

COMPARATIVE STUDY OF FLEXURAL STRENGTH OF CONVENTIONAL AND FLY ASH PERVIOUS CONCRETE

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Abstract: Pervious Concrete is one of the leading material which helps to recharge ground water table and contribute in the sustainable development. In this work two mix proportions 1:3 and 1:4 is used with constant W/c ratio 0.40. Test which carried out during experimental study Flexural strength of pervious concrete mix by using two different size of coarse aggregate as 10mm and 20mm. Results of experimental study shows that there is drastic decrease in the strength of pervious concrete mix as the size of the aggregate increase. Mix is made by using ordinary Portland cement as well as by incorporating 10 percentage of fly ash by the weight of cement to make pervious concrete mix. Addition of Fly ash increases the tensile strength of pervious concrete but also reduce the permeability of the mix.

Pervious concrete is a Sustainable Solution to a challenge that often exists in urban areas like clogging of water at road site area, improper distribution of drainage and improper facility of water distribution. The challenge is handling the large amount of existing impervious area in urban environments and additional area created during urban growth and development. The challenge of impermeable areas is that runoff is produced and it requires an infrastructure system for adequate control. Pervious concrete has two functions: a paved surface available for low volume, low speed applications; and a storm water management alternative. The rigid concrete creates a paved surface for various uses while the open voids in the concrete allow water to drain from the surface. In this work, only low volume and low speed applications were considered.

Keywords: Fly Ash, Pervious Concrete, Tensile strength.

I. DESIGN MIX MATERIALS

During experimental study following materials have been incorporated to make pervious concrete mix.

A. Cement

The Ordinary Portland Cement of 53 grade conforming to IS: 12269-2013 was used. Tests like Consistency tests, Setting tests, Soundness and Compressive strength (N/mm²) at 28 days were conducted on cement.

TABLE I: - PROPERTIES OF CEMENT

Item	Tests	Results	Requirement as per IS: 12269-
1	Consistency (%)	33	30 - 35
2	Specific Surface Area (m ² /kg)	282	> 225
3	Initial Setting Time (minutes)	130	> 30
4	Final Setting Time (minutes)	210	< 600
5	Compressive Strength (N/mm ²)		
	3 days	30	> 27
	7 days	40	> 37
	28 days	55	> 53
6	Soundness (Le-Chetelier)	1 mm	< 10 mm

Source: Tested at S.N.P.I.T & R.C, Umrakh.

B. Machine Cut Metal (Kapchi 20 mm)

The fractions from 80 mm to 10 mm are termed as Machine cut metal. The Machine cut metal from crushed Basalt rock, conforming to IS: 383-1970 was used. The combined Flakiness and Elongation Index was above 15%.

TABLE II: PROPERTIES OF MACHINE CUT METAL

Sr.	Tests	Results	Requirement as per IS : 383-
1	Gradation percent passing on IS sieve		
	40mm	100%	100 %
	20mm	96%	95 to 100 %
	10mm	48%	25 to 55 %
	4.75mm	5%	0 to 10 %
2	Impact value (%)	13.60	Sub base < 50 %
			Base course < 40 %
			Surface course < 30 %
3	Abrasion value (%)	18.50	<40%
4	Combined Flakiness & Elongation Index	20.50	< 30 %
5	Specific Gravity	2.820	----
6	Water absorption (%)	0.942	< 2 %

Source: Tested at S.N.P.I.T & R.C, Umrakh

C. Fly Ash

Fly ash is a by-product obtained during the combustion of coal in thermal power plants. Nearly 73% of India's electricity generation is through coal-burning thermal power stations.

TABLE III: - PROPERTIES OF FLY ASH

CHARACTERISTIC	VALUES (%)
SILICON DIOXIDE (SiO ₂)	62.22
MAGNESIUM OXIDE (MGO)	6.09
TOTAL SULPHUR TRIOXIDE (SO ₃)	3.00
CALCIUM OXIDE (CAO)	5.30
ALUMINIUM OXIDE (AL ₂ O ₃)	7.63
FERRIC OXIDE (FE ₂ O ₃)	0.13
LOSS ON IGNITION	9.98
OTHERS	5.65

SOURCE: GEO TEST HOUSE, (ISO 17025) GORWA ESTATE , VADODARA, GUJARAT

II. DESIGN MIX AND RESULTS

A mix of 1:3 and 1:4 was taken and the same was used to prepare the test samples. The design mix proportion is done below in the tables.

TABLE IV: MIX DESIGN PROPORTION

For 1m ³ Cube	Water/Cement Ratio	Water(Liter)	Cement(Kg)	Kapchi(Kg)	Fly Ash(Kg)	Grit (Kg)
By Weight [kg] For 1:3 Mix	0.4	218	543	1629	-	1629
		218	489	1629	54.3	1629
By Weight [kg] For 1:4 Mix	0.4	174	435	1740	-	1740
		174	391.5	1740	43.5	1740

TABLE V: TYPES OF PERVIOUS CONCRETE

Sr.	Type of Concrete	Description OF MIX	Water/Cement
1	A(1:3)	Standard 1:3 Mix Proportion (20mm)	0.4
2	A1(1:3)	1:3 with 10% Fly Ash	
3	B(1:4)	Standard 1:4 Mix	
4	B1(1:4)	1:4 with 10% Fly Ash	
5	X(1:3)	Standard 1:3 Mix	
6	X1(1:3)	1:3 with 10% Fly Ash	
7	Y(1:4)	Standard 1:4 Mix	
8	Y1(1:4)	1:4 with 10% Fly Ash	

III. TENSILE STRENGTH TEST

Tensile Strength Tests Were Performed On Universal Testing Machine (UTM) Using Beam Having Size Of 700mmx150mmx150mm For 28 Days. Three Samples for Each Component Were Casted and Then Tested. The Average Strength Values Are Reported In This Paper.



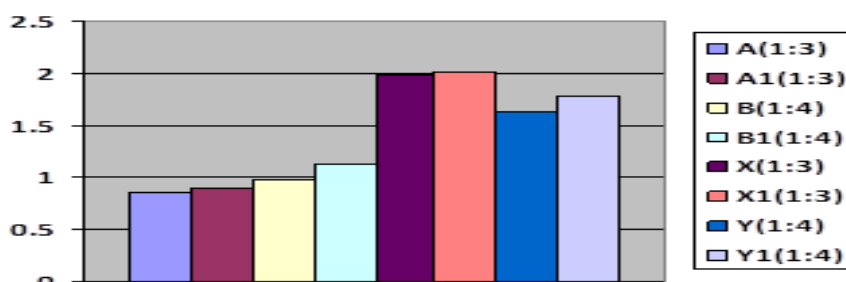
Figure 1: Flexural strength test on Pervious Concrete Beam

Source: Concrete Testing Lab, S.N.P.I.T & R.C, Umrahk

IV. RESULTS

TABLE VI: FLEXURAL STRENGTH OF PERVIOUS CONCRETE WITH 20MM AND 10MMAGGREGATE (KAPCHI) AT 28 DAYS

Type of	Average Flexural Strength of Concrete
A(1:3)	0.85
A1(1:3)	0.89
B(1:4)	0.97
B1(1:4)	1.12
X(1:3)	1.98
X1(1:3)	2.01
Y(1:4)	1.63
Y1(1:4)	1.78



Flexural Strength test results for 1:3 & 1:4 C/A Ratio at 28 days

From the test result for Conventional and Fly ash pervious concrete we can clearly say that as fly ash has been incorporated in the Pervious Concrete mix, maximum strength we can able to achieve for the mix proportion 1:3 with 10% replacement of the fly ash. As the size of aggregate increase the Flexural strength of the pervious concrete mix is decrease.

V. CONCLUSION

From this study the following conclusion can be drawn:

- From the results of pervious concrete mix we can say that larger size of aggregate offers very less Flexural strength.
- Addition of fly ash in the Pervious Concrete mix can improve its Flexural strength.
- Pervious Concrete mix which is made with the use of 10mm aggregate is provide feasible results for the application of pervious concrete.
- Results for X and X1 type of mix shows that use of smaller size of coarse aggregate helps to increase the flexural strength of the design mix.
- Mix proportion 1:3 with the fly ash provides the maximum 2.01 N/mm² Strength for 28 days.

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