ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 3, Issue 5, May 2018

Comparative Study of Bubble Deck Slab Using Different Materials

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Abstract: **Slab is one of the largest structural members which consume structural concrete. The slab of greater thickness should be provided in the building if span of the slab is more or it is subjected to larger loads. Due to greater thickness of the slab, more amount of concrete and steel are being used and this leads to the increase in its self weight. To overcome this problem several researches are being conducted which results into the construction of slab of less weight that is elimination of excess concrete from the slab which is of no use. Therefore this leads to the construction of bubble deck slab. This paper deals with the analysis of bubble deck slab in which bubbles are made up of different materials which are high density poly ethylene and high density polypropylene and then comparing them with the reinforced concrete conventional slab using finite element analysis on ANSYS Workbench 14.0. Total deformation was calculated for the bubble slab made of high density poly ethylene, high density poly propylene and epoxy and for the conventional slab. Also the percentage reduction is calculated for the slabs and then these data were compared. The primary objective of this work is to compare the structural performance of the bubble deck slab with the reinforced concrete slab.**

Key words: bubble deck slab, ANSYS Workbench, high density poly ethylene, high density poly propylene.

INTRODUCTION

For centuries, concrete has been the material which is used by the builders because of its high compressive strength. But it also has certain disadvantages like poor performance in tension and increased self weight.

Bubble slab is the method of eliminating all the concrete from the middle of the slab which is not performing any function therefore this leads to the decrease in the self weight of the slab. In place of concrete, hollow spherical balls made of different materials can be used which tends to increase the efficiency of the slab and also reduce its dead weight.

Currently the implementation of this technology has been done to few hundred high rise buildings and industrial floor slab due to limited understanding. Because of this, the structural performance of bubble deck slab under various loading conditions would be analysed in order to gain the understanding.

Therefore in this study bubble slabs in which spheres are made up of high density poly ethylene, high density poly propylene and epoxy are analysed and then they are compared with the reinforced concrete conventional slab using ANSYS Workbench 14.0. The parameters compared are total deformation and the weight of the slab.

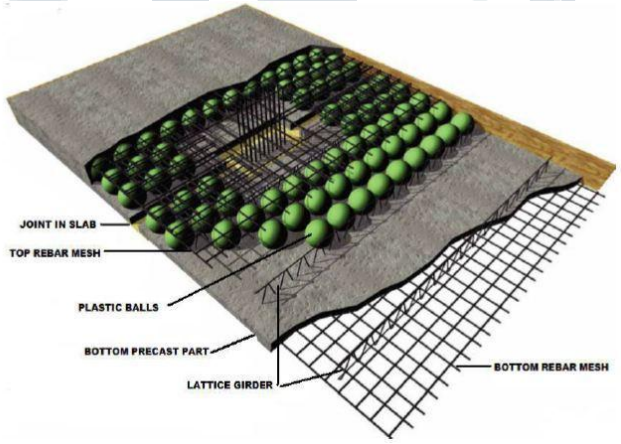

Fig 1: Cut through section of bubble deck slab

METHODOLOGY:

Using ANSYS Workbench 14.0, four models have been generated which are of conventional slab and bubble slab using two different materials. The dimensions of all the models of slab are kept same under the varying loading conditions with same supports.

Material properties of concrete:

Density	2300	kg/m^3
Young's Modulus	30000000000	Pa
Poisson ratio	0.18	
Bulk Modulus	15625000000	Pa
Shear Modulus	12712000000	Pa

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Material properties of structural steel:

Density	7850	kg/m^3
Young's Modulus	2×10^{11}	Pa
Poisson Ratio	0.3	
Bulk Modulus	1.667×10^{11}	Pa
Shear Modulus	7.6923×10^{10}	Pa
Specific Heat	434	$J\ kg^{-1}\ C^{-1}$

Material properties of high density poly ethylene:

Density	970	kg/m^3
Young's Modulus	1035	Pa
Poisson Ratio	0.45	
Bulk Modulus	3450	Pa
Shear Modulus	356.9	Pa

Material properties of high density poly propylene:

Density	850	kg/m^3
Young's Modulus	1265	Pa
Poisson Ratio	0.42	
Bulk Modulus	2635.4	Pa
Shear Modulus	445.42	Pa

Material properties of epoxy:

Density	1570	kg/m^3
Young's Modulus	1.2×10^{11}	Pa
Poisson Ratio	0.25	
Bulk Modulus	8×10^{10}	Pa
Shear Modulus	4.8×10^{10}	Pa

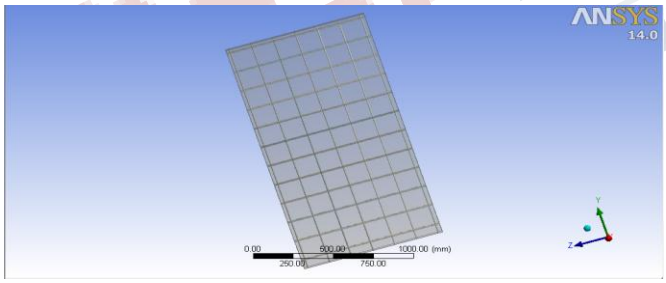

Figure showing the top view of conventional reinforced slab

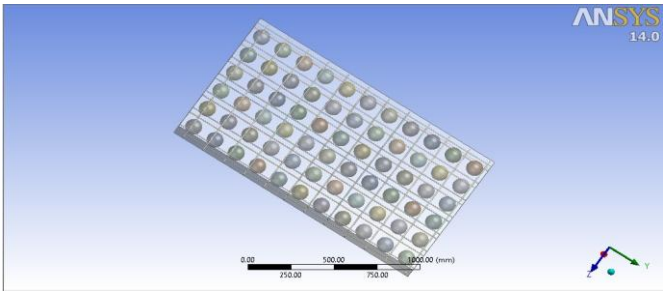

Fig 2: The top view of the bubble deck slab.

RESULTS AND CONCLUSIONS:

Total deformation of bubble deck slab made of high density polyethylene balls at maximum load is 10.24% more than that of reinforced concrete conventional slab.

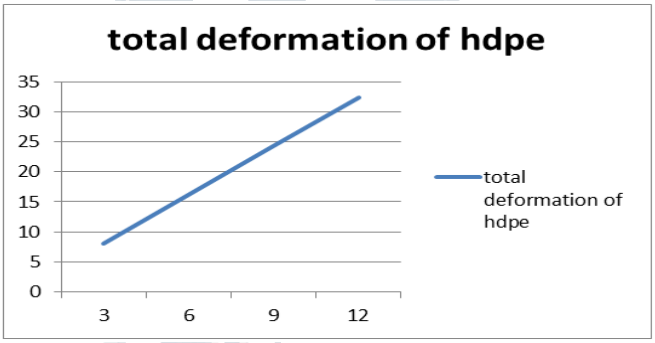

Fig 3: Load vs total deformation graph of bubble slab made of hdpe balls

Total deformation of bubble deck slab made of high density polypropylene balls at maximum load is 17.10% more than that of reinforced concrete conventional slab.

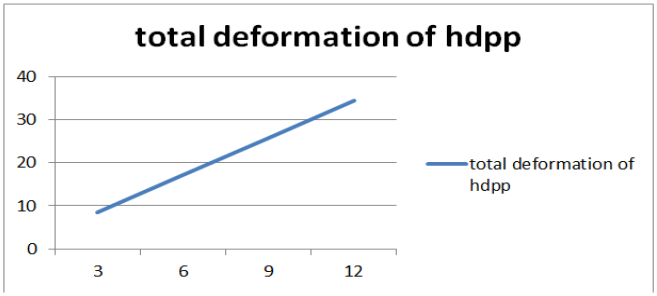

Fig 4: Load vs total deformation graph of bubble slab made of hdpp balls

ISSN (Online) 2456-1290

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Total deformation of bubble deck slab made of epoxy balls at maximum load is 0.634% less than that of reinforced concrete conventional slab.

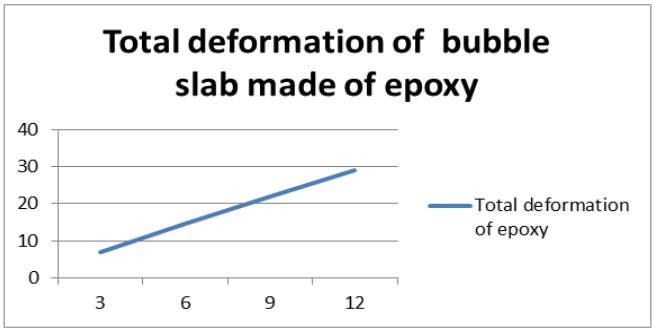

Fig 5: Load vs total deformation graph of bubble slab made of epoxy balls

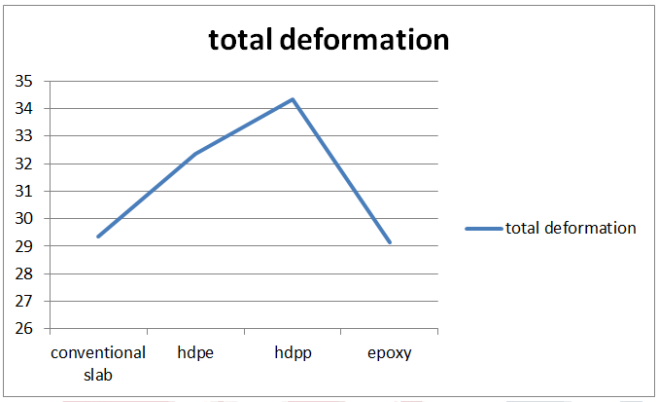

Fig 6: Comparative graph of total deformation for different materials

Percentage weight reduction of bubble deck slab made of hdpe balls in comparison with reinforced concrete conventional slab is 8.85%.
Percentage weight reduction of bubble deck slab made of hdpp balls in comparison with reinforced concrete conventional slab is 4.16%.
Percentage weight reduction of bubble deck slab made of epoxy balls in comparison to with reinforced concrete conventional slab is 6.51%.

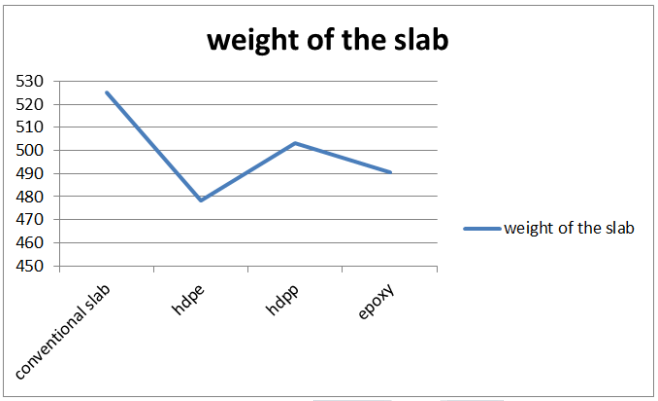

Fig 7: Comparative graph of weight of the slab using different materials

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