ANALYSIS OF CORRUGATED STEEL WEB IN PRESTRESSED CONCRETE GIRDER

[1]Amol Vinod Neralwar, [2]S.B. Sohani

[1]Post Graduate Student, [2]Associate Professor
Structural & construction management
Department of Civil Engineering, BIT, Ballarpur, Maharashtra, India

***Abstract*—Recently, steel web prestressed concrete bridges with corrugated webs have been increasing rapidly in Japan. In general a hybrid prestressed concrete bridge with corrugated steel webs is a sophisticated modification of the in France in the 1980's, and later introduced to Japan in the 1990's. Thereafter, researching into this structure has been increased and several unique techniques have been developed in Japan. As a cost reduction technique, the hybrid prestressed concrete bridge with corrugated steel webs has been gaining attention based on a number of constructions conventional prestresssed concrete box girder bridges by replacing the concrete webs with corrugated steel plates. Reducing the dead load of main girders, improving the prestress efficiency, and reducing the construction work and cost are principally main advantages of this structure. The hybrid prestressed concrete bridge with corrugated steel webs was originally developed increasing every year in Japan. Recently, the hybrid prestressed concrete bridge with corrugated steel webs has been applied to long span bridges, for example, extradosed bridges and cable stayed bridges with spans in excess of 200m.**

***Index Terms*—Hybrid prestressed concrete bridge, Corrugated steel web.**

I. INTRODUCTION

Corrugated steel webs were recently used to replace the stiffened steel webs of plate/box girders . The commonly used corrugation profile for corrugated web plates is the trapezoidal profile .The flexural strength of a steel girder with a corrugated web plate is provided by the flanges with almost no contribution from the web and with no interaction between flexure and shear behavior. The corrugated steel web solely provides the shear capacity of the girders where the shear strength is controlled by buckling and/or steel yielding of the web. The flanges provide boundary supports for the web which lie somewhere between a simply supported boundary and a clamped one. Failure of a corrugated steel web plate occurs by the classical steel yielding of the web under a pure shear stress state. It may also occur by web buckling due to either local instability of any "panel" between two folds or overall instability of the web over two or more panels. An interactive failure mode between these different failure criteria represents another possibility of failure. Lateral torsion buckling is another possible failure mode for steel I-girders with corrugated web. Codes of practice commonly use the critical moment of a simply supported I-girder with a plane web subject to a constant moment and relate it to the critical moment of any other loading case via an "equivalent moment factor".

II SCOPE OF STUDY

The recommendations for future studies of PCSC girders are suggested as follows:

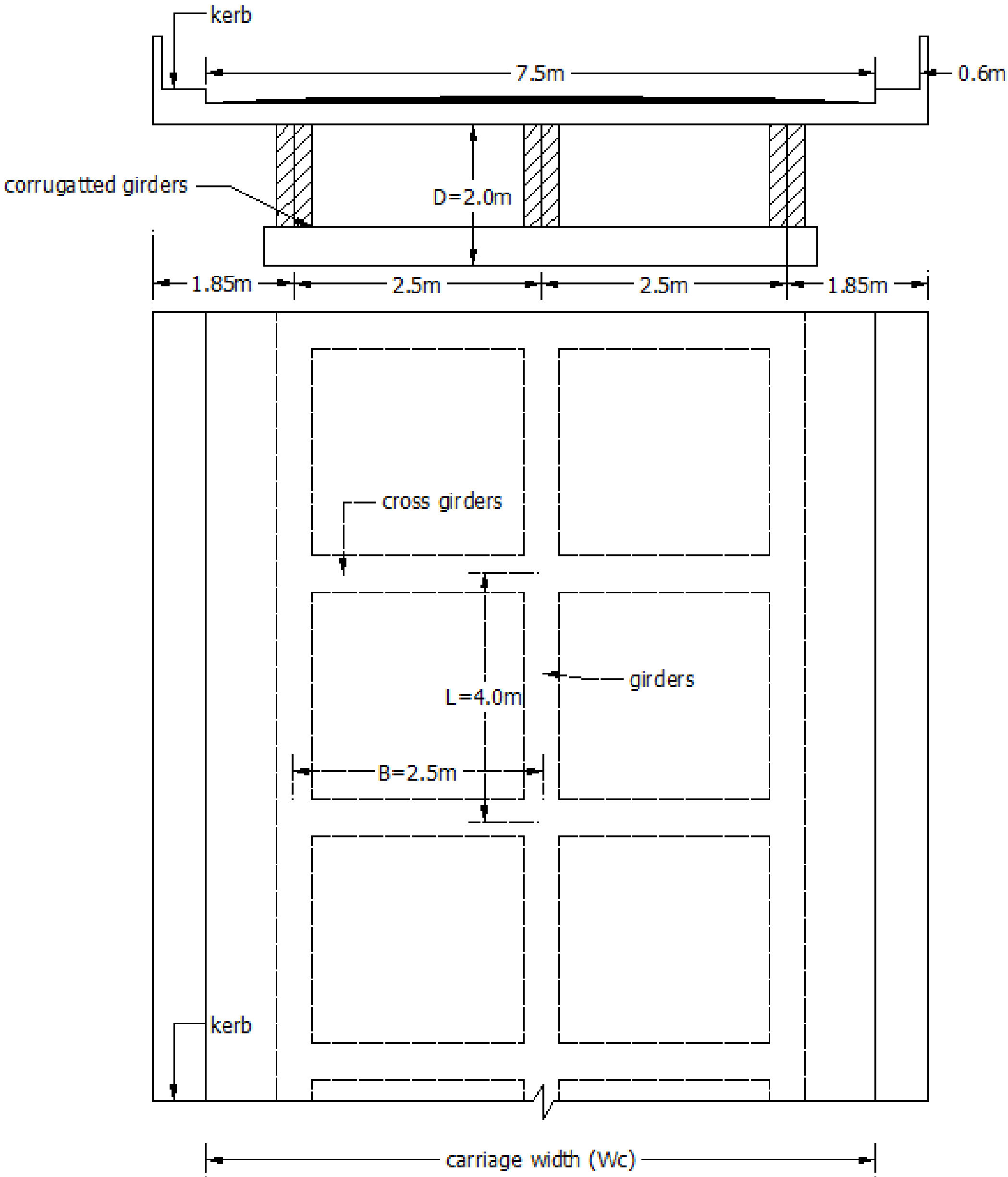
- In order to avoid end zone crack in concrete bottom flange, confinement stirrups in concrete bottom flange should be well designed at the ends and bearing plates with embedded studs should be used at ends.
- Experimental tests should be conducted to investigate fatigue strength of PCSC girders.
- Girder continuity detail can be further designed for PCSC girders applied in bridges with continuous spans. Their structural performance should be well studied experimentally and analytically.
- Curved and non-prismatic PCSC girders need to be investigated.
- Inclined corrugated web plate in box girder can be studied.
- Different shaped box corrugated bridge can be studied.

III .OBJECTIVE OF THE STUDY

- Consider box girder with plane web plate of 2m depth and 20mm thick.
- Consider box girder with corrugated web of three types of corrugation.
    a. Corrugated plate of 0.25mm width
    b. Corrugated plate of 0.125mm width
    c. Corrugated plate of 0.086mm width
- Loading is IRC – class AA tracked and wheel loading
- STAAD – pro software is used for modeling.
- Models are analyzed for critical dead and live load combination.
- Results are compared for critical stresses, deflection, principal stresses.

IV. PROBLEM STATEMENT

Design of Post tensioned prestress concrete box girder and bridge Deck with corrugated web.



Material :
Concrete Grade M50

prestressing tendons :

High tensile strands as per IRC: 6006-2000
Dia of tendons : 15.2mm
R/F. Bars : Fe 415

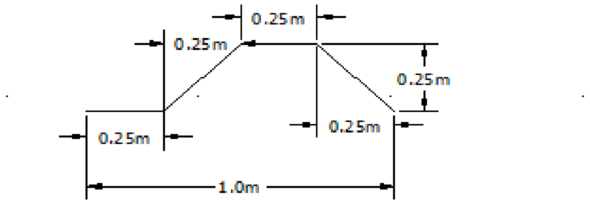
Dimensional details :

Span of bridge longitudinal : 32m
Width of carriage way : 7.5m

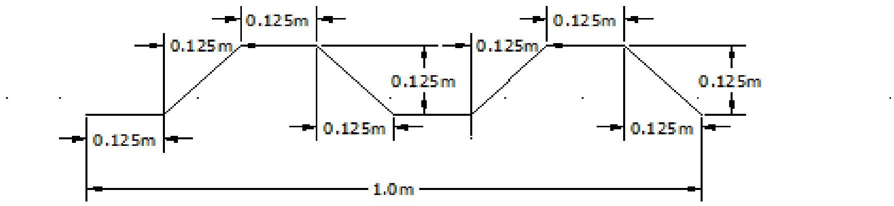
kerb **80m**
wearing coat : **80mm**

V. DIMENTIONAL DETAILS OF CORRUGATED STEEL WEB

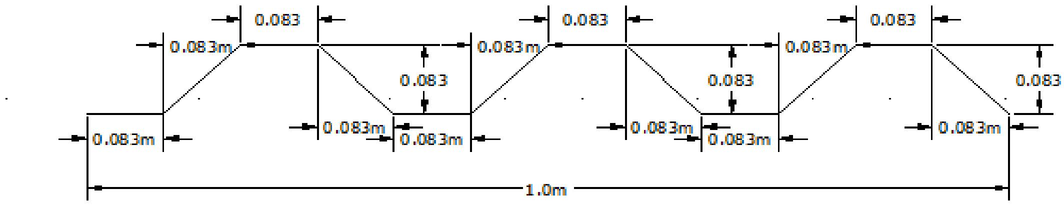
Type 1 Plain 20mm th.



Type 2 0.25m wide corrugatted, 20mm th.



Type 3 0.125m wide corrugatted, 20mm th.



Type 4 0.083m wide corrugatted, 20mm th.

VI. 3D VIEW OF CORRUGATED WEB TYPES

VII. 3D VIEW OF BRIDGE DECK SLAB

VIII. RESULTS & GRAPHS

Absolute displacement

Table : Absolute displacement in mm

Absolute displacement (mm)	Type of corrugation
10.06	Plain
22.153	0.25m wide
26.71	0.125m wide
18.502	0.083m wide

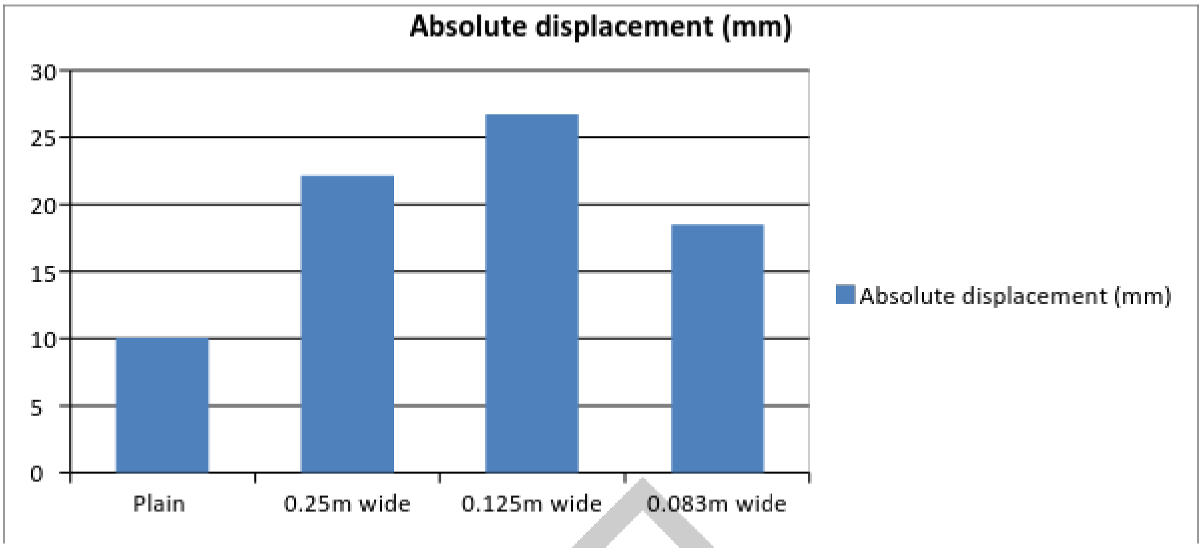


Fig. Absolute displacement in mm

Above bar diagram shows absolute displacement in mm for box girder with plain plate, 0.25mm thick corrugated plate, 0.125mm thick corrugated plate and 0.0.083mm thick corrugated plate.

Support reactions

Table: Support reaction in Kn

Support reactions			Type of corrugation
Force-Z kN	Force-Y kN	Force-X kN	
123.049	370.972	682.423	Plain
138.482	736.746	1100.631	0.25m wide
142.991	595.489	584.37	0.125m wide
227.833	584.805	609.124	0.083m wide

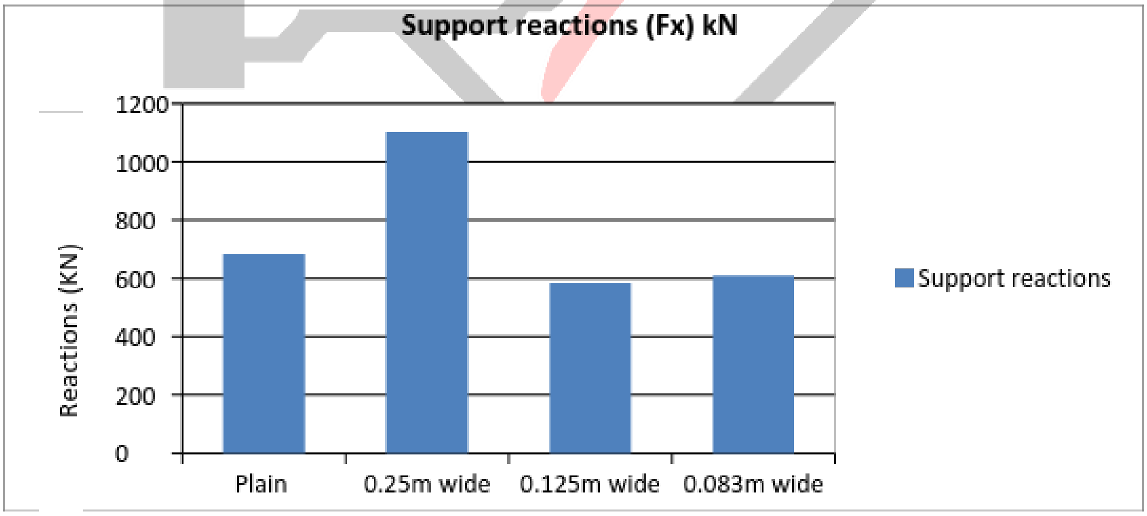


Fig. Support reaction Fx in kN

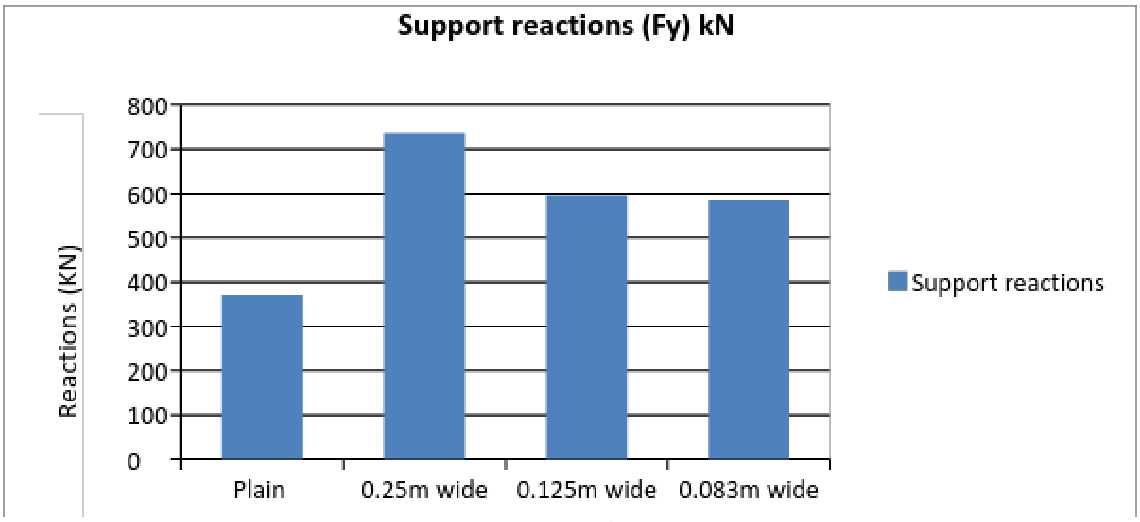


Fig. Support reaction Fy in kN

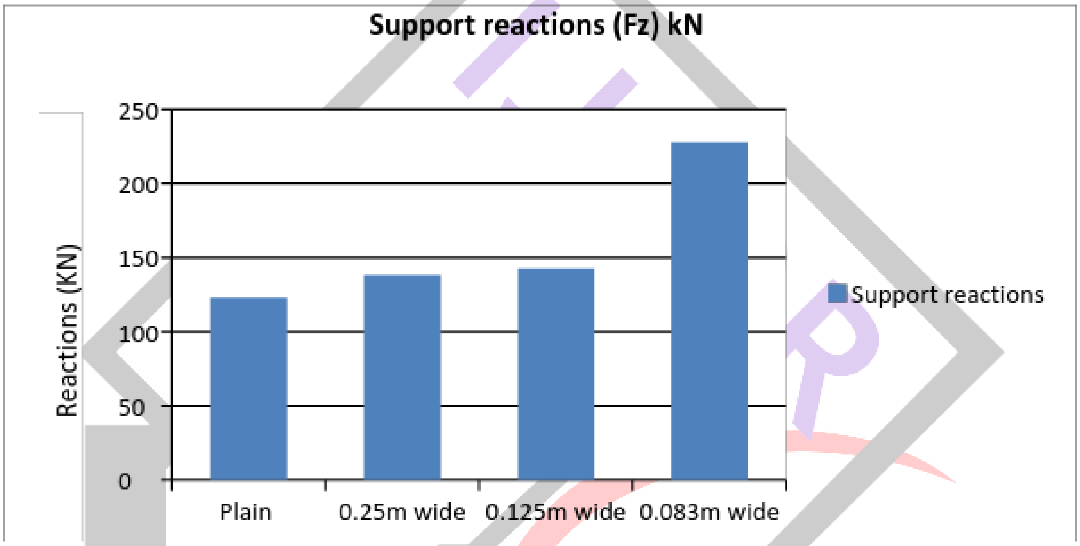


Fig. Support reaction Fz in kN

Above Fig. 5.2, Fig.5.3, Fig.5.4 shows support reaction Fx, Fy, Fz in kN respectively for box girder with plain plate, 0.25mm thick corrugated plate, 0.125mm thick corrugated plate and 0.0.083mm thick corrugated plate.

IX. CONCUSON

From the above analyze of four types of box girder bridge with uniform web thickness of 20mm and of span 32m with IRC class AA Tracked and wheel loading the following conclusions are drawn :

- The absolute displacement is less in plane webbed bridge and is more in 0.125m wide corrugated bridge.
- The max. support reaction (Fx) is more in 0.25mwide corrugated bridge and least in 0.125m wide corrugated bridge.
- The max. support reaction (Fy) is more in 0.25mwide corrugated bridge and least in plane webbed bridge.
- The max. support reaction (Fz) is more in 0.083m wide corrugated bridge and least in plane webbed bridge.

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