Literature Survey on Polypropylene Sandwich Composite Slab

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Abstract— In this paper, experimental and analytical studies on the flexural behaviour of Concrete Sandwich Composite slabs were reported. Single point flexure test on three slabs varying in core elements such as providing horizontal and vertical polypropylene sheets to the slab panel. The dimensions of the slabs are 1.00 x 1.00 x 0.15 m. These slabs are casted using self-compacting concrete. The experimental tests include the testing of panels under static loading. Load is applied using a 500kN hydraulic jack. Linear voltage displacement transducers with 50 mm gauge range are used to measure the transverse deflections. The test results includes the ultimate load-bearing capacity, load-deflection profiles, typical modes of failure and cracking patterns under constantly increasing the loads were discussed. The experimental and analytical results are compared and reported.

Key words: Sandwich Slab, Self-Compacting Concrete, Polypropylene Sheet

I. INTRODUCTION

In civil engineering construction, the objective of using or selecting any material is to make full use of its properties in order to get the best performance for the formed structure. The merits of a material are based on factors such as availability, structural strength, durability and workability. Methods of improving material utilization can be classified into two categories. The first is to select appropriate materials mixed and the second dispersed to form a new product with desired properties, thus resulting in a composite material.

A sandwich composite slab is a three layer slab it consist of skin layer at top and bottom and core layer at middle. The core material is normally of light weight material, but its higher thickness provides the sandwich composite with high bending stiffness with overall low density. The strength of the composite material is dependent largely on two factors such as outer skin and the interface between the core & the skin.

In this project one conventional and two sandwich slab have been casted, with one horizontal projection and one with vertical projection of polypropylene sheet which going to act as core material.

Sandwich slab unit is a relatively new and innovated form of construction in which the system is increased bearing load, good insulations panels, easier to handle, material and labour cost reduction, quick and easy installation.

Polypropylene is highly impermeable to water. In a 24hrs soak test, the material absorbs less than 0.01% of its weight in water.

Polypropylene is an adhesive material hence interaction between two different material is good in nature. It will resist many organic solvents, acids, and alkaline.

II. LITERATURES

A. Amir Fam and Tareksharaf (2010) "Flexural performance of sandwich panels comprising polyurethane core and GFRP skins and ribs of various configurations" Volume: 92, Issue: 12, pg. 2927 – 2935.

In this study flexural performance of panels composed of low-density polyurethane foam core sandwiched between two GFRP skins. A material testing program was first carried out on the constituents. Large scale panels with nominal dimensions of 2500, 660, 80 mm were tested in one-way bending under a simulated uniform load. Various configuration of internal and exterior GFRP ribs connecting the two skins were explored and compared to a panel without ribs. The study showed that, by integrating the ribs, strength and stiffness of the panels increased substantially, by 50 – 140%, depending on the configuration of the ribs. The ribs were added flexure became more dominant and shear deformations of the ribs contributed only 15–20% of the total deflection. Analysis has been proposed, and captured these effects reasonably accurately. It was shown that ultimate strength of the panels were equivalent to those of similar size reinforced concrete panels with moderate to heavy steel reinforcement ratios of 0.6–2.0%, but sandwich panels were 9–14 times lighter in weight.

B. M. Mastali, I.B. Valente, J.A.O. Barros (2013)"New composite slab system for the structural rehabilitation of traditional buildings"

In this paper, a new generation of composite sandwich slab is proposed as a solution for rehabilitation of slabs in old masonry buildings. The new slab composite system is composed of four elements that include, High Performance Fibre Reinforced Concrete (HPFRC) layer, GFRP ribs, foam core and GFRP skin. In this an innovative GFRP-HPFRC hybrid solution has been developed, with a GFRP laminate on the bottom tension under skin layer, and an HPFRC layer on the top compression skin, preventing the occurrence of buckling, improving the resistance to the effects of impact and fire, providing a ductile behaviour and allowing for an easy application of floor covering materials. GFRP ribs and foam core are able to transfer stress between skins. The design process of the proposed hybrid GFRP-HPFRC sandwich slab is presented. The effects of various parameters on the behaviour of the slabs are investigated by using both linear and material nonlinear analysis, with the aid of the software FEMIX. According to the obtained results, some criteria are established in order to choose the best slab solutions, which include design codes recommendations, serviceability criteria and economic aspects.

C. Gautam SOPAL, Sami RIZKALLA (2011)"Performance of GFRP sandwich panels with corrugated GFRP sheets"

In this paper the behaviour of an glass fibre reinforced polymer sandwich panel constructed with GFRP corrugated sheet in addition to the through thickness fibres to enhance their structural characteristics. An experimental program is undertaken to determine the fundamental characteristics of these sandwich panels in tension, compression, and shear which are critical in the structural design of these panels for

civil engineering application. Test results indicate that the addition of corrugated sheet has significantly increasing the flexure and shear modulus delayed the formation of cracks in the core foam and enhanced the fatigue resistance of the fibre insertions, therefore in addition of corrugated web improved the in overall structural performance of these sandwich panels.

D. SaliniTheres (2013) "Fatigue analysis of glass fibre reinforced polymer (GFRP) bridge deck panel" Volume 2, issue 1, pg. 174 – 180.

Reinforced Concrete structure deteriorate due to several reasons including steel corrosion. Once bond between the concrete and steel is lost then reinforcement become ineffective. There are several cases of failure of bridge due to defect of reinforced concrete. Glass Fibre Reinforced Polymer (GFRP) bridge deck panel is an alternative for conventional RC panel in bridge which remains unaffected by environmental attack. The paper discuss that result of the analytical study on the fatigue characteristic of GFRP bridge deck panel. Finite element software ANSYS used for modelling and analysing multicellular GFRP bridge deck panel. The analysis showed good performance of GFRP panel under the fatigue load.

E. Rahman, Haftirman, K.S. Basaruddin (2015) "Failure behaviour of aircraft sandwich panels under bending load"Volume 745 – 755, pg. 844 – 848.

Failure behaviour of aircraft sandwich panel under bending load has investigated in this study. In this study it focused in effect of support span length under bending load. Three point bending test was performed to the specimens with various span length 125 mm, 80 mm, 65 mm, and 55 mm. Standard test method and dimensions were adhere to the ASTM C393. Deflection and energy absorption of the sandwich panel have been characterized by the variation span length. It was found that the deflection and the energy absorption of the sandwich panel were strongly influenced by the length of support span. In the bending test of sandwich panels at 135 mm support span length, the panel show the lowest deflection at a critical load which is around 4.26 mm compared to the other support span length. The difference of the collapse load for 65 mm support span length is highly significant. The value of experimental was found at 1.74 kN whereas the theoretical value is 2.85 kN The ability to absorb energy of sandwich panel was affected by the collapse mechanism. It was found that the decrease of support span length increases the absorbed energy in aircraft sandwich panel.

F. M.P.Arunkumar (2016) "Effect of core topology on vibro-acoustic characteristics of truss core sandwich panels"Volume 144, pg. 1397 – 1402

This paper present the numerical simulation study on effect of core topology on vibro acoustic characteristic of truss core sandwich panels with metal facing. Free and forced vibration response of the panels that are obtained using finite element method which based on the equivalent two dimensional models. Sound radiation characteristics of the panel are obtained by Rayleigh integral. It is found that influence of nature in core topology of sound radiation is significant in low frequency. It is observed that when compared to trapezoidal, rectangular core and triangular core is suitable for low frequency application and it radiate less sound compare to trapezoidal and rectangular core.

G. Elzathomasukken, Beenab.r. (2017) "Structural performance of honeycomb sandwich panel" Volume 4, Issue 6, pg. 2558 – 2562.

Honeycomb cores are one of the most structurally efficient core constructions, especially in stiffness-critical applications. The basic idea of honeycomb panel was to use the honeycomb as a shear web between two skins. It provides minimal density and high out-of-plane compression and shear properties. It has high strength to weight ratio and good impact resistance. Structural properties of honeycomb structure depend on lower and upper face sheet thickness, the core material thickness, cell diameter, cell angle and foil thickness. Debonding is one of the major failure modes of honeycomb sandwich panels. Material used for the honeycomb construction also has very important in its structural performance. This study focused on the dynamic and static performance of honeycomb sandwich structures and their applicability in bridge deck constructions. This study investigates the effect of geometric parameters on the structural performance of the honeycomb structures such as lower and upper face sheet thickness, the core material thickness, cell diameter, and core configuration.

H. Krunal .V. Dholakiya (2018)"A review on vibration control of composite slab using tuned mass damper" Volume 5, Issue 4, pg. 605 - 610

Floors are highly susceptible to vibrations during its functional usage and owing to its lesser thickness as compared to the plan dimensions. The type of vibrations induced depends on the functionality of the floor. The induced vibrations can lead to serviceability issues and also can render psychological effects on the inhabitants. The services used in the building can also be badly affected due to the induced vibrations which can be due to machine running on the floors, walking, dancing activities and other human induced impact forces. This review has been undertaken to understand the ill effects caused by vibrations generated by various sources on floor systems. Many authors have worked to reduce these vibrations by installations of various control systems. A detailed study has been undertaken in this paper to study and understand the mitigations of these vibrations.

III. CONCLUSION

Self weight of sandwich slab of horizontal layer and vertical layer comparing to conventional slab will be reduced.
Flexural strength of the slabs will be increased by providing additional reinforcements at top and bottom of the slab.
The structural behaviour of the slabs can be increased by providing polypropylene sheets as a core material.
Amount of concrete used in sandwich slab will be lesser than that is required for conventional slab.
Due to its low weight, the erection process will be easier.
By using this sandwich slab, the labour cost will be reduced.

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