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Comparative Analysis and Design of Voided Deck Slab and T-Beam Deck Slab for Short Span Bridges Using Midas Civil Software

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ABSTRACT: The thesis basically deals with the analysis and design of conventional T beam deck slab and the voided deck slab of bridge for short bridge span of 15 m for both the designs. Incorporating voids into the deck slab has various benefits over a traditional solid concrete slab, including cheaper construction costs overall, less wasteful material use, and improved structural effectiveness. In solid slabs, voids are added to the concrete section to lower the self-weight of the material without reducing its flexural strength with the guidelines provided in the IRC:SP:64-2016. The structure's voids, however, make it more difficult to analyse. In this project the MIDAS CIVIL software is used for the analytical investigation. It is stated that using rectangular gaps in a solid slab is acceptable for the span under consideration and more cost-effective than using a conventional deck.

KEYWORDS: Voided deck slab, T beam, Midas civil

I. INTRODUCTION

The surface of a bridge is called a deck. It is a structural component of its superstructure.A cellular deck has cells that are enclosed by a number of thin slabs and webs. When performing analysis, a box girder deck is one in which the deck forms the top of the box girder. The voids can have any shape, including circles. It should be noted that the voids are typically created using polystyrene, thick cardboard, thin wood, or thin metal, and that these void formers are typically not releasable, increasing the cost of the void-filled slab. Additionally, because the ends of the voids must be closed for shear consideration, it is impossible to evaluate the structure inside the void portion.

In tee beam bridges, the deck portions on each side of the top of the beam are integrated cast-in-place reinforced concrete beams. The beamscross sections are deeper than their corresponding deck sections, creating the T-shape that lends them their names. To withstand tension (the forces that would cause the beam to pull apart), the main reinforcing steel is positioned lengthwise in the bottom of the beam. The deck that makes up the top of the T-shape is compressed.

The latter are built similarly to solid composite slabs, but before the in-situ concrete is applied, void formers are inserted between the webs of the precast beams. In solid slabs, voids are added to the concrete section to reduce the self weightof the material without reducing its flexural strength.Compared to a traditional solid concrete slab, this technique has various benefits, including less material waste, a cheaper overall construction cost, and higher structural effectiveness.

Fig.1. Voided deck slab

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II. RELATED WORK

B. Vaignanetal.[1].In this project, an experiment has been carried out utilizing the Midas-civil software, employing the voids as 60% of the entire depth of deckand analyzing it in accordance with several Indian codes. Brajesh Kumaret al. [2] This paper by above authors illustrates that concrete bridge decks sometimes have circular gaps added to them to minimize self-weight while maintaining flexural rigidity by including spaces in the Compared to a traditional solid surface, deck slab has several benefits concrete slabs, which minimize building costs overall and material costs use of materials and improved structural effectiveness.In [3],the authors Kunal Songra etal. have done the comparison of the applications of Voided Slab, RCC Solid Slab, and RCC Girder forms the core of this thesis. In this study, a superstructure with a 20-m length is analyzed and the costs of RCC Solid slab deck, RCC Voided slab deck, and RCC Girder are compared.Ramesh PurushottamRampariya et.al.[4]. This paper by above authors deals with, how to use voided slab of a bridge and this paper presented crucial methods for lessening the dead weight of the concrete by utilizing gaps in areas where it does not contribute to the structural integrity.In [5], The purpose of this research is to apply the grillage analogy approach to evaluate prestressed horizontal curved solid and voided slab for 25 m bridge span. The research shows how bending moments, shear force, and displacement due to curvature change behave under different load situations of solid and voided deck slabs.

III. METHODOLOGY

In this project the use of rectangular voids has been designed and analyzed for 15 m length and 10.5 m width for the bridge.The voided slab bridge under consideration is a 15 m-long RCC cast-in-place, simply supported bridge. Structural analysis and design is done for voided deck slab bridge to reduce the self weight of the solid slab which is not performing any structural function in the middle portion. Designs are carried out using MIDAS CIVIL software. For the validation of results, the components of bridge are manually designed. The main objective of this study is to compare the analysis and design results of voided deck slab and T-beam deck slab for short span bridges using Midas civil software. The analysis is done for dead load, live load and impact load.

Design of tee beam and bridge deck slab

Table 1. Data

SL.NO.	BRIDGE DETAILS	MEASUREMENTS
1	Span	15m
2	Road width	7.5m
3	Footpath width	1.5m on each side
4	WC thickness	80mm=0.08m
5	Design loading (LL)	IRC Class AA
6	Longitudinal girders	At 2.5m intervals
7	Total road width	10.5m
8	Deck thickness	0.25m
9	Concrete density	$25kN/m^3$
10	Concrete grade	M 35
11	Steel grade	Fe500

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Design BM & SF

Table 2. BM&SF

BM	DL BM	LL BM	Total BM	units
Outer girder	1184.156	971	2155	kN-m
Inner girder	1184.156	747.1	1931.2	kN-m
SF	**DL SF**	**LL SF**	**Total SF**	**units**
Outer girder	279.225	278	557	kN
Inner girder	279.225	400	679	kN

Design of voided deck slab

Table 3. Data

Description/ Void's shape	
No.of voids	5 no.s
Size of void	600x400 mm
Area of void	0.6x0.4=0.24 m^2
For 5 voids	5x0.24=1.2 m^2
Depth of deck	1.2m

Table 4. Criteria for dimension checks for rectangular voids as per IRC:SP:64-2016

Cl.no.	Description	Dimensions	Check
3.1.1	Center-to-center void spacing should not be less than the slab's overall depth.	1240<1200 mm	OK
3.1.4	For rcc slab, thickness of concrete above and below the void should not be less than 175mm	400mm>175 mm	OK
4.1.1	Void ratio is < 40%, hence acts as solid slab	2% for 15m <40%	OK

Table5. Reinforcements

	Mid-section	Support to start of void
Top flange	12mm ϕ at150 mm c/c	10 mm ϕ at 100 mm c/c
Bottom flange	12mm ϕ at 150 mm c/c	10 mm ϕ at 100 mm c/c

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IV. EXPERIMENTAL RESULTS

Table 6. BM results

Max BM for T girder	Max BM for voided deck slab	Unit	Check
1010 (+ve)	790 (+ve)	kN-m	+ve BM is more in conventional T girder. Hence, Satisfied
531 (-ve)	247 (-ve)	kN-m	-ve BM is more in T girder. Hence, Satisfied

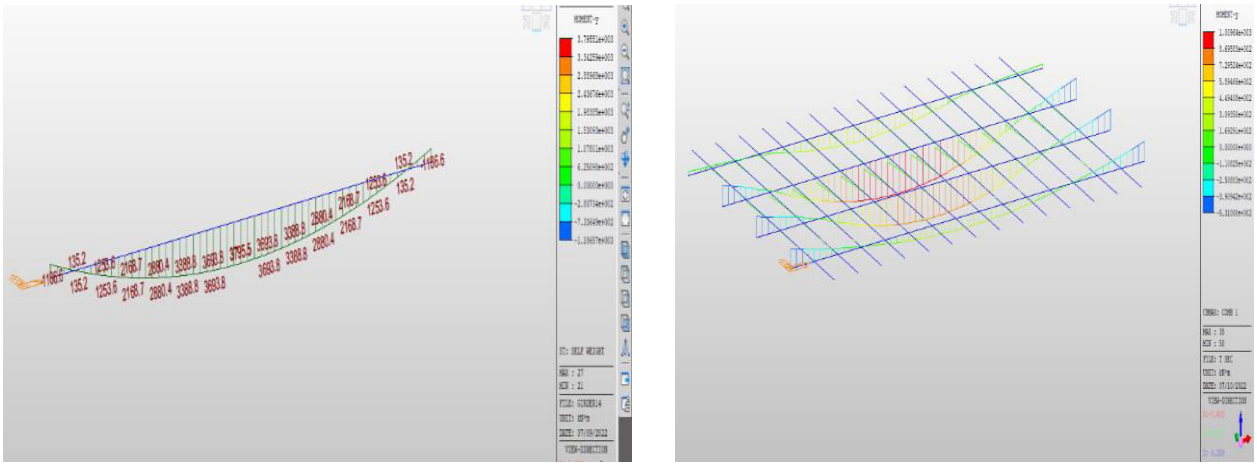
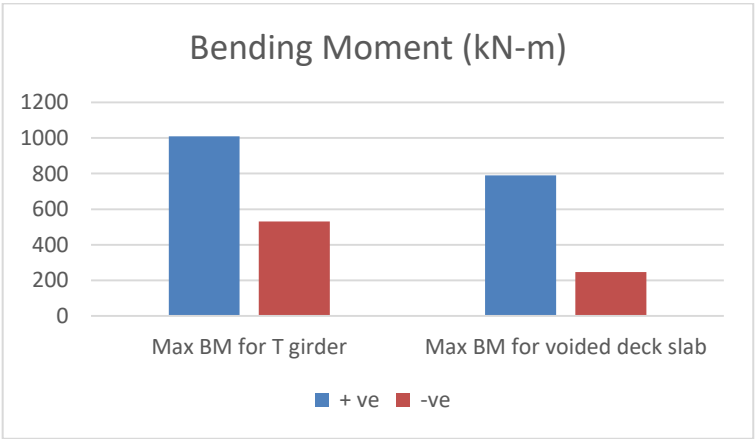


Fig.2. Results showing BM diagram of T beam and voided deck slab

Chart 1. Bending moment



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V. CONCLUSION

After the analysis and design of the voided deck slab bridge and tee beam bridge deck, the following conclusions are arrived:

- Bridge of span 15m and width 10.5m was studied using voided deck slab and T Beam deck. It was found that, response of the voided deck slab bridge is efficient as compared to the T beam bridge deck slab.
- It became apparent from the study that how the employment of various shapes of voids in the deck slab affects the bending moments, shear forces, reactions, and displacements in the bridge structure.
- Understanding the crucial load location and combinations that control the overall design has been made easier by detailed investigation of the IRC loadings.
- Compared to a normal T-girder deck slab, the beam forces of a voided deck slab produce lower values in Mz.
- So, the best way to support greater weight than a normal slab with the same size is a rectangular-shaped voided deck.

SCOPE FOR FUTURE STUDIES

The same work can be extended for higher spans and higher void ratio (> 40%) to obtain the optimum results.The work can further be carried out by using different void shapes and software.

REFERENCES

[1] Vaignan B and Prasad B. S. R. K, "Analysis of voided and cellular deck slab using Midas civil", IJERT, Vol. 3 Issue 9, September- 2014

[2] Brajesh Kumar, Pankaj Singh, Ravindra Gautam, "Analysis and design of voided Slab Bridge", IJTRD 2020

[3] Kunal Songra, Paliwal M. C., "Comparative analysis and design of voided slab and RCC I girder with solid slab in bridge structure", IJTSRD, Volume 5 Issue 6, September-October 2021

[4] Ramesh PurushottamRampariya and Rohan Kumar Choudhary, "Use of voided slab for bridge deck", AEGAEUM JOURNAL, Volume 8, Issue 7, 2020

[5] Rajeev Ranjan and Pankaj Singh, "Analysis of prestressed solid and voided slab type bridge superstructure on curved alignment", IJTRD 2020

[6] Diksha Kamble, Vedika Kadav, Rohit Kharat, Vishwas Dhas, Reetika Sharan, Reshma Shaikh, "Design and analysis of river bridge deck slab at Vangani-Karav-Pashane", IRJET, Volume: 06 Issue: 04, Apr 2019

[7] Prathap. D, Mohammed Rafi. D, "Structural design and stability analysis of a high-level voids bridge", IJIRSET, Vol. 5, Issue 12, December 2016

[8] Abhishek Gaur, Ankit Pal "Parametric study of RC deck slab bridge with varying thickness: A conceptual review", 2019, IRJET

[9] Mahesh Pokhrel "Comparative study of RCC T-girder bridge with different codes", A thesis, february, 2013

[10] Bandi Lavanya Reddy, KankalaNarendar "Design and comparative analysis of conventional slab and voided slab lightened with polypropylene", Volume: 07 Issue: 05, May 20202020, IRJET

[11] Bridge Super Structure by N. Rajagopalan

[12] Design of bridges fifth edition by N Krishna Raju. Oxford and IBH publishing Co. Pvt Ltd.

[13] IRC SP:64-2005 Guidelines for the analysis and design of Cast-in-place voided slab superstructure

[14] IRC 6, Standard specification and code of practice for road bridges section II Loads and stresses, The Indian Road Congress, 2014.

[15] IRC:21, "Standard Specifications and Code of Practice for Road Bridges", Section III,2000.

[16] SP 16: Design Aids for Reinforced Concrete", Bureau of Indian Standards New Delhi.

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