

No. PL-87 (16)/75

Dated the 26th March, 1975

To

All the Chief Engineers of States/Union Territories (connected with roads)

Sub : Design Procedure for Shear in Prestressed Concrete Beams of Road Bridges for all Bridge works on National Highways and other Centrally Aided Schemes-Provisional modifications to Clause 14 of IRC : 18-1965 (Design Criteria for Prestressed Concrete Road Bridges)-Reg.

The design rules laid down in Clause 14 of IRC: 18-1965 (Design Criteria for Prestressed Concrete Road Bridges-Post tensioned Concrete), hitherto being adopted for the design of shear in prestressed concrete bridge beams, have since been reviewed in this office in the light of the present state of the art of design practice. This review has revealed certain major deficiencies and anomalies in the aforesaid design rules.

2. In order to remove the above mentioned deficiencies and to ensure safety of prestressed concrete bridge beams in shear, a set of modified design rules have now been framed and enclosed in Annexure 'A', for adoption with immediate effect.

3. The modified design rules given in Annexure 'A' may be treated as a provisional modification to clause 14 (including sub-clauses 14.1 and 14.2 thereof) of IRC 18: 1965 and shall substitute the said clauses which shall be deemed inoperative for the purposes of design specifications of all P.S.C. bridge works on National Highways and other Centrally sponsored bridge works.

3.1. These provisional modifications shall be considered applicable only until the prestressed concrete code of the Indian Roads Congress, now under preparation is finalised, which will then supersede IRC : 18-1965, currently in force.

3.2. The design rules defined in Annexure 'A' shall substitute and supersede the said clause 14 only, without prejudice to any other stipulations of IRC : 18-1965 or any other IRC Codes. The shear design of reinforced concrete structural elements shall conform to IRC-21 in all respects and the applicability of the design principles defined in Annexure A shall not be extended thereto in any form.

4. The design procedure given in Annexure 'A' may be included in design specifications forming part of tender conditions of 'design and construction' type of tenders to be invited for bridge works.

Enclosure to letter No. PL-87 (16)/75 dt 26.3.75

ANNEXURE 'A'

DESIGN RULES FOR SHEAR IN PRESTRESSED CONCRETE BEAMS FOR ROAD BRIDGES

1. Scope

The specifications hereof shall apply to prestressed concrete beams in simple bending and not to slabs, deep beams and short cantilevers etc. for the design of which a reference may be made to specialist literature on the subject.

2. General

2.1. Webs of beams shall in all cases be provided with shear reinforcement.

2.2. Shear reinforcement shall be placed perpendicular to the axis of the beam.

2.3. Calculations for shear are required to be done for ultimate load conditions only.

3. Design Shear Force V :

3.1. The design shear at any section shall be calculated for ultimate loads specified in clause 12 of IRC : 18-1965

3.2. For sections with inclined prestressing tenders, the component of the effective prestressing force available (after deducting all prestress losses from the initial prestressing force) normal to the longitudinal axis of the beam shall be deducted from the total shear calculated according to 3.1 above.

3.3. Wherever applicable, the effects of variable depths of a beam shall also be taken into account.

4. Shear reinforcement as per design :

The shear reinforcement shall be calculated from the formula

$$A_v = (V - V_c) / f_{y,d}$$

where

A_v = cross sectional area of one stirrup in cm^2

b = web width in cm

V = design shear force in kg

$V_c = 10.b.d$ in kg

s = longitudinal spacing of stirrups

f_y = specified yield or proof strength of reinforcement in kg/cm^2

(f_y shall in no case exceed 4250 kg/cm^2 even if high-strength deformed bars are used).

d = effective depth or 0.80 times the overall depth of the section whichever is more, in cm.

5. Minimum web reinforcement

The minimum percentage of web reinforcement shall be 0.25 as specified in clause 15 of IRC:18-1965 if it is mild steel. For high strength deformed bars, this minimum shall be 0.14 per cent.

6. Maximum shear force permissible :

In no case shall the design shear force V exceed the value of $0.1 F_c b.d$ where F_c is the specified cube of strength of concrete. If this is exceeded, the section shall be redesigned.

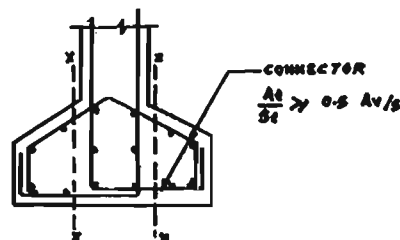
7. Connector Reinforcement :

For flanged beams including box girders, adequate shear connection across the vertical junction planes between tension/compression flanges and the web shall be provided by horizontal connector reinforcement. The area of such reinforcement per unit length of beam shall not be less than 50% of the web steel, both in top and bottom flanges, and for L-beams it shall not be less than web steel, both in top and bottom flanges. The spacing of the connector reinforcement shall in no case be greater than that of the main web reinforcement.

(Vide Fig. 1)

Note : Reinforcement if available at Section XX from considerations of flexural resistance may also be taken into account as connector steel independently, provided the requirements of anchorage and spacing are satisfied. Only when A_t required exceeds the tensile steel available, additional connector steel is to be provided. The top flange of beam would therefore require generally little additional connector steel.

ENCL. TO LETTER No. PL-87(16)/75 DATED 26.3.75



CONNECTOR DETAILS TENSION FLANGE
(BUILT) OF T-BEAM.

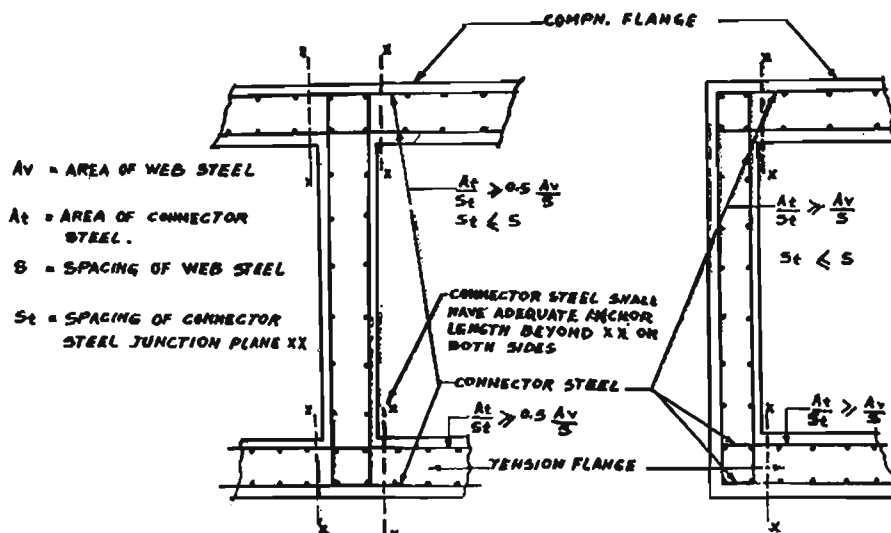


FIG.1 CONNECTOR REINFORCEMENT FOR COMPRESSION
FLANGE & TENSION FLANGE.