International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 3.45 (SJIF-2015), e-ISSN: 2455-2585
Volume 4, Issue 5, May-2018

Foot over Bridge at East Fort

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***Abstract*— Pedestrian accidents are one of the main causes of death worldwide. The neglect is now resulting in 20,000 deaths and more than one lakh injuries every year in India. Enactment of suitable legislation to protect pedestrians, integration of pedestrian facility in highway projects and pedestrian education are necessary steps to enhance the safety on road. Many countries have their own design specifications and standards for pedestrian facilities. Footpaths have become narrow due to widening of roads to accommodate vehicles and in some busy areas they do not exist. People cross the roads with great difficulty. Therefore, proper foot over bridges has to be provided.**

In this study, effort has been made to identify the pedestrian traffic demand at East Fort (Bus terminal – Railway station) area at Thiruvananthapuram, owing to its high congestion, poor crossing facilities, great risk of accidents, difficulty to catch the bus or train on time, high pollution and its need for pedestrian safety. A steel lattice girder type foot over bridge is recommended for this site. The main truss, roof truss and other components such as floor, top and bottom chord members, vertical and diagonal members, supporting beam, cross beam, stair, column, diagonal braces and slab base was designed and checked for safety.

***Keywords*— Pedestrian crossing, foot over bridge, steel lattice girder**

I. INTRODUCTION

Walking is an environmental friendly transportation which enhances both personal and social well- being. A large segment of road users consisting of persons walking on road, operating hand carts, pushing cycle, carrying load on head or shoulder etc. are all termed as pedestrians. As of now at East Fort, there is a total lack of pedestrian facilities such as safe walkways, raised foot paths, foot over bridges, pedestrian subways, pedestrian refuge islands, crosswalks or zebra crossings, pedestrian malls and pedestrian friendly road signs/markings. As a result a lot of problems are faced by the pedestrians. The road side shops, improper sidewalks, broken slabs, makes a lot of inconvenience in the pedestrian flow. Hence there is a pedestrian congestion, and people choose roads to walk and cross. There lies the need for a foot over bridge. Careless crossing of pedestrians causes accidents in the absence of proper zebra crossings. Especially children and elderly people are more affected while crossing. Due to urbanisation and increase in vehicle population, footpath have become a casualty and neglected. Footpaths have become narrow due to widening of roads to accommodate vehicles and in some busy areas they do not exist. People cross the roads with great difficulty. There is need for proper crossing facility (foot over bridge) in the areas which are always busy with high pedestrian traffic. Through this project improvement of the pedestrian safety and easy movement of them by designing a foot over bridge based on the pedestrian traffic demand on road networks is to be undertaken.

II. METHODOLOGY

A. Study area

The area we have chosen for the foot over bridge, based on the pedestrian traffic demand is the East Fort (Bus terminal – Railway station) area at Thiruvananthapuram. East Fort is the geographic center of Thiruvananthapuram. The major Bus station and Railway station is situated here. Since the bus station and railway station are situated opposite to each other, there is a large pedestrian flow, both, flowing in and out of East Fort.

B. Data collection

Reconnaissance survey was conducted and the problems were identified. An inventory of the area is prepared by collecting primary data on the present state of the study area. The inventory includes width of clear way, available footpath width, surface type and conditions as well as the obstacles present. A rough layout of the study area is shown in the figure 1.1. The physical features and geometric measurements were taken. The design of the foot over bridge is based on this plan. Pedestrian opinion survey, pedestrian volume survey for cross movements accident data were collected along with the subsoil investigation.

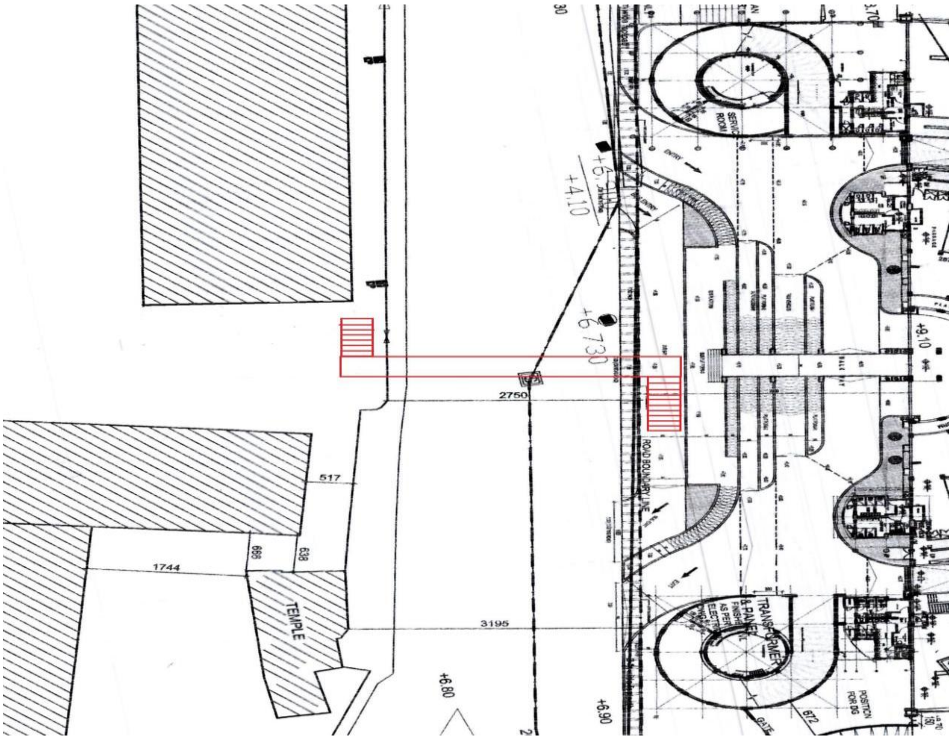

Fig 1: Plan of the East Fort Bus stand & Railway station area

C. Subsoil investigation report:

Subsoil conditions have to be checked so that a suitable foundation can be designed for the structure. The site is level and has concrete flooring almost completely in the area, because of very heavy and frequent vehicle movements. The depth of water table is 0.9m below ground level at the time of soil investigation in January 2000. Seventeen cm diameter bore holes were advanced into the ground manually, using spiral augers, extension rods and other accessories. The sides of the bore holes were stabilized using bentonite slurry wherever necessary. SPT tests were conducted at short depth intervals and also at change of strata. The soil samples collected from the SPT test samples were classified in the laboratory to assess the strength characteristics. It was recommended that a 50cm diameter R.C.C pile, which is well embedded, in the weathered rock at depths greater than 12m is estimated to safely transmit a load of 50 tones. The recommendations are based on the observations of the 7 bore holes and the tests on the soil samples.

TABLE I: SUB SOIL REPORT

Bore Hole no.	Depth of Sample (m)	Description	SPT-N	Gravel (%)	Sand (%)	Silt fines (%)
BH1	3.1	Grey silty sandy clay with trace of gravelly	12	12	34	54
1	11.8	Weathered rock- silt and sand with rock pieces	>100	22	52	26
2	4.8	Stiff clay with sand trace	10		14	86
3	9.5	Black and grey clay	3		3	97
4	12.6	Severely weathered rock reduced to sand & silt	>100		64	36
5	6.5	Yellow stiff silty clay	9		2	98
6	11.8	Severely weathered rock reduced to silt & sand	>100		69	31
7	10.5	weathered rock- silt , sand and gravel	>100	15	54	31

III. DESIGN PRINCIPLES

Working stress method and limit state method are the two main principles out of which working stress method is adopted and design is based on IS 800:2007.

A. *Design of beam*

Purlins which rest between the trusses and support roof sheets are beams. A trial section is selected assuming it is going to be plastic section. Then it is checked for the class it belongs. Then check for bending strength, shear strength and deflection. Bending strength of a laterally supported beam is calculated as per the formulas on IS 800.2007. Shear strength of laterally supported beam is calculated by eq. 1

$$Vd = (Av\ fyw/ \sqrt{3})\ (1/\gamma mo) \qquad (1)$$

where, Av = shear area

fyw= yield strength of the web

B. *Design of compression member*

Design stress in compression stress in member is to be assumed. Effective sectional area required is calculated from eq. 2

$$A=Pd/fcd. \qquad (2)$$

Select a section to give effective area and calculate rmin. Knowing the end conditions and deciding the type of connection determine effective length. Find the slenderness ratio and hence design stress fcd and load carrying capacity Pd. Revise the section if calculated Pd differs considerably from the design load. Thus the design of compression member is by trial and error method.

C. *Design of tension member*

Design strength due to yielding of gross section, design strength due to rupture at critical section and the bolts were also designed for all these members as per IS 800:2007

D. *Design of column base*

The maximum bearing pressure on concrete should not exceed 0.6fck, where fck is the characteristic cubic compressive strength of concrete. The bearing pressure distribution in the base plate may be determined on the basis of linear variation. When the column is heavily loaded, the actual base plate dimension are large compared to that required to limit the bearing pressure. In such cases, the effective plan area of the base plate is obtained by taking equal projection from the face of the column such that the bearing pressure on the effective area does not exceed the bearing capacity of concrete. Design of base plate means finding the plan area to limit the bearing stress on the concrete block, deciding breadth and depth as per the column cross sectional dimensions and to determine the thickness t. If the base plate requires transfer of axial load and heavy bending moment from column to foundation, then it is essential to design anchor bolts.

E. *Design of roof truss*

These are the dimensions and angle of the roof truss

Pitch of roof = 1/12

Inclination of roof with horizontal = 9027‟44.36”

Type of roof = king post truss

Span of roof = 2.5 m

Spacing of truss = 3 m

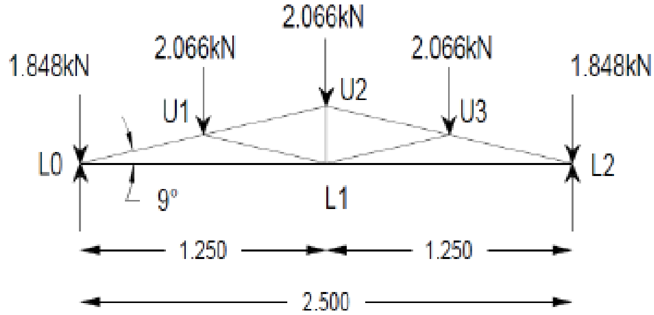

Fig 2- Loads acting on the roof

Dead load and live loads were taken as per IS 875 Table 1 and Table 2. Design of top chord members, design of bottom chord members and bolted connections were done as per the steps mentioned before. From the result strength of one bolt for bearing is greater than shear and 2 bolts were given for the connection of each member. The floor of the roof was designed.

1) *Design of main truss*

Type of girders = Lattice type

Span of girders = 36 m c/c of bearings

Cross girders to be spaced at 3m c/c

Clear walking width b/w main girders = 2.50 m

Pedestrian load = 5000 N/m2

Flooring to be made of concrete slabs of M25 grade

Analyses of loads were done using STAAD pro v8. Then maximum load coming on the truss members were found design of top and bottom chord member, design of vertical members, design of diagonal members and design of stairs were done.

IV. SUMMARY AND CONCLUSION

The need for the foot over bridge at our site is studied and analysed. Pedestrian cross movement survey and public opinion survey were conducted. Since the construction of new bus terminal at East Fort is nearing to completion, there will be more flow of pedestrian and vehicles. This can be countered by the realization of our foot over bridge. A steel lattice girder type foot over bridge is recommended for this site The main truss, roof truss and other components such as floor, top and bottom chord members, vertical and diagonal members, supporting beam, cross beam, stair, column, diagonal braces and slab base was designed and checked for safety. Also a proposal that foot over bridge (FOB) can be extended to the inside of railway yard and can be used to connect the passengers coming through the FOB's on both sides of FOB was given. The reason for this proposal is that the height of FOB inside railway yard is equal to the height of FOB. Also this will help to reduce construction and passenger movement complications in future.

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