Bubble Deck Slab

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Abstract – Bubble deck slab was a new floor system of reinforced concrete which contains spherical hollows as concrete economy elements. It is a revolutionary technique which practically eliminates all concrete from the middle portion of a floor slab. The structural dead weight was condensed due to the non-performance of any structural function by the middle part of the slab. High concentration polypropylene spherical balls replace with the in-effective concrete in the center of the slab. Voids in the middle of the slab provide thermal insulation and also leads to 30 to 50% lighter slab. Bubble deck slab allows larger spans between columns supports. In the bubble deck technology reduce the concrete volume by replacing the spherical bubbles, these are locally accessible which was called as PEPSI balls, these balls are made up of HDPE (High Density polyethylene). In this experimental program conventional slab and bubble deck slab are cast with various bubbles arrangement which is continuous arrangement of bubbles within whole slab and two types of another bubbles arrangement in the slab.

Key words: - Bubble Deck, Recycle Plastic, HDPE

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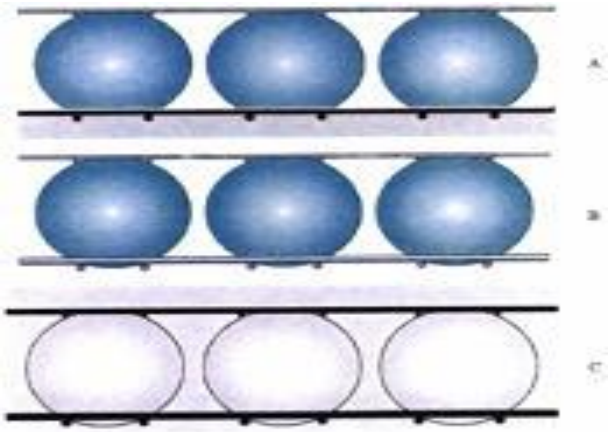
1. INTRODUCTION

In structure constructions, slab is one of the largest structural member consuming concrete. Jorgen Bruenig in 1990's invented the first biaxial hollow slab (now known as bubble deck slab) in Denmark. Bubble deck offers a more sustainable construction option by using less concrete than traditional concrete floor systems and also contributes less CO_2 to the atmosphere in the manufacturing process.

It meets sustainability goals through the use of recycled plastic spheres. Even after the building is demolished or renovated in the future, the spheres could be recycled. By virtually eliminating the concrete part in the middle of the conventional slab it leads to 30 to 50% lighter slab which reduces the loads on the columns, walls and foundations, and of course of the entire building.

Bubble deck technology eliminates up to 35% of the structural concrete. When coupled with the reduced floor thickness and facade, smaller foundations and columns, construction costs can be reduced by as much as 10%. Using Bubble deck means floor cycles up to 20% faster than traditional construction methods.



2. LITERATURE SURVEY

a) **M .Surendar** [1]:-"Numerical and experimental study on bubble deck slab" This paper content, the structural behavior of the Conventional slab and Bubble deck slab

b) **Prof .Shikha Saini**[2] :-"Experimental study on bubble deck slab**"** This paper content ,the bubble deck slabs were not as efficient as the conventional slab

c) **Neeraj Tiwari1 Sana Zafar**[3]**:-** "Structural Behavior of Bubble Deck Slabs and Its Application" This paper content, Bubble Deck technology is more useful and efficient than a solid conventional slab in office floor system

d) **Bhagyashri G. Bhade**[4]**S.M Barelikar**[4] **:- "**An experimental study on two way bubble deck slab with spherical hollow ballsSpherical hollow balls" In that experiment found that the bubble deck (continuous)is reduced the volume of concrete so that weight of slab ultimately decreases. Simultaneously the load carrying capacity has also increase as compare to conventional slab. But the arrangement of the bubbles are effect on the load carrying capacity of the slab, in alternative arrangement of bubbles are increase the load carrying capacity than conventional slab but less than continuous bubble deck slab.

e) **Prof. Trupti Kshirsagar** [5]**:- "**Study of bubble deck slab" This paper was to discuss about various significance of Bubble Deck Slab based on the various studies done abroad. Reinforced concrete slabs are one of the most common components in modern building construction consume the most concrete. Due to the large amount of concrete required to produce these slabs, the dead weight of these structures was very large

f) **Dr. Mangulkar Madhuri Nilesh** [6]**:-** "Comparative Study of Bubble Deck Slab and Solid Deck Slab" In the present scenario of the construction industries we need different types of methods which are more economical, easy to construct and environment friendly. The Bubble Deck Slab is one the technology which helps us to achieve the economy, easy to construct and environment friendly. Bubble deck Technology is the innovative system that eliminates Concrete in the middle section, secondary supporting structure such as beams reinforced concrete columns or structural walls

g) **P. Vijay Kumar** [7]**:-** "Structural behavior of bubble deck slab" The aim of this paper is to discuss about various properties of Bubble deck slab based on the various studies done abroad. Moment, deflection and stress distributions are verified using Finite Element Method (FEM) in SAP2000

h) **Ajay V Joseph** [8]:- "Structural behavior of bubble deck slab" The aim of this paper was to discuss about the various properties of Bubble deck slab based on various studies done abroad. The paper also gives a brief idea about the different Bubble deck slabs, their production and advantages over conventional concrete slabs.

3. MATERIAL CONTENT

Bubble deck slab is composed of three main materials; they are steel, plastic spheres and concrete.

Concrete: The concrete is made of standard Portland cement with max aggregate size 20 mm. No plasticizers are necessary for concrete mixture. Tests have proved that the characteristic compressive strength of concrete is achieved by bubble deck slabs in the same manner as that of solid slabs.

Steel: The steel reinforcement is of grade Fe500 strength or higher. The Reinforced Steel mesh is created over the ball and below the ball so that the ball can be placed without any movement. Proper locking of bubbles are only possible by placing them in reinforcements. Extra bars and shear bars are provided when required. Mostly shear bars are provided near the columns.

Plastic Hollow Spheres: The hollow spheres are made from recycled high-density polyethylene or HDPE. Plastic Hollow Spheres are available in different sizes based on the size of structure. These balls can be reused again or recycled. Thus contributes to the green properties of bubble deck slab.

4. METHODOLOGY

Preparation of Reinforcement Mesh

The steel bars are provided in Bubble deck for tension zone and concrete is provided for compression zone. The size of the steel bars in horizontal and vertical direction is 50cm.The spacing provided between is 6.5cm.The diameter of steel bar is 8mm and the diameter of HDPE sphere is 7.3cm

Construction: Depending on the manufacturer, plastic voided slab systems are constructed by two primary methods: a filigree method in which part of

the system is precast off site, and a method in which the entire system is constructed on site. Both methods uses the same three basic components. In both methods, the main component is the plastic void. These voids are often spherical, hollow, and made of recycled plastic. The voids allow the slabs to be lighter than traditional concrete slabs since the voids are nearly weightless and replace concrete in the centre of the slab. The next main component is the steel cage. Steel reinforcement is added to resist flexure for the slab, but a cage of thin steel is also used to hold the voids in place, keeping them in the centre of the slab. The third main component is the concrete, which surrounds the voids and forms the slab. The concrete ultimately determines slab strength. Though both methods use each of these components, the two methods use different approaches. The voids are assembled in steel cages and then concrete is poured to a height part way up the voids. The slab panels (filigree) are typically eight feet (2.5m) wide and thirty feet (9m) long. The filigree are then transported to the construction site and lifted in place by crane. Once in place, the top layer of concrete is placed, covering the voids and completing the slab. Wire trusses run between the precast and cast-in-place layers of concrete to ensure that the two layers bond properly.

5. ADVANTAGES OF BUBBLE DECK SLABS

1. It allows freedom of design with non-rectilinear plan forms
2. As no beam support is required, it allows longer spans between supports
3. It enables reduced foundation sizes since the structural dead-weight is reduced by 50%
4. Cross-bracing and intermediate supports are eliminated
5. Concrete usage is significantly reduced; 1kg of recycled plastic replaces 100kg of concrete. It is, therefore, environmentally friendly.
6. It uses fewer building elements compared to steel frame and metal decking systems and so reduces erection time
7. Since the block-work is non load-bearing, it is taken off the critical path
8. Conduits and cooled slab systems can be incorporated into the slabs in the factory

6. LIMITATIONS

1. There is an increase in cost of production due to assembly and manufacturing of HDPE spheres.
2. Punching shear capacity is low.
3. Difficulty in structural health monitoring.
4. Skilled labour's required
5. Not applicable to slabs having limited Thickness.

7. RESULT &DISCUSSION

In that experiment found that the bubble deck (continuous) is reduced the volume of concrete so that weight of slab ultimately decrease. Simultaneously the load carrying capacity has also increase as compare to conventional slab. But the arrangements of the bubbles are effect on the load carrying capacity of the slab, in alternative arrangement of bubbles are increase the load carrying capacity than conventional slab but less than continuous bubble deck slab.

Simultaneously, bubble deck slab has improve the elasticity property of slab, such as conventional slab is less deflect than bubble deck slab, and quantity of bubbles in slab also affect on the this elasticity property.

Weight reduction is the important factor is found in bubble deck slab. Weight of the conventional slab is more than the bubble deck slab.

FUTURE SCOPE

Best for larger span hall like theatres and auditoriums, pedestrian bridge deck. Used in parking area as less number of columns are required. Used for constructing all types of building especially sky scrapers.

CONCLUSION

1. Concrete usage is reduced as 1 kg of recycled plastic replaces 100 kg of concrete. This avoids the cement production and allows reduction in global CO2 emissions. Hence this technology is environmentally green and sustainable.
2. Reducing material consumption made it possible to make the construction time faster, to reduce the overall costs. Besides

that, it has led to reduce dead weight up to 50%, which allow creating foundation sizes smaller.

3. The Bubble Deck configuration gives much better flexural capacity, stiffness and shear capacity of at least 70% when the same amount of concrete and the same reinforcement is used as in the solid slab.

4. By using the hollow elliptical balls, the better load bearing capacity in Bubble Deck can be achieved.

5. Advantage of Bubble Deck system is the significant cost saving, because of the possibility of obtaining great spans with less support elements.

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