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Comparative Study of Bubble Deck Slab with Conventional R.C.C Slab

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Abstract: ***When designing a reinforced concrete structure a primary design limitation is the span of the slab between the columns. Designing large spans between columns often requires very thick slabs thereby increasing the weight of the structure by requiring use of larger amounts of concrete.***
Heavier structures are less desirable than light weight structures in seismically active regions because a larger dead load for a building increases the magnitude of inertia forces which the structure must resist as larger dead load contributes to higher seismic weight. A new solution to reduce the weight of concrete structures and increase the span of reinforced concrete is "Bubble Deck Technology''.
Bubble Deck Slab is a futuristic method which can effectively eliminate all the concrete from the middle of slab by replacing it with high density polyethylene balls. In this technique reinforcement mesh acquires, allocates and attaches the balls at exact position and also stabilizes the lattice. By these techniques the structural weight can be reduced from 25% to 50%. The main aim of our study is to compare bubble slab and conventional slab under cost analysis, stress and deflection. In our project, we designed both the slabs using AutoCAD and tested our design using Ansys software. The advantages are less energy consumption - both in production, transport and carrying out, less emission - exhaust gases from production and transport, especiallyCO2.
Keywords: Bubble Deck Technology, HDPE Balls, AutoCad, Ansys, Conventional RCC Slab,Stress and Deflection.

I. INTRODUCTION

Reinforced concrete structural members are one of the most common components in modern building construction consuming most of the concrete. Due to the shear amount of concrete required to produce these members, the dead weight of them tends to be very large. Heavier structures are less desirable than lighter structures in seismically active regions because a larger dead load for a building increases the magnitude of inertia forces which the structure must resist, as large dead load contributes to higher seismic weight.

A concrete slab is a common structural element of modern buildings. It tends to use more concrete than required, hence has to be optimized. Concrete in beams is heavy, and 5% of the world's CO2 is created during the manufacture of the cement that goes into it. Not only that, but most of the concrete that is in a beam isn't even needed; it is just a spacer between the bottom, where the reinforcing steel is in tension, and the top, where the concrete is in compression. In order to reduce the use of concrete without Bubble deck slab is the slab in which some amount of the concrete is replaced by the plastic hollow bubbles which are made by the waste plastic material, which reduces the self-weight of the structure. Plastic voided slabs are capable of reducing the amount of concrete necessary to construct a building by 30 percent or more. Voids in the middle of a flat slab eliminate up to 35% of a slab's self-weight removing constraints of high dead loads and short spans.

II. METHDOLOGY

A. Conventional flat slap

This is a slab prepared with specifications with normal concrete of M30 grade by adopting conventional methods of design according to IS 456:2000.

B. Bubble deck flat Slab

This is a slab is prepared with specification with normal concrete of grade M30 by using Hollow plastic balls.

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C. Experimental Procedure

1) Conventional Flat Slab: The conventional flat slab is prepared of M30 grade of concrete with dimensions 9mX3mX0.175m. Cover blocks of 25mm are provided to maintain the cover.



Fig-1: Reinforcement

D. Reinforcement

The initial step is laying the reinforcement for increase the tensile strength of the structure. The reinforcement is provided in the form of mesh 8mm bars with spacing 150mm centre to centre in both directions.

1) Concreting: Concrete is poured in three layers each of 40mm compacted using tamping rod.

2) Curing: Curing is done for 28 days after 24 hours of casting. Ponding method is used for curing.



Fig-2: Concreting of conventional slab

E. Bubble deck flat slab

The conventional flat slab is prepared of M30 grade of concrete with dimensions 9mX3mX0.175m. Cover blocks of 25mm are provided to maintain the cover.

1) Reinforcement: The initial step is laying the reinforcement for increase the tensile strength of the structure. The reinforcement is provided in the form of mesh consist 8mm bars with spacing 150mm centre to centre in both directions.

2) Bottom Concrete: Concrete is provided at the bottom of the slab. It acts as a bonding material for ball because the ball attached with the concrete. It is compacted manually using tamping rod.



Fig-3: Location of plastic balls

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F. Location of Hollow Plastic Balls

The hollow plastic balls are placed on bottom concrete as per design. balls having 135mm diameter and distance between two balls is 50mm for each slab.

1) *Concreting:* After placing the plastic balls concrete is poured manually and compacted by using tamping rod.



Fig-4: Concreting of Bubble deck flat slab

2) *Curing:* Curing is done for 28 days after 24 hours of casting. Ponding method is used for curing.

G. Testing Procedure

4 specimens were casted, 2 conventional, 2 bubble deck flat slab. Out of which one slab of each type was tested for single point load. The slab of 9m x 3m and thickness of 175mm makes it a thick slab, and the comparison is to be done accordingly. As the slab was simply supported. The specimen was tested under UTM of capacity 1000KN, the specimen was placed in the UTM and load was applied at the centre of the slab as shown in the figure below. The reason behind using point load was to study the behaviour of slab in high shear, and the kind of failure associated with it. The deflection of the slab was calculated at centre.

III. LITERATURE REVIEW

A. Mr. Devyanshu Jain & Miss. Nidhi Gupta

Review paper study on a comparative study of bubble deck slab and conventional deck slab.

1) *Name of journal:* International journal of advanced technology in engineering and science
2) *Aim:* To assess all the technological and monetary aspects of bubble deck technology
3) *Objective:* The main objective of this study is to investigate the potential use of granite waste in concrete as replacement for coarse aggregate and is to arrive at a suitable mix design for the application of discarded granite waste as a partial replacement of coarse aggregate in concrete; and to test and analyze the workability, density of hardened concrete, compressive and flexural strength, of concrete of grade M30.
4) *Method:* The method of design and analysis of the bubble deck bridge slab are two types which are elucidated below.

a) Design and analysis in laboratory
b) Design and analysis in softwares

B. N. Lakshmipriya & M. Karthik pandi

Study and model making of slab using bubble deck technology

1) *Name of journal:* International Research Journal of Engineering and Technology (IRJET)
2) *Aim:* To study the bubble deck technology and model making
3) *Objective:* The objective of this paper is to convey the recent advancements in civil construction and implement the new technique of using high density polyethylene hollow spheres in the construction field. It deals with the construction techniques and the innovation implemented considering the cost, efficiency and structural behavior of the concrete structure.

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4) *Method:* Method used in this research is as follows :
a) Evaluation of properties
b) Model making
c) Cost comparison

C. Sunil Yadav & Mohd. Sharif Uddin

An Experimental Study on Bubble Deck Slab System with HDPE Balls.

1) *Name of journal:*International Journal Of Innovative Research In Technology.
2) *Aim:* Effectively eliminate all the concrete from the middle of the slab by replacing it with High Density Polyethylene Balls (HDPE) and providing thermal insulation.
3) *Objective:*
a) To reduce the dead load of slab by almost 25%
b) To reduce the cost of materials.
c) To use HDPE balls and hence reduce the environmental impact.
d) To increase the strength of the slab.
4) *Method:* In this project, one way bubble deck slab (770mm*380mm*110mm) using the High Density Polyethylene balls (70mm diameter) of size prepared which is made up of plastic waste. These balls are place in middle of the slab, Generally the plastic waste is Non-Biodegradable waste harms the environment. By using this method, reduction of plastic waste and amount of concrete has been made and it makes the Green design.

IV. SCOPE OF PROJECT

One can test the Bubble Deck Slab system by changing the thickness of the slab using different bubble diameters in the future. One can test the results with the HDPE balls being filled with gases lighter than air, such as Helium and Nitrogen which in turn will produce inner thrust. The results coming from lower grades of concrete can also be checked. In the future we can extend the study for behavior of bubbled beams at beam-column junctions. As bubbled beams lack strength, further study can be made on improving strength of the same. Bubble deck slab is light in weight and therefore it can be used in skyscraper. Bubble deck slab is light in weight and the load transfer to the column is less. The number of columns required is less.

V. RESULT & CONLUSION

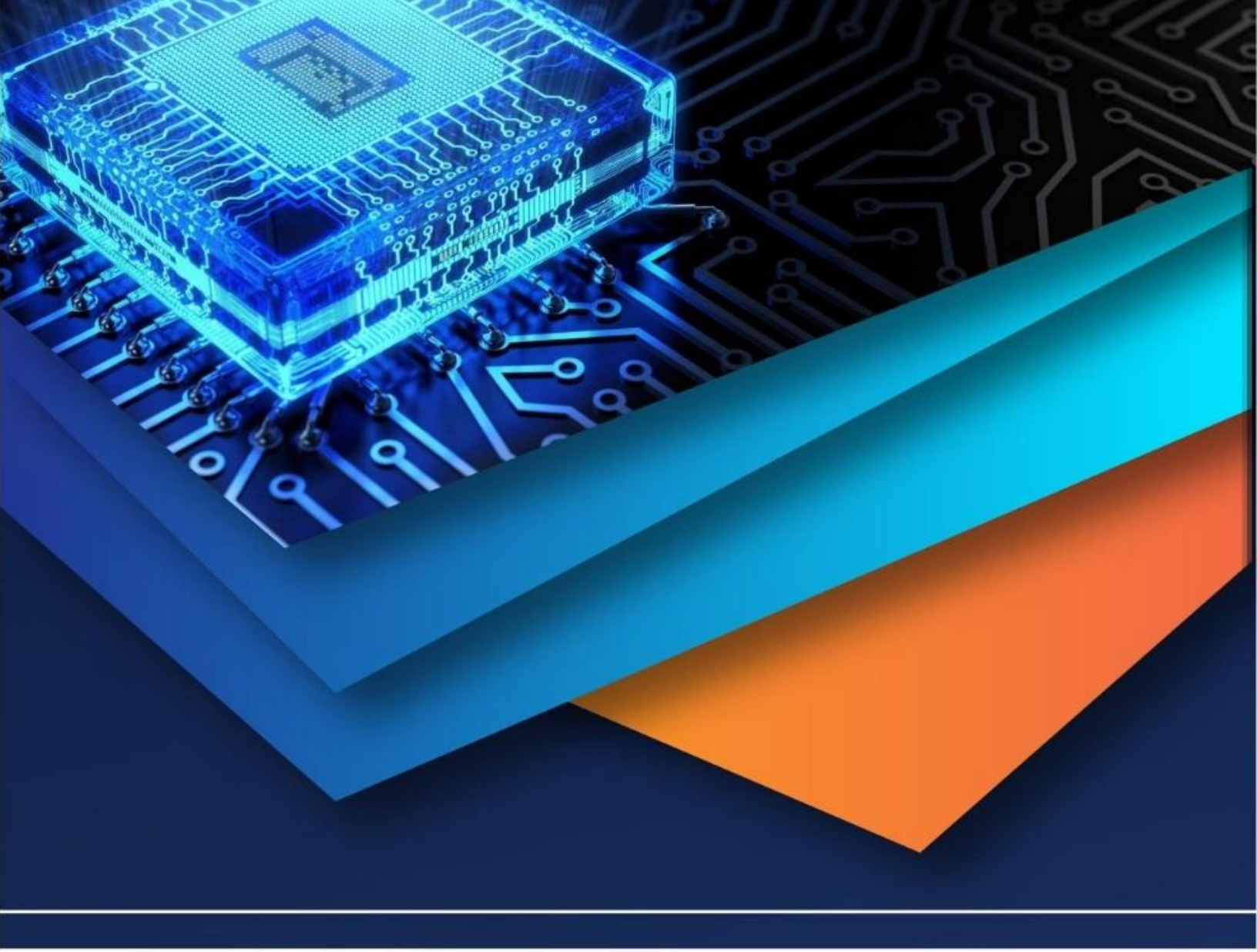
Therefore, we can conclude that by replacing concrete with HDPE we implement this technique for all the slab it can save considerable amount of money thus this method is cost effective.

The test was conducted to evaluate the structural behavior of the Conventional slab and Bubble deck slab. The experiment was carried out using a loading frame by applying the udl load over the slab to know the ultimate load carrying capacity and deflection. Also finite element analysis was carried by using ANSYS software to study the ultimate load carrying capacity, stresses and deflection. Based on the experiment, numerical and analytical studies the following conclusions were made, Bubble deck slab gives much improved performance than the conventional slab but slight variation was found in numerical investigation. The numerical and experiment results shows the bubble deck slab can withstand 75% of load carrying capacity when compared to conventional slab. Also, the experimental results are compared with analytical results for the better, economic construction of slabs in day-to-day life From the results, 1m^3 of concrete can be eliminated from 3m x 9m of slab by using 135 mm ball which results in reduction in weight of slab. From these results it is observed that the Bubble Deck Slab is better in stress criteria and its weight than that of Conventional slab. The stress and deformation results were evaluated and compared the bubble deck slab with conventional slab were observed using finite element analysis and by experimental. At last the comparison has been made for Bubble Deck Slab with the Conventional slab over its self-weight. From the evaluation of these results, Bubble Deck Slab gives better performance than that of the conventional slab.

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