DESIGN CONSIDERATION & PRINCIPLES FOR DECK TYPE STEEL RAILWAY BRIDGES

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Abstract—in the present study discussion about deck type steel Railway Bridge is carried out. Railway Bridge is designed for Strength, safety and economy purpose. While selecting the types of bridge, spans and other parameters are to be studied carefully to meet out the need of suitability to site conditions. The scope of this paper is to confine to the design aspect related to variable parameters. The scope of this paper is to confine to the design aspect related to variable parameters.

Keywords—Steel bridges, strength,Plate girder bridge,Web.

1. INTRODUCTION:

Among all the types of bridge Plate Girder Bridge is the most common category of steel conduit worn for railways and highways Plate girder bridges are regularly use for river crossings. The plate girder bridge be a lot used in structures having spanned varying from 15 to 30 m.

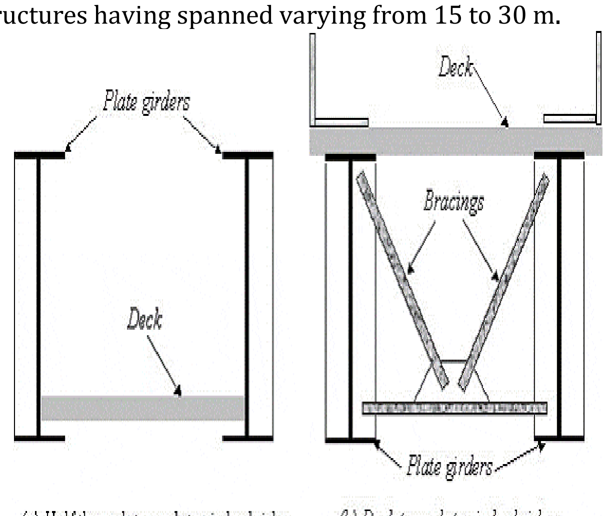

Fig.1: Deck Type Plate Girder Bridge

3. LITERATURE REVIEW:

In order to better understand the in progress state of practice within the India, cohesive States and the world, a survey was conducted where the current study may be most useful for this project. The later in turn is provided as an overview of the technical literature offered taking leave this topic; the coverage is extensive and include long-ago conditions, study that focus lying on selective technical issues correlated to the design and analysis that present overview information. An overview of the journals studied is in a few words discuss below. Plate girders bridges are planned by a trial and error approach due to the complexity of the design rules. The design of a composite girder is a tedious and time-consuming job for the designer. (1) Bhatti (1995) introduced the structural mass minimization, in the context of a highway bridge composite welded plate girder. (2) Adeli and Kim (2001) developed a cost objective function which includes the costs of concrete, steel beams and shear studs using neural dynamics model programming. (3) Kravanja and Šilih (1992) applied the structural optimization method rather than classical structural analysis. (4) Neal and Johnson (1992) concludes that composite trusses of spans exceeding 18 m are generally the most economic structural systems, while for spans between 12 and 15 m, the cost is determined by floor height limitations. (5) Razani and Goble (1966) were the first to attempt cost optimization of steel girders. (6) Holt and Heithecker (1969) studied the minimum weight design of symmetrical welded plate girders without web stiffeners. (7) Annamalai et al (1972) studied cost optimization of simply supported, arbitrarily loaded, welded plate girders with transverse stiffeners. (8) Anderson and Chong (1986) presented the minimum cost design of homogeneous and hybrid stiffened steel plate girders. (9) Yoshiaki Okui, (2011) "Recent Topics of Japanese Design Codes for Steel and Composite Bridges". This paper gives an overview of Japanese design codes for steel and composite Standard Specifications for Steel and Composite Structures published by JSCE are introduced. The positive bending moment capacity of composite steel girders is examined through parametric study employing elasto-plastic finite displacement analyses. (10) Swapnil B Kharmale, (2007).``Comparative study of IS 800(Draft) and Eurocode 3 ENV 1993-1-1" . In this comparative study IS: 800 (Draft) & Eurocode 3 are compared. The limit state design of steel structures and comparison of design methodology for basic structural element by both codes are done. (11) Akira Takaue, (2010)"Applied design codes on international long-span bridge projects in Asia". In this report, several bridge types and application of the design codes relevant to steel or composite structures utilized in international long-span bridge construction projects executed in Asian region in cooperation with Japanese consultant firms are introduced. (12) Subramanian. N, (2008) "Code of Practice on Steel Structures -A Review of IS 800: 2007". This paper reviews the important features' of IS 800:2007. These include advanced analysis methods, fatigue provisions, durability, fire resistance, design for floor vibrations etc. (13) Arijit Guha and Ghosh M M,(2008) "IS: 800 - Indian Code of Practice for Construction in Steel and its Comparison with International Codes". The authors in this paper discusses that IS 800- (LSM) is mostly based on international standards with load factors and partial safety factors suiting Indian conditions. The code has been mainly modelled in line with the Euro codes, with some additional references taken from the existing British Codes also. (14) Krishnamoorthy. M and D.Tensing, (2008). "Design of Compression members based on IS 800-2007 and IS 800-1984 - Comparison". This paper discusses the design methodologies for the steel structures namely, working stress design method and limit state design methods are briefly explained. (15) Hermin Jonsson, Johan Ljungberg, (2005).

``Comparison of design calculations for the railway bridge over Kvillebecken''. The aim of his thesis wok is the comparison of design calculations between Swedish and European standards. (16) Ajeesh ss and sreekumars, (2011).

``Shear behaviour of hybrid plate girders''. The objective of this paper is to investigate shear behaviour of hybrid plate girder under varying parameters such as aspect ratio, slenderness ratio and yield strength of web panel using finite element method. (17) Marta sulyok, Theodore V Galambos,(1995).

``Evaluation of web buckling test results on welded plate beams and plate girders subjected to shear''. The purpose of this paper is to report values of reliability indices of welded beams and plate girders subjected to shear and combine bending and shear which are designed as per the load resistance and factor criteria according to the American institute of steel construction (AISC) and Cardiff model accepted by the Euro code 3. (18) Granath (2000) addresses the issue of establishing a service load level criteria for web plates by developing an easy, closed form design method for evaluating steel girders subject to patch loading. The method is based on the premise that no yielding is allowed in the web plate. (19) Rosignoli (2002) presented a very detailed discussion of local launch stresses and instabilities in steel girder bridges. The author discussed the factors that contribute to a complex state of stress in the bottom flange of launched steel girder bridges.

4. LOADS ON BRIDGES:

The following are the various loads to be considered for the purpose of computing stresses, wherever they are applicable.

• Dead load
• Live load
• Impact load
• Longitudinal force
• Thermal force
• Wind load
• Seismic load
• Racking force
• Forces due to curvature.
• Forces on parapets
• Frictional resistance of expansion bearings
• Erection forces

5. GENERAL DESIGN PRINCIPLES

5.1.1 OPTIMUM DEPTH OF TRUSS GIRDER

The optimum value for span to depth ratio depends on the magnitude of the live load that has to be carried. The span to depth ratio of a truss girder bridge producing the greatest economy of material is that which makes the weight of chord members nearly equal to the weight of web members of truss. It will be in the region of 10, being greater for road traffic than for rail traffic. IS: 1915-1961, also prescribes same value for highway and railway bridges. As per bridge rules published by Railway board, the depth should not be greater than three times width between centers of main girders. The spacing between main truss depends upon the railway or road way clearances required.

5.1.2 DESIGN OF COMPRESSION CHORD MEMBERS

Generally, the effective length for the buckling of compression chord member in the plane of truss is not same as that for buckling out-of-plane of the truss i.e. the member is weak in one plane compared to the other. The ideal compression chord will be one that has a section with radii of gyration such that the slenderness value is same in both planes. In other words, the member is just likely to buckle in plane or out of plane. These members should be kept as short as possible and consideration is given to additional bracing, if economical. The effective length factors for truss members in compression may be determined by stability analysis. In the absence of detailed analysis one can follow the recommendations given in respective codes. The depth of the member needs to be chosen so that the plate dimensions are reasonable. If they are too thick, the radius of gyration will be smaller than it would be if the same area of steel is used to form a larger member using thinner plates. The plates should be as thin as possible without losing too much area when the effective section is derived and without becoming vulnerable to local buckling. Trusses with spans up to 100 m often have open section compression chords. In such cases it is desirable to arrange for the vertical posts and struts to enter inside the top chord member, thereby providing a natural diaphragm and also achieving direct connection between member thus minimizing or avoiding the need for gussets. However, packing may be needed in this case. For trusses with spans greater than about 100 m, the chords will be usually the box shaped such that the ideal disposition of material to be made from both economic and maintenance viewpoints. For shorter spans, rolled sections or rolled hollow sections may be used.

5.1.3 DESIGN OF TENSION CHORD MEMBERS

Tension members should be as compact as possible, but depths have to be large enough to provide adequate space for bolts at the gusset positions and easily attach cross beam. The width out-of-plane of the truss should be the same as that of the verticals and diagonals so that simple lapping gussets can be provided without the need for packing. It should be possible to achieve a net section about 85% of the gross section by careful arrangement of the bolts in the splices. This means that fracture at the net section will not govern for common steel grades. In this case also, box sections are preferable for ease of maintenance but open sections may well prove cheaper.

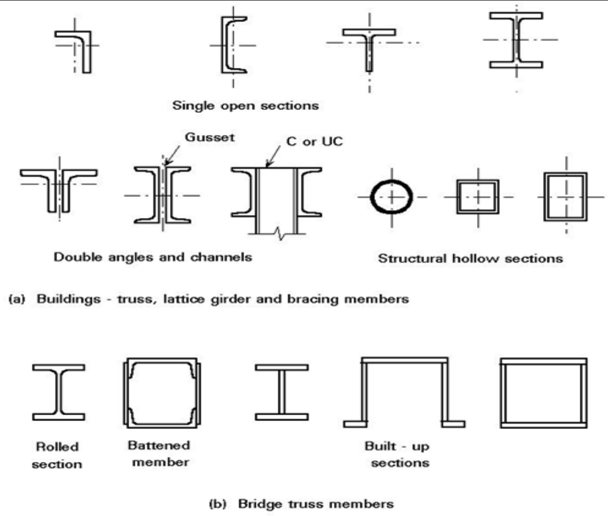

Fig 2 : Typical Cross Sections For Truss Members

5.1.4 DESIGN OF VERTICAL AND DIAGONAL MEMBERS

Diagonal and vertical members are often rolled sections, particularly for the lightly loaded members, but packing may be required for making up the rolling margins. This fact can make welded members more economical, particularly on the longer trusses where the packing operation might add significantly to the erection cost. Aesthetically, it is desirable to keep all diagonals at the same angle, even if the chords are not parallel. This arrangement prevents the truss looking over-complex when viewed from an angle. In practice, however, this is usually overruled by the economies of the deck structure where a constant panel length is to be preferred.

5.1.5 LATERAL BRACING FOR TRUSS BRIDGES

Lateral bracing in truss bridges is provided for transmitting the longitudinal live loads and lateral loads to the bearings and also to prevent the compression chords from buckling. This is done by providing stringer bracing, braking girders and chord lateral bracing. In case of highway truss bridges, concrete deck, if provided, also acts as lateral bracing support system.

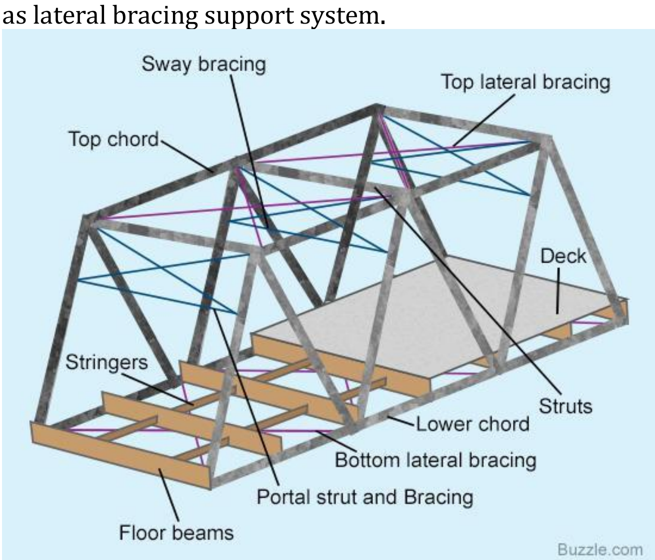

Fig 3: Lateral Bracing for Truss Bridges

6 SUMMARY:

This chapter deals with the design of steel bridges using Limit States approach Basic considerations that are to be taken into account while designing the plate girder bridges are emphasized.

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