INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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SPECIAL ISSUE FOR
NATIONAL LEVEL CONFERENCE
"SUSTAINABLE TECHNOLOGIES IN CIVIL ENGINEERING"

ANALYSIS OF PUSH BACK BRIDGE

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Accepted Date: 13/03/2015; Published Date: 01/04/2015

Abstract: The Underpass RCC Bridge is very rarely adopted in bridge construction but recently the Underpass RCC Bridge is being used for traffic movement. Hence constructing Underpass Bridge is a better option where there is a constraint of space or land. The bridges are structure, which provides means of communication over a gap. Bridges provided passage for vehicular or other type of traffic. The bridges are made of timber, stone masonry, brick masonry and reinforced cement concrete, pre-stressed concrete and steel. The timber bridges are used to short span, light load and for temporary purposes. The masonry bridges are used for short span. There are various types of RCC bridges, which are suitable for different spans and different conditions. In the past the bridges were mostly built in stone masonry or timber. The present day bridges are made in RCC, Pre-stressed concrete, structural steel or composite construction of RCC and structural steel. Bridges having very long spans are built in structural steel or pre-stress concrete whereas for moderate span bridges are constructed in RCC. Durability, economy in cost of construction and flexibility of giving derived aesthetic treatment makes concrete an ideal material for construction of bridges. Bridges made with concrete are therefore commonly recommended for highway as well as railways.

Keywords- Bridge

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Access Online On:

www.ijpret.com

How to Cite This Article:

Manisha D. Bhise, IJPRET, 2015; Volume 3 (8): 354-361

PAPER-QR CODE

INTRODUCTION

Bridges have always figured prominently in human history. They enhance the vitality of the cities and the cultural, social and economic improvement of the areas around them. Great battles have been fought for cities and their bridges. The mobility of army at war is often affected by the availability or otherwise of bridges. Bridges are Nations lifelines and backbones in the event of war. Bridges symbolize ideals and aspirations of humanity. They span barriers that divide, bring people, communities and transportation and facilitate commerce. Bridge construction constitutes an important element in communication and is an important factor in progress of civilization.

History of Bridge Development

The history of development of bridge construction is closed linked with the history of human civilization. Nature fashioned the first bridge. The tree fallen accidentally across the stream was the earliest example of a beam type bridge. Similarly the natural rock arch formed by erosion of the loose soil below was the earliest forever of the arch type bridge. Likewise the creepers hanging from tree to tree gave birth to suspension bridges. The primitive man imitated nature and learned to built beam and suspension bridges. Since the primitive man was a wanderer in search of food and shelter, the first structure he built was bridges.

Importance of Bridge

Bridges have always figured prominently in human history. They enhance the vitality of the cities and the cultural, social and economic improvement of the areas around them. Great battles have been fought for cities and their bridges. The mobility of army at war is often affected by the availability or otherwise of bridges. Bridges are Nations lifelines and backbones in the event of war. Bridges symbolize ideals and aspirations of humanity. They span barriers that divide, bring people, communities and transportation and facilitate commerce. Bridge construction constitutes an important element in communication and is an important factor in progress of civilization.

Classification of Bridges

Bridges may be classified in many ways, as follows-

a. According to material of construction of superstructure as timber masonry, steel, reinforced concrete and pre-stress concrete.

b. According to form or type of superstructure as slab, beam, truss, arch or suspension bridge.

c. According to inter span relation as simple, continuous or cantilever bridge.

d. According to position of bridge floor relative to superstructure as a deck, through, half-through or suspension bridge.

e. According to method of connection of different parts of superstructure particularly for steel structure as pin connected, riveted or welded bridge.

f. According to span length as culvert (less than 8m), minor bridge (8-30m) or long span bridge (more than 30m).

Mathematical formulation & Loading Details

width is taken center-to-center distance between vertical members is taken as effective span for the horizontal For the present study Two-dimensional cross sectional model is considered for the analysis. The analysis is carried out in Visual Basic language. For the cross section model two-dimensional cross section of unit of unit width is taken centre to centre distance between vertical members is taken as effective span for the horizontal members.

Load calculations:

For calculating imposed load Length of sleeper and Dispersion ballast are considered IRC code for calculating SF and BM. Considering broad gauge loading, main line. From Bridges rules, the dispersion of load through sleepers and ballast. For type B.G. sleeper The load under sleeper shall be assumed to be dispersed at a slope not greater than half horizontal to one vertical (1V:0.5H) and As per clause 2.3.4.2(b), distribution through RC slab when there is effective lateral transmission of shear, the load may be further distributed in a direction at right angle to the span of slab equal to ¼ spans on one side of the loaded area in the case of simply supported, fixed and continuous span.

Dispersion width =Length of sleeper +2+ (length of

box/4)

Equivalent Uniformly Distributed Load (EUDLL) for BM for live load for span 8 m =1193 kN from table 4.2 for 400 mm cushion.

Coefficient of dynamic augment (CDA)

CDA=0.15+ (8/ (6+Span))

UDL on top slab = weight x CDA/ (span x Dispersion width)

Geometric Properties

- Overall width of bridge = 24.30m
- Thickness of the top slab = 0.500m
- Thickness of the bottom slab = 0.500m
- Thickness of the vertical wall = 0.500m
- Thickness of wearing coat = 0.081m
- Effective horizontal span for Bridge =5.1+ 0.5 = 5.6m
- Effective vertical span =2.9+0.5 = 3.4m

Parametric Study

The Underpass Bridge has been analyzed for its self-weight superimposed dead load (due to wearing coat), live load (IRC Class AA Wheeled Vehicle) and earth pressure on sidewalls. The following loads to be considered for the analysis:

1. Dead Load

2. Live Load

3. Concentrated loads

4. Uniform distributed load

5. Weight of side walls

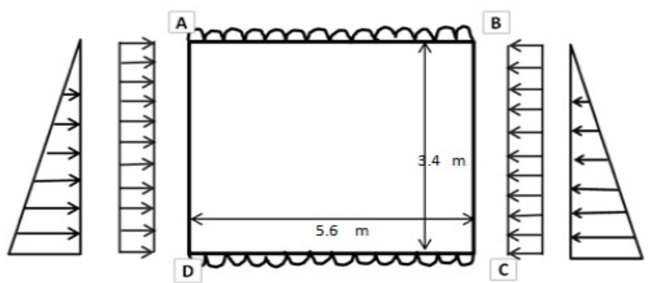
6. Earth pressure on vertical side walls

7. Uniform lateral load on side walls

Loads:

- Dead load (Including imposed load)

- Water pressure
- Earth pressure on vertical walls
- Live load (Above box) – Train load
- Live load (Inside box) – Class A 1 Train
- Live load (Inside box) – Class A 2 Train



The following load combinations are considered for the analysis:

- Dead load
- Dead load + Earth pressure
- Dead load + Water pressure + Earth pressure
- Dead load + Water pressure + Earth pressure + Train load
- Dead load + Earth pressure + Live load (Inside box) Class A1 Train
- Dead load + Earth pressure + Live load (Inside box) Class A2 Train
- Dead load + Earth pressure + Train load + Live load (Inside box) Class A 1 Train
- Dead load + Earth pressure + Train load + Live load (Inside box) Class A 2 Train

Load calculations:

For calculating imposed load Length of sleeper and Dispersion ballast are considered IRC code for calculating SF and BM. Considering broad gauge loading, main line. From Bridges rules, the dispersion of load through sleepers and ballast. For type B.G. sleeper The load under sleeper shall be assumed to be dispersed at a slope not greater than half horizontal to one vertical

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Dispersion width =Length of sleeper +2+ (length of box/4)

Equivalent Uniformly Distributed Load (EUDLL) for BM for live load for span 8 m =1193 kN from table 4.2 for 400 mm cushion.

Coefficient of dynamic augment (CDA)

CDA=0.15+ (8/ (6+Span))

UDL on top slab = weight x CDA/ (span x Dispersion width)

Loads on the top of slab:

Imposed load of track structure (Considering one track) is considered from IRC code to find out

Dead load of earth fill over the box =Area x Depth X Density

- Total vertical pressure on top slab= Imposed load + Dead Load + Live Load

Loads on sidewalls:

As per clause 5.7.1 of IRS code for substructure and Foundation

Density of soil = γ

Angle of internal friction = ϕ

Angle of friction between wall and soil (For concrete structure) (δ) =ϕ/3

i = Angle which the earth surface makes with the horizontal behind the earth retaining structure

Hence Angle of earth face with vertical (For Embedded Structure) (i) =0

Surcharge angle = 90o

- The coefficient of active earth pressure of the soil is given by the equation

$$Ka = \frac{\cos^2(\phi-\alpha)}{\cos^2\alpha \times \cos(\alpha+\delta) \times \left(1+\sqrt{\frac{\sin(\phi+\delta)-\sin(\phi-i)}{\cos(\alpha-\delta)-\cos(\alpha-i)}}\right)^2}$$

Earth pressure acting on the sidewalls:

Earth pressure due to backfill

Earth pressure center of top slab = $Ka \times \gamma \times H$

Earth pressure center of bottom slab = $Ka \times \gamma \times H$

Earth pressure due to dead load surcharge

Earth pressure acting on sidewalls:

At Top = Imposed load of track + Earth pressure on the top of slab + Live load

AT Bottom = Horizontal effect of surcharge +

Earth pressure center of bottom slab

Reaction at the bottom of box

Self weight of walls = weight of top slab+ weight of side walls+ weight of bottom slab

Total reaction at bottom = self weight of box +Live load on top slab + weight of imposed load

The forces acting on the box from all directions and the boundary condition are fixed.

Analysis of 2D Plain Frame

The values of max bending moments at mid span and at corner along with max Shear force for all the loading cases considered are tabulated below. The box type structure is analyzed as 2D model and obtained values for max bending moment and shear force.

The results is only for max value are getting during the analysis are as below.

RESULTS AND DISCUSSIONS

The analysis of 2-D frame model is carried out for without soil stiffness

Sr. No.	Load Combination	Max.SF kN	BM at Mid Span kN-m	BM at corner kN-m
1	Dead load	251.02	346.46	155.60
2	Dead load + Earth pressure	304.13	370.50	237.75
3	Dead load + Water pressure + Earth pressure	304.13	391.01	217.24
4	Dead load + Water pressure + Earth pressure + Train load	456.33	572.72	339.94
5	Dead load + Earth pressure + Live load (Inside box) Class A1 Train	302.71	358.8	244.02
6	Dead load + Earth pressure + Live load (Inside box) Class A2 Train	304.09	342.47	256.49

CONCLUSION

From the analysis of 2-D frame model without soil stiffness and with soil stiffness the results for BM at mid span are differ for top slab 5.3%. A 2D model can be effectively used for analysis purpose for all the loading condition mentioned in IRC: 6 and Directorate of bridges & structures (2004),"Code of practice for the design of substructures and foundations of bridges" Indian Railway Standard.

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