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Experimental study of double T slab with conventional concrete and flay ash based Geopolymer concrete

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Abstract— the double tee slab is capable of withstanding high loads while having a long span. Two point load test will be conducted to study the behavior and load carrying capacity of slabs. In this experimental work different parameters will be used such as alkaline solution to fly ash ratio was fixed at 0.5 and sodium silicate to sodium hydroxide ratio 2.5, molar content of sodium hydroxide 14M, ratio of silicate oxide to sodium oxide 2.25 and 3.35, percentage of GGBS 0%, 25%, 40%, 55%, 70% has been use for replace with classified class Fly ash in geopolymer concrete. Cube, cylinder and beams to be cured with hot air at 60°C -100°C for 24hr. Hence, there are six batch mixes including conventional one. IS: 10297 is used for deciding the geometry of slab panel. The slab panel made for the experiments are having a 1.5 meter length and 0.6 meter width. The concrete grade M25 is used as per IS: 456-2000.The water-binder is 0.45.

Keywords— Geopolymer, Double T slab, Micropozz , GGBS

I. INTRODUCTION

The double tee slab is a load bearing structure that resembles two T-beams connected to each other side by side. The strong bond of the flange and the two webs creates a structure capable of withstanding high loads while having a long span. The use of this precast slab has been increasing due to shorten construction time. The double tees are manufactured in factories. The process is same as other precast elements. The beds for making double tees are of typical sizes of the area that double tees will be used. The provision of groove is provided at the bottom of the ribs to enables the resting of slab on the support.

.II. OBJECTIVE AND SCOPE

Mostly, the research work is done to replace the coarse aggregate in the slab. Very less or no work is done to check the effect of partial substitution of fine aggregate and cement on slab. Fly ash and GGBS are the waste materials which are dumped at one place, creating an environmental problem. Production of cement releases vast amount of greenhouse gases and there is a problem of natural sand

Scarcity. The whole slab system ultimately leads to a cost effective flooring system.

A. Objective

To compare the load carrying capacity of precast slab panel experimentally with conventional concrete and the geopolymer concrete with micropozz and GGBS.To determine the first crack load and ultimate failure load.

B. Scope

In the experimental work, classified fly ash (micropozz) And GGBS will be used as the base materials for making a Geopolymer concrete. Alkaline liquid to fly ash ratio will be considered is 0.4.Concentration of sodium hydroxide (NaOH) liquid measured in terms of Molarity (M) will be considered as 14M.The ratio of silicate oxide (SiO2) to sodium oxide (Na2O) will be taken as 2.25.The ratio of sodium silicate (Na2Sio3) to sodium hydroxide (NaOH) will be taken as 2.5 .The percentage of GGBS taken as 0%, 25%, 40%, 55%, 70% consequently. Super plasticizer has been taken 0.4 % of fly ash by mass. Curing of cubes and cylinder has done at a specified temperature of 70°C in oven for 24 hours.

III. EXPERIMENTAL PROGRAM

A. Alkaline liquid

The alkaline liquid is prepared by mixing sodium hydroxide pellets mixed with water in different concentration and sodium silicate solution) together at least 24 hours prior to use for thorough mixing and reaction .Ratio of these solutions is 2.5. The sodium hydroxide with 97-98% purity in pellet form is commercially available. The solids are dissolved in water to prepare the NaOH solution of required concentration of and 14 M.

Figure 1 NaOH Pellets

Figure 2 Na2SiO3 Solution

B. Micropozz

Micropozz is basically a class F fly ash which is recommended the world over for structural concrete applications. Use of a Micropozz increases the life of concrete structures substantially.

TABLE I
Properties of micropozz

Test name	Unit	Result
Loss on Ignition	%	1.07

Fineness Specific Surface by blain	M^2 / Kg.	335.12
Moisture	%	0.11
Passing on 45 Micron sieve (Wet sieving)	%	74.10
Retention on 45 Micron sieve (Wet sieving)	%	25.90
Total sulphur as Sulphur trioxide(SO_3)	%	0.62
Available alkalis as Sodium oxide (Na_20)	%	0.68
Silicon dioxide, as Si02,	%	60.52

A. GGBS

GGBS slag is by product of iron and steel manufacturing process. It contains the entire basic constituent of OPC but not exactly in the same ratio and chemical form. Slag itself has no cementing property but when mixed with OPC, it develops hydraulic properties similar to cement.finness of GGBS is 275 M^2/ kg

Table 2

Properties of GGBS

Test name	**Unit**	**Result**
Magnesia content (%)	%	8.16
Suiphide suiphur (%)	%	0.53
Sulfate content as SO_3	%	0.28
Loss on ignition	%	0.72
Magnesia content	%	0.28
CaO + MgO +SiO_2	66.66(min)	77.21
CaO + MgO /SiO_2	>1.0	1.30
CaO /SiO_2	<1.40	1.06
Silica as SiO2	No limit	

B. Aggregate

1) Role of aggregate is to give body to the concrete, reduce the shrinkage effect of cement and make the concrete durable. The aggregates having maximum size of 10 mm will be used as per IS10297.Bulk density is 1600Kg/m3. The Specific gravity and water absorption of aggregate is find out as per IS: 2386-3(1963).It is find out by pycnometer test.

2) *Sand*

Table 3

Data for specific gravity of sand

Sand	
Weight of saturated surface dry sample	501g
Weight of pycnometer + sample + Water	1750g
Weight of pycnometer + Water	1460g
Weight of oven dry sample	500g
Specific gravity	2.37
Water absorption	0.2%

C Mix design

For conventional concrete

Table 4 conventional concrete mix design

Mass of Cement (kg/m_3)	Mass of Water (kg/m_3)	Mass of Fine Aggregate (kg/m_3)	Mass of coarse Aggregate (kg/m_3)

462.22	208	780	847.49

Table 4 mix design of GPC

	For 0%	**40 %**
Fly ash (Kg	404.15	242.50
GGBS (Kg)	0.00	161.66
NaOH solution (Kg)	46.18	46.18
Na2SiO3 solution (Kg)	115.44	115.44
Coarse agg.10mm (Kg)	1325.94	1325.94
Fine agg. (Kg)	568.25	568.25
Extra water	20.20	20.20
Super plastisizer (Kg)	1.67	1.67

D casting

The 8mm diameter bars are used for under reinforced slab panel as main steel. The steel wire mesh of 2 mm diameter at the spacing of 30 mm center to center is provided as temperature reinforcement in the flange. The 20 mm cement block is used as a cover. Geopolymer mixing process includes four main steps. These steps are activator solution preparation, dry mixing of solid materials (fine aggregate, coarse aggregate and fly ash), mixing liquid components (activator, extra water and supper plasticizer) and finally mixing all components in mechanical mixer. The fly ash and the aggregates were first mixed together dry mixture for about three minutes. The liquid component of the mixture is then added to the dry materials and the mixing continued usually for another four minutes. After the mixing of fly ash GGBS, fine and coarse aggregate in mechanical mixture then adding alkaline liquid in dry mix which is a mixture of sodium silicate solution and the sodium hydroxide solution mix about three minute in mixture and add super plasticizer between this process.

Fig 3 formwork preparartion and castin

E. curing

Curing of slab has done at 700 c temperature for 24hrs at temporary setup of heating chamber, which is done by two electric heating coil stove. Temperature is examine at every hrs for 10 hrs to resist the slab from overheating.

Fig 4 curing of slab

F. Test setup

For the experiment work, dial gauges, proving ring and loading jack were used. The test set up along with the loading frame is shown in above figure. The longitudinal edges of slab panel were supported on the main cross girders of loading frame. The simple supports were placed in such a way that effective span is 1.32 m. Then two I-sections were placed perpendicular to the longitudinal edges of the slab at a distance equal to shear span 440 mm from the support both side. So, the applied shear span is 440 mm. Then the two I-girders are placed parallel to the longitudinal edges of the slab.

Fig 5 test setup for double T slab

IV. RESULT AND DISCUSSION

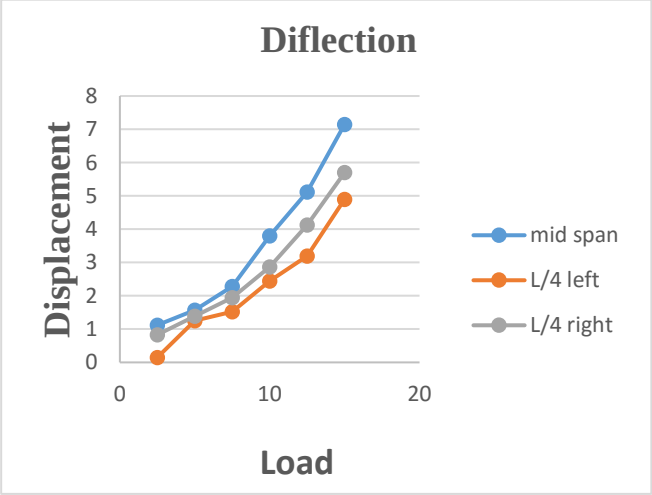

Fig 6 Displacement of conventional double T slab

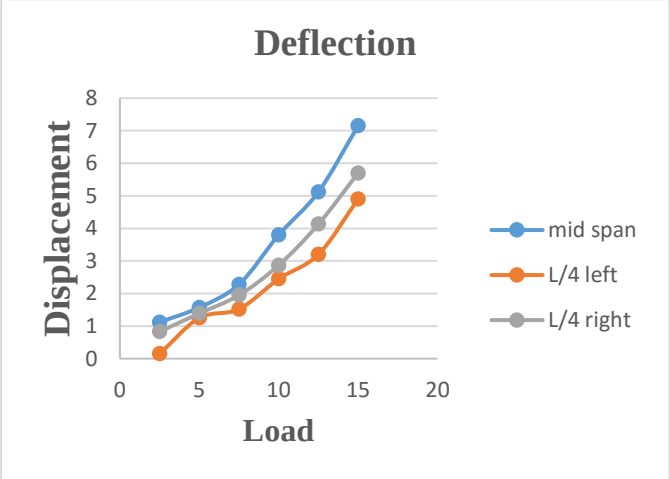

Fig 7 Displacement of GPC 0 double T slab

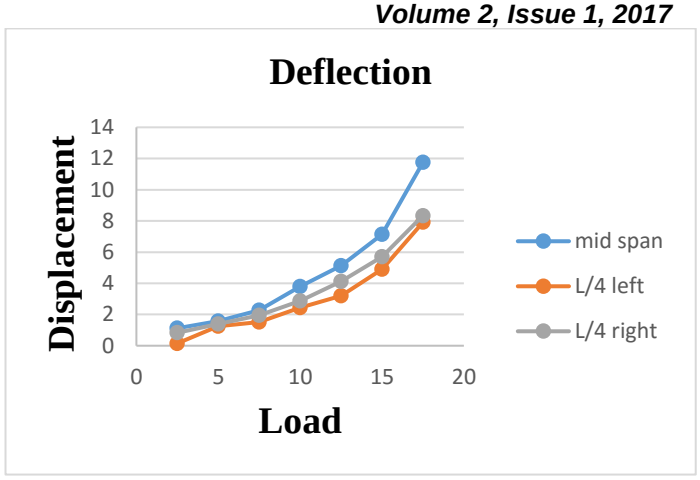

Fig 8 Displacement of GPC 40 double T slab

A. DISCUSSION

After testing the slab result t shown in graph of load vs displacement. Load is applied on slab in 2.5kn variations.

- For convention slab ultimate lad is found 10kN/m. deflection measure is 5.02mm at mid span. Maximum allowable deflection for slab as per IS code is L/250.
- Maximum load taken by slab is 15KN
- For GPC 0 slab the max deflection is measure at 12.5 KN load is 7.04 which is little higher then allowable load.
- Breaking load for GPC 0 is 15.0 KN
- The crack pattern for GPC 0 slab failure observe in flexure crack.
- For GPC 40 maximum deflection observe 15.0 KN.
- The deflection at mid span is 7.05 mm at left end is 4.9mm and right end is 5.7mm

V. CONCLUSIONS

From the study of slab load and its crack pattern, deflection the conclusion of the study is that for double t slab longer span behavior of slab in conventional concrete and micropozz based geopolymer concrete is almost same. For both first crack was found in flexure. For conventional slab shear failure found earlier than GPC slab. At 40% replacement GGBS to micropozz in geopolymer concrete load caring capacity increase than normal concrete and micropozz based GPC. Benefit of GPC instead of normal concrete is curing period shorter than conventional concrete and also get earlier strength. 70% of strength get within a 3days in GPC

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