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Test Study for Light Weight Concrete by Partial Replacement of aggregate with Wood Ash, Quarry Dust and Copper Slag

Shivam Parmar[1], Amit shukla[2]
M.Tech Scholar, Department of Civil Engineering, SSSUTMS, Sehore (MP)[1]
Assistant Professor, Department of Civil Engineering, SSSUTMS, Sehore (MP)[2]

Abstract: *Concrete is a most common advancement material on earth. It is made by mixing fine and coarse totals, water, concrete, and added substances in a particular embraced degree. Concrete has found use in liberal an enormous differ of advancement shape turnpike, channel, linings, platform, and dams to the most exquisite and tasteful of constructions. "One would not consider using wood for a dam, steel for black-top, or dark top for a structure diagram, anyway concrete is used for each of these and for some unexpected uses in comparison to other improvement materials. To be sure, even where another material is the fundamental fragment of a design, concrete is regularly used with it for explicit pieces of the work. It is used to help, to encase, to surface, and to fill. More people need to get some answers concerning concrete than about other explicit materials".*

Keywords: *Copper Slag, Wood Ash, Quarry Dust, Aggregates, Sand, Cement etc.*

1. Introduction

Cement is a coupling material utilized as a part of development exercises. The utilize of concrete is expanded as rate of development expanded. Concrete is used as a part of development of different building and non- designing structures (here and now structures). As determined by the review, 10-12 million tons squander materials are create and consume. We are supplanting the fine aggregates (Cement) with wood powder and copper slag, quarry dust. Decide the properties while supplanting the cement (some rate) with wood powder and copper slag, quarry dust. The issues of profitability, economy, quality and condition, they need to rival other growth materials, for example, cement, aggregates, sand and so outward. However this issue can be comprehend by substitute of aggregates and cement with some bonding material or by halfway restoration or by replacement of aggregate with squander materials.

2. Objectives

The general objectives of this dissertation work is to search out the properties of fresh and hardened concrete for M-25 grade of concrete for cement replacement at various percentages of 0%, 5%, 10%, 15% & 20% by quarry dust, copper slag or wood ash. In this experimental study compressive strength, flexural strength, split tensile strength and workability of concrete has been found out.
The aims of the study are:

- To research the impact of Copper Slag, quarry dust and wood ash waste materials in concrete on its strength.
- Replacing the conventional material such as cement by using the different squander materials such as quarry dust, copper slag and wood ash.
- To determine optimum dose of alternative materials such as quarry dust, copper slag and wood ash as partial substitute of cement respectively for target strength.
- The investigation concentrates on to determine the relative performance of concrete by using various waste products like quarry dust, copper slag and wood ash.

3. Literature Review

The literature study presents the present state of information and examples of productive uses of different materials in concrete technology, and especially the utilized of copper slag, wood ash & quarry dust with partial substitute of cement.

[Kamlesh Saini, Vijay Chaudhary ,Ankush Bisnohi, Harshit Agarwal, Meghalal Ram,Sandeep Saraswat, (2018)] Effect on strength properties of concrete by using waste wood powder as partial replacement of cement." International Journal of Civil Engineering 3: 172-176 Learned about the impact on quality characteristic of concrete by utilizing squander wood powder as incomplete substitution of cement. The primary point of this undertaking is use of squander materials (wooden powder) as fine aggregates which are blended (expansion and fractional substitution) with OPC to investigate the effect of these squander materials on different limit of concrete review i.e. M30. The wooden dust is supplanted in changing extent set up of sand (0%, 5%, 10%, 15%, and 20%). Undertaking is figured that the substitution of fine aggregates by wooden powder in concrete for the most part expands a definitive quality of concrete. The accompanying focuses are as:

[Rohini, V.Arularasi, (2017)] Effect of Fly Ash and Quarry Dust as a Partial Replacement of Cement and Fine Aggregate in Concrete, International Journal of Latest Research in Engineering and Technology, ISSN 2454-5031, 02(08), 15-33, Has perform about impact of quarry dust & fly ash as a fractional replacement of cement and fine aggregate in concrete. The concrete organization can likewise be appropriate for incomplete replacement (up to 60%). The fly ash, quarry shake dust can be used as frame a of 20% substitute of cement & fine aggregate in concrete. It was concentrated to keep away from natural debasement because of industrial squanders shape cement processing plants. The outcomes were empowering in that they uncovered that concrete of the required compressive quality can be created. It is presumed that another development material with minimal effort can be made accessible.

[Dr. suji. D, Narayanan.A.M ,Kartic Kumar.M , Perarasan. M, (2016)] Experimental Study on Partial Replacement of Fine Aggregate with Quarry Dust and Saw Dust, International Journals of Advancement In Engineineering Technology, Management Applied Science, ISSN NO. 2349-3224 In preparation of fine aggregate with concrete is partly supplanted by saw dust & quarry dust. This examination had been embraced to think about the effect of quarry dust and saw dust by quarry dust of 0%, 10%, 20%, 30% and 40%. Also, saw dust of 0%, 5%, 10%, 15% and 20% with the fine aggregate developed fine aggregate has formed.

[N.Kavibala, (2015)] Experimental Study on Partial Replacement of Cement with Marble Powder and Fine Aggregate with Quarry Dust and with Addition of Polypropylene Fiber. International Conference on Current Research in Engineering Science and Technology, E-ISSN :2348 – 8352, 39-42. The test examine on fractional substitution of fine aggregate with quarry dust & cement with marble powder with growth of polypropylene fiber. The arrangement of tests are light-emitting diode to think overthe effect of 5%, 10% & 15% substitution of cement with marble powder on compressive strength and split elasticity and contrast it and also the regular concrete and moreover to search out the best substitution of marble powder between 10 percent to 145%. With the best substitution of quarry dust & marble powder is swapped for fine aggregate at 10%, 20% & 30% and tested for compressive strength and split rigidity. With these ideal outcomes polypropylene fiber is included for promote change in quality.

4. Mix Design

CONCRETE MIX DESIGN METHOD

The way toward choosing reasonable elements of concrete and deciding their relative sums with the goal of producing a concrete of the required, quality, solidness, and workability as financially as could be normal under the circumstances, is named the concrete blend outline.

Indian standard recommended process for concrete mix configuration (IS 10262:1982) was first displayed in the midst of the year 1982. In the revision of IS 456:2000, different changes were displayed in IS-456 where necessities the refresh of IS 10262 of 1982. Indian standard prescribed strategy IS 10262:2009.

- Arbitrary degree
- Fineness modulus method
- Maximum thickness method
- Surface domain methodology
- Indian road congress procedure
- High quality concrete mix
- ACI Committee 211 procedure
- DOE procedure
- Mix outline of pump able concrete

Step 1. Target Strength for Mix Design Proportion

f 'ck = f ck + (ts)

f 'ck = Target mean strength of 28 Days

f ck = Characteristics strength at 28 days t = Tolerance factor = (IS- 10262)

s = Standard Deviation given in table 3.1

IS Method (Indian standard prescribed strategy IS 10262:2009)

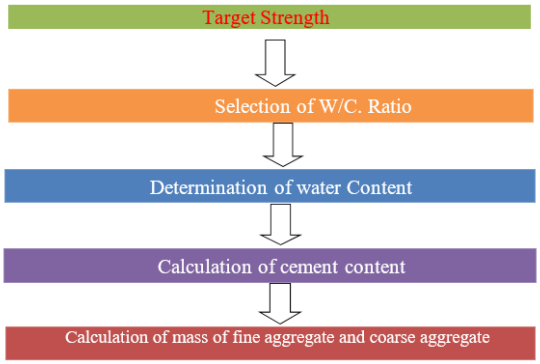

Table 1: Standard Deviation

S.No.	Grade of Concrete	Assume Standard Deviation (N/mm^2)
1	M-10	3.5
2	M-15	
3	M-20	4.0
4	M-25	
5	M-30	5.0
6	M-35	
7	M-40	
8	M-45	
9	M-50	
10	M-55	

Step 2. Selection of Water Cement Ratio

Table 2: Water Cement Ratio (IS – 456-2000, Table- 5)

S.No.	Exposure	Maximum W/c Ratio
1	Mild	0.55
2	Moderate	0.50
3	Severe	0.45
4	Very Severe	0.45
5	Extreme	0.40

Step -3 Water Content

Table 3: Approximate Water Content

S.No.	Nominal Maximum Size of Aggregate (mm)	Maximum Water Content
1	10	208
2	20	168
3	40	165

Table 4: Coarse Aggregate Proportion

S.No.	Nominal Maximu m Size of Aggregate . (mm)	Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zone of Fine Aggregate			
		Zone-4	Zone- 3	Zone-2	Zone - 1
1.	10	0.50	0.48	0.46	0.44
2.	20	0.66	0.64	0.62	0.60
3.	30	0.75	0.73	0.71	0.69

Content of Fine Aggregate = (1- Content of Course Aggregate)

Volume of Cement =Macc of Content / Specific Gravity of CeNent× 1/1000

Volume of Water = Macc of Mater/ Specific gravity of water× 1/1000

$$\text{Volume of Admixture} = \frac{\text{Macc of CheNicaŝ EdNisture}}{\text{Specific gravity of CheNicaŝ EdNisture}} \times \frac{1}{1000}$$

Mass of Coarse Aggregate

= Va ×Volume of C.A× Specific gravity of C.A×1000

Mass of Fine Aggregate

= Va ×Volume of F.A× Specific gravity of F.A×1000

Where,

V_a = Volume of Admixture

CA= Coarse Aggregate

FA= Fine Aggregate

5. Methodology Used

First Trial (Replacement of Cement by Wood Ash)

- Normal mix (control) i.e. cement + coarse aggregate + sand+ water.
- Special mix 1 i.e. cement (5% of WA replaced by weight of the cement) + coarse aggregate + sand + water.
- Special mix 2 i.e. cement (10% of WA replaced by weight of the cement) + coarse aggregate + sand + water.
- Special mix 3 i.e. cement (15% of WA replaced by weight of the cement) + coarse aggregate + sand + water.
- Special mix 4 i.e. cement (20% of WA replaced by weight of the cement) + coarse aggregate + sand +

water.

Second Trial (Replacement of Cement by Quarry Dust)

- Normal mix (control) i.e. cement + coarse aggregate + sand + water.
- Special mix 1 i.e. cement (5% quarry dust replaced by weight of the cement) + coarse aggregate + sand + water.
- Special mix 2 i.e. cement (10% quarry dust replaced by weight of the cement)
- + coarse aggregate + sand + water.
- Special mix 3 i.e. cement (15% quarry dust replaced by weight of the cement)
- + coarse aggregate + sand + water.
- Special mix 4 i.e. cement (20% quarry dust replaced by weight of the cement)
- + coarse aggregate + sand + water.

Third Trial (Replacement of Cement by Copper Slag)

- Normal mix (control) i.e. cement + coarse aggregate + sand + water.
- Special mix 1 i.e. cement (5% copper slag replaced by weight of the cement) + coarse aggregate + sand + water .
- Special mix 3 i.e. cement (15% copper slag replaced by weight of the cement)
- + coarse aggregate + sand + water.
- Special mix 4 i.e. cement (20% copper slag replaced by weight of the cement)
- + coarse aggregate + sand+ water.

INGREDIENTS

Cement

OPC is most ordinary type of cement is generally use all over the world. It retard the faster setting time of cement. In this experimental work the OPC is used with 43 grade validate to Indian Standard IS 8112-1989 is used.

- General civil construction.
- R.C.C. Works
- Pre-cast items like Blocks, Tiles & Pipe lines Etc.
- Asbestos sheets & pipes.
- Plastering & flooring in Non- structural work.

Table 5 Properties of Cement

Properties	Value	Standard Value
Fineness of cement	8.8 %	Less than 10%
Grade of Cement	OPC (43 grade)	OPC (33,43,53)
Specific gravity of cement	3.10 g/cc	3.15 g/cc
Initial setting time	55	Min 30 Minutes
Final setting time	520	Max 600 Minutes
Normal Consistency	31%	26 to 33%

Aggregates

Aggregate can be classified as normal weight, light weight, heavy weight aggregate. Aggregate usually exist of natural sand and gravel, crushed rock or mixture of those materials. Natural sand and gravels are most generally used and can be acquired economically in sufficient quality. Crushed rock is widely used for coarse aggregate The state of the particles of crushing rock depends to a great extent on the kind of rock and technique for crushing**.**

Table 6 Properties of Coarse Aggregate

Properties	Values	Standard Value
Specific Gravity	2.76	2.8-2.9
Size of Aggregates	20mm	20-22 MM
Fineness Modulus	5.96	-
Water absorption	1.0%	0.1 to 2 %
Impact Test	18.2%	<30 %
Crushing Test	25.5%	<25% for wearing surfaces

Sand

Aggregate which go from 4.75 mm sifter and contains just so considerably coarser material as allowed, fine aggregate is regular sand which is coming about because of the characteristic crumbling of shake and which has been stored by streams or frosty offices, it is likewise pounded stone sand which is created by pulverizing hard stone, it is additionally smashed rock sand which delivered by squashing common rock. Sand, rock, residue and mud are for the most part results of all characteristic and simulated deterioration of shake sand minerals.

Table 7 Properties of Fine Aggregate

Properties	Value	Standard Value
Specific Gravity	2.54	2.6-2.9
Fineness Modulus	2.4	2.2-2.6 (Fine Sand)
Water absorption	2.0%	more than 1-1.5% by mass

Mixing water

The blending water needs to be clear and apparently clean free of substances that discolor it, makes it taste or smell in uncommon manner. Alternative sources like ocean water will increase the chance of corrosion in reinforced and pre-stressed concrete, however it doesn't have any effects on the strength of plain concrete. since, the pH scale is between 7.0 and 9.0. It must be in observation that this also relevant to water existing on the surface and pores of aggregates utilized for concrete preparation.

Alternative Material

Wood Ash

Wood ash is a waste material the residue powder left after the combustion of wood, such as burning wood in a home fireplace or an industrial powerhouse. It used commonly by gardeners as a great origin of potash. Once it's not soft is termed setting. Wood powder is essentially carry out of potassium, phosphorus, calcium, and magnesium, additionally contains follow measures of iron, manganese, sodium, boron, zinc, copper, and molybdenum. Since it's made through the burning of plant materials.

Copper Slag

Copper slag is a by-result of copper purifying and cleansing process. Copper slag which is a mechanical waste acquired from purifying and refining procedure of copper from Sterlite Industry Ltd., Tuticorin, and Tamilnadu. Almost 4 tonnes of copper is acquired as waste is arranged to grounds bring about's natural effects. So it can be reused as cementing materials. In refinery plants when copper metal delivered by extraction prepare then copper slag is created in an expansive sum in the generation of copper metal.

Quarry Dust

A quarry is a part from which measuring stone, shake, development total, riprap, sand, rock or slate has been excavated starting from the earliest stage. A quarry is an indistinguishable thing from an open-pit mine from those minerals is removed. The most non-unimportant variation among the 2 is that open-pit mines that deliver building materials & measuring stone are generally alluded to as quarries. It's one among the most necessary characteristic of concrete and effects several alternative expressible characteristic of the hardened concrete.

6. Conclusion

There are three waste materials (Copper Slag, Wood Ash and Quarry Dust) to be used as a fractional substitute of cement. We can consider about cost are insignificant by contrast with typical ordinary concrete. Accordingly this proposal manages checking the plausibility of the ranch, quarry stone, copper result quarry dust, wood ash & copper slag which is delivered as a loss in production lines for utilizing it as cement replacement material.

Over the most recent 20 years, a extensive measure of works regarding the usage of a few sorts of urban waste in building materials industrials process have been divided. Various specialists have been stretched out to contemplate new sorts of waste to research profoundly specific angles. The expansion of waste, aside from the ecological advantages, likewise delivers great consequences for the characteristic of conclusive items.

Today we are having diverse waste material, which isn't used other reason. So we are chipping away at some level of supplanting material like cement, sand and aggregate. That waste material is used in development industry. There are various beneficial like practical, better condition and quality successful. So we are used waste material like quarry dust, wood ash and copper slag with some rate and we are deciding quality by UTM.

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