AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF COPPER SLAG AS FINE AGGREAGTE IN PAVER BLOCK AND BEAM

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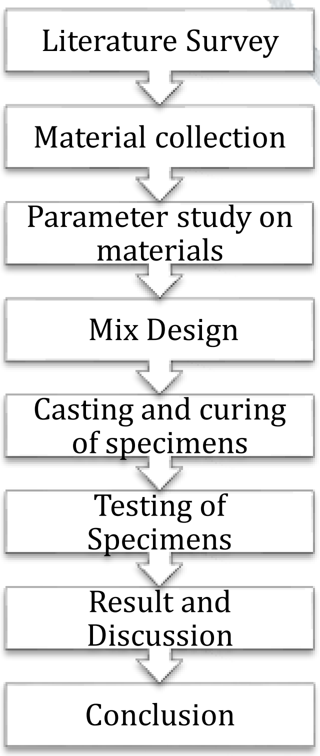
Abstract- The study is based on the replacement materials such as copper slag, GGBS and addition of thermocol balls and steel fibre. This study is focused on two major things such as paver blocks and beam with the dimensions 260x 110x 80mm and 1200 x 150x 230 mm.M40 grade is used for paver block which is casted with addition of copper slag, GGBS to its weight with 1% of thermocol balls .M30 grade is used for cube and beam which is casted with addition of copper slag, GGBS to its weight with 1% steel fibre. When paver blocks are considered the proportions used for copper slag are 10%,20%,30%,40%,50%,60%,70%,80%,90% and 100% and with GGBS kept constant with 30%. When cubes are considered the proportions used for copper slag are 25%,50%,75% and 100% and with GGBS kept constant with 40%.the beam is casted with the strength that is tested with the hardened cube. Therefore 25% of copper slag .40% of GGBS and 1% of steel fibre is casted into Beam. Various tests are conducted for each such as compressive strength test, water absorption test and flexural behaviour for beam.

Key words: **Copper Slag, GGBS, Steel Fibre, Thermocol Balls, Cube, Paver Blocks, Beam, Bi-Arc.**

1.INTRODUCTION

Our country India is a developing country so the development of road ways and buildings play an important role in our society. nowadays the paver blocks are used as road ways in many areas. The main idea of this study is to use the waste products that are produced from the steel and iron industries as a byproduct in daily life construction. The byproducts selected for this study are copper slag and GGBS. these are used in casting beam, cube and paver blocks.

2.METHODOLOGY



3.MATERIALS USED

3.1. Cement

OPC 53 grade cement was used in casting for paver blocks, cube and beam according to IS: 12269-2013.the specific gravity of cement is 3.15.

3.2. Fine Aggregate (River Sand)

It confirming to zone II of IS 383-1970.Sand is used in the work which has the particle was less than 4.75mm.the specific gravity of fine aggregate is 2.54.

3.3. Water

Water is the important part is mixing the concrete. A part of mixing water is utilized in the hydration of cement to form binding matrix in which the inert aggregates are held in suspension until the matrix has harden. The remaining water serves as a lubricant between the fine and coarse aggregate and makes concrete workable.

3.4. Coarse Aggregate (10mm,20mm)

The coarse aggregate used for paver block is having the size of 10mm and for cube and beam the size used is 20mm.

3.5. Copper Slag

Copper slag is a by-product of copper extraction by smelting. Copper slag is obtained by smelting process the impurities float on the molten metal in the form of slag. Slag that is placed in water produces angular granules which are completely removed of as waste.

3.6. GGBS

Ground-granulated blast-furnace slag (GGBS) is a product that is obtained by quenching molten iron slag from a blast furnace in water, to produce a glassy, granular product which is then dried and ground into a very fine powder.

There are two uses of GGBS that are in the production of a good quality slag cement, namely Portland Blast furnace cement and high-slag blast-furnace cement which has GGBS content from 30 to 70%.

3.7. Thermocol Balls

Thermocol balls are used as an additional material for paver block with a constant of 1 %.

3.8. Steel Fibre

Steel fibre is a metal reinforcement. Steel fibre for reinforcing concrete is defined as short, discrete lengths of steel fibres with an aspect ratio (ratio of length to diameter) from about 20 to 100, with different cross-sections, and that are sufficiently small to be randomly dispersed in an unhardened concrete mixture using the usual mixing procedures.

4.RESULT AND DISCUSSION

4.1. Paver Block

4.1.1. Compressive Strength Test

Table-1: Compressive strength test for paver block

SL.NO	TYPE	7th day (N/mm^2)	14th day (N/mm^2)	28th day (N/mm^2)
1	Normal	35.97	37.34	39.23
2	Type-1	32.09	34.33	39.02
3	Type-2	34.47	35.03	40.06
4	Type-3	35.06	39.09	43.21
5	Type-4	35.59	39.44	46.36
6	Type-5	36.04	40.56	50.27
7	Type-6	34.16	36.36	48.98
8	Type-7	33.81	34.82	48.81
9	Type-8	32.18	30.59	47.41
10	Type-9	31.39	30.06	45.34
11	Type-10	30.76	27.58	43.07

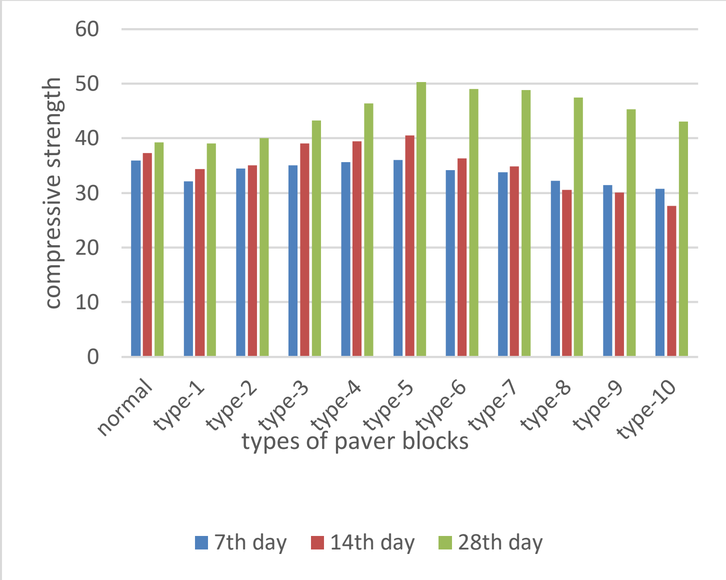


Chart-1: Compressive strength of paver blocks

4.1.2. Water absorption test

Table-2: water absorption test for paver block

Type of Concrete paver block	Dry weight (W_1)	Wet weight (W_2)	% of Water Absorption
Normal	4.996	5.073	1.54
Type-1	5.079	5.153	1.45
Type-2	5.186	5.295	2.1
Type-3	5.181	5.250	1.38
Type-4	4.654	4.765	2.38
Type-5	3.604	3.654	1.33
Type-6	4.291	4.365	1.72
Type-7	4.689	4.786	2.06
Type-8	5.461	5.593	2.41
Type-9	5.546	5.662	2.09
Type-10	5.603	5.695	1.64

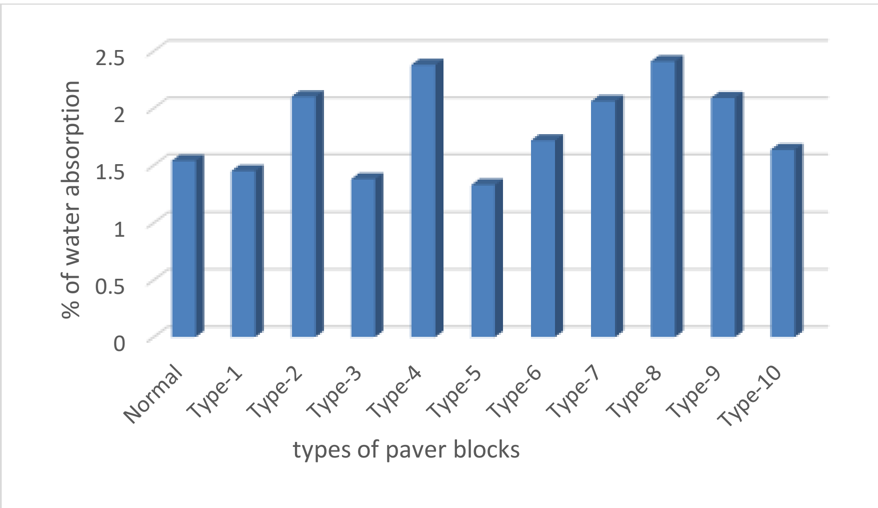


Chart-2: water absorption test for paver block

4.2. CUBE

4.2.1. Compressive strength test

Table-3: compressive strength test for cube

S.No	Type	7th day (N/mm^2)	14th day (N/mm^2)	28th day (N/mm^2)
1	Normal	10.97	16.35	20.17
2	Type-1	15.37	21.24	29.73
3	Type-2	10.84	15.82	20.35
4	Type-3	8.88	12.84	18.8
5	Type-4	8.75	11.64	17.77

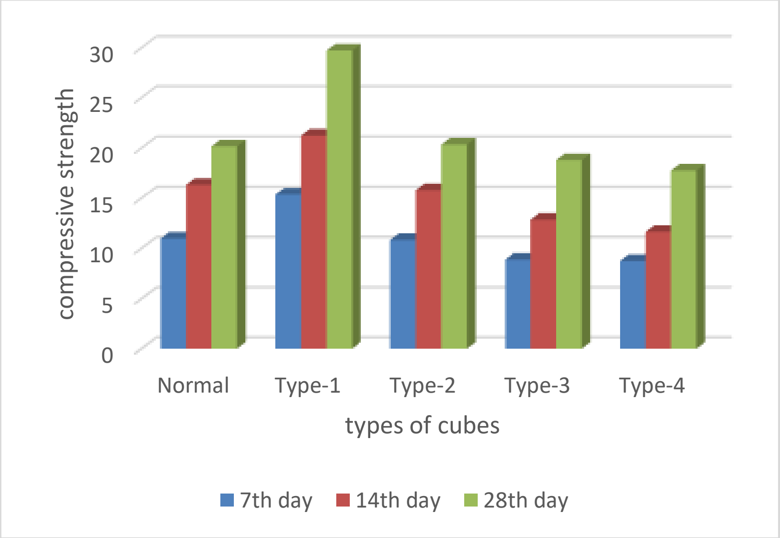


Chart-3: Compressive strength test for cube

4.2.2. Water Absorption Test

Table-4: water absorption test for cube

Type of Concrete paver block	Dry weight (W_1)	Wet weight (W_2)	% of Water Absorption
Normal	8.317	8.366	0.58
Type-1	8.103	8.133	0.37
Type-2	8.575	8.613	0.44
Type-3	8.838	8.878	0.42
Type-4	9.173	9.232	0.64

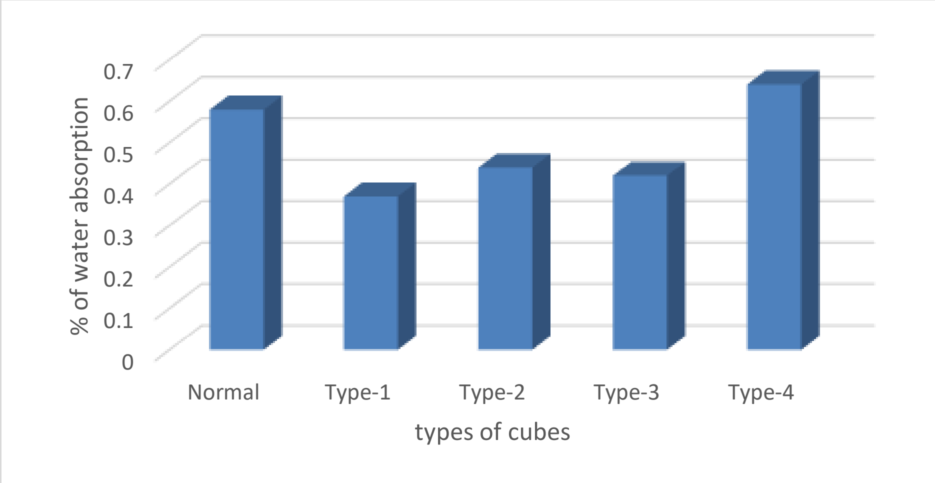


Chart-4: Water absorption test for cube

4.3. BEAM

4.3.1. Load vs deflection

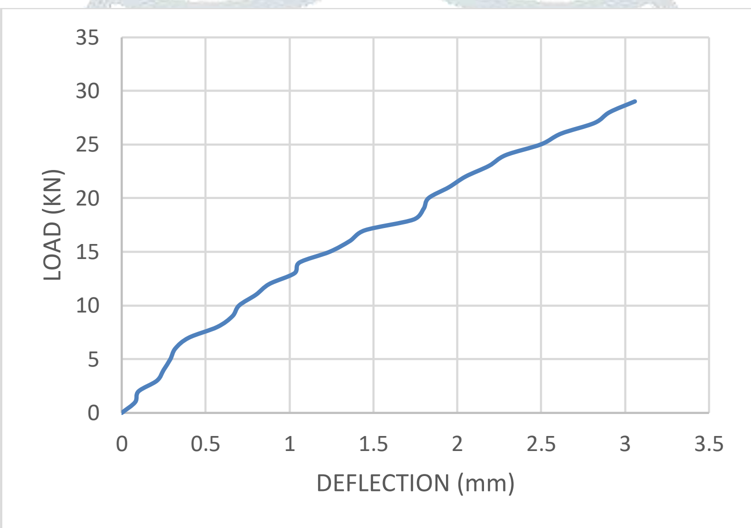


Chart- 5: Load vs deflection for normal beam

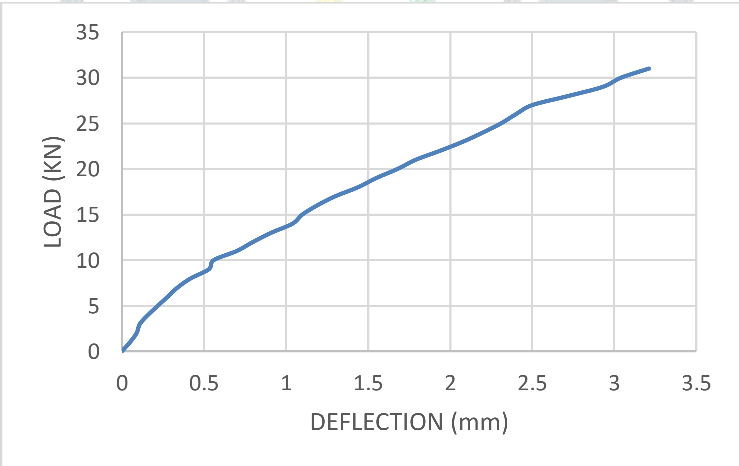


Chart -6: Load vs deflection for type-1 beam

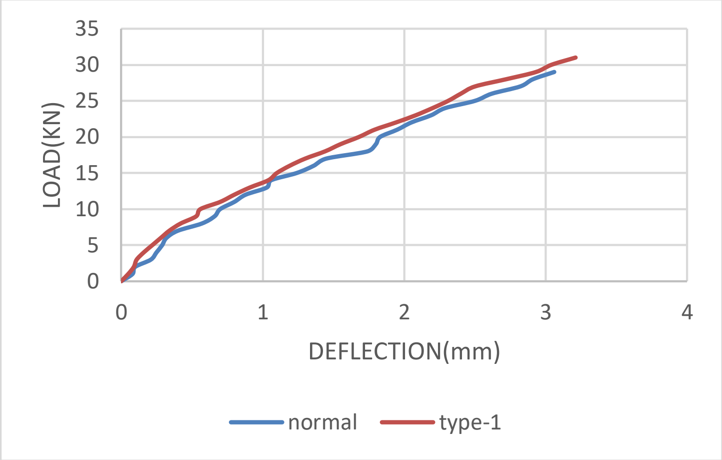


Chart -7: Comparison of al and type-1 beam

4.3.2. Flexural strength

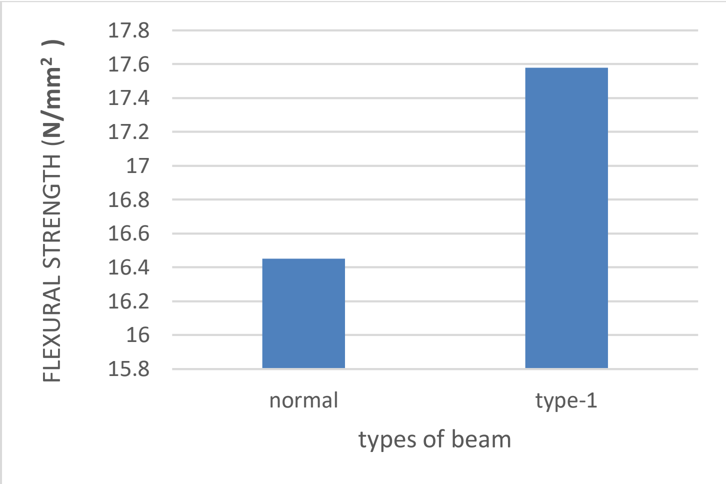


Chart -8: Flexural strength

4.3.3. Crack Pattern

Fig-1: Crack pattern observed form normal beam

Fig-2: Crack pattern observed form type-1 beam

4.3.4. Theoretical and experimental cracking moment

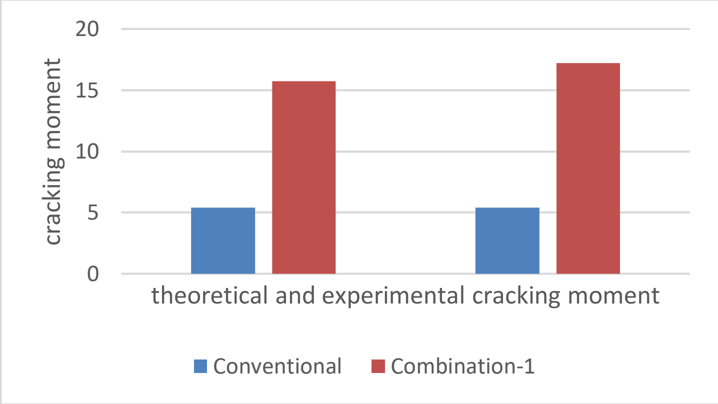


Chart-9: Cracking moment

4.3.5. Ductility factor

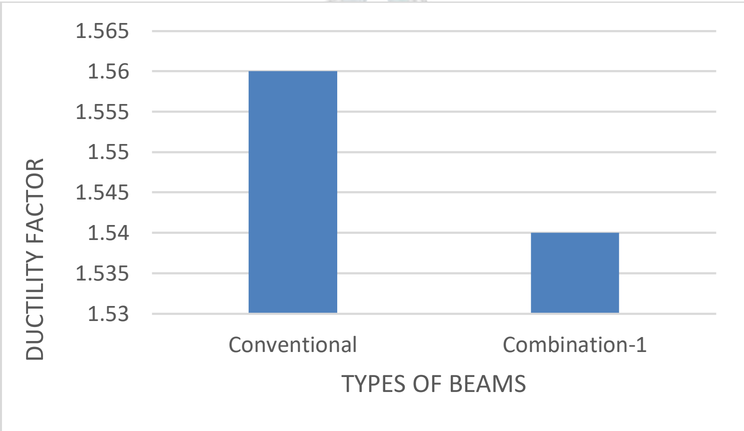


chart-10: Ductility factor

5.CONCLUSION

The following conclusions were obtained after the testing of the specimens

- The initial crack was observed when the loading provided was 105 KN for conventional beam and 115 KN for combination-1 beam.
- At 60% of the loading hairline cracks was noticed in both the beams.
- When the loading was increased after the initial cracking the cracks started to develop in various places.
- No sudden failure was observed in the concrete and the failure was gradual as the loading was provided. The failure occurred in safe manner.
- It was observed that the flexural strength of combination-1 beam was more compared to that of conventional beam.
- The ductility factor calculated was more in convectional beam compared to the combinational-1 beam which shows that combination-1 beam has good properties than the conventional beam.

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