International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 8 ǁ 2021 ǁ PP. 72-77

Experimental Study on Bubbled Beam

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Abstract:
A beam is structural member that primarily carries transverse loads like. Bubbled beam is method of virtually eliminating concrete below the neutral axis of the beam, which is not performing any structural function only work as filling material thereby dramatically reduce dead load of beam. High density polyethylene hollow spheres replace the in-effective concrete below neutral axis, due to which the dead loads on the column and foundation reduces.
The advantage is less energy consumption both in production and transport carrying out, less emission exhaust gases especially CO_2. The aim of this paper to study comparatively conventional beam and bubbled beam properties like flexural strength and compressive strength.

Keywords*: Neutral axis, Bubbled beam.*

Date of Submission: 12-08-2021 Date of acceptance: 27-08-2021

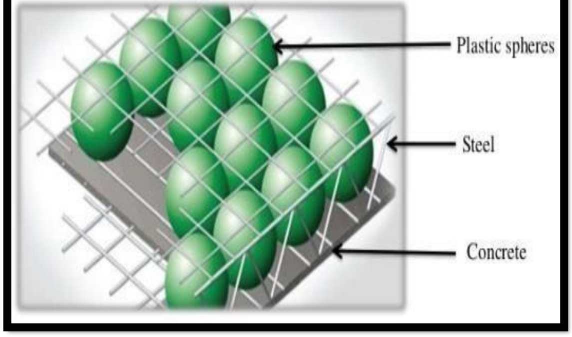
I. INTRODUCTION

A beam is a structural member used for bearing loads. It is typically used for resisting vertical loads, shear forces and bending moments. According to its requirement, different beams use in different conditions like fix beam, cantilever beam etc.

Stresses in beams are maximum at top and bottom and zero at neutral axis. In RC beams concrete below neutral axis is not performing any structural function so this un-utilized concrete is removed by high density polyethylene balls which do not react with concrete. Experimental work is carried on bubbled beam in comparison with conventional beam. In bubbled beam ineffective area of concrete below neutral axis is replaced by high density polyethylene balls.

Bubble Deck Technology:

Bubble Deck System is a revolutionary construction method by eliminating concrete from the neutral axis of a floor slab that is structurally not performing, as a result dramatically reducing in Dead Weight. The Bubble Deck System is based upon patented integration technique - the direct way of linking air and steel. Void formers inside the flat slab eliminates at least 30% of a slab's dead weight.



II. LITERATURE REVIEW

1. Structural Behaviour of Bubble Deck Slab

P. Prabhu Teja1, P. Vijay Kumar, S. Anusha1, CH. Mounika1, Ramachandra Saah

In this paper they have checked the properties of bubble deck slab like flexural strength, shear strength, durability, deflection, sound insulation, vibration, fire resistance etc. using finite element analysis. They observed that deformations developed in the solid slab were comparatively less than bubble deck slab. Market of construction floors in building industry consist mainly of massive concrete floors. This situation has not changed for more than 20 years. But this innovative slab construction technology was proved to be more efficient than a traditional biaxial concrete slab in an office floor system. They have concluded from this paper that bending stresses in the bubble deck slab were found to be 6.43% lesser than that of a solid slab, deflection of bubble deck was 5.88% more than the solid slab as the stiffness was reduced due to hollow portion, weight reduction was 35% compared to solid slab, Shear resistance of bubble deck slab was 0.6 times the shear resistance of the solid slab of same thickness.

2. Behavioural Analysis of Conventional Slab and Bubble Deck Slab under various Support and Loading Conditions using ANSYS Workbench Sameer Ali1, Mr. Manoj Kumar.

The objective of this study was to perform the behavioral analysis of conventional slab and bubble deck slab using ANSYS workbench 14.0. This comparative study includes the study of normal slab and slab with HDPE spherical ball at Centre to form voids. This paper presented a brief overall review on the conventional slab suitability and bubble deck slab suitability at different places as a different component (office slab, bridge deck slab etc.).Office slab test provides the results of prior research, proving that the Bubble Deck slab performed better than a traditional solid concrete, biaxial slab. The maximum stresses and internal forces in the voided deck about to 40% less than the solid slab due to the decreased dead load from the use of HDPE spheres in place of concrete. The deflection of the Bubble Deck slab was slightly higher but the stiffness decreased due to the presence of the bubbles but this situation will be overcome by the reduced overall stress in the slab. This paper demonstrated that this type of biaxial deck will give better results under long-term and a more durable floor slab under a dominant gravity and uniform load.

3. Experimental study on bubble deck slab

Mr. Muhammad Shafiq Mushfiq, Asst. Prof. Shikha Saini, and Asst. Prof. Nishant Rajoria

Objectives of this paper was To determine the load bearing capacity of bubble deck slab and compare with conventional slab with different B/H ratio and to estimate the amount of concrete saved as a result of spherical balls introduction into the core of the slab. From the foregoing it was evident from tests conducted that though the bubble deck slabs were not as efficient as the conventional slab, (having lesser load bearing capacity), they are very much satisfactory in slab construction considering the negligible difference in load bearing capacity between them and the conventional. It is however interesting to note a weight reduction of 10.55% & 17% in the bubble deck slabs compared to the conventional slab which was an added advantage for the bubble deck slabs especially in structures where load is an issue.

4. Experimental study of bubble deck beam

Bhalerao Aadesh, Pathan Taha, Pathan Altamash, Prof. Kulhere R.V.

In this paper they have checked the properties of bubble deck beam like flexural strength, compressive strength, and percentage of amount of saved concrete as compared to conventional beam by placing bubble of plastic and rubber of diameter 35mm in this paper the experimental results are near about same of conventional beam and bubble deck beam.

III. RESULT

Materials used

1. Portland pozzolana cement:

We Used Ultratech PPC Cement (The Engineer's Choice)

2. Sand (fine aggregate):

The sand most of which pass through 4.75mm IS sieve are termed as fine sand or fine aggregate. We used locally available Manjra River Sand which pass through 4.75mm IS sieve

3. Coarse Aggregate:

The aggregate which retain above 4.75 mm IS sieve are termed as coarse Aggregate. The crushed stone or metal, called khadi or gitti comes under coarse aggregate. We used 12.5 mm to 15mm size Angular Shape Coarse Aggregate.

4. Reinforcement Steel:

We used Fy -500 grade of Steel -8 mm and Stirrups -6mm.

5. High Density Polyethylene (HDPE) Balls:

We used HDPE ball having 50 mm Diameter.

6. Water

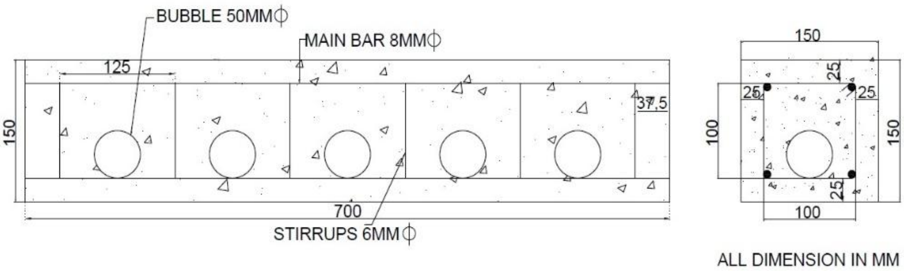
We used potable water for concrete.

7. Concrete

We used M30 grade of concrete in this experiment.

Experimental setup of sample:

Beam Size - 150mm x 150mm x 700mm (Simply supported), Fck -30 N/mm^2, Fy-500 N/mm^2 ,
R/ F = 8mm Ø -4 bars , Stirrups – 6mm Ø bar Spaced 125 mm- 6 Nos , HDPE Ball – 50 mm in Dia. , Side and Bottom Cover – 20 mm,



Beam Section with HDPE Ball

Estimation of saved amount of concrete:

Volume of beam = 0.15 x 0.15 x 0.7 = 0.01575m^3

No. of Beam bubble beam=6

Volume HDPE Balls V1= $(\pi/6)$ XD^3 X5
= 0.5235X0.05^{3}X5
=3.27X10^{-4} m^3

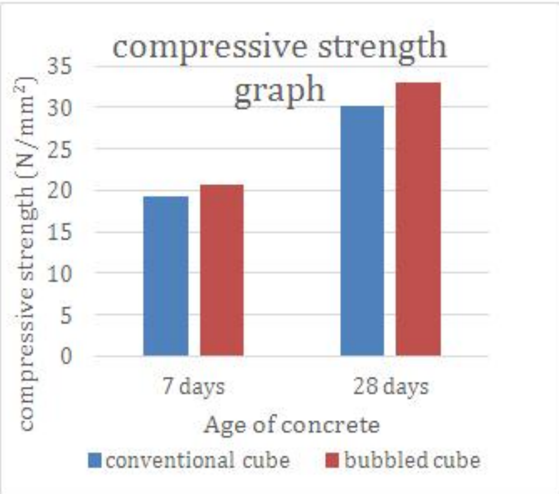
Volume of Beam V_2 =0.15X0.15X0.7
= 0.1575 m^3
Saved amount of concrete= (volume of beam) - (Volume of balls)
= (0.01575) - ($3.27X10^{-4}$)
= 0.015427m3 in each beam
Percentage of concrete saved=$3.27X10^{-4}$ / (0.01575) X100=2.07% in each beam

Result:

1. Compression Test.

To calculate compressive strength of concrete the cube of size 150mmX150mmX150mm casted.

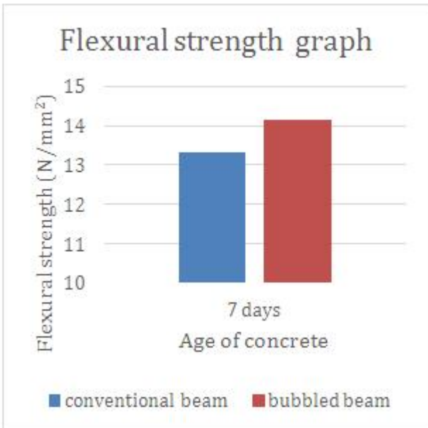
Number of specimens	Age of concrete (days)	Average compressive strength(N/mm^2)	
		Conventional concrete	Bubble concrete
3	7	19.24	20.75
3	28	30.17	32.97



2. Flexure Test:

The flexural strength of concrete is carried out on beam

Number of specimens	Age of concrete (days)	Average flexural strength(N/mm^2)	
		Conventional concrete	Bubble concrete
3	7	13.33	14.13

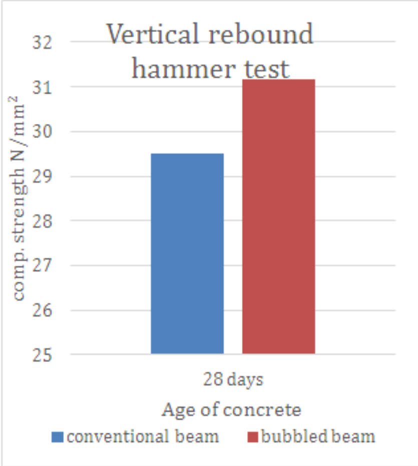


3. Rebound hammer test:

For the beams rebound hammer test carried out for 28 days strength

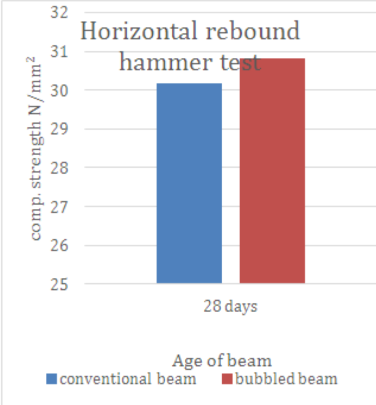
a) Vertical rebound test value

Number of specimens	Age of concrete (days)	Average compressive strength(N/mm^2)	
		Conventional concrete	Bubble concrete
3	28	29.5	31.16



b) Horizontal rebound test value

Number of specimens	Age of concrete (days)	Average compressive strength(N/mm^2)	
		Conventional concrete	Bubble concrete
3	28	30.16	30.83



IV. CONCLUSIONS

1. Due to use of bubbles in beam the reduction of concrete 2.07% without affect to the strength of concrete.
2. The compressive strength of conventional concrete and bubble concrete at the age of 7 days is to be found 19.24N/mm^2 and 20.75 N/mm^2 respectively. The compressive strength of bubble concrete increased by 7.84% by using concrete mix having w/c ratio 0.42 and aggregate to cement ratio 4.04
3. The compressive strength of conventional concrete and bubble concrete at the age of 28 days is to be found 30.17N/mm^2 and 32.97N/mm^2 respectively. The compressive strength of bubble concrete increased by 9.28% by using concrete mix having w/c ratio 0.42 and aggregate to cement ratio 4.04
4. The flexural strength of conventional concrete and bubble concrete at the age of 7 days is to be found 13.33N/mm^2 and 14.13N/mm^2 respectively. The flexural strength of bubble concrete increased by 6% by using concrete mix having w/c ratio 0.42 and aggregate to cement ratio 4.04
5. The vertical rebound hammer test carried out on beam in which the compressive strength of conventional concrete and bubble concrete at age of 28 days is to be found 29.5N/mm^2 and 31.16N/mm^2 respectively. So, the compressive strength of bubble concrete increase by5.62%.
6. The horizontal rebound hammer test carried out on beam in which the compressive strength of conventional concrete and bubble concrete at age of 28 days is to be found 30.16N/mm^2 and 30.83N/mm^2 respectively. So, the compressive strength of bubble concrete increase by 2.22%.

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