A Study on Reliability Assessment of Truss Girder Bridge

S. Sasidhar[1] S. Pavan Kumar[2]
[2]Assistant Professor
[1,2]NRI Institute of Technology, Agiripalli, India

Abstract— Bridges, over the overall scaffolds the expense of railroad connect is more than alternate scaffolds. The issue of productively planning auxiliary framework includes unwavering quality imperatives forced at both workableness and extreme limit state. Strategies are created utilizing auxiliary unwavering quality guideline to assess time subordinate dependability of structure. These techniques empower the effect on security and usefulness of vulnerabilities in stacking conditions, basic corruption because of forceful condif administration life of harmed or decayed steel structures stays at the phase of parametrisation to be evaluated subjectively. Which are utilized for various purposes, for example, on the off chance that it is utilized to cross cycles and creatures, it is called as foot spans. In the event that it utilized for expressway activity, it is called Highway Bridge, or in the event that it is utilized to convey railroad stacking, it is called Railway erosion in steel structures for as fa back as three decades. Administration life of steel structures is restricted by the powerlessness of the part to erosion. Oxidation of iron prompts the plan of different items, (for example, ferrous and ferric oxides), some of which possess a lot more noteworthy volume than the first iron that gets devoured by the erosion procedure. At this stage the part loses its capacity to oppose the powers.

Key words: Truss Girder Bridge, RCC, Floor system

I. Introduction

The truss girder bridges are normally used for spans greater than 30 m. Truss girder bridges are also known as open web girder bridges or lattice girder bridges. In contrast to the plate girder bridges where there is continuous web, the truss girder bridges have open web in the form of diagonals and verticals. The chord members from the perimeter of the truss figure while the end members form a part of the web; the end members are also called end posts. The upper most members form the top chord, while the lower most members from the bottom chord. Both chord members as well as web members are absolutely necessary for the stability of the truss girder, and hence they are known as main members. These are stressed for the load portion anywhere on the truss girder. However, in some truss girders, there are sub members or secondary members which are stressed only when loads act directly upon them. The points of intersection of web members with the chord members are called panel points. Thus, truss girders are triangulated framed structures in which the arrangement of the members and the connections at their ends are such that the external loads are applied to the joints or panel points. A through type truss bridge consists of following components

1) Main vertical truss girders
2) Floor system
3) Bottom lateral bracing
4) Top lateral bracing
5) Portal bracing
6) Sway bracing

A. *Diagrammatic View of a Through Type Truss*

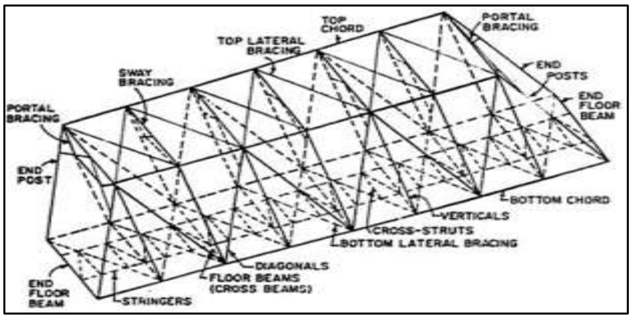

Fig. 1: Girder Bridge

1) Reliability

The computational assessment of system reliability of structures has remained a challenge in the field of reliability engineering. Calculation of the failure probability for a system is generally difficult even if the potential modes are known or can be identified, as available analytic methods require determination of sensitivity of performance functions, information on mutual correlations among potential failure modes, and determination of design points.

2) Expected Service Life of Structures

There is very little literature available on the subject of expected service life of structures. The life span of RCC is generally is taken as 100 years. However, there are some expected as well as prevalent conventions about design life span, which are given here:

1) Monumental structures like temple, mosque or church etc- 500 to1000 years
2) Steel bridges, steel building or similar structures- 100 to 150 years
3) Concrete bridges or High-rise building or stone bridges etc- 100 years
4) Residential houses or general office/commercial buildings etc- 60 to 80 years
5) Concrete pavements- 30 to 35 years - 30 to 35 years
6) Bituminous pavements-- 8 to 10 years- 8 to 10 years

II. Analysis of Truss Girder Railway Bridge

Different Loads Calculation on Bridge:

1) Dead load
2) Live load
3) Impact load
4) Wind load

Wind pressure limits for different gauges:

Broad gauge bridges	1.47 KN/m2 (150kg/m2)
Meter gauge bridges	0.98 KN/m2 (100 kg/m2)
Foot bridges	0.74 KN/m2 (75 kg/m2)

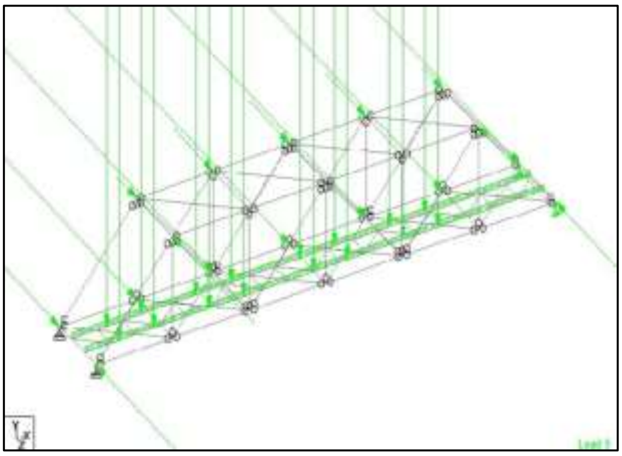

Fig. 2: Bridge under Full Loading Condition

A. Compression Members Composed of Two Components Back to Back

1) Compression members composed of two angles, channels or tees, back to back and separated by a distance, shall be connected together by riveting, bolting or welding so that maximum slenderness ratio l/r of each component of the member between such connection is not greater than 50 or 0.5 of the maximum slenderness ratio of the member as a whole, whichever is less, where l is the distance between centers of connection.
2) In no case shall the ends of the strut be connected together by less than two rivets or bolts or their equivalent in welding and there shall be not less than two additional connections spaced equidistant in the length of the strut. Where the members are separated back to back, the rivets or bolts in these connections shall pass through solid washers or packing and where the connected angles, legs or tables of tees are 125 mm wide or over, or where webs of channels are 150mm wide or over, not less than two rivets or bolts shall be used on each connection, one on the line of each gauge mark.
3) Where the connection are made by welding, solid packing shall be to effect the joining unless the members are sufficiently close together to permit welding, and the members shall be connected by welding along both pairs of edges of the main components.
4) The rivets, bolts or welds in these connections shall be sufficient to carry the shear forces and moments specified for battened struts, and in no case shall the rivets or bolts be less than 16 mm.
5) Compression members connected by such riveting, bolting or welding shall not be subjected to transverse loading in a plane perpendicular the riveted, bolted or welded surfaces.

1) Variation of Reliability index with reduction in cross sectional area of Member 2001:

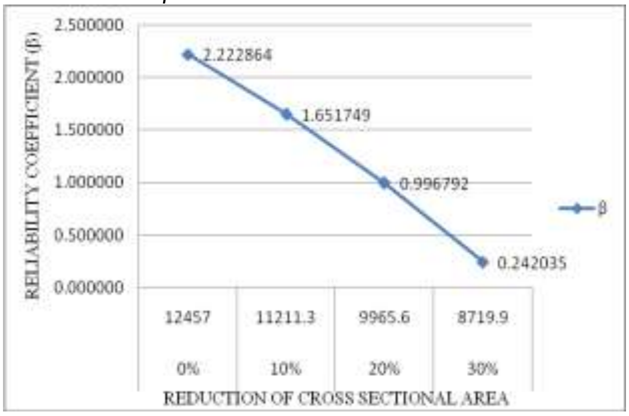

Fig. 3: Variation of reliability with percentage reduction of section area in member 2001

2) Variation of Reliability index with reduction in cross sectional area of Member 2002:

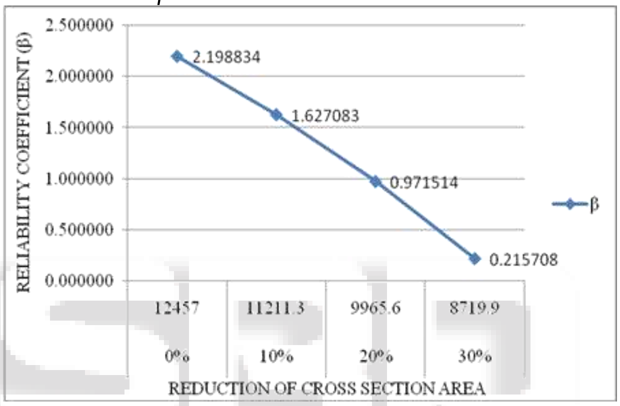

Fig. 4: Variation of reliability with percentage reduction of section area in member 2002

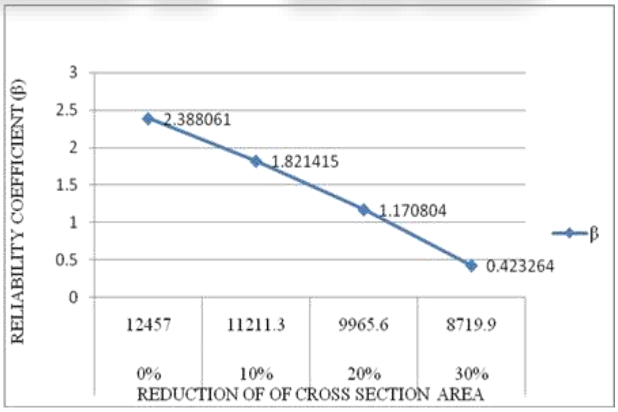

Fig. 5: Variation of reliability with percentage reduction of section area in member 2003

3) Results of Diagonal Compression Members

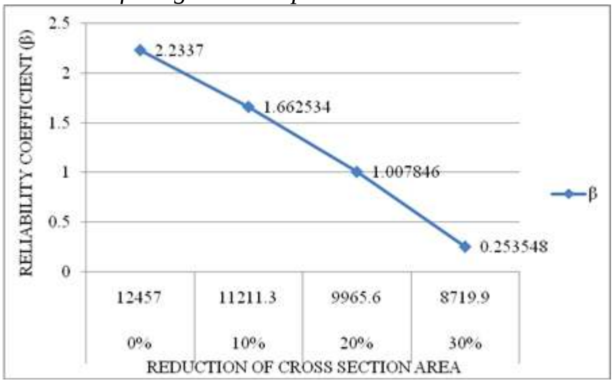

Fig. 6: Variation of Reliability index with reduction in cross sectional area of Member 3001

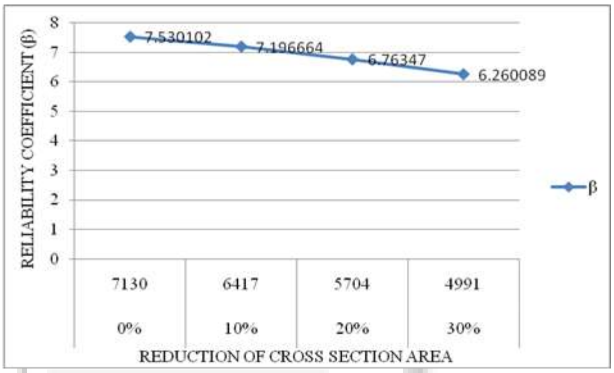

Fig. 7: Variation of Reliability index with reduction in cross sectional area of Member 3003

4) Conclusion on reliability of compression members of the bridge truss

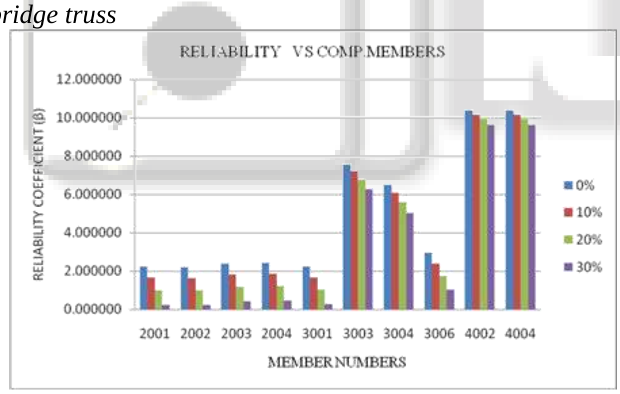

Fig. 8: Present consolidated reliability indeces of all the compression members

5) Conclusion on reliability of tension members of the bridge truss

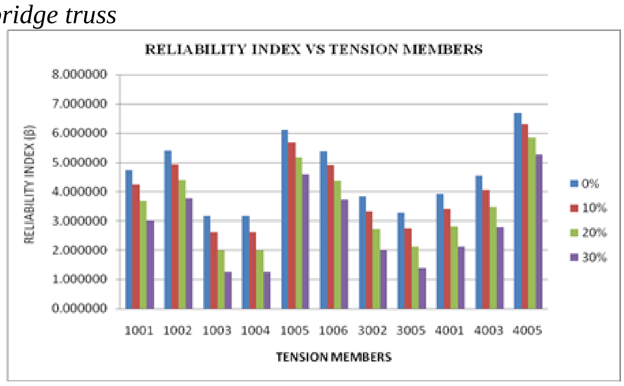

Fig. 9: Present consolidated reliability indeces of all the tension members

III. CONCLUSIONS

1) The assessment of reliability can be very effectively used for planning and optimizing complicated structures like rail road bridges as well as highway bridges.
2) Different members on complicated structures can be studied inducing failures of different nature and their combinations.
3) From the study of reliability of through type truss girder Railways Bridge, it is found that compression members are more critical than tension member. As the railway bridge is a column like structure which predominantly support train wagon loads which generate forces compression in nature.
4) The system reliability is significantly depends on cross section area of the members. As the cross section area decreases the reliability reduces.
5) The primary compression top chord member 2001 are having low reliability coefficient with 20% reduction of cross section area. Care must be taken while designing the members due to considerable reduction in the reliability coefficient.
6) The primary compression top chord member 2002 is critical, which is having low reliability coefficient for all the percentages of reduction in cross sectional area. In the case of 20% and 30% reduction of cross section area of member, the performance of this member is not up to the mark in those cases so special care must be taken.
7) The primary compression top chord member 2003 is having low reliability coefficient, in the case of 20% reduction of cross section area of member. Care must be taken while designing the members due to considerable reduction in the reliability coefficient.
8) The primary compression top chord member 2004 is having low reliability coefficient, in the case of 20% reduction of cross section area of member. Care must be taken while designing the members due to considerable reduction in the reliability coefficient.

REFERENCES

[1] Structural reliability analysis & design by R. Ranganathan.
[2] Design of steel structures by Dr. B. C. Punmia., Ashok Kumar Jain and Anil Kumar Jain.
[3] Aruz Petcherdchoo1, Luis A. C. Neves, and Dan M. Frangopol (2008) “Optimizing Lifetime Condition and Reliability of Deteriorating Structures with Emphasis on Bridges”, Journal of Structural Engineering, Vol. 134, No.4.
[4] Brent Hall W (1988), “Reliability of service – proven structure” Journal of Structural Engineering, Vol. 114, No. 3.
[5] Dagher H. J., Q. Lu. Q. and A.H. Peyrot A. H. (1998), “Reliability of Transmission Structures including Nonlinear Effects” Journal of Structural Engineering. Vol. 124, No.8.
[6] Eidinger J. M. and Kempner L. “Reliability of Transmission Towers under Extreme Wind and Ice Loading” G&E Engineering Systems Inc. and Bonneville Power Administration.

[7] Gayatri Devi T., (2012) M.Tech. Dissertation Thesis titled "Reliability analysis of truss using MATLAB", submitted to Andhra University, Visakhapatnam.
[8] Lidvin Kjerengtraen and Paul H. Wirsching (1984) "Structural reliability analysis of series systems" Journal of Structural Engineering, Vol. 110, No. 7.
[9] Michael Havbro Faber (2009), "Basics of Structural Reliability" Swiss Federal Institute of Technology ETH, Zürich, Switzerland
[10] Alberto López López, Luis E. Pérez Rocha, David de León Escobedo, and Jorge Sánchez Sesma, (2009) " Reliability and Vulnerability Analysis of Electrical Substations and Transmission Towers for Definition of Wind and Seismic Damage Maps for Mexico", 11th American Conference on Wind Engineering – San Juan, Puero Rico June 22-26.
[11] Radu VĂCĂREANU, Alexandru ALDEA & Dan LUNGU (2007), "Structural reliability and risk analysis" lecture notes by from Technical University of Civil Engineering of Bucharest.