Design of Railway Foot Over Bridge (Shelu)

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Abstract - *In recent years, there has been much progress in foot over bridge design with increasing use of advanced analytical design method, use of raw materials and new bridge concepts. A foot over bridge is becoming very popular in urban India as it helps to cross the road for pedestrians without worrying about high speed traffic as well as it is very safe option without interrupting vehicles. Due to increase in use as advanced analytical design methods there has been progress in construction of foot over bridge. This project deals with the design of steel foot over bridge at Shelu platform in such a way that, it should be durable, stable, usable, economical as well as eco-friendly. As there is only one bridge of Reinforced cement concrete which has a negative impact on environment and it is located at tail end of platform which is inconvenient for people while crossing the railway track. So we are going to design new steel bridges Steel fulfills all the ideal requirements for the construction of a bridge. Preferring steel bridge over RCC Bridge helps in speedy construction and it is economical for the span up to 10-25m. In this project, our Bridge is being designed manually and analyzed using Ansys software by using limit state method.*

Key Words: **shelu, foot over bridge, rolled steel girder, economical, Ansys.**

1. INTRODUCTION

This project deals with the study of railway bridges. Rail bridges are constructed to connect two platforms separated by rail track so that people can safely move from one platform to another and also to exit station. Bridges are usually constructed at such a location where it provides overall ease to users. Steel bridges are an essential feature of a countries infrastructure and landscape. Among various bridges steel bridges has the most highest and favorable strength, qualities and therefore it is suitable for the most daring bridges. There are various types of steel bridges that are used namely girder bridge, truss bridge, rigid frame bridge, arch bridge.

This project comprises of rolled steel plate Girder Bridge. Plate girders can be built to any desired proportion to suit the particular requirements and of a cross section with the properties needed. As steel have many advantages so in this project steel bridge has been designed. The location of the site is at shelu station. Shelu station had only one bridge at further end of the platform which was quite inconvenient to the users from the other end of platform so people usually prefer trespassing which is really prefer trespassing which is really dangerous as it can cause serious accidents. TO prevent trespassing and to provide ease and safety t users a bridge has been designed at shelu station. The designing is done by Limit State Method. According to Indian Standard Codes. Many IS codes has referred during design most of the designing is done by referring ID codes 800: 2000. Various load combinations has been taken into consideration. Loading data has been taken according to IRC standards while designing main importance is given to safety of the users and also tired to have an economical design.

1.1 RAILWAY STEEL FOOT OVER BRIDGE

One of the important structures in civil engineering is a bridge. Railway bridges are constructed to connect to platform separated by railway track to carry pedestrians safely from one platform to another platform and also to exit station. Nowadays Steel foot over bridges is widely adapted by railways. Steel bridges provide overall ease and economy for construction. Steel bridges are easy to construct within a short period of time. It is environment- friendly and commuter – friendly.

The fob uses lighter structural members making it easy to be erected on site. The connections used in fob are simple weld and bolt connection. The major advantage of steel fob is they can be cut or molded into any shape or size desired without wasting material. Steel structures can be pre-fabricated in the workshop or at a place away from site therefore less area at construction site is required and this is highly advantageous in congested urban areas.

Foot over bridges is provided at platform in such a place where it can carry maximum pedestrian traffic at peak hours and also at non peak hours. And also it could be very convenient to users from both sides of platform. Steel fobs can be used right from the time construction is over.

1.2 STATEMENT OF PROBLEM

Due to existing foot over bridge at failure end of steels station people hesitate to use the bridge for movement. Moreover frequency of train is less but each train contains approximate 500 people which results in traffic of movement in existing bridge. Trespassing is usually seen as people think crossing is more convenient than using foot over bridge which may results in accidents. Unauthorized crossing at shelu is observed by students without safety because there is only one foot over bridge at csmt end of station. The existing foot over bridge is an old RCC bridge which may collapse or IRC will demolish it in upcoming years.

1.3 OBJECTIVES

- To design a light weight foot bridge at shelu station without compromising the strength, durability and stiffener of the structure.
- To make use if simple and the effective design techniques
- To design a bridge which is economically efficient
- To Analyze the structure using ANSYS
- To meet the requirements of Is provisions
- To overcome the difficulties to approach the bridge from all direction
- To design the structure manually
- To prevent trespassing

2. LITERATURE REVIEW

Mohan Gupta and Shekhar Gupta 01-2011 adopted high strength and light weight, tubular steel for proper design of foot over bridge since the clear span 30m and clear height above road level was 75m.Moreover foot over bridge was supported solely by the steel beam of 30m thus heavy depth of beam have to be involved in order to get the structure to be in stability.

Rahul and kaushik Kumar 10-2014 has made efforts to design and optimize portable foot bridge which provide a solution that will aid a person carrying a load in crossing stream. The main motto was to minimize the total deformation of the structural member by optimizing the cross sections, materials properties and weight.

A Das and S Barau 09-2015 surveyed and investigated performance of existing foot over bridge facilities and identified people's hesitation to the use of foot over bridge due to inconvenience, unawareness, congested, time consuming, poor accessibility and bad conditions. Considering above issues foot over bridge is provided at that spot with adequate service and become capable of performing public demand.

Patil MB 06-2016 carried out efforts to analyze check and study the structural behavior of composite bridge under static analysis. Also compared its results numerically to know its suitability by using SAP2000.

Vishal Gajghate, Aniket Rewatkaral 04-2017carried out seismic analysis of foot over bridge for different soil conditions. They highlighted the effect of different soil conditions indifferent zones with response spectrum analysis and also checked bridge to withstand for bending moment and shear for different span column members and foot over bridges respectively.

T.Prashant 01-2018 stated that the bridges are often required very close to the public outlook resulting in careful arrival. Therefore foot bridges are necessary where Separate Street must be required for people to move site visitors' flows or some physical obstruction along with a river. The appropriate layout of foot over bridge together with connection details and additional estimation of structural components at the side of foundation detail is needed.

3. METHODOLOGY

Designing bridge considering various components as per IS 800:2007

Materials properties:

A. Steel

i. Structural steel confirming to IS 2062 having following properties is used in this design

Yield stress = 250 MPa

Ultimate stress = 415 MPa

ii. HYSD reinforcing bar of grade Fe 415 confirming to IS 1786 is used

B. Concrete

Design grade of concrete M20

Dimensions of bridge:

Height of bridge= 10m

Span of bridge= 21m

Width = 4m

Components of bridges

1) TRUSS

a. *ROOF*

Dimensions = 4m × 3m

Rise = 1m

θ=26.56°

Loading data

Dead load = 562.59 N

Live load = 836.95 N

Wind load = 3.083 KN/m

b. PURLIN

Spacing of purlin =0.74m

Dead load = 142.82 N/m

Live load = 309.91 N/m

Wind load = 1018.61 N/m

c. PRINCIPLE RAFTER
Design force = 2 KN

C/s area required = 45.87 mm^2

Section used ISMB 100

2) SLAB
Live load = 5 KN/m^2

Floor finish = 2 KN/m^2

Aspect ratio = 3.75 > 2 ∴ one way slab

Providing main steel of 12mm dia bars @ 150 mm c/c and distribution steel of 10 mm dia bars @370 mm c/c.

3) GIRDER
Max BM = 1695.71 KNm

Max SF = 362.18 KN

Providing I section

Size of web = (650× 6) mm

Size of flange = (450× 30) mm

4) STAIRCASE
Height of Staircase = 7 m

Riser = 150 mm, Tread = 300 mm

Providing 3 flights

No of risers in each flight = 16 Nos

No of tread in each flight = 15 Nos

Dead load of waist slab = 5.33 KN/m^2

Floor finish = 1 KN/m^2

Wt. of steps = 1.8 KN/m^2

Imposed load = 5 KN/m^2

Total load = 20 KN/m^2

Providing main steel of 10mm dia bars @ 50 mm c/c and distribution steel of 8 mm dia bars @230 mm c/c.

5) COLUMN

Total load on column = 450 KN

Height of column = 5.7 m

C/s area required = 3000mm^2

Section used ISMC 150 two channels back to back.

6) PEDESTAL

Size of base plate = 500× 500 mm

SBC = 150 KN/m^2at 1.5m

Height of platform = 1 m

Height of pedestal above platform = 0.3 m

Concrete quality = M20

Reinforcement = Fe 415

Centre to centre distance of bolt holes = 250 × 250

Provide 20mm Ø of reinforcement

80mm Ø of ferrule

40mm cover to steel

Size of pedestal = 550× 550 mm

Asc = 3025mm^2

Providing 10-20mm Ø bars and 8mm Ø tie bars at 300mm c/c.

7) FOOTING

Self weight of column = 0.917 KN

Self weight of base plate = 0.385 KN

Self weight of pedestal = 9.075 KN

Total load on footing = 469.46 KN

Load on footing @ 5% = 23.473 KN

Factored load = 750 KN

Ultimate bearing capacity of soil = 300 KN/m^2

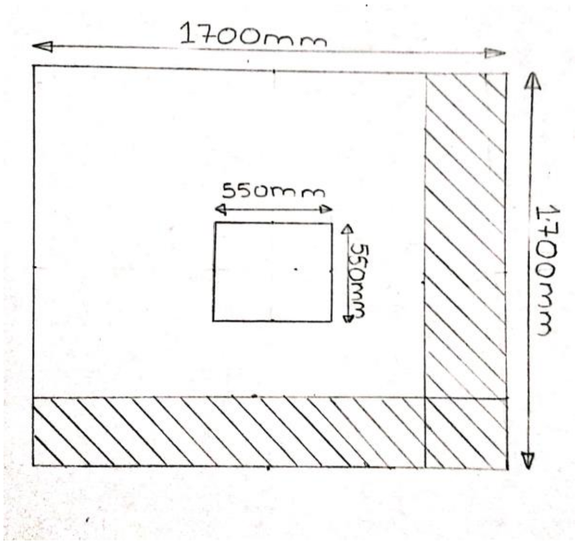
Size of footing = 1.7× 1.7 m

Depth of footing for one way shear

$\tau_v \leq k_s \tau_c$

$k_s = 1$

$\tau_v = \tau_c = 1.11 \mathrm{N}/mm^2$

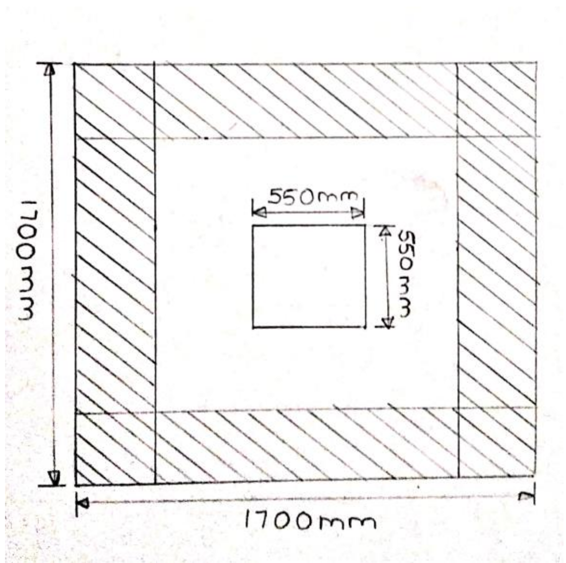


Shear resisted by concrete

$v_u = \tau_c bd$

d = 0.102 m

Case (2) Two way shear



$v_u = [1.7^2 - (0.55 + d)] \times 240$

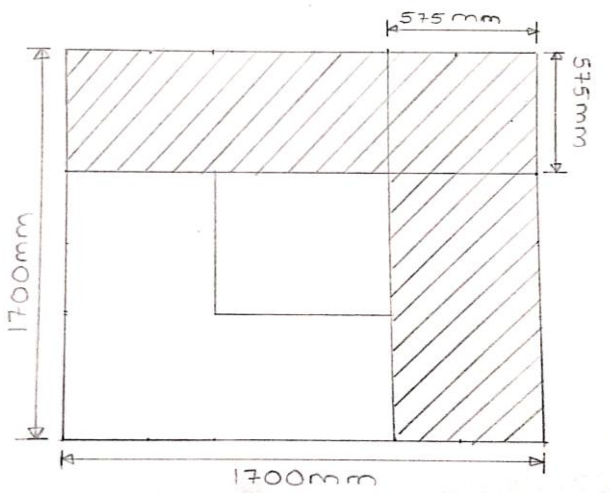
$v_u = \tau_c bd$

d = 0.5 m

BM per m width of footing

$$M_y = M_x = 1.7 \times 0.575 \times 240 \times \frac{0.575}{2}$$

$$M_y = M_x = 67.447\ KN.m$$



Provide 12 mm dia bars on both side.

Development length L Ø = 677 mm

Where,

C/c =centre to centre

C/s = cross section

Ast = area of steel in tension

Wt = weight

Ø = diameter

Asc = area of steel in compression

M_y = moment in y direction

M_x = moment in x direction

v_u = shear force

τ_c = shear stress

Fig -1: Rcc foot over bridge at shelu station

5. RESULTS

1) TRUSS

a) PURLIN
Design bending strength > required bending moment

318.18 N.m > 213.53 N.m

b) PRINCIPLE RAFTER
Design compressive strength > design force

200 KN > 2 KN

2) SLAB
Depth provided > depth required

140 mm > 100 mm

∴Safe against bending moment

Ast provided > Ast required

∴Safe in deflection

3) GIRDER
Design bending strength > required bending moment

2086.36 KN.m > 1695.71 KN.m

Shear force corresponding to web buckling < maximum shear force

423.89 KN < 506.613 KN

Shear capacity of end panel:

179.67 KN < 511.736 KN

∴ Safe in shear

Bending moment strength of end panel > bending due to anchor forces

∴ End panel can carry the bending moment safely

4) CROSS GIRDER
Providing ISMC 125 @ 12.7 kg/m ... (2 NOS)

5) STAIRCASE
Design bending strength > required bending moment

120.22 KNm > 106.73 KNm

Design shear strength > maximum shear force required 288.67 KN > 80.55 KN

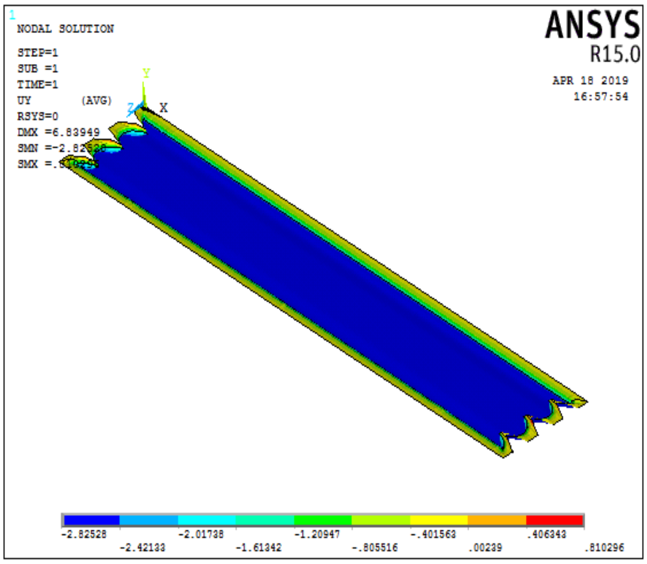
6) COLUMN
Design compressive strength > total load on column

676.51 KN > 450 KN

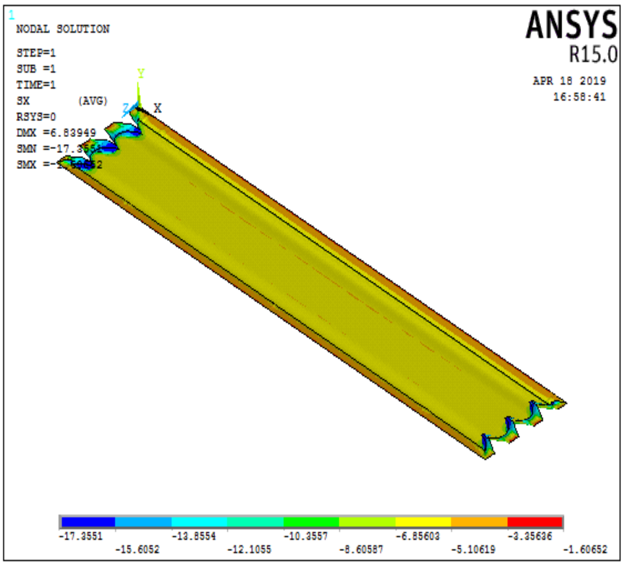
Provided ISMC 150

7) FOOTING
Effective depth required < depth provided

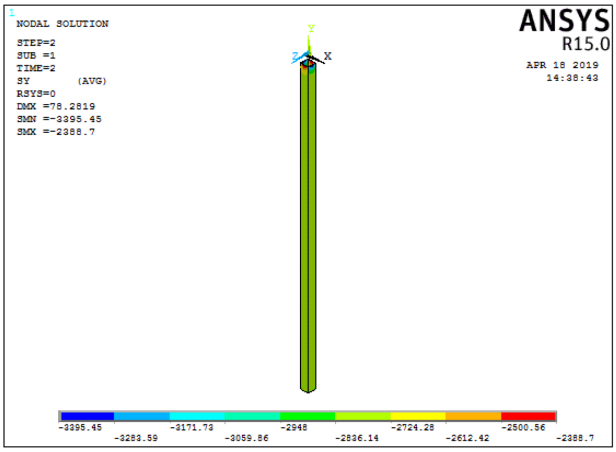
156.324 mm < 500 mm



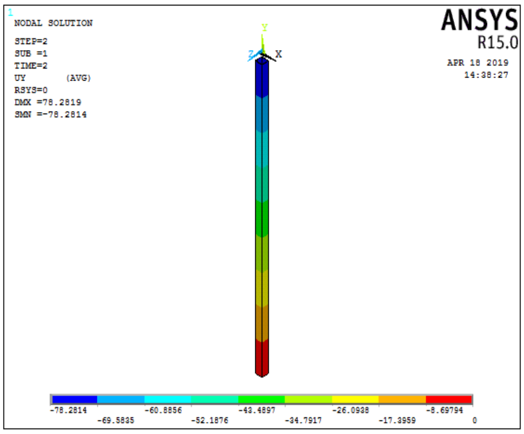
deflection of slab in y direction



stress at slab in x direction



Buckling of column in y direction



stress in y direction

5. CONCLUSION

With this project we aim to contribute a working solution to the recurring problem of inconvenience and time lost for both the users. With the construction of a bridge at shelu station Pedestrian traffic will be dispersed freely and effectively resulting in reduction of congestion inside Railway Stations, better pedestrian safety, movement of pedestrians got their due right. . It will also help to reduce the number of accidents occurring at station due to trespassing. This has been a motivating factor throughout the duration of the project as different issues and learning curves have come about. After designing the bridge manually and also analyzing the same in the Ansys software it is concluded that bridge can bear the load safely.

References

[1] T. Prashanth, "Design and analysis of foot over bridge using staad pro," *International journal of Civil Engineering and Technology,* vol. 9, no. 1, p. 13, 2018.

[2] M. Gupta, "Analysis and Design of Foot over bridge using HSS," *Internatioal journal of Multidispl.Research and advances in Engineering,* vol. 3, no. 1, p. 8, 2011.

[3] A. Rewatkar, "Siesmic analysis of Foot over bridge," *International Research journal of engineering and Technology,* vol. 4, no. 4, p. 4, 2017.

[4] D. Gupta, "Engineering journal of application of scopes," vol. 1, no. 2, p. 5, 2016.

[5] D. A. Zamare, "seismic design construction of foot bridge," *international journal for Research in applied science and Engineering technology,* vol. 3, no. 2, p. 8, 2015.

[6] A. D. a. Barua, "A Survey Study For User Attributes On Foot Over Bridge In Perspective Of Dhaka City," *International Conference On Recent Inovation In Civil Engineering for Sustainable Development,* vol. 1, no. 1, p. 7, 2015.

[7] G. D. &. R.Koroumi, Life Cycle Assessment Frame work For Railway Bridge: Literature Survey & Critical Issues, Stockholm , 2014.

[8] R. &. K. Kumar, Procedia Enineering, Ranchi: Elsevier Ltd., 2014.