IS 6509 (1985): Code of practice for installation of joints in concrete pavements [CED 13: Building Construction Practices including Painting, Varnishing and Allied Finishing]

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CODE OF PRACTICE FOR INSTALLATION OF JOINTS IN CONCRETE PAVEMENTS

(First Revision)

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CODE OF PRACTICE FOR INSTALLATION OF JOINTS IN CONCRETE PAVEMENTS

(First Revision)

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(*Continued on page* 20)

Indian Standard

CODE OF PRACTICE FOR INSTALLATION OF JOINTS IN CONCRETE PAVEMENTS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 28 January 1985, after the draft finalized by the Building Construction Practices Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Joints in concrete pavements are provided both longitudinally and transversely. Such joints are provided to keep within safe limits the stresses caused due to variation in temperature and moisture, and frictional restraint to sliding. These joints limit the discontinuities in the pavements to predetermined joint locations thus avoiding random cracks.

0.2.1 This standard was first published in 1972. Present revision has been prepared with the assistance of Central Road Research Institute, New Delhi. Transverse expansion joint details have been elaborated for various types of pavement including prestressed concrete pavements. Transverse elastic joint details have been included in the revision. Requirements regarding dowel bars and spacing of joints have been modified.

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

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

1. SCOPE

1.1 This standard lays down general principles, design and details of installation of joints in concrete pavements for roads and airfields.

NOTE — The general principles shall be applicable for joints in roads and airfield pavements in particular, but may also be applicable to driveways and industrial pavements.

2. TERMINOLOGY

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

2.1 Type of Pavement — Depending upon the absence or provision of reinforcement, the type of reinforcement provided and the manner of its provision, concrete pavements are classified as given in **2.1.1** to **2.1.4**.

2.1.1 *Plain Cement Concrete (PCC) Pavements* — No reinforcement is provided in this case except the optional local provision of dowel bars and tie bars, or hairpin reinforcement at corners.

2.1.2 *Reinforced Cement Concrete (RCC) or Jointed Reinforced Cement Concrete (JRCC) Pavements* — These pavements are provided with longitudinal and transverse reinforcement, which is discontinued at joints.

2.1.3 *Continuously Reinforced Concrete Pavements with Elastic Joints (CRC-EJ)* — These are a special type of reinforced concrete pavements in which the steel reinforcement is not discontinued at the contraction joints, but painted with a bond-breaking layer for a specified distance on either side of the joint, which is termed as 'elastic' joint.

2.1.4 *Prestressed Concrete (PSC) Pavements* — These pavements are provided with high-tensile prestressing steel, and prestressed either longitudinally or both longitudinally and transversely.

2.2 Elastic Joints — The joints provided in continuously reinforced concrete pavements, through which the steel reinforcement is not discontinued, but is painted with a bond-breaking agent for certain length on either side of the joint.

2.3 Contraction Joint — The joints provided in a pavement to relieve stresses and to prevent formation of irregular cracks due to contraction of concrete in slabs.

2.4 Construction Joints — The joints provided in a pavement whenever construction operations require them.

2.5 Dowel Bars — Mild steel bars provided at transverse joints to affect load transfer from one slab to the next, while permitting relative longitudinal movement of the slabs.

2.6 Expansion Joint — The joints provided in a pavement at suitable intervals so as to relieve compressive stresses and prevent buckling during expansion of concrete in slabs.

2.7 Joint Filler — The compressible material used to fill the gap between adjacent pavement slabs at the expansion joints.

2.8 Joint Sealing Compound — The material used to provide a seal at the top of the joint to prevent ingress of water or other foreign matter, liquid or solid.

2.9 Longitudinal Joint — The joints provided in a pavement which are parallel to the centre line of the pavement.

2.10 Skew Joint — A transverse joint which is not at right angle to the centre line of the pavement.

2.11 Tie Bars — Steel bars, provided at longitudinal joint to prevent shifting apart of the adjacent lanes, while permitting angular warping movement. Tie bars are bonded to both the slabs on either side of the joint.

2.12 Transverse Joint — The joints provided in a pavement which are generally at right angles to the centre line and to the surface of the pavement.

2.13 Warping Joint — The joints provided to relieve stresses due to warping by allowing angular movement with or without permitting relative movement to accommodate contraction. These are provided in the longitudinal direction.

3. DESIGN AND PLANNING DATA

3.1 For efficient planning, design, execution and placing of joints in pavements, the following data are needed:

a) Area and layout of the projects;

b) Climatic conditions of the locality (maximum annual and daily temperature range) and season of the year during which concrete will be laid, whether summer or winter;

c) Concrete mix proportions, and size and type of the aggregate proposed to be used; and

d) Nature of sub-grade on which pavement is to be laid.

4. MATERIAL

4.1 Joint Filler — The joint filler shall be of premoulded type and shall be resistant to insects and decay in burried positions. It shall not deteriorate under any weather conditions and shall confirm with the requirements as given in IS : 1838 (Part 1)-1983*

4.2 Joint Sealing Compound

4.2.1 Ordinary joint sealing compound shall comply with Grade A of IS : 1834-1984†, and shall be capable of adhering to the concrete without cracking, spalling and disintegration. A primer conforming to IS : 3384-1965‡ shall be used to improve adhesion.

4.2.2 Fuel and heat-resisting joint sealing compound shall be similar in general properties to the material described in **4.2.1** for ordinary sealing compound except that it must not get, softened by immersion in kerosine or petrol and shall comply with Grade B of IS : 1834-1984†.

4.3 Dowel Bars and Tie Bars

4.3.1 Dowel bars shall be made from steel conforming to IS : 432 (Part 1)-1982§.

4.3.2 Tie bars shall be made from steel conforming to either IS : 432 (Part 1)-1982§ or IS : 432 (Part 2)-1982‖ or IS : 1139-1966¶ or IS : 1786-1979**.

5. DESIGN CONSIDERATION

5.1 Layout of Joints

5.1.1 The joints shall be so arranged as to avoid acute angles and re-entrant angles. The angles at the corner of slabs should preferably be not less than 90° and not more than 180°.

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*Specification for preformed fillers for expansions test in concrete pavement and structure (non-extruding and resilient type: Part 1 Bitumen-impregnated fibre) (*first revision*).

†Specification for hot-applied sealing compound for joints in concrete (*first revision*).

‡Specification for bitumen primer for use in waterproofing and damp-proofing

§Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars (*third revision*).

‖Specification for mild steel and medium tensile bars and hard-drawn steel wire for concrete reinforcement: Part 2 Hard-drawn steel wire (*third revision*).

¶Specification for hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement (*revised*).

**Specification for cold-worked steel high strength deformed bars for concrete reinforcement (*second revision*).

5.1.2 The transverse joints in adjacent lanes may be kept in one line in order to avoid sympathetic cracking which is likely to develop if the joints are staggered.

5.1.3 Skew joints shall be avoided as they may lead to cracking at the acute angled corners and may tend to make the slab move sideways.

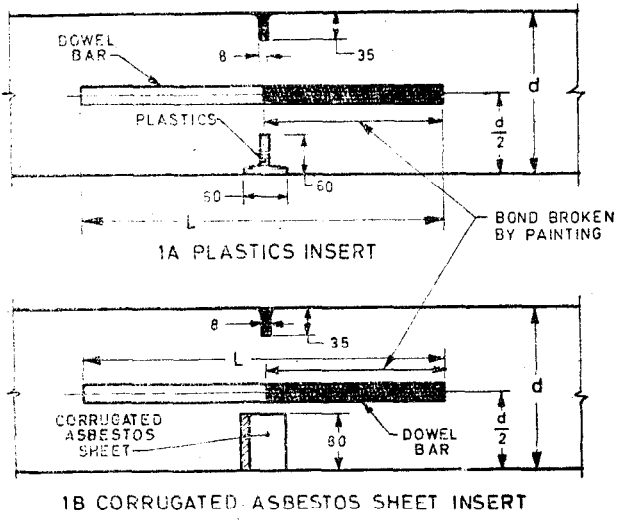
5.2 Details of Joints

5.2.1 *Transverse Joints*

5.2.1.1 *Transverse expansion joints (PCC, JRCC or CRC-EJ Pavements)* — These joints shall be continuous from edge to edge of the pavement through all lanes constructed at the same or different times. The joint filler shall extend to the entire width of the pavement and from the sub-base to 25 to 30 mm below the surface of the pavement. The slab edge adjacent to the joint shall be formed truly vertical. Provision of dowel bars is imperative for load transfer and maintenance of continuity of surface levels, particularly over weaker foundations. No dowel bars should however, be provided in expansion joints at junctions with structures. The basic principle governing the design of such joints is that the thickness of joint filler provided shall not be less than two times the maximum estimated expansion of the concrete slab on one side of the joint so that the filler material will not be compressed to more than 50 percent of its thickness.

5.2.1.2 *Transverse contraction joint* — These may be of dummy groove type in concrete. These are intended to create a plane of weakness through concrete slab along which the concrete may crack when contraction or shrinkage takes place. These shall have a depth equal to 1/3 to 1/4 the pavement thickness and shall be 8 to 10 mm wide. For slab thicknesses greater than 200 mm, it is advisable to provide inserts at the bottom of the slab before casting in order that a vertical crack may be formed at the joint. These inserts may be of metal, plastic or asbestos strips as indicated in Fig. 1. The depth of the groove on top plus the height of the parting bottom shall not exceed one-third the pavement thickness.

5.2.1.3 *Transverse construction joint* — Such joints are provided when concrete laying is suspended for more than 30 minutes. Except for emergency stops the construction joints shall be located at the site for an expansion or contraction joint. If the joint is at the site for an expansion joint, regular expansion joint shall be provided. If at any other place, the construction joint shall extend to the full depth of the pavement and preferably be provided with dowel bars for load transfer.

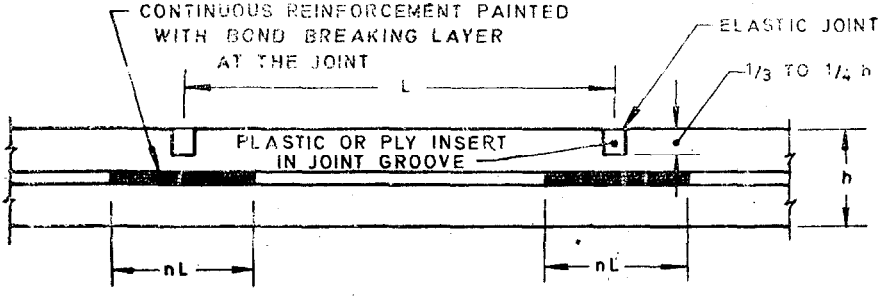


L = length of dowel or the bar
d = slab thickness

All dimensions in millimetres.

FIG. 1 INSERTS PROVIDED AT CONTRACTION JOINTS

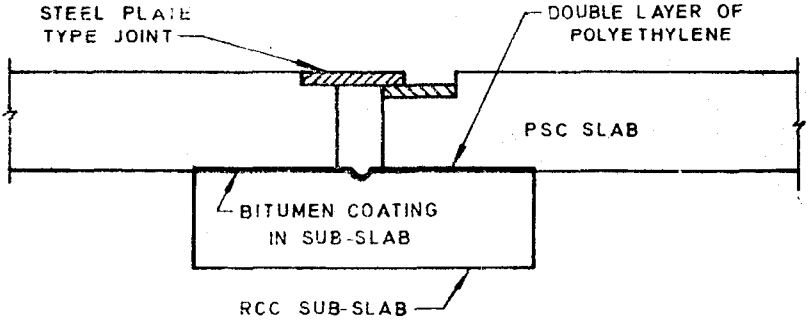
5.2.1.4 *Transverse elastic joint* — These shall be of dummy groove type as in case of PCC or JRCC pavement, excepting that the steel reinforcement shall be allowed to continue through them, and shall be painted with a bond-breaking layer for a specified distance on either side of the joint (*see* Fig. 2). As due to the 'elastic' or spring action of steel, the movement at these joints is much smaller than that for the dummy joints in PCC or JRCC pavement, the joint groove at the top may be filled with a plastic or ply insert immediately after formation and may not be sealed with the sealing compound.



NOTE — n generally varies between $\frac{1}{3}$ and $\frac{1}{4}$.

FIG. 2 ELASTIC JOINT FOR CRC-EJ PAVEMENT

5.2.1.5 *Transverse expansion joint (PSC or CRC-EJ) pavement* — Prestressed concrete pavements are normally provided with steel-plate type expansion joint (*see* Fig. 3) to accommodate large joint movements. To provide adequate support to the joint edges, the joints are provided with RCC subslabs. A channel is provided in the subslab under the joint plate, to drain out any rainwater which might find its way therein. This type of joint is also suitable for provision at the ends of continuously reinforced concrete pavement.



NOTE — Reinforcement and fixing arrangement for joint plates not shown.

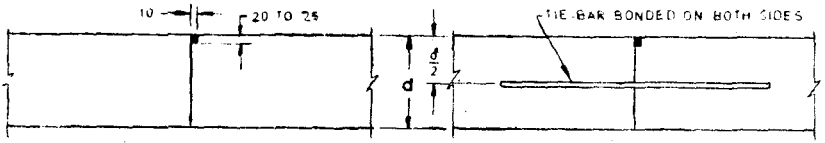
FIG. 3 EXPANSION JOINT FOR PSC PAVEMENT

5.2.2 *Longitudinal Joint*

5.2.2.1 *Longitudinal expansion joint* — These joints shall be formed in the same way as transverse expansion joints excepting that no dowel bars shall be provided in this case.

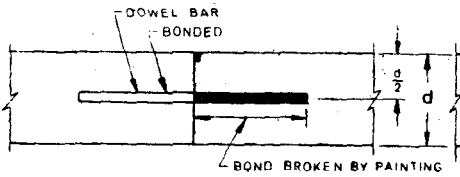
5.2.2.2 *Longitudinal warping joints* — These joints at the edge of construction lanes may be of plain butt, keyed or dummy groove type, the depth of groove being 1/3 to 1/4 the pavement thickness. The dummy groove type will be applicable in cases where pavers are employed for concreting over 6 m width at a time. Where the thickness is more than 200 mm these may preferably be of the tongue and groove type keyed to provide load transference. Where necessary, longitudinal warping joints should be provided with tie bars to prevent progressive opening of the joints due to lateral movement of slabs. Tie bars are necessary at curves for pavements on expansive soils or fills or when the pavement is subjected to heavy traffic. For air-fields, ties may be provided at the joints nearest the extreme edges of the paved area.

5.2.3 Typical illustrative sketches for different types of joints are shown in Fig. 4.

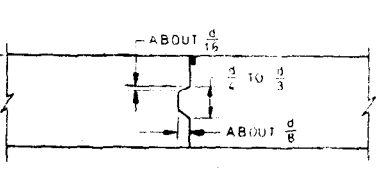


4A PLAIN BUTT JOINT

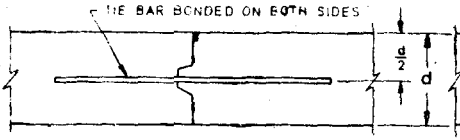
4B BUTT JOINT WITH TIE BAR



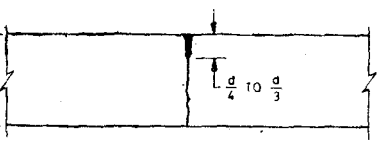
4C BUTT JOINT WITH DOWEL BAR



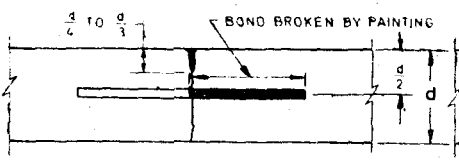
4D KEYED JOINT



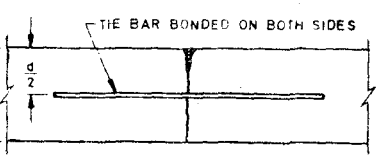
4E KEYED JOINT WITH TIE BAR



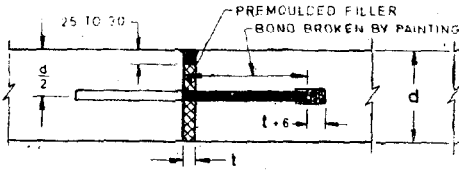
4F DUMMY GROOVE JOINT



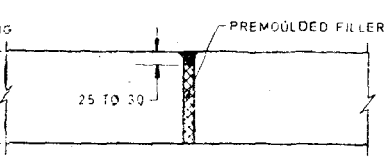
4G DUMMY GROOVE JOINT WITH DOWEL BAR



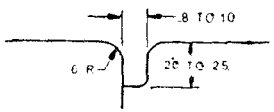
4H DUMMY GROOVE JOINT WITH TIE BAR



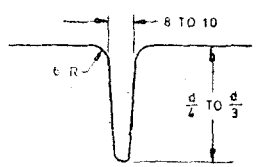
4J EXPANSION JOINT WITH DOWEL BAR



4K EXPANSION JOINT WITHOUT DOWEL BAR



DETAIL OF SEALING GROOVE FOR BUTT JOINTS AND KEYED JOINTS



DETAIL OF GROOVE FOR DUMMY GROOVE JOINTS

All dimensions in millimetres.

d = slab thickness
t = expansion joint width

FIG. 4 TYPICAL DETAILS OF DIFFERENT TYPES OF JOINTS

5.2.4 *Reinforcement in Slab* — The reinforcement in the slab, if provided, shall not be carried across an expansion or contraction joint but may be carried across a construction or warping joint.

5.3 Spacing

5.3.1 *Transverse Joints* — The spacing of transverse joints depends on several factors, the more important of which are the coefficient of thermal expansion of the concrete, the temperature during placing, the frictional restraint of the sub-grade to the movement of the slabs, the thickness of the slab and amount of the reinforcement. For unreinforced concrete slabs, the spacing of joints shall be such as to avoid the formation of cracks at places other than joint locations. For reinforced slabs, the spacing of joints shall be related to the amount of reinforcement provided so that formation of hair cracks is controlled.

5.3.1.1 Transverse expansion joints shall be so spaced that they will permit thermal expansion over a range of temperature from the lowest at which any slab in a complete pavement is placed to the maximum likely to be attained. In case of airfield pavements, the transverse and longitudinal expansion joints shall be so positioned as to divide the pavement into approximate square bays.

5.3.1.2 The recommended spacings for both expansion and contraction joints are given in Table 1 for PCC and JRCC pavements. In case of CRC-EJ pavements, elastic joints shall be provided at the same spacing as dummy joints for PCC pavements. No expansion joints are provided within a continuous section of CRC-EJ regardless of its length. At the ends of the section, and at junctions with structures, a series of 4 to 5 dowelled expansion joints at the same spacing as adopted for elastic joints within the CRC-EJ section or single expansion joint of the type used in case of PSC pavements is provided. For PSC pavements, only expansion joints (steel-plate type) are provided between consecutive slabs, the maximum slab length being of the order of 140 m.

5.3.1.3 *Transverse construction joint* — The construction operations shall be so planned that the location of the construction joints coincide with either an expansion joint or a contraction joint. Construction joints shall be provided at other locations only when the concreting has to be suspended due to unforeseen reasons.

5.3.2 *Longitudinal Joint*

5.3.2.1 *Longitudinal expansion joint* — Recommended spacing for transverse expansion joints shall also apply to longitudinal expansion joints.

TABLE 1 RECOMMENDED SPACING OF EXPANSION AND CONTRACTION JOINTS

(*Clause* 5.3.1.2)

Sl No.	Type of Slab	Thickness of Slab	Mass of Reinforcement	Spacing of Expansion Joints*	Spacing of Contraction Joint
(1)	(2)	(3)	(4)	(5)	(6)
		m	kg/m²	m	m
i)	Reinforced conerete slabs with expansion joints only	0·25	7·6	45	—
		0·20	5·5	36	—
		0·15	3·8	25	—
		0·10	2·7	12·5	—
ii)	Reinforced concrete slabs with expansion and dummy contraction joints	0·25	5·5	51	17
		0·20	3·8	45	14
		0·15	2·7	36	13
		0·10	2·2	30	7·5
iii)	Unreinforced concrete slabs	0·20 and above	—	36	4·5
		0·15	—	27	4·5
		0·10	—	27	4·5
iv)	Continuously reinforced concrete pavement with elastic joints	—	—	At ends of CRC-EJ section or junctions with structures only, 5 expansion joints at 4·5 m intervals or a single steel plate expansion joint	Elastic joints at 4·5 m intervals
v)	Prestressed concrete pavement	—	—	Steel plate expansion joint between slabs (*Max* slab length of the order of 140 m)	—

NOTE — In case of thicker airfield pavements, somewhat higher expansion joint spacings may be permitted particularly when construction is mainly carried out during summer months. Construction joint spacings could be increased to some extent in case a 'smooth' under-layer of sand and polyethylene sheeting, etc, is provided below the pavement. Type of cement and its early strength development characteristics also have a bearing on contraction joint spacing. Whereas limited experience with higher spacings indicates the possibility of increasing the contraction joint spacing to 6-7·5 m and expansion joint spacing to about 60 m, each case may need individual consideration in view of variety of factors involved.

*Width of expansion joints = 20 mm.

5.3.2.2 *Longitudinal warping joints* — Spacing of such joints is determined by the lane widths to be provided in the carriage way but shall be limited to a maximum of 4·5 m.

5.4 Provision of Dowel Bars

5.4.1 Dowel bars are required to transfer wheel loads to the adjacent slab, when the wheel is located on the slab edge next to the transverse joint. One half of the dowel bar is painted with a bond-breaking layer of bitumen. This bond-breaking layer shall preferably be provided on opposite sides of the joint in adjacent dowel bar. In case of transverse expansion joints, the unbonded portion of the dowel is provided with expansion cap at the end. Cotton waste or other compressible material shall be inserted but not tightly packed before fitting the cap over the painted end of the dowel bar so that there is sufficient gap between the bar end and the inside of the cap.

5.4.1.1 Dowel bars are not satisfactory for slabs of small thickness, and shall not be provided for slabs less than 150 mm thick.

5.4.2 Recommended minimum requirements of dowel bars for different thickness of highway pavements are given in Table 2.

TABLE 2 RECOMMENDED MINIMUM REQUIREMENTS OF DOWEL BARS IN HIGHWAY PAVEMENTS

All dimensions in millimetres.

Pavement Thickness	Dowel Diameter	Dowel Length	Dowel Spacing
150	25	500	200
200	25	500	300
250	32	500	300

5.4.3 The recommended minimum requirements of dowel bars for various thicknesses of airfield pavements are given in Table 3.

TABLE 3 RECOMMENDED MINIMUM REQUIREMENTS OF DOWEL BARS FOR AIRFIELD PAVEMENTS

All dimensions in millimetres.

Pavement Thickness	Dowel Diameter	Dowel Length	Dowel Spacing
(1)	(2)	(3)	(4)
200	25	500	300
250	32	500	300
300	36	550	350
350	36	550	350
400	40	600	350

5.5 Provision of Tie Bars

5.5.1 Whenever provided, tie bars shall be designed to withstand tensile stresses only, the maximum tension in the tie bars across any joint being equal to the force required to overcome friction between pavements and sub-base, from the joint in question to the nearest free joint or edge.

5.5.2 The diameter, spacing and length of tie bars may be computed from the following formulae:

$$A = \frac{b\, f\, w}{f_s}$$

$$L = \frac{2\, f_s\, a}{B\, p}$$

where

A = area of steel per m length of joint in mm^2;

b = distance between joint in question and the nearest free joint or edge in m;

f = coefficient of friction between pavement and subgrade or sub-base (usually taken at 1·5);

w = weight per m^2 of concrete slab in N;

f_s = allowable working stress in steel in N/mm^2;

L = length of tie bars in mm;

a = cross-section area of one tie bar in mm^2;

B = allowable bond stress in the tie bars in N/mm^2; and

p = perimeter of one tie bar in mm.

The diameter of tie bars should not be greater than 20 mm so as to facilitate angular warping movement at the joints, and their spacing, not more than 750 mm so as to avoid concentration of tensile forces. In addition to the calculated length L an allowance of about 75 mm may be added to account for inaccuracies in placing the tie bar during construction.

6. CONSTRUCTION

6.1 Transverse Joint

6.1.1 *Transverse Expansion Joint* — The premoulded expansion joint filler and dowel bars shall be held accurately in place during the placing and finishing of concrete. This may be achieved by means of bulkheads consisting of hardwood beams of appropriate section, with holes drilled along the centre-line to accommodate the dowel bars, or a metal channel

cap or other approved method (two-piece split bulkheads may be used, if considered more convenient). Dowel bars should be placed parallel to each other and parallel to the surface and centre line of the pavement. The maximum permissible tolerance in the alignment of dowels shall be ±1 mm in 100 mm for dowel bars of 20 mm or lower diameters. For dowels of 25 mm diameter the tolerance shall be ±0·5 mm in 100 mm.

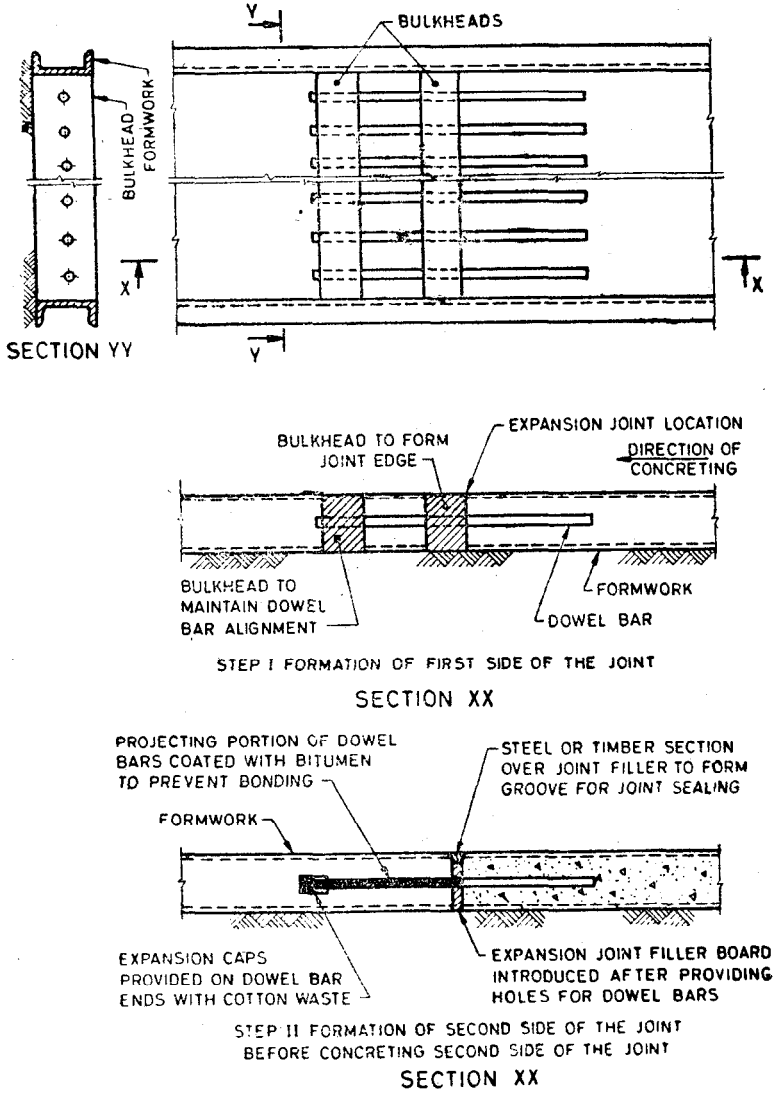
6.1.1.1 Bulkheads when employed shall be used in pairs, one at the joint location, and the other some distance away to hold the projecting ends of the dowel bars to maintain their alignment so that they are parallel to centre line of the pavement as well as to its surface. The bulkheads shall be securely staked in place at right angles to the centre-line of, and surface of the pavement with sufficient stakes to hold them in the specified position. Holes to accommodate dowel bars shall be accurately bored or punctured out in the premoulded joint filler. The joint filler may be introduced initially against the bulkheads or after the first slab has been cast and bulkheads have been removed and held against the hardened concrete. An oiled or greased mild steel rectangular section or metal channel cover shall be placed at the top of the joint filler for protection of the sealing groove over it during construction layout for construction of transverse expansion joints using bulkheads is illustrated in Fig. 5.

6.1.1.2 The metal channel cover, when used, shall be of 3 mm thick steel having two equal, parallel lugs not less than 50 mm deep. The metal cover shall be placed over the top of the expansion joint material in the sub-grade by flat metal stakes spaced so closely together that the joint material will remain straight as the concrete is placed and finished.

6.1.1.3 Thorough compaction shall be ensured for concrete around the dowels by giving additional compaction with the internal vibrator. Concrete shall be allowed to harden sufficiently so as not to disturb the joint assembly before removing the bulkhead, or metal channel cover (*see* Fig. 5).

6.1.1.4 In case it is desired to proceed continuously with construction on the other side of the expansion joint, in place of bulkhead suitable mild steel reinforcement assembly to hold the joint filler dowel bars securely in place shall be used as an integral part of the joint assembly.

6.1.2 *Transverse Contraction Joint* — The dummy groove type joint may be formed by driving or vibrating into the fresh concrete a flat metal bar or the web of a T-bar, held on its edges by guides. The bulks which form on either side of the joint shall be smoothed out by trowelling using a wooden float and finished to match the surface texture of the remainder of the slab. The metal bar shall be withdrawn as soon as the concrete has set sufficiently so as not to flow back into the groove. Alternatively, the slot may be formed by sawing the concrete with joint cutting machine when the concrete has sufficiently hardened, that is, between 12 and 18 h of laying of concrete under moderate climatic conditions. Under extreme cold conditions this period may be suitably increased on the basis of experience.



NOTE — Holding devices for bulkheads and formwork not shown.

FIG. 5 LAYOUT FOR CONSTRUCTION OF TRANSVERSE EXPANSION JOINT IN CONCRETE PAVEMENTS USING BULKHEADS

6.1.3 *Transverse Construction Joint* — These joints shall be so constructed that when work is resumed, the surface shall conform to the grade and cross-section of previously laid pavement. The procedure for construction is similar to transverse expansion joint except that the premoulded joint filler is not provided, and no expansion caps are necessary in case of dowel bars.

6.2 Longitudinal Joint

6.2.1 *Longitudinal Expansion Joint* — Same procedure as followed for transverse expansion joint shall be adopted, except that the dowel bars need not be provided.

6.2.2 *Longitudinal Warping Joint* — These joints, if of butt type shall be formed by placing the concrete against the faces of the slabs concreted earlier. The faces of the old concrete slabs shall be painted with bitumen before placing of fresh concrete. For tongue and groove type butt joint the formwork of the slab concreted earlier shall have projection of suitable dimensions. In the case of dummy type joint, the procedure as followed for transverse contraction joint shall be adopted.

6.2.3 Tie bars when provided shall be well supported so as not to be displaced during construction operations. These shall be bonded in the slabs across the joints, and holes should be provided in the side shuttering to accommodate the tie bars.

6.3 The edges of all joints shall be rounded with an edging tool having a radius of 6 mm. The level on both the sides of the joint shall be checked; any difference in level shall be corrected. The general level of the surface shall be checked with a straight edge across the joint and any irregularity in excess of 3 mm shall be corrected.

6.4 Sealing of Joints

6.4.1 After the curing period is over and before the pavement is opened to traffic, the intruded materials in all joints shall be removed completely and the joint groove filled in with the sealing compound. The joint opening shall be thoroughly cleared of all foreign matter before the sealing material is placed. The contact faces of the joint shall be cleared with a wire-brush to remove loose materials and shall be surface-dry when the sealing compound is poured.

6.4.2 In the case of deep grooves, the lower portion of the groove may be filled with fibre board strip, chopped fibre, tarred rope or other suitable material, leaving the top 25 mm of the groove to be filled with sealing compound.

6.4.3 The contact faces of joints shall be primed with a thin bituminous paint which shall be allowed to dry before the sealing compound is

applied. The primer shall be applied with a brush. The primer may be prepared by fluxing a soft straight run bitumen with light cresote oil and solvent naphtha. The bitumen shall be melted and fluxed with the oil. When cold, solvent naphtha shall be added. Bituminous emulsions shall not be used as primers.

6.4.4 Sealing compound shall be poured into the joint opening in such a manner that the material will not get spilled on the exposed surface of the concrete. Any excess filler on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

6.4.5 It is recommended that while in summer the joints may be sealed flush with the adjacent pavement surface, in winter the sealing compound may be filled to a depth 3-4 mm below the surface.

6.4.6 To prevent tackiness or pick up under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if necessary.

7. MAINTENANCE OF JOINTS

7.1 Routine Inspection of Joints — It is good practice to make a detailed inspection and record of the condition of each joint once every six months.

7.2 If either of the failures referred in **7.2.1** and **7.2.2** is suspected because the sealing compound is becoming loosened or hard, or because there are obvious signs of grit in the joint, the old seal should be removed and the joint re-sealed. If spalling has occurred this should be repaired as described in **7.3**.

7.2.1 *Letting in of Water* — The sealing compound comes away from the joint faces and admits water to the sub-grade.

7.2.2 *Letting in of Grit* — The sealing compound may become soft or be pulled out of position by traffic, allowing stones and grit to be pressed into the compound or to become wedged in the joint, leading to spalling of the edges of the slab.

7.3 Repair of Spalled Edges — The defective edge should be cut away to a depth of not less than 50 mm and to a width normal to the joint from 75 to 150 mm. The edges of the patch should be trimmed vertical and thoroughly wetted with a thin layer of neat cement paste applied to the faces. Concrete of as dry a mix as possible of suitable proportions not linear than 1 : $1\frac{1}{2}$: 3 is then placed in position, worked well with a trowel, struck off and finished with a wooden float to match the surface texture of the adjacent slab. The joint edges shall then be rouned off. The patch should be cured for a period not less than ten days. The period of curing may be reduced if high early strength cement is used.

Alternatively, the repair may be carried out with suitable resin-sand after priming the prepared surface with the resin formulation, in which case the repaired portions may be opened to traffic the next day.

7.4 If the sealing compound requires only replenishing, any stones or grit or other extraneous material should first be removed, the concrete surface primed and new sealing compound added.

7.5 Where the filler has deteriorated or the joint has been filled with an extruding type of material the defective material should be removed and a compressible material such as impregnated fibre board chopped into small pieces, hemp or sawdust packed firmly but not rammed hard to about 25 to 30 mm of the top surface. The joint should then be primed and sealed.

(*Continued from page* 2)

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