Analysis and Optimization of Fibre Rainforced Voided Pracast Concrete Slabs as Low Cost Housing Solution

Dr.C.P.Pise [1], Pratiksha sonawane[2]
[1,2]*PG Student, Structural Engineering, Punyashlok Ahilyabai holkar University, Solapur*

Abstract: The productivity of the construction industry worldwide has been declining over the past 40 years. One approach for improving the situation is using lean construction. Lean construction results from the application of a new form of production management to construction. Essential features of lean construction include a clear set of objectives for the delivery process, aimed at maximizing performance for the customer at the project level, concurrent design, construction, and the application of project control throughout the life cycle of the project from design to delivery. An increasing number of construction academics and professionals have been storming the ramparts of conventional construction management in an effort to deliver better value to owners while making real profits. As a result, lean-based tools have emerged and have been successfully applied to simple and complex construction projects. In general, lean construction projects are easier to manage, safer, completed sooner, and cost less and are of better quality. Significant research remains to complete the translation to construction of lean thinking in several areas of construction. Sanitation facilities in India even to date remain space and costly and hence un-available to the major Indian population. Hence development of low cost and durable sanitation facility enclosures, which is an important application of the lean construction concepts and methodologies and is more prevalent, proved that it could enhance the construction management practices in various aspects. Also, it is intended to develop methodology for process evaluation and define areas for improvement based on lean approach principles.

This project identifies the modular construction methods and u-boot technology of casting concrete as the methods of lean construction. The project work will include the design development and testing of permutations of the above said methods and thereby proving their effectiveness in terms of cost saving, time saving and durability.

Keywords: Lean concrete (LC), Fiber-reinforced concrete (FRC), U-boot

1. INTRODUCTION

Lean construction (LC) is a method of production aimed at reducing costs, materials, time and effort. Essentially, the methodology is to minimize the bad and maximize the good. Using the principles of lean-construction, the desired outcome would be to maximize the value and output of a project while minimizing wasteful aspects and time delay. This outcome is produced when standard construction approaches are merged with a clear and concise understanding of project materials and information and two sets of management archetypes, planning and control. This may seem complex to understand, but the essence of this system to use what is necessary without extra. This can only be done by strategic planning and action by a management group and with the help and aid of all workers.

It should be understood that lean construction is a philosophy with principles and ideologies, but it is not a concrete plan of action with set tools and methods. LC principles are the same throughout the many different schools of thought. The basic principles include: creating a predictable atmosphere based on planning and data, reducing the overflow of waste from careful planning and increasing the communication flows between the customer and the project at hand. Lean is a way of thought based on the notion that less is more. In the following sections hopefully a clear understanding of the principles and practices of the lean mindset are clearly expressed.

1. Identification of various lean construction models for project execution of low cost sanitation facility enclosures to stand the cost, time and durability test
2. Proposal of innovation in construction methods, materials in the form of U-boot technology of casting and modular rebar sets in various

permutations for effective low cost, manufacture time and maximum durability

2. EXPERIMENTAL WORK

2.1 Fabrication

Suitable manufacturing methods will be employed to fabricate the components and then assemble the test set –up.

2.2 Metal Grid

A concrete frame is a common form of structure, comprising a network of columns and connecting beams that forms the structural 'skeleton' of a building. This grid of beams and columns is typically constructed on a concrete foundation and is used to support the building's floors, roof, walls, cladding and so on. Concrete has little tensile strength, it generally needs to be reinforced. Rebar, also known as reinforcement steel (or reinforcing steel), is a steel bar or mesh of steel wires used to strengthen and hold the concrete in tension. To improve the quality of the bond with the concrete, the surface of rebar is often patterned.

2.3 U-boot

U-Boot Beton is a recycled polypropylene form work that can be used to create two-way voided slabs and rafts. It is implemented in Italy for the first time. U-boot beton is the simple solution for most problems in Laying slabs and laying foundations where the capacity of the layer soil is very low. It can be used as are placement for raft foundation where slabs were used to distribute the loads to the deeper soils. But we use U-boot betons for transferring loads to deeper soils in U-boot technology. Disposable formwork for two-way voided slabs in reinforced concrete cast on site. U-Boot Beton is used to create slabs with large span or that are able to support large loads without beams.

2.4 Fiber-reinforced concrete (FRC)

fibre-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers – each of which lend varying properties to the concrete.[1] In addition, the character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities.

Test and Trial on Specimens OF Concrete +FRC+u-boots

Slump test is conducted to know the workability of the Concrete, slump value varies between 5-7 for M20 grade concrete. The Slump value depends upon the water content and chemical composition of the grade of concrete

Properties of Concrete

Composition of the concrete. Water-cement ratio-0.55, Cement: CEM I 32.5 R 318 kg/m3, Aggregate: 2/8 mm 703 kg /m3Super plasticizer -1.20 kg/m3 Fiber: 10 % Volume Nylon 6 filaments-boots :20 No's

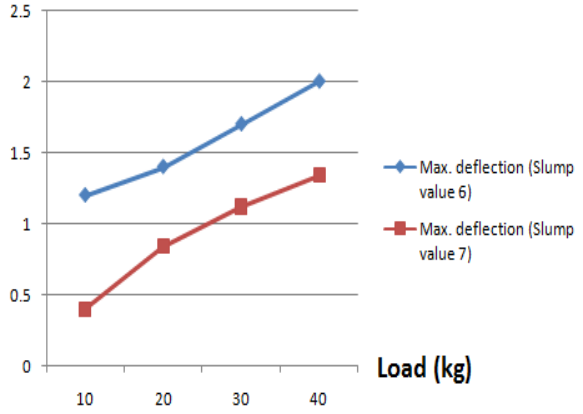
A)Slump Value =7

Load(P)	Effective Load (Pe)	Stress max	Cycles :	Maximum deflection
10	15.6	276.5	36200	0.39
20	31.2	389.4	31980	0.85
30	46.8	482.9	28750	1.22
40	62.4	532.6	19450	1.29

B) Slump Value =6

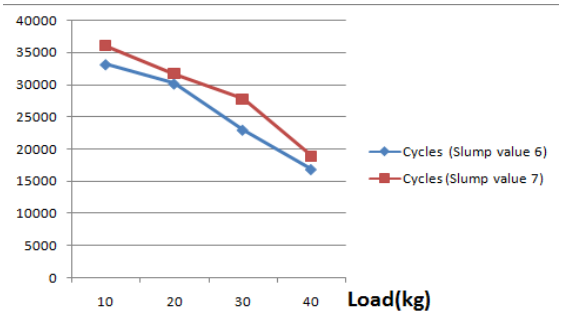
Load(P)	Effective Load (Pe)	Stress max	Cycles :	Maximum deflection
10	15.6	282.9	35200	0.68
20	31.2	393.6	33090	1.06
30	46.8	489.1	26190	1.46
1.56	62.4	542.8	17200	1.65

Graph of Maximum deflection Vs Load



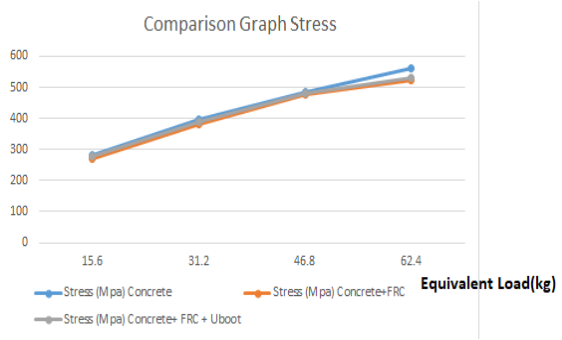
Graph indicates that the specimen with slump value 7 show less deflection as compared to specimen of slump value 6.

Graph of Maximum deflection Vs Load



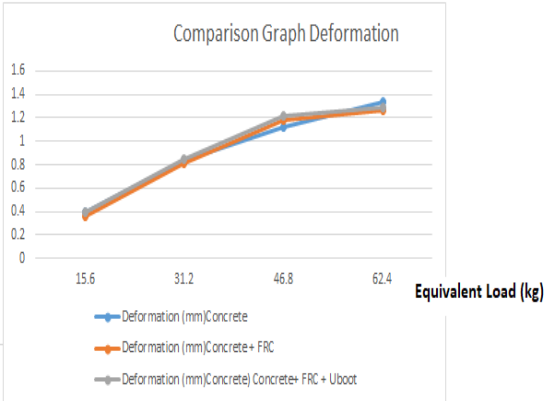
Graph indicates that the specimen with slump value 7 show more cycles as compared to specimen of slump value 6 indicating that the slump Value 7 specimen is more durable than the slump value 6 specimen

Comparison graphs of Concrete, Concrete + FRC & Concrete+FRC+U-boot



The graphs show that the Concrete + FRC material shows the least stress value followed by the Concrete +FRC+U-boot

The graphs show that the Concrete + FRC material shows the highest cycles value followed by the Concrete +FRC+U-boot and then the Plain Concrete with lowest cycles value. Comparison Graphs (Deformation)



The graphs show that the Concrete + FRC material shows the least deformation value followed by the Concrete +FRC+U-boot and then the Plain Concrete with highest deformation value.

CONCLUSION

- Concrete block casted with slump value of 7 shows lower deformation as compared to the concrete block casted with slump value of 6
- Concrete block casted with slump value of 7 shows more cycles with standing as compared to the concrete block casted with slump value of 6
- The graphs show that the Concrete + FRC material shows the least stress value followed by the Concrete +FRC+U-boot and then the Plain Concrete with highest stress value. But as the U-boot system is low in weight and there is no significant change in the stress value as compared to the Concrete +FRC it is recommended for optimal strength and lowest weight.
- The graphs show that the Concrete + FRC material shows the highest cycles value followed by the Concrete +FRC+U-boot and then the Plain Concrete with lowest cycles value . But as the U-boot system is low in weight and there is no significant change in the cycles value as compared to the Concrete +FRC it is recommended for optimal strength and lowest weight.
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