International Journal of
Emerging Research in Management &Technology
ISSN: 2278-9359 (Volume-4, Issue-4)

Research Article

April 2015

Parametric Study of Underpass Bridge

[1] Mohankar R. H.[*], [2]Pidurkar M.D, [3]Pathan Mohd. G.
[1, 2, 3]Assistant Professor, P.J.L. College of Engineering,
Dehradun, India

Abstract—

The bridges are structure, which provides means of communication over a gap. The Underpass RCC Bridge is adopted in bridge construction and used for traffic movement and control. It is very rarely adopted in bridge construction but recently the Underpass RCC Bridge is being used for traffic movement. Since the availability of land in the city is less, such type of bridge utilizes less space for its construction. Hence constructing under pass Bridge is a better option where there is a constraint of space or land.
The model is analyzed with two dimensional without soil stiffness and with soil stiffness considering spring constant. As the box structure directly rests on earth surface, soil pressure acts at the walls as well as on top. It is important to study the soil structure interaction. Here we show a 3D model can be effectively used for analysis purpose.

Keywords— Underpass RCC Bridge, spring constant, soil stiffness.

I. INTRODUCTION

The underpass bridges was constructed and designed from decades. It provides best suitable facility for transportation in different situations such as, for crossing highways and railways by wild animals, providing access for pedestrian and different modes of transportation.

For bridges in urban areas or other areas that are likely to see increased development, this may require additional width and accommodations for bicycles and pedestrian modes of travel on or under a bridge.

The model is analyzed for bending moment and shear force for different loading combinations as per IRC: 6-2010 standards. As the box structure is push into the soil, soil pressure acts at the sidewalls as well as on top. It is important to study the soil structure interaction of such structure. To study the response of structure with rigid supports, with soil structure interaction applied to base only results and with soil structure interaction applied to base and side walls of the structure.

II. ANALYSIS OF 3-D PLAIN FRAM

The 3-D model is analyzed in SAP. The values of max Bending moments at mid span and at corner along with max Shear force for maximum load case considered are tabulated below. The box type structure is analyzed as 3D model and obtained values for max. Bending moment and shear force.

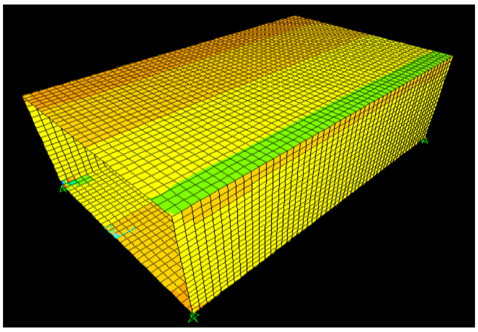

Figure 2.1 Stresses for S.F.

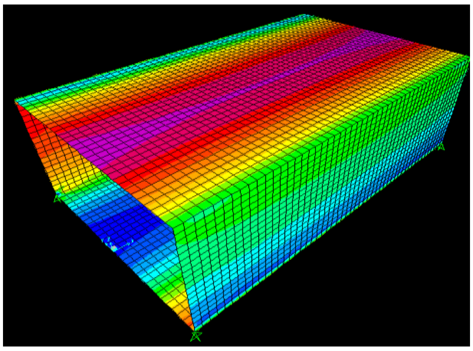

Figure 2.2 Stresses for B.M.

2.1 Result of 3-D Model

The max BM and SF obtained for 3-D model considering without soil stiffness are shown in table.

Table 2.1 Comparison of Max BM and Max SF of 2-D model and 3-D model of the box

Max BM of 3D model without soil stiffness		
Member	Results	Max BM of 3D model without soil stiffness(kN-m)
TOP SLAB	Max SF	458.85
	BM at Mid Span	530.49
	BM at Corner	413.63
BOTTOM SLAB	Max SF	282.49
	BM at Mid Span	377.87
	BM at Corner	154.14
SIDE WALLS	Max SF	78.93
	BM at Mid Span	220.74
	BM at Corner	413.63

III. ANALYSIS BY CONSIDERING SPRING CONSTANT FOR SOIL STIFFNESS

The analysis of the box by conventional method is done without considering the stiffness of the surrounding soil. But as the soil affects significantly the behavior of the box, it should be considered in the analysis. In conventional method of analysis it is not possible to account soil stiffness and thus will give much approximate results. In the analysis by FEM the soil stiffness can be accounted by applying the springs of specific stiffness all over the area of box in contact with soil. Thus it gives much realistic approach to get the results closed to exact.

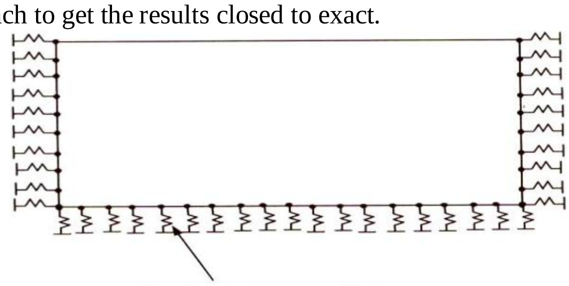

FIGURE 3.1 FEM MODEL OF THE FRAME

The stiffness of the surrounding soil is the function of the modulus of sub grade reaction of the soil and can be calculated as fallows.

For present case, **Medium dense soil** has been considered with modulus of sub-grade reaction as 9600-80000 kN/m2

3.1 Result of 3-D Model considering Soil Stiffness

The analysis of **3D** model can be done for most critical load case for 8000kN-m of soil stiffness and values of bending moment and shear force can be tabulated below.

Table 3.1: SF and BM for different ranges of soil stiffness

x BM of 3D model with soil stiffness (8000kN-m)		
Member	Results	Max BM of 3D model with soil stiffness(kN-m)
TOP SLAB	Max SF	461.75
	BM at Mid Span	434.25
	BM at Corner	373.48
BOTTOM SLAB	Max SF	253.23
	BM at Mid Span	215.78
	BM at Corner	81.46
SIDE WALLS	Max SF	130.69
	BM at Mid Span	135.69
	BM at Corner	373.48

IV. Comparison of Analyzed Result

The comparison of the max BM and SF obtained with considering soil stiffness and without soil stiffness for 3D model are compared with its member as Top slab, Bottom slab and Side wall shown in table 4.1.

Table 4.1: Comparison of 3-D frame model without soil stiffness and soil stiffness

Member of box	Parameter	3-D Model Without soil stiffness	3-D Model With soil stiffness	% Dev.
Top slab	Max SF	458.85	461.75	-0.63
	BM at Mid Span	530.49	434.25	18.14
	BM at corner	413.63	373.48	9.71
Bottom slab	Max SF	282.49	253.23	10.36
	BM at Mid Span	377.87	215.78	42.90
	BM at corner	154.14	81.46	47.15
Side walls	Max SF	78.93	130.69	-65.58
	BM at Mid Span	220.74	135.69	38.53
	BM at corner	413.63	373.48	9.71

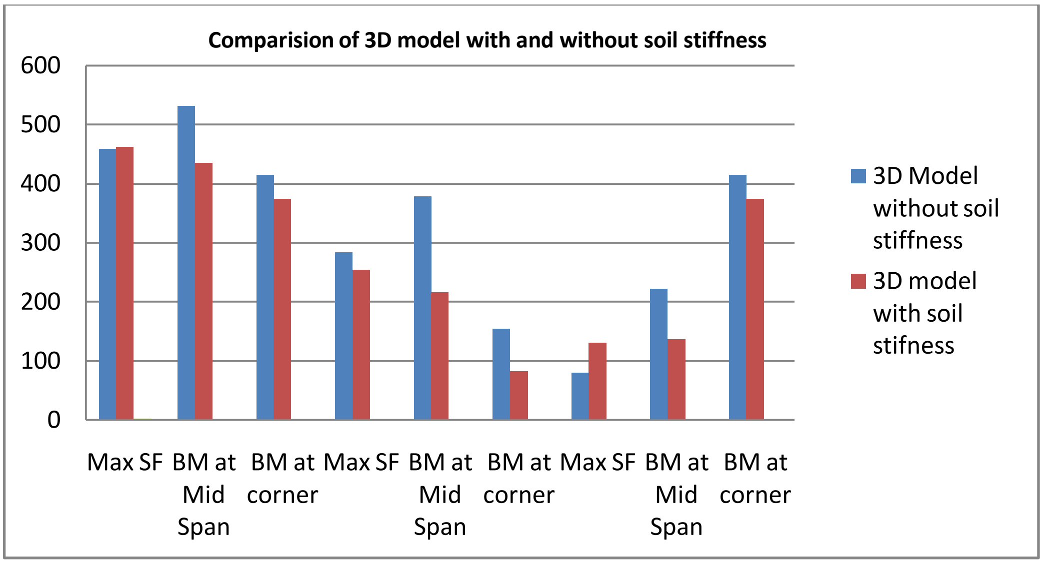

Figure 4.1: Comparison of 3-D frame model without soil stiffness and soil stiffness

V. Conclusion

1. From the analysis it can be observed that for 3-D model with soil stiffeners the results related to BM at corner, at mid-span and S.F. is less.
2. Percentage deviation for maximum shear force of top slab is 0.63, for bottom slab is 10.36 and for side walls is 65.58.
3. Percentage deviation for maximum bending moment at mid span of top slab is 18.14, for bottom slab is 42.90 and for side walls is 38.53.
4. Percentage deviation for maximum bending moment at corner of top slab is 9.71, for bottom slab is 47.15 and for side walls is 9.71.
5. It is also concluded that by providing soil stiffeners values of shear force and bending moment get reduces.

References

[1] Mohankar.R.H, Ronghe.G.N, "Analysis and Designof Underpass RCC Bridge" International Journal Of Civil And Structural Engineering Volume 1, No 3, 2010

[2] THOMAS C. SANDFORD "Soil-Structure Interaction of Buried Structures"A2K04: Committee on Subsurface Soil-Structure Interaction

[3] N. Krishna Raju, "Design Of Bridges" (2009), Oxford & IBH Publishing Pvt. Ltd. New Delhi.

[4] IRC: 21:2000, "Standard Specifications And Code Of Practice Road Bridges" The Indian Road Congress.

[5] IS 456:2000, "Plain and Reinforced Concrete Code For Practice" Bureau Of Indian Standards.

