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VIBRATION ANALYSIS OF STEEL DECK

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Abstract: Most human activities involve vibration in one form or other. For example, we hear because our eardrums vibrate and see because light waves undergo vibration. Breathing is associated with the vibration of lungs and walking involves (periodic) oscillatory motion of legs and hands. Human speech requires the oscillatory motion of larynges (and tongues). Early scholars in the field of vibration concentrated their efforts on understanding the natural phenomena and developing mathematical theories to describe the vibration of physical systems. In recent times, many engineering applications of vibration, such as the design of machines, foundations, structures, engines, turbines, and control systems. On the basis of typical theory on vibration analysis between bridge and vehicles, finite element model of bridge with FRP is established by ANSYS software. Through the numerical simulation analysis dynamic response characteristics of the bridge body are acquired when the vehicle passes through the bridge at different speeds and different frequents, and inner force of bridge is gotten. These will provide reference for improving the vibration control measures of bridge under moving loads.

Keywords: *Vibration analysis, Bridge, ANSYS*

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I INTRODUCTION

Most prime movers have vibrational issues because of the intrinsic unbalance in the motors. The unbalance might be because of broken structure or poor assembling. Awkwardness in diesel motors, for instance, can cause ground waves adequately ground-breaking to make an annoyance in urban zones. The wheels of certain trains can rise in excess of a centimeter off the track at high speeds because of awkwardness. In turbines, vibrations cause astounding mechanical disappointments. Architects have not yet had the option to forestall the disappointments that outcome from edge and circle vibrations in turbines. Normally, the structures intended to help substantial outward machines, similar to engines and turbines, or responding machines, similar to steam and gas motors and responding siphons, are additionally exposed to vibration. In every one of these circumstances, the structure or machine part exposed to vibration can fall flat due to material exhaustion coming about because of the cyclic variety of the instigated pressure. Moreover, the vibration causes progressively fast wear of machine parts, for example, course and outfits and furthermore makes over the top commotion this section considers just lumped parameter frameworks made out of perfect springs, masses, and dampers wherein every component has just a solitary capacity. In translational movement, removals are characterized as direct separations; in rotational movement, relocations are characterized as rakish movements.

A. What is an FRP bridge deck?

A number of terms commonly used to describe a bridge's superstructure are illustrated in Figure shown below the components of the bridge above the bearings are referred to as superstructure, while the substructure includes all parts below. The main body of the bridge superstructure is known as the deck and girders/beams (Fig 1.). An FRP bridge deck in this discussion is defined as a structural element made from FRP materials that transfers Times transversely to the bridge supports such as longitudinal running girders, cross beams, and/or stringers that bear on abutments.

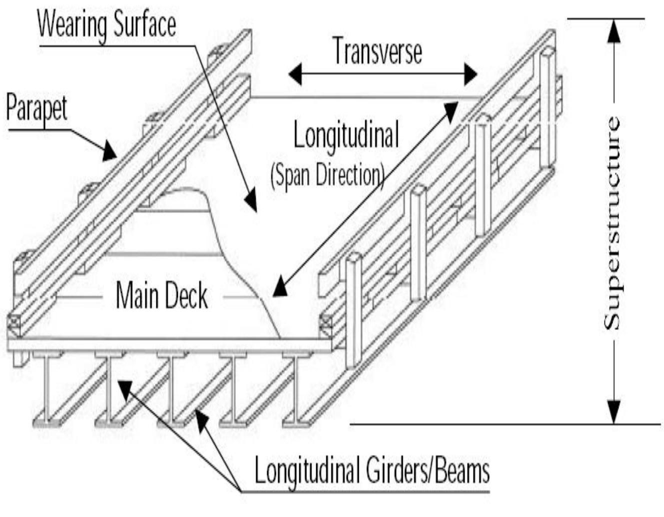


Fig.1 Superstructure of a bridge illustrating bridge engineering terms

Different from conventional construction materials, FRP is an engineered material. Engineers can design the material properties and structural shapes of FRPs based on their requirements. Therefore, it is essential to know the composition of FRP material. FRP material consists of two major components: a polymer matrix resin and fiber reinforcements. Fillers and additives, as a third component, can improve certain characteristics of the final product.

B. Objectives

Within this over all aim the main objectives are defined as below,

1. Study of steel girder bridge under influence of moving Time in accordance with IRC.

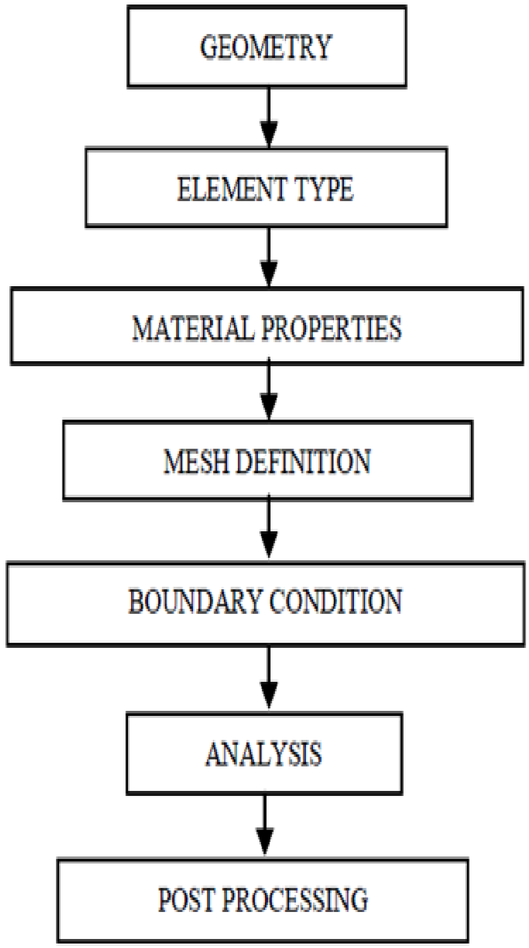
2. To analyses design parameters such as type of truss, bridge behavior using finite element modeling tool in ANSYS and its verification.

3. To check Response of steel deck bridge under influence of moving Time using FRP.

II. LITERATURE REVIEW

Mr.Powar A.R., Mr. Vibration of an extension structure under the section of vehicles is a significant thought in the plan of scaffolds. Mohamad Ibrahim Zaed Ammar, Endah Wahyuni (2016). Scaffolds have manufactured quite a while it is dynamic on the planet. What's more, vibration can impact wellbeing just as solace of clients and breaking point functionality of the scaffold. Lipeng Ana, Dejian Li , Peng Yua, Peng Yuan[2016]. Based on oneself gathered Fortran program and scaffold building, the dynamic reaction of long range persistent brace connect under vehicle Time was considered. This investigation additionally incorporated the computation of vehicle sway coefficient, assessment of vibration solace, and examination of dynamic reaction parameters. Yufen Zhou, Suren Chen[2016]. The proposed philosophy is then applied to a model long range link stayed extension and traffic framework to show the proposed ride comfort valuation procedure. The impacts of dynamic cooperations, nearness of different vehicles and wind excitations on the ride comfort are likewise numerically assess. Patel S G Vesmawala G R [2015]. Vibration testing of extensions can give exceptionally accommodating data dependent on the conduct and execution during its administration life. J. Zwolski Wroclaw P. Constrained vibration test is a technique empowering us to break down the progressions of dynamic attributes of steel connects structures. Thiri Phyoe Dr. This paper presents vibration examination of steel bracket connect under different moving Times by utilizing STAAD-Pro Software. The considered Timings on connect are dead Times, live Times, wind Time, sway impact, seismic impact and temperature impact. Luca Della Longa Antonino ,Morassi Anna Rotaris [2014]. The strategy for partition of factors is Used to discover careful answers for a class of free vibrations of the structure. An examination among systematic and trial common frequencies and vibration methods of the scaffold is introduced and talked about. Geert Lombaert1, Joel P. Vehicle-connect communication has been read for quite a while to explore the basic conduct of extensions and vehicle ride comfort. Aswani M. Panicker and Alice Mathai[2013]. Fiber-fortified polymer FRP composite extension deck boards are high-quality, consumption safe, climate safe, and so on . Tests were led on 16 FRP composite deck boards and four strengthened cement customary deck boards.

III. METHODOLOGY



A. Problem Statement

In this chapter the steel deck bridge analyses with effective span 35m, slab thickness 100 mm and section area 85. 91cm^2.The deck having depth of section(h) 350mm, width of flange (b) 250mm, thickness of web (tw) 8.3 mm Ixx=19159.7 cm^4, Iyy=2451.4cm^4 rxx=14.93cm ryy=5.34, w=67.4kg

B. Material Property

- **STEEL**

  Yield strength, fy= 248 MPa (33 ksi)

  Modulus of elasticity, Es= 200 GPa (29,000 ksi)

- **CONCRETE**

  Modulus of elasticity, Ec =26.3 GPa (3.81 ksi)

- **FRP**

  Modulus of elasticity, E = 30 GPa

  Ultimate tensile strength, Xt =1700 MPa

  Ultimate compression strength, Xc = 639.54 MPa

  Density = 2100 kg/m^3

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C. Cases Consideration

- Case 1 - FRP Thickness 50 mm
- Case 2 - FRP Thickness 100mm
- Case 3 - FRP Thickness 150mm

IV. RESULTS AND DISCUSSIONS

A. Modeling in ANSYS

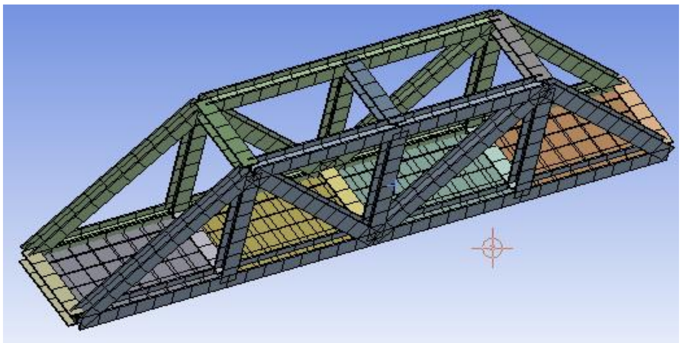

Fig 2 Modeling of bridge in ANSYS

B. Comparison of normal stress between with FRP and without FRP under Timing of IRC class AA Timing of 50 mm 100mm and 150 mm thickness of FRP

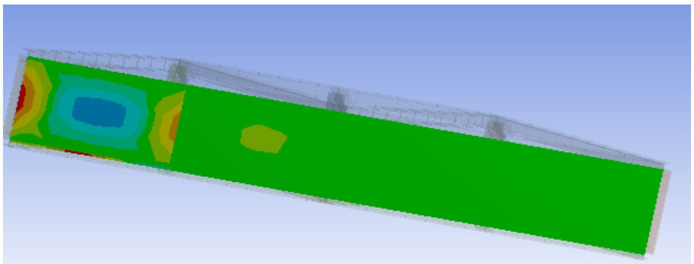

Fig 3. Normal stress with FRP

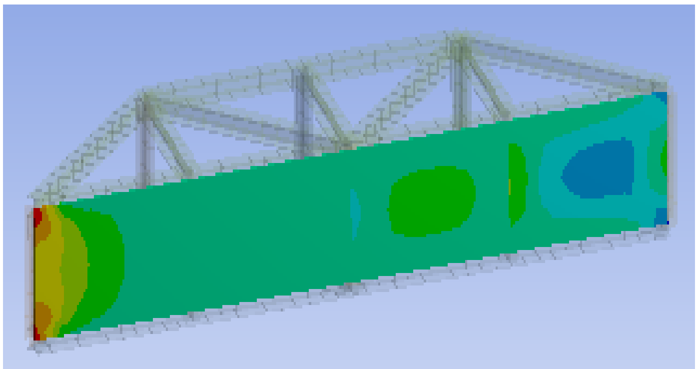

Fig 4. Normal stress without FRP

Table 1 Normal Stress 50 mm thicknesses

Normal Stress For 50 mm thickness	
With FRP	Without FRP
4.5256 (max)	5.6531 (max)

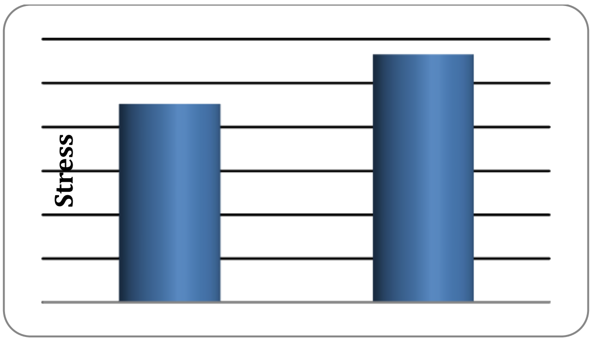

Fig 5. Normal stress variation of 50 mm thickness

From above graph of normal stress for 50 mm thickness FRP it observed that normal stress with FRP layer is less than normal stress of without FRP layer.

Table 2 Normal stress 100 mm thicknesses

Normal Stress For 100 mm thickness	
With FRP	Without FRP
4.3812 (max)	5.6531 (max)

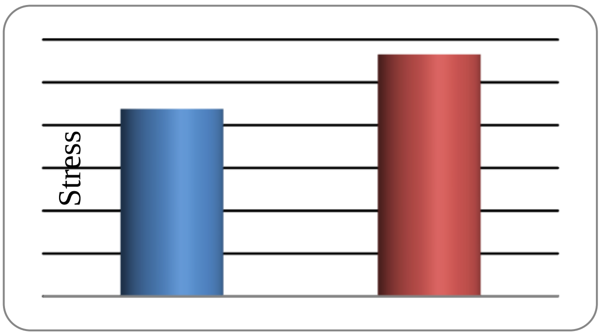

Fig 6 Normal stress variation of 100mm thickness

From above graph of normal stress for 100 mm thickness FRP it observed that normal stress using FRP is less than normal stress Without FRP

Table 3 Normal stress 150 mm thicknesses

Normal Stress For 150 mm thickness	
With FRP	Without FRP
4.3776(max)	5.6531 (max)

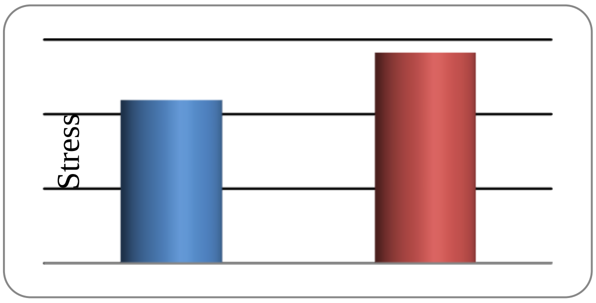

Fig 7 Normal stress variation of 150 mm thickness

From above graph of normal stress for 150 mm thickness FR it observed that normal stress using FRP is less than normal stress Without FRP

V. CONCLUSION

1. For moving Time FRP bridge deck gives better performance
2. Total Deformation is reduced using FRP by 25% which can affect the design approach of steel deck bridge
3. Strain energy observed more than without FRP
4. Normal stress is 20% less than without FRP
5. shear stress is observed 20% to 25%less without FRP it indicates better shear resistance against vibration induce due to moving Time
6. FRP layers can be used for rehabilitation of bridge deck
7. According to time step Timing total deformation normal stress, shear stress and strain energy are decrease continuously using FRP layer for IRC Class A
8. According to time step Timing total deformation normal stress, shear stress and strain energy are decrease continuously using FRP layer for IRC Class AA
9. In vibration analysis in ANSYS the application of FRP reduces the response peak displacement by 15%

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