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RESEARCH ARTICLE OPEN ACCESS

Experimental Analysis of Concrete Replacin Cement with Polypropylene Fibers and Glass Powder

Mr. P. Sudhir Kumar Reddy, Dr E. ARUNA KRANTHI.
M Tech (Structural Engineering), Civil Engineering Department, JNTUA College of Engineering, Anantapur, A.P India.
Professor of Civil Engineering, JNTUA college of Engineering Anantapuram,515002. India

ABSTRACT
Now a day's cement using is common in every construction. Due to its abundant availability of its materials and resources available in its surrounding areas. This paper explains the usage of polypropylene fibers and waste glass powder (WGP) in replacing cement with polypropylene fibers and glass powder. Large quantity of glass powder is wasting in industries and metro cities. The wastage of glass powder is replacing in cement is useful utilization of fibers show extensive improvement in tractable properties of cement and furthermore diminish shrinkage and breaks. As glass powder with molecule size under 75µn pozzolanic properties, past examination uncovers that glass powder can be successfully use as a halfway replacement of concrete. The experimental research held with partial substitution of waste glass powder of 5%, 10%, 15%, 20%, 25%, 30% of cement and polyproplene fiber of 1.5% constant replacement of cement by weight. This paper shows the experimental results of compressive strength, split tensile strength and flexural strength were conducted. This examination indicated that the blend mix in with specific rates invigorated higher contrasted with ordinary blend extents.

KEYWORDS: Polypropylene fiber, Waste Glass powder, Compressive strength, Split Tensile Strength, and Flexural Strength.

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I. INTRODUCTION:

Cement is truly sturdy and mouldable development material that comprises of concrete, sand, and mix blended in with water. What is more, any admixtures required are utilized relying on the outcomes. concrete is the indispensable material where development is preparing all over the place. Because of expansion sought after of development materials for infrastructural reason we will utilize substitute material for solid blend.

The utilization of waste glass powder in replace cement could reduce the expense of cement and furthermore the utilization of concrete; there by straight forwardly reduce the CO2 emission which is identified with the creation of concrete. Likewise, this decreases the cost of making concrete since a waste material in utilized. Endeavors have been made to utilize glass as a substitution for coarse total and furthermore as a hydration upgrading filler. Be that as it may, replace of concrete with flass to cause solid will be an incredible worth expansion. As a pozzolan, glass powder gives a more uniform conveyance and a more prominent volume of hydration items. Expansion of glass powder to a solid blend modifies the concrete glue structure. The coming about glue contains a greater amount of the solid calcium silicate hydrates (C-S-H) and less of the frail and effectively solvent calcium hydroxides (Ca(OH)2) than normal concrete glues. The calcium silicate hydrate shaped is the paste, or cover, which holds the framework together, and is the fundamental wellspring of solid strength. The weak calcium hydroxide doesn't contribute as a cover and can consume space.

The Polypropylene strands are available in monofilament structure, furthermore, fit in the thermoplastic polypropylene gathering. The Polypropylene fibers are fine or more common assistance temperature their properties might be misshaped. Polypropylene filaments are genuinely hydrophobic. Polypropylene strands have been utilized at minimal inside to oversee plastic shrinkage breaking in cement.

II. OBJECTIVE:

To examine the strength of Compressive strength, Split tensile strength, and flexural strength by partial substitution of cement with WGP in proportions of 5%, 10%, 15%, 20%, 25%, and 30%, and for each proportion cement is replaced with

1.5% constant polyproplene fiber in normal concrete.
Compressive strength on concrete cubes.
Split tensile strength on concrete cylinder.
Flexural strength on concrete beams.

III. MATERIALS USED:

The Physical properties as well Chemical properties of relevant materials utilized for setting up the concrete mix.

1.Cement: -
Ordinary Portland Cement with 53 grade (Ultra Tech Company).
Cement Physical characteristics as per IS 12269: 2013.
Specific gravity of Cement = 3.15.
Normal consistency = 29%.
Fineness of cement = 5.3% from 90 micron IS sieve as per IS: 4.31 (part1).
Initial setting time = 30mins
Final setting time = 10 hours from VICA needle test

2.COARSE AGGREGATIVE: -
CA (Coarse aggregate) maximum size = 20mm which validates from IS 383-1970
CA specific gravity – 2.702 which validates to IS 2386 (part 4)-1963.
Water absorption -0.25%

3.FINE AGGREGATE (SAND): -
Natural Sand which is passing through 4.75mm IS Sieve size as per IS-383-1970 it belongs to Zone – II.
Locally available sand.
Specific gravity of fine aggregate=2.63
Fineness modulus =2.46%
Water absorption of sand=0.5%

4.WASTE GLASS POWDER: -
As locally gathered waste glass bottles were milled to powder form.
Glass is made up of several elements such as sodium oxide, calcium oxide, potassium oxide. As it is use as aggregate in building and road construction.
Glass powder size maintained as per cement standards 0.075mm. Glass bottles as shown in fig.1 and smoothly grined powder form shown in fig.2.


fig.1


fig.2

5. POLYPROPLENE FIBERS: -
Polypropylene fibers are synthetic fiber. It is used in many different industries. Polypropylene fibers are used at little to manage plastic shrinkage cracking in concrete. Polypropylene fibers were collected form Indi mart. This was replaced by weight of cement.

Mechanical properties of polypropylene fibers.

Tensile strength (gf/den)	3.5 to 5.5
Elongation (%)	40 to 100
Abrasion resistance	good
Moisture absorption (%)	0 to 0.05

Softening point (ºC)	140
Melting point (ºC)	165

The length of polypropylene fiber is 8mm and its diameter is 10-200µm.Polypropylene fibers are fit in thermoplastic polypropylene group and hand in monofilament form. Polypropylene fibers shown in fig.3.

properties	**Polypropylene fiber**
Alkali	Polypropylene by nature is damaged by concentrated alkali
Specific gravity	0.90-0.91 g/cm^3
Elastic modulus	3.5-4.9Gpa
Ultimate elongation	6-15

fig.3

Table no.1: Characteristics of cement (OPC), and waste glass powder (WGP)

Properties	*WGP*	*CEMENT(OPC)*
Specific Gravity	2.55	3.15
Si o_2	70.22	20.6
Al_2 O_3	3.52	4.0
fe_2 O_3	1.77	3.1
Ca O	10.59	62.8
S o_3	0.03	3.1
Mg O	1.56	4.43
K_2 O	0.89	-
Na_2 O	10.46	-
Loss on Ignition	0.60	1.8

METHODOLOGY:

A Study conducted on concrete with a partial replacement of cement with waste glass powder and constant replacement of polypropylene fibers. Cement is substituted with WGP in the amounts of 0%, 5%, 10%, 15%, 20%, 25%, 30%. And same cement partial replacement with 1.5% polypropylene fiber.

- Grade of concrete: - M30
- Grade of cement:-OPC 53 grade.
- Proportion of replacement of cement with polypropylene: - 1.5%
- Proportion of replacement of cement with Glass powder: - 5%,10%,15%,20%,25%,30%.

1.Cube size - 15×15×15 cm – Three specimens for each proportion to compressive strength.

2.Cylinder size – 15 cm (dia)×30 cm (height)- Three specimens for each proportion to split tensile test.

3.Beam size - 10×10×50 cm – Three specimen for each proportion to flexure test.

Mix Proportions:-

Mix proportions was calculated as per IS: 10262 : 2009 and IS: 456 :2000 to get M30 mix.

Cement = 419.347 kg/m^3

Water = 191 liters

Fine aggregate = 648.6 kg/m^3

Coarse aggregate = 1175.754 kg/m^3

Water cement ratio W/C =0.45

Detailed proportions mentioned of cubes are shown in **Table no_2.**

Table no_2 Mix proportions of cubes.

Sl.no	Name of mix	Cement (%)	Polypropylene (%)	WGP (%)	Cubes
1	S1	100	0	0	3
2	S2	98.5	1.5	0	3
3	S3	93.5	1.5	5	3
4	S4	88.5	1.5	10	3
5	S5	83.5	1.5	15	3
6	S6	78.5	1.5	20	3
7	S7	73.5	1.5	25	3
8	S8	68.5	1.5	30	3

Detailed proportions mentioned of cylinder are shown in **Table no_3.**

Table no_3 Mix proportions of cylinders.

Sl.no	Name of mix	Cement (%)	Polypropylene (%)	WGP (%)	Cylinder
1	S1	100	0	0	3
2	S2	98.5	1.5	0	3
3	S3	93.5	1.5	5	3
4	S4	88.5	1.5	10	3
5	S5	83.5	1.5	15	3
6	S6	78.5	1.5	20	3
7	S7	73.5	1.5	25	3
8	S8	68.5	1.5	30	3

Detailed mix proportions mentioned of beams are shown in **Table no_4.**

Table no_4 Mix proportions of Beams.

Sl.no	Name of mix	Cement (%)	Polypropylene (%)	WGP (%)	Beams
1	S1	100	0	0	3
2	S2	98.5	1.5	0	3
3	S3	93.5	1.5	5	3
4	S4	88.5	1.5	10	3
5	S5	83.5	1.5	15	3

6	S6	78.5	1.5	20	3
7	S7	73.5	1.5	25	3
8	S8	68.5	1.5	30	3

IV. TEST RESULTS ON CONVENTIONAL CONCRETE.

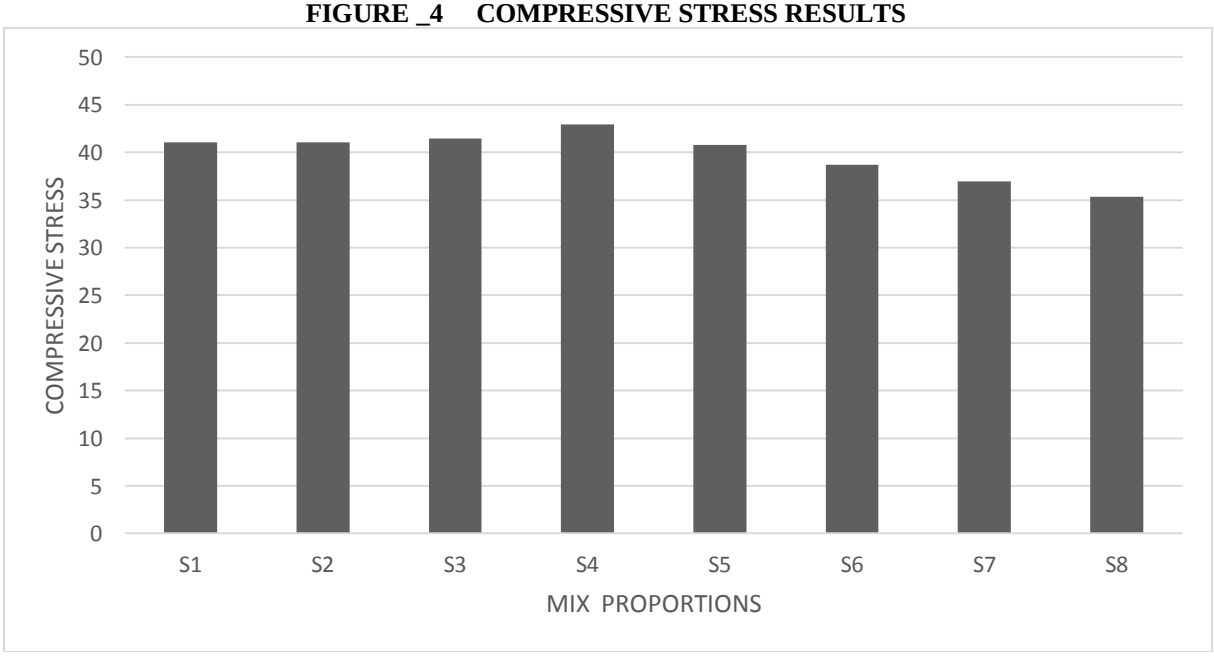
4.1 Compressive test results on cubes:

The cube size of 15cm×15cm×15cm dimension is used to find the compressive strength. The compressive strength is conducted on specimen as per IS 516: 1959(2004). After 28 days curing with the help of 2000KN capacity was applied Compressive Testing Machine. Test was conducted till the sample cube fails and then final loads are noted down. Results are represented in **Table no_5** and graph are shown in **fig.4.**

Table no_5 Compressive strength

Sl.no	Name of the mix	% of cement replaced with PPF and WGP Cement%+PPF%+WGP%	Compressive Strength of Cubes(N/mm^2) 28days
1	S1	100%+0%+0%	40.53
2	S2	98.5%+1.5%+0%	41.03
3	S3	93.5%+1.5%+5%	41.48
4	S4	88.5%+1.5%+10%	42.96
5	S5	83.5%+1.5%+15%	40.77
6	S6	78.5%+1.5%+20%	38.68
7	S7	73.5%+1.5%+25%	36.93
8	S8	68.5%+1.5%+30%	35.31

FIGURE _4 COMPRESSIVE STRESS RESULTS



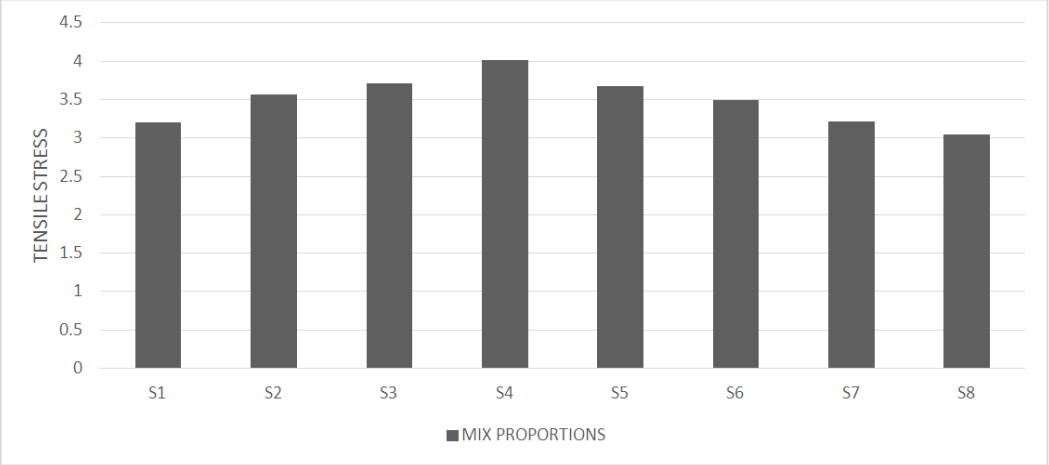
4.2 Split Tensile Test on Cylinder: -

The cylinder size of length 30 cm and diameter 15 cm is used to find the split tensile strength. Specimens are conducted as per IS- 5816: 1999 (2004). Test was conducted till the sample cylinder fails. Results are represented in **Table no_6** and graph are shown in **fig.5.**

Table no_6 Split Tensile Strength.

Sl.no	Name of the mix	% of cement replaced with PPF and WGP Cement%+PPF%+WGP%	Tensile Strength of the Cylinders (N/mm^2) 28days
1	S1	100%+0%+0%	3.20
2	S2	98.5%+1.5%+0%	3.57
3	S3	93.5%+1.5%+5%	3.71
4	S4	88.5%+1.5%+10%	4.02
5	S5	83.5%+1.5%+15%	3.68
6	S6	78.5%+1.5%+20%	`3.49
7	S7	73.5%+1.5%+25%	3.21
8	S8	68.5%+1.5%+30%	3.05

FIGURE NO_5 SPLIT TENSILE STRESS RESULTS



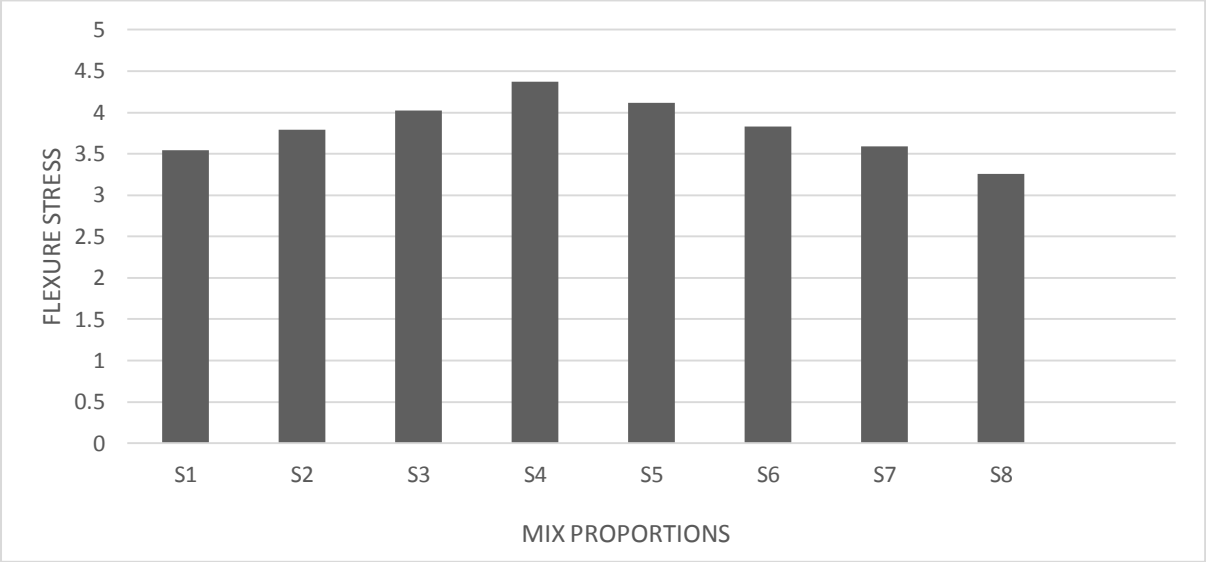
4.3 Flexure Bending Test on Beams: -

The Beam size of length 50 cm width 10 cm and depth 10 cm were prepared. To find the flexure tensile strength as per accordance IS – 5816: 1999 (2004). Test was conducted until the Beam fails. Results are shown in **Table no_7** and graph were shown in **fig.6.**

Table no_7 Flexure Tensile Strength

Sl.no	Name of the mix	% of cement replaced with PPF and WGP Cement%+PPF%+WGP%	Flexural Strength of the Beams (N/mm^2) 28days
1	S1	100%+0%+0%	3.54
2	S2	98.5%+1.5%+0%	3.79
3	S3	93.5%+1.5%+5%	4.02
4	S4	88.5%+1.5%+10%	4.37
5	S5	83.5%+1.5%+15%	4.12
6	S6	78.5%+1.5%+20%	3.83
7	S7	73.5%+1.5%+25%	3.59
8	S8	68.5%+1.5%+30%	3.26

FIGURE NO_6 FLEXURE TENSILE STRESS RESULTS



V. CONCLUSIONS.

By using waste glass powder and polypropylene fiber with partial replacement of cement it is possible to achieve desire strength. It shows good results by replacing glass powder and polypropylene fiber. Compressive strength, split tensile strength and flexural strength results following conclusion are given.

- By using glass powder is eco-friendly and economic. Shows strength, durability and better results.
- When partial replacement of ordinary Portland cement (OPC) with polypropylene fibers with 1.5% and waste glass powder (WGP) up to 10% the conventional concrete strength has been raised. For M30 grade mix ratio at 28days of curing.
- Compressive strength raised with increase of glass powder percentage up to 10% and polypropylene fiber 1.5%. By comparison of normal mix and waste materials added the strength were raised more than the target mean strength. For 28days curing of M30 mix ratio.
- Flexural and split tensile strength were raised with increase of waste glass powder up to 10% and polypropylene fibers 1.5%. By comparison of normal mix and waste material were added with cement the strength was raised more than the target mean strength. For 28days curing of M30 mix ratio.
- By partial replacement of cement with 1.5% polypropylene fiber and 10% of glass powder it is observed that compressive strength, split tensile strength and flexural strength for M30 mix grade concrete were greater than the target mean strength of normal M30 mix proportion.

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