International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | Jun 2022 www.irjet.net p-ISSN: 2395-0072

# ANALYSIS OF BRIDGE DECK SLAB WITH CERAMIC MATRIX COMPOSITE BARS AS REINFORCEMENT

**Riswana M.H[1], Jinu V.R [2]**

*[1]PG student, KMEA Engineering college, Edathala P.O, Aluva, kerala, India*
*[2]Assistant professor, Civil Department, KMEA Engineering college, Edathala P.O, Aluva, Kerala, India*

---

**Abstract –** *Current study of bridge deck slab includes the modal and transient analysis of bridge deck slab subjected to moving load by using ANSYS software. This method can be a viable and reliable tool for bridge deck slab analysis. In this paper two different materials such as CVI-C/Sic and LPI-C/Sic are replaced instead of steel reinforcement. Also analysis was done with combination of these material. The purpose of this study is to assess the total deformation and equivalent stress in bridge deck. Nonlinear analysis in structural elements are performed using the ANSYS workbench.*

***Key Words***: **Bridge deck slab, Finite element analysis, Ceramic matrix composite, natural frequency**

## 1. INTRODUCTION

The bridge can also be evaluated with laboratory experiments, field test and analytical tools. Fatigue is the progressive deterioration of a structure caused by an increase in a fracture that results in a series of stress change. Repetitive loads, such as during traffic and heavy vehicles on bridge sections. Crossing bridge decks must withstand one of the most damaging types of live loads, such as centralized and direct. The primary function of the deck is to distribute these force in a convenient manner. The present study used to examine the total deformation and equivalent stress of bridge deck under varying reinforcement materials. In the analytical method the accuracy of the outcome depends on the ability to stimulate the problem.

## 2 MODELING USING ANSYS

The finite element analysis modelling is done using ANSYS software. 6 degree of freedom 3D element is used for concrete material and Beam element as reinforcement. The depth of slab is 200mm. Reinforced concrete bridge modelling is carried out by ANSYS design modular. Material properties of deck slab are given in table 1.

### 2.1 DECK SLAB DETAILS

**Table -1:** Material properties of deck slab

| Properties | CVI-C/Sic | LPI-C/Sic | Concrete |
|---|---|---|---|
| Young's modulus | 65000MPa | 95000 MPa | 3000 MPa |
| Poisson's ratio | 0.3 | 0.3 | 0.18 |
| Bulk modulus | 54167MPa | 79167 MPa | 15625 MPa |
| Shear modulus | 25000MPa | 36538 MPa | 12712 MPa |

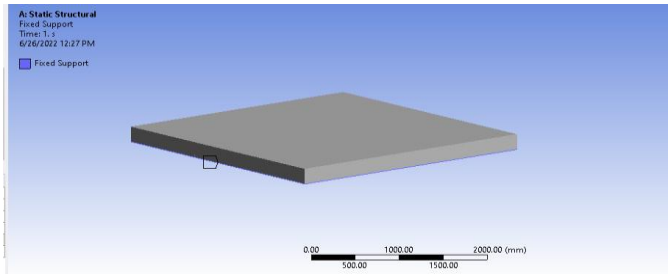


**Fig -1**: Modelled view of deck slab with CVI-C/Sic material

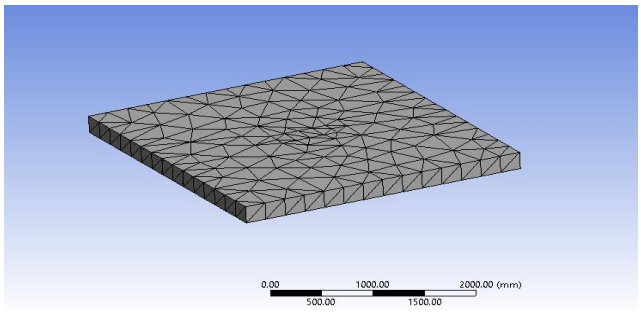


**Fig -2**: Tetrahedral meshing of modelled deck slab

From figure 1 the modelled view of deck slab with CVI-C/Sic material can be seen. Figure 2 shows the meshing of modelled slab and Figure 3 shows the boundary conditions of deck slab. In these a 20 mm displacement is applied in X-direction. Here fixed support is provided.

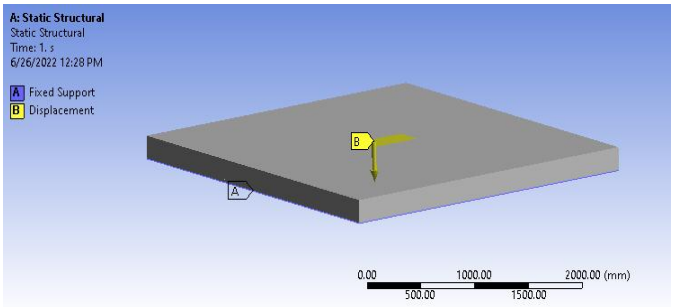


**Fig -3**: Boundary condition

### 2.3 ANALYSIS USING VARIOUS MATERIAL

Material such as CVI-C/Sic, LPI-C/Sic and steel are used. From these, replacement of reinforcement fully with various materials were carried out. Figure 4 shows the replacement of reinforcement fully with CVI-C/Sic material, Figure 5 shows the replacement of reinforcement fully with LPI-C/Sic material, Figure 6 shows the replacement of reinforcement fully with Steel material.

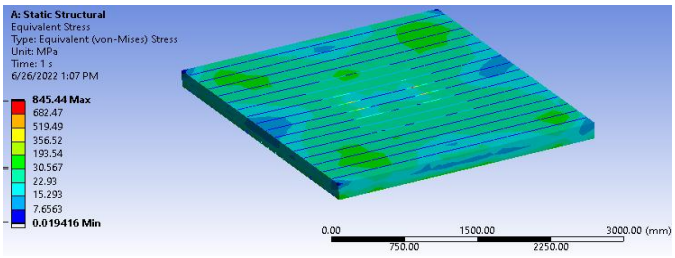


**Fig -4**: Equivalent Stress of CVI-C/Sic material

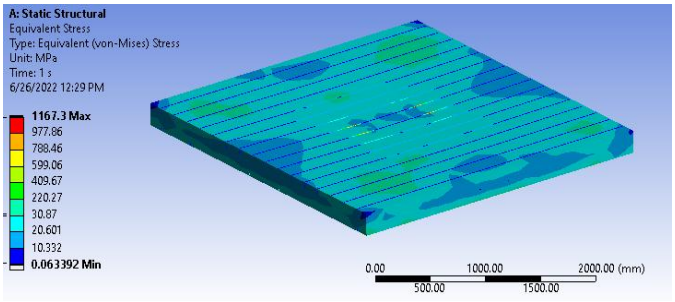


**Fig -5**: Equivalent Stress of LPI-C/Sic material

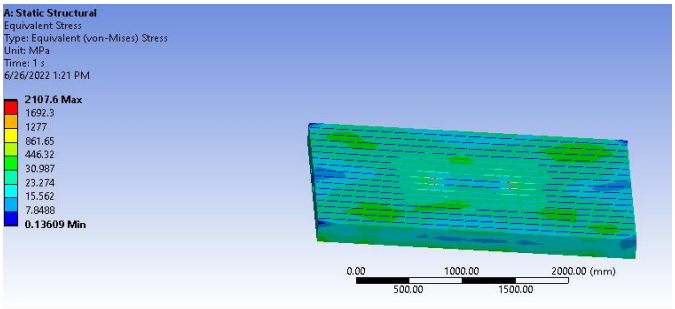


**Fig- 6**:Equivalent Stress of Steel material

Figure 7 shows the stress, when replacement of reinforcement with CVI-C/Sic and steel material. Figure 8 shows the stress, when replacement of reinforcement with CVI-C/Sic and LPI-C/Sic material. Figure 9 shows the stress values, when replacement of reinforcement with LPI-C/Sic and Steel material.

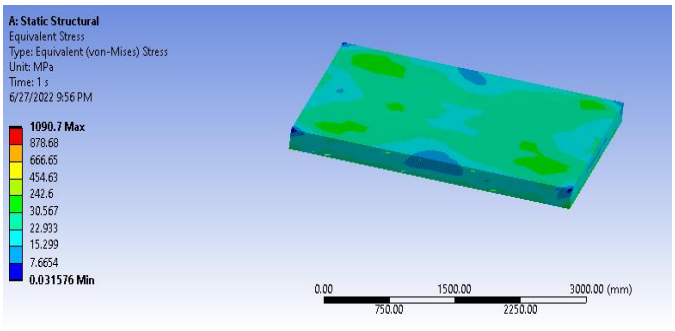


**Fig -7**: The Equivalent stress after replacement of reinforcement with CVI-C/Sic and steel material

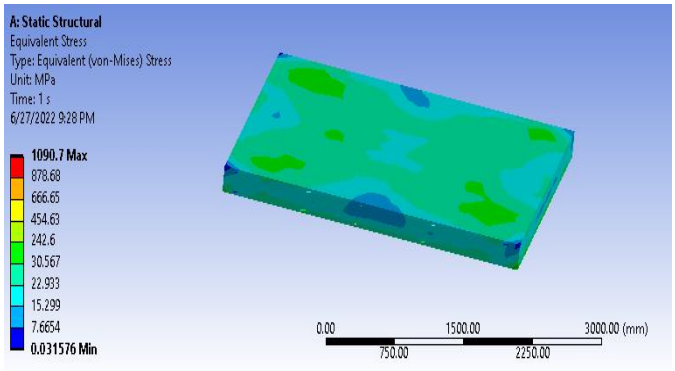


**Fig -8**: The The Equivalent stress after replacement of reinforcement with CVI-C/Sic and LPI-C/Sic material

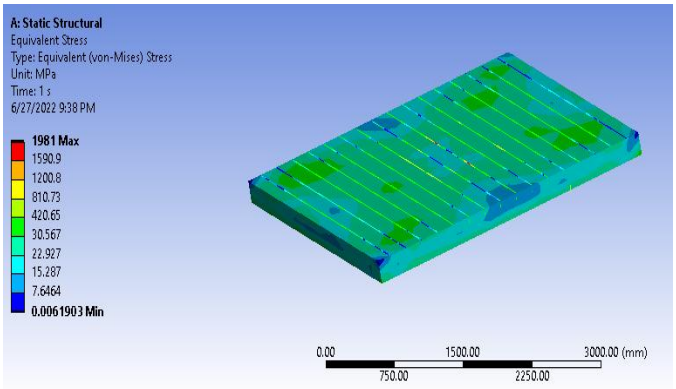


**Fig- 9:** The Equivalent stress after replacement of reinforcement with LPI-C/Sic and Steel material

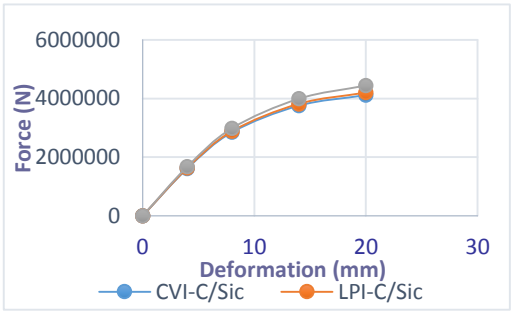


**Chart -1:** Comparison of various reinforcement material used in deck slab

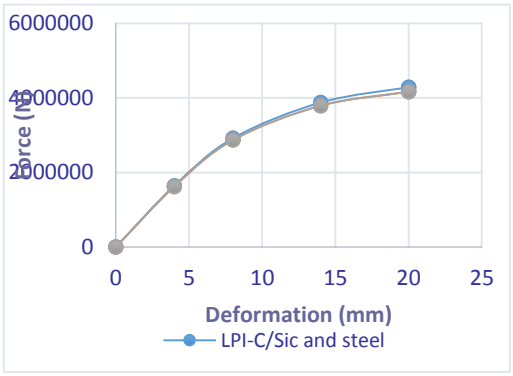


**Chart -2:** Combination of various reinforcement material used in deck slab

## 3. CONCLUSIONS

Analysis of the deck slab bridge as per IRC codes can be easily done by ANSYS workbench 2021R2.

- The total deformation and equivalent stress of each model can be easily examined by these analysis.
- In first objective of project, replacement of reinforcement is done with different materials and the result shows that steel has a better yield.
- In second objective of project, replacement of material with combination of different materials, LPI-C/Sic and steel shows the better result.

## ACKNOWLEDGEMENT

I wish to thank the Management, Principal and Head of Civil Engineering Department of KMEA Engineering College, affiliated by Kerala Technological University for their support. This paper is based on the work carried out by me (Riswana M.H), as part of my PG course, under the guidance of Jinu V.R (Assistant Professor, KMEA Engineering College, Edathala, Aluva). I express my gratitude towards her for valuable guidance.

## REFERENCES

1. Amsa M, Divya G, "Design and Analysis of Path Over Bridge by Using Staad Pro", International Research Journal of Engineering and Technology (IRJET), Volume: 05, Issue: 09, Sep 2018.
2. Helu Yu, Bin Wang, "Road Vehicle-Bridge Interaction considering Varied Vehicle Speed Based on Convenient Combination of Simulink and ANSYS", Hindawi, Shock and Vibration, Volume 2018, Article ID 1389628, 14 pages.
3. Bhagwant Singh Siddhu, "Design and Analysis of Bridge Structure using Staad-Pro", Journal of Engineering andApplied Sciences, 2017.
4. Prashant S. Patil, "A comparative study of steel girder bridge with FRP using ANSYS", VJER-Vishwakarma Journal of Engineering Research, Volume 1 Issue 2, June 2017.
5. Ajinkya S. Shah, Srinivas R. Suryawanshi, "Response of steel deck bridge under influence of moving load using FRP", IJSDR, Volume 1, Issue 5, 2016.
6. Iqra Zaffar, Priyanka Singh, "Analysis and Design of Deck Slab Bridge", Journal of Civil Engineering and Environmental Technology, Volume 3, Issue 6; April-June, 2016, pp. 517-522.
7. Habeeba A, Sabeena M.V, "Fatigue Evaluation of Reinforced Concrete Highway Bridge", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 4, April 2015.
8. Prateek S. Hundekar, Dilip K. Kulkarni, "Performance Based Analysis of Bridge Deck for Distinctive Girder Types" ,international Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 8, August - 2014.
9. Shwetha, Siddesha H, "Vibration Response of Deck Slab", Proceedings of Twelveth IRF International Conference, 31st August 2014.