

No. NHII-86 (108)/66

Dated the 7th July, 1969

To

All Technical Officers in the Bridges Directorate at the Headquarters/Superintending Engineers of all Regional Offices

Sub: Positioning of bearings for skew bridges in beam and slab construction

While designing bearings for a skew bridge with T-beam-cum-slab arrangement, correct positioning of bearings deserves special attention, so as to permit a longitudinal movement as well as a rotation of the beam ends simultaneously. Accordingly, a reference was made to Dr. Leonhardt, requesting for his views in the matter as well as the current practice in Germany. Copies of letters exchanged on this subject are enclosed for information and guidance of technical officers in the Bridges Directorate and in the Regional Offices.

Enclosures to Circular No. NHII-86 (108)/66

Dated 7.7.69

D.O. No. NHII-86 (108)/66 dt. 3.3.1969 from ADG (B) to Dr. Leonhardt

Sub: Positioning of bearings for skew bridges in beam and slab construction

I am writing this letter with a view to obtaining your valuable opinion, as well as the present practice in your country in respect of the correct positioning of bearings under girders of skew bridges.

In India, the practice, so far, in respect of road bridges, has been to keep the movable as well as the fixed bearings at right angles to the longitudinal axis of the skew girders. While this arrangement permits a free horizontal movement (due to expansion or contraction) of the girders in the direction parallel to their axis, a doubt has arisen as to whether this will permit a free rotation of the beams over the fixed as well as the movable bearings. The contention is that the span tends to rotate about the line joining the centres of bearings (i.e. parallel to the supports) while the horizontal movement takes place parallel to the axis of the beams. If this position is to be accepted as correct, in principle then some difficulty may arise in the actual design and positioning of bearings. For instance, in the case of metallic roller bearings (either with single roller or multiple roller assembly), kept at right angles to the beam axis, it may become difficult to provide for rocking parallel to the piers, unless some special provision is made for such rocking, between the top plate under the beam and the saddle plate over the rollers. Similar complicated arrangements may become necessary even in the case of concrete pendulum bearings.

I understand that a very careful thought has been given in Germany to this problem of orientation of bearings for skew bridges. I shall be grateful if you could throw some light on this problem and help us with a few sketches illustrating the practice being followed in your country particularly with regard to the orientation of such bearings (metallic, concrete and also rubber) for one or two typical cases, and also indicating thereon, if possible, the procedure of the design generally being followed for such bearings. As I have to incorporate these ideas in the design of some skew bridges now under consideration, I shall be obliged if you could kindly send me your reply at your earliest convenience.

D.O. letter dt. 7.5.1969 from Dr. Leonhardt to ADG (B)

Sub: Positioning of bearings for skew bridges in beam and slab construction

For skew bridges with girders parallel to the main longitudinal axis of the bridge, the bearings should always be placed at right angles to the longitudinal axis of the girders. However, the girders should be connected only by the top slab and a slender transversal beam along the skew end, in order to avoid torsional fixity to this end beam. For load distribution, there could be one stiff transversal diaphragm in the middle of the span, but not close to the bearings.

In Europe, we prefer solid slabs for our skew bridges and I am sending you the principles which we use for the bearings of skew slabs. For dimensioning these skew slabs, big books are available, giving all the necessary influence surfaces for bending moments, shear forces, bearing forces etc.

Annexure to Dr. Leonhardt's D.O. letter dt. 7.5.1969

Positioning of Bearings for Skew Bridges

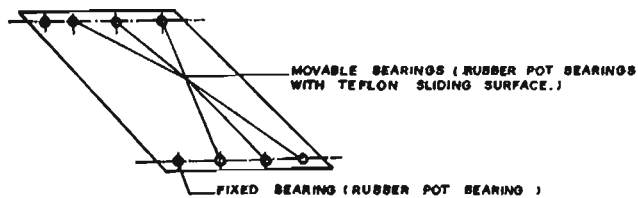
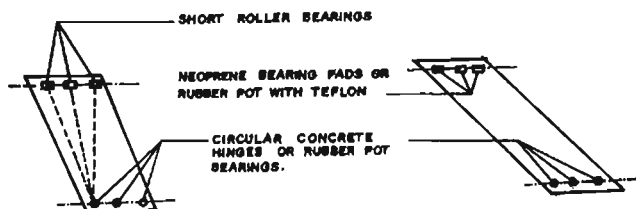
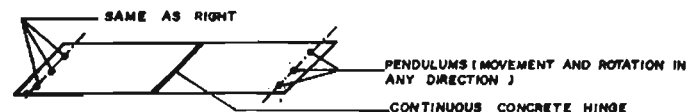
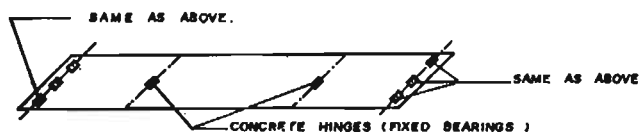
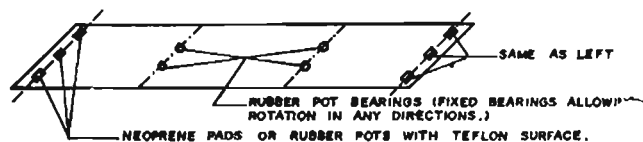
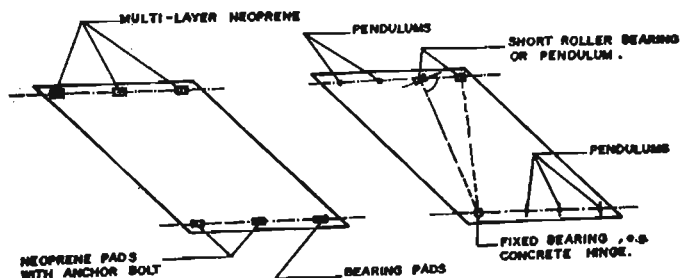
A General Principles:

1) Fixed Bearings: All types of bearings (steel or concrete) with rotation along one axis only are generally not suitable for bridges with considerable skew, e.g. the conventional rocker bearings are inadequate. Since the axis of rotation and the direction of longitudinal movements are not perpendicular, point bearings have to be used allowing rotation in any direction.

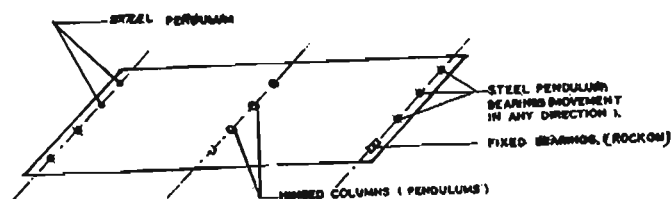
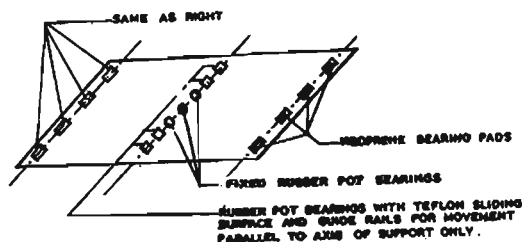
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ALTERNATE FOR LARGE SPAN AND HEAVY LOADING.

D - EXAMPLES1 SINGLE SPAN BRIDGES1.1. SMALL TO MEDIUM WIDTHSMALL SKEWLARGE SKEW2 CONTINUOUS BRIDGES2.1. SMALL-TO-MEDIUM WIDTH.1.2. WIDE BRIDGES (WIDE SLAB OR MULTI-BEAM BRIDGES)SMALL SPAN OR LOADLARGE SPAN OR LOAD

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2.2. WIDE BRIDGES (SLAB OR MULTI-BEAM BRIDGES)

Suitable point bearings are for example:

Steel point bearings

Circular concrete hinges

Modern rubber pot bearings [for high loading up to 5000 tons, compare (3)].

2) Movable bearings

Bearings must allow rotation and movement in any direction, thus e.g. conventional steel roller bearings are inadequate. Suitable bearings are:

multi-layer rubber pads with inserted steel plates

rubber pot bearings with sliding surface made of Teflon (see (3))

steel pendulums

hinged columns (usually concrete)

B. Special Design Principles for wide bridges

1) Place fixed bearings preferably into obtuse corner of bridge and allow movement parallel and perpendicular to axis of bridge.

2) Spacing of bearings along support line not too close in order to avoid high concentration of negative bending and shear as well as support reaction in obtuse corner. Most economical spacing should be about $1/6$ to $1/4$ of span (Lit. (4), (5)).

3) Elastic bearings (rubber) also reduce concentration of reaction and negative moment in obtuse corner (Lit. (4)).

C. Design of Bearings

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| (1) M. Weihprecht: | Auflagerung von Brücken, Arthur Tetzlaff-Verlag, Frankfurt |
| (2) Lindley: | Design and use of natural rubber bridge bearings. London, Natural Rubber Producers' Research Association, 1962 Technical Bulletin No. 7 |
| (3) Andra/Leonhardt: | Neue Entwicklungen für Lage-von Bauwerken, Gummi-und Gummitopflage, Die Bautechnik 39 (1962), Heft 2, S. 37. |
| (4) Mehmel/Weisa: | Ein modellstatistischer Beitrag zum Tragverhalten schiefwinkliger Platten. |
| (5) Andra/Leonhardt: | Beton-u. Stahlbetonbau 1962, No 10.
Einfluß des Lagerabstandes auf Biegemomente und Auflagerkräfte Schiefwinkliger Einfeld-Platten.
Beton-u. Stahlbetonbau 1960, Heft 7, S. 151. |