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Enhancing strength of concrete using stone dust and recycled coarse aggregate

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Abstract : Different materials, including such concrete, steel, brick, stone, glass, and etc, are required for every construction job. Cement and concrete, on the other hand, continue to be key construction materials in the construction industry. For its applicability and flexibility in various environments, concrete must be designed in such a way that it conserves resources, protects the environment, saves money, and leads to proper energy use. Because aggregates make up 75 percent of concrete, the utilization of recycled material is particularly promising. Slag, power station waste, recycled concrete, mining & construction waste products, are all considered aggregates in this scenario. Massive quantities of demolished building are now available at different construction sites, providing a severe disposal problem in urban areas. This material is easily recyclable as aggregate and can be used in concrete. Worldwide, research and development have been undertaken to demonstrate its practicality, economic viability, and cost effectiveness.
Leaving waste products in the environment causes direct damage to the natural climate patterns, hence waste materials are given top priority in this study. When cement is manufactured, it emits the same amount of CO2. As a result, partial cement replacement can be practiced to optimize cement content effects on cement production and CO2 content creation.
Use of reused concrete aggregate can help to safeguard the environment. Aggregates made from recycled resources are resources for the future. Recycled aggregate is now being used in a huge number of projects across Europe, the United States, Russia, and Asia. Many countries are relaxing infrastructure rules. This paper discusses the fundamental features of recycled fine and coarse Aggregates, as well as how they compare to natural aggregates. Basic variations are identified, and their implications for concrete are thoroughly explored. The qualities of recycled aggregate are also determined in the same way. Basic concrete qualities including such compressive strength, flexural strength, workability, and so on are discussed for various recycled aggregate with natural aggregate combinations. Here are the codas guidelines for recycled concrete in several nations, along with their implications for concrete work. The current state of natural aggregates in India, as well as its potential demand and successful application, are reviewed in general.

IndexTerms **–** Concrete, Steel, Recyled Agregate etc

I. INTRODUCTION

Different materials, including such concrete, steel, brick, stone, glass, and so on, are required for every construction job. Cement and concrete, on the other hand, continue to be key construction materials in the construction industry. For its applicability and flexibility in various environments, concrete must be designed in such a way that it conserves resources, protects the environment, saves money, and leads to proper energy use. Because aggregates make up 75 percent of concrete, the utilization of recycled material is particularly promising. Huge quantities of demolished building are now available at different construction sites, providing a severe disposal problem in urban areas. This material is easily recyclable as aggregate and can be used in concrete. Worldwide, research and development have been undertaken to demonstrate its practicality, economic viability, and cost effectiveness. Leaving waste products in the environment causes direct damage to natural climate patterns, so waste materials are given top priority in this study. When cement is manufactured, it emits the same amount of CO2. As a result, partial cement replacement can be practiced to optimize cement content effects on cement production and CO2 content creation.

2. MATERIAL USED

2.1 STONE DUST

The stone blocks are cut into block to obtained shape and size. Cutting process, 25% of mass of this original stone is lost in dust. Its considered waste facing difficulty of solid waste disposal. Fine powder less than 150 microns in crusher dust has a high affinity for water, high demand for water, and reduced strength of stones and concrete, so fine powder smaller than 150 microns was removed on a trial basis. Microfine less than 150 microns accounts for about 15% of the total amount of crusher dust. Studies on the strength of concrete using rock flour as a partial alternative to fine Aggregate have been reported by several researchers.

2.1.1 Advantage of using stone dust:

The finest sort of crushed stone is stone dust, sometimes known as stone screens. It's made of the same stone as the others, but it's been ground into a powder. When used alone, stone dust creates a hard, water-resistant surface. It functions as a binding agent when combined with a larger stone. Stone dust is frequently utilized between the stones or bricks in patios and walkways because of its capacity to make a strong, non-porous surface. This not only protects the area's base from moisture, avoiding heaving or mould growth, but it also successfully prevents weeds and grass from sprouting up between lavers in this application.

3. RECYCLED COARSE AGGREGATE

The increasing difficulties in getting coarse Aggregates (NCA) for production, together with costs associated with unregulated aggregate exploitation, prompted a quest for viable alternatives. Reusing waste (CDW) as aggregates to include into creation of concrete. As a result, Institute Superior Ticino (IST), large and extensive campaign was launched with goal of assessing the viability of adding coarse Aggregates into concrete (Gomes and Brito, 2007). RCA have lower environmental effect, lowers energy consumption, and save money. Crushed, graded organic particles that were processed from demolition trash make up recycled aggregate. Fresh concrete strength parameters including such compressive strength and flexure strength were studied for their workability.
Recycled coarse Aggregate (RCA) made of crushed concrete rubble can be used in the building industry instead of being stored. Moisture content and specific gravity were estimated as essential aggregate properties. The physical properties of concrete made from recycled coarse Aggregate and stone dust are diverse. The findings indicate that the use of concrete with partial replacements is a smart option. (Patel and colleagues, 2013).

3.1 Advantages of using recycled coarse Aggregate:

Recycling is practice of use old materials to make new ones. Recycled coarse Aggregate used as substitute for aggregate to less the quantity of aggregate utilized. These materials come from various sources, including buildings, roads, as well as natural disasters like wars and earthquakes. This numerous use of using reused aggregate. The benefit cares aggregate include its sustainability, ease of acquisition, and less cost than virgin material. Environmental problems that arise as a result of waste material can be mitigated.

a) Environmental Gain
b) Coste
c) Job Opportunities
d) Sustainability
e) Market isewide

4. POZZOLANA PORTLAND CEMENT (PPC)

PPC is Blended Cement made by inter griding OPC clinker with gypsum and pozzolanic ingredients in predetermined quantities. When pozzolana is a mixture, PPC is formed. Pozzolana is a siliceous and aluminous substance that has little or no qualities by itself, but chemical react with CaOH in presence of water to generate compounds having cementitious capabilities.

5. LITERATURE REVIEW

Rao and his colleagues (2006) The topic was studied by first providing a brief summary of the international situation in terms of garbage production, recyclable aggregates (RA) generated from trash and their use in concrete, and governmental initiatives to expand waste recycling. A description of the influence of coarse Aggregates use with the fresh and hardened properties concrete, and a short overview of the engineering aspects of recycled aggregates, are included in the publication. According to the paper, some of the key hurdles to more widespread use of RA in recycled aggregate concrete (RAC) are a lack of awareness, a lack of government support, and a lack of specs for recycling these aggregates in fresh concrete.

Eguchi and colleagues **(2007)** The structural properties were all evaluated. Information is gathered in order to construct a generally produces design and a quality assurance mechanism. A method for generating recycled concrete which does not necessitate the use of a mixing facility is also proposed.

Binici et al. (2008) looked on the long-term durability of concrete made with coarse Aggregates like granite and marble. The new concrete's location has been determined. The Young's elastic modulus, abrasion resistance, chloride penetration resistance, and sulphate resistance, were all determined. The coarse Aggregate inside the test mortars was crushed limestone. The effect of course and small particles on the strength of concrete was explored. The marble and GBFS concretes were found to be more durable than the control concrete. In cases comprising marble, granite, and GBFS, the binding between both the additives as well as the cement was significantly better. It might also be argued that substitution of marble, granite, and GBFS resulted in a well-compacted matrix.

6. Testing of the specimens

On the 2000 tones AIMIL compression test equipment, cylinders, and beams are calculated according IS 516-1959 at load rate of around 140 kg/cm2/min. The deflection measure using two dial gauges in diametrically opposing directions.

The for testing the below specimen are casted:

- The cylinder size 150mm height and dia. 75mm for split tensile strength.

- The beam size 500mm×100mm for flexure strength.

7. RESULTS & DISCUSSION

7.1 Compressive Strength with replacement of stone dust:

It show compressive strength of 40 percent replacement concrete increment by 4.74 percent at , whereas compressive strength of 30 , 50 percent, 60 percent, and 70 percent replacement concrete decreased by 15.13 percent, 17.21 percent, 7.12 percent, and 10.08. When proportion of dust in stone dust is large, the w/c ratio rises, result in a decrement in compressive strength.

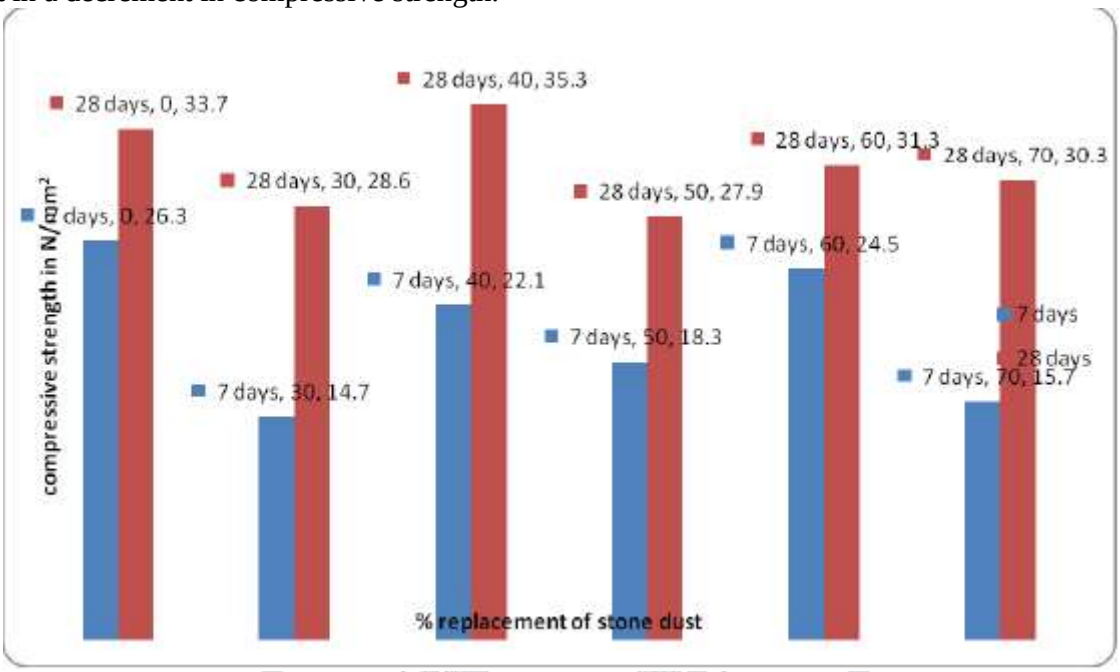

Fig. 1- Compressive strength of specimens with replacement of stone dust

4.2 Compressive Strength with replacement of stone dust and recycled coarse Aggregate:

The results show that replacing 10% recycled aggregate with 30% stone dust and 10% recycled coarse Aggregate reduces compressive strength by 14.24 percent at month coarse Aggregate reduces compressive strength by 8.9%. The w/c ratio grows as the fraction of fine particles in stone dust rises, resulting in a drop in compressive strength. Because recycled coarse Aggregate has a low water absorption capacity, compressive strength diminishes.

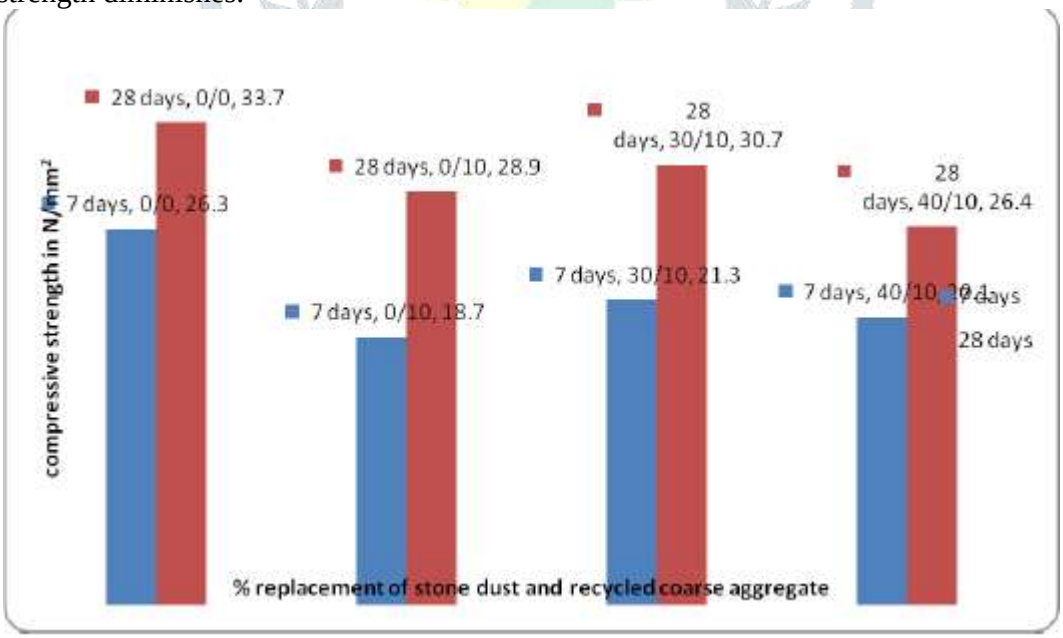

Fig. 2- Bar chartefor Compressive strength of specimens with replacement of stone dust and recycled coarse aggregate

7.3. Flexure strength with replacement of stone dust:

The results indicate that when 60 percent and 70 percent substitute concrete is used, flexure strength increases by 12 percent and 44 percent at 28 days compared to referring concrete, while flexure strength decreases by 28 percent, 12 percent, and 12 percent at 28 days compared to referral concrete when 30 percent, 40 percent, and 50 percent replacement concrete is used.

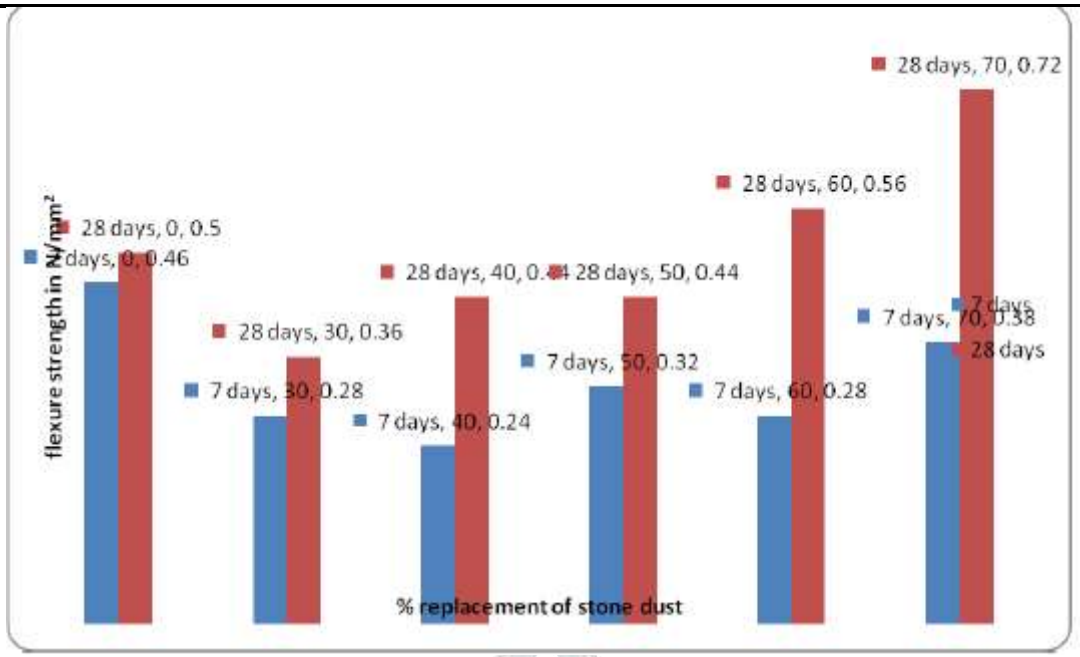

Fig. 3- Flexure strength with replacement of stone dust

8. CONCLUSION

The following findings can be taken from the aforesaid study:

1. At a 40% replacement level, fine Aggregate is partly replaced by stone dust up to 40%. The concrete in the suggestion has a compressive strength. At each replacement level, however, stonedust concrete has a higher tensile strength than referral concrete.
2. When fine aggregate is replaced with stone dust and coarse aggregate is changed with recycled coarse aggregate at same time, both compressive and tensile strength are compromised
3. Flexural strength was increased by 70% by replacing fine aggregate with stone dust and coarse aggregate with recycled coarse aggregate at same time.

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