International Journal for Modern Trends in Science and Technology
Volume: 03, Issue No: 05, May 2017
ISSN: 2455-3778
http://www.ijmtst.com

Influence of Granite Powder as Partial Replacement of Fine Aggregate and Crushed Tiles as Coarse Aggregate in Concrete Properties

M.Padma[1] | M.Nageswara Rao[2]

[1]PG Student, Amara Institute of Engineering & Technology, Satuluru, Guntur, A.P,India
[2]Associate Professor &HOD of Civil Engineering, Amara Institute of Engineering & Technology, Satuluru, Guntur, A.P,India

To Cite this Article
M.Padma and M.Nageswara Rao, "Influence of Granite Powder as Partial Replacement of Fine Aggregate and Crushed Tiles as Coarse Aggregate in Concrete Properties", *International Journal for Modern Trends in Science and Technology*, Vol. 03, Issue 05, May 2017, pp. 9-14.

ABSTRACT

Due to the day by day innovations and development in construction field, the use of natural aggregates is very high and at the same time production of solid wastes from the demolitions of constructions is also very high. Because of these reasons the reuse of demolished constructional wastes and granite powder came into the picture to reduce the solid waste and to reduce the scarcity of natural aggregates. Crushed waste tiles and Granite powder are used as a replacement to the coarse aggregates and fine aggregate. The combustion of waste crushed tiles were replaced in place of coarse aggregates by 10%, 20%, 30% and Granite powder were replaced in place of fine aggregate by 10%, 20%, 30% without changing the mix design. M25 grade of concrete was designed to prepare the conventional mix. Without changing the mix design different types of mixes were prepared by replacing the coarse aggregates and fine aggregate at different percentages of crushed tiles and granite powder. Experimental investigation like Compressive strength test, Split tensile strength test, Flexural strength test, and Bond strength test for different concrete mixes with different percentages of waste crushed and granite powder after 7, 14 and 21, 28 and 90 days curing period. Variations in the workability for these different mixes were studied and observed that, increase in the percentage of replacement of granite powder and crushed tiles.

KEYWORDS: *Cement, Granite powder, Crushed Tiles.*

I. INTRODUCTION

Generally in design of concrete mix, cement, fine aggregates and coarse aggregates are using from a long years back. These three materials only play a crucial role in designing of a particular grade of concrete. But now a days there is a scarcity in aggregates. So, some new materials which are very near to our surroundings and some type of materials have to be introduce for replacing the fine aggregates, coarse aggregates and as well as cement to get the same strength as that these basic materials can give.

In the present study we have to replace the Waste tiles and granite powder were collected from the surroundings. Crushed tiles are replaced in place of coarse aggregate and granite powder in place of fine aggregate by the percentage of 10% and 20% and 30%.The fine and coarse aggregates were replaced individually by these crushed tiles and granite powder and also in combinations that is replacement of coarse and fine aggregates at a time in single mix.

II. EXPERIMENTAL PORGRAMME

A. CEMENT

Ordinary Portland cement, 53 grade shall be manufactured by intimately mixing together calcareous and argillaceous and/or other silica, alumina or iron oxide bearing materials, burning them at a clinkering temperature and grinding the resultant clinker so as to produce a cement capable of complying with this standard. No material shall be added after burning, other than gypsum (natural mineral or chemical, see Note), water, performance improver(s), and not more than a total of 1.0 percent of air-entraining agents or other agents including coloring agents, which have proved not to be harmful.

Table 1 Physical Properties of Cement

S.NO	Properties	Test Values	Standard Values (IS)
1	Specific gravity	3.12	
2	Fineness (%)	2.6	< 10
3	Initial setting time (min)	148	>30
4	Final setting time(min)	235	<600

B. FINE AGGREGATE

Well graded river sand passing through 4.75 mm was used as fine aggregate. It consists of natural sand or, subject to approval, other inert materials with similar characteristics, or combinations having hard, strong, durable particles.

Specific gravity of fine aggregate-2.6
Fineness modulus of fine aggregate-2.42

C. COARESE AGGREGATE

Coarse aggregate shall consist of naturally occurring materials such as gravel, or resulting from the crushing of parent rock, to include natural rock, slag's, expanded clays and shale's (lightweight aggregates) and other approved inert materials with similar characteristics, having hard, strong, durable particles, conforming to the specific requirements of this Materials substantially retained on the No. 4 sieve, shall be classified as coarse aggregate.

Specific gravity for 20mm size = 2.4
Specific gravity for 10mm size=2.68
Fineness modulus of coarse aggregate-8.25

D. GRANITE POWDER

Industry granite powder will be collect; 4.75 mm passed materials was separated to use it as a partial replacement to the fine aggregate. Granite powder was partially replaced in place of fine aggregate by the percentages of 10%, 20% and30% individually and along with replacement of coarse aggregate with crushed tiles also.

The specific gravity of granite powder = 2.53
The fineness modulus = 2.4 with a particle size less than 90 µm.

E. CRUSHED TILES

Broken tiles were collected from the solid waste of ceramic manufacturing unit. Crushed them into small pieces by manually and by using crusher. And separated the coarse material to use them as partial replacement to the natural course aggregate. Separated the tile waste which is lesser than 4.75 mm. Crushed tiles were partially replaced in place of coarse aggregate by the percentages of 10%, 20% and 30% and 40% individually and along with replacement of fine aggregate with granite powder also

The specific gravity of granite powder = 2.78
The fineness modulus = 3.12

III. MIX DESIGN AND TEST RESULTS

Design grade of concrete: M25 (as per IS: 10262-2009 and IS 456-2000)

Mix proportions cement: Fine aggregate: Coarse aggregate-1:1.65:3.62

Table 2 Mix Proportions for 1m³

S.No	Mix Code	Cement (%)	Fine aggregate (%)		Coarse aggregate (%)	
			Sand	Granite powder	Coarse aggregate	Crushed tiles
1	A0(0,0)	100	100	0	100	0
2	A1(10, 10)	100	90	10	90	10
3	A2(10, 20)	100	90	10	80	20
4	A3(10, 30)	100	90	10	70	30
5	A4(20, 10)	100	80	20	90	10
6	A5(20, 20)	100	80	20	80	20
7	A6(20, 30)	100	80	20	70	30
8	A7(30, 10)	100	70	30	90	10
9	A8(30, 20)	100	70	30	80	20
10	A9(30, 30)	100	70	30	70	30

A. SLUMP TEST

Slump test is used to determine the workability of fresh concrete. The slump test result is a measure of the behavior of a self-compacted inverted cone of

concrete under the action of gravity. It is a measure of the concrete's workability or the dampness of concrete. Slump test as per IS: 1199 – 1959 is followed. The apparatus used for doing slump test are Slump cone and tamping rod.

Table 3 Slump cone Test Results in mm

1	A0(0,0)	105
2	A1(10,10)	104
3	A2(10,20)	98.4
4	A3(10,30)	96.2
5	A4(20,10)	103.5
6	A5(20,20)	99.7
7	A6(20,30)	93.8
8	A7(30,10)	95.6
9	A8(30,20)	96.9
10	A9(30,30)	92.3

B. COMPRESSION TEST

The compressive strength of cube was obtained, at a loading rate of 2.5kN/s at the age of 7, 14 and 21, 28 and 90 days on 3000kN machine. The average compressive strength of three specimens was considered for each age.

Table 4 Compressive strength of concrete in Mpa

Mix type	7 Days	14 Days	21 Days	28 Days	90 Days
A0(0,0)	23.16	27.28	30.16	34.15	37.91
A1(10,10)	23.27	27.69	30.27	34.31	38.08
A2(10,20)	23.84	28.88	31.84	34.52	38.31
A3(10,30)	24.18	29.33	32.18	35.14	39.13
A4(20,10)	24.54	29.56	32.54	35.54	39.47
A5(20,20)	24.69	29.77	33.69	36.12	40.09
A6(20,30)	25.12	30.27	34.12	36.89	40.94
A7(30,10)	24.84	29.87	33.84	36.64	40.63
A8(30,20)	24.87	29.82	33.27	35.72	39.64
A9(30,30)	25.14	30.14	33.54	35.64	39.56

C. SPLIT TENSILE STRENGTH

The split tensile strength of cylinder was obtained, at a loading rate of 2.5kN/s at the age of 7 and 28 days on 3000kN machine. The split tensile strength was also tested on the same machine at the age of 7, 14 and 21, 28 and 90 days.

Table 5 Split Tensile strength in Mpa

Mix type	7 Days	14 Days	21 Days	28 Days	90 Days
A0(0,0)	1.32	2.11	3.21	3.68	4.08
A1(10,10)	1.45	2.31	3.25	3.88	4.32
A2(10,20)	1.67	2.39	3.65	4.12	4.57
A3(10,30)	2.04	2.45	3.82	4.36	4.83
A4(20,10)	1.69	2.89	4.03	4.79	5.31
A5(20,20)	1.95	3.12	4.18	4.95	5.49
A6(20,30)	2.36	3.38	4.43	5.21	5.78
A7(30,10)	1.74	3.19	4.11	5.16	5.72
A8(30,20)	1.68	3.12	4.09	4.89	5.42
A9(30,30)	2.01	3.28	3.76	4.91	5.45

D. FLEXURAL STRENGTH

For this test the beams of dimension 100mmX100mmX500mm were casted. Flexural strength, also known as modulus of rupture, bend strength, or fracture strength [dubious – discuss] a mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. The beam tests are found to be dependable to measure flexural strength. The value of the modulus of rupture depends on the dimensions of the beam and manner of loading. In this investigation, to find the flexural strength by using third point loading. In symmetrical two points loading the critical crack may appear at any section not strong enough to resist the stress with in the middle third, where the banding moment is maximum. Flexural modulus of rupture is about 10 to 20 percent of compressive strength depending on the type, size and volume of coarse aggregate used.

Table 6 Flexural strength in Mpa

Mix type	7 Days	14 Days	21 Days	28 Days	90 Days
A0(0,0)	4.12	4.91	5.92	6.88	7.63
A1(10,10)	4.18	5.23	6.17	7.21	8.12
A2(10,20)	4.62	5.74	6.54	7.36	8.16
A3(10,30)	4.89	6.14	6.84	7.85	8.71
A4(20,10)	5.12	5.65	6.96	7.92	8.79
A5(20,20)	5.15	5.98	7.24	8.37	9.29
A6(20,30)	5.22	6.34	7.31	8.45	9.37
A7(30,10)	4.98	5.69	7.12	8.23	9.13
A8(30,20)	4.87	5.88	6.78	8.08	8.96
A9(30,30)	5.04	6.13	6.94	7.59	8.42

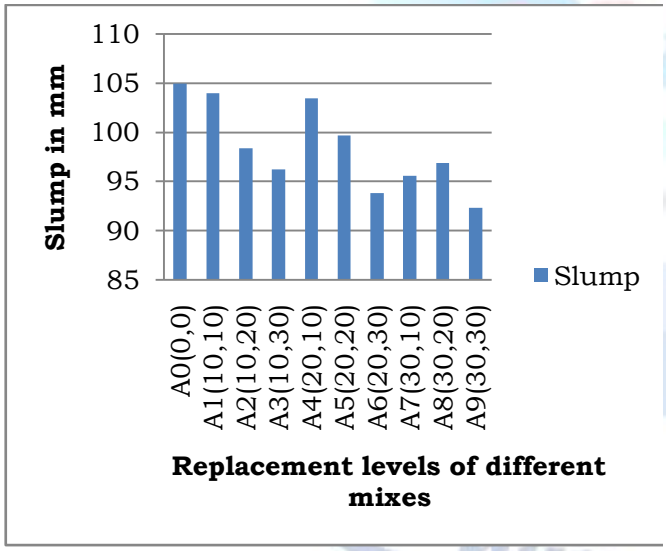
E. BOND STRENGTH

A hollow hydraulic machine with maximum loading capacity of 30 ton was needed to perform cement bond tests. The load was applied with a rate of 2KN/sec and distributed on the specimen surface by a square plate with size of 20cm and a hole at the centre. Bond stress is calculated as average stress between the reinforcing bar and the surrounding concrete along the embedded length of the bar.

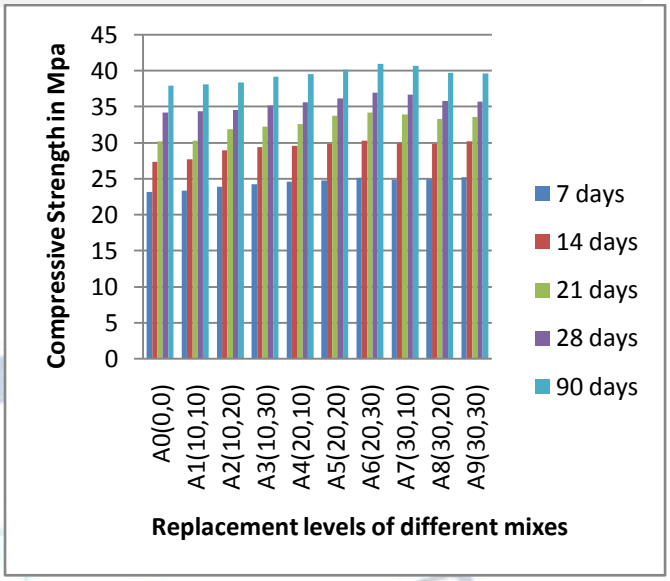
Table 7 Bond Strength in Mpa

Mix type	7 Days	14 Days	28 Days
A0(0,0)	1.88	2.65	3.09
A1(10,10)	1.94	2.95	3.22
A2(10,20)	2.14	3.02	3.48
A3(10,30)	2.25	2.99	3.65
A4(20,10)	2.45	3.26	3.86
A5(20,20)	2.54	3.51	4.07
A6(20,30)	2.63	3.65	4.29
A7(30,10)	2.48	3.48	4.18
A8(30,20)	2.52	3.42	3.78
A9(30,30)	2.56	3.18	3.63

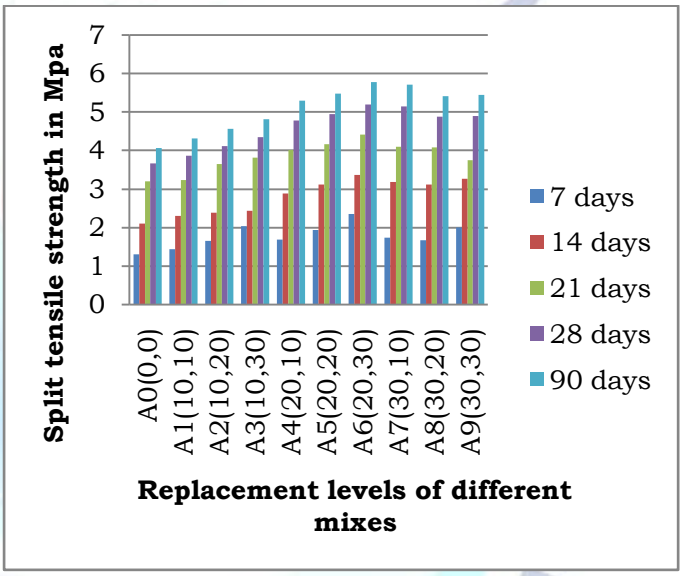
IV. GRAPHS



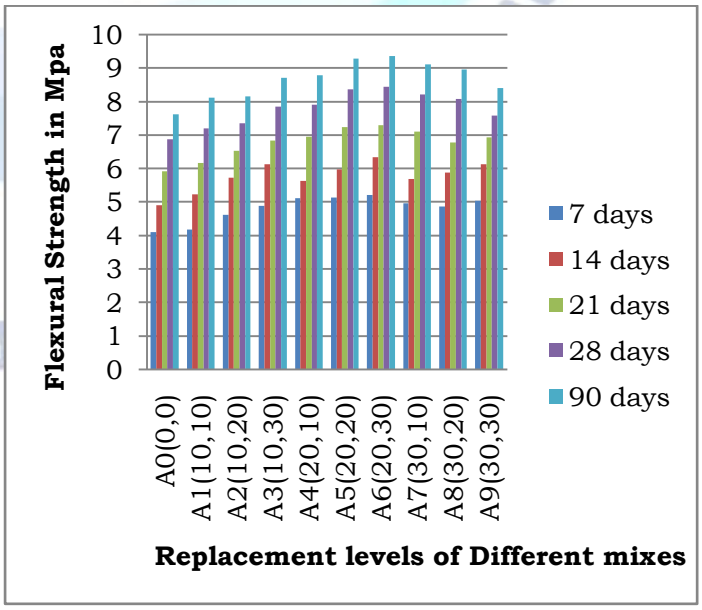
Graph for table 3



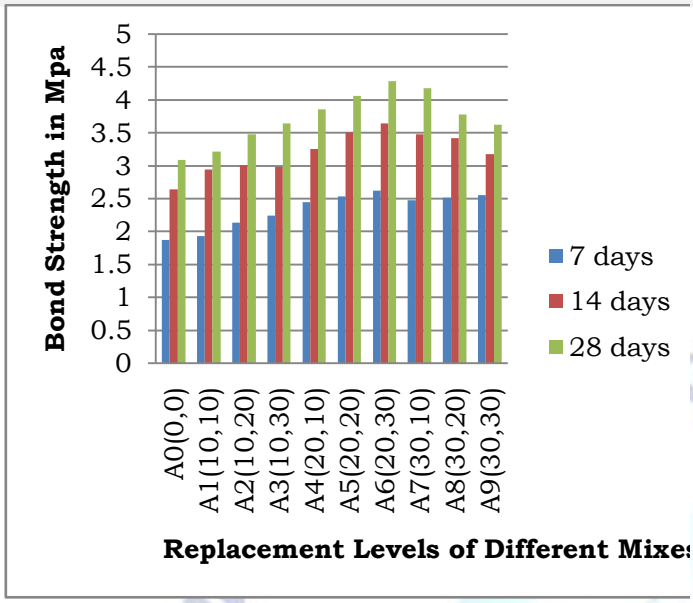
Graph for Table 4



Graph for table 5



Graph for table 6



Graph for table 7

V. CONCLUSION

1. At 7 days, It is observed that the maximum compressive strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased upto 8.46%
2. At 28 days, It is observed that the maximum compressive strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 8.02%
3. At 90 days, It is observed that the maximum compressive strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 7.99%

   From the above results we can state that the maximum compressive strength is obtained at A6(20,30) replacement.

4. At 7 days, It is observed that the maximum Split tensile strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 78.79%
5. At 28 days, It is observed that the maximum Split tensile strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 41.58%
6. At 90 days, It is observed that the maximum Split tensile strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 41.67%

   From the above results we can state that the maximum Split tensile strength is obtained at A6(20,30) replacement
7. At 7 days, It is observed that the maximum Flexural strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 26.70%
8. At 28 days, It is observed that the maximum Flexural strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 22.82%
9. At 90 days, It is observed that the maximum Flexural strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 12.28%

   From the above results we can state that the maximum Flexural strength is obtained at A6(20,30) replacement.

10. At 7 days, It is observed that the maximum Bond strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 39.89%
11. At 28 days, It is observed that the maximum Bond strength of the concrete cube is obtained at **A6(20,30) i.e.** crushed tiles were replaced in place of coarse aggregates by 20% and Granite powder were replaced in place of fine aggregate by 30%. It is increased up to 38.83%

    From the above results we can state that the maximum Bond strength is obtained at A6(20,30) replacement.

REFERNCES

[1] Alduaij, J., Alshaleh, K., Haque, M. N. & Ellaithy, K. (1999). Lightweight concrete in hot coastal areas. Cement & Concrete Composites, Vol. 21, pp. 453-458.

[2] Corinaldesi, V., Giuggiolini, M. & Moriconi, G. (2002). Use of the rubble from building demolition in mortars. Waste Management, Vol. 22, pp. 893-899.

[3] Sagoe-Crentsil, K. K., Brown, T. & Taylor, A. H. (2001). Performance of concrete made with commercially produced coarse recycled concrete aggregate. CCR, Vol. 031, pp.707-712.

[4] Chen, H., Yen, T. & Chen, K. (2003). Use of building rubbles as recycled aggregates. Cement and Concrete Research, Vol. 33, pp. 125-132.

[5] Mansur, M. A., Wee, T. H. & Cheran, L. S. (1999). Crushed bricks as coarse aggregate for concrete. ACI Materials Journal, Vol. 96, No. 4, pp. 478-484.

[6] Khaloo, A. R. (1995). Crushed tile coarse aggregate concrete. Cement, Concrete, and Aggregates (ASTM Journal), Vol. 17, No. 2, pp. 119-125.

[7] Topçu, İ. B. & Canbaz, M. (2005). Utilization of crushed tile as aggregate in concrete. Twelfth International Conference on Composites/Nano Engineering (ICCE-12), Tenerife, Spain.

[8] Concrete Technology" Theory and practice, A text book by M.S.Shetty, 2005.

[9] A.A Ramezanianpour, P.pourbiek, M.Mahdikhani, and F.Moodi. "Mechanical properties and durability of concrete containing rice husk ash as supplementary cementing material" International journal of civil Engineering. Vol. 7. 2, june 2009, june 2010.

[10] Alireza Nirshid,, suraya Abdul Rashid,Farah Nora A.Aziz, Mohamad Amran Mohd Salleh. "Contribution of Rice husk ash to the properties of mortar and concrete A Review" journal of American science: 2010.

[11] Moayad N A1-Khalaf and Yousif," Use of rise husk ash in concrete" , the International journal of cement composites and Lightweight concrete, Vol. 6, November 4 ,1984.

[12] Muhammad Soaid Ismail and A.M. Waliuddin, " Effect of rice husk ash on high strength concrete", Construction and Building Material,Vol. 10.No. 7,1996, 521-526.

[13] Gemma Rodriguez de Sensale, " Syrength development of concrete with Rice-husk ash",Cement & Concrete Composition , Vol. 28, 2006, 158-160.

[14] Dr.Suji D, Poovendran S, Prabhakar P "Experimental Study on Partial Replacement of Waste Foundry Sand in Flexible Pavements" in IJCSER, 2015.

[15] Lejumol.T.U "Experimental study on Sulphate Attack in Granite Powder concrete with GGBFS" in IJCSER, 2015.

[16] Krishna Kumar S "Experimental Study on Concrete using Waste Marble Power and Quarry Dust as Partial Replacement of Cement and Fine Aggregate" in IJCSER,2015.

[17] P.Rajalakshmi, Dr.D.Suji "Studies on Strength Characteristics on Utilization of Waste Ceramic Tiles a Aggregate in Concrete" in IJCSER, 2015.

[18] Kshiti ja Nadgouda"Coconut Fibre Reinforced Concrete" in Proceedings of Thirteenth IRF International Conference, 14th September 2014, Chennai, India, ISBN: 978-93-84209-51-3.

[19] Naveen Kumar MS, Nikhil B, Nikhil Patel AR Experimental studies on clay tile powder as partial replacement of cement for sustainable concrete.

[20] Lejumol.T.U, Dr.D.Suji, Niranjani, M.Perarasan Experimental Study on Sulphate Attack in Granite Powder Concrete with GGBFS