Experimental Investigation of Profile Deck Slab with GFRP Wrapping

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ABSTRACT

The concrete deck slab, also known as 'composite slab', in which the tension steel is replaced by profile deck sheet. The profile deck sheet is a steel sheet profiled with corrugations. The profile deck sheet acts like a formwork and takes the construction load coming over it. The composite behaviour of concrete deck slab comes into action once the concrete of the slab gains the required compressive strength after the curing process and thus helps to sustain the imposed load. Composite slab construction is found to be very efficient and economical and it reduces the time of construction. It is stated that about 30% reduction in overall weight of the structure is possible by using composite slab construction. The behaviour of the composite slab depends on shear bonding between the concrete and profile deck sheet. This can be judged analytically as well as experimentally by carrying out tests on full length specimens.

In the present dissertation work it is proposed to study the behaviour of composite deck slab using trapezoidal deck with varying depths of corrugations along with layers of GFRP wrapping by using ANSYS software and carrying out relevant experiments. The overall depth of the specimen to be analysed is 125mm. The depth of profile deck is 55mm. The size of specimen is 900mm x 2100mm.

Keywords: Deck slab, GFRP, Profile deck, epoxy etc.

I.INTRODUCTION

These enhanced inventions are needed in the construction industry to overcome the threat of natural disaster like earthquake. In performance of any structure mass plays an important role and hence, the need of reducing load is predominant demand of current situation. The mass of structure using composite slab construction reduces the total weight of the structure and also gives higher load carrying capacity [5]. Composite slab construction is very economical and efficient in terms of reducing construction cost, time of construction and deformation of structure as a whole. Profile deck sheets are an integral part of composite deck slab. Common shapes available in market for profile deck sheet are rectangular and trapezoidal with varying heights and corrugation depths which affect the shear-bond behaviour and longitudinal shear strength of composite slabs [2].

The profile deck sheet works as a formwork under constructional loads, and in composite action, it behaves as tensile reinforcement [6]. But, this formwork is going to be reused for each panel with wrapping of GFRP to slab panel in order to sustain the tensile stresses and act as tensile reinforcement and reuse this profile steel sheet as formwork and achieve economy. The chemical or mechanical (epoxy) interlocking plays an important role in the composite action of concrete deck and GFRP mesh.

II.RELEVANCE

Optimization of the composite element is predominant issue of the upcoming demand of construction industry to tackle many structural problems in simple way. The composite construction is growing fast as it offers efficient and economical structure with more strength and reduces time of construction. Also, there is reduction in overall mass of the building which helps in satisfying the structural performance in case of earthquakes.

The design procedures suggested by various codes are given in accordance with some empirical formulae. The study of complex behavior of the concrete deck slab is not yet completely revealed. Therefore, study of behavior of concrete deck slab by analytical methods is essential for understanding performance of the slab. Thus, in the present dissertation work it is proposed to study the behavior of composite deck slab using trapezoidal deck with varying depths of corrugations along with layers of GFRP wrapping.

III.METHODOLOGY

1. Select appropriate sections for analysis from previous literature.
2. Create model of selected section in 3D software.
3. Analyze these models using 2-line loading.

IV.3D MODELLING

For generating 3D model as per required dimensions solid edge software has been used.

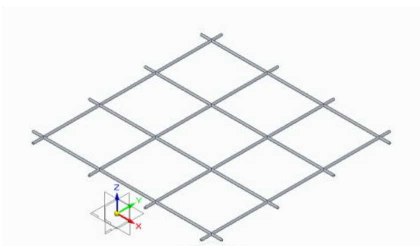

Fig.1 3D Model 8mm bar mesh

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The above figure shows the reinforcement for positive bending moment.

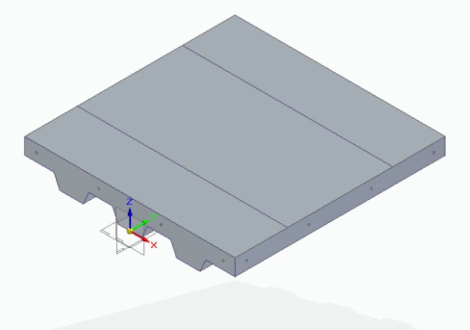
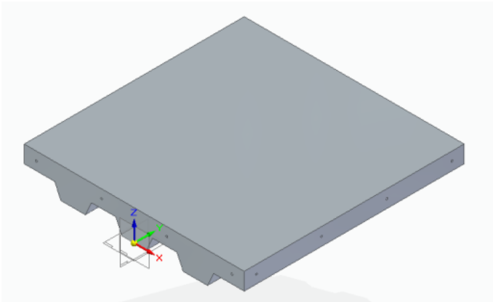

Fig. 2 3D Model Assembly **Fig. 3 3D Model Concrete**

Figure 2 and 3 show the assembled model of positive bending moment and concrete deck slab.

V.ANALYSIS OF 3D MODEL IN ANSYS SOFTWARE

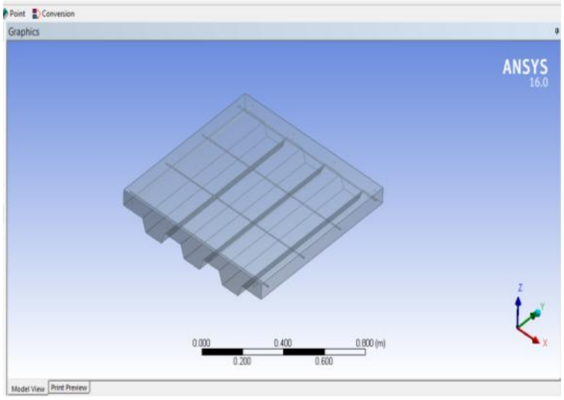

Fig. 4 Importing Geometry

The 3D model created in solid edge software has been imported to the ANSYS software for analysis of composite concrete deck slab.

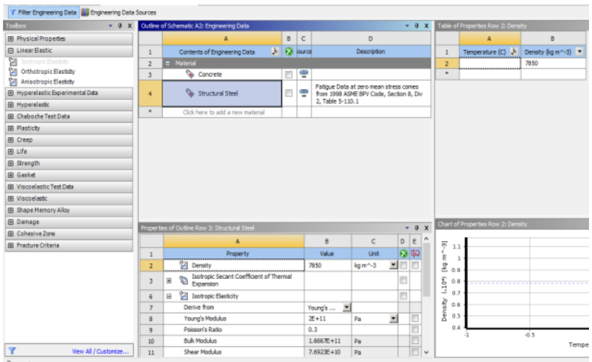

Fig. 5 Defining Material Properties

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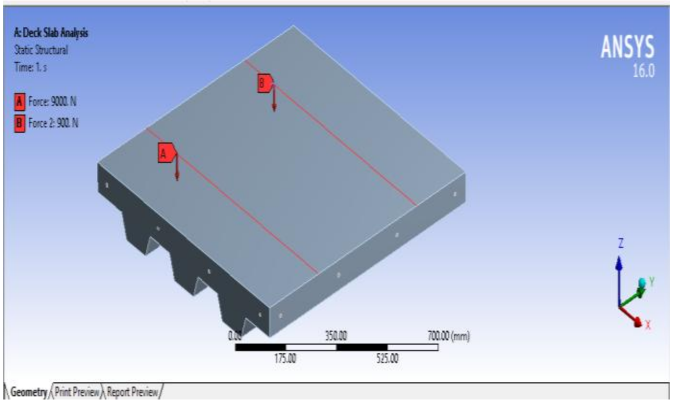

Fig. 6 Loading Conditions

Figure 6 shows the loading on the composite deck slab. It consists of 2-line loading. Load A and Load B both are 9 kN.

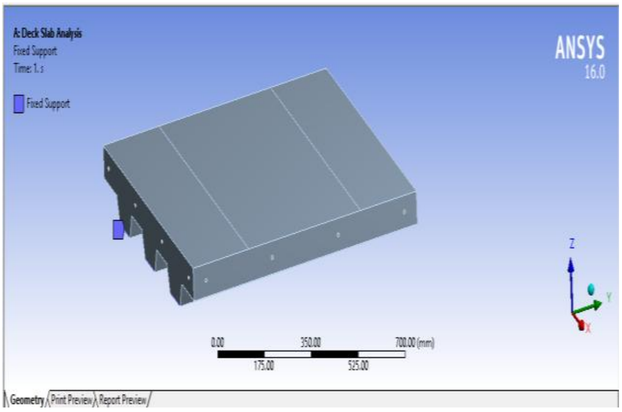

Fig. 7 Boundary Conditions

Figure 7 shows the support conditions applied on the composite deck slab. Both ends are fixed supports.

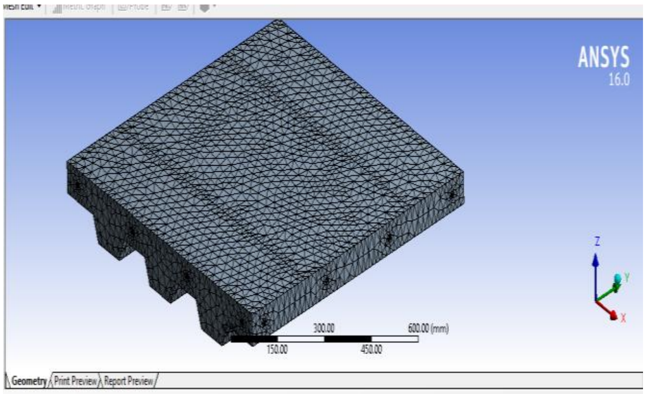

Fig. 8 Meshing of Composite Deck Slab

Meshing is the most important parameter in FEM in ANSYS. It is very important to select proper mesh size and type of element to get accurate results. Figure 8 shows the meshing of the composite deck slab to be analyzed. The mesh size used is 15mm.

VI.RESULT

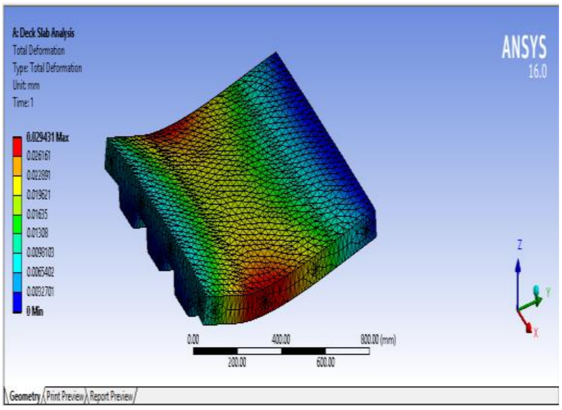

Fig. 9 Total Deformation

After meshing has been done, it is ready for analysis. This is done in job module by creating job and submitting it. After ANSYS composite pre-post analysis is completed, we can see the results in visualization module. The pictorial view of results of deflection of sample composite slab is shown in figure 9.

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