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COST EFFICIENT CONSTRUCTION TECHNIQUES

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Abstract

Cost is the Major Constraint in any Construction Project. As there is a Universal demand for faster as well as cost efficient construction one needs to adopt the Techniques that are cost efficient as well as time saving hence fulfilling the needs of future demand. India being a developing country ,the economy plays an important role in development of the country. Therefore the use of cost efficient Construction techniques for timely delivery of the construction projects by adopting alternative methods of construction is necessary in India to fulfil the increase in demand for Housing. Further the construction done has to be affordable and sustainable as well .With all those demands of end users and the advancement in construction techniques the contractors and designers are ought to introduce something new and smart to fulfil their demands and needs. The motive of the paper is to introduce some innovative techniques through which the total cost of construction can be reduced without much affecting the quality of construction. These techniques will be helpful for ongoing as well as upcoming future construction projects of high scale area to minimize the cost, time and waste and for enhancement of the structure.

Index Terms: *Cost Efficient, Bubble Deck, Bond , Formwork.*

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Introduction

India being a developing country, the economy plays an important role. Time and Cost are the two main concerns in construction. A technique or method is considered smart only when it contributes something to upgrade the quality of building. With all those advancements in construction techniques and also with the demand of end users for smart buildings we as a contractor or a designer ought to introduce something new and smart to fulfil their demands and needs. Many countries have initiated adopting innovative yet cost efficient construction techniques now its time for India to adopt modern and more efficient construction techniques .Adopting traditional methods of construction for housing and other building requires more time and adds significant construction cost so in order to reduce the time of construction and to reduce the cost of construction making the construction envoirnment friendly at the same time new techniques are desired to be adopted in construction . The motto behind the paper is to provide some cost efficient construction techniques which fulfills all the performance objectives and meets the functional requirements of the owner and hence provides the building substitute that integrates and optimizes all the major high performance building attributes being less sophisticated, less time consuming and having practically adoptable methodology.

1. Bubble Deck Slab

In any structure, Slab has most important role, used for berthing purpose and used to transmit the loading to other structural members. Many Attempts were made from last few decades to reduce the dead weight of slab. Many attempts consisted of laying blocks of less heavy materials like expanded polystyrene between the bottom and top reinforcement, while other types included Waffle slabs, primarily lack of structural integrity, inflexibility and reduced architectural possibilities, focus has been on biaxial slabs and the ways to reduce the weights. Several methods have been introduced during the last decades, but with very limited success, due to major problems with shear capacity and fire

resistance as well as impractical execution. Of these types, only Waffle slabs can be regarded to have a certain use in market but the use the use will always be very limited due to reduced resistance towards shear, local punching and fire. To overcome all such drawbacks bubble deck slab was invented by Jorgen Brueing in 1990 which was first biaxial hollow slab in Denmark.

Bubble deck system is a new construction technology which virtually eliminates 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 (HDPE) 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, thus having various advantages over the traditional slab system.Bubble deck slab is conceptualized to exclude a significant volume of concrete as compared to a solid slab in the central core where the slab is principally un-stressed in flexure. The depth of compressed concrete is usually a small proportion of the slab depth .The concrete between the ball and the surface so there is no reasonable difference between the behaviour of a Bubble Deck and solid slab. The only working rudiments are the steel on the tension side and the outer 'shell' of concrete on the compression side. In terms of flexural strength, the moments of resistance are the same as for solid slab.The use of spherical balls to fill the voids in the middle of a flat slab eliminates considerable amount of a slab self-weight compared to solid slab having same thickness without affecting its deflection behavior & bending strength.

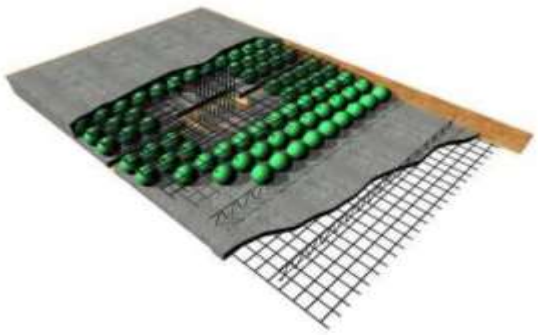

Fig-1: Typical layout of Bubble Deck Slab

TYPES OF BUBBLE DECK SLAB

All of the bubble deck versions come in three forms :-

1.Filigree Elements

2.Reinforcement Modules

3. Finished Planks.

Type A- Filigree Elements :- Bubble deck type A is a combination of constructed and unconstructed elements. A 60mm 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 the supported by the temporary stands on 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 the common concreting techniques and finished necessary. This type of BubbleDeck is optimal for new construction projects where the designer can determine the bubble position and steel mesh layout.

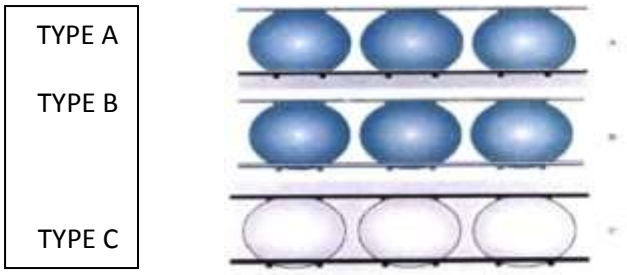

Fig-2:Types of Bubble Deck Slab

Type B- Reinforcement Modules :- It 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 by the additional reinforcement, and then concreted in place of 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 unit needed.

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

ADVANTAGES OF BUBBLE DECK SLAB

- Bubble Deck slab have less weight when compared to traditional solid slab
- Increased strength
- Bubble deck slab can be used for larger spans as it eliminates the require.ment of beams
- Only few columns are required to support deck slab
- Freedom of choice of shape.
- Bubble Deck slab requires less foundation depth
- Ducts and Pipes Can be easily Incorporated in Bubble Deck Slab.
- Bubble Deck slab Requires Less Work on Site.
- Bubble Deck slab Consumes less material and energy.
- Reduction of CO2 emission up to 40 kg/m2.
- 1kg of plastic replaces 100kg of concrete.
- Every component is recyclable.
- Faster construction can be done.

Bubble Deck has proved to be highly successful in Europe since its invention ten years ago. In Denmark and Holland over 1million square meters of floors have been constructed in the last seven years using the BubbleDeck system in all types of multi-storey buildings now its time for India to adopt the Bubble Deck Slab.

2 .Rat Trap Bond

The rat trap bond is a masonry technique, where the bricks are used in a way which creates a cavity within the wall, while maintaining the same wall thickness as for a conventional brick masonry wall. While in a conventional English bond or Flemish bond, bricks are laid flat, in a Rat trap bond, they are placed on edge forming the inner and outer face of the wall, with cross bricks bridging the two faces. The main advantage of Rat-trap bond is reduction in the number of bricks and mortar required as compared to English/ Flemish bond because of the cavity formed in the wall. The cavity also makes the wall more thermally efficient. This also reduces the embodied energy of brick masonry by saving number of bricks and the cement-sand mortar. It is suitable for use, wherever one-brick thick wall is required. Since its original dissemination in Kerala in the 1970sby architect Laurie Baker, rat trap bond has been extensively used in every category of building from large institutional complexes, community buildings. Government offices/village panchayats, individual homes both for high income and middle income and also in government supported EWS housing programs. The following figure shows the basic layout difference in the traditional English/ Flemish Bond Masonry methods Vs Rat Trap Bond Masonry.

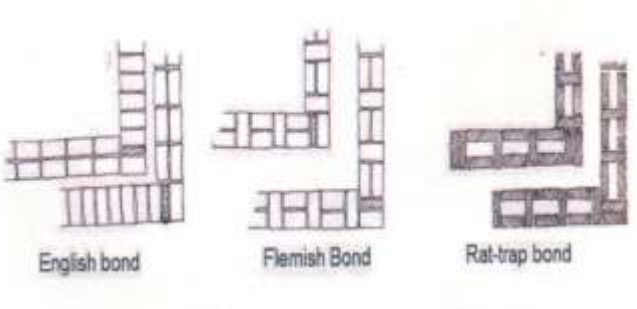

Fig-3:Basic Layouts of Various Bonds

BENIFITS OF ADOPTING RAT TRAP BOND

1. By adopting this method of masonry, you can save on approx. 20-35% less bricks and 30-50% less mortar; also this reduces the cost of a 9 inch wall by 20-30 % and productivity of work enhances.
2. For 1 m3 of Rat trap bond, 470 bricks are required compared to conventional brick wall where a total of 550 bricks are required.
3. Rat trap bond wall is a cavity wall construction with added advantage of thermal comfort. The interiors remain cooler in summer and warmer in winters.
4. Rat-trap bond when kept exposed, create aesthetically pleasing wall surface and cost of plastering and painting also may be avoided.
5. Rat trap bond can be used for load bearing as well as thick partition walls.
6. All works such as pillars, sill bands, window and tie beams can be concealed.
7. The walls have approx. 20% less dead weight and hence the foundations and other supporting structural members can suitably be designed, this gives an added advantage of cost saving for foundation.

Fig-4: Corner joint in Rat trap bond

Cost Savings

Material saving per m^3: Rat trap bond vs. Conventional Brickwork

- 1.11 bags (57% saving) saving in cement cost = Rs288/m3
- 80 nos. of bricks (20% saving) saving in brick cost. = Rs 576/m^3
- 0.80 m^3 less sand (61% saving) saving in sand. = Rs 13/m^3

Summarizing the material cost an approximate saving of Rs 478 is achieved per m^3 of Rat trap bond brickwork compared to conventional solid brickwork.

3.Plastic Formwork

Considering the labour problem and the cost of formwork system at Desire Construction Systems thought to develop an alternative formwork system which could help the industry to not only reduce construction cost but also a system that is easy to install, dismantle and handle.

This system is made from special grade plastic and hence no chemical reaction takes place nor the material stick to it. Because of this property you cannot get any patched on the RCC finish. Also the gap between two plates are so negligible that no water nor cement gets leaked out at the time of RCC and it gets cured from the bottom of the plate , which also enhance the final quality of RCC casting. Comparatively our foam systems are very less in weight compared to conventional M.S. Plate (1/4th) and Plywood (1/2). Due to easy plugging systems and easy to fit makes this foam shuttering system most labour friendly.

By using Desire systems one need not nail or apply oil to the plates before casting RCC. Due to auto leveling of plugging

systems the plates are automatically leveled. Hence 30 % time saves in assembling and also while dismantling the same.

You can cast Slab, Beam & Column, etc. A lot of the parts in the Desire system are supportive to each other and you can cast a beam from 9 inch to 21 inch by this same plate by simply adjusting the locking systems. Desire formwork systems are made from Petroleum waste and its long lasting and gives more than 100 repetitions.

After every usage of Desire foam systems once can easily clean the plates with water. Where as in M.S. Plate one has to apply oil to clean the M.S. surface plates. In Desire plates if any breakage occurs by mishandling it can be very easily sealed by low voltage hot air gun.

COMPRARISION OF TRADITIONAL FORMWORK WITH PLSTIC FORMWORK

ITEM	PLASTIC FORMWORK	TIMBER	STEEL
Water Resistant	YES	NO	NO
Corrosion Resistant	EXCELLENT	BAD	BAD
Weight	LIGHT	FAIRLY LIGHT	HEAVY
Deformation condition	NO	YES	YES
Time saving	100%	50%	40%
Recycling	40%	NO	10%

Advantages of Plastic Formwork

- The installation of plastic formwork is easy
- Plastic formwork system is more time saving
- Deforestation and cut down of green plants will no longer be need
- It is economical them any other formwork system
- Plastic formwork makes the finishing of constructed work easy
- Plastic formwork is reusable
- Low maintenance and repeatability , makes it environment friendly.
- No shuttering oil is required in case of Plastic Formwork

CONCLUSION

By adopting the modern construction techniques like Bubble deck slab,Rat Trap Bond,Plastic formwork,etc. We can fullfill the demand of faster as well cost efficient construction making the construction envoirnment friendly as well by reducing the CO2 consumption.Bubble deck slab eliminates the quantity of ineffective concrete from the slab hence reducing the cost of construction and reducing the enegy consumed for manufacturing of cement on the other hand by adopting Rat Trap bond the consumption of bricks in masonary work can be reduced making the houses more affordable for common man in India.we can conclude that by replacing our tradinational consruction methods or techniques with modern and innovative ones we can make the construction less time consuming , more cost efficient and more envoirnment friendly at the same time.

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