TO STUDY THE BEHAVIOUR OF CONVENTIONAL SLAB AND BUBLE DECK SLAB

Tushar pundir[1], Reeta joshi[2]

[1] Tushar pundir Asst. professor, Dept. of civil engineering , Roorkee college of engineering, India

[2]Reeta joshi Asst. professor, Dept. of civil engineering , Roorkee college of engineering, India

ABSTRACT

Fortified solid chunks are one of the most widely recognized parts in current structure development . piece is a biggest part which devours concrete and when burden following up on the section is enormous or clean range between segments is more the chunk thickness is expanding .it prompts expend more materials, for example, cement and steel because of that , self – weight of section is expanded, to keep away from these disservices different examinations are does and inquires about propose voided section framework

Fortified solid section with plastic voids is new and creative kinds of basic solid chunk framework created to take into consideration lighter self load of the structure while keeping up comparable burden conveying limit of a strong piece. Plastics voided slabs are capable of reducing the amount of concrete necessary to construct a building by30 percent or more. This reduction can be beneficial in terms of financial saving as well as building performance.

Long span flat slab systems with internal void formers have been used in Europe for decade the main advantages is the possibility of long spans due to the significant reduction in self weight as well as the construction sequence

Keyword : *- of , chunks, framework, and concrete*

---

1. INTRODUCTION

This paper displays the empty center piece innovation that have showed up over last twenty years.The voided chunks are strengthened solid sections in which voids permit to diminish the sum (volume) of concrete.The creation of the empty section was in 1950s. Be that as it may, it was utilized distinctly in one way crossing development, and must be bolstered by shafts and/or fixed dividers. The thought was to make an empty biaxial section with indistinguishable abilities from a strong piece, however with significantly less weight because of the disposal of abundance concrete. In building developments, the piece is a significant auxiliary part to make a space. What's more, the piece is one of the biggest part expending concrete. The principle obstruction with solid developments, if there should arise an occurrence of even sections, is the high weight, which restrains the range. Thus significant improvements of fortified cement have concentrated on upgrading the range diminishing the weight or conquering solid's common shortcoming in strain. In a general manner, the chunk was planned distinctly to oppose vertical burden. Nonetheless, as individuals are getting more enthusiasm of private condition as of late, clamor and vibration of section are getting increasingly significant, as the range is expanded; the redirection of the piece is additionally expanded. In this way, the chunk thickness ought to be increment. Expanding the section thickness makes the pieces heavier, and will expanded segment and establishments size. In this manner, it makes structures devouring more materials, for example, cement and steel fortification. To keep away from these hindrances which were brought about by expanding of self-weight of chunks, the voided section framework, was recommended.

When planning a strengthened solid structure, an essential structure constraint is the range of the piece between sections. Planning huge ranges between segments regularly requires the utilization of help pillars as well as thick chunks, accordingly expanding the heaviness of the structure by requiring the utilization of a lot of cement. Heavier structures are less attractive than lighter structures in seismically dynamic areas on the grounds that a bigger dead burden for a structure expands the extent of dormancy powers the structure must oppose as huge dead burden adds to higher seismic weight. Fusing bolster bars can likewise add to bigger floor-to-floor statures which thus builds costs for finish materials and cladding.

Plastic voided sections expel concrete from non-basic zones and supplant the expelled concrete with empty plastic void formers while accomplishing comparative burden limit as strong chunks. Voided chunk standards have been applied in various applications going back to the mid 1900s. This report analyzes the plan procedure of plastic voided pieces. The standards behind plastic voided chunk frameworks are displayed. A parametric investigation of two-way level plate fortified solid chunks and plastic voided sections with a similar structure requirements is talked about. Before plastic voided sections can be completely comprehended, a careful information on level plate strengthened solid pieces conduct, disappointment systems, structure, and confinements is critical.Traditional level plate fortified solid chunks by depicting how the pieces are built and coming about favorable circumstances and inconveniences of this development. The structure technique and disappointment systems for strong chunks are additionally depicted. The standards of utilizing voids in pieces have been applied in different applications for a long time.

1.1 Introduction of Voided Slab Concept:
A new system, the Voided Biaxial Slab was invented in the 1990s. The system utilizes the positive aspects of concrete slab construction while at the same time minimizing the negative attributes of solid slabs by lightening the self-weight of the structure

Plastic Voided Slabs:
Materials - The plastic voided slabs are composed of three main materials namely:

- ***Steel***– The steel reinforcement is fabricated in two forms:
  - ➢ Meshed layer for lateral support
  - ➢ Diagonal girders to provide vertical support
- ***Plastic spheres*** – The hollow spheres are made from recycled high-density polyethylene (HDPE) or polypropylene (PP).
- **Concrete** – The concrete is from standard Portland cement and no plasticizers are necessary for the concrete mixture.

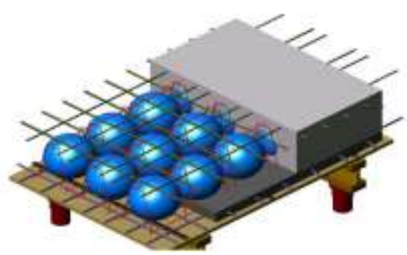


Fig 1: Typical illustration of a voided slab and its components

Plastic Voided Slab Systems:
Since the inception of the Plastic voided slab systems in the1990s many European companies have patented their own systems.The main brands of this system are as follows:

1. Bubble Deck
Bubble Deck is a plastic void system which comes in three forms- a precast filigree element, reinforced modules and finished planks (Nasvik, 2011).

2. Cobiax

In Cobiax system, decks form the bottom of the slab, and the bottom layer of reinforcing steel must also be placed. The voids are locked in steel wire meshes which can be altered to fit the particular application (Corey, 2013). The top layer of steel reinforcement can be placed after the bundles are in place. Concrete is then poured in two lifts. The first concrete pour covers the bottom reinforcement and a portion of the voids and holds the voids in place as the concrete becomes stiff. The second lift is poured after the first lift is stiff but still fresh, finishing the slab. This method requires more formwork and on-site labor, but requires less transportation of materials.

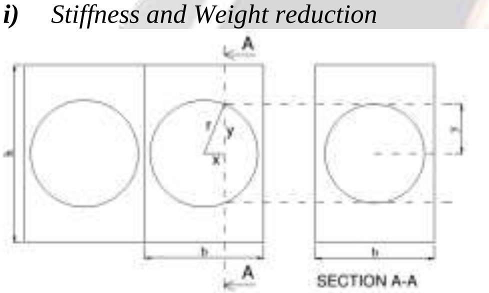
3. U-Boot Beton

U-boot is a voided slab system which uses recycled polypropylene formwork designed to create two-way voided slabs and rafts. These void formers create many "I" shaped beams making up the slab (U-boot Beton, 2011). The U-boot system is cast entirely on-site using formwork. After forms are erected, the steel and void formers are placed before the concrete is poured in two lifts. In addition, this system is advantageous because the shape of U-boot void formers allows them to be stacked efficiently during transportation to the site, saving space and potentially leading to reduced shipping costs compared to spherical former systems (Corey, 2013)

1.2 **METHODOLOGY**

The overall procedure for carrying out the analysis and design of the voided biaxial slab is as outlaid as below:

i) *Stiffness and Weight reduction*



The stiffness of uncracked Cobiax slab sections was investigated with theoretical calculations. The second moment of inertia of a solid slab without void former was calculated using the following notations:

$$I_s = \frac{bh^3}{12}$$

Where, b = Width of solid section surrounding a single sphere.
h = Thickness of the slab

The second moment of inertia of circle was obtained from the following equation which considered the average void area with radius y.

$$I_c = \frac{\pi y^4}{4}$$

The stiffness reduction factor was then be derived from the below notations:

$$Stiffness\ reduction\ factor = \frac{I_s - I_c}{I_s}$$

Bending Strength

If μ_{ms} was less than 0.2, then the moment stress was allowed to redistribute within the section of the slab and the voided biaxial slab designed using conventional design principles.

Note: The variable μ_{ms} refers to the ratio of the moment resisted by the void region to the total moment resisted by the whole cross section.

That is, $\frac{M_{void}}{M_u}$

The ratio μ_{ms} was be calculated as:

$$\mu_{ms} = \frac{M_u\,1.96D}{f'_c h^3} \leq 0.20$$

Where;
D = Ball diameter
h = Overall depth of the slab
M_u = Design moment on the slab, derived from structural analysis

2. DISCUSSION

A) Shear strength The results of a number of practical tests confirm that the shear strength depends on the effective mass of concrete. The shear capacity is measured to be in the range of 72-91% of the shear capacity of a solid deck. In calculations, factor of 0.6 is used on the shear capacity for a solid deck of identical height. This guarantees a large safety margins. Areas with high shear loads need therefore a special attention, e.g. around columns. That is solved by omitting a few balls in the critical area around the columns, therefore, giving full shear capacity. Shear strength of slab mainly depend on effective mass of concrete, as the special geometry shaped by the ellipsoidal voids acts like the famous roman arch, hence enabling all concrete to be effective. This is only valid when considering the bubble deck technology. ; Due to use of plastic bubbles, the shear resistance of bubble deck greatly reduces in comparison of solid slabs. In any flat slab, design shear resistance is usually critical near columns. The shear stresses removed from the columns diminishes rapidly outside the column zones it has been demonstrated by testing and calculation and longitudinal shear stresses are within the capacity of the bubble deck slab system. Near the columns, bubbles are left out so in these zones a bubble deck slab is designed exactly the same way as the solid slab.

B) Bending quality Bubble Deck when contrasted with a strong deck, both for all intents and purposes and hypothetically. The outcomes in the table underneath shows that for a similar deck thickness, the twisting quality is same for Bubble Deck and for a strong deck and that the solidness of the Bubble Deck is somewhat lower. Twisting worries in the Bubble Deck section are seen as 6.43% lesser than that of strong chunk. A definitive burden esteem getting bowing tests were up to 90% more prominent than a definitive burden esteem. The base support steel and the top compressive segment of pressure square adds to flexural firmness in the twisting. In % of a strong deck Bubble Deck Same quality Same bowing firmness Same solid volume Strength 100 105 150* Bending solidness 87 100 300 Volume of cement 66 69 100 TABLE:I

IN % OF A SOLID DECK	BUBBLE DECK		
	SAME STRENGTH	SAME BENDING STIFFNESS	SAME CONCRETE VOLUME
STRENGTH	100	105	150
BENDING STIFFNESS	87	100	300
VOLUME OF CONCRETE	66	69	100

C) Deflection The redirection of the test examples was estimated at their mid-range underneath the lower face of the tried sections. At the point when the chunk arrived at cutting edge phase of stacking, littler additions were applied until disappointment, where the heap pointer quit recording any longer and the diversions expanded extremely quick with no expansion in applied burden. Length profundity proportion computations for redirections are exceptionally rough and are not proper in level pieces of sporadic format aside from the most straightforward or insignificant cases. FE displaying, including non-direct broke area examination is utilized to figure the redirection utilizing ordinary basic cement with a Young's Modulus Ecm , increased by 0.9 and the rigidity, fc tm duplicated by 0.8 (to diminished the split minute). Diversion of Bubble Deck is 5.88% more than strong section as the solidness is decreased because of the empty part. Reinforced Bubble Deck has low redirection contrast with un fortified Bubble Deck section. Ordinary piece conveyed the pressure of about 30.98 M Pa by applying the udl heap of around 340 kN and causes avoidance of 12.822 mm. The Bubble Deck section conveyed the pressure of about 30.8 MPa by applying the udl heap of around 320 kN and causes diversion of 14.303mm. The Bubbl eDeck piece can withstand 80% of stress when contrasted and regular section. Slide variety happens in the twisting when contrasted with ordinary chunk. Kind of chunk Load(KN) Deflection (mm) Weight (Kg) Conventional piece 260 8.70 321 Continuous air pocket deck 320 9.20 242 Alternative air pocket deck type I 290 8.95 278 Alternative air pocket deck type II 275 8.80 281 TABLE: II

TYPE OF SLAB	LOAD (KN)	DEFLECTION(MM)	WEIGHT(KG)
CONVENTIONAL SLAB	260	8.70	321
CONTINOUS BUBBLE DECK	320	9.20	242
ALTERNATIVE BUBBLE DECK TYPE I	290	8.95	278
ALTERNATIVE BUBBLE DECK TYPE II	275	8.80	281

D) Fire Resistance The imperviousness to fire of the piece is an intricate issue yet is predominantly subject to capacity of the steel to hold adequate quality during a fire when it will be warmed and lose noteworthy quality as the temperature rises. The temperature of the steel is constrained by fire and the protection of the steel from the fire. Regardless, all solid is split, and in a fire, almost certainly, the air would get away and the weight scattered. On the off chance that the standard air pocket material is utilized (HDPE), the results of ignition are generally amiable, surely contrasted with different materials that would likewise be consuming in the region. In an extraordinary, delayed fire, the ball would dissolve and in the long run roast without critical or noticeable impact. Imperviousness to fire relies upon solid spread about 60-180 minutes. Smoke obstruction is about 1.5 occasions the fire protections.

STEEL STRESS	STEL UTILIZATION	FIRE RESISTANCE (MM)				
		30	60	90	120	180
190	66%	17MM	17MM	17MM	17MM	-
286	100%	17MM	17MM	35MM	42MM	55MM

E) Comparison of Cost Price regarding the general tests, an all out cost value figuring of the Town Hall in sanctum Haag is completed. The Town Hall was worked with pressurized solid components. The total development has been assessed so as to make a solid examination .Two sorts of correlations were made: 1. Air pocket Deck and a strong deck were thought about in three different courses of action adjustment of arrangement of segments. The figurings were made for expanding ranges in the x bearing. For a given blend of range and deck thickness, Bubble Deck was 5… 16% more affordable than a strong deck. Emphasize that the ideal blend of deck thickness and arrangement of sections with Bubble Deck contrasts from a strong deck. A right examination must think about this reality, which was made in the subsequent correlation: 2. Two variations of Bubble Deck were looked at; the outcome was clear – the Bubble Deck building was noteworthy more affordable than the customary framework. The all out investment funds was in the request for 20%

2.1 COMPARISION BETWEEN CONVENTIONAL SOILD SLB AND PLASTICVOIDED SLAB

Some of the comparison of plastic voided slab over solid conventional slab can be listed below:

- Voided slab utilized very less amount of concrete and is relatively very light as compared to solid conventional slab
- Increase in dead load of slab due to high concrete content required beams but in voided slab dead load is low and the beams are not required
- When using the voided slab the span of the structure can be enhanced but in solid conventional slab the span length is limited
- When talking about the earth quick resistivity we talk about the building inertia which depends upon the weight of the structure as plastic voided slab construction are light weight than the solid conventional slab it is more earth quick resistance
- As we are neglecting the beams we gain a structure having reduced height and as we reduce the height we can add floor with respect to solid conventional slab
- When dealing with the bay areas of the slab we can get more area covered with less amount of column in voided slab
- Due to use of non-biodegradable materials it becomes environmental friendly structure
- Voided slabs are more economical in compared to solid conventional slab

3. CONCLUSIONS

From above discussion of various parameters of plastic voided slabs and parametric study of it over conventional flat slab. We came into conclude that this technology reduced amount of concrete in slab and weight of slab is reduced from 35%to50% in this technology the number of pillars required for a any structure are less than conventional slab i.e ,it reduces approximately 10 percent of vertical arrangement by using this technology co_2 emmision will be less and overall cost will be decrease by 20 percent The advantages of utilizing plastic voided chunks as opposed to strong pieces are more noteworthy for bigger ranges. Littler ranges don't require generously thick pieces, in this manner just little voids can be used and negligible reserve funds are accomplished. Bigger ranges are equipped for utilizing bigger voids that significantly diminish the general load of the piece while meeting load limit necessities. Development of plastic voided pieces requires a bigger number of steps than strong chunks, yet the development procedure isn't fundamentally increasingly entangled. For coves of a similar size, plastic voided pieces regularly require less fortification. Generally speaking, plastic voided section frameworks give a superb option in contrast to strong solid pieces for some applications. Weight and cost reserve funds just as building adaptability can be accomplished with plastic voided chunks. The examination has demonstrated that voided section innovation is more productive than a conventional biaxial solidchunk. The limited component models of the section made for the investigation check the earlier examination and test

4. REFERENCES

1]. Analysis of voided deck slab & cellular deck slab using Midias Civil by B Vaignam,Dr.B.S.R.K Prasad. [2]. Summary of tests and studies done abroad on the BubbleDeck system by SergiuCalin,RoxanaGintu,GabrielaDascalu.

[3]. Expt. program regarding BubbleDeck concrete slab with spherical gaps by SergiuCalin,CiprianAsavoaie

[4]. An experimental study on bubble deck slab system with elliptical balls by AratiShetkar and NageshHanche

[5]. Issues of achieving an experimental model concerning bubble deck concrete slab with spherical gaps by SergiuCalin,CiprianAsavoaie,N-Florea

[6]. Flexural capacities of reinforced concrete two-way bubbledeck slabs of plastic spherical voids by Amer M. Ibrahim, Nazar K. Ali

[7]. The expt. analysis of bubbledeck slab using modified elliptical balls by L. V. Hai, V.D. Hung

[8]. Design factors and the economical application of spherical type voids in RC slabs by KivaneTaskin&KeremPeker

[9]. A study obbehavior of bubbledeck slab using ANSYS by Rinku John &Jobil Varghese

[10]. Punching shear strength development of bubbledeck slab using GFRP stirrups by Reshma Mathew &Binu P.

[11]. Numerical & experimental study on bubbledeck slab by M. Surendar& M. Ranjitham

[12]. An experimental study on two-way bubbledeck slab with spherical hollow balls by Bhagyashri ,G.Bhade& S. M. Barelikar

[13]. Finite element analysis of voided slab with HDPP void formers by K Subramanium, P Bhuvaneshwari [14]. Calculation of voided slab rigidities by Gee-CheolKim,Joo-Won Kang

[15]. Structural behaviour of bubble deck slab by P.PrabhuTeja,P.Vijay Kumar

[16]. Parametric study of solid slab and voided slab by YogeshTambe,PrashantKulkarni

[17]. Flat slabs with spherical voids by MihaiBindea,DumitruMoldovan,Zoltan Kiss

[18]. Comparative study of voided flat plate slab & solid flat plate slab by SaifeeBhagat,Dr. K.B. Parikh [19]. Comparative structural analysis of Biaxial voided slabs and solid slab by Mosioma,WycliffeOnchura,MosesOnyangoOpiyo

[20]. Collapse of reinforced concrete voided slab by L.A Clark

[21]. Numerical analysis of flat slabs with spherical voids subjected to shear force by M. Bindea,Claudia Maria Chezan,APuskas