Experimental and Analytical Investigation of Hollow Core Slab Using Light Weight Concrete

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***Abstract*: Concrete plays a major role in the construction field. In building construction slab is one of the largest and important structural member consuming concrete. Slabs in building mainly support dead load and live loads .Concrete slab use more concrete than requirement, hence has to be optimized. So reduce the concrete in centre of the slab by providing various openings.**
This paper mainly aims to compare the structural adequacy of hollow core slab using high strength light weight concrete.Light weight structural concrete is an enhanced version of concrete, with emphasis on decrease in density of concrete. It keeps the structure light weight by providing adequate strength.The objective of this thesis work is to demonstrate the flexural behaviour and also to compare the void ratio of hollow core slabs with various openings(circular,square,diamond) using light weight concrete.
***Keywords:* Hollow core slab, High strength light weight concrete, Flexural Behaviour**

1.INTRODUCTION

Concrete slabs are rigid structures typically made of concrete with a small height compared with the other dimension. Slabs in building mainly support dead load and live loads. Reducing self –weight of slabs is necessary in order to reduce the total cost of structures. One of the alternatives is to use hollow core slab. Prestressed concrete hollow-core panels have been widely used throughout the world in concrete and steel structures, including buildings, parking structures, and bridges. One of the most common uses of these elements is in floor systems, where precast prestressed concrete hollow-core panels are used together with a cast-in-place (CIP) concrete topping to form a load-resisting composite floor system. Light weight structural concrete is an enhanced version of concrete, with emphasis on decrease in density of concrete. When structural concerns require a minimum to the dead load, light weight concrete is used. It is ideal for roof deck repairs, stair pan fill, elevated floor slabs or over lays on existing floor decks .Since it is light weighted it is ease in lifting and carrying which is an important advantage of light weight concrete. It also offers slower temperature transfer rates than standard concrete, resulting in improved insulation fact. In this study, a new hybrid construction of hollow core slab-type members, in which a hollow core slab of high strength light weight aggregate concrete are used inorder to examine their structural adequacy.

The study is limited to

- Hollow core slab with circular, rectangular and diamond opening.
- Light weight concrete material (M40 grade)
- Two point loading

II. OBJECTIVES

- To compare the performance of hollow core slab with M40 grade concrete and high strength light weight concrete
- To check the performance of hollow core slab with different shape of openings
- To plot and compare the load deflection curve of hollow core slab with different shape of openings using M40 grade high strength light weight concrete
- To validate the experimental result using ANSYS.

III.SCOPE

IV.LITERATURE REVIEW

This chapter gives a brief review of previous studies conducted in field of hollow core slabs.
Nanang Gunawan Wariyanto, Yanuar Haryant, Gathot Heri Sudibyo studied the flexural behaviour of precast hollow core slab using PVC pipe and Styrofoam with different reinforcement. This study discusses the flexure behaviour of precast hollow core slab with different types of reinforcements.

Haryanto,Gathot Heri Sudiby Hollow core slabs are commonly used in different types of structures. They usually include a 50-mm concrete topping. Structural engineers can use this topping to increase the slab load-carrying capacity. North American design standards relate the horizontal shear strength at the interface between hollow core slabs and the concrete topping to the slab surface roughness. This paper presents the results of four push-off tests on hollow core slabs supplied by two manufacturers and roughened using a conventional steel broom.

Eray Baran Results of a study focusing on the flexural response of precast prestressed concrete hollow-core slabs with cast-in-place concrete topping are presented. The experimental part of the study included load testing of five precast concrete hollow-core units. The numerically determined flexural response of test specimens was later compared with the experimentally obtained behaviour.

Ronglan Zhang Basic assumptions are proposed for the continuity model of a tubular hollow slab combined with continuity analysis and calculation of a finite-element model; the continuity Equation of a tubular hollow slab at the minor axis supported at two ends of the hollow axle under a vertical even load is determined and solved.

V.METHODOLOGY

In the present study, the experimental program is conducted to compare the flexural behaviour of hollow core slabs with different openings .Concrete cubes are casted by M40 grade concrete and high strength light weight concrete. An RC slab is designed to investigate the load deflection behaviour of RC beam using the mix which gives the optimum strength. The experimental investigation is to be validated using ANSYS software. The properties of the constituents in concrete such as cement, fine aggregate, coarse aggregates are determined. The properties should conform to recommendations given in IS codes. Mix design of M40 grade concrete and M40 grade light weight concrete is prepared by using the material properties. RC hollow core slab is to be designed with the M40 mix. Dimension of hollow core slab is1m×1m×0.12m

A. Mix Design

Table 1
Slump Values for Various Super Plasticizer Percentage

Mix ID	w/c	SP Dosage (%)	Obtained Slump
M1	0.4	0.5	70mm
	0.4	0.6	75mm
	0.4	0.75	90mm

Table II
Mix Proportion- Trial Mixes

Mix ID	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Water (kg/m^3)	SP (%)	7 Day Compressive Strength (N/mm^2)
1	350	695.44	145.8	140	0.5	19.77
2	350	695.44	145.8	140	0.6	23.59
3	350	695.44	145.8	140	0.75	27.72

Table III
Final Mix proportion for M40 grade concrete

Material	Cement	Fine Aggregate	Coarse Aggregate	Water
Weight (kg/m^3)	350	695.44	145.8	140
Ratio	1	1.98	3.56	0.4

VI.RESULTS

Test on Hardened Concrete
Compressive Strength Values Obtained For M40 Control Mix

Fig.1 Compressive Strength Test on cube

Fig.2 Flexural Strength Test on Beam

Fig.3 Split Tensile Strength Test on Cylinder

Table IV
Compressive Strength of Hardened Concrete Cubes

% of SP	sample	7th day compressive strength (N/mm²)	14th day compressive strength (N/mm²)	28th day compressive strength (N/mm²)
0.5%	1	20.56	28.46	33.67
	2	20.11	29.92	32.78
	3	18.66	28.68	32.11
	Average	19.77	29.02	32.85
0.6	1	23	33.12	38.88
	2	24.11	33.44	39.1
	3	23.66	34.67	39.33
	Average	23.59	33.75	39.1
0.75	1	27.55	39.69	46.33
	2	28	38.1	46.66
	3	27.62	38.33	45.62
	Average	27.72	38.71	46.2

Table V
Flexural strength on hardened concrete

SP %	Age (Days)	Flexural Strength (N/mm²)	Average Flexural Strength (N/mm²)
0.5%	28	4.010	3.92
		3.970	
		3.780	
0.6%	28	4.250	4.29
		4.370	
		4.250	
0.75%	28	4.757	4.775
		4.680	
		4.890	

Table VI
Split Tensile strength of hardened concrete

SP %	Age (Days)	Split Tensile Strength (N/mm²)	Average split tensile Strength (N/mm²)
0.5%	28	2.292	2.328
		2.346	
		2.340	
0.6%	28	2.880	2.886
		2.860	
		2.920	
0.75%	28	3.230	3.310
		3.260	
		3.470	

Table VII
Mix Proportion by Varying Percentages of Metakaolin

Mix id	Cement (kg/m³)	M.K (%)	F.A (kg/m³)	C.A (kg/m³)	Water (ml)	S.P (%)	7 day compressive strength (N/mm²)
1	350	15%	695.44	1245.8	140	0.75	26.58
2	350	20%	695.44	1245.8	140	0.75	28.56
3	350	25%	695.44	1245.8	140	0.75	27.35

Table VIII
Effect of Metakaolin on Compressive Strength of Concrete

Mix id	sample	7th day compressive strength (N/mm²)	14th day compressive strength (N/mm²)	28th day compressive strength (N/mm²)
1(15%)	1	26.90	32.12	43.52
	2	26.34	32.34	42.68
	3	26.52	33.08	43.08
	Average	26.58	32.51	43.09
2(20%)	1	28.4	38.51	49.14
	2	29.1	37.68	49.98
	3	28.2	38.21	50.11
	Average	**28.56**	**38.13**	**49.74**
3(25%)	1	27.2	36.2	45.68
	2	27.56	36.89	46.32
	3	27.35	35.96	45.97
	Average	27.37	36.35	45.99

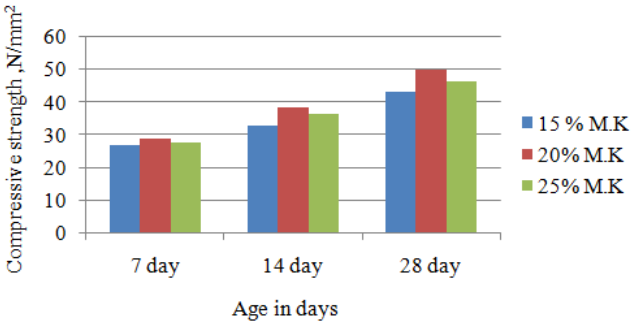

Fig.4 Graphical Representation of Cube Compressive Strength of Various Mixes with Age

Table IX
Mix Proportion for M40 Grade Light Weight Concrete-Trial Mix

Material	Cement	MK	Fine Aggregate	Light Aggregate	Steel Fibre	Water	Super Plasticizer
Weight (kg/m³)	350	20%	695.44	552	1%	140	0.75%

VII.CONCLUSIONS

- Priliminary investigation of coarse aggregate, fine aggregate, cement and Leca aggregate were carried out
- Mix design of M40 and M40 light weight concrete
- Optimum of super plasticizer—0.75%
- Optimum of metakaoline—20% of cement

- From the trial mix full replacement of coarse aggregate is not possible in order to get a high strength concrete

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