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Prestressed Concrete Box Girder Bridge

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ABSTRACT

Bridge construction today has achieved a worldwide level of importance. Bridges are the key elements in any road network Use of box girder is gaining popularity in bridge engineering fraternity because of its better stability, serviceability, economy, aesthetic appearance and structural efficiency. The structural behavior of box girder is complicated, which is difficult to analyze in its actual conditions by conventional methods. In present study a two lane simply supported Box Girder Bridge made up of prestressed concrete which is analysis for moving loads as per Indian Road Congress (IRC:6) recommendations, Prestressed Code (IS: 1343) and also as per IRC: 18 specifications. The analyzed of box girder using SAP 2000 14 Bridge Wizard and prestressed with parabolic tendons in which utilize full section. The various span/ depth ratio considered to get the proportioning depth at which stresses criteria and deflection criteria get satisfied.

Keywords: **Concrete Box Girder Bridge, Prestress Force, Eccentricity, Prestress Losses, Reinforcement, Flexure strength, shear strength,**

1. INTRODUCTION

The first bridges were made by nature as simple as a log fallen across a stream. The first bridges made by humans were probably spans of wooden logs or planks and eventually stones, using a simple support and crossbeam arrangement. Most of these early bridges could not support heavy weights or withstand strong currents. It was these inadequacies which led to the development of better bridges. Prestress concrete is ideally suited for the construction of medium and long span bridges. Ever since the development of prestressed concrete by Freyssinet in the early 1930s, the material has found extensive application in the construction of long-span bridges, gradually replacing steel which needs costly maintenance due to the inherent disadvantage of corrosion under aggressive environment conditions. One of the most commonly used forms of superstructure in concrete bridges is precast girders with cast-in-situ slab. This type of superstructure is generally used for spans between 20 to 40 m. T or I-girder bridges are the most common example under this category and are very popular because of their simple geometry, low fabrication cost, easy erection or casting and smaller dead loads. In this paper study the India Road Loading considered for design of bridges, also factor which are important to decide the preliminary sizes of concrete box girders. Also considered the IRC:18-2000 for "Prestressed Concrete Road Bridges" and "Code of Practice for Prestressed Concrete " Indian Standard. Analyze the Concrete Box Girder Road Bridges for various spans, various depth and check the proportioning depth.

2. MATERIALS USED IN BRIDGE CONSTRUCTION

Bridges help vehicles and pedestrians bypass obstacles. Bridges can span rivers, canyons or roads, and often cut travel time dramatically by providing a more direct route. Bridges are complex structures, and must be carefully engineered using strong, long-lasting materials that are also light enough for practical use.

Cement: Concrete is popular for all types of bridge construction because of its affordability and strength. Concrete requires little maintenance, although it tends to hold up poorly against saltwater and erosion. Though it can be easily shaped and formed, concrete is often thought of as unattractive because of its dull, gray finish. When used on longer spans, concrete can be reinforced with steel bars or subject to a treatment known as "pre-stressing" to help increase its strength.

Steel: Steel is the one of the strongest bridge materials available, and can be used to span distances that are not possible with other products. It is 10 to 100 times stronger than concrete and weighs less. Steel bridges are susceptible to rust and corrosion, however, and tend to require a lot of maintenance. Many steel bridges are painted to improve their appearance. Aluminum is sometimes used in place of steel because of its anti-corrosive properties.

Wood: Wood is not as reliable as other bridge construction materials, and should only be used on relatively simple structures. It is one of the more affordable bridge-building materials, and is easy to work with using basic tools and equipment. Wood bridges are primarily chosen for their natural beauty, and are used for pedestrian access or light vehicle traffic. Because wood can swell and rot when exposed to moisture, wood bridges will last longer when protected from rain by a chemical treatment.

Composites: Composite products made of fiber-reinforced polymers (FRP) are one of the newest materials to be used for bridge construction. They weigh 70 percent to 80 percent less than steel yet are just as strong and durable. While even the strongest steel or reinforced concrete bridge will require substantial maintenance over the years, FRP requires virtually no upkeep. It will also not corrode in saltwater, making it the superior choice for construction in the water. This product has only been used to construct bridges since 1975, so it's long-term properties are still under evaluation.

3. LOADING ON BOX GIRDER BRIDGE

The various type of loads, forces and stresses to be considered in the analysis and design of the various components of the bridge are given in IRC 6:2000(Section II. But the common forces are considered to design the model are as follows:

Dead Load(DL): The dead load carried by the girder or the member consists of its own weight and the portions of the weight of the superstructure and any fixed loads supported by the member. The dead load can be estimated fairly accurately during design and can be controlled during construction and service.

Superimposed Dead Load (SIDL): The weight of superimposed dead load includes footpaths, earth-fills, wearing course, stay-in -place forms, ballast, water-proofing, signs, architectural ornamentation, pipes, conduits, cables and any other immovable appurtenances installed on the structure.

Live Load(LL): Live loads are those caused by vehicles which pass over the bridge and are transient in nature. These loads cannot be estimated precisely, and the designer has very little control over them once the bridge is opened to traffic. However, hypothetical loadings which are reasonably realistic need to be evolved and specified to serve as design criteria. There are four types of standard loadings for which road bridges are designed.

i. IRC Class 70R loading
ii. IRC Class AA loading
iii. IRC Class A loading
iv. IRC Class B loading

4. LOSSES IN PRESTRESS

While assessing the stresses in concrete and steel during tensioning operations and later in service, due regard shall be paid to all losses and variations in stress resulting from creep of concrete, shrinkage of concrete, relaxation of steel, the shortening (elastic deformation) of concrete at transfer, and friction and slip of anchorage.In computing the losses in prestress when untensioned reinforcement is present, the effect of the tensile stresses developed by the untensioned reinforcement due to shrinkage and creep shall be considered.

5. DESIGN OF PRESTRESSED CONCRETE

(i) Prestressing transforms concrete into an elastic material.
By applying this concept concrete may be regarded as an elastic material, and may be treated as such for design at normal working loads. From this concept the criterion of no tensile stresses in the concrete was evolved.

In an economically designed simply supported beam, at the critical section, the bottom fibre stress under dead load and prestress should ideally be the maximum allowable stress; and under dead load, live load and prestress the stress should be the minimum allowable stress.

Therefore under dead load and prestress, as the dead load moment reduces towards the support, then the prestress moment will have to reduce accordingly to avoid exceeding the permissible stresses. In post-tensioned structures this may be achieved by curving the tendons, or in pre-tensioned structures some of the prestressing strands may be deflected or de-bonded near the support.

(ii) Prestressed concrete is to be considered as a combination of steel and concrete with the steel taking tension and concrete compression so that the two materials form a resisting couple against the external moment. (Analogous to reinforced concrete concepts).This concept is utilized to determine the ultimate strength of prestressed beams.

(iii) Prestressing is used to achieve load balancing. It is possible to arrange the tendons to produce an upward load which balances the downward load due to say, dead load, in which case the concrete would be in uniform compression.

CONCLUSION

This paper gives basic principles for portioning of concrete box girder to help designer to start with project. Box girder shows better resistance to the torsion of superstructure. As the depth increases, the prestressing force decreases and the no. of cables decrease. Because of prestressing the more strength of concrete is utilized and also well governs serviceability.

REFERENCES

[1]. Irc: 18 – 2000 " Design Criteria For Prestressed Concrete Road Bridges (Post – Tensioned Concrete)" The Indian Roads Congress.
[2]. Irc: 6- 2000 "Standard Specifications and Code of Practice For Road Bridges" The Road Congress.
[3]. Is: 1343 – 1980 " Code of Practice For Prestressed Concrete" Indian Standard.
[4]. Krishna Raju "Design of Bridges" Oxford & Ibh Publishing Co. Pvt. Ltd.