International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

National Conference on Recent Advances in Civil Engineering Infrastructure (rACEi-2021)

Performance of U Boot Beton Technology in Concrete Slabs

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Received 05 Aug2021, Accepted 10 Aug 2021, Available online15 Aug 2021, **Special Issue-9 (Aug 2021)**

Abstract

U-Boot Beton a recycled polypropylene formwork that was designed to create two-way voided slabs. A voided slab is a concept that simply removes the excess concrete from the expensive part of the structure slab. It was invented by Jorgan Breuning of Denmark about 20 years ago. It is now gaining popularity both in Europe and in Asia. The realization of the proposed objectives involves documentation activity and theoretical study of all work done by several authors on voided slab concept. The quality of the used mixture, the innovative shape, the thickness and dimensions of the product, the fire safety and strict working techniques make it the product of excellence. U boot beton, is not subject to deformations, either during or after the casting, either due to the weight of concrete or the dynamic effect connected to the work operation; It enable to support before casting the workers and fresh concrete. Numerous national and international product and system certifications have been received that prove not only product quality but also the validity of the constructive solutions and the applications in the building industry all of this, together with advantages. U boot beton the product of reference for operators and professionals.

Key Words: *U boot- performance-recycled waste plastic.*

1. Introduction

U-boot Beton a formwork made of recycled polypropylene, designed to create lightened intermediate slabs and raft foundations in reinforced concrete. The use of U-boot formworks permits to build specific mushroom slabs: the mushroom is part of the slab thickness. U-boot remains dip into the concrete casting. Thus, a grid of orthogonal beams, superiorly and inferiorly closed by plane slabs of different heights, is obtained without executing two distinct concrete castings, all that implies a remarkable saving of concrete and reinforcement.

A new system of hallow formers to decrease transportation cost and carbon dioxide production was patented in 2001 by Italian engineer, Roberto II Grande. U Boot beton, or U Boot, is a voided slab system from the Italian company Daliform. U boot beton does not use spherical void former like previous system, but uses truncated-pyramid shaped void formers instead. This void former creates many grid shaped beams making of the slab (U boot beton, 2011). The U boot system issame as co-biax system in terms of construction because it is meant to be cast entirely on site using form work. After forms are erected, the steel and void formers are placed before the concrete is poured in two lifts.

In addition to many design benefits that all voided slabs system provides, the u boot system as won benefit over systems that use spherical void formers the shape of u boot void formers allows them to stacked efficiently during transportation to the site, saving space and potentially leading to reduce shipping cost compared to spherical former system.

2. Objectives

- To reduce the volume of concrete.
- To minimize the cost of the project.
- To reduce the self-weight of structure.
- To reduce the slab thickness

2.1 Shapes of U Boot Beton

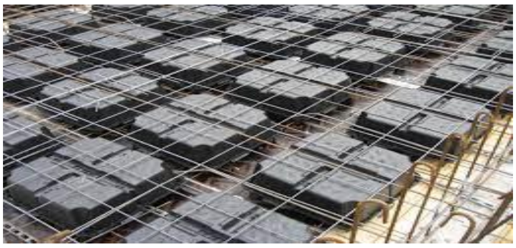


Fig.1 U Boot Beton

3. Methodology

3.1 Voided Slab Construction

The entire surface of the slab to be cast on site is shuttered with wood decking (or similar systems), then the lower reinforcement concrete bars are positioned in two mutually perpendicular directions according the design and the lattice for the upper reinforcement concrete is arranged.

The U-Boot Beton form works are positioned using the lateral spacers joints to place them at the desired center distance that will determine the beam width. Thanks to the conic elevator foot, the U-Boot Beton form works will be lifted from the surface, making it possible for the lower slab to be formed. If double or triple elements are used, these elements must first be assembled, which will be supplied on distinct pallets in the yard.

The positioning of the reinforcement concretes is completed by placing above the U-Boot Beton formwork the upper bars in the two directions as well as the reinforcement for shear and punching where necessary, according the design.

The concrete casting must be performed in two phases to prevent the floatation of the formworks: an initial layer will be cast to fill a thickness equal to the height of the elevator foot. Casting will continue for this first portion of the slab until the concrete starts to set and become semi fluid.

Once suitably set, the casting can be restarted from the starting point, completely burying the U-Boot Beton. The casting is then levelled and smoothed in a traditional man

Once the structure has hardened, the formwork can be removed. The surface is smooth in correspondence of the soffit.

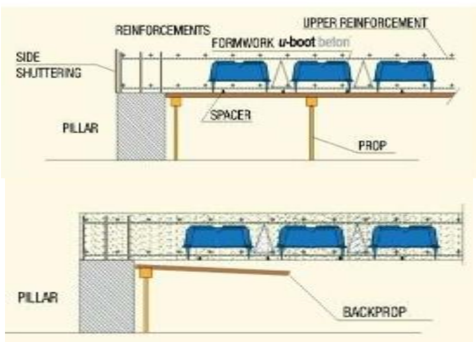


Fig.2 placing of U Boot

3.2 Applications

U-boot Beton a recycled polypropylene formwork that was designed to create two way voided slabs and rafts. The use of U-boot Beton formwork makes it possible to create mushroom pillars, with the possibility to have the mushroom in the thickness of the slab. U-Boot Beton used to create slabs with large span or that able to support large loads without beams. Light and quick and easy to position, thanks to their modularity the designer can vary the geometric parameters as needed to adapt to all situations with great architectural freedom.

- Used in raft foundation
- Used in public buildings and parking etc.,
- Used in two way slabs.

3.3 Advantages of U-Boot Technology

- Increased number of floors.
- Large span.
- Reduced slab thickness.
- No beams between pillars.
- Reducing in the number of pillars.
- Reduction in the overall load of the structure weighing on the pillars and the foundation.
- Reduced foundations- less deep foundation excavation

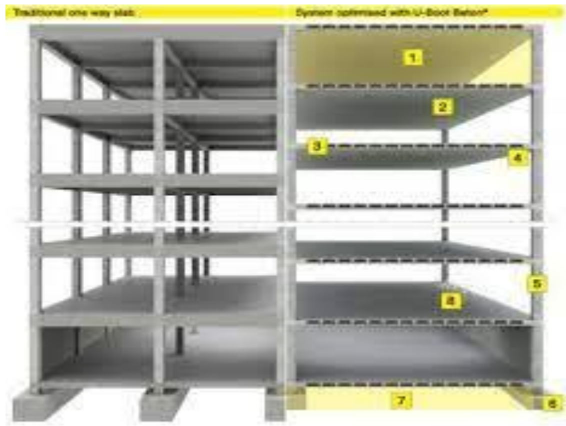


Fig.3 Comparison for Non- Voided and Voided Slab

4. Concrete Mix Design

Data Required for Concrete Mix Design
Concrete Mix Design Stipulation
Characteristic compressive strength required in the field at 28 days grade designation - M 25
Nominal maximum size of aggregate - 20 mm
Shape of CA - Angular
Degree of workability required at site -50-75 mm (slump)
Degree of quality control available at site - As per IS:456
Type of exposure the structure will be subjected to (as defined in IS: 456) - Mild

Type of cement: PSC conforming IS:455
Method of concrete placing: pump able concrete

Test data of material (to be determined in the laboratory)
Specific gravity of cement - 3.15
Specific gravity of FA - 2.64
Specific gravity of CA -2.84
Aggregate are assumed to be in saturated surface dry condition.
Fine aggregates confirm to Zone II of IS - 383
Procedure for Concrete Mix Design of M25 Concrete

Step 1 - Determination Of Target Strength
constant for 5% risk factor is 1.65. In this case standard deviation is taken from IS:456 against
M 25 is 4.0.
Ftarget = fck + 1.65 x S
= 25 + 1.65 x 4.0 = 31.6 N/mm2
Where, S = standard deviation in N/mm2 = 4 (as per table -1 of IS 10262- 2009)

Step 2 - Selection of water / cement ratio:-
From Table 5 of IS 456, (page no 20)
Maximum water-cement ratio for Mild exposure condition = 0.55
Based on experience, adopt water-cement ratio as 0.5, 0.5<0.55, hence OK.

Step 3 — Selection of Water Content
From Table 2 of IS 10262- 2009,
Maximum water content = 186 Kg (for Nominal maximum size of aggregate — 20 mm)
Table for Correction in water content Parameters Values as per Standard reference condition Values as per Present Problem Departure Correction in Water Content
Slump 25-50 mm 50-75 25 (+3/25) x 25 = +3
Shape of Aggregate Angular Angular
Estimated water content = 186+ (3/100) x 186 = 191.6 kg /m3

Step 4 — Selection of Cement Content
Water-cement ratio = 0.5
Corrected water content = 191.6 kg /m3
Cement content = From Table 5 of IS 456,
Minimum cement Content for mild exposure condition = 300 kg/m3
383.2 kg/m3 > 300 kg/m3, hence, OK.
This value is to be checked for durability requirement from IS: 456.
In the present example against mild exposure and for the case of reinforced concrete the minimum cement content is 300 kg/m3 which is less than 383.2 kg/m3. Hence cement content adopted = 383.2 kg/m3.
As per clause 8.2.4.2 of IS: 456, Maximum cement content = 450 kg/m3.

Step 5: Estimation of Coarse Aggregate proportion:-
From Table 3 of IS 10262- 2009,
For Nominal maximum size of aggregate = 20 mm,
Zone of fine aggregate = Zone II
And For w/c = 0.5, Volume of coarse aggregate per unit volume of total aggregate = 0.62

Note 1: For every ±0.05 change in w/c, the coarse aggregate proportion is to be changed by 0.01. If the w/c is less than 0.5 (standard value), volume of coarse aggregate is required to be increased to reduce the fine aggregate content. If the w/c is more than 0.5, volume of coarse aggregate is to be reduced to increase the fine aggregate content. If coarse aggregate is not angular, volume of coarse aggregate may be required to be increased suitably, based on experience.
Note 2: For pump able concrete or congested reinforcement the coarse aggregate proportion may be reduced up to 10%, Hence.
Volume of coarse aggregate per unit volume of total aggregate = 0.62 x 90% = 0.558
Volume of fine aggregate = 1 – 0.558 = 0.442

Step 6: Estimation of the mix ingredients
Volume of concrete = 1 m3
Volume of cement = (Mass of cement / Specific gravity of cement) x (1/100)
= (383.2/3.15) x (1/1000) = 0.122 m3
Volume of water = (Mass of water / Specific gravity of water) x (1/1000)
= (191.6/1) x (1/1000) = 0.1916 m3
Volume of total aggregates = a – (b + c) = 1 – (0.122 + 0.1916) = 0.6864 m3
Mass of coarse aggregates = 0.6864 x 0.558 x 2.84 x 1000 = 1087.75 kg/m3
Mass of fine aggregates = 0.6864 x 0.442 x 2.64 x 1000 = 800.94 kg/m3
Concrete Mix proportions for Trial Mix 1
Cement = 383.2 kg/m3
Water = 191.6 kg/m3
Fine aggregates = 800.94 kg/m3
Coarse aggregate = 1087.75 kg/m3
W/c = 0.5

Step 7: Correction due to absorbing / moist aggregate:-
Since the aggregate is saturated surface dry condition hence no correction is required.

5. Results& Discussions

We Manually Designed The M25 (Non – Voided Slab & Voided Slab).

S no.	Parameter	Flat slab	Voided slab	% Reduction
1.	Dead load	7.12KN/m	6KN/m	8.53%
2.	Effective Depth	260mm	240mm	8.57%
3.	Moment at mid-span	590.67KN-m	471KN-m	11.27%%
4.	Moment at column strip	114.78KN-m	99.38KN-m	7.19%
5.	Ast at mid span	837.76m2	314.93 m2	45.35%
6.	Ast at column strip	1110.16m2	1043.05m2	3.11%

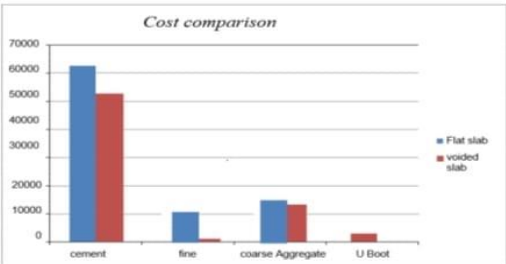
Parameters	Non voided slab (M25)	Voided Slab (M25)
Water Cement Ratio	0.48	0.45
Cement	336.14 Kg	162.3 Kg
Fine aggregate	336.14 Kg	162.3 Kg
Coarse aggregate	672.28 Kg	324.6 Kg
Mix Proportion	1:1:2	1:1:2

Cost Comparision for Non- Voided Slab

S.No	Parameters	Quanitity (cum)	Rate Rs.	Amount (Rs)
1.	Cement	7.9	280/bag	62440/-
2.	Fine Aggregate	7.9	4000/Mini truck	12000/-
3.	Coarse Aggregate	15.8	2200/Mini truck	13200/-

Cost Comparison for Voided Slab

S.No	Parameters	Quanitity (cum)	Rate Rs.	Amount (Rs)
1.	Cement	6.64	280/bag	52640/-
2.	Fine Aggregate	6.64	4000/Mini truck	10000/-
3.	Coarse Aggregate	13.29	2200/Mini truck	11000/-
4.	U boot Beton	120 no's	7/ per piece	840/-



Conclusion

- At the end of the study we conclude that the cost of the voided slab can reduce 13 to 15% than conventional slab.
- By using U boot beton technology we can reduce 15.91 to 16% volume of Concrete comparatively conventional slab.
- Also we conclude that U boot are manufactured by recycling the waste plastic. Hence the wastage of the plastic can be avoided. We can reduce pollution of the environment to some extent.

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