TECHNICAL NOTE NO: 20

Sub: **Rigid Pavements- Construction of Interlocking Concrete block Pavement- Guidelines - Reg.**

Ref: Observations during inspection of APRRP works by the Project Advisor in different Districts.

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1. Introduction:

Interlocking Concrete Block Pavements have been extensively used in a number of countries for quite some time. Interlocking concrete block pavement is a versatile, durable, and environmentally friendly option for various construction projects. Its ease of installation, aesthetic flexibility, and cost-effectiveness make it a preferred choice for many developers and builders.

Interlocking concrete block pavement (ICBP) offers several advantages, making it a popular choice for various construction projects. Here are some key benefits:

Durability and Strength:

ICBP is highly durable and can withstand heavy loads and traffic. The interlocking nature of the blocks distributes loads evenly, reducing the risk of pavement failure.

Ease of Installation and Maintenance:

The installation process is relatively straightforward and does not require specialized skills. Additionally, maintenance is simple, as individual blocks can be replaced without disturbing the surrounding pavement.

Aesthetic Flexibility:

ICBP comes in various shapes, colors, and textures, allowing for creative and aesthetically pleasing designs. This flexibility makes it suitable for both functional and decorative applications.

Environmental Benefits:

Permeable interlocking concrete pavements allow water to infiltrate through the joints, reducing surface runoff and promoting groundwater recharge. This feature helps in managing stormwater and mitigating urban heat island effects.

Cost-Effectiveness:

ICBP is cost-effective in the long run due to its low maintenance requirements and long lifespan. It also offers savings in terms of reduced repair and replacement costs.

Resistance to Weather and Chemicals:

ICBP is resistant to various weather conditions, including freeze-thaw cycles, and is not affected by chemicals like oils and fuels. This resistance enhances its longevity and performance.

Safety:

The textured surface of interlocking concrete blocks provides good skid resistance, making it a safe option for pedestrian and vehicular traffic.

2. Advantages compared to Conventional Cement Concrete Pavements:

- Speedy Construction
- High Dimensional Accuracy
- Good Quality
- Not require Curing at site
- Low Manpower
- Easy Maintenance
- No Need of Cutting Joints.
- Traffic can be allowed immediately.

3. Justification to implement in APRRP Roads:

As seen from the sanctioned lengths of CC roads in APRRP, which have not yet started, it is better to implement interlocking concrete block pavement instead of conventional concrete pavement for early completion of works where there is no possibility of providing traffic diversion for extended periods. Furthermore, for roads that connect to a single habitation with no scope for future extension and dead-end habitations with traffic of less than 100 motor vehicles per day, this type of pavement provides an economical solution.

The details of the not-started works, package-wise, with lengths less than 1.00 km are as follows.

APRRP-Component-1A Package wise Below 1 km Not Started Roads Abstract						
Sl.No	**District Name**	**Package No**	**No of works**	**Length in Km**	**Est.Cost in Cr**	**Remarks**
1	Anantapuram	46	9	5.40	3.58	
2	Anantapuram	47	2	1.80	1.29	
3	Anantapuram	48 A	4	1.95	1.28	
4	Anantapuram	48 B	11	7.30	4.85	
5	Anantapuram	49 A2	2	1.57	1.29	
6	Anantapuram	49 B	1	0.70	0.49	
7	Anantapuram	50 A	2	2.00	1.98	
8	Anantapuram	50 B	2	1.46	1.42	
		Total	**33**	**22.18**	**16.17**	
11	Chittoor	29	3	1.86	1.42	

12	Chittoor	32	20	12.88	9.55	
13	Chittoor	79	1	1.00	0.70	
14	Chittoor	100 A	1	0.80	0.52	
15	Chittoor	100 B	2	1.76	0.83	
16	Chittoor	101 A	2	1.20	1.00	
17	Chittoor	101 B	1	0.50	0.30	
18	Chittoor	99 B	4	2.89	2.19	
		Total	**34**	**22.89**	**16.51**	
19	East Godavari	12	1	2.00	2.05	
20	East Godavari	13 A 2	1	0.54	0.52	
21	East Godavari	13 B1	1	0.46	0.84	
22	East Godavari	13 C1	1	0.63	0.50	
23	East Godavari	13 C2	1	0.96	0.60	
24	East Godavari	13 C3	2	1.80	1.58	
25	East Godavari	13 C4	1	0.60	0.47	
26	East Godavari	13 C6	1	0.80	0.65	
27	East Godavari	13 C7	1	0.60	0.51	
28	East Godavari	13 D 2	1	0.67	0.64	
29	East Godavari	87 A	1	1.00	0.40	
30	East Godavari	87 B	1	0.50	0.21	
31	East Godavari	87 D	1	0.60	0.25	

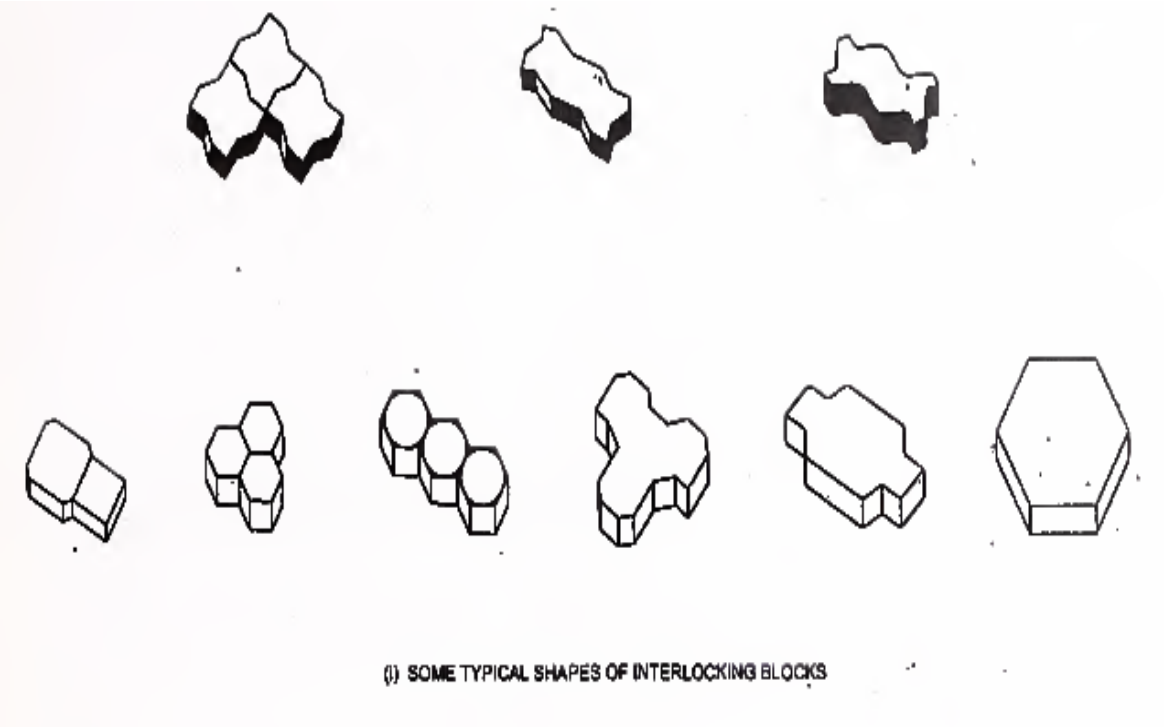
32	East Godavari	88 A	1	0.90	0.45	
33	East Godavari	88 B	2	1.98	0.80	
34	East Godavari	88 C	1	0.54	0.20	
35	East Godavari	88 E	1	0.64	0.30	
36	East Godavari	88 F	1	1.00	0.40	
		Total	**20**	**16.22**	**11.36**	
37	Guntur	21	1	0.70	0.87	
		Total	**1**	**0.70**	**0.87**	
38	Kurnool	41	1	0.70	0.60	
		Total	**1**	**0.70**	**0.60**	
39	SPSR Nellore	27	1	0.80	0.54	
		Total	**1**	**0.80**	**0.54**	
40	Srikakulam	1	6	4.78	4.28	
41	Srikakulam	2	10	7.38	6.47	
42	Srikakulam	3	12	8.66	8.11	
43	Srikakulam	4	2	1.60	1.13	
		Total	**30**	**22.42**	**19.99**	
44	Visakhapatnam	10 A	1	1.00	2.42	
45	Visakhapatnam	10 C	1	1.00	0.85	
46	Visakhapatnam	9 B	1	0.80	0.74	
		Total	**3**	**2.80**	**4.00**	

47	Vizianagaram	7	2	1.80	1.41	
48	Vizianagaram	5 A 1	2	1.15	1.22	
49	Vizianagaram	5 A 2	3	1.94	2.25	
50	Vizianagaram	5 A 3	3	1.88	1.59	
51	Vizianagaram	5 A 5	1	0.70	0.63	
52	Vizianagaram	5 B 4	1	0.70	1.02	
53	Vizianagaram	5 C	2	1.80	0.94	
		Total	**14**	**9.97**	**9.06**	
54	West Godavari	16	1	0.58	0.40	
55	West Godavari	51	1	0.08	10.00	
56	West Godavari	90	1	0.60	0.25	
57	West Godavari	89 A	3	1.52	0.68	
58	West Godavari	89 B	1	1.00	0.39	
59	West Godavari	90 C	2	1.45	0.85	
60	West Godavari	90 D	1	1.00	0.20	
61	West Godavari	90 E	2	0.70	0.40	
62	West Godavari	90 F	3	2.10	0.90	
63	West Godavari	92 C	1	1.00	0.30	
		Total	**16**	**10.03**	**14.37**	
64	YSR Kadapa	64	1	0.92	0.37	
65	YSR Kadapa	65	1	0.63	0.52	

66	YSR Kadapa	70	1	0.38	4.35	
67	YSR Kadapa	72	2	1.35	1.03	
68	YSR Kadapa	96	1	0.68	0.66	
69	YSR Kadapa	38 A	1	0.89	1.50	
70	YSR Kadapa	38 D	1	0.40	0.29	
		Total	**8**	**5.25**	**8.72**	
		Grand Total	**161**	**111.96**	**102.18**	

4. Types and Shapes of Blocks:

The blocks can be interlocking horizontally and vertically as shown in Fig 1.



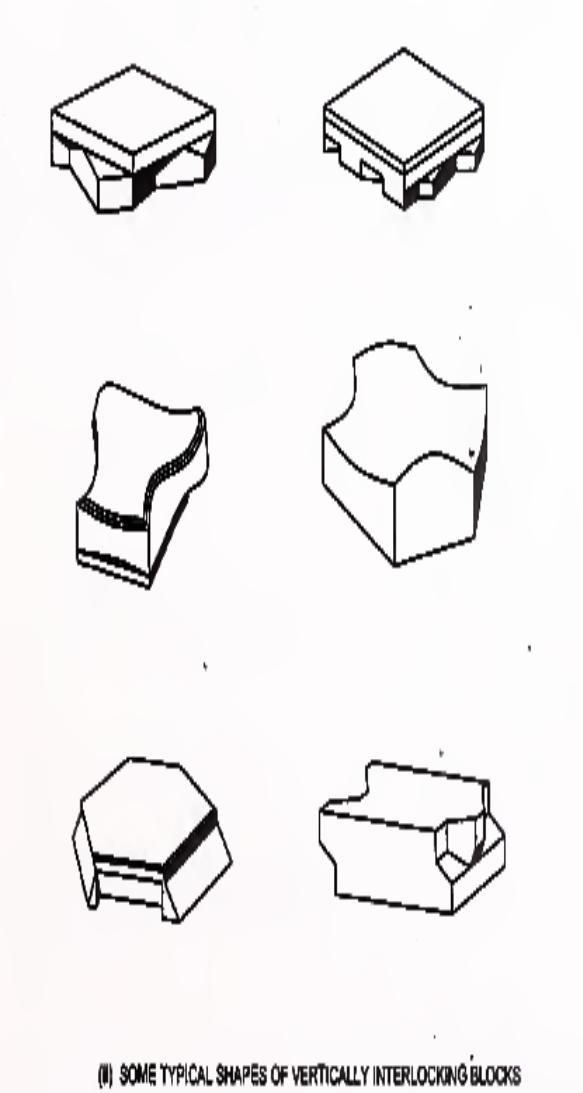


Fig. 1. Some shapes of interlocking blocks

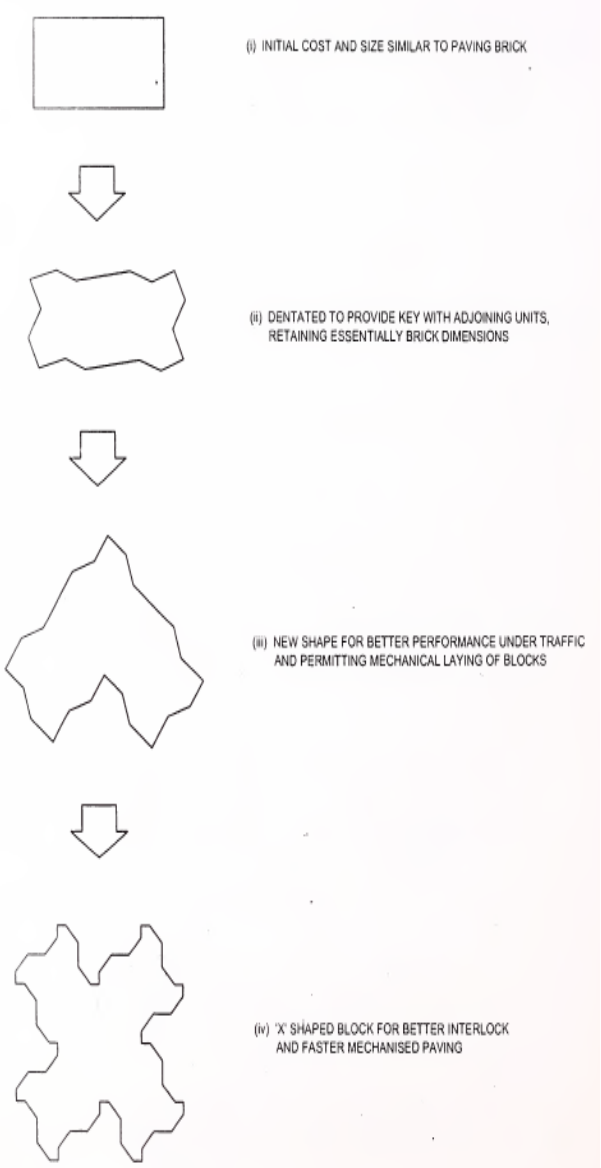


Fig. 2. Basic shapes of blocks

The dented blocks further can be grouped as shown in Fig 3 in to three categories as under and out of which "Cat A" is suitable for our roads

Category A: Dented 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 the joint. These blocks are generally capable of being laid in herringbone bond pattern.

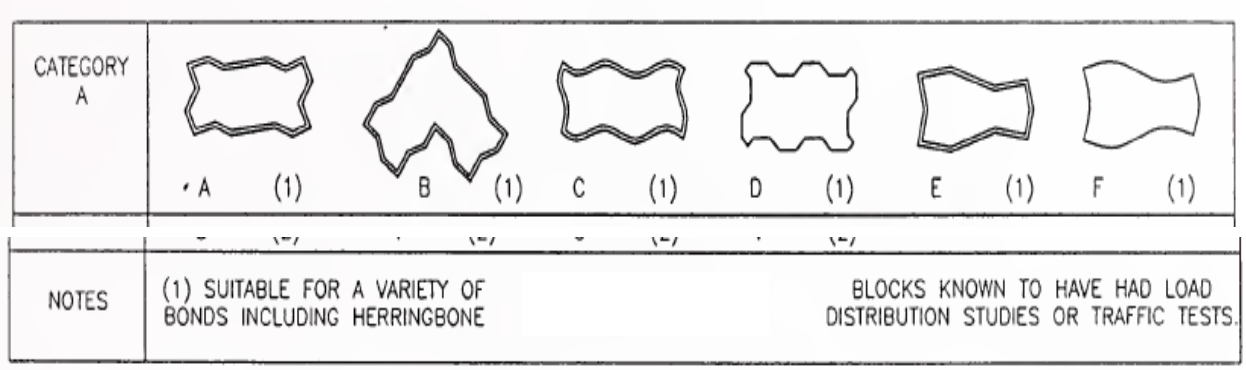


Fig. 3. Different catagories of blocks

5. Composition of Block Pavement:

Except the top wearing part of the pavement, the base and sub base layers are similar to the conventional flexible or rigid pavement. Depending upon the load coming on them, the composition of the pavement differs.

Typical pavement composition normally used for medium traffic roads is given in Fig.

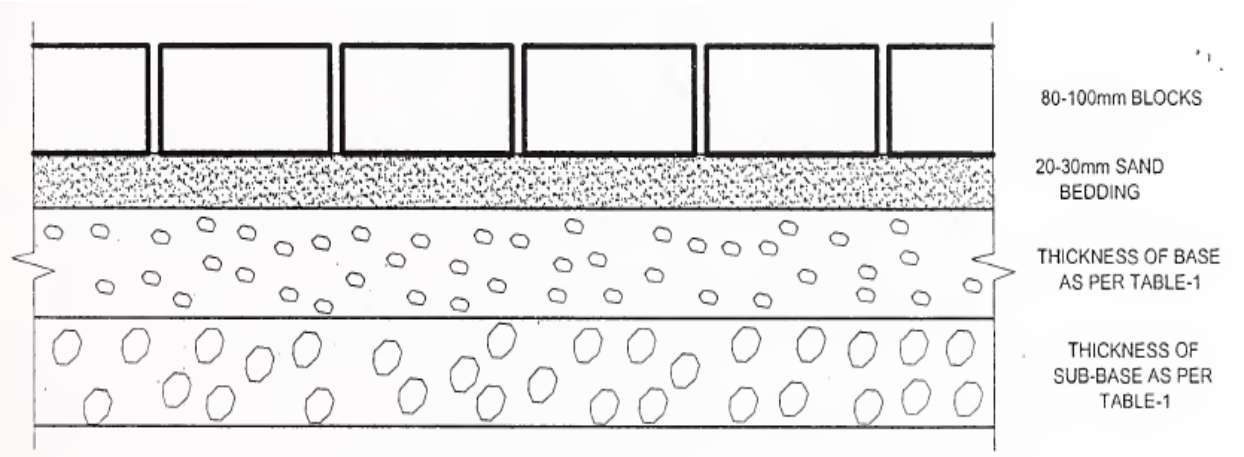


Fig. A typical cross section of block pavement for heavily trafficked roads

For Category 'A' blocks used for light traffic, such as pedestrians, motor cars, cycles etc., a block thickness of 60 mm is adequate; for medium traffic, a thickness of 80 mm is generally used.

Non-uniformity in thickness of blocks affects the evenness of the surface. A block pavement which is initially paved to a levelled surface will settle unevenly

with the movement of vehicles. In view of this all blocks should be of the same thickness, with a maximum allowable tolerance limit of +/- 3 mm. Similarly, variation in length and width of blocks should be limited to +/- 2 to 3 mm for ensuring uniform joint width and avoiding staggering effect.

6. Sand Bedding and Jointing

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

i) To provide a cushion between the hard base and the paving blocks

ii) By providing a layer of sand bed, the paved block can be levelled perfectly due to some permitted surface unevenness.

iii) The sand bed acts as a barrier and does not allow propagation of cracks formed in base/sub-base.

iv) The sand also helps to keep lower part of the joint filled with sand and provides added interlocking effect.

A layer thickness of 20 to 40 mm is found to be satisfactory.

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

7. Base and Sub-base Layers

The materials used for base construction consists of

i) Bound material like lean concrete or soil-cement

ii) Bituminous layers

iii) Un - bound materials like WMM or WBM.

The sub bases are generally of granular material and function as drainage layer, provided proper disposal arrangement for water is made.

For weak sub grade soils like clays, where ground water table is shallow, bound bases are preferred.

8. Edge restraint Blocks and Kerbs

Concrete blocks on trafficked pavement tends to move and this tendency has to be counteracted at the edges by special edge blocks and kerbs. These members should be manufactured or constructed in-situ to have at least a 28 day compressive strength of 30 MPa or flexural strength of 3.8 MPa. As far as posible the edge block should have vertical face towards the inside blocks. A few typical edge blocks are also shown in Fig 8.

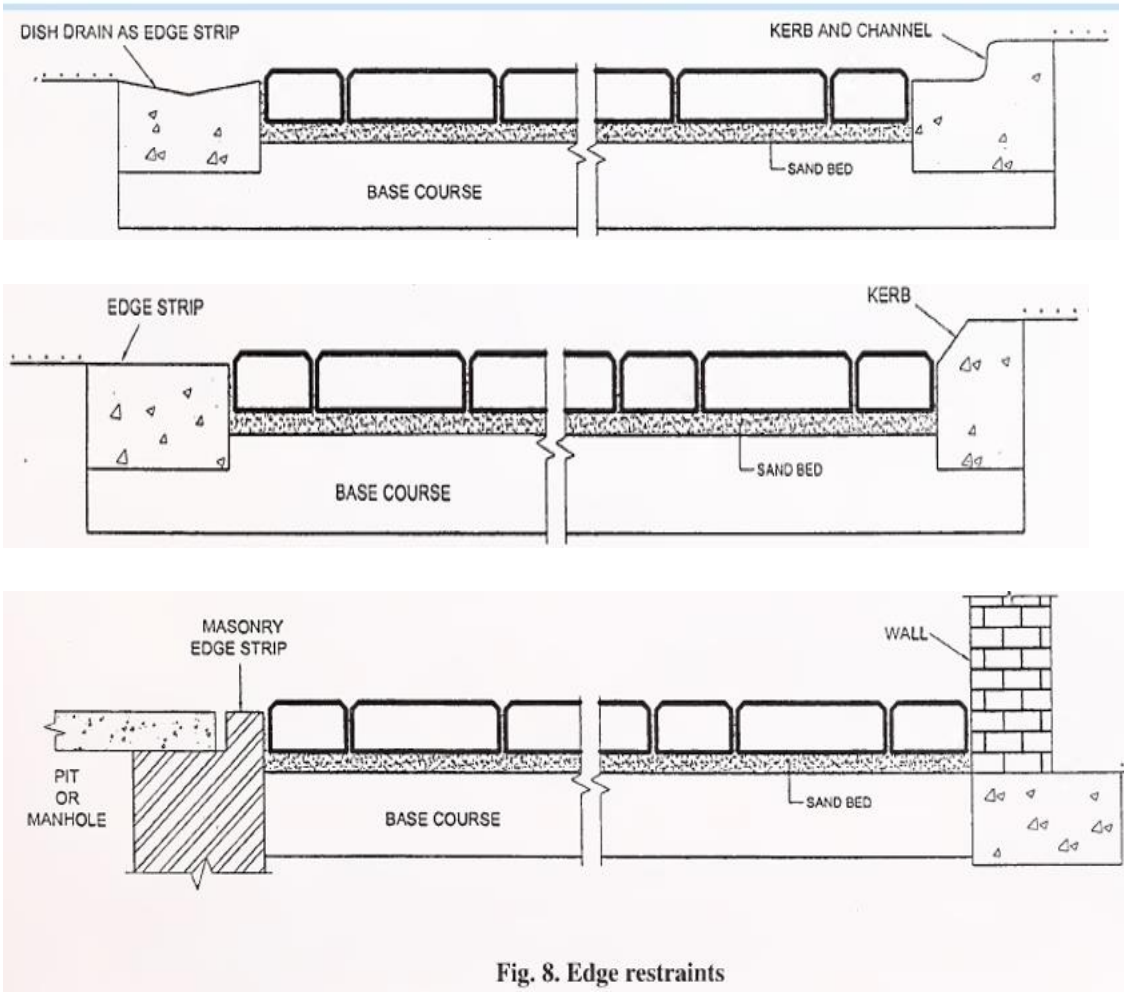


Fig. 8. Edge restraints

9. Structural Design of Concrete Block Pavement

Table 1 shows the design catalogue for different traffic conditions

TABLE 1 : DESIGN CATALOGUE FOR PAVEMENT THICKNESS

Traffic and Road Type		Subgrade CBR (%)	
		Above 10	5-10
• Cycle Tracks, Pedestrian Footpaths	Blocks Sand Bed Base	60 20-30 200	60 20-30 200
• Commercial Traffic Axle Load Repetitions less than 10 msa • Residential Streets	Blocks Sand Bed WBM/WMM Base Granular Sub-base	60-80 20-40 250 200	60-80 20-40 250 250
• Commercial traffic Axle Load Repetitions 10-20 msa • Collector Streets, Industrial Streets, Bus and Truck Parking Areas	Blocks Sand Bed WBM/WMM Base Granular Sub-base	80-100 20-40 250 200	80-100 20-40 250 250
• Commercial traffic Axle Load Repetitions 20-50 msa • Arterial Streets	Blocks Sand Bed WBM/WMM Base or WBM/WMM Base and DLC over it* Granular Sub-base	80-100 20-40 250 150 75 200	80-100 20-40 250 150 75 250

Notes :

1. Thickness of layers given above are 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. 6.
4. If the subgrade soil has a CBR of less than 5, it should be improved by suitable stabilisation technique to bring the CBR value to 5.
5. msa denotes repetitions in million standard axles

* in case of roads having inadequate drainage or heavy rainfall areas (above 1500 mm per annum)

10. Dimensional and other Requirements of Paving Blocks

For normal paving work, the length of a paving block should ordinarily be not greater than twice the mean width; the thickness is a minimum of 60 mm ; the maximum length generally not exceeding 280 mm ; the width generally is in the

range 75 to 140 mm with a maximum chamfer of 10 mm(preferably chamfer should be in the range 3-5 mm). The blocks should have the following dimensional tolerances:

Plan dimensions +/- 2 mm

Thickness +/- 3 mm

To ensure durability, the average water absorption in a block should not exceed 5 percent.

11. Bedding and Joint Filling sand

Bedding Sand: The desired gradation of bedding sand should be as under:

IS Sieve Size	**Percent Passing**
9.52 mm	100
4.75 mm	95-100
2.36 mm	80-100
1.18 mm	50-95
600 micron	25-60
300 micron	10-30
150 micron	0-15
75 micron	0-10

12. Joint Filling Sand

The gap between two paving blocks (typically about 3 mm wide) need to be filled by sand, relatively finer than the bedding sand. The desired gradation for the joint filling sand is as under

IS Sieve Size	Percent Passing
2.36 mm	100
1.18 mm	90-100
600 micron	60-90
300 micron	30-60
150 micron	15-30
75 micron	0-10

13. Drainage

Block pavement with joints filled with sand is not a waterproof layer and hence care has to be taken to drain out the surface water seeping through the joints in initial stage of the construction. The drainage provided generally consists of subsurface drains surrounded by filter material or a geotextile which would allow the water to pass through and at the same time prevent the escape of bedding/jointing sand. Typical subsurface drainage arrangement used in block pavement is shown in Figs 9 and 10.

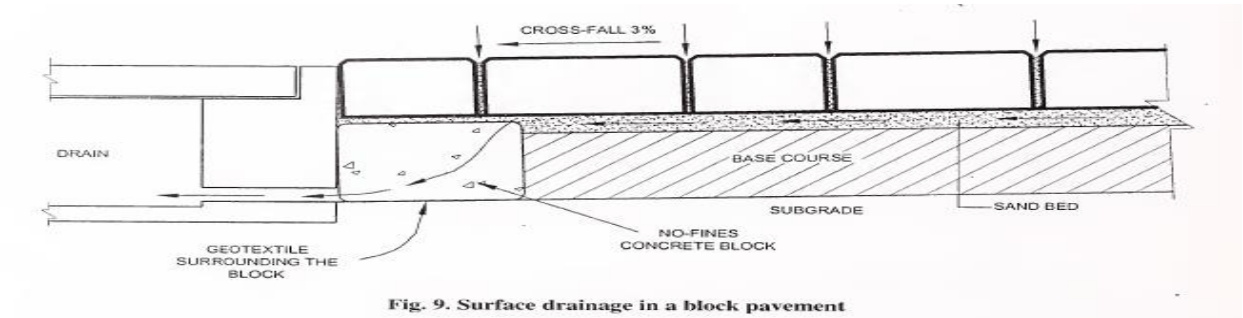


Fig. 9. Surface drainage in a block pavement

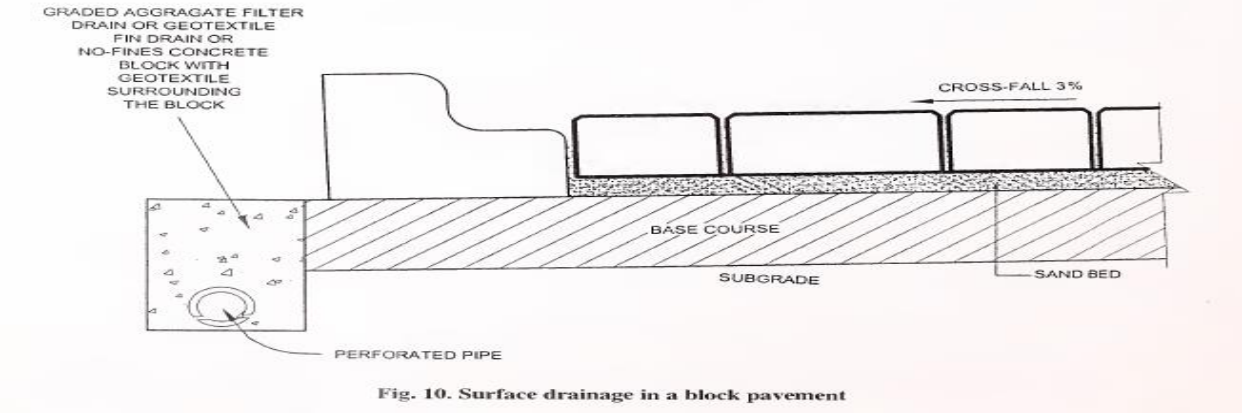


Fig. 10. Surface drainage in a block pavement

14. Construction

The construction of block pavement involves preparation of subgrade, sub - base and base course layers, bedding sand and finally the laying of blocks. The block paving can be done entirely by manual labour.

Preparation of Sub grade:

This is the foundation layer on which the block pavement is constructed as per MORD specifications and IRC:SP:76-2015.

Base and Sub-base Course

Base and sub-base courses are constructed in accordance with standard procedures contained in the relevant IRC specifications, like IRC:SP:76-2015 and MORD. Constructing the layers to proper level and grade is very essential to maintain the level and surface regularity of the block pavement.

Compacting the GSB with Plate Vibrator

Placing and Screeding of Bedding Sand:

The thickness of bedding sand after compaction should be in the range of 20-40 mm, where as 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 pre compaction, which would affect the final block surface level. Best moisture content is that when sand is neither too wet nor too dry and have a value of 6 to 8 percent.

Sand Spreading over GSB

Finished Sand Bed surface over GSB

The processed sand is spread with the help of screed boards to the required thickness and is compacted with plate vibrators weighing 0.6 tonnes or more.

Compacting the Sand with Plate Vibrator

Laying of Blocks:

Normally, laying should commence from the edge strip and proceed towards the inner side. As far as possible, laying should proceed in one direction only, along the entire width of the area to be paved.

Precast M40 concrete blocks of 80mm thick laying in progress after sectioning the sand bed.

Precast M40 concrete blocks of 80mm thick : Laying in Progress

15. Bonds or Patterns of Laying Blocks

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

i) Stretcher or running bond

ii) Herringbone bond

iii) Basket weave or parquet bond

The typical layout of these bonds are given in Fig 14.

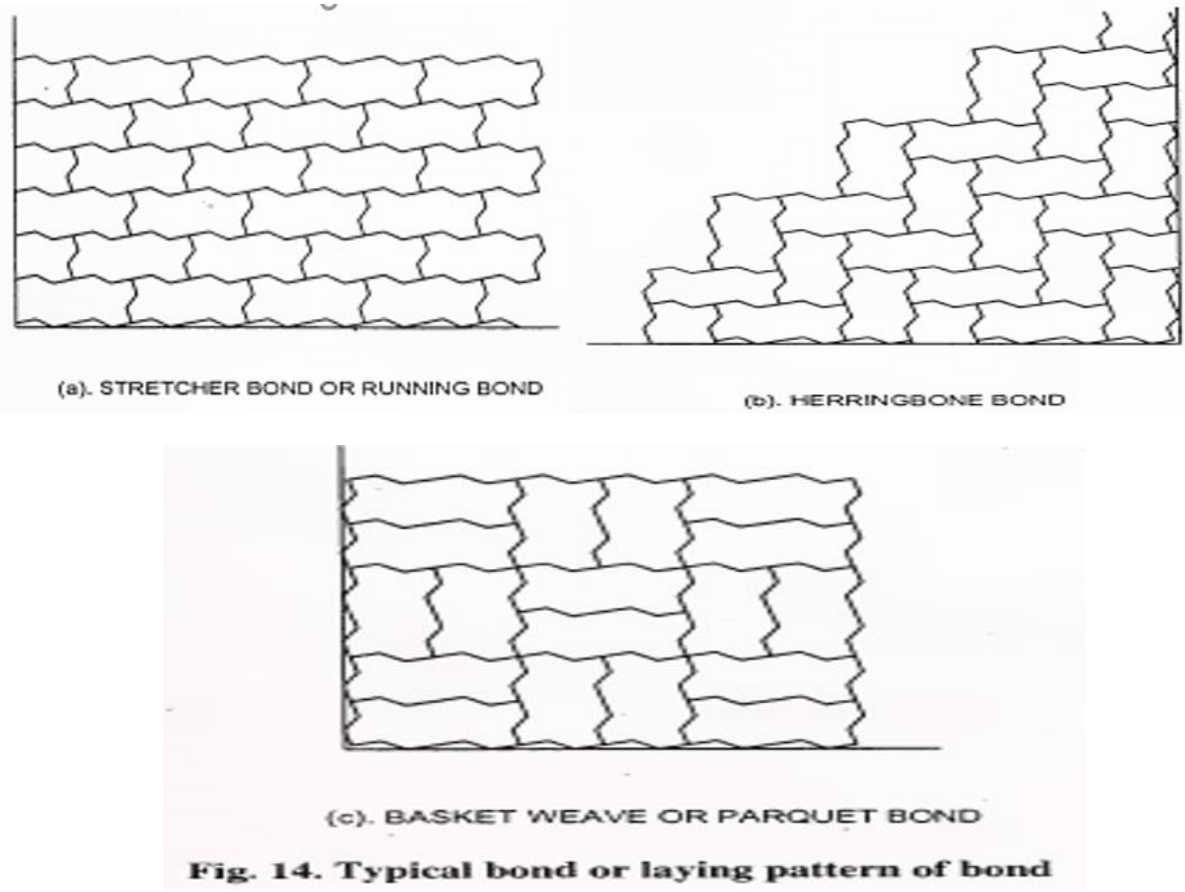


Fig. 14. Typical bond or laying pattern of bond

16. Establishing the Laying Pattern

To start with full block should be used: only subsequently, cutting and in-filling at edges be permitted. Under no circumstances should the blocks be forced or hammered in to the bedding sand at this stage of laying. 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 instead.

17. Compaction:

Laying the Pavers:

Start laying the pavers in the desired pattern. Ensure they are placed tightly together to minimize gaps.

Use a string line or chalk lines to keep the rows straight.

Initial Compaction:

Once the pavers are laid, use a plate compactor to compact the pavers into the bedding sand. This helps to set the pavers and ensures they are level.

Pass the compactor over the pavers at least twice in different directions.

Joint Sand:

Spread dry joint sand over the surface of the pavers. Sweep the sand into the joints between the pavers.

Use the plate compactor again to vibrate the sand into the joints. Repeat this process until the joints are completely filled with sand.


Sweaping in the Jointing Sand


Vibrating the Jointing Sand in to the joints


Cleaning of Jointing Sand

Final Compaction:

After the joints are filled, make a final pass with the plate compactor to ensure everything is tightly set.

Sweep off any excess sand from the surface.

Inspection:

Check for any uneven areas or gaps and make necessary adjustments.

Ensure the surface is smooth and level

View of finished surface of Precast M40 concrete block pavement

Finished surface of Precast M40 concrete block pavement

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References:

1. IRC: SP:63-2004: Guidelines for the use of Interlocking Concrete Block Pavement.
2. IS 15658:2006: Precast Concrete Blocks for Paving- Specifications
3. MoRD -2014.