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AN EXPERIMENTAL STUDY ON CONCRETE BY PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH SOLID PLASTIC WASTE AND GRANITE WASTE

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Abstract—In recent time, world is observer the construction of very challenging and difficult civil engineering structures. Concrete has been the best construction material for all types of structures. The unaccountable population growth rate makes problem of availability of coarse aggregate for construction. Increases population owing to that raises demand of the industrial products and by products. It has been noticed in India that granite usage as a finishing product of construction materials which create a large quantum of waste as well as some non-biodegradable solid plastic wastes created by industry and individuals, which affects on environment issues owing to this requires large damping sites. These by-products are left largely unused. In this present study, To investigate the strength and density of ordinary concrete mix using solid plastic and granite waste as coarse aggregate together with cement and natural fine aggregate. Furthermore, effects of partially replacement of coarse aggregate by different percentages of Granite Waste (GW) and Solid Plastic Waste (SPW) and check mechanical properties of this composite concrete. The range of replacement of SPW with coarse aggregate as 0% 5% and 10% and GW replaced by coarse aggregate as 0% 10% 20% 30% and 40% by weight of NCA.

Keywords— concrete, environmental problems, coarse aggregate, granite waste, solid plastic waste, partial replacement, strength.

I. INTRODUCTION

Concrete is a material which widely used in construction industry. In this research, discuss about industrial by product waste used in construction material Industrial by product waste such as Granite cutting waste and some kind of non-biodegradable solid plastic waste material which can be used as a substitute for aggregates. Both the material are mostly thrown away as waste material and can be used as a coarse aggregate in construction. Using SPW and GW will also result in reduced amount of waste and thus will prevent land pollution.

It has been noticed in India that granite usage as a finishing product of construction materials which create a large quantum of waste as well as some non-biodegradable solid plastic wastes created by industry and individuals, which effects on environment issues owing to this requires large damping sites. Granite is a very hard crystalline igneous or metamorphic rock primarily composed by of feldspar, quartz and such amount of dark mineral In India that, granite usage as a finishing product of construction materials. At present day Southern and eastern belts of the Nation are abundant in granite deposits. In India there are 43 granite processing unit of which are 12 in Andhra, 13 Karnataka, 3 in Rajasthan. Total granite production in Indian industry is estimated to be 350 to 400 containers per month. India has of the largest reserves of granite in the world and exported RS 2600 crore worth of the past year. In latest report the production in increased up to RS 4000 crore. Only Rajasthan granite mining is an approximately 800 crore. In recent the world is facing a waste crisis from the most problematic plastic produced today polyvinylchloride or PVC. PVC wastes to replace natural aggregate for concrete production can be one of the environmentally friendly methods because there is a great demand for eco-friendly concrete worldwide.

II. MATERIAL SELECTION

Raw materials are required for the concreting operations of present work are cement, fine aggregate, coarse aggregate, granite waste solid plastic waste and water.

A. CEMENT:

The ordinary Portland cement 53 grade was used for all concrete mixes. The properties of cement are fine, greenish, and grey powder. The cement and water form a past that binds the other material together as the concrete harden state.

B. AGGREGATE:
Fine aggregate is used to range of 4.75 mm to 150 µ.and coarse aggregate used to range of 20 mm to 4.75 mm.according to IS: 383-2016

C. WATER :
Water is an important ingredient of concrete. As a general guidance, if the water is fit for drinking it is fit for making concrete. Other yard-stick adopted is if the PH is between 6 to 8 the water is accepted to be suitable.

D. GRANITE WASTE & SOLID PLASTIC WASTE
Industrial Granite Cutting Waste & Solid plastic waste use As a Coarse Aggregate and Replaced at Natural Coarse Aggregate at various percentage.

TABLE I
PHYSICAL PROPERTIES

Sr. no	Physical property	Granite waste	Solid Plastic Waste	Normal aggregate	Concern IS Codes
1	Specific gravity	2.9	1.2	2.74	IS: 2386 –1963 part-3
2	Water Absorption	0.5 %	Nil	0.5%	IS: 2386 –1963 part-3
3	Impact value	16.50%	9.06%	21%	IS: 2386 – 1963 part - 1,2
4	Abrasion value	20.0%	-----	24%	IS: 2386 – 1963 part-4

III. EXPERIMENTAL INVESTIGATION

In this research various material used and study their properties and various test or experiment are conduct.

A. Test procedure

1) Prepare mix design using IS code
2) Selection of mixing procedures and test
3) Hardened concrete test (compressive, tensile and flexure strength)
4) Hardened property check by industrial waste material

- As per rocks IS 13365-part1&2 code classification of rocks to identified the rock is a granite rock based on compressive strength. Made 50mm x 50mm x 50mm granite block and check its compressive strength. Generally compressive strength of granite rocks lies between range of 160 to 200 or above.
- Our case average range of granite block is 177.33 MPa, it's prove that the rock is granite rock.

TABLE III
COMPRESSIVE STRENGTH OF GRANITE ROCK

Sr. No.	LOAD (KN)	STRENGTH (MPa)	AVERAGE STRENGTH (MPa)
1	432	172.8	177.33
2	456	182.4	
3	442	176.8	

Fig. 1 Granite block

B. Mix proportion

In this experiment, Natural coarse aggregate was partially replaced by mix proportion of granite waste varying from 0% to 40% at the interval of 10% & solid plastic waste varying from 0% to 10% at the interval 5%. The replaced concrete is compared with the normal concrete. Test was carried out for M20 grade concrete. For this cube samples of size 150mmx150mmx150mm are casted foe each percentage of replaced concrete and normal concrete. Adopted w/c ratio of 0.50. After 24 hours the cubes are remoulded and they are cured in curing tank for 28 days and then measured the strength.

IV. RESULT AND ANALYSIS

A. Fresh concrete property

Fresh properties of M20grade of concrete are shown in table III

TABLE IIIII
SLUMP TEST RESULT

Mix	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15
Plastic waste (%)	0	0	0	0	0	5	5	5	5	5	10	10	10	10	10
Granite waste (%)	0	10	20	30	40	0	10	20	30	40	0	10	20	30	40
Natural aggregate %	100	90	80	70	60	95	85	75	65	55	90	80	70	60	50
Slump value (mm)	72	69	67	64	62	76	73	71	67	63	79	75	73	71	68

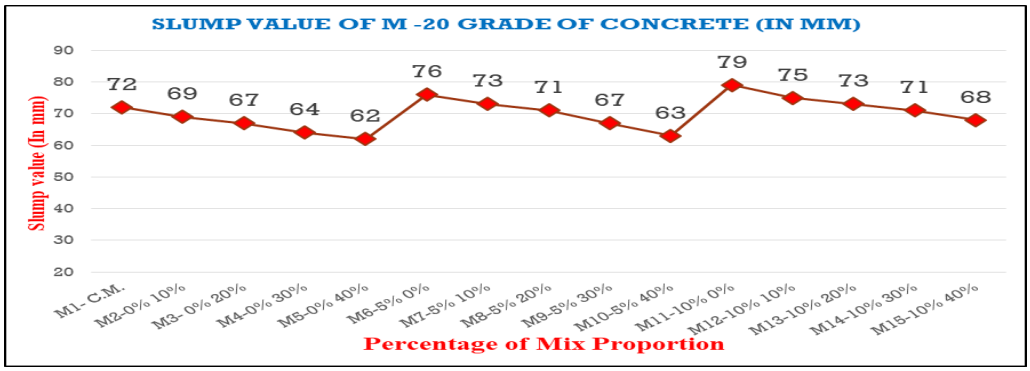

Fig. 2 Slump test result of concrete mix

B. Hardened concrete properties

Table VI shows the 28 days compressive strength, splitting tensile strength and flexural strength of the specimen of various mix

TABLE VIV
HARDENED CONCRETE PROPERTIES

Concert mix	Plastic waste %	Granite waste %	Natural aggregate %	Compressive strength		Tensile strength	Flexural strength
				7 DAYS	28 DAYS	28 DAYS	28 DAYS
M1	0	0	100	17.26	26.73	2.74	3.61
M2	0	10	90	17.56	27.02	2.89	3.83
M3	0	20	80	18.25	27.88	2.92	3.91
M4	0	30	70	19.11	28.81	3.12	3.99
M5	0	40	60	18.19	27.09	3.11	3.87
M6	5	0	95	17.11	25.15	2.71	3.55
M7	5	10	85	17.17	26.17	2.8	3.66
M8	5	20	75	17.57	26.7	2.82	3.72
M9	5	30	65	18.5	27.21	2.91	3.76
M10	5	40	55	17.67	25.75	2.88	3.67
M11	10	0	90	16.03	23.56	2.59	3.42
M12	10	10	80	16.4	25.32	2.72	3.58
M13	10	20	70	17.01	25.91	2.76	3.66
M14	10	30	60	17.3	26.15	2.83	3.71
M15	10	40	50	16.92	25.29	2.79	3.64

1) COMPRESSIVE STRENGTH

Form the observation replacement of CA with GW in concrete the compressive strength was increased up to 10%. The replacement of CA with SPW in concrete the strength of decreased up to 8%.from the observation the combination (5%spw+30%GW) of both material and replaced by NCA. The strength is 2%to 3% increased as compare to normal concrete.

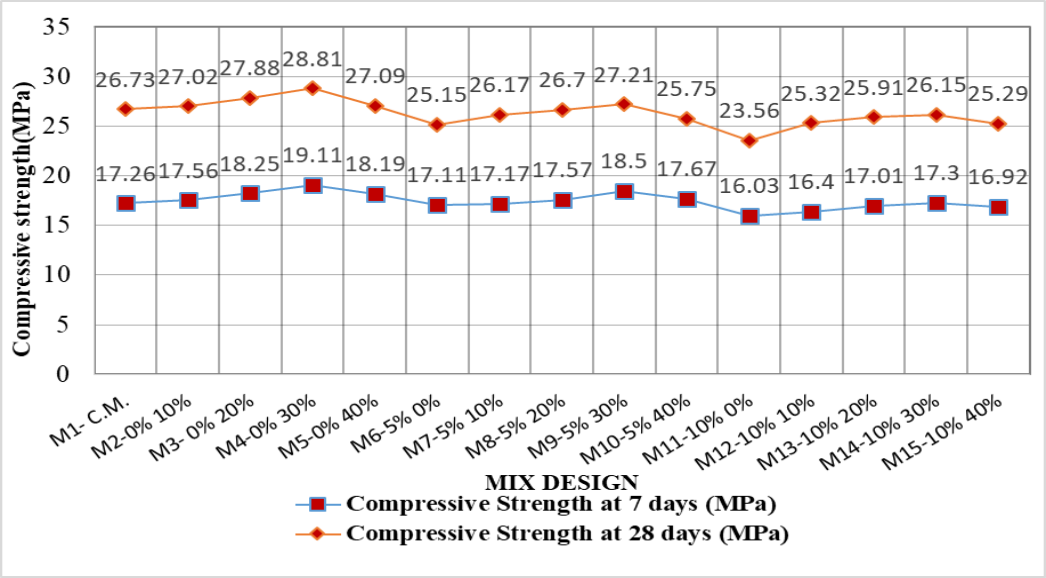

Fig. 3 compressive strength test result of concrete mix

2) TENSILE STRENGTH

Form the observation replacement of CA with GW in concrete the tensile strength was increased up to 9%. The replacement of CA with SPW in concrete the strength of cylinder decreased up to 5 %.from the observation the combination (5%spw+30%GW) of both material and replaced by NCA. The strength is 6%to 8% increased as compare to normal concrete.

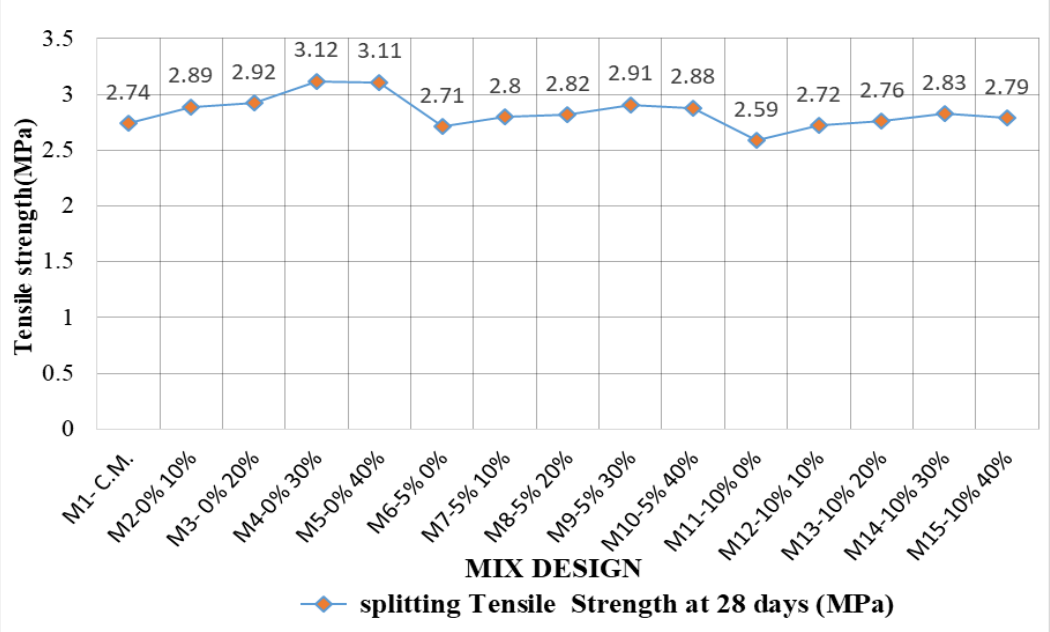

Fig. 4 Tensile strength test result of concrete mix

3) FLEXURAL STRENGTH

Form the observation replacement of CA with GW in concrete the flexural strength was increased up to 6%. The replacement of CA with SPW in concrete the strength of cylinder decreased up to 3%.from the observation the combination (5%spw+30%GW) of both material and replaced by NCA. The strength is 4%to 5% increased as compare to normal concrete.

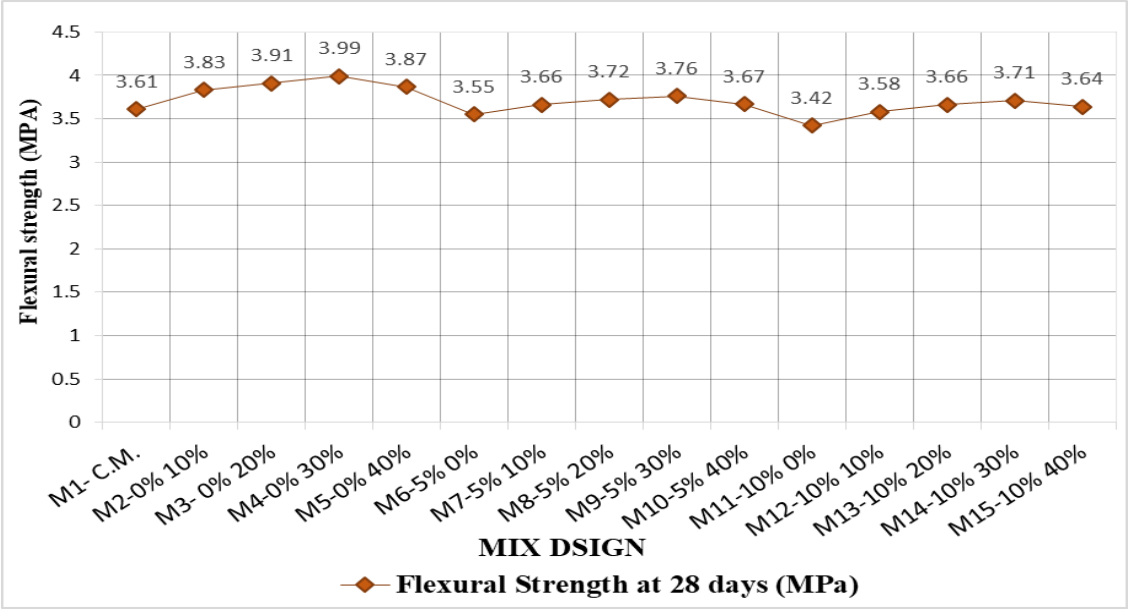

Fig. 5 flexural strength test result of concrete mix

C. Durability properties of concrete

Table V shows the 28 days Density value, ultrasonic pulse velocity, and compressive strength after acid attack and sulphate attack at 56 days.

TABLE V
DURABLE CONCRETE PROPERTIES

Concert mix	Plastic waste %	Granite waste %	Natural aggregate %	Acid attack H_2SO_4	Sulphate attack $MGSO_4$	UPV TEST (KM/SEC)	DENSITY OF BLOCK KG/M^3
				56 DAYS	56 DAYS	28 DAYS	28 DAYS
M1	0	0	100	22.56	25.69	4.6	2634.07
M2	0	10	90	22.95	25.96	4.71	2640.59
M3	0	20	80	23.84	26.84	4.81	2698.96
M4	0	30	70	24.90	27.75	5.11	2723.26
M5	0	40	60	23.49	26.11	5.19	2732.15
M6	5	0	95	21.08	24.09	4.12	2569.19
M7	5	10	85	22.13	25.10	4.22	2605.04
M8	5	20	75	22.67	25.62	4.55	2633.78
M9	5	30	65	23.14	26.18	4.69	2647.11
M10	5	40	55	21.10	24.82	4.59	2652.44
M11	10	0	90	18.54	22.45	3.99	2533.04
M12	10	10	80	21.29	24.21	4.15	2580.74
M13	10	20	70	21.65	24.79	4.26	2613.63
M14	10	30	60	22.32	25.07	4.39	2631.41
M15	10	40	50	21.25	24.13	4.24	2640.32

4) COMPRESSIVE STRENGTH AFTER ACID ATTACK

By replacement of coarse aggregate together with SPW & GW in concrete, the strength constantly decreased after 58 day curing in 5% of H2SO4 solution.

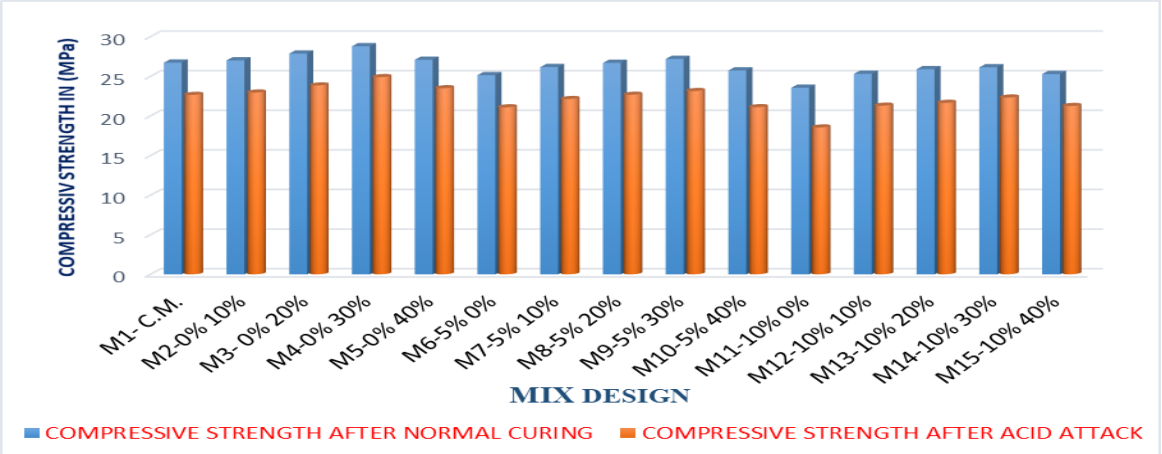

Fig. 6 Comparison between compressive strength after normal curing and acid attack

5) COMPRESSIVE STRENGTH AFTER SULPHATE ATTACK

After sulphate attack, Compressive strength value calculated for all mixes.

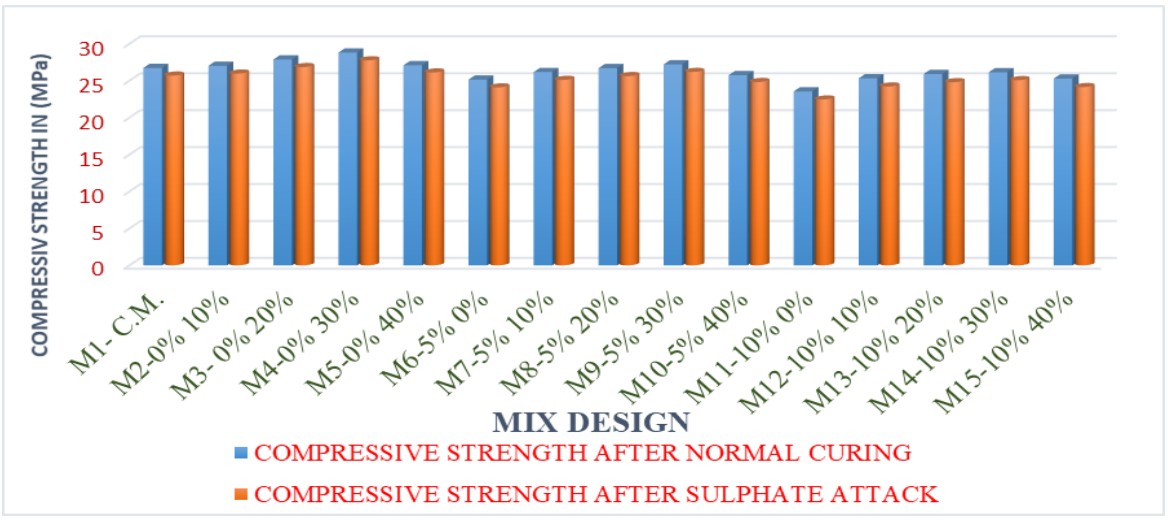

Fig. 7 Comparison between compressive strength after normal curing and sulphate attack.

6) ULTRASONIC PULSE VELOCITY OF CONCRETE BLOCK

An ultrasonic pulse velocity (UPV) test is an in-situ, non-destructive test to check the quality of concrete and natural rocks. Ultrasonic testing is conducted according to IS:13311-1992(part -1).From observation, This test indicates the quality of workmanship and to find the cracks and defects in concrete In this test, the strength and quality of concrete or rock is assessed by measuring the velocity of an ultrasonic pulse passing through a concrete structure or natural rock formation.

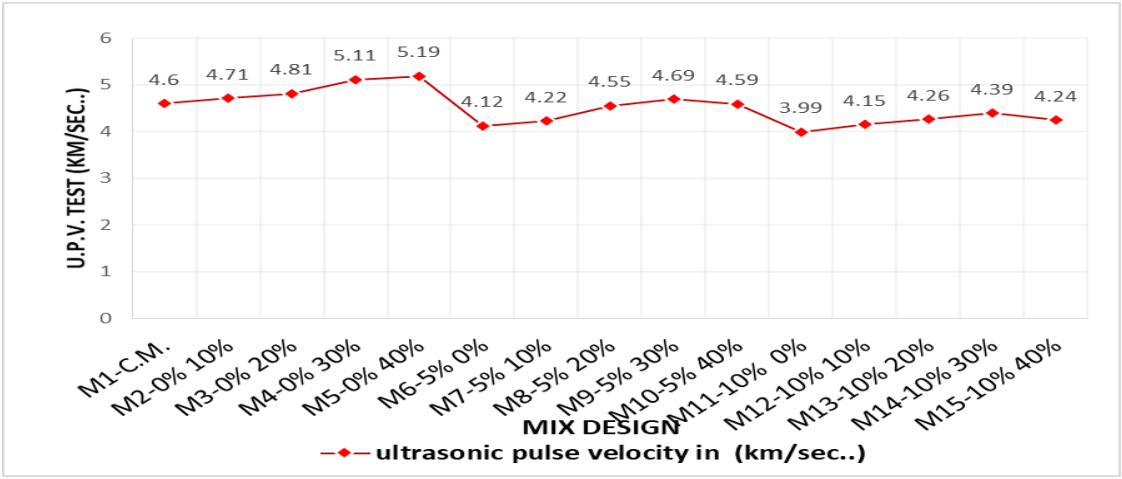

Fig. 8 value of pulse velocity passed in concrete

V. CONCLUSIONS

In Various tests were carried out on different mixes of concrete containing replacing solid plastic waste & granitewaste along with control mix. Conclusion based on the results and discussions are summarized below

A. The slump value decreases up to 13 % when NCA replaced by 5% of solid plastic waste and 40% of granite waste. But the percentage of SPW are increased the slump is also increased.

B. The compressive strength is increases up to range of 8% to 10% when NCA replaced by 40% of GW & strength decreases when NCA replaced by range of 5% to 10% SPW. But the compressive strength is increases up to 3% when NCA replaced by combination of (5% SPW +30% GW).

C. The splitting tensile strength is increases up to 6% to 7%, when NCA replaced by combination of (5% SPW +30% GW). & the flexural strength is also increased up to 4% to 5%, when NCA replaced by combination of (5% SPW +30% GW).

D. Ultrasonic pulse velocity passing in concrete is decreases when the solid plastic waste increases. But the range of replacement (5% SPW + 20% to 30% GW), the pulse velocity obtain same as a control mix.

E. Optimum result obtain by using combination of 5%SPW+40%GW in place of natural coarse aggregate.

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BIOGRAPHIES

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