

PLAN OF A STEEL FOOT OVER BRIDGE IN A URBAN RAILWAY STATION

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1. Introduction

Civil engineering deals with the design, construction and maintenance of physical and naturally built environment, including works like bridges, roads, canals, dams and buildings. It is the oldest and broadest engineering profession. All the engineering specialties have been derived from civil engineering. It is divided into various sub disciplines including environmental engineering, geotechnical engineering, structural engineering, transportation engineering, material engineering, surveying and construction engineering. The principles of all the above engineering aspects are applied to the residential, commercial, industrial and public works projects of all sizes and levels of construction[1-8].

2. Objectives

1. To analyse and design a Foot Over Bridge at a railway station in a metropolitan city.
2. To design a light weight structure with maximum strength, durability and safety factor.
3. To make use of a simple and effective design methodology and construction. The design procedure and methodology adopted is to be in conformance to the present methodology being used in the industry.
4. To analyze the structure using STAAD.Pro for the various loads acting on the structure.
5. To meet the requirements of the codal provisions given in the codes, being considered and try to adopt economical sections in the structure.
6. To make detailed drawings indicating the sections used for the various components

3. Methodology

1. Collection of details and information about analysis and design of steel structural elements and current practices in the industry.
2. Review of literature and study of examples for the proposed project.
3. Study of codal provisions for Design of steel structures, loading details.
4. Selection of site and collection of site information from previously completed projects and concerned authorities.
5. Preparation of plan and elevation of the structure using AUTOCAD.

6. Making the models of the various components in STAAD and assigning member and material properties as per the design[9-12].

7. Loading the structure elements for Dead Loads, Imposed Loads and Wind Loads as per the Indian Railway Standard – Steel Bridge code.

8. Design of structural components of the foot over bridge for the loading details acquired from STAAD model.

9. Design of the appropriate foundation for the loading details.

10. Preparation of detailed design drawings.

11. The site chosen for the design of Foot Over Bridge is Park Railway Station located in Chennai district, Tamil Nadu. The Foot Over Bridge spans for a total length of 28m over 3



Figure 1. View of Location

Design Data

The various parameters considered in the design of foot over bridge are as follows:

Minimum Specifications

Minimum specifications as per Indian Railways Work Manual are listed below:

Width of gangway : 2m

Clearance from centre line of rail

: 2.36m

Height from the rails to the base of gangway :

6.26m

Loading Data

Location : Park

Railway Station, Chennai

Total span : 28 m

Gangway width : 3 m

Height from the rails to the base of gangway : 6.26

m

Live load : 5 kN/ m²**Loading Details**

The loads acting on the structure is distributed to all the structural elements. The live load and dead load acting on the main truss gets distributed from the gangway to the column. This load is then transferred to the footing below[13-18].

Material Properties**Steel**

- i. Structural steel used in this design confirms to IS 2062 with the following properties:

Yield stress : 250

Mpa

Ultimate stress : 410

Mpa

- ii. HYSD reinforcement of grade Fe 415 confirming to IS 1786 is used throughout.

Concrete

All components unless specified in design : M20 grade

Characteristic compressive strength f_{ck} : 20 N/mm²

Analysis By Staad.Pro - Structural Software**Main Truss**

The dead loads and the live load were considered for the Main Truss. The loads act on all the panel points equally with the end panels taking up half of the load

Column:

The loads acting on the structure get distributed through the primary and secondary girders to the column. This load is then distributed to the foundation below. Horizontal and inclined bracings are provided to arrest buckling. The loading diagram is shown below[19-24].

Load Calculation:

Live load = 500 kg/m² = 5.00 kN/m²

Weight of RCC slab = 0.15x25 = 3.75 kN/m²

Total load = 8.75 kN/m² say 10 kN/m²

Dead load (safety) = 1.5 kN/m²

Final load = 11.5 kN/m²

Load on each panel = $11.5 \times 3 \times 1.4 / 2$ = 24 kN

Load at the end panels = 12 kN

The forces in the members were calculated using STAAD and the maximum forces in the members were found to be as follows:

- i. Top chord members = 660.02 kN (compression)
- ii. Bottom chord members = 213.38 kN (tension)
- iii. End diagonals = 272.22 kN (compression)
- iv. Other diagonals = 253.13 kN (tension),
- v. Vertical members = 22.15 kN (tension)

4. Results and Conclusions

The various structural elements of the Foot Over Bridge were analyzed using STAAD.Pro for the dead load and live load. The structural steel elements were then designed for the corresponding data using IS 800:2007. The footing

which acts on the other panel points. The loading diagram is as shown

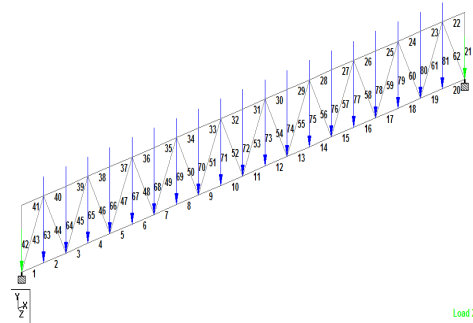


Figure 2. Loading diagram of Main Truss

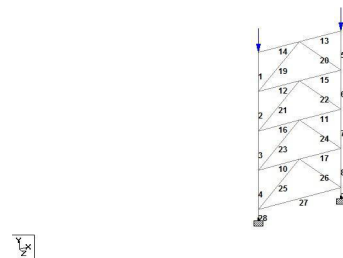


Figure 3. Loading diagram of Column

was designed according to IS456:2000. The sections which are designed for use for the various structural elements are specified in the following Table 1 to Table 4. The detailed structural drawings have been presented in Figure.

Table 1. Sections used for main truss

COMPONENT	MEMBER	SECTION
Top chord	Compression	ISA 150x150x12 (double)
Bottom chord	Tension	ISA 150x150x12 (double)
Diagonals	Compression	ISA 100x100x10 (double)
	Tension	ISA 100x100x10 (double)
End diagonals	Compression	ISA 150x150x12 (double)
Vertical	Tension	ISA 90x90x8 (single)

Table 2. Sections used for gangway

COMPONENT	SECTION
Primary girder parallel to gangway	ISMB 200
Secondary girder perpendicular to gangway	ISMB 200

Table 3. Sections used for column

COMPONENT	SECTION
Main column	ISMB 500
Horizontal bracing	ISA 75x75x8 (double)
Inclined bracing	ISA 75x75x8 (double)

Table 4. Schedule of footings

COMPONENT	X(m)	Y(m)	D(m)	REINFORCEMENT
Footing	1400	1400	300	10mm dia @ 100mm c/c both ways

5. Conclusions

Thus the various components of the Foot Over Bridge namely Main Truss, Columns along with the Footings have been analyzed using STAAD.Pro software and the most economic and safe sections are arrived through manual design. The use of steel as the construction material has resulted in the overall economy of construction when compared to Reinforced Concrete Structure. The components are designed for the maximum safety and the adaptability of the structure to future changes has also been given due consideration

References

- [1] Arun Kumar N., Srinivasan V., Krishna Kumar P., Analysing the strength of unidirectional fibre orientations under transverse static load, International Journal of Applied Engineering Research, v-9, i-22, pp-7749-7754, 2014.
- [2] Srinivasan V., Analysis of static and dynamic load on hydrostatic bearing with variable viscosity and pressure, Indian Journal of Science and Technology, v-6, i-SUPPL.6, pp-4777-4782, 2013.
- [3] Srinivasan V., Optimizing air traffic conflict and congestion using genetic algorithm, Middle - East Journal of Scientific Research, v-20, i-4, pp-456-461, 2014.
- [4] Praveen R., Achudhan M., Optimization of jute composite as a noise retardant material, International Journal of Applied Engineering Research, v-9, i-22, pp-7627-7632, 2014.
- [5] Raja Kumar G., Achudhan M., Srinivasa Rao G., Studies on corrosion behaviour of borated stainless steel (304B) welds, International Journal of Applied Engineering Research, v-9, i-22, pp-7767-7772, 2014.
- [6] Ganeshram V., Achudhan M., Design and moldflow analysis of piston cooling nozzle in automobiles, Indian Journal of Science and Technology, v-6, i-SUPPL.6, pp-4808-4813, 2013.
- [7] Ganeshram V., Achudhan M., Synthesis and characterization of phenol formaldehyde resin as a binder used for coated abrasives, Indian Journal of Science and Technology, v-6, i-SUPPL.6, pp-4814-4823, 2013.
- [8] Achudhan M., PremJayakumar M., Mathematical modeling and control of an electrically-heated catalyst, International Journal of Applied Engineering Research, v-9, i-23, pp-23013-, 2014.
- [9] Anbazhagan R., Satheesh B., Gopalakrishnan K., Mathematical modeling and simulation of modern cars in the role of stability analysis, Indian Journal of Science and Technology, v-6, i-SUPPL.5, pp-4633-4641, 2013.

- [10] Udayakumar R., Kaliyamurthi K.P., Khanaa, Thooyamani K.P., Data mining a boon: Predictive system for university topper women in academia, *World Applied Sciences Journal*, v-29, i-14, pp-86-90, 2014.
- [11] Kaliyamurthi K.P., Parameswari D., Udayakumar R., QOS aware privacy preserving location monitoring in wireless sensor network, *Indian Journal of Science and Technology*, v-6, i-SUPPL5, pp-4648-4652, 2013.
- [12] Kumar J., Sathish Kumar K., Dayakar P., Effect of microsilica on high strength concrete, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5427-5432, 2014.
- [13] Dayakar P., Vijay Ruthrathi G., Prakesh J., Management of bio-medical waste, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5518-5526, 2014.
- [14] Iyappan L., Dayakar P., Identification of landslide prone zone for coonoortalukusingspatialtechnology, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5724-5732, 2014.
- [15] Swaminathan N., Dayakar P., Resource optimization in construction project, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5546-5551, 2014.
- [16] Swaminathan N., Sachithanandam P., Risk assessment in construction project, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5552-5557, 2014.
- [17] Srividya T., Kaviya B., Effect on mesh reinforcement on the permeability and strength of pervious concrete, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5530-5532, 2014.
- [18] Sandhiya K., Kaviya B., Safe bus stop location in Trichy city by using GIS, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5686-5691, 2014.
- [19] Ajona M., Kaviya B., An environmental friendly self-healing microbial concrete, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5457-5462, 2014.
- [20] Kumar J., Sachithanandam P., Experimental investigation on concrete with partial replacement of scrap rubber to granite stones as coarse aggregate, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5733-5740, 2014.
- [21] Sachithanandam P., Meikandaan T.P., Srividya T., Steel framed multi storey residential building analysis and design, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5527-5529, 2014.
- [22] Srividya T., Saritha B., Strengthening on RC beam elements with GFRP under flexure, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5443-5446, 2014.
- [23] Saraswathy R., Saritha B., Planning of integrated Satellite Township at Thirumazhisai, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5558-5560, 2014.
- [24] Saritha B., Rajasekhar K., Removal of malachite green and methylene blue using low cost adsorbents from aqueous medium-a review, *Middle - East Journal of Scientific Research*, v-17, i-12, pp-1779-1784, 2013.
- [25] Saritha B., Ilayaraja K., Eqyaabal Z., Geo textiles and geo synthetics for soil reinforcement, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5533-5536, 2014.
- [26] Ilayaraja K., Krishnamurthy R.R., Jayaprakash M., Velmurugan P.M., Muthuraj S., Characterization of the 26 December 2004 tsunami deposits in Andaman Islands (Bay of Bengal, India), *Environmental Earth Sciences*, v-66, i-8, pp-2459-2476, 2012.
- [27] Ilayaraja K., Ambica A., Spatial distribution of groundwater quality between injambakkam-thiruvannamiyur areas, south east coast of India, *Nature Environment and Pollution Technology*, v-14, i-4, pp-771-776, 2015.
- [28] Ilayaraja K., Zafar Eqyaabal M.D., Study of ground water quality in Cooum belt, *Indian Journal of Science and Technology*, v-8, i-32, pp--, 2015.
- [29] Sandhiya K., Ilayaraja K., Application of GIS for countering nuclear disaster, *International Journal of Applied Engineering Research*, v-9, i-22, pp-5561-5566, 2014.
- [30] Ambica A., Ground water quality characteristics study by using water quality index in tambaram area, Chennai, Tamil nadu, *Middle - East Journal of Scientific Research*, v-20, i-11, pp-1396-1401, 2014.

