibs — Small protruding profiles on the vertical face of a paver block used as a device for keeping minimum joint gap while paving blocks.

3.54 Squareness — Normally between the vertical faces of a paver block and the horizontal wearing surface, and parallelism between wearing surface and lower horizontal surface.

3.55 Surface Course — Layer of interlocked a paving unit that acts as a wearing surface and forms part of the structure of the pavement.

3.56 Surface Relief — Regularly shaped protrusions on the wearing surface of a paver block.

3.57 Surface Texture — Microscopic and macroscopic features of the wearing face of a paver block.

3.58 Thickness — Vertical distance between the upper face and bed face of a paver block.

3.59 Wearing Face — That surface of a paver block which, when paved, faces the atmosphere and which is directly subjected to loading and movement of vehicle tyres or pedestrian traffic.

3.60 Wearing Face Area — Horizontal area bounded by the vertical faces of a paver block, minus the area reduced due to the presence of arris.

3.61 Wearing Layer — Layer of concrete or mortar on the upper face of a two- layer paver block, made of material same as or different from that used in the backing layer of the block.

3.62 Width — Shortest distance between nearest opposite vertical faces or corners of a paver block.

3.63 Work Dimension — Any dimension of a paver block specified for its manufacture, to which the actual dimension should conform, within specified permissible tolerances.

4 MATERIALS

4.1 General

The quality of materials, cement concrete strength, durability and dimensional tolerance, etc, is of great importance for the satisfactory performance of block pavements. These aspects and the block manufacturing process itself, which immensely affect the quality of paving blocks, are broadly outlined in **4.2** to **4.6** describing the desired engineering properties of bedding/joint filling sand layer beneath the block; the base course and sub-base materials.

4.2 Precast Concrete Paver Blocks

The precast concrete blocks for paving shall be conforming to IS 15658.

4.3 Bedding Sand

The quality and thickness of bedding sand are of utmost important for ensuring good riding quality and service life of block pavements. Non-uniform thickness of bedding sand layer results in serious irregularities in surface profile that may include excessive differential deformation and uneven surface riding quality of the block pavement. The desired gradation of bedding sand shall be as given in Table 1.

Use of single-sized or gap graded sand or sand with excessive amount of fines or plastic fines shall be avoided. Sand particles with sharp edge shall preferably be used as this sand posses a higher strength and resists the migration of sand particles under the block to less frequently trafficked areas. Even though sharp sand is relatively more difficult to compact than rounded one. The use of sharp sand is preferred for the heavily trafficked pavements. The bedding sand shall be free from deleterious materials.

Table 1 Gradation for Bedding Sand
(*Clause* 4.3)

Sl No.	IS Sieve Size	Percent Passing
(1)	(2)	(3)
i)	9.52 mm	100
ii)	4.75 mm	95-100
iii)	2.36 mm	80-100
iv)	1.18 mm	50-95
v)	600 micron	25-60
vi)	300 micron	10-30
vii)	150 micron	0-15
viii)	75 micron	0-10

4.4 Joint Filling Sand

The gap between two paving blocks (preferably 3 mm and not more than 4 mm wide) needs to be filled with a dry sand, relatively finer than the bedding sand. The gradation of the joint filling sand shall be as given in Table 2.

It is necessary to restrict the fines (silt and/or clay passing 75 micron sieve) to 10 percent, since excessive fines make joint filling very difficult. It is not advisable to use cement in the joint filling sand as it adversely affects the desired flexibility characteristics of the paving block layer. The joint filling sand shall be as dry as possible; otherwise complete filling of joints will be difficult. To overcome the problem of efflorescence on the surface of paving block layer, the joint filling sand should be washed to remove soluble salts.

Table 2 Gradation of Joint Filling Sand
(*Clause* 4.4)

Sl No.	IS Sieve Size	Percent Passing
(1)	(2)	(3)
i)	2.36 mm	100
ii)	1.18 mm	90-100
iii)	600 micron	60-90
iv)	300 micron	30-60
v)	150 micron	15-30
vi)	75 micron	0-10

4.5 Base Material

The properties of the base materials and layer play a vital role in the structural integrity and performance of concrete block pavements similar to other types of pavement Although, local availability and economics generally dictate the choice of base material at the design stage, the commonly used materials considered suitable for base courses are unbound crushed rock, water-bound macadam, wet mix macadam, cement bound crushed rock/granular materials, and lean cement concrete/ dry lean concrete as per MORTH specifications. The climatic and environmental factors also need to be considered during the choice of a base material.

4.6 Sub-base Material

Generally, a sub-base is warranted where commercial traffic is expected. The quality of sub-base materials is inferior to the base materials and includes natural gravels, cement treated gravels and sands and stabilized sub-grade materials.

5 CONCRETE BLOCKS AND THEIR SHAPE

5.1 General

The evolution of block shapes is marked by four clear stages. In the first stage the block shapes and sizes were designed to imitate the stones and bricks, which they were meant to replace. In the second stage the block sizes were more or less retained, but their shapes were refined to provide interlocking on some faces. In the third stage, blocks capable of interlocking on all faces were introduced. In fourth stage which was recently introduced, block shapes in 'L' and 'X' formats capable of still better interlocking and suitable for mechanical paving are being tried out. These blocks are yet to be introduced in India.

Present day interlocking blocks have evolved in shape after observing their performance. The three phases in the evolution of the shape of the blocks are shown in Fig. 1 and Fig. 2. The blocks further can be grouped into three categories as under:

a) Category A : Dentated units are designed to key into each other on all four faces and which, by their plan geometry when keyed together, resist the widening of joint. These blocks are generally capable of being laid in herringbone bond pattern.

b) Category B : These blocks are dentated on only two sides. Their dimensional accuracy of laying helps in bringing about the interlock effect on other faces. Generally, with some exception, theses blocks can only be laid in stretcher bond.

c) Category C : These are not dentated type but depend on dimensional accuracy for interlocking effect. These blocks can be laid only in stretcher bond.

6 PATTERNS FOR LAYING BLOCKS

The paver blocks can be placed to different bonds or patterns depending upon requirement, some popular bonds commonly adopted for block paving are:

a) Stretcher or running bond,
b) Herringbone bond, and
c) Basket weave or parquet bond.

The typical layouts of these bonds are given in Fig. 3.

7 TYPE OF CONSTRUCTION

7.1 Manual Methods

In the traditional manual method, the sand is screeded and a skilled worker (called a pavior) levels the sand and then embeds the block using a hammer; he works backwards so as to have a continuous view of the completed pavement in order to obtain a good finish. A pavior, along with an assistant, can lay 50 to 75 m^2 of paving per day.

An alternative to the above method, the block pavers (generally semi-skilled labourers) work on the completed surface, moving forward.

For optimum output, it is advantageous to select an easy fitting block shape, with the desirable size being that which can be easily accommodated in the worker's hand; in addition, the block should be chamfered for easy handling.

The optimum output of finished pavement varies widely with training of workmen, over a wide range from a low of 20 to a high of 120 m^2/man-day; the higher

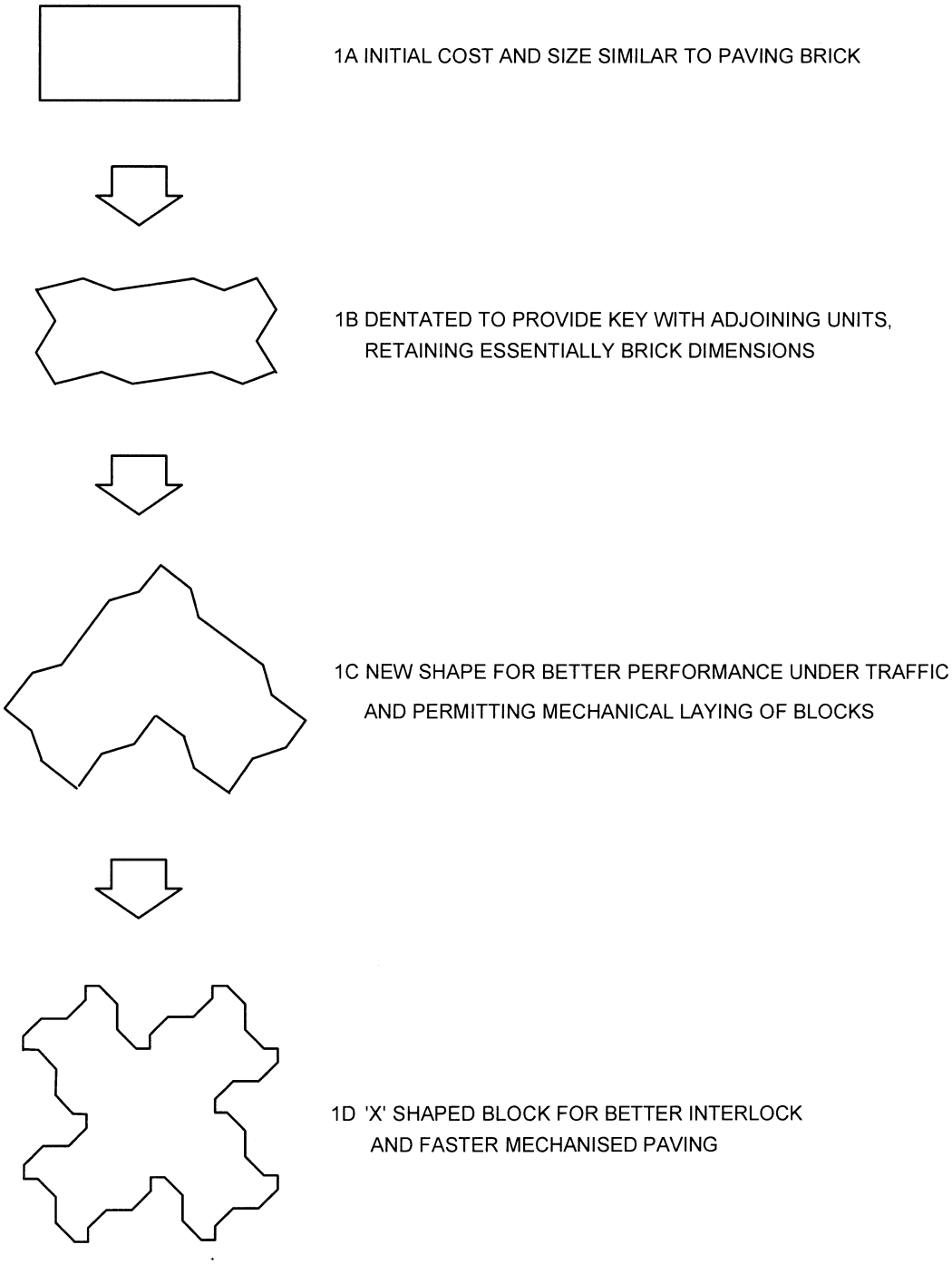


FIG. 1 EVOLUTION OF BASIC SHAPES OF BLOCK

outputs being for industrial hard standings where intrusion like manholes, etc, are minimal. To keep up the speed of work, it is important to maintain an adequate supply of paving blocks to the laying site for manual paving. Ordinarily, hand pushed trolleys are adequate for the purpose, but for large projects employing a number of laying teams, use of powered trolleys is preferable.

Care must be taken to see that paving blocks are not tightly butted against each other, otherwise there could be non-uniformity in the laying patterns and the blocks may spall or even crack.

Since each workman may produce slightly different joints widths, it is desirable to rotate workman along the workface, and also periodically interchange the personnel laying and transporting blocks.

The average joint width can be measured and checked, by determining statistically the represented value of

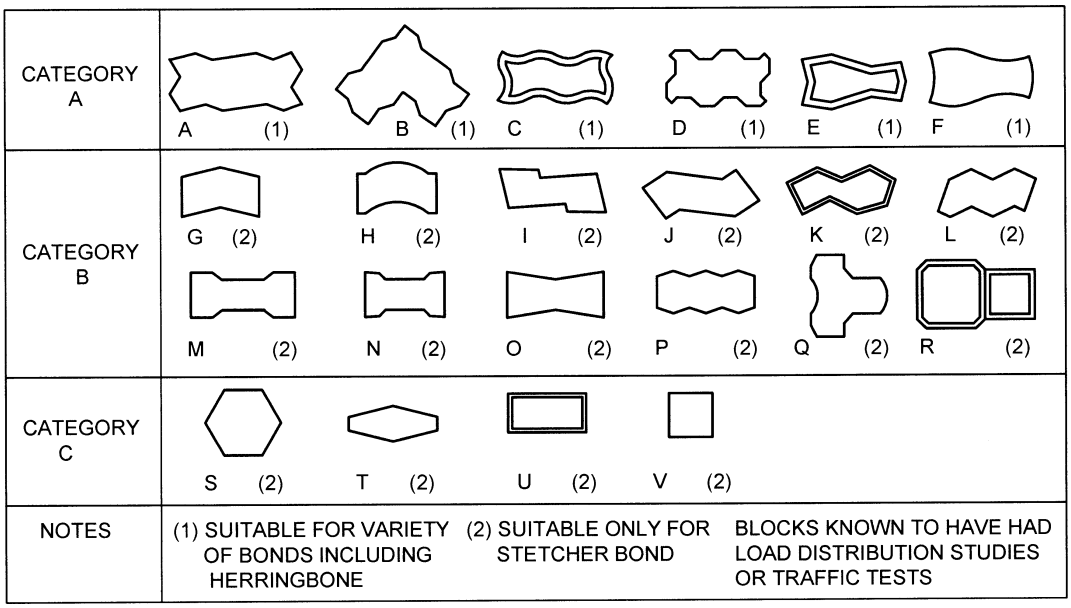


FIG. 2 DIFFERENT CATEGORIES OF BLOCKS

average length and breadth of blocks at the project site and then obtaining average distance between joints, say 40 blocks apart; or it can be done by measuring joints widths directly, using a calibrated, hardened steel mandrel which is forced into joints at a series of randomly selected locations, to obtain a statistically representative figure.

7.2 Mechanised Methods

Mechanised laying requires the use of specialized equipment for transporting and placing clusters of paving blocks. The size of paving block cluster suitable for paving, is usually 0.3 to 0.5 m^2 in area for hand-operated equipment; for fully mechanized equipment, the cluster surface area can be up to about 1.2 m^2. These cluster are designed to maintain a joint space of about 3 mm between blocks, when clamped together.

Since the blocks are placed in separate cluster, there exists the possibility of damage, if joints between adjacent cluster run uninterrupted throughout the pavement. To overcome this problem, cluster may be arranged so that the joints are periodically staggered both along and across the cluster axis or link blocks are installed by hand across these joints.

Mechanised laying must be coordinated with the manufacturer, so that the blocks are delivered stacked on pallets in the required pattern; spacing ribs may be cast on the sides of blocks to preserve the required joint spacing.

8 CONSTRUCTION OF CONCRETE BLOCK PAVEMENT

8.1 Sequence of Operations

The sequencing of operations (*see* Fig. 4) for construction of block pavement should be as follows:

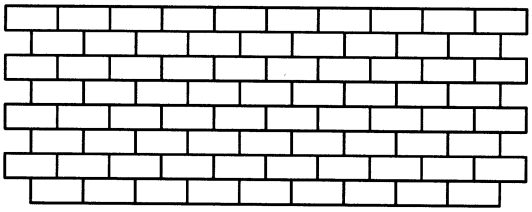
a) Installation of sub-surface drainage structures.
b) Levelling and compaction of sub-grade and profile checking.
c) Provision and compaction of sub-base course (where needed).
d) Provision and compaction of base-course and checking for correct profile.
e) Installation of edge restraints.
f) Provision and compaction of coarse bedding sand and profile checking.
g) Paving of blocks and construction.
h) Application of joint sealing sand and compaction.
j) Cleaning of surface.
k) Filling any remaining empty portions in the block layer especially near edge restraint blocks with *in-situ* concrete.

8.2 Paving Job Planning

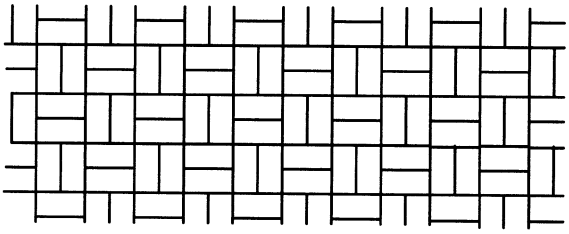
Proper job planning, use of proper techniques and coordination of materials handling, paving and compaction teams can greatly enhance efficiency and economy of paving job.

The following are some of the key factors in job planning and cost control:

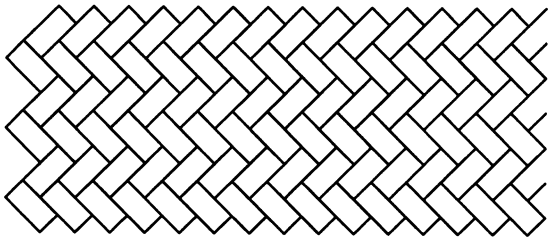
a) Ensure that edge restraints are properly located to minimize cutting of blocks.
b) Use cut blocks and end blocks, wherever needed.
c) Spread bedding sand mechanically, when possible.



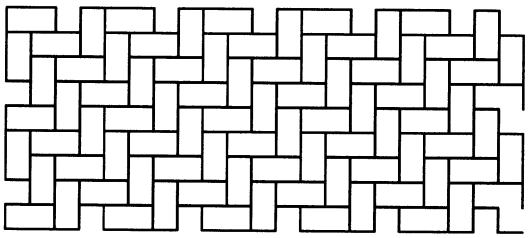
3A STRETCHER OR RUNNING BOND



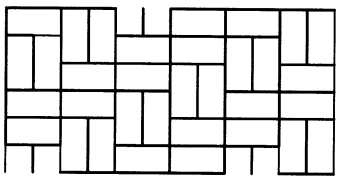
3B PARQUET OR BASKET WEAVE



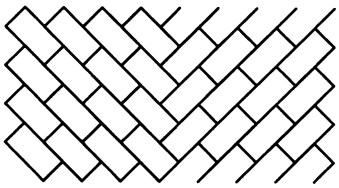
3C 45° HERRINGBONE BOND



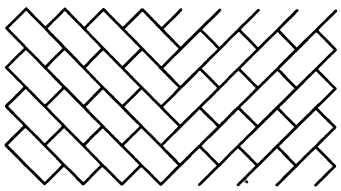
3D 90° HERRINGBONE BOND



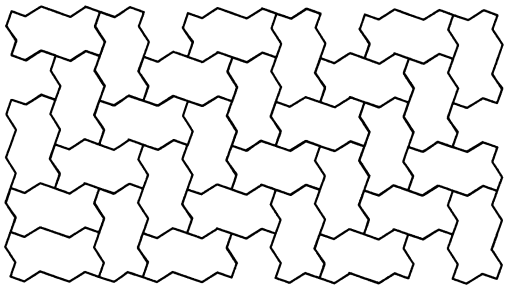
3E PARQUET DERIVATED



3F DOUBLE - V

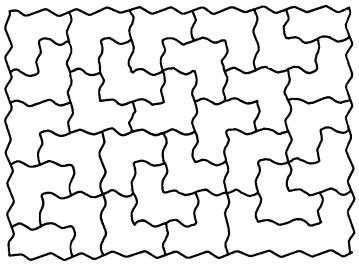


3G DOUBLE HERRINGBONE

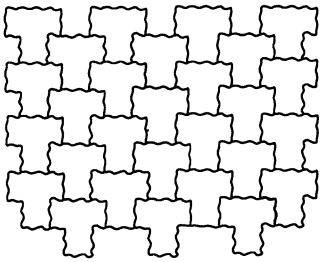


3H HERRINGBONE

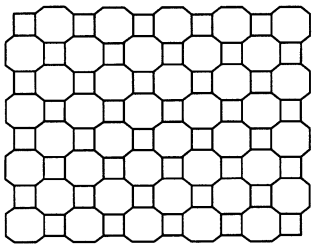
FIG. 3 VARIOUS LAYING PATTERNS — (*Continued*)



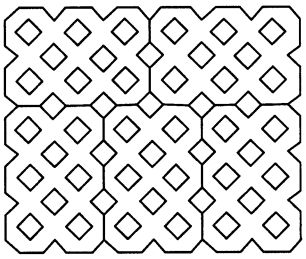
3J HERRINGBONE BOND



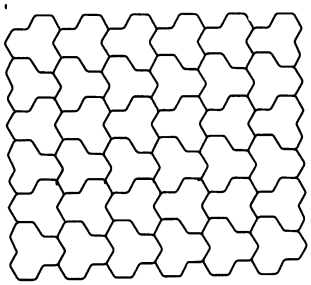
3K HERRINGBONE BOND



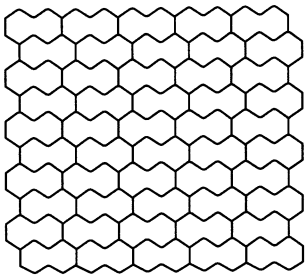
3L HERRINGBONE BOND



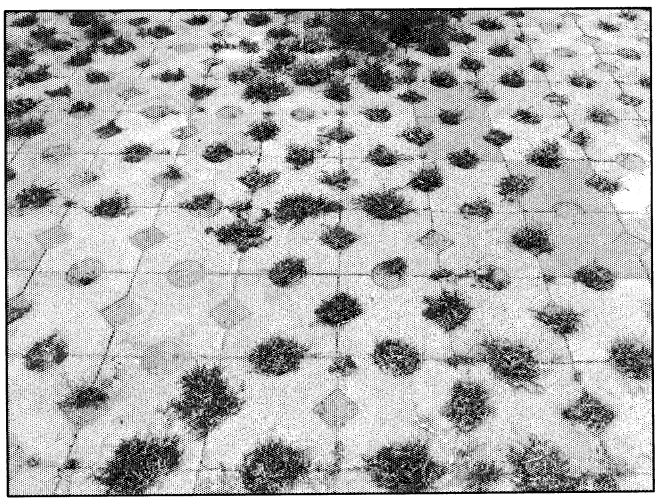
3M CONCRETE GRID PAVEMENT



3N CROSS-JOINT BOND



3P CROSS-JOINT BOND



3Q GRASS PAVER BLOCKS (TYPICAL)

FIG. 3 VARIOUS LAYING PATTERN

d) Locate pavement start lines and subsequent development of the laying face to ensure that a laying face continues in one general direction.

e) Use guidelines to control regularity of bond.

f) Anticipate and plan detailing of the pavement at perimeters and obstructions and aprons of manholes, drainage pits, etc.

g) Placing of bedding sand, joint sealing sand and concrete block deliveries so as to minimize repeated handling.

h) Use suitable trolleys or buggies to ease transport of blocks from delivery points to the laying face.

j) Locate and phase paving and compaction teams to facilitate orderly progress of work. Use manually light weight wooden hammer or poles for compaction/positioning of blocks or layers.

Do not allow traffic or pedestrian movement on block-paved surface until compaction is completed.

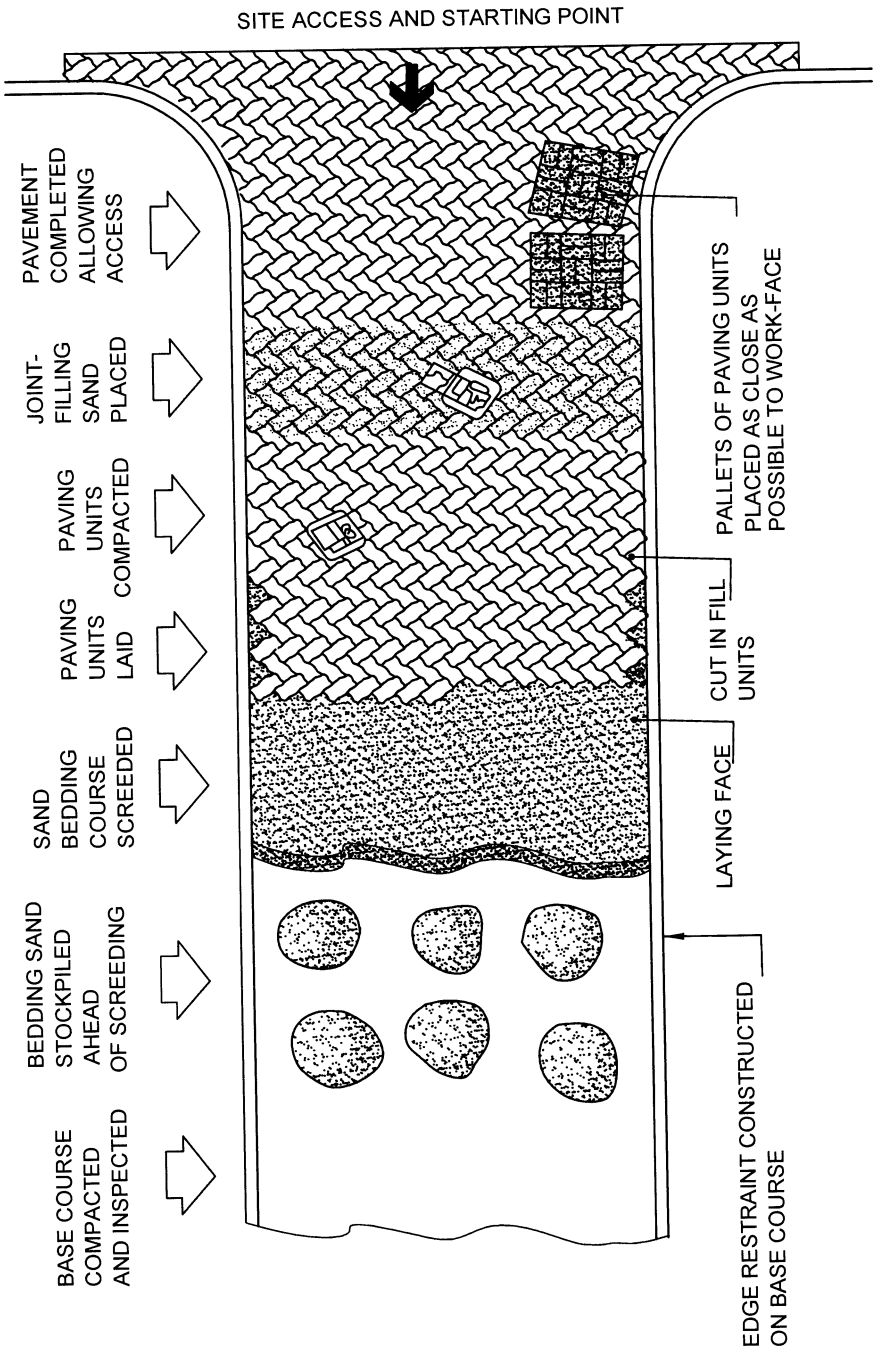


FIG. 4 SEQUENCING OF LAYING

8.3 Construction of Sub-grade

This is the foundation layer on which the block pavement is constructed. Like in conventional pavements, the water table should be at a minimum depth of 600 mm below the sub-grade. It should be compacted in layers of 150 or 100 mm thickness. The prepared sub-grade should be graded and trimmed to a tolerance of ± 20 mm of the design levels, and its surface evenness should have a tolerance of within 15 mm under a 3 m straight edge.

8.4 Construction of Base and Sub-base Layers

The requirements for construction of block pavement up to the base course level are the same as for flexible pavement. Sub-surface drainage structures should be installed before compaction of sub-grade. Compacted sub-grade should provide a stable working platform for subsequent construction. Base course should be constructed in layers of 100 mm to 150 mm compacted thicknesses. The surface evenness of the base course should be checked to ensure that the variation is within 5 mm of the design profile. Any undulation in the base course profile will be reflected on the block surfacing. Bedding sand should not be used as filler to correct base course profiles. The base course should be extended on both sides of the pavement, at least just beyond (about 60 cm) the positions of edge restraints.

For granular base course, when ingress of water into the base course is expected under worst moisture conditions, a bituminous primer should be applied to the base course surface at the rate of 0.3 to 0.6 litre/m^2. Continuous and uniform bitumen cover should be obtained. For compaction of areas inaccessible to normal compaction equipments, vibrating plate compactors must be used. At the edge where plate vibrator can not reach, manual compactor shall be used. For typical locations like areas adjacent to walls, lampposts, manholes, grated gully pits and other surface inlets, provision of cement bound or lean concrete base course is recommended to limit the potential for future settlement. After completion of base course construction, edge restraints should be installed.

8.5 Edge Restraint Blocks and Kerbs

Concrete blocks on trafficked pavements tend to move sideways and forward due to braking and maneuvering of vehicles. The tendency to move sideways has to be counteracted at the edges by special edge blocks and kerbs. The edge block should be designed such that the rotation or displacement of blocks is resisted. These are to be made of concrete of high strength to withstand the traffic wheel loading without getting damaged. These members should be precast or constructed *in-situ* with continuing kerb paving machine to have at least a 28 day characteristic compressive strength of 30 MPa or flexural strength of 3.8 MPa. As far as possible the edge blocks should have vertical face towards the inside blocks. A few typical edge blocks are also shown in Fig. 5. Where plate vibrators are also inaccessible, *Durmat* or manual compactor using small size plate hammer may be used.

The road kerbs provided on the edge of the road also serve the purpose of edge blocks as shown in Fig. 6. In case the kerbs are not provided, it has to be replaced by edge strips. In case of heavy traffic 150 mm × 150 mm plain cement concrete (M-25) may also be provided over dry lean concrete to give further confinement of blocks. In between the edge restraint blocks cement mortar (1 : 3, cement : coarse sand) may be used in place of sand for sealing of units.

8.6 Bedding Sand

A layer of sand bedding is provided between block pavement and base for the following reasons:

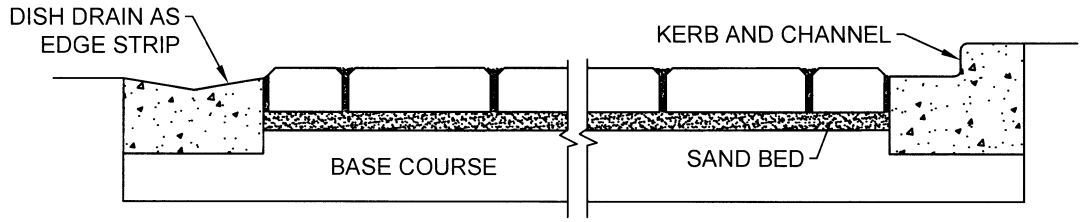
a) Provide a cushion between the hard base the paving blocks;
b) Base or sub-base will have some permitted surface unevenness. By providing a layer of sand bed, the paved block can be levelled perfectly;
c) Sand bed acts as a barrier and does not allow propagation of cracks formed in base/ sub-base; and
d) Sand also helps to keep lower part of the joint filled with sand and provides added interlocking effect.

The sand bedding thickness should be reasonably constant and all level and slopes should be made in sub-base. For heavy traffic area, sand bedding should be 30 to 50 mm thick (uncompacted). Vibration in thickness of bedding sand should not exceed 5 mm in any case. If sand bedding thickness varies above 5 mm it will definitely result in undulation/ unevenness of paving surface.

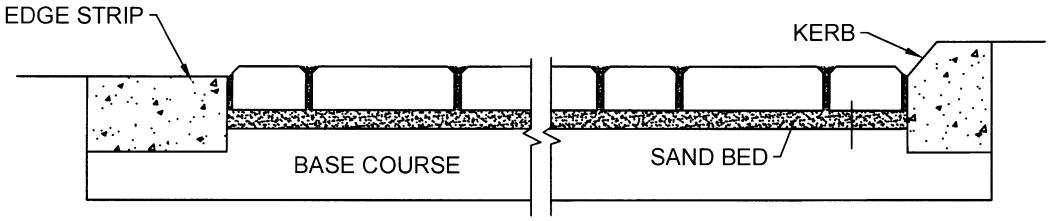
For block pavement to perform satisfactorily, it is necessary that the lower layers are profiled to proper level and finish and that the bedding sand layer is of uniform thickness. Varying thickness of sand bed ultimately results in uneven surface of the pavement.

8.7 Placing and Screeding of Bedding Sand

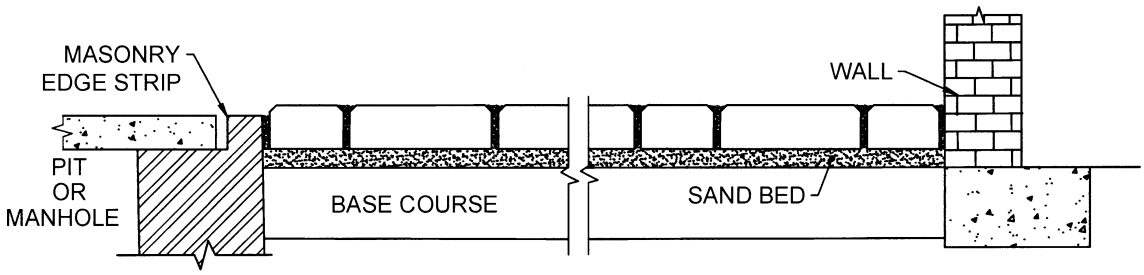
The thickness of the sand bed after compaction should be in the range of 20-40 mm, whereas, in the loose form it can be 25 to 50 mm. It is preferable to restrict the compacted thickness to 20-25 mm to reduce the risk of any localized precompaction, which would affect the final block surface level. Bedding sand should not



5A

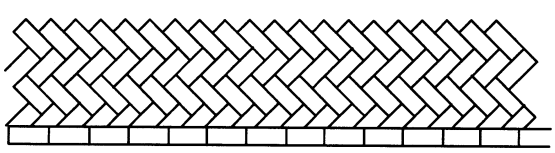


5B

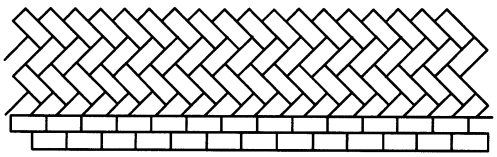


5C

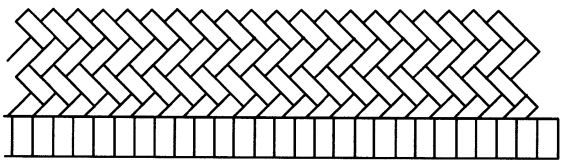
FIG. 5 SCHEMATIC DIAGRAM FOR EDGE RESTRAINT BLOCKS



6A SINGLE STRETCHER COURSE



6B DOUBLE STRETCHER COURSE



6C SOLDIER COURSE

FIG. 6 USE OF BLOCK AT EDGES

be used to fill-up local depressions on the surface of a base or sub-base. The depressions if any, should be repaired with same material in advance before placing sand.

The sand of specified gradation to be used, should be uniformly in loose condition and should have uniform moisture content. Best moisture content is that when sand is neither too wet nor too dry and has moisture of 6 to 8 percent. Requirement of sand for a day's work should be prepared and stored in advance and covered with tarpaulin or polythene sheets.

The processed sand so obtained is spread with the help of screed boards to the thickness. The screed boards are provided with nails at 2-3 m apart which when dragged gives the desired thickness. The length of nail should take into account the surcharge to be provided in the uncompacted thickness. Alternatively, the screed can be dragged on edge strips kept on both sides as guide.

8.8 Laying of Blocks

Blocks can be laid generally by manual labour but mechanical aids like hand-pushed trolleys can expedite the work.

Normally, laying should commence from the edge strip and proceed towards the inner side. When dentated blocks are used, the laying done at two fronts will create problem for matching joints in the middle. Hence, as far as possible, laying should proceed in one direction only, along the entire width of the area to be paved.

While locating the starting line, the following should be considered:

a) On a sloping site, start from the lowest point and precede uphill on a continuous basis, to avoid downhill creep in incomplete areas.

b) In case of irregular shaped edge restraints or strip, it is better to start from straight string line as shown in Fig. 7.

c) Influence of alignment of edge restraints on achieving and maintaining laying bond.

8.9 Establishing the Laying Pattern

In relation to the starting line, the blocks should be placed at the correct position to achieve the final orientation as required by the laying pattern. If the edge restraint and suitably oriented, the first row of blocks can abut it. For irregular-shaped and unfavorably oriented edge restraints, a string line should be established a few rows away to position the first row as shown in Fig. 7.

With the help of gauges, the joint width specification (2 to 4 mm) should be checked in the first few square metres, where it should be ensured that the block alignment is correct. The laying patterns and face should be established (*see* Fig. 8) to permit fast and easy laying without the necessity of forcing a block between previously positioned blocks. To start with, full blocks should be used; only subsequently, cutting and in filling at edge be permitted. Under no circumstances should the block be forced or hammered into the bidding sand at this stage of lying. For cutting paving blocks, hydraulic or mechanical block cutters, or power saws are used. Cut units less than 50 mm minimum dimension should not be used, as these are difficult to cut accurately and can be dislodged under traffic. Where space does not permit use of a larger segment, use premixed concrete or a sand-cement mortar of same grade of blocks instead.

The control over alignment, lying pattern and joint widths can be maintained by the use of chalked string lines, at about 5 m intervals.

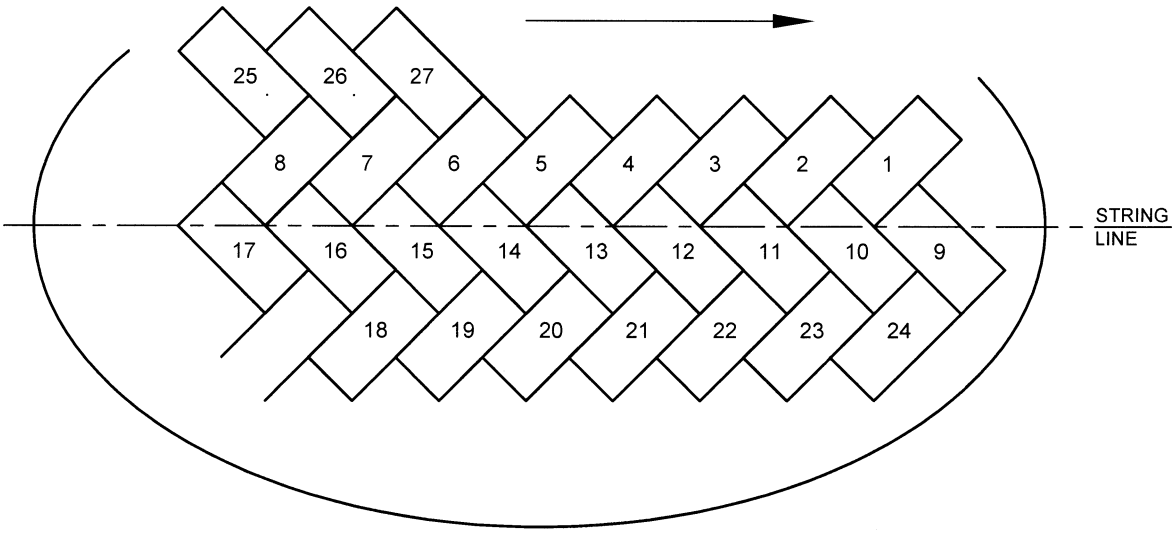
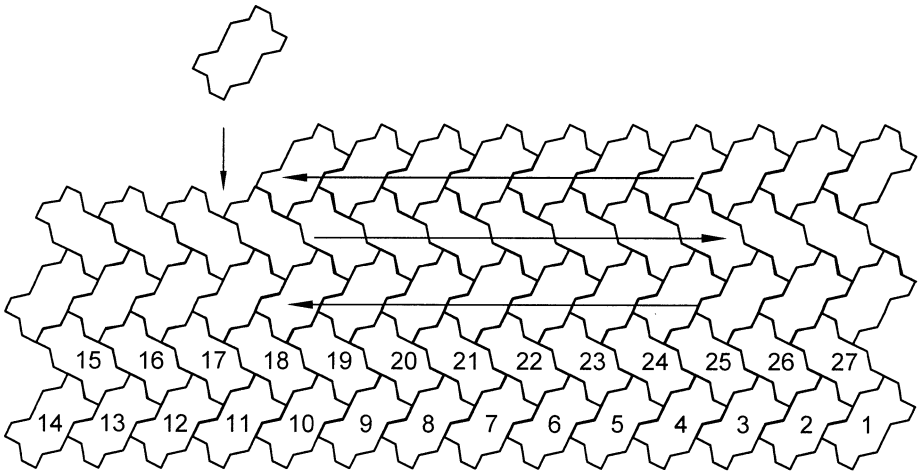
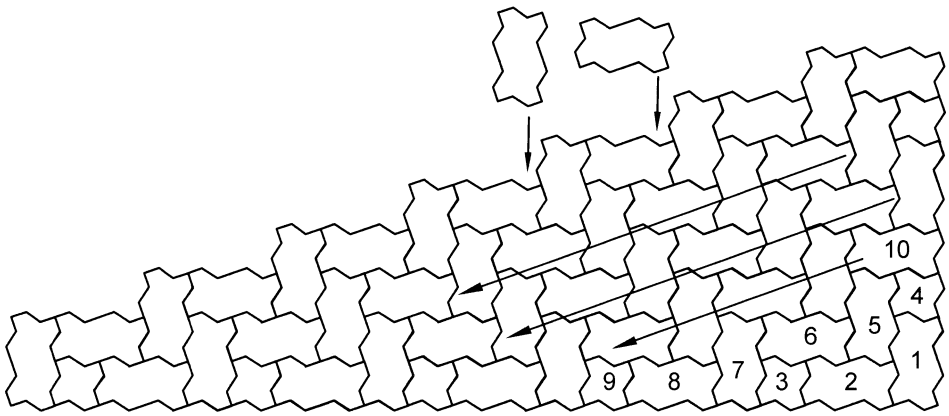


FIG. 7 STARTING AT IRREGULAR SHAPED EDGE RESTRAINT



8A AXIS OF UNITS NOT PARALLEL TO EDGE RESTRAINTS-ONLY ONE OPERATOR CAN WORK ON THE LAYING FACE



8B AXIS OF UNITS PARALLEL TO EDGE RESTRAINTS-MORE THAN ONE OPERATOR MAY WORK ON THE LAYING FACE

FIG. 8 ESTABLISHING LAYING FACE FOR BLOCKS IN HERRINGBONE BOND

8.10 Typical Pavement Composition

A few typical compositions normally used are given in Table 3.

8.11 Drainage

Block pavement with joints filled with sand is not a waterproof layer and hence care has to be taken to drain out the water seeping through the joints in initial stage of the construction. This water can find way to sand bed below, base, sub-base and sub-grade layers. Unless these layers are free draining, appropriate drainage arrangement has to be provided. The drainage provided generally consists of sub-surface drains surrounded by filter material or geotextile, which would allow the water to pass through and at the same time prevent the escape of bedding/jointing sand. The water collected is to be taken through 80 mm diameter perforated pipe. Typical sub-surface drainage arrangement used in block pavement is shown in Fig. 11. Drainage system with no fines concrete provided below the sand bed is shown in Fig.12.

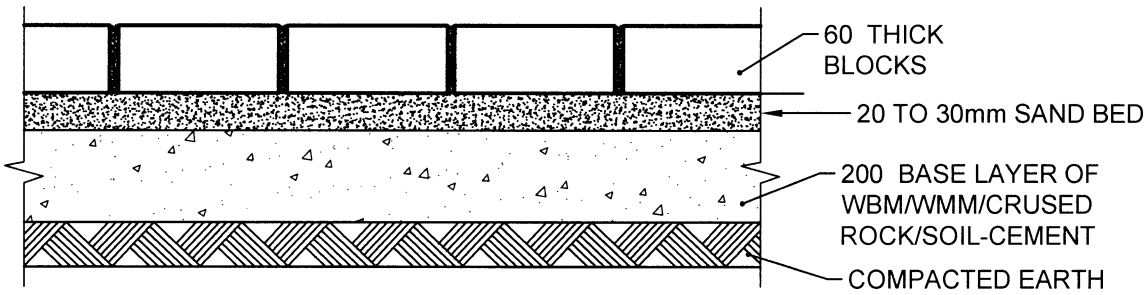
A cross fall of 2 percent slope is generally sufficient to drain the surface run-off but it is desirable to provide 3 percent cross fall in the case of heavily trafficked roads to avoid formation of water puddles. The block pavement should be at least 5 mm above the manholes, side drains, etc.

Table 3 Catalogue for Pavement Thickness
(*Clause* 8.10)

Sl No.	Traffic and Road Type		Sub-grade CBR	
			Above 10 mm	5-10 mm
(1)	(2)	(3)	(4)	(5)
i)	Cycle tracks, pedestrian footpaths	Blocks	60	60
		sand bed	20-30	20-30
		base	200	200
ii)	a) Commercial traffic axle load repetitions less than 10 msa	Blocks	60-80	60-80
		sand bed	20-40	20-40
	b) Residential streets	WBM/WMM base		
		granular sub-base	250	250
			200	250
iii)	a) Commercial traffic axle load repetitions less than 10-20 msa	Blocks	80-100	80-100
		sand bed	20-40	20-40
	b) Collector street, bus and truck parking areas	WBM/WMM Base	250	250
		granular sub-base	200	250
iv)	a) Commercial traffic axle load repetitions less than 20-50 msa	Blocks	80-100	80-100
		sand bed	20-40	20-40
	b) Arterial streets	WBM/WMM Base	250	250
		Or WBM/WMM Base	150	150
		and DLC over it[1)]	75	75
		granular sub-base	200	250

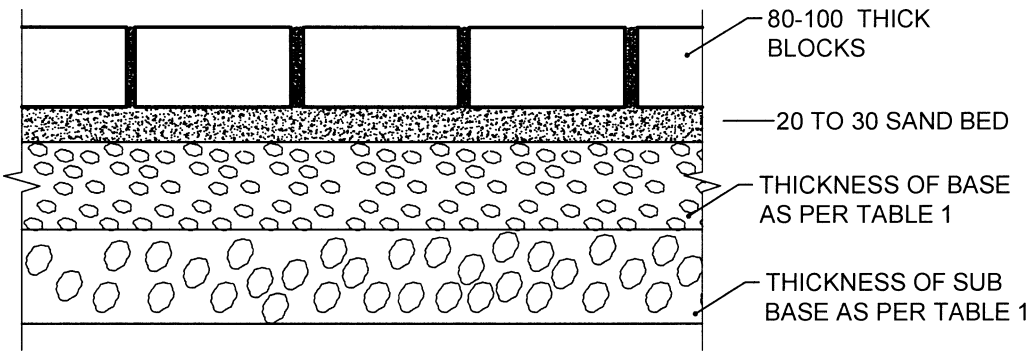
NOTES
1 Thickness of layers given above is in mm.
2 Granular sub-base should have at least 150 mm layer at the bottom which is drainable.
3 A typical cross-section is given in Fig. 9 and Fig. 10.
4 If the sub-grade soil has a CBR of less than 5, it should be improved by suitable stabilization technique to bring the CBR value to 5.
5 msa denotes repetitions in million standard axles.

[1)] In case of roads having inadequate drainage or heavy rainfall areas (above 1 500 mm per annum).



All dimensions in millimetres.

FIG. 9 TYPICAL CROSS-SECTION OF BLOCK PAVEMENT USED IN SIDEWALKS/FOOT-PATHS/CAR-PARKS/CYCLE TRACK



All dimensions in millimetres.

FIG. 10 TYPICAL CROSS-SECTION OF BLOCK PAVEMENT USED IN HEAVILY TRAFFICKED ROADS

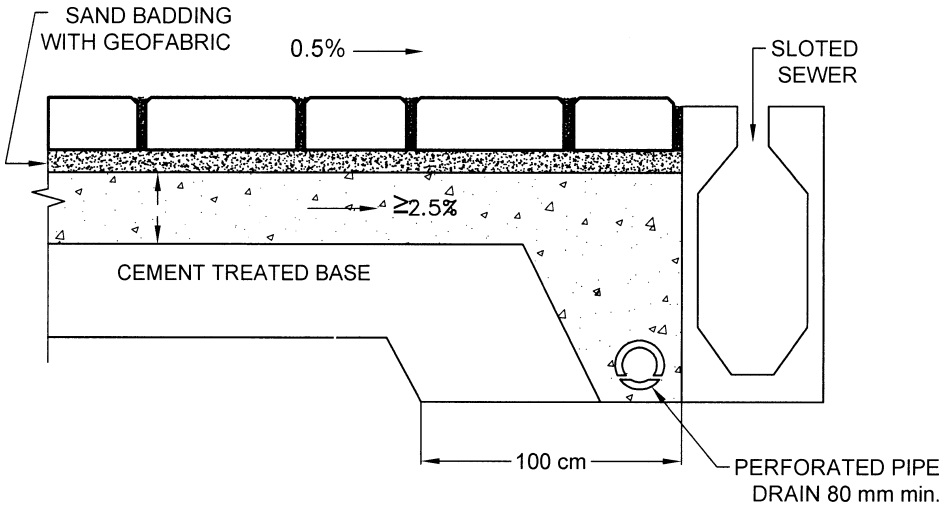
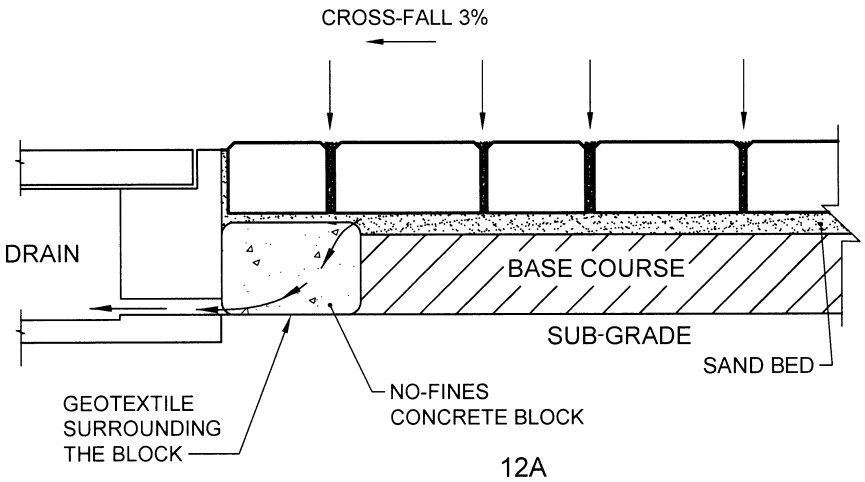


FIG. 11 SUB-SURFACE DRAINAGE IN A BLOCK PAVEMENT



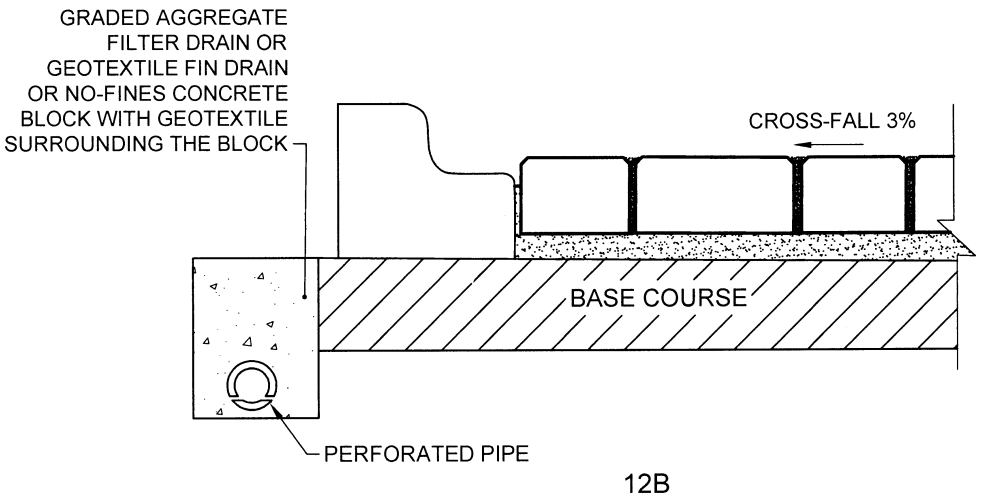


FIG. 12 SURFACE DRAINAGE IN A BLOCK PAVEMENT

8.12 Detailing Block Pavements

Essentially, there are three important aspects in detailing. These are illustrated in **8.12.1** to **8.12.3**.

8.12.1 *Curves*

It is necessary to cut the paving units to fit the edge restraints. Rectangular blocks of a similar or contrasting colour as an edging have been used to minimize the visual effects of small errors in block cutting. To avoid unsightly and potentially weak joints, it is often preferable to change the laying pattern at the curve. The curve itself can be installed in herringbone bond and yet the pavement can revert to stretcher bond on the approaches.

8.12.2 *Pavement Intrusions*

On some pavements, like in city streets, there could be several intrusions, like, manholes, drainage gulleys, etc. where mating these intrusions with the pavement is desirable. Figure 13 shows how this should be done around a manhole.

Around intrusions, it is good practice to lay along both sides of the intrusion simultaneously so that closure is made away from the starting workface, rather than carrying the pavement around the intrusion to return to the original laying face (*see* Fig. 13) to avoid accumulation of closing error.

8.12.3 *Changes in Alignment*

Changes in alignment of a road pavement can sometimes be achieved by the use of special blocks. However, it is generally easier to choose a block that can be installed in herringbone bond and simply cut the blocks to fit the edge restraints. Where aesthetic requirements of shape of the paving unit dictate the use of stretcher bond, then only a 90° shape change in alignment can be achieved without cutting the blocks**.** At intersections, if a herringbone bond laying pattern is adopted, the paving can proceed without the need for construction joints**.** An alternative to this is to install a shoulder (support) course of rectangular paving units between the main roadway and the side streets; this permits different laying patterns to be used in two roadways.

8.13 Joint Filling

The importance of complete joint filling cannot be over-emphasised. Unfilled or partially filled joints allow blocks to deflect, leading to loose blocks, possibly spalling the edges and a locally disturbing bedding sand layer.

After the compaction of the bedding sand has been completed (and some bedding sand has been forced up in the joints between blocks), the joints should be completely filled with sand meeting the desired specifications. The joints filling sand should be stockpiled at suitable locations for convenience. There should be minimum delay in joints filling; the end of the day's work should in any case complete the process.

The operation of joints filling comprises of spreading a thin layer of the joint filling sand on the block surface and working the sand into each joints by brooming. The sand should be broomed or spread over the surface with a small surcharge.

Dry sand and dry blocks are best for the filling of joints, as damp sand tends to stick at the very top of the joints; also, if the blocks is wet and the sand dry, the sand will again stick at the joint top. Hence, if either the block or sand is wet, one may get a false impression of the joints being full, but the next rain will reveal that they are

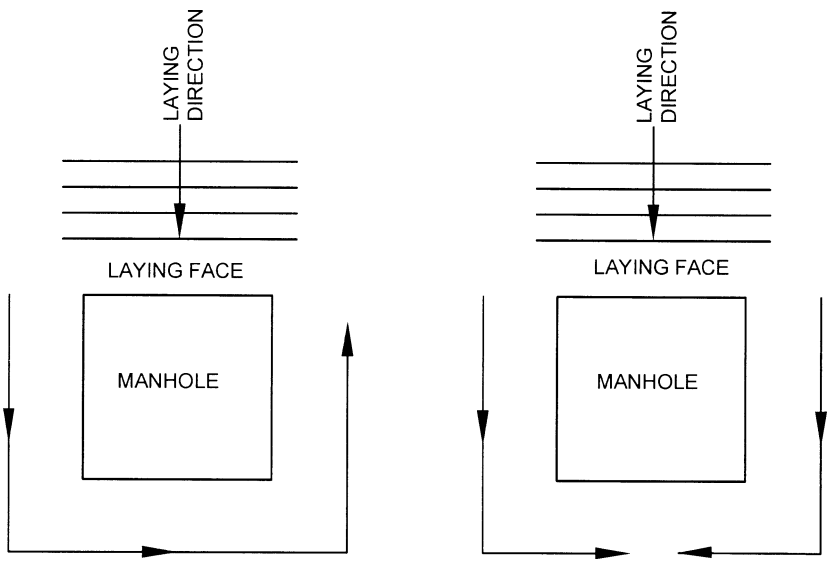


FIG. 13 LAYING AT MANHOLE

actually hollow. If the weather does not allow sand and blocks to be dry, the joints filling sand should be washed in by light sprinkling of water. In this, case, several cycles of application of sand, water-sprinkling and plate compaction will be necessary to completely fill the joints.

Joints between blocks are filled by fine sand. Normally, the bottom 20 to 30 mm of the joint gets filled with bedding sand, whereas, the reminder space has to be filled with jointing sand by brooming it from the top. The joints are normally 2 to 4 mm wide.

8.14 Compaction

For compaction of the bedding sand and the blocks laid over it, vibratory plate compactors are used over the laid paving units; at least two passes of the vibratory plate compactor are needed. Such vibratory compaction should be continued till the top of each paving block is level with its adjacent blocks. It is not good practice to leave compaction till end of the day, as some blocks may move under construction traffic, resulting in the widening of joints and corner contact of blocks, which may cause spalling or cracking of blocks. These should be minimal delay in compaction after laying of paving blocks to achieve uniformity of compaction and retention of the pattern of laying; however, compaction should not proceed closer than 1m from the laying face, except after completion of the pavement.

During vibratory compaction of the laid blocks, some amount of bedding sand will work its way into the joints between them; the extent of sand getting worked up into the joints will depend on the degree of pre-compaction of sand, the force applied by the block compactor. Standard compactors may have a weight of about 90 kg, plate area of about 0.3 m^2 and apply a centrifugal force of about 15 kN, while heavy duty compactors may weigh 300-600 kg, have a plate area of about 0.5-0.6 m^2 and apply a centrifugal force of 30-65 kN. Where the bedding sand has been pre-compacted and for heavily trafficked block pavements, heavy-duty compactors should be used. After compaction by vibratory plate compactors, some 2 to 6 passes of a vibratory roller (with rubber coated drums or those of static weight less than 4 tonne and nominal amplitude of not more than 0.6 mm) will further help in compaction of bedding sand and joint filling.

8.15 Laying and Surface Tolerances

While the laying, the surface tolerances, given in Table 4 may be observed.

9 OPENING TO TRAFFIC

Until all the joints are completely filled, no traffic should be permitted over the block pavement. In case of lime or cement treated layers in the pavement, it must be ensured that these are given proper specified time preferably at least 14 days to cure, before traffic is permitted. The block pavement should be inspected frequently, to ensure that any incompletely filled joints, exposed by traffic and/or weather are promptly filled. Such frequent inspection should be continued till dust and detritus from the roadway tightens the surface of the joints.

10 MAINTENANCE

10.1 General

Like any other work, block pavement also should be maintained to give long service. The maintenance requirement of block pavement is minimal. The block pavement requires initial maintenance soon after its

Table 4 Laying and Surface Tolerances
(*Clause* 8.15)

Sl No.	Layer/Item	Tolerance
(1)	(2)	(3)
i)	Sub-grade	$^{+0}_{-25}$ mm of nominated level
ii)	Select sub-grade/Sub-base	$^{+0}_{-20}$ mm of nominated level
iii)	Base course	$^{-0}_{+10}$ mm of nominated level 10 mm deviation from a 3 m straight edge
iv)	Plane deviation: a) From any 3 m line b) From any 10 m line	 10 mm (maximum) 20 mm (maximum)
v)	Vertical deviation from 3 m line at kerbs intrusions, channels, edge restraints elsewhere	$^{+3}_{-0}$ mm
vi)	Maximum difference in surface level between adjacent paving units	$^{+10}_{-15}$ mm
vii)	Deviation of finished surface level from designated level	$^{+10}_{-15}$ mm
viii)	a) Joint width range b) Percentage of joints outside range c) Nominal joint width	2 mm to 4 mm 10 percent maximum along 10 m line 3 mm

laying, say after a week or two for checking sand in the joints. Subsequently, the maintenance is in the form of replacing any damaged block/blocks or raising the settled section, if any repair especially after laying a cable duct is much simpler in the case of block pavements. The cut area can be reinstated without any blemish.

10.2 Initial Maintenance

After about a week of laying the blocks there is a need to inspect the surface to check for any loss of sand at joints. Wherever sand level has dropped down it should be reinstated. This type of inspection should continue for two to three months till the sand level is stabilized and topping up is no more required. With time, the joints receive fine dust and detritus thus making them waterproof. During rains these joints may allow weeds to grow but these normally should get eliminated with the traffic. In case, it does not get eliminated these may have to be controlled by spraying herbicide or by manual removal. Annual inspection, however, will be required.

10.3 Storage of Blocks

For the purpose of reinstating damaged blocks it is necessary to stockpile a small percentage of blocks from the lots used in the construction. The size and colour of the blocks may be difficult to obtain at a later matching with the original blocks. For important projects, it is normal to stockpile blocks from 1 percent to 3 percent initial supply for subsequent use.

10.4 Coating and Cleaning

As part of preventive maintenance, blocks can be sealed using compounds, like, silicone, acrylics and silica fluorides for enhancing the colour, reducing absorptive nature of the blocks and for improving surface toughness. These coating have life of 1 to 3 years and hence they have to be repeated as per the requirement. The most durable of these chemicals is solvent-borne acrylics, which are abrasion resistant and also minimize chemical effects of spillage even at 60°C.

Cleaning of block pavement can be done by mechanical brooms, compressors or even by manual means. For removing certain stains, chemicals, like, oxalic, and phosphoric acids, etc, are used. Sometimes it may be expedient to replace the block where stains have penetrated to a greater depth.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Flooring, Wall Finishing and Roofing Sectional Committee, CED 05

Organization	*Representative(s)*
In Personal Capacity (*L/109, Sarita Vihar, New Delhi*)	Shri Ashok Khurana (***Chairman***)
Ardex Endura India Pvt Limited, Bengaluru	Shri K. P. Paulson Shri Gopinath Krishnan (*Alternate*)
Building Materials & Technology Promotion Council, New Delhi	Shri S. K. Gupta Shri Pankaj Gupta (*Alternate*)
Carborundum Universal Limited, Chennai	Shri R. Rajagopalan Dr N. Ramasubramanian (*Alternate*)
Central Public Works Department, New Delhi	Shri Rajesh Kumar Kaushal Shri Arun Kumar Tyagi (Alternate)
CSIR-Central Building Research Institute, Roorkee	Shri S. K. Singh Shri Achal Kumar Mittal (*Alternate*)
CSIR-Central Glass & Ceramic Research Institute, Naroda	Dr Satyendra Nath Misra
CSIR-Central Road Research Institute, New Delhi	Dr Rakesh Kumar
Choksi Laboratories Limited, Indore	Shri R. D. Mathur Shri Ramesh Basappa (*Alternate*)
Construction Chemicals Manufacturers Association, Navi Mumbai	Shri Upen Patel Shri Samir Surlaker (*Alternate*)
Construction Industry Development Council, New Delhi	Shri P. R. Swarup Shri Ravi Jain (*Alternate*)
Delhi Development Authority, New Delhi	Chief Engineer (DWK) Superintending Engineer (P) (*Alternate*)
Directorate General of Border Roads, New Delhi	Col Indra Kumar Jaggi
Engineers India Limited, New Delhi	Shri J. K. Bhagchandani Shri Akhilesh Maurya (*Alternate*)
Ultratech Cement Limited, Mumbai	Shri B. Kumar
Gyan Construction Company, Mumbai	Representative
H. R. Johnson (India) Limited, Dewas	Shri G. S. Patnaik Shri Arun Rao (*Alternate*)
Indian Council of Ceramic Tiles & Sanitaryware, New Delhi	Shri Arun Rao Shri P. K. Sharma (*Alternate*)
Institution of Engineers (India), New Delhi	Shri K. K. Kapila
Lloyd Insulation (India) Pvt Limited, New Delhi	Shri Mohit Khanna Shri K. K. Mitra (*Alternate*)
Mapie Construction Products India Pvt Limited, Bengaluru	Dr G. S. Ravi Shankar Shri Abhijit Dutta (*Alternate*)
Military Engineer Services, Engineer-in-Chief's Branch, New Delhi	Shrimati Mala Mohan Shrimati Namrata Kohli (*Alternate*)
Modern Tiles & Marble, New Delhi	Shri Subhash Kapoor Shri Kameswar Rau (*Alternate*)
Morbi Dhuva Glaze Tiles Association, Morbi	Shri Nilesh Jetparia Shri Jeram Madhav Kavar (*Alternate*)
Municipal Corporation of Greater Mumbai, Mumbai	Representative
MYK Laticrete India, Hyderabad	Dr P. Arjunan Shri N. Radhakanth (*Alternate*)
National Council for Cement and Building Materials, Ballabgarh	Dr S. K. Breja
National Highways Authority of India, New Delhi	Shri S. C. Jindal Shri R. P. Khandelwal (*Alternate*)

Organization	*Representative(s)*
National Test House, Kolkata	Shri D. V. S. Prasad Shri Aloke Dev (*Alternate*)
National Tiles Corporation, Panchkula	Shri Prem Chand Gupta Shri S. R. Garg (*Alternate*)
New Delhi Municipal Corporation, New Delhi	Representative
Premier Polyfilm Limited, Ghaziabad	Dr Sanjeev K. Verma Shri R. K. Narad (*Alternate*)
Research, Designs and Standards Organization, Ministry of Railways, Lucknow	Executive Director (Works) Shri Ashutosh Kumar (*Alternate*)
Responsive Industries Limited, Mumbai	Shri Rishabh Agarwal Shri Abhishek Agarwal (*Alternate*)
Shriram Institute of Industrial Research, New Delhi	Dr P. K. Kaicher Dr Laxmi Rawat (*Alternate*)
Somany Ceramic Ltd, Bahadurgarh	Shri G. G. Trivedi Dr Ashutosh Goel (*Alternate*)
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