COMPARATIVE ANALYSIS OF TWO DIFFERENT STEEL BRIDGE CONSIDERING LIVE PROJECT DATA USING ANALYSIS TOOL SAP2000

Sonali soni, Deepak Bandewar2, Dr. Rakesh Patel3
P.G. SCHOLAR1, ASST PROF.2 ASSOC. PROF 3
Department of civil engineering, S.I.R.T.S, Bhopal M.P.

Abstract

Larger part of the bracket spans in India and abroad are either primarily lacking as well as practically old. There is a urgent need to improve the exhibition of these current scaffolds by a proper strategy which ought to be efficient and with least unsettling influence to the traffic. The point of the present scientific work is to know the impact of Pre-pushing on the part powers, diversions and all out weight of steel of a statically determinate three kinds of brackets, for example, Pratt type or Warren truss. Pre-focusing on method has been taken on to redesign the exhibition of the support. The bracket is pre-pushed with high elastic steel link and the profile of the link is straight. The bracket is examined for part powers and redirections utilizing SAP 2000 Programming. From the got scientific outcomes, it is seen that there is a perceptible improvement in the exhibition of the construction. Part powers have been diminished fundamentally in the whole support individuals and there is a decrease in redirection at the middle and material necessity after pre-focusing.

Key words: Bridges, Truss, Pre-stressing, Cable, Member forces, Deflections and SAP 2000.

INTRODUCTION:

Span is a construction which allows the segment of individuals by walking or vehicles worked over any prevention or water body. There are a few extension plans that fill a proper need. Contingent upon the way of behaving of extension.

There are different kinds of extensions

1. Lumber span
2. Substantial scaffold
3. Steel span
4. Composite scaffold

Span has chiefly two areas the superstructure and the base. The superstructure has deck section, I-Brace and shear connectors however base has of the footer, stem and the cap. Composite development comprises of two extraordinary materials which emphatically will undoubtedly shape a lone unit.

"Composite" suggests that the substantial part of the deck is related with the steel piece of the scaffold by shear connectors. Shear connectors are essentially fixed on steel shafts and afterward they are epitomized in the substantial piece. Shear connectors can be related by welding, or using nut and bolts.A steel pillar which is collected composite by using the shear connectors and substantial which is areas of strength for more solid when contrasted with bar.

Steel Bridge

Steel spans are generally involved all over the planet in various underlying structures with various range length, for example, parkway spans, rail route scaffolds, and footbridges. The principal benefits of underlying steel over other development materials are its solidarity, malleability, simple creation, and fast development. It has a lot higher strength in both strain and pressure than concrete, and generally great solidarity to cost proportion and firmness to weight proportion. Steel is a flexible and viable material that gives effective and maintainable answers for span development, especially for long range scaffolds or extensions requiring upgraded seismic execution.

Among span materials steel has the most noteworthy and most ideal strength characteristics, and it is consequently appropriate for the most trying scaffolds with the longest ranges. Typical structure steel has compressive and elastic qualities of 370 N/sq mm, multiple times the compressive strength of a medium concrete and multiple times its rigidity. An exceptional value of steel is its flexibility because of which it distorts significantly before it breaks, since it starts to yield over a specific anxiety.

Properties of steel spans include:

- Contrasted with substantial scaffolds, oneself weight is generally light and long-length extensions can be built.
- It is feasible to produce sturdy and homogeneous quality materials in huge amounts, and quality affirmation is conceivable in light of the fact that the components are made in controlled conditions.
- Plan and development of dazzling extensions to match the encompassing scene is conceivable.
- Simple to review for weakening or harm; simple to fix/support or destroy; materials are recyclable.

Fig 1 Steel Bridge

Summary of Literature Review

Nitin Indulkar et.al (2022) research paper examine the elements that causes the seismic powers in the framework. A worked on examination strategy is placed ahead in light of IRC SP 114; 2018. It is pertinent for seismic plan of scaffolds with a plan administration life of 100 years, taking into account Plan Premise Tremor (DBE). It takes care of the seismic guide and otherworldly speed increase diagrams as determined in IS: 1893-Section I-2016. It additionally takes on the technique recommended for assessment of liquefaction plausibility, as determined in IS: 1893-Section I-2016. For the assessment of seismic powers, Versatile Seismic Speed increase technique, Flexible Reaction Range strategy and Direct Time History strategy are determined. The IRC Rules portray the different kinds of unique examinations to be completed for scaffolds to be built in close to handle zones, slant, and bended extensions, etc. For burdens and burden blends, IRC 6-2017 gives the rules and details. The goal of this code is to give normal methodology to plan of scaffolds. It manages the different loads, for example, vehicular burdens, slowing down powers, wind load, water ebb and flow powers and their mixes. Results expressed that the greatest resultant power in zone III expanded by 112% in Zone V and the most extreme and least resultant second in zone III was expanded by 123.6% and 128.8% separately in Zone V.

Pratik Soni et.al (2022) studies paper investigated 3 kinds of sections (i.e. Warren truss, Pratt truss and Howe truss). Two span lengths become analyzed, forty m and eighty m, with a top of seven m and a width of 6 m, and become really supported on the ends. The appropriate locomotive loading for vast gauge (1.676 metre wide) railway song become taken into consideration as consistent with IRS Bridge law whilst the railway bridge become examined. These bridges have been analysed for evaluating node displacement, beam forces, and reaction on the helps because of motion load of locomotives with seismic quarter five being taken into consideration. STAAD.Pro V8i become used to behavior the evaluation on parameters of node displacements, beam give up forces, and aid responses have been used to interpret the results. Results said that for a forty-meter-lengthy truss bridge, the Warren truss well-knownshows much less node displacement and aid reaction than the Pratt and Howe trusses. Overall, one could declare that the Warren truss is the best piece of truss for a forty- meter span truss bridge. The Pratt truss or Howe truss can be utilised because the superstructure for an eighty metre span bridge without a alteration in member move-section, whilst the Warren truss behaves the worst of the 3 kinds of truss for the same.

A Jayaraman et.al (2021) studies paper aimed to face up to the seismic pressure/ vibration pressure in railway metallic truss bridges the use of splice connection. Using the Warren kind of railway truss bridges Analysis and designed through Indian widespread railway code (IRC) and IS 800 -2007. The connection of the railway truss bridge is bolted with splice connection. Same move sectional vicinity has been carried for each theoretical and experimental investigation. Results said that the splice connection has excessive load wearing ability, low deflection and excessive degree seismic resistance. The participants designed with splices display extra discount withinside the structural weight. Experimental assessment suggests growth withinside the load wearing ability and reduce withinside the deflection whilst the use of participants with splices through 24% Splice

Objectives of the research

1. To justify the utilization of analysis tool
2. To determine the effect of vehicular loading over steel bridge
3. Analysis of a steel bridge considering lateral load using I.S. specified sections.

Methodology:

This section presented the steps undertaken while modelling and analysis of the two cases using analytical application SAP2000. The materials and sections will be specified and loading conditions will be defined to generate the optimised results.

the primary steps which will be followed in the research work are stated below:

Step 1: In the first step we will review the literature to justify the aims and objectives of the study.

Step 2: Modelling of the Frame using SAP2000 as per the cases considered in this study.

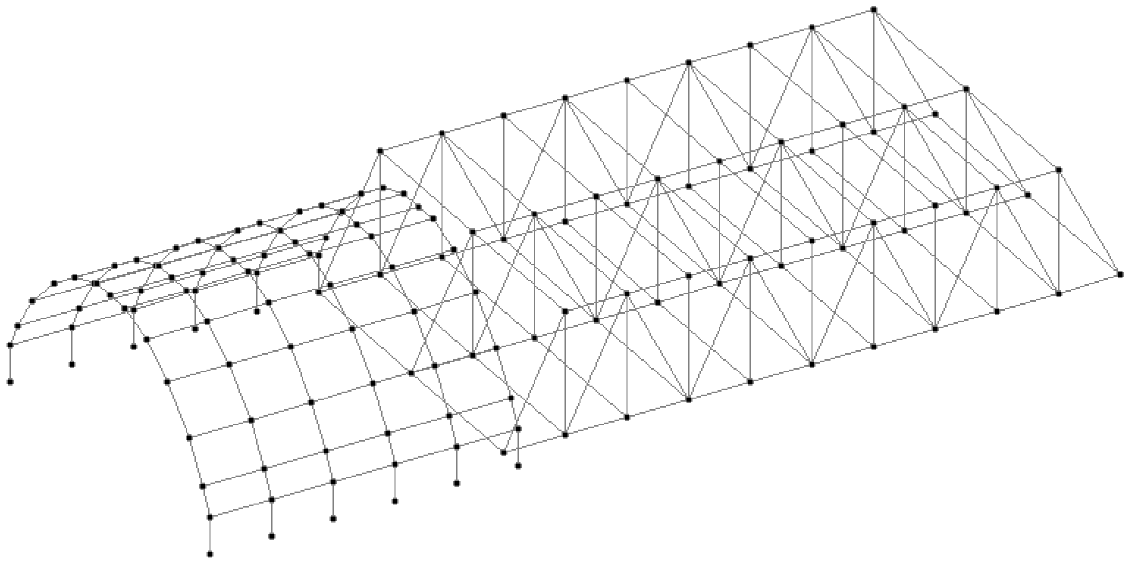


Fig 2 Model of Bridge with Tunnel

Step 3: In this step, assigned sectional data and material description and Path Data

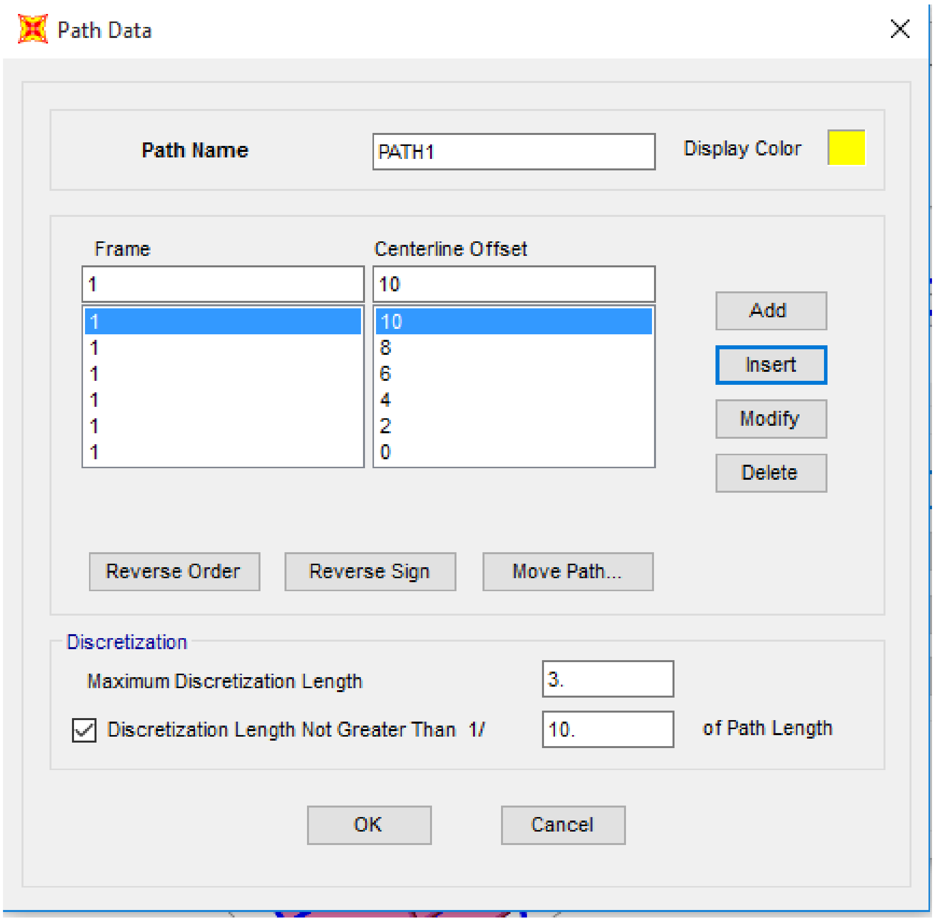


Fig 3 Path Data

Step 4: In this step assigned support condition to the models.

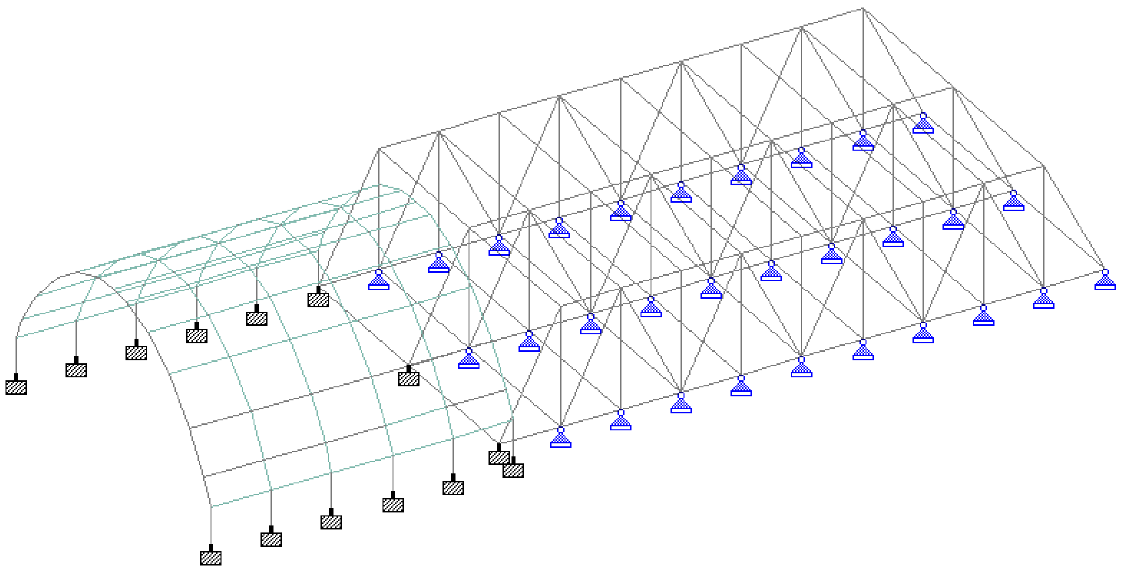


Fig 4 Defining Support Condition

Step 5: In this step we will assign loading condition as per I.R.C. loading condition.

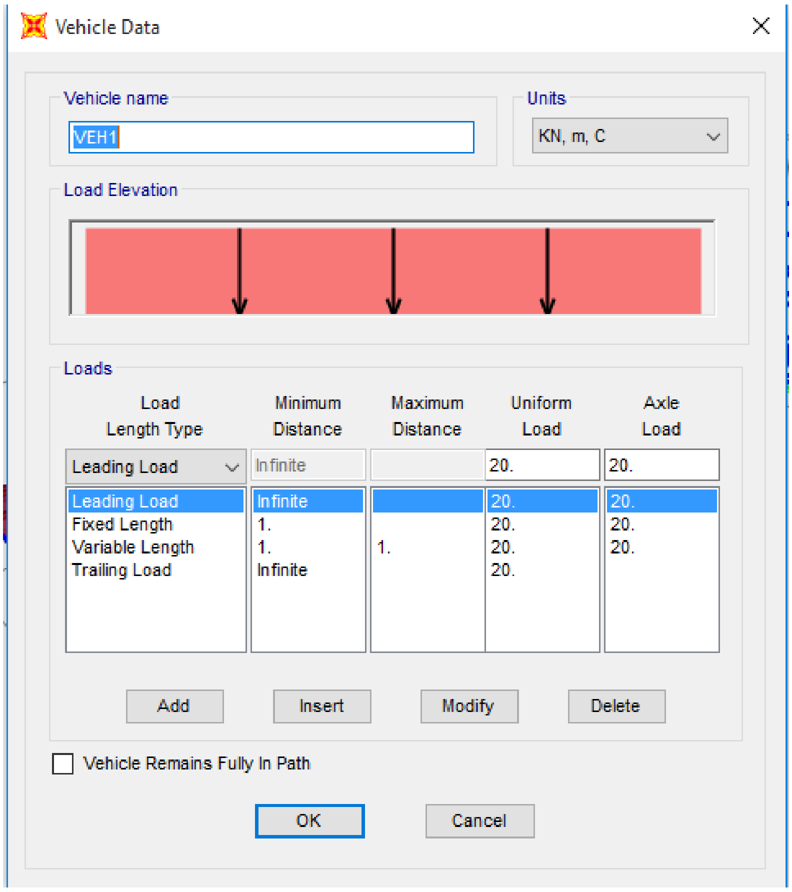


Fig 5 Defining Load Condition as per IRC Loading

Step 6: In this step assign loading condition and seismic data

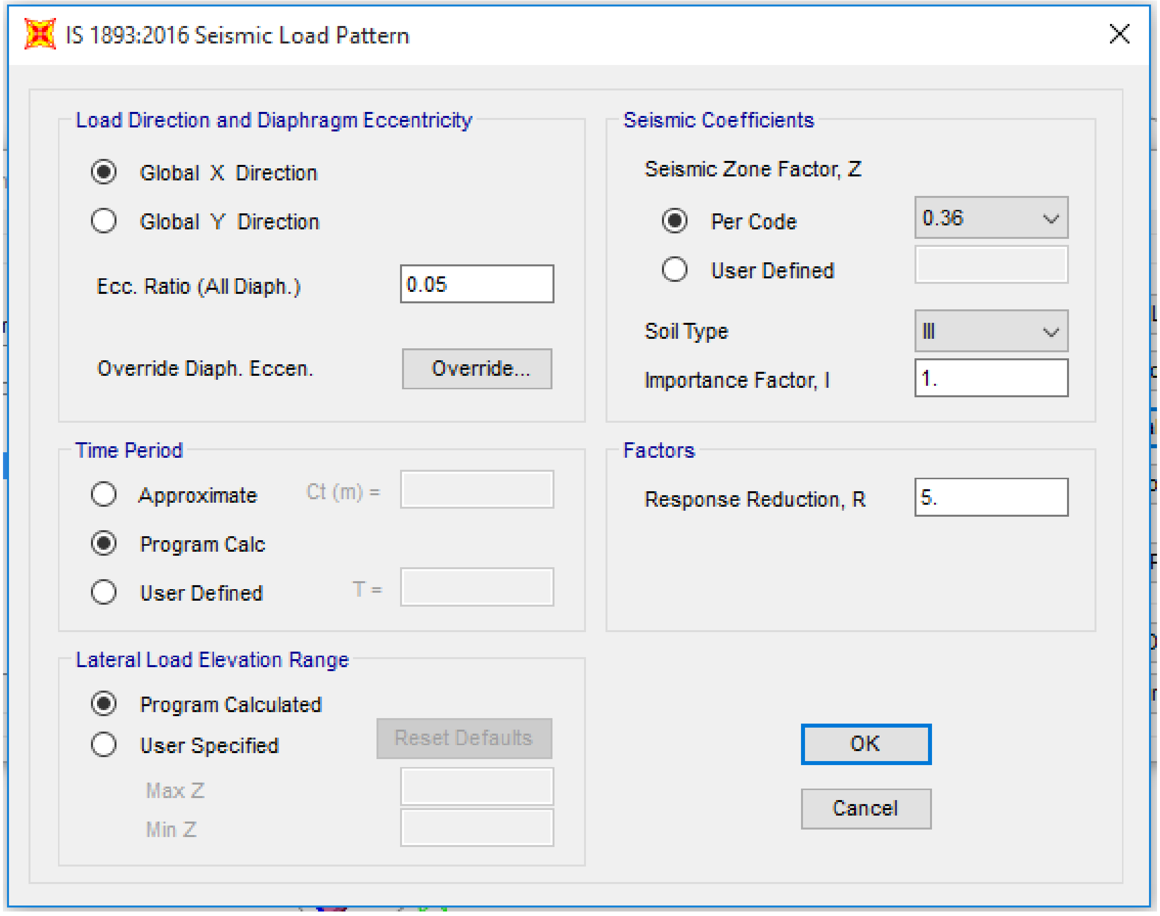


Fig 6 Assigning Loading condition as per Seismic data

Step 7: Analyzing the output and comparing the results.

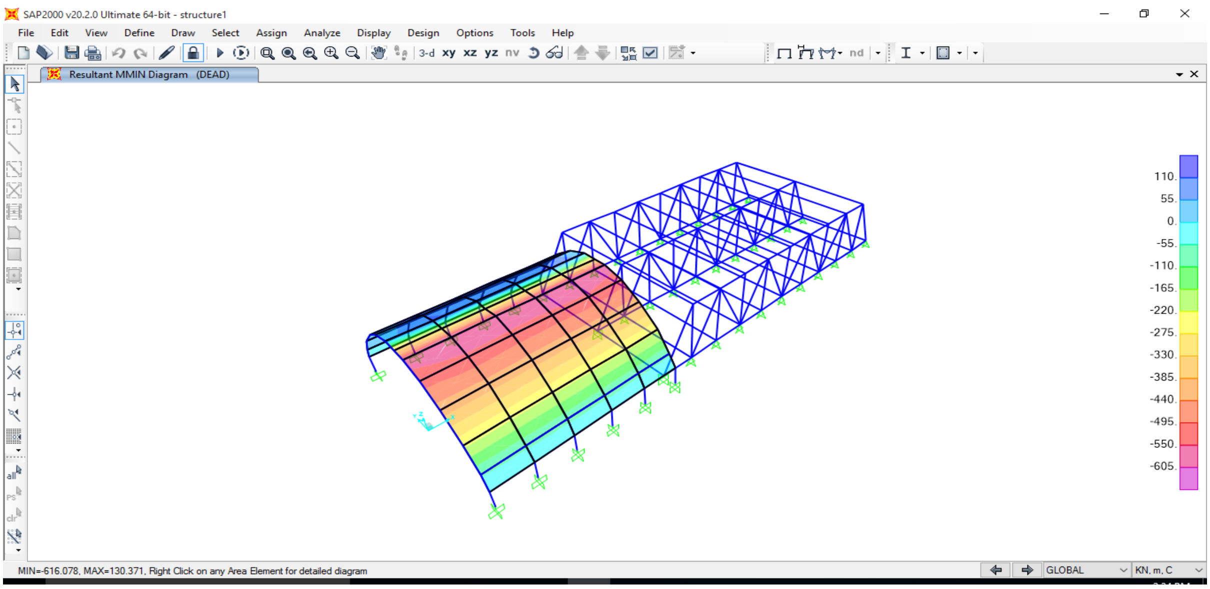


Fig 7 Stress Analysis of the Model

Blueprint of the Case Study

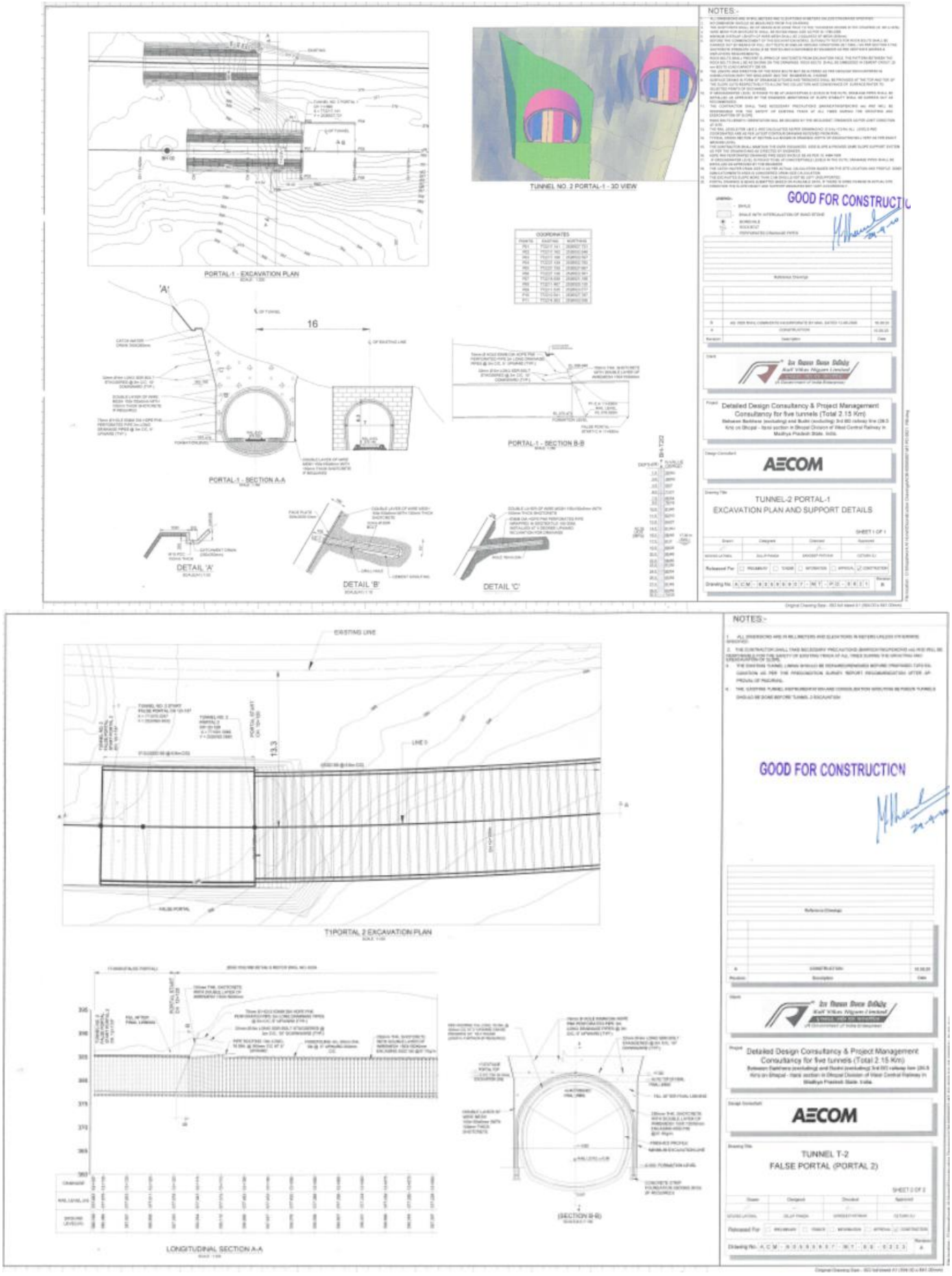


Fig 8 Blueprint of the Bridge

Case Study

Case I- Bridge with Pratt Truss

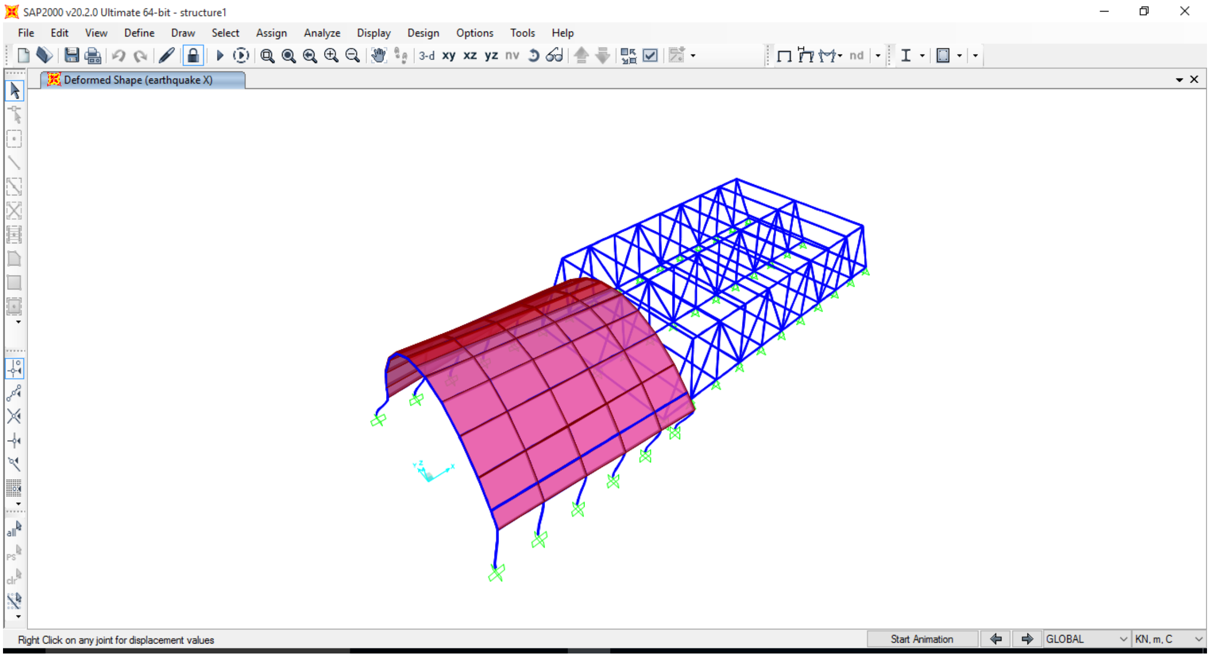


Fig 9 Bridge with Pratt Truss

Case II- Bridge with Warren Truss

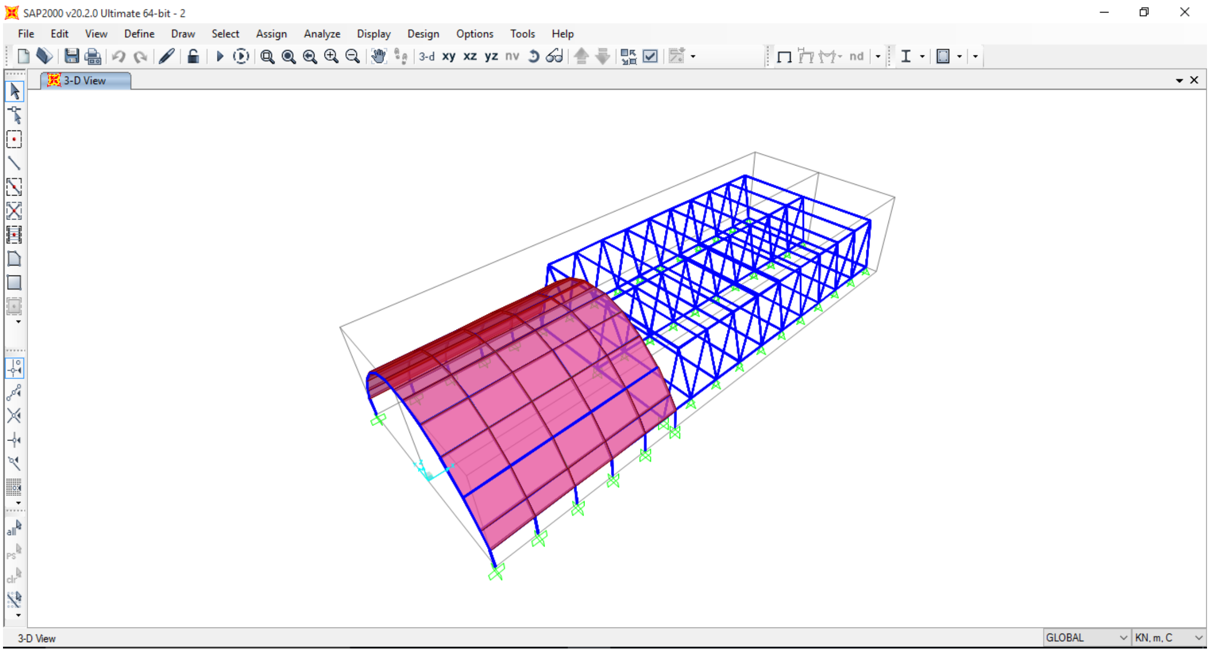


Fig 10 Bridge with Warren Truss

Geometrical Description of the Structure

Table 1 Geometrical Description

Dimension of the model	
Length	450 m

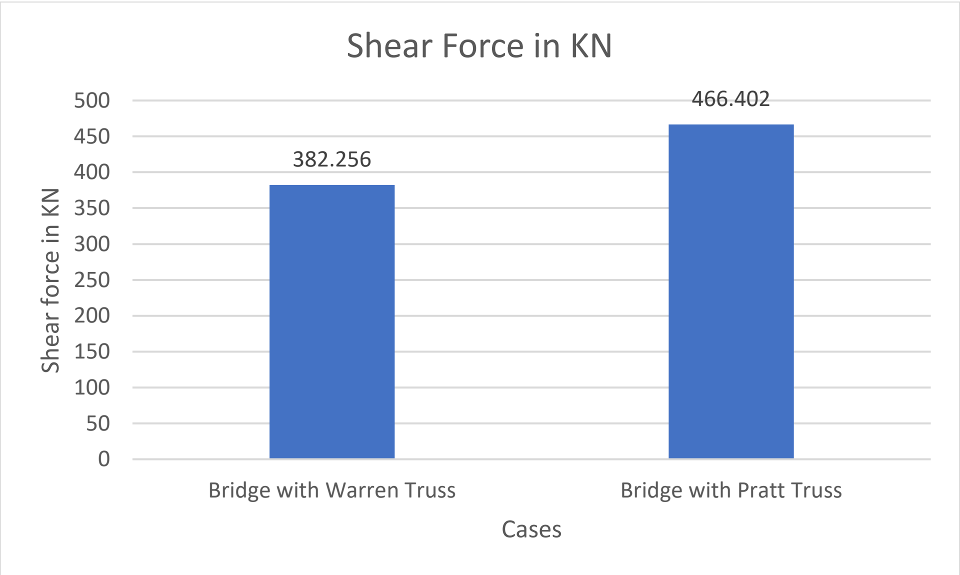
Height	20 m
Steel Section	As per Steel Table Indian Section
Connection	Bolted
Material	Mild Steel
Haunch	100 x 100 mm

Result & Discussion:

Shear Force

Table 2 Shear Force in kN

Maximum Shear Force in kN	
Bridge with Warren Truss	Bridge with Pratt Truss
382.256	466.402

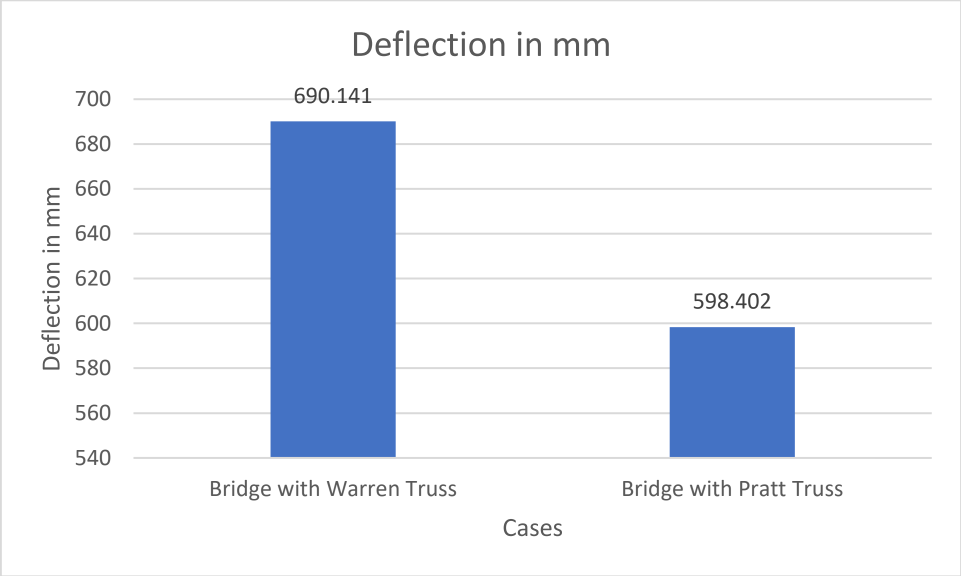


Discussion: A shear force is a force applied along the surface, in opposition to an offset force acting in the opposite direction. This results in a shear strain. In simple terms, one part of the surface is pushed in one direction, while another part of the surface is pushed in the opposite direction. Shear force was maximum in Bridge with Pratt Truss when compared to bridge with Warren truss providing to be 12% on the higher side.

Maximum Deflection in mm

Table 3 Maximum Deflection in mm

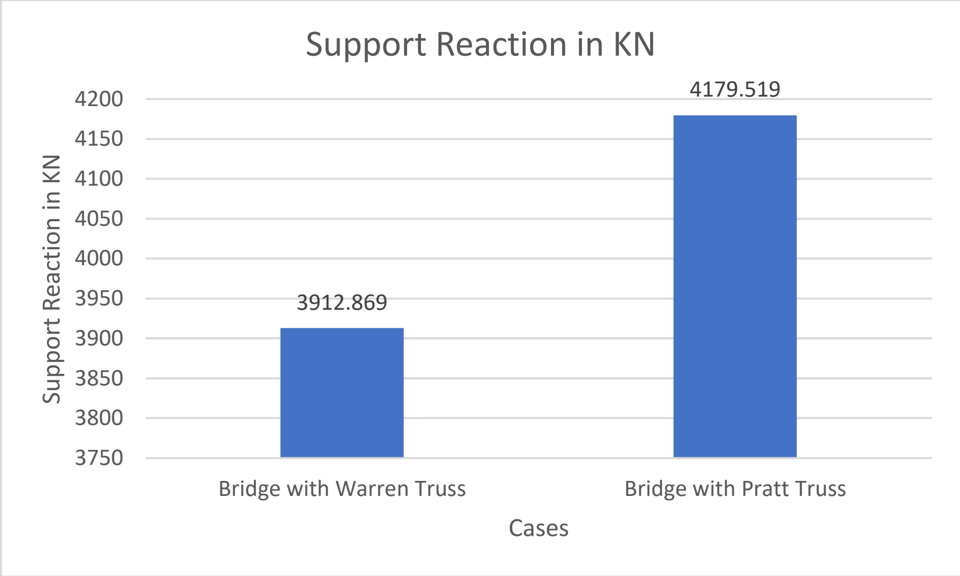
Maximum Deflection in mm	
Bridge with Warren Truss	Bridge with Pratt Truss
690.141	598.402



Support Reaction in kN

Table 4 Support Reaction in kN

Support Reaction in kN	
Bridge with Warren Truss	Bridge with Pratt Truss
3912.869	4179.519



Discussion: A support reaction can be a force resulting in a support or a resulting restraining end moment, which results due to a prevented possibility to move. In the case of structural systems, support reactions are in equilibrium with the external forces acting on the structure. Support reaction was 3.9 % on higher side in case of bridge with Pratt Truss when compared to Bridge with Warren Truss

Conclusion

This undertaking mentioned the evaluation and layout of metallic truss bridge related to tunnel, the bridge is 450m lengthy and 20 m high, the areas among the trusses withinside the roof are various, from the start via way of means of leaving area that identical 0.five m, divided all areas in 10 section the duration of every one identical 7m. **Shear Force** : A shear pressure is a pressure implemented alongside the floor, in competition to an offset pressure appearing withinside the contrary direction. This effects in a shear strain. In easy terms, one a part of the floor is driven in a single direction, even as every other a part of the floor is driven withinside the contrary direction. Shear pressure became most in Bridge with Pratt Truss whilst in comparison to bridge with Warren truss supplying to be 12% at the better facet. Maximum shear pressure cost is for Pratt truss bridge that's 485.763 KN related with tunnel.

Maximum Deflection: similar to 75% of top load and post-top deflection at 80% of top load, respectively. Maximum deflection became 9% better in case of bridge with Pratt Truss whilst in comparison to bridge with warren truss.

Torsional Values: In the sphere of stable mechanics, torsion is the twisting of an item because of an implemented torque. Torsion is expressed in both the pascal (Pa), an SI unit for newtons in keeping with rectangular metre, or in kilos in keeping with rectangular inch (psi) even as torque is expressed in newton metres (N. · m) or foot-pound pressure (ft.). Torsional values had been 6.7% better in bridge with Pratt Truss whilst in comparison to bridge with Warren truss. Torsional cost for pratt truss bridge is 30% extra than pratt truss & 22% extra than warren truss bridge.

Support Reaction A help response may be a pressure ensuing in a help or a ensuing restraining stop moment, which ends up because of a avoided opportunity to move. In the case of structural systems, help reactions are in equilibrium with the outside forces appearing at the structure. Support response became 3.9 % on better facet in case of bridge with Pratt Truss whilst in comparison to Bridge with Warren Truss. Maximum help response is 4946.319

References

1. Heena Dewangan and Kaushik Majumdar, [COMPARISON OF DIFFERENT TYPES OF TRUSSES IN VIBRATION ANALYSIS USING STAAD PRO], International Journal of Engineering Sciences & Research Technology, June, 2018, ISSN: 2277-9655.
2. Kuihua Mei, Wangwang Fu and Jufeng Su, [Seismic Analysis of Hybrid System Bridge of Multi-Span Continuous Girder and Arches], E3S Web of Conferences 165, 04032 (2020).
3. Purevdorj Sosorburam and Eiki Yamaguchi, [Seismic Retrofit of Steel Truss Bridge Using Buckling Restrained Damper], Appl. Sci. 2019, 9, 2791.
4. Li Yuanming and Zhou Zhixiang, [Earthquake Performance Analysis of Steel Truss-Concrete Continuous Rigid Frame Bridge], Int. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 4(Version 3), April 2014, pp.24-30.
5. Mohamed Ghannam, Nabil S. Mahmoud, Ahmed Badr and Fikry A. Salem, [Numerical Analysis for Strengthening Steel Trusses using Post Tensioned Cables], 2017 Global Journals Inc.
6. Daihai Chen, Wenze Wang, Zheng Li, Zhenqi Xu and Fengrui Ma, [Comparative analysis of seismic performance of 122-meter long concrete-filled steel tube arched chord truss bridge before and after reinforcement], JOURNAL OF ASIAN ARCHITECTURE AND BUILDING ENGINEERING 2020, VOL. 19, NO. 2, 90–102.
7. Ebrahim Amirihormozakia, Gokhan Pekcana and Ahmad Itania, [Analytical Modeling of Horizontally Curved Steel Girder Highway Bridges for Seismic Analysis], Journal of Earthquake Engineering, 19:220–248, 2015.
8. Mohd Waseem and Mohammad Saleem, [Seismic Analysis of Box Girder Bridge using CSiBridge Software], International Journal of Management, IT & Engineering Vol. 9 Issue 5, May 2019, ISSN: 2249-0558 Impact Factor: 7.119.
9. Nitin Indulkar, A.N. Humnabad and Dr. Navnath V. Khadake, [Comparative Study of Seismic analysis of Bridge Substructure in different Seismic Zones as per IRC Guidelines], International Journal for Research in Applied Science & Engineering

Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue V May 2022.

10. Yongjian Chen, Honglie Sun and Zhenfa Feng, [Study on Seismic Isolation of Long Span Double Deck Steel Truss Continuous Girder Bridge], Appl. Sci. 2022, 12, 2567.
11. Mohamed Abdel-Basset Abdo, [ANALYSIS OF STEEL BRIDGES WITH RECTANGULAR WEBOPENINGS: FINITE ELEMENT INVESTIGATION], Journal of Engineering Sciences, Assiut University, Vol. 38, No. 1, pp. 1-17, January 2010.
12. E. Bhargavi and G.V.Rama Rao, [Comparative Parametric Study of Steel Bridge Trusses by Applying External Prestressing], International Journal of Engineering Technology, Management and Applied Sciences, July 2015, Volume 3, Issue 7, ISSN 2349-4476.
13. Jayakrishnan. T J and Lekshmi Priya. R, [Analysis of Seismic Behaviour of a Composite Bridge using ANSYS], International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 6 Issue 05, May - 2017.
14. Baokui Chen, Yujie Du, Yan Shi and Li Fan, [Seismic Analysis of Isolated Continuous Bridge considering Influence of Seawater and Site Condition], Hindawi Shock and Vibration Volume 2021, Article ID 7599715, 17 pages.
15. E. Tapia-Hernández, T. Perea, K.E. Barth and M.G. Barker, [SEISMIC INFLUENCE ON THE SHORT SPAN STEEL BRIDGE DESIGN], Tenth U.S. National Conference on Earthquake Engineering Frontiers of Earthquake Engineering July 21-25, 2014.
16. Mehmet F. Yılmaz and Barlas Ö. Çaglayan, [Seismic assessment of a multi-span steel railway bridge in Turkey based on nonlinear time history], Nat. Hazards Earth Syst. Sci., 18, 231–240, 2018.