A Review Study on Bubble Deck Slab

Mr. Vishvajeet V. Mali[1] Mr. Aditya M. Kadolkar[2] Mr. Vishal V. Malage[3] Mr. Abdulsajid G. Gavandi[4]
[1,2,3,4]UG Students
[1,2,3,4]Department of Civil Engineering
[1,2,3,4]Sharad Institute of Technology, Polytechnic, Ichalkaranji, India

Abstract— Bubble deck slab is a method of virtually eliminating all concrete from the middle of a floor slab, which is not performing any structural function, thereby dramatically reducing structural dead weight. High density polyethylene hollow spheres replace the in-effective concrete in the center of the slab, thus decreasing the dead weight and increasing the efficiency of the floor. By introducing the gaps, 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. The aim of this paper is 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.

Keywords: Bubble Deck Slab

I. INTRODUCTION

In the 1990's, Jorgen Breuning invented a way to link the air space and steel within avoided biaxial concrete slab. The Bubble Deck technology uses spheres made of recycled industrial plastic to create air voids while providing strength through arch action. for a section cut of a Bubble Deck. As a result, this allows the hollow slab to act as a normal monolithic two-way spanning concrete slab. These bubbles can decrease the dead weight up to 35% and can increase the capacity by almost 100% with the same thickness. As a result, Bubble Deck slabs can be lighter, stronger, and thinner than regular reinforced concrete slabs.

Currently, this innovative technology has only been applied to a few hundred residential, high-rise, and industrial floor slabs due to limited understanding. For this investigation, the structural behavior of Bubble Deck under various conditions will be studied in order to gain an understanding on this new technique and to compare it to the current slab systems. This technology will then be applied to create lightweight bridge decks since a significant portion of the stress applied to a bridge comes from its own self-weight. By applying the knowledge gathered during the behavioral analysis, a modular deck component for pedestrian bridges that is notably lighter but comparable in strength to typical reinforced concrete sections will be designed.

II. LITERATURE REVIEW

A. Author: Nagesh Hanche and Arti Shetkar

- Abstract: - The author studied the use of hollow plastic balls in the reinforced concrete slab and its effects.
- Conclusion :-
  1) They founded that 50% dead weight reduction compared to solid slab, less CO2 emission.
  2) Less concrete required.
  3) Load carrying capacity of slab is depending on arrangements of bubbles.

B. Author: - Prof.Nishant Rajoria, Muhammad Shafiq Mushfiq(IRJET)

- Abstract: - To determine load bearing capacity and to estimate amount of concrete saved.
- Conclusion :-
  1) Results shows bubble deck slab carried less load due to stiffness reduction because of plastic balls introduce in to the slab.
  2) 10.55-25% of concrete saved as compare to solid slab.

III. TYPES OF BUBBLE DECK

All of the Bubble Deck versions come in three forms- filigree elements, reinforcement modules, and finished planks. They are depicted in Figure 3-2. For all types of Bubble Deck, the maximum element size for transportation reasons is 3 m. Once the sections are connected on site. However, there is no difference in the capacity.

A. Type A- Filigree Elements

Bubble Deck Type A is a combination of constructed and unconstructed elements. A 60 mm thick concrete layer that acts as both the formwork and part of the finished depth is 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 a honeycomb of interconnected steel mesh. Additional steel may be inserted according to the reinforcement requirements of the design. The full depth of the slab is reached by common concreting techniques and finished as necessary. This type of Bubble Deck is optimal for new construction projects where the designer can determine the bubble positions and steel mesh layout.

B. Type B- Reinforcement Modules

Bubble Deck Type B is a reinforcement module that consists of a pre-assembled sandwich of steel mesh and plastic bubbles, or "bubble lattice". 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.

C. Type C- Finished Planks

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. Unlike

Type A and B, it is a one-way spanning design that requires the use of support beams or load bearing walls. This class of Bubble Deck is best for shorter spans and limited construction schedules.

IV. ADVANTAGES

- Material and weight reduction :-
  Bubble deck slab uses 30-50 % less concrete than normal slab.
- Structural properties :-
  The dead load carrying capacity of solid slab is 3:1. While a bubble deck slab of the same thickness has a 1:1 Dead load carrying capacity ratio.
- Construction and time saving:-
  On site construction can be minimized since Bubble Deck Slab can be precast.
- Cost saving
- green design

V. DISADVANTAGES

- Costing much money for transport these structures on site.
- Sometimes the thin concrete layer may be broke during transportation.
- It is essential to use high capacity cranes to lift these structures to the planned position and it is also very difficult for crane to access the desired position.
- Costing more steel used to fabricate stiffness which are used to move and lift the deck structure.

VI. EXAMPLE OF BUBBLE DECK SLAB

A. *MILLINUM Tower:*

- Located at Rotterdam, Netherland.
- The first high rise building erected with bubble deck filigree-element.
- The second highest building in Netherlands.
- 34 stories and 131 meter high.
- Bubble deck was chosen, in spite of being completely new product. Because of its advantage in cost, construction time and flexibility and because of environmental issue.
- Built in 1998-2000.

VII. APPLICATION

- The Construction application include:
  - Commercial offices including high rise building, Hotels.
  - Building for storing retail and bulky goods, Industries- Warehouse and factories.
  - Multi-unit residential buildings.
  - Airports, Car parks
  - Special structure (marine, Stadium, Rail platform, etc.)
- Every component can be recycled. Easy demolition.
- Substantial reduction in materials and transportation;
- Less emission and energy consumption.

VIII. CONCLUSIONS

- As per studies, the Bubble deck configuration gives much improved 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, realizing 30-50% concrete economy, in comparison with the solid slab.
- Another advantage of Bubble deck slab system is the significant cost saving, because of the possibility of obtaining great spans with less support elements.
- By using the hollow elliptical balls, the better load-bearing capacity in Bubble deck can be achieved.
- Numerous application in various countries, highlight the viability and the efficiency of this system.
- Concrete usage is reduced as 1 Kg of recycled plastic replace 100Kg of concrete.

REFERENCES

[1] Churakov A,(2014) Biaxial hollow slab with innovative types of voids, Technical paper-sciencedirct, 6 (21),70-80.
[2] David A, Fanella Mustafa MaHamid and Michal Mota,(2017), flat plate-voided concrete slab system,design, serviceability, fire resistence ,and construction, ascelibary.org, 3(22), 1943-5546.
[3] Ashish Kumar Dwivedi Mohabey,(2016) Voided slab design, Review Paper, International journal of Reasearch and scientific Innovation, 1(4), 2321-2705.
[4] Bhagyashri G, Bhade and S.M Barelikar, (2016), An Experimental study on two way bubble deck slab with spherical hollow slab, International Journal of Recent Scientific Research, 7(6), 11624-11626.

