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Design and Analysis of Steel Girder Bridge using StaadPro V8i

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ABSTRACT: In this study, superstructure of three spans steel plate girder is analysed by using STAAD-Pro software. The total length of bridge is 110 metres. Side spans are 30 metres for each and main span is 50 metres Roadway width is 12 metre and sidewalk are 1.5 metre at each side. The concept of a highway is adopted from AASHTO specification with truck load of IRC. Temperature load, Impact load, Wind load and Seismic load are considered according to I.S.: 875 (Part 3)-1987, IS 1893: 1962, and IS 800 codes. The proposed bridge will be considered in the region of Maharashtra**KEYWORDS:**Three Spans Steel Plate Girder Bridge, AASHTO-2002, 1893: 1962, IS 800, STAAD-Pro Software.

I. INTRODUCTION

The need of bridge is felt by people and it is communicated to Government through Public representatives or the importance of bridge is felt by Government. Due to the increased traffic demand that may be due to various reasons viz. important road, tourist place, pilgrimage centre, industries etc. Government thus decides to construct a bridge at a particular location. A structure that crosses over a body of water, traffic, or other obstruction, permitting the smooth and safe passage of vehicles. In highway transportation systems, the term "bridge" is usually reserved for structures over bodies of water. However, many other structures are generally considered highway bridges. An overhead is a structure carrying a highway over a railroad, and an underpass is a structure providing passage of a highway under a railroad. An over crossing is a structure carrying a country road or a city street over a state highway, and an under crossing is a structure providing passage of a county road or a city street under a state highway. A separation is a structure separating into two state highways. A connector ramp is a structure connecting intersecting highways and roads. An interchange is the group of ramps and structures providing connections for traffic between intersecting highways. See also: Bridge; Highway engineering Highway bridges can be made of steel, concrete, timber, stone, metal alloys, or advanced composite materials, and may have different structural systems such as girder (beam), truss, arch, cable stayed and suspension. Based on material, they can be classified as Stone Bridge, Brick Bridge, Timber Bridge, Steel Bridge, Composite Bridge, etc. Based on form of superstructure, they can be classified as Arch Bridge, Slab Bridge, Beam and Plate Girder Bridge, Trusses Bridge, Suspension Bridges, and Cabled Stayed Bridge.

Three spans continuous steel plate girder bridge will be studied in this study because steel girder is high strength, long life, ease of fabrication, and fire resisting. Moreover, structural steel has high construction speed, availability of various grades and shapes, reduced substructure costs due to its light weight, etc. Comparing to a simply supported structure, continuous bridge offers the advantages of reduction deflection and variation, better riding and reducing the joints. Nowadays, plate girder bridges are increasingly built because they are economical where spans are long enough to permit saving in cost by proportioning for the particular requirements. Thus, in this study, the design ofbridge is done with the aid of computer software program named "STAAD-Pro". The design specification is based on Indian Standard Specification for Highway Bridges.

II. CASE STUDY

1. **Modelling of Proposed Bridge** The Proposed Bridge is three spans steel plate girder bridge and total length of bridge is 110m. The proposed bridge is modelled by using STAAD-Pro engineering software. And then, loading specification for modelling is used by the India Road Congress. Its specifications contain provisions governing loads and load

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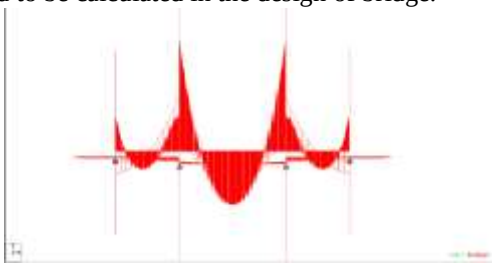
distributions as well as detailed provisions relating to design and construction. The design calculation of slab and piers are also done using StaadPro.

Bridge Type - Steel Plate Girder Bridge
Number of span - 3
Main Span – 50m
Side Span – 30m (each side spam)
Total length – 110m
Carriageway Width – 15m
Roadway Width – 12m (6m two lanes)
Sideway Width – 1.5m (each)

2. Load Consideration

❖ Dead Load

The dead load is nothing but a self-weight of the bridge elements. The different elements of bridge are deck slab, wearing coat, railings, parapet, stiffeners and other utilities. It is the first design load to be calculated in the design of bridge.



❖ Live Load

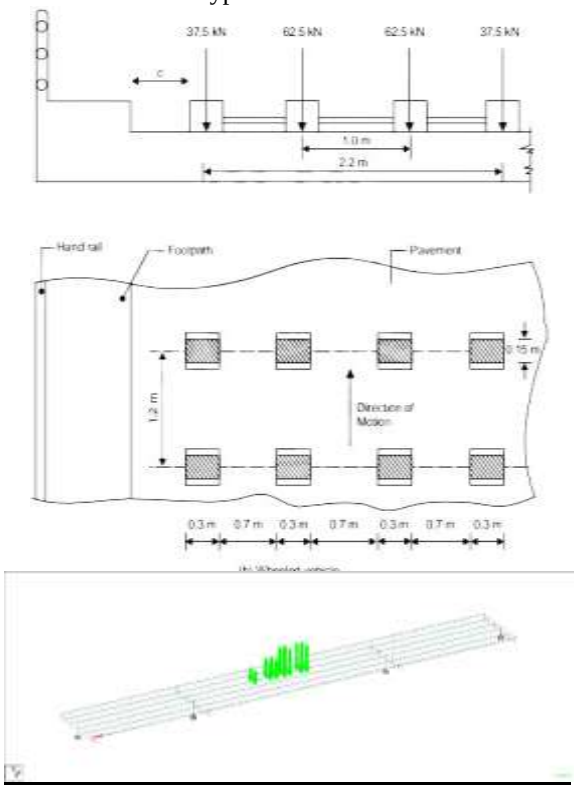
The live load on the bridge, is moving load on the bridge throughout its length. The moving loads are vehicles, Pedestrians etc. but it is difficult to select one vehicle or a group of vehicles to design a safe bridge. So, IRC recommended some imaginary vehicles as live loads which will give safe results against the any type of vehicle moving on the bridge. The vehicle loadings are categorized in to three types and they are

1. IRC class AA loading
2. IRC class 70R loading
3. IRC class A loading
4. IRC class B loading

IRC class AA / 70R Loading

This type of loading is considered for the design of new bridge especially heavy loading bridges like bridges on highways, in cities, industrial areas etc. In class AA loading generally two types of vehicles considered, and they are

- Tracked type
- Wheeled type



Side Walk Loading

For Bridge spam of 110m sidewalk loading is taken as **2KN/M^2**

❖ Temperature Loading

In general, thermal forces are caused by fluctuations in temperature (i.e., from hot to cold or cold to hot). The change in temperature is greatly dependent on the location of the bridge site. As a reference point, the estimated temperature at the time of construction is determined using temperature rise and fall values which are computed from the extreme hot and cold temperatures. The range of temperature change in this structure is considered as follows:

- Temperature change for axial elongation = 16°F
- Temperature differential from top to bottom = 10°F
- Temperature differential from side to side = 10°F

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❖ **WIND LOAD**

The loading on a bridge due to wind forces is specified by IS:875 (Part 3)-1987 based on assumed wind velocity for Pune. The wind pressure on a structure depends on the wind velocity, height, exposure and dynamic response of the structure. Wind load is considered according to IS:875 (Part 3)-1987. Data for wind load are as follows:

Exposure type	Type C
Basic wind velocity	39 m/sec
Important factor	1
Building classification category	II
Structure Type	Lattice framework
Method used	Normal force method

❖ **Earthquake Load**

An earthquake consists of horizontal and vertical ground motions, with vertical motion usually having much the smaller in magnitude. The horizontal motions of the ground cause the most significant effect. It is that effect which is usually thought of as earthquake load. When the ground under structure having certain mass suddenly moves; the inertia of the mass tends to resist the movement. A shear force is developed between the ground and the mass.

Earthquake load data are as follows: -

Seismic zone	3
Zone factor, Z	0.4
Soil type	SD
Importance factor, I	1.0
Response modification factor, R	8.5
Seismic coefficient, Ca	0.44 Na
Seismic coefficient, Cv	0.64 Nv
Near source factor, Na	1.0
Near source factor, Nv	1.0
Analysis types	Dynamic Analysis

❖ **LOAD COMBINATION**

Load combinations defined by IS 800 and created automatically by StaadPro.

Group	Loading Combination
I	D+L+I
II	D+W
III	D+L+I+0.3W
IV	D+L+I+T
V	D+W+T
VI	D+L+I+0.3W+T
VII	D+EQ

Were,

- D = dead load
- W = wind load on structure
- EQ = earthquake force
- L = live load
- I = live load impact
- T = temperature force

III. RESULTS

The proposed bridge is analysed and designed in seismic zone 3 by the use of STAAD-pro software. The bending stress, shear stress and combination of these stresses will be checked according to Indian Standard Specification for safety of the planned bridge. The design sections from the output data from the software are:

1. Stell Girder:WPB900X300X333 (JINDAL STEEL TABLE SECTIONS)

Note: - DOUBLE-I SECTION HAS BEEN DESIGNED USING THE PROVISIONS OF GENERAL I-SECTION

2. Concrete Beam: Prismatic Tee

3. Concrete Colum: 1.6m Diameter

4. Slab Thickness: 2.5m +1m= (3.5m)

CROSS SECTION OF DESIGNED MODEL

IV. ANALYSIS

Steel bridges are widely used on account of three advantages. They are low weight of

components, easy fabrication and simple installation and durability. Steel has the advantages of lighter weight and more rapid construction, when compared with concrete.

V. CONCLUSION

1. This project concludes the, analysis and design of flyover by using STAAD pro and STAAD. Beava.
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3. These loads that create the maximum load responses can then be transferred into STAAD.pro as load cases to load combinations for further analysis and design. Similarly, we can use this design method for design of concrete members, slab elements and foundations
4. The structure is designed as per IRC class 70R loading.

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