

Study of U-Boot Technology in Construction

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Abstract— U-boot beton is a box like formwork structure made up of recycled polypropylene, which is a byproduct of industrial plastic waste used to create lightened void slabs in reinforced concrete structures. The use of U-boot technology helps us to reduce the amount of concrete used in laying the slabs. That means we are saving the natural resources for future generation.

Keywords: U-Boot Technology, Footh/Needles (H Lower), Spacer Joint

I. INTRODUCTION

The U-boot technology was introduced by Roberto II Grande an Italian engineer in 2001. He developed and patented a new system of hollow formers in order to decrease the self-weight (Dead load) of the structure. U-boot earliest projects were executed in 2002 Italy and since that time it has been used all over the world. This technology may also be combined with pre-fabricated systems/pre stressing systems.

II. OBJECTIVES

U-Boot beton is used to create slabs with large span that are able to support large loads without beams. Rather than conventional principle of mono directional load transmission, due to monolithical structure it bi directionally transmits the loads directly to the columns then to foundation and soil beneath. Due to beams are completely absent in this type of structures, it can also be used for laying mushroom pillars. It is very easy and quickest process to lay U-boot betons as they are very light weight (1 to 2kg) and simple to use.

III. U-BOOT BETON

The main element in the U-boot technology is the U-boot beton. It is the heart of U-boot technology. It is made up of recycled polypropylene which is a byproduct of industrial plastic waste. As we all know Polypropylene is a Thermo plastic Alkene material contains 3 carbon molecules & 6 hydrogen molecules (C₃H₆). It is a versatile material available in plenty throughout the world.

The properties of U-boot beton are:

- It is light in weight
- It is chemically inert in nature
- It can withstand against generally occurred wear&tear
- It has high melting point
- It doesnot react with any other material present in concrete like cement, water, admixture etc.,
- Density of U-boot beton is very low
- It doesnot emits very dangerous toxic gases into atmosphere at room temperature compared to Polystyrene
- It is a durable material
- It is flexible in nature

IV. PARTS OF U-BOOT

There are mainly 5 parts in U-boot technology. They;

A. Fooths/Needles:

These represents bottom portion of U-boot beton used to fix U-boot beton on formwork firmly. These are in different heights and different sharpness according to structure.

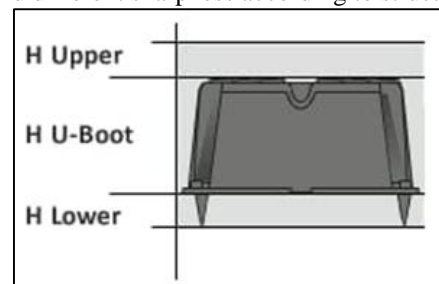


Fig. 1: Fooths/Needles (H Lower)

B. U-boot beton:

As we already discussed it is the main part of the structure. It represents lightness for structure by reducing its self-weight. It is a box like form structure to create voids in slabs.



Fig. 2: U-boot beton

C. Spacer Joint:

Spacer joint is used to join two/more U-boot betons while fixing on the shuttering so that there cannot be any change in the distance between gaps while pouring concrete.

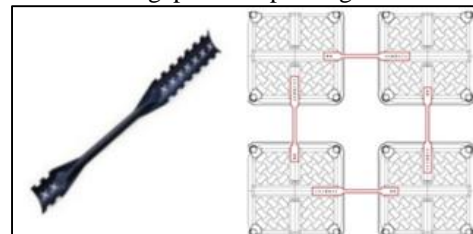


Fig. 3: Spacer joint

D. Connection Bridge:

The connection bridge is necessary in order to join two U-boot betons longitudinally, wherever the length of the beton needed to be increased.

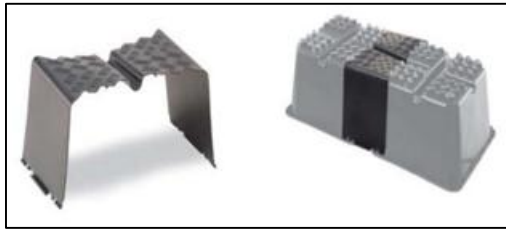


Fig. 4: Connection Bridge

E. Closing plate:

Closing plate is used to close the U-boot beton box, which can resist the flow of concrete into box. The closing plate and its quality plays a major role, so it cause problems if concrete tends to move into beton from damaged plate after concrete is placed.

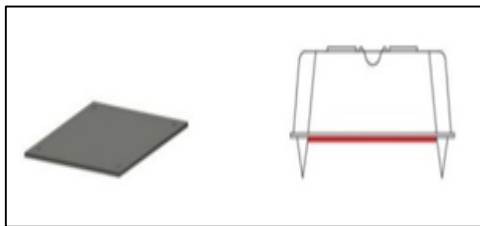


Fig. 5: Closing plate

V. SIZE OF U-BOOT BETON

The sizes of U-boot beton varies on the mode of work and based on the load acting on the beton. The general working cross sectional dimensions of the U-boot beton is 52X52cm. The height of the U-boot beton can vary from 10cm to 56cm (10,13,16,18,20,22,23,24,25,28cm) based on the mode of slab. The weight of U-boot beton also changes with change in dimensions of the beton.

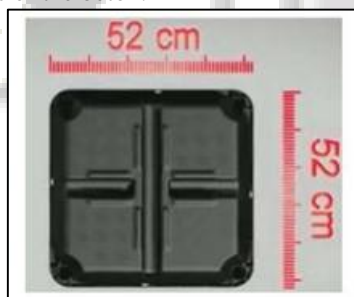


Fig. 6: Size of U-boot beton

VI. TYPES OF U-BOOT BETONS

There are mainly 2 types for arranging U-boot betons;

A. Single U-boot beton:

The single U-boot beton is generally used while laying single reinforced slabs. It is generally an open type polypropylene box which can be closed by using a closing a plate to resist the entry of concrete into the beton.

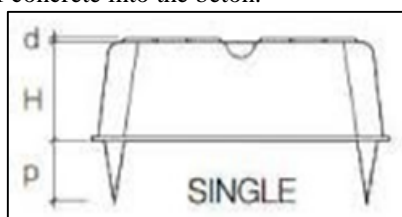


Fig. 7: Single U-boot beton

B. Double U-boot beton:

The double U-boot beton is generally used for laying double reinforced slabs. It consists of 2 boxes which are closed against each other to prevent entry of concrete into beton.

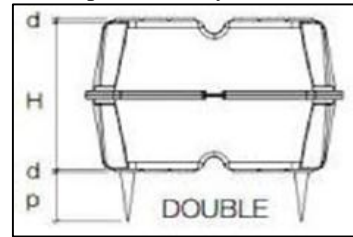


Fig. 8: Double U-boot beton

Note: Sometimes if it is possible, Thriple U-boot beton also used in the construction for larger depths of slab.

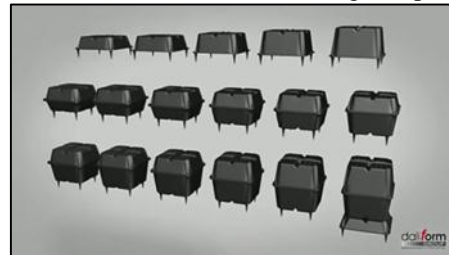


Fig. 9: Different types of U-boot betons

VII. CONCEPT OF U-BOOT TECHNOLOGY

A. Bending Stress Concept:

In this type of slab due to U-boot betons voids created in central section and the cross section behaves like as I section (Double T). We all know I section is the best section to take more bending stresses by saving concrete material.

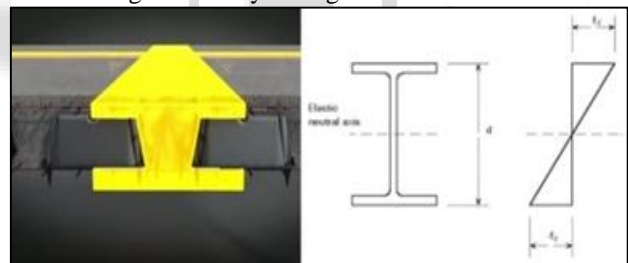


Fig. 10: Bending stress diagram

B. Shear Stress Concept:

Generally slabs are safe against shear stresses. In this type of slab the negligible amount of shear stresses is taken at columns. So at corners column caps are provided to take shear stresses. This is achieved by providing solid section (No I section) at columns by donot providing U-boot betons at corners.

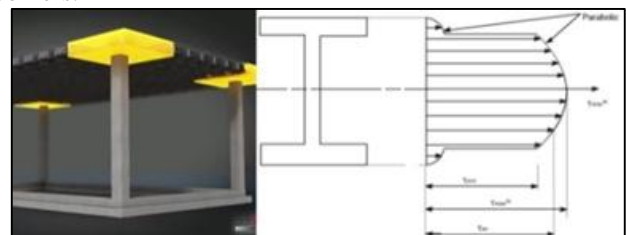


Fig. 11: Shear stress diagram

VIII. INSTALLATION

The installation process of U-boot slab is done by 6 simple steps;

- 1) Step 1- Fixing of strong formwork properly for laying U-boot slab. We already know it is the basic operation for execution of any slab.
- 2) Step 2- Place lower reinforcement above the formwork, which acts as compression reinforcement for slab.
- 3) Step 3- Place the triangular reinforcement for the purpose of work as the beam. It creates a space for fixing U-boot betons and for proper alignment of betons.
- 4) Step 4- Now place the U-boot betons between triangular reinforcement. If needed spacer joints, connection bridges, closing plates are used.
- 5) Step 5- Now complete the upper reinforcement properly above the U-boot betons which acts as tension reinforcement for slab.
- 6) Step 6- Finally pouring of concrete is being done upto needles of foots of U-boot betons/till closing plate to bind concrete to foots of betons. Then after concrete is laid to full depth of slab.

IX. APPLICATIONS

- Raft foundations
- Mushroom pillars
- Sky scrapers/High rise buildings
- Parking lots
- Malls, Hotels, Restaurants, Auditoriums
- Hospitals
- Fire resistant structures
- Temples
- Schools and public buildings
- Earthquake resistant structures

X. ADVANTAGES

- Decreases self-weight up to 40%
- Main advantage is construction is without beams
- Reduces deformations (deflections)
- Columns cross section reduced
- Reduces total load on foundation due to its decreased self-weight
- Longer spans of construction achieved
- Due to its very low weight, there is no need of lifting devices and movement devices
- Also number of columns reduced in the construction
- Easy to construct
- Usable height saving in each floor enables a higher number of floors
- Slab thickness is less compared to normal conventional slabs
- Steel and aggregates quantity reduced, so there is great saving in material
- Easy to transport the U-boot betons due to its light weight
- Construction cost reduced upto 15% of total cost of construction
- Due to this construction there is no need of false ceiling at an aesthetical level
- Its main advantage is, it is fire resistance

- Due to its shape, these are easy to stock anywhere
- This structures have high stiffness due to its U-boot properties
- Very economical
- Reduces the foundation sizes
- These structures takes more vibrations than normal structures
- Architecturally this constructions are more beautiful compared to normal buildings

XI. IMPLEMENTATIONS



Fig. 12: Railway station enlargement, Parma, Italy



Fig 13 Shaktidham temple, Aurangabad, Maharashtra

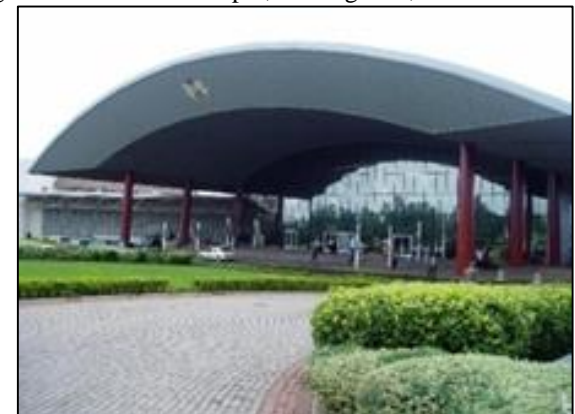


Fig. 14: Tower hotel and international conference center, Abuja, Nigeria

XII. RESULT

As we study about the U-boot technology, we come to know that using polypropylene gives many advantages than using

polystyrene. When the slab with polystyrene catches to fire, it releases toxic gases and if we don't arrange any vents, there might be a chance of blasting of slab. So the U-boot technology is the best technique as compared with conventional technique. By using this system concrete usage is reduced approximately 1kg of recycled plastic replaces 100kg of concrete.

XIII. CONCLUSION

The U-boot technology is a very advanced, economical, architectural, eco-friendly and fastest method of construction of a slab. Reducing material consumption made it possible to make the construction time faster and reduction in overall cost of structure. The usage of U-boot technology is very rare due to lack of awareness in our country. As we all have responsibility of saving natural and renewable resources for our future generations, this technology should be utilised more.

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