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An Experiment on Effect of Mineral Admixture in Coconut Shell Concrete

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Abstract: **The demand to make this material lighter has challenged scientists and engineers alike. The challenge in making a lightweight concrete is decreasing the density while maintaining strength and without adversely effecting cost. One such alternative is coconut shell (cs), as coarse aggregate in the production of concrete. Even though coconut shell possesses several desirable properties, its relative low tensile strength and deformation properties prompted many researches to work on to improve these properties. One such development of improving or modifying the properties of concrete is by supplementing the mineral admixtures with**

coconut shell concrete. Experimental investigations and analysis of results were conducted to study the compressive and flexural strength behavior of concrete with varying percentage of mineral admixtures. The concrete mix adopted were m25 with varying percentage of mineral admixtures ranging from 2%, 4%, 6%, 8%, 10%, 12%, 14%, 16%, 18%, 20%, 22%, 24%, and 26%. On the analysis of result the concrete with mineral admixtures in coconut shell had improved performance as compared to the ordinary concrete.

Index terms— **coarse aggregate, coconut shell, mineral admixtures, silica fume confinement; steel; coconut shell; quarry dust; concrete; mechanical properties.**

I. INTRODUCTION

The high cost of conventional building materials is a major factor affecting housing delivery in India. In developing countries where abundant agricultural and industrial wastes are discharges, these wastes can be used as potential material or replacement material in the construction industry. This will have the double advantage of reduction in the cost of construction material and also as a means of disposal of wastes. It is reported that about 600mt of waste have been generated in India from agricultural source are sugarcane, paddy, wheat straw and husk, vegetable wastes, food products tea, oil production, jute fibre, groundnut shell, wooden mill waste, coconut shell husk, cotton stalk etc., the new and alternative building components that will reduce to an extent the cost of conventional building materials.

Coconut shell (cs) is one of the forms of agricultural solid waste. It is one of the most promising agro wastes with its possible uses as coarse aggregate in the production of concrete. This has good potential where crushed stone are costly and coconut are available in large quantities as waste from agriculture sector statically data of coconut production shows that, India is producing nearly 27% of total world production and the annual production of coconut is reported to be more than 12 million tons.

II MATERIALS USED

2.1 Admixtures: An admixture is defined as a material other than hydraulic cements, water, aggregates and fibre reinforcement used as an ingredient in concrete and added to batch immediately before (or) during mixing

2.1.1 Micro silica

Silica fume or micro silica is an industrial by product consisting of ultra-fine particle (0.01µm). It is recovered from electric furnace by means of dust collectors from the waste gas emitted during the production of Ferro silicon metal. It is extremely fine with particle size less than 1 micron and with an average diameter of about 0.1 micron, about 100 times smaller than average cement particles. Micro silica has specific surface area of about 20,000m2 / kg as against 230 to 300 m2 / kg. The micro silica not only increase the compressive strength of concrete, being very fine pozzolanic material it creates dense packing between the fine aggregate and coarse aggregate paste.

2.1.2 Super plasticizer (conplast sp 430)

Workability is one of the most important characteristic of concrete, the use of very fineness admixture like silica, fly ash etc, will increase the demand of water cement ratio in the concrete to overcome these defects the super plasticizer has been used to improve the workability of concrete, these admixture appropriate quantity improves workability, reduces the rate of amount of bleeding, increases the strength of lean concrete and may not increase water requirement and drying shrinkage. The conplast sp 430 complies with is: 9103-1999 and bs: 5075 part 3 and also conforms to astmc –

c- 494 type 'f' and type 'a' depending upon the dosage used as per supplier of the product. The conplast sp 430 is based on sulphated naphthalene polymers, which is in liquid form of brown colour, instantly dispersible in water. This has been specially formulated to give high water reducers by improving their workability which easier in planning and compacting, it also increases strength of concrete and improved quality of denser closed texture concrete with reduced priority and risk of segregation and bleeding has been minimized. The early increase of compressive strength by reducing the water cement ratio and cohesion as also improved due to dispersion of cement particles.

2.2 Material properties:

S. No.	Materials	Properties	Results
1	Cement	Specific gravity	3.15
2	Fine aggregate	Specific gravity	2.65
		Water absorption	3.1%
3	Coarse aggregate	Specific gravity	2.68
		Water absorption	0.50 %
4	Silica fume	Specific gravity	2.22

2.3 Properties of super plasticizer

Parameter	Specification	Analysis
Chemical requirements		
Sio2	Min 85.0%	88.62
Moisture content	Max 3.0%	0.38
Loss ignition physical	Max 6.0%	1.02

Physical requirements		
> 45 micron	Max 10%	0.18
Pozz activity index (7d)	Min 1055%	135
Sp surface	M2/g min 15	19.4
Bulk density	Kg/m3 500-700	610

2.4 Concrete mix proportion

Description	Parameters
Specific gravity	1.22 – 1.225
Chloride	Nil to is:456
Air entrainment	Approximately 1% additional air is entrained

2.5 Mix design of with concrete

As with any other type of concrete, the mix proportion for silica is depend upon the cement content in conventional concrete coconut shell concrete, in term of strength, workability and so on. In general, silica fume mixes with, conventional concrete and coconut shell concrete for improving the strength then ordinary concrete. In the increasing of silica fume in concrete the strength will be increasing with reduced aspect ratio. The silica fumes are added 0%, 2% up to 26%.

2.6 Test for concrete;

1) Fresh concrete
2) Hardened concrete

2.6.1 Fresh concrete test:

Slump cone test

It measures the consistency or the wetness of concrete. The test is carried out using a mould known as a slump cone. The cone is placed on a hard non-absorbent surface. This cone is filled with fresh concrete in three stages, each time it is tamped using a rod of standard dimensions. At the end of the third stage, concrete is struck off flush to the top of the mould. The mould is carefully lifted vertically upwards, so as not to disturb the concrete cone. Concrete subsides. This subsidence is termed as slump, and is measured in to the nearest 5 mm if the slump is <100mm and measured to the nearest 10mm.

Fig 2.1: slump cone test

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2.6.2 Hardened concrete test

The concrete which is done the test after the day of the concrete mix is called as hardened concrete. Compression test and flexural test had been done in the project.

Compressive test

For compressive strength test, cube specimens of dimensions 100 x 100 x 100 mm were cast for m25 grade of concrete. The moulds were filled with 0%, 2% 4% up to26% of silica fume in conventional concrete & coconut sell concrete. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were remolded and were transferred to curing tank wherein they were allowed to cure for 28 days.

Compressive strength (N/mm2) = failure load / cross sectional area.

Fig 2.2: compacting

Various percentage of concrete is properly mixed and compacting a concrete in cubes. It is curing in a particular water tank for 28days. The concrete were conducted test on 3rd day, 7th day, and 28th day for the particular concrete. The particular day test can be conducted on 3cubes for various percentages of silica fumes in conventional concrete & coconut sell concrete. Each cube test load can be noted and calculated the average value for the three cubes.

Fig 2.3: testing of the cube in compressive machine

2.6.3 Flexural strength test:

One normal concrete beam of size (500mm x 100mm x 100mm) is casted in the mould and kept to cure for 24 hours. It is then demoulded and kept in water tank for 28 days. After 28 days, the beams would be tested for their flexural strength in the following method. The bed of the testing machine should be provided with two steel rollers, 38mm in diameter on which the specimen is to be supported. These rollers should be so mounted that the distance from center to center is 60 mm for 150 mm specimen. The bearing surfaces of the supporting and the loading rollers shall be wiped, clean and any loose sand or other material should be removed from the surfaces of the specimen where they are to make contact with the Rollers.

Two points loading can be conveniently provided by the arrangement. The load is transmitted to through a load cell and spherical seating on to a spreader beam. This beam bears on rollers seated on steel plated bedded on the test member with mortar, high strength plaster or some similar material.

The test member is supported on the roller bearings acting on similar spreader plates. The loading frame must be capable of carrying the expected test load without significant distortions. In each category two beams were tested and their average value is reported. The flexural strength was calculated as follows Flexural strength (mpa) = (p x l) / (b x d2)

Where, p = failure load,

l = centre to centre distance between the support= 400 mm,

b = width of specimen=100 mm, d = depth of specimen= 100 mm

Fig 2.4: testing of concrete beam in flexural testing machine

Fig 2.5: Concrete beam after testing in flexural testing machine

2.6.4 Split tensile strength test

The test specimens used for the split tensile test were 100 mm in diameter and 200 mm depth for both conventional concrete & coconut shell. The casted specimen is demoulded after 24 hours. After kept in water tank to curing .the test will be taken in 3rd day 7th day & 28th day.

Split tensile strength=2p/ dl Were,

P-failure load,

d-dia of specimen&

L-depth of specimen.

Fig 2.6: Cylindrical specimen after split tensile strength test.

2.6.5 Impact resistance

The test specimens used for the impact test were 165 mm in diameter and 60 mm thick for both conventional concrete & coconut shell. The cast impact specimen is shown in fig. During this test, the number of blows was counted till the first crack appeared (initial crack) on each specimen and counting was continued till the specimen tested for impact resistance similarly fig shows the specimen tested for 3rd day, 7th day &28th day its impact resistance.

Fig 2.7: testing of cylinder for split tensile strength

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Fig 2.8: testing for impact resistance

III RESULT & DISCUSSIONS

3.1 Overview of test conducted

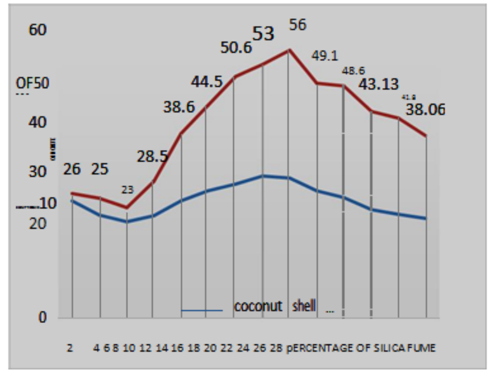
Tests were conducted on concrete cubes both conventional concrete and coconut shell concrete using varying percentage of silica fume replaced by cement to check the variation in compressive strength. To find out the optimize point in coconut shell concrete. The flexural strength test, split tensile strength test and impact resistance test conducted both conventional concrete coconut shell concrete at the optimize point. The tests are conducted on 3rd, 7th, and 28th days

3.2 Compressive strength test

3rd, 7th & 28th days compressive testing of concrete in mineral admixtures

Table 1 Compressive strength test

Area of specimen (mm^2)	% of silica	Conventional concrete N/mm2			Coconut shell concrete N/mm2		
		3-days testing	7-days testing	28-days testing	3-days testing	7-days testing	28-days testing
10000	0	9.5	13.1	26	8	12.7	24.5
10000	2	10	14	25	9	12.9	21.5
10000	4	11.5	15.5	23	9.5	13.5	20.1
10000	6	12.5	18.5	28.5	11	14.1	21.3
10000	8	14	22	38.6	12	14.5	24.5
10000	10	15	26.9	44.5	13.5	16	26.5
10000	12	16	31.2	50.6	14.5	18.4	28
10000	**14**	**16.5**	**32.3**	**53**	**15.5**	**21**	**29.7**
10000	16	16.5	34.7	56	14	20.1	29.3
10000	18	16	30.2	49.1	13.5	19.5	26.6
10000	20	15.5	30.11	48.6	13.5	19.3	25.16
10000	22	14.5	28.2	43.13	12.5	19	22.6
10000	24	13	25.8	41.8	12	18.9	21.67
10000	26	12.8	25	38	11.9	18	21.51



Comparative analysis of compressive strength for 14% of mineral admixture replaced by cement in concrete 3 day compressive testing of conventional concrete with 14% of mineral admixtures

S.N	Weight of specimen (kg)	Area of specimen (mm^2)	Ultimate load (kN)	Compressive strength (N/mm2)
1	2.43	10000	165	16.5
2	2.36	10000	152	15.2
3	2.61	10000	178	17.8

Average value = 16.5 N/mm2

Table 2: 3rd day compressive testing of coconut shell concrete with 14% of mineral admixtures

S.no	Weight of specimen (kg)	Area of specimen (mm2)	Ultimate load (kN)	Compressive strength (N/mm2)
1	2.02	10000	153	15.3
2	2.10	10000	160	16
3	1.98	10000	152	15.2

Average value =15.5 N/mm2

Table 3: 7th day compressive testing of conventional concrete with 14% of mineral admixtures

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S. N	Weight of specimen (kg)	Area of specimen (mm^2)	Ultimate load (kN)	Compressive strength (N/mm2)
1	2.48	10000	324	32.4
2	2.46	10000	309	30.9
3	2.54	10000	336	33.6

Average value =32.3 N/mm2

Table 4: 7th day compressive testing of coconut shell concrete with 14% of mineral admixtures

S.No	Weight of specimen (kg)	Area of specimen (mm2)	Ultimate load (kN)	Compressive strength (N/mm2)
1	2.01	10000	190	19.0
2	2.12	10000	225	22.5
3	2.00	10000	215	21.5

Average value = 21 N/mm2

Table 5: 28th day compressive testing of conventional concrete with 14% of mineral admixtures

S.no	Weight of specimen (kg)	Area of specimen (mm2)	Ultimate load (kN)	Compressive strength (N/mm2)
1	2.47	10000	508	50.8
2	2.52	10000	525	52.5
3	2.55	10000	557	55.7

Average value =53 N/mm2

Table 6: 28thday compressive testing of coconut shell concrete with 14% of mineral admixtures

S.no	Weight of specimen (kg)	Area of specimen (mm2)	Ultimate load (kN)	Compressive strength (N/mm2)
1	2.03	10000	292	29.2
2	2.11	10000	255	25.5
3	2.00	10000	344	34.4

Average value =29.7 N/mm2

Table7: comparative analysis for compressive strength result

Specimen type	3rd day	7th day	28th day
Conventional concrete	16.5N/mm2	32.3N/mm2	53N/mm2
Coconut shell concrete	15.5N/mm2	21N/mm2	29.7N/mm2

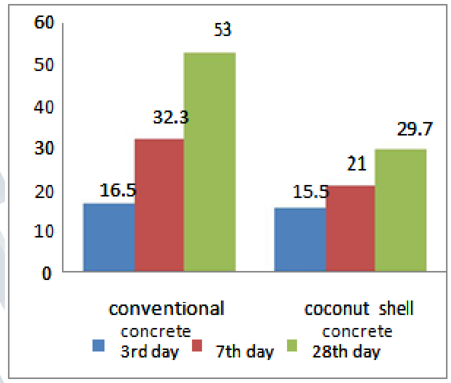

Fig 3.1 comparative analysis for compressive strength

3.3 flexural strength testing

3.3.1 Comparative analysis of flexural strength for 14% of mineral admixture replaced by cement in concrete

Table 8: 3rd day flexural testing of conventional concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Breadth (mm)	Depth (mm)	Load (kN)	Flexural strength (N/mm2)
1	12.9	500	100	100	10	4
2	13.24	500	100	100	14	5.6
3	13.12	500	100	100	13	5.2

Average value =4.93 N/mm2

Table 9: 3rd day flexural testing of coconut shell concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Breadth (mm)	Depth (mm)	Load (kN)	Flexural strength (N/mm2)
1	10.10	500	100	100	6	2.4
2	9.88	500	100	100	7	2.8
3	10.06	500	100	100	5	2

Average value =2.4 N/mm2

Table 10: 7th day flexural testing of conventional concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Breadth (mm)	Depth (mm)	Load (kN)	Flexural strength (N/mm2)
1	12.7	500	100	100	13	5.2
2	13.2	500	100	100	15	6
3	12.9	500	100	100	16	6.4

Average value =5.9 N/mm2

Table 11: 7th day flexural testing of coconut shell concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Breadth (mm)	Depth (mm)	Load (kN)	Flexural strength (N/mm2)
1	10.8	500	100	100	9	3.6
2	10.5	500	100	100	8.5	3.4
3	9.95	500	100	100	9.5	3.8

Average value =3.6 N/mm2

Table 12: 28th day flexural testing of conventional concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Breadth (mm)	Depth (mm)	Load(kN)	Flexural strength (N/mm2)
1	13.2	500	100	100	21	8.4
2	13.11	500	100	100	18	7.2
3	13.05	500	100	100	20	8

Average value =7.9 N/mm2

Table 13: 28th day flexural testing of coconut shell concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Breadth (mm)	Depth (mm)	Load (kN)	Flexural strength (N/mm2)
1	10.12	500	100	100	15.5	6.2
2	9.90	500	100	100	13	5.2
3	10.5	500	100	100	14	5.6

Average value =5.7 N/mm2

Table 14: comparative analysis for flexural strength result

Specimen type	3rd day	7th day	28th day
Conventional concrete	4.93 N/mm2	5.9 N/mm2	7.9 N/mm2
Coconut shell concrete	2.4 N/mm2	3.6 N/mm2	5.7 N/mm2

Fig13: comparative analysis for flexural strength

3.4 split tensile strength testing

3.4.1comparative analysis of split tensile strength for 14% of mineral admixture replaced by cement in concrete

Table 15: 3rd day spilt tensile test of conventional concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Dia (mm)	Load (kN)	Tensile strength (N/mm2)
1	3.42	200	100	43	1.37
2	3.34	200	100	45	1.43
3	3.39	200	100	49	1.55

Average value =1.45 N/mm2

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Table 16: 3rd day spilt tensile test of coconut shell concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Dia(mm)	Load (kN)	Tensile strength (N/mm2)
1	2.88	200	100	34	1.08
2	2.96	200	100	33	1.05
3	2.99	200	100	35	1.11

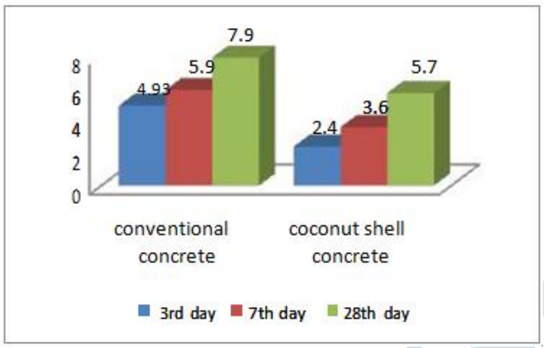

Fig 3.2 comparative analysis for Flexural strength

Table 17: 7th day spilt tensile test of conventional concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Dia (mm)	Load (kN)	Tensile strength (N/mm2)
1	3.42	200	100	71	2.26
2	3.34	200	100	70	2.23
3	3.39	200	100	80	2.55

Table 18: 7th day spilt tensile test of coconut shell concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Dia (mm)	Load (kN)	Tensile strength (N/mm2)
1	2.97	200	100	38	1.4
2	2.90	200	100	48	1.53
3	3.01	200	100	46	1.46

Average value =1.463 N/mm2

Table 19: 28th day spilt tensile test of conventional concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length (mm)	Dia (mm)	Load (kN)	Tensile strength (N/mm2)
1	3.42	200	100	98	3.12
2	3.34	200	100	84	2.67
3	3.39	200	100	94	2.99

Average value =2.93 N/mm2

Table 20: 28th day spilt tensile test of coconut shell concrete with 14% of mineral admixtures

S.no	Weight (kg)	Length(mm)	Dia (mm)	Load (kN)	Tensile strength (N/mm2)
1	2.88	200	100	50	1.59
2	2.96	200	100	47	1.49
3	2.99	200	100	49	1.56

Average value =1.55N/mm2

Table 21: comparative analysis for spilt tensile strength results

Specimen type	3rd day	7th day	28th day
Conventional concrete	1.45N/mm2	2.35N/mm2	2.93N/mm2
Coconut shell concrete	1.08N/mm2	1.463N/mm2	1.55N/mm2

Average value =2.35 N/mm2

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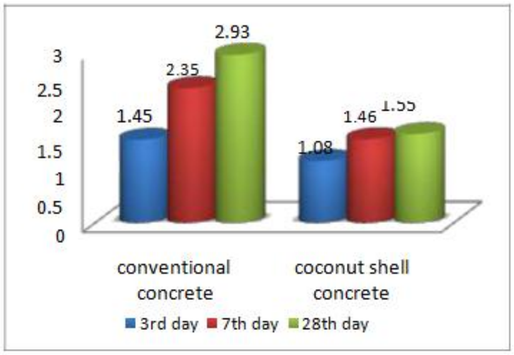

Fig 3.3: comparative analysis for split tensile strength

3.5 impact resistant test

3.5.1comparative analysis of impact resistant for 14% of mineral admixture replaced by cement in concrete

Table 22: 3rd day impact test of conventional concrete with 14% of mineral admixtures

S.no	Dia(mm)	Depth	Initial crack	Final crack
1	165	60	19	25
2	165	60	20	27
3	165	60	23	30

Average value = 20.6 = 27.33

Table 23: 3rd day impact test of coconut shell concrete with 14% of mineral admixtures

S.no	Dia(mm)	Depth	Initial crack	Final crack
1	165	60	18	25
2	165	60	21	28
3	165	60	24	31

Average value = 21 = 28

Table 24: 7th day impact test of conventional concrete with 14% of mineral admixtures

S.no	Dia(mm)	Depth	Initial crack	Final crack
1	165	60	22	27
2	165	60	21	24
3	165	60	20	23

Average value = 21 = 24.67

Table 25: 7th day impact test of coconut shell concrete with 14% of mineral admixtures

S.no	Dia(mm)	Depth	Initial crack	Final crack
1	165	60	24	29
2	165	60	19	22
3	165	60	23	34

Average value = 22 = 28.33

Table 26: 28th day impact test of conventional concrete with 14% of mineral admixtures

S.no	Dia(mm)	Depth	Initial crack	Final crack
1	165	60	59	64
2	165	60	65	67
3	165	60	60	62

Average value = 61.33 = 64.33

Table 27: 28th day impact test of coconut shell concrete with 14% of mineral admixtures

S.no	Dia (mm)	Depth	Initial crack	Final crack
1	165	60	75	80
2	165	60	72	79
3	165	60	82	88

Average value = 76.33 = 82.33

Table 28: comparative analysis for impact strength result

Specimen type	3rd day		7th day		28th day	
	Initial crack	Final crack	Initial crack	Final crack	Initial crack	Final crack
Conventional concrete	20.6	27.33	21	24.67	61.33	64.33
Coconut shell concrete	21	28	22	28.33	76.33	82.33

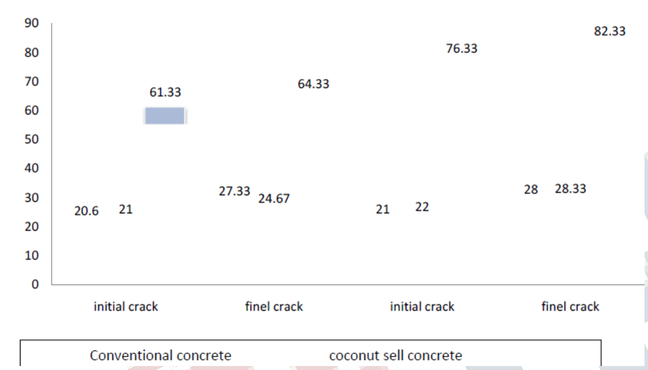

Fig 3.4: comparative analysis for impact strength

IV RESULTS

Compressive strength is calculation by using load/area

1) Compressive strength for conventional concrete 26 N/mm2
2) Compressive strength for coconut sell concrete 24.5 N/mm2
3) Compressive strength for 14% of mineral admixture in conventional concrete 53 kN/mm2
4) Compressive strength for 14% of mineral admixture in coconut sell concrete 29.7 N/mm2

Flexural strength is calculated by using pl/bd2

1) Flexural strength for 14% of mineral admixture in conventional concrete 5.9 N/mm2
2) Flexural strength for 14% of mineral admixture in coconut sell concrete 5.7 N/mm2

Split tensile strength is calculated by using 2p/ dl

1) Split tensile strength for 14% of mineral admixture in conventional concrete 2.93 N/mm2
2) Split tensile strength for 14% of mineral admixture in coconut sell concrete 1.55 N/mm2

Impact strength calculation

1) Impact strength for 14% of mineral admixture in conventional concrete
Initial crack 61.33
Final crack 64
2) Impact strength for 14% of mineral admixture in coconut sell concrete
Initial crack 76.33
Final crack82.33

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