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Bubble Deck Slab

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Abstract:Slab is one of the important structural member and the largest member in the building. Slab consume maximum amount of concrete. Due to which the dead weight of slab is increase. By using high density plastic balls with reinforcement. The amount of concrete can be reduced to large extent by using bubble deck method. It will reduce the self weight of slab as compare with solid slab without significant change in its structural performance. The self weight of slab can be reduced by replacing the middle portion of the cross section of slab with voids. By doing this the overall cost is reduced, material reduction will be there, enhanced structural skill. It is used to decrease the amount of concrete used in a building, greatly strengthen the overall frame and distribute the weight of concrete that is actually used. The recycled plastic is used to make bubbles. These recycled plastic balls can be recovered during the demolition of building which helps to meet the goal of sustainable construction.

Keywords: bubble, concrete, hollow slab, reinforcement, solid slab.

1. Introduction

In the construction world, slabs are very important structural member and one of the largest concrete consuming members. Traditional slab have high dead weight, resulting in low free span and high construction cost. The concrete in the middle of solid slab perform no structural function and is structurally ineffective. A Denish Engineer, Jorgen Breuning, in the 1980s suggested a slab filled with plastic balls called as Bubble Deck Slab. Bubble deck slab is also termed as voided slab as hollow, bi-axial slab in which the structurally ineffective concrete in middle part of slab has been replace with spherical plastic ballsto create a grid of void forms inside the slab. The plastic balls are usually made of recycled high-density polyethylene (HDPE). Bubble Deck Slab is usually prefabricated and mainly consisting of three materials: spherical plastic balls, reinforcement, concrete. As a result of its low weight, the dead weight of reduced, therefore it leads to small column and foundation section and longer span between supports. Bubble deck slab can be advantage in terms of cost reduction, recuction in material use, shorter construction time, sustainabiliy and green renovation. Recycled of plastic waste is of utmost important to create an eco-friendly atmosphere. Bubble deck system produces floors 20% with less formwork, reduces construction cost. The bubble deck slabs has low weight, simplicity, symmetry and uniform extent which reduce the impact effect, uniform and continues distribution, monolithic and ductile structure. It serves 30-50% of self weight compared to the corresponding solid slabs which has equal stiffness. Bubble deck acts like a solid slab, which does not have the earlier problems with reduced resistances towards shear, local punching and fire. As a consequence of reduced load, it is possible to achieve larger spans than a solid span. Depending upon the design, spans of 20 to 40 times the deck height are possible, cantilevers can be made 10 times the deck height.

1.1 TYPES OF BUBBLE DECK SLAB

1.Type A – Filigree Elements

2.Type B – Reinforcement Modules

3.Type C – Finished Planks

1.1.1 Type A – Filigree Elements

Bubble deck Type A is a combination of constructed and unconstructed elements. A 60 mm thick concrete layer and part of the finished depth are precast and brought on-site with the bubbles and steel reinforcement unattached. The bubbles are then supported by temporary stands on top of the precast layer and held in place by interconnected steel mesh. This type of bubble deck is optimal for new construction projects where the designer can determine the bubble positions and steel mesh layout.

1.1.2 Type B – Reinforcement Modules

The bubble deck Type B is a reinforcement module that consists of a pre-assembled steel mesh and plastic bubbles. These components are brought to the site, laid on traditional formwork, connected with any additional reinforcement, and then concreted in place by traditional methods. This category of Bubble Deck is optimal for construction areas with tight spaces since these modules can be stacked on top of one another for storage until needed.

1.1.3 Type C – Finished Planks

The bubble deck Type C is a shop-fabricated module that includes the plastic spheres, reinforcement mesh, and concrete in its finished form. The module is manufactured to the final depth in the form of a plank and is delivered on-site.

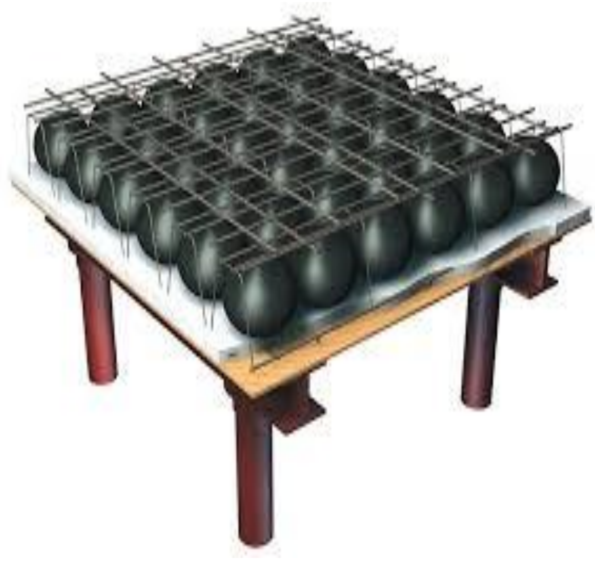

Fig. 1. Bubble deck slab

2. Literature Review

Sonal R. Naik, et al.(2017). The present study is carried out to study the seismic behavior of structure due to reduction in dead weight of structure by modelling and analysis of grid system. The slab thickness of 250 mm, ball diameter of 180 mm, spacing of 200 mm was compare with other slab sample and % weight of savinf abiut 30.53 is obtained. The base shear of structure is reduced by 12 to 14% due to reduced concrete weight. The self weight of voided slab will reduce due to which the moment of the slab is reduced from 7 to 10% of the solid flat slab at same point under same loading condition. The result of reaction is same for reinforced concrete voided slab and solid flat slab system.

Gore Mahesh Popat, et al.(2018). The use of fly ash in concrete work is done with wasted plastic bottles. The main idea is removing excess concrete from the slab by the use of plastic bottles which fill up with fly ash. In the experiment UDL applied over the slab to know the load carrying capacity and deflection. The result show that the bubble deck slab is better in stress criteria and its weight as compared to normal concrete slab. Bubble deck slab gives better performance than that of the conventional slab.

Abhishek R. Pandharipande, et al.(2019).The main aim is to study the practicality of hollow plastic ball in a reinforcement concrete slab.the three slab specimen namely conventional slab, B.D.S of 50 mm diameter and B.D.S of 100 mm diameter having dimension of 750mm X 500mm X 150mm. M25 grade of concrete is used with steel bars and high density polyethylene balls. It involves evaluating the flexure strength and behavior of light weight slab and conventional slab by analytical and experimental method. The test was conducted on Universal Testing Machine. The grap of load v/s deormation of both bubble slab and conventional slab was compared.

3. Methodology

The actual construction of the bubble deck incorporates what is known as biaxial slab, meaning that two wire grids rest on a ball. Each of these grids can be placed between slabs of concrete, with numerous balls closely arranged in a approximate grid form and a thinner grid is welded on top to form a “cage”. This cage is fixed into 3 inches of concrete to form a panel. The bubbles are made by embodying high density polypropylene in the concrete and placed between the reinforcement meshes. The material that are not react chemically with the concrete or the reinforcement, it has no porosity, has enough rigidity and strength to take over loads as much as possible from the pouring of concrete.

Fig. 2. Process of bubble deck slab

4. Comparison between bubble deck slab and solid slab

Bending strength and deflection behavior

When the bubble deck slab compared to solid deck slab by the technical university of Denmark. They carried out test on stiffness of bubble deck slab. After verifying the result, they discovered, for a similar quality, bubble deck has 87% of bending stiffness of comparable strong chunk however just 66% solid volume due to HDPE circles.

Sound

An examination was made between bubble deck and single direction pre-assembled empty deck of comparable stature. The noise decrease with bubble deck was 1 DB higher than the single direction pre-assembled empty deck. The principle pattern for lessening racket is the heaviness of the deck and subsequently bubble deck won't act in any case than other deck types with equivalent weight.

Shear strength and punching strength

The after effects of various down to earth tests affirm that the shear quality relies upon the compelling mass of the solid. The shear limit is estimated to be in the scope of 72-91% of the shear limit of a strong deck. In computations, a factor of 0,6 is utilized on the shear limit with respect to a strong deck of indistinguishable tallness. This ensures a huge security edge. Regions with high shear loads need accordingly an given data.

Anchoring

The anchoring in the two types is identical. The balls do not influence the anchoring.

Comparison in Weight between the Bubble and the same Sphere of Concrete

Considering the HDPE Hollow Ball Thickness to be 150mm in diameter. And it replaces the middle concrete sphere of the same diameter. So, the concrete sphere is of 150 mm in diameter. The weight of the HDPE Hollow Ball weighs 154 grams.

Cost comparison

Just contrasts in materials concerning the sections are considered. For a similar measure of steel and solid, Bubble Deck has 40 % bigger range and is moreover 15 % less expensive. For a similar range, bubble deck lessens the measure of cement with 33 % and reduce the cost with 30 %.

It is found that bubble deck slab is more economical than conventional slab in terms of all the above given criteria.

The bubble deck slab is more lighter in weight then conventional slab.

5. Conclusion

- 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 CO_2 emissions. Hence this technology is environmentally green and sustainable.
- 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.
- 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.
- By using the hollow elliptical balls, the better load bearing capacity in Bubble Deck can be achieved.
- 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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