An Investigation on Light Weight Concrete to Construct Prefabricated Composite Panel

Priyanka Dominic K[1] Neenu Joy[2]
[2]Assiatant Professor
[1,2]Department of Civil Engineering
[1,2]Christ Knowledge City, Mannoor, Muvattupuzha, Kerala Technological University, Kerala, India,

Abstract— Steel-Concrete Composite construction is widely accepted technique in the construction industry. Sandwich Composite panel is heterogeneous in nature. The reduction in weight of concrete helps easy removal, transport and erection of precast products. So necessity of light weight precast panels arises there. Here we have discussed about three different varieties of panels, which can be used further for the construction purpose. Here we prepare sandwich composite panel consist of three layers of two different materials (concrete and steel). Panels are created with corrugated steel sheet or decking sheet sandwiched between foamed concrete, fiber reinforced foamed concrete and polystyrene concrete. Behaviors of sandwich panels were studied in detail. Advantages and disadvantages of light weight panel construction are examined here. It was found that advantages are more compared to the disadvantages. Environmental pollution due to excess usage of thermocol is solved here by introducing this waste material into the concretes thus makes it economical and more suitable for the specified purposes. Determination of Cube Compressive strength, split tensile strength for cylinder specimen is done here for foamed concrete and thermocol mixed concrete which is used to make the panels.

Key words: Compressive strength, sandwich panels, corrugated steel sheet, EPS concrete, Foamed concrete, Split tensile strength

I. INTRODUCTION

Each and every day new new innovations are experimentally checked and verified by our engineers in construction industries for our dynamic world. Our world is still under construction, in the worlds of success. Yes, our world is full of wonders that are made by our engineers, for well being of the society. As we construct houses, commercial buildings, roads, bridges, towers, with conventional construction materials such as river sand, cement, bricks, steel bars etc, we experience a great shortage for these conventional building materials. While hovering to the requirements of new generation buildings, with a lot of innovative technologies force the engineers for the demolition and faster ineffable constructions. We should recognize that it is too late to imbue the dormant conservationism in restorationist of our society. Vastly growing generation prefers faster construction techniques.

So at the demise of this era of using conventional materials for construction, we need a sustainable development in composition of materials and faster construction technique, for the construction industry, while it should not be frugal, but should saginate dexterity of architect and engineers, to fulfill requirements of the client.

The chasm between the ideologies of experts in different fields, to grapple the best ideas, accentuate the necessity of testing and confirming their ideas, but I am quiet sure that it will transcend the limits of time of this investigation.

II. SANDWICH TECHNOLOGY AND PANEL WORKS

Today, the exploitation of the economical advantages of weight reduction has become essential for many industries. It is well known that the task distribution in sandwich construction enables high stiffness and strength for lightweight panels and parts. Concrete is week in taking tension and steel is good in taking the tension. That means, Sandwich construction with low cost materials can not only be more lightweight but also more cost effective, especially because the advancement and automation of production processes results in a reduction of the production cost for lightweight sandwich panel. The combination of materials to utilize their favorable properties is the basic idea of composites engineering. With a monolithic material, a thickness increase leads to an increase of both weight and material cost of a panel. Here we can see that, the honeycombs enable the best mechanical performance per weight, thus they offer the largest potential for material cost savings. Sometimes, clumsy or sagital ideas derived from studies, by the experimental confirmations, points to the great innovations, but i know that it is not trifling in nature.

Structural weight reduction is the major consideration and the sandwich construction is frequently used instead of increasing material thickness.

III. MIX PROPORTION

Mix designation	Density (kg/m^3)	Compressive strength (N/mm^2)	$\frac{W}{C+F}$	OPC 53 grade (kg)	Fly ash (kg)	Water (kg)	Vegetable oil (kg)
FC	1200	2.93	0.4	275	550	300	30

Table 1: mix propotions for foamed concrete

Mix designation	Cement(kg)	Fly ash (kg)	EPS Beads (kg)	Coarse aggregate (kg)	Water (kg)
ECC	420	189	441	441	176.4

Table 2: mix propotions for Concrete containing EPS beads

IV. COMPRESSIVE STRENGTH OF CONCRETE CUBES

This test is done to determine the compressive strength of concrete cubes. One of the important properties of concrete is its strength in compression. The strength in compression has a definite relationship with all the other properties of concrete ie, these properties areimproved with improvement in compressive strength. Hence the importance of the test.

The height of the test specimen in relation to its lateral dimension greately influences the results. The more slender the specimen, lower will be the crushing strength. The ratio of the minimum dimension of the specimen to the maximum size of the aggregate should be at least 4:1. There are two types of standared test specimen: cubes and cylinders

Apparatus required for the test are 150mm cube moulds, ramming rod, weighing machine, compression testing machine Moulds for the testing cubes should be of steel and cast iron. The internal faces are machined flat to a tolerance of o.25mm. when the mould is properly assembled its height and the distances between opposite faces should be provided as 90+_0.50.

A base plate with machined plane surface large enough to prevent the leakage of water and cement during filing of the mould should be provided. Clips and screws should be used to assit in holding the mould on the base plate.

Tamping rod is a16 mm in length and bullet pointed at the lower end.

Cast the cubes as per the dimension of the mould. On no account the specimen be allowed to dry, even partially and they must be tested in wet condition. A minimum of 3 cubes should be tested and the mean crushing strength of three being taken as crushing strength of the concrete.. neglect the results, which fall outside by 15% of the average results on either side.

Fig. 1: cube testing for compressive strength

Coir fibre is very abundantly available in kerala , india. So it is cheap. Here we have studied cube compressive strength test of foamed concrete, foamed concrete with fiber and expanded polystyrene bead concrete cube.

V. SPLIT TENSILE TEST ON CONCRETE CYLINDERS

As per IS : 5816 – 1999, we conducted the test for determining the split tensile strength of the concrete. The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very week in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack.

Apparatus required for this test are:

1) Compression testing machine
2) Two packing strios of plywood 30 cm long and 12mm wide.

Procedure for the test is as follows. Take the wet specimen from water after 28 days of curing. Wipe out water from the surface of the specimen. Draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place.note the weight and the dimension of the specimen. Set the compression testing machine for the required range.keep the plywood strip on the lower plate and place the specimen. Align the specimen so that the lines marked on the ends are vertical and centred over the bottom plate. Place the other plywood strip above the specimen. The load shall be applied without shock and increased continuously at a nominal range 1.2N/(mm2/min) to 2.4N/(mm2/min). Note down the breaking load (P).

Fig. 2: Split Tensile Strength in the Testing Machine

Split tensile strength,

$$T = \frac{2P}{\pi DL}$$

P = Failure load(KN)
D = Diameter of the cylinder (mm) = 150mm x150mm
L = Length of the cylinder (mm) = 300mmx300mm

Fig. 3: Specimen splite tensile strength test in compression testing machine

Failure load is noted from the machine.

VI. RESULTS AND DISCUSSIONS

Type Of Concrete	Compressive Strength (N/Mm^2)			Average
	Specimen 1	Specimen 2	Specimen 3	
Foamed Concrete	2.93	2.97	2.97	2.95
Eps Concrete	4.25	4.25	4.24	4.24

Table 3: Compressive strength of concrete (FC and EPS)

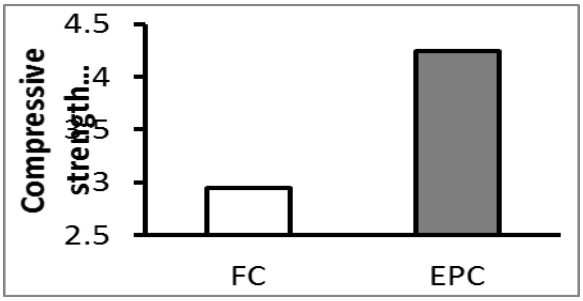

Fig. 4: graph showing compressive strength of the cubes

Type Of Concrete	Failure Load (Kn)	Split Tensile Strength (N/Mm^2)
Foamed Concrete	31.2	0.44
Fiber Added Foamed Concrete	32.7	0.46
Eps Concrete	42.8	0.92

Table 4: Split tensile strength of FC and FRFC

VII. CONCLUSIONS

Split tensile strength of EPC is high compared with FC. It is because of air present in the foamed concrete less compressive strength. Addition of fiber in foamed concrete does not work here much, even if we heard that fiber increase the compressive strength of concrete. Compressive strength of EPS is higher compared to FC. expanded polystyrene which is waste material can be recycled and used in this concrete. Expanded polystyrene in 2 to 5mm is used here, for the study.

REFERENCES

[1] Vinoth Kumar K, et. Al (2016)," Experimental Study on Composite Sandwich Panels with Concrete and Corrugated Steel Faces", International journal of scientific research and development, vol.4, Issue 1, page no. 939-942
[2] Y.H. Mugahed Amran et. Al (2016) ,"Structural behavior of axially loaded precast foamed concrete sandwich Panels", Science direct, construction and building materials, page 307-320
[3] E.A. Flores-Johnson et. Al (2012)," Structural behavior of composite sandwich panels with plain and fiber-reinforced foamed concrete cores and corrugated steel faces" , Science direct, composite structures, page 1555-1563
[4] Qin xin(2016), "Research status of foamed concrete", International journal of multidisciplinary research and development, vol. 3, Issue 4, page no. 328-330
[5] Hanizam Awang et al (2014), "Durability properties of foamed concrete with fibre inclusion", International journal of civil, environmental, structural, construction and architectural engineering, vol. 8, No.3 , page no. 273-276
[6] Mohiyuddin.C.S.(2015), "A study on behavior of sandwich panels under impact loads", SSRG International journal of civil engineering (SSRG-IJCE), page 89-95
[7] Ameer A. Hilal et al (2015), The Use of Additives to Enhance Properties of Pre-Formed Foamed Concrete, International journal of engineering and technology, vol. 7, No. 4, August, page 286-292
[8] E P Kearsley et al (2001), Porosity and permeability of foamed concrete, journal of Cement and concrete research , February, p805-812
[9] Roshan Gawale et al (2016), Light weight concrete by using EPS beads, international journal of innovative research in science and engineering , vol. 2, issue 3, March, p470-475
[10] Sasi Kumar M et al (2015), Development and testing of coir fibre reinforced sandwich panel, International conference on systems, science, control, communication, engineering and technology, vol. 1, July, p209-214
[11] Ben Sabaa et al(1997), Engineering properties of light weight concrete containing crushed expanded polystyrene waste, Materials research society, Symposium –Advances in cementitious composites , December, p1-11

