COMPARATIVE STUDY OF PLATE GIRDER AND PRATT TRUSS FOR FOOTBRIDGE

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Abstract : The objective of this paper is to select an appropriate type of footbridge structural system between plate girder and Pratt truss for a suitable spans. STAAD.Pro software will be used to analyze and design the footbridge. Footbridges needs to withstand dead loads, live loads, seismic loads and wind loads. For evaluating seismic loads static method is used with IS 1893. Since the work is being carried out expected results from work after complete analysis and design of plate girder and Pratt truss will be in the form of comparison between base shear, time period, horizontal and vertical displacement, cost comparison and constructability.

IndexTerms **- Footbridges, Plate Girder, Pratt Truss, Seismic Co-efficient Method, Static analysis, Displacement, Optimum Design.**

I. INTRODUCTION

Bridges are part of our life from a very long time. Bridge is defined generally as a structure which connects two parts which are separated from each other due to natural contours of earth. On the basis of functional use Bridges are classified into three types: Footbridges, Road bridges and Rail bridges. Footbridges are the ones which are used by pedestrian traffic or animal traffic. Road bridges are used for vehicular traffic on roads. Similarly Rail bridges are used for supporting the train loads. Design philosophy and method of analysis are different for each type of bridges due to increase in loads and sizes of members. Bridges are made up of various materials. Earlier wood or timber and stones were the only known and available source of material for mankind to construct structures out of it. As we progress in our life, we discovered various materials, some were naturally occurring while some were manmade alloys. R.C.C, Iron, Steel, Aluminum, Composite materials were later on introduce to civil engineers, research were carried out in full swing to use these materials as construction materials. To reduce the dead load of the bridge lighter materials are given preferences. Now a day, steel bridges are preferred as it gives more aesthetic looks and good weight to strength ratios. In this paper, comparison for economy and selecting a type of footbridge between a plate girder footbridge and Pratt truss footbridge will be the objective.

II. REVIEW OF LITERATURE

In 2009, **Renan Constantino et al.** designed a pedestrian bridge crossing in which four types of bridges and six different parameters were kept for selection a best type of bridge. Cable stayed bridge, Truss bridge, Suspension bridge and Arch bridge were shortlisted and the parameters were Structural design, Constructability, Maintenance and Inspection, Construction schedule impact, Aesthetics and Cost. Each bridge was given points based on the above discussed parameters. Based on these points selection was undertaken. While **S. Rajesh** (2016) analyzed and designed a steel foot over bridge at a railways station in metropolitan city. It was modeled as truss bridge in STAAD Pro software with RCC slab on it to support the gangway. Components like truss members, column, base plate, anchor bolts, pedestal, footing were thoroughly analyzed and designed. In 2017, **Pawan Patidar et al.** presented a parametric study on Plate Girder Bridge using software STAAD Pro. The Span of the bridges and the web thickness were made to vary while keeping all other parameters constant. The results concluded from this study were depth of web varies linearly with span for the constant web thickness. With depth of web to thickness of web ratio remains the same. At constant thickness of web, area of flange varies as per the variation of span. Using the transverse stiffeners, the weight of girder is controlled with span variation.

III. OBJECTIVE OF PAPER

Selecting Plate Girder & Pratt Truss for steel footbridge of 12m span. Modelling, Analyzing & design the Steel footbridges for given span with the relevant loading conditions & Seismic zones. Obtaining results in the form of Base shear, Displacement, Time period. Comparison of results between Plate girder and Pratt truss which will help the designers and planners to suitably choose the type of footbridge.

IV. PROBLEM FORMULATION

In previous research studies, the individual Plate Girder and Trusses were designed and analyzed for different cases and economy was considered for various spans separately. Software's like STAAD.Pro, ANSYS, etc. were used. In present study we are going to compare a Plate Girder and a Pratt Truss for footbridge of a span keeping the loading and load cases constant, to know which one is more economical and various effects governing the design like deflection, strength, etc.

Structural Modelling

In present study 2 models of Plate Girder and Pratt Truss for given span of 12m will be modelled in software. Software used is STAAD Pro V8i (SELECT series 5).

Types of Structure: Foot-over Bridge (Bridge Structure)
Material: Structural Steel Fe-250 Confirming IS2062
Bridge Type: Simple Span (Plate Girder & Pratt Truss)
Span of Bridge: 12 m
Height of Gallery: 3.0 m
Width of Gallery (Gangway): 3 m
Type of soil: Medium
Zone: III
Damping: 2%
Importance factor: 1.5 (IS1893 part-1:2016, clause 6.4.2)
Dead load: Self weight of the structure
Live load: 5 kN/m2 along the gangway
Column: ISMB400 (After Designing)
Plate Girder: 600x200x16x10 (After Designing)
Truss Members: ISA75x75x6 (After Designing)
Vertical/Horizontal Bracing Members: ISA65x65x6 (After Designing)

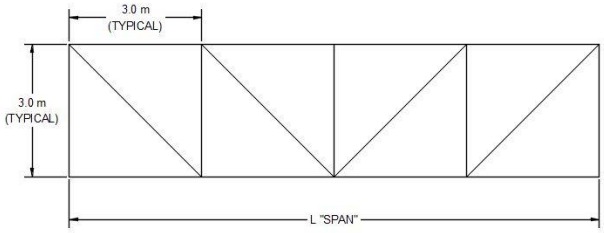

Fig. 1. Typical elevation of Pratt truss.

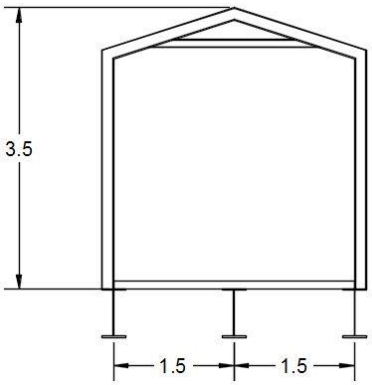

Fig. 2. Typical section of Plate Girder.

V. METHODOLOGY

The seismic weight of each floor is calculated as its full dead load plus the appropriate amount of imposed load while computing this weight. In the equivalent static method (also referred to as the seismic coefficient method), which accounts for the dynamics of the building in an approximate manner, the total design seismic base shear (VB) if determined by

VB= Ah W

Where Ah is the design horizontal acceleration spectrum value, using the approximate fundamental natural period Ta, in the considered direction of vibration, and W is the seismic weight of the building. Following results will be determined after complete analysis and design of Plate Girder & Pratt truss Footbridges modelled in STAAD.Pro software and the results of both these models will be compared with respect to the safety and structural performance. Base shear, Maximum Lateral & Vertical Displacement, Time period.

VI. RESULTS AND DISCUSSION

Following results are interpreted from above analysis & design of Plate Girder & Pratt Truss.

First Chart (Fig. 3) shows us that time period for both the bridges are same as their plan dimensions are same. Second chart (Fig. 4) shows Base shear, Plate Girder & Pratt Truss have similar base shear here we can say that the seismic weights of both structure is somewhat similar which gives us idea that the material weight is similar. Third chart (Fig. 5) shows deflection in horizontal plane & vertical plane. Plate Girder has more deflection in both plane as compared to Pratt Truss. This makes Pratt Truss more stable in serviceability.

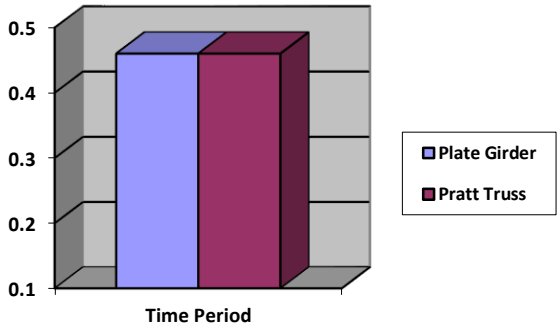

Fig. 3. Time period comparison of plate grider footbridge & Pratt truss footbridge.

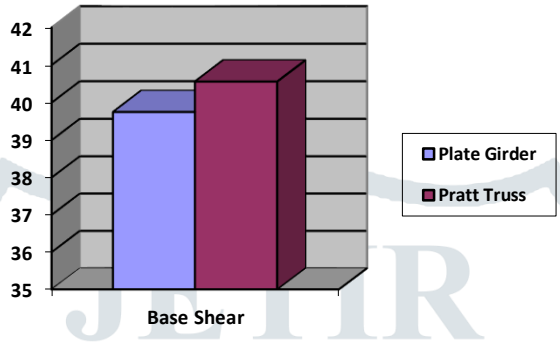

Fig. 4. Base shear comparison of plate grider footbridge & Pratt truss footbridge.

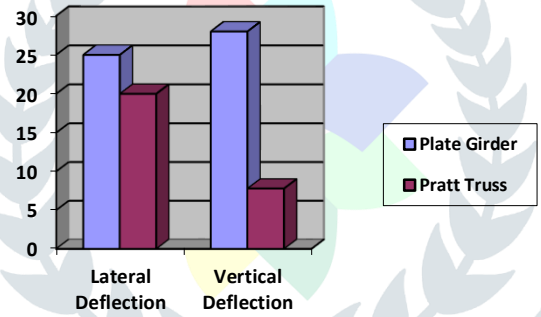

Fig. 5. Lateral & Vertical deflection comparison of plate grider footbridge & Pratt truss footbridge.

VII. CONCLUSION

The seismic weight and the time period of both plate girder footbridge & Pratt truss footbridge for 12m span is more or less similar, which makes deflection (serviceability) the only criteria for judgment. Therefore from above figures of deflection, the Pratt truss is a better option for 12m span. Also the rolled section lengths available in 12m so fabrication of this will also be readily available. Highly skilled labour charge which is required in fabrication of plate girder is also eliminated, giving us more economy & ease for the footbridge construction and execution.

VIII. REFERENCES

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