REUCRETE: "Replacement of Fine Aggregate by Demolished Waste Concrete"

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ABSTRACT- In this paper deals with the scrap concrete, get from the construction industry which is our biggest industrial waste and can't be recycled or can't be reused. Here had tried to reuse and Replaced the fine aggregates by crushed demolished scrap waste concrete. The all laboratory test are conducted on Sand, Cement and Concrete along with the Mix design and get satisfactory result .These results are compared with the other standard mixes and get satisfactory result.

Key words- *Concrete, Reucrete, Demolished Concrete, Fine aggregate, Sand.*

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I. INTRODUCTION

Concrete has been around with us from many centuries, the first known use of a material resembling concrete was found by the Minoan Civilization around 2000 BC.

A huge amount of solid waste is generated annually from construction and demolition activities. This has lead to the promotion of waste recycling as a major measure to reduce waste and to mitigate the harmful effects of construction activities on the environment. Among these waste, concrete apportions more than half of the total. The construction industry conspicuous consumer of raw material of many types and thus large material inventories are required to sustain the growth. Among the various raw materials used in construction, aggregates are important components for all the construction activities and the demand in 2007 has seen increase by 5%, to over 21 billion tones the largest being in developing countries like china, India etc]. The use of swine manure, animal fat, silica fume, empty palm fruit bunch, citrus peels, fly ash, foundry sand, glass, plastic, carpet, and concrete aggregate in construction is becoming increasingly popular due to the shortage and increasing cost of raw materials. This study present an initial understanding of the current strengths and weaknesses of the practices intended to support construction industry in developing effect policies regarding uses of waste and recycled materials as construction material.

Regardless of the replacement ratio, recycled aggregate concrete (RAC) had a satisfactory performance, which did not differ significantly from the performance of control concrete in this experimental research. However, for this to be fulfilled, it is necessary to use quality recycled concrete waste rubble and to follow the specific rules for design and production of this new concrete type.

1.1 Waste Characterization Study

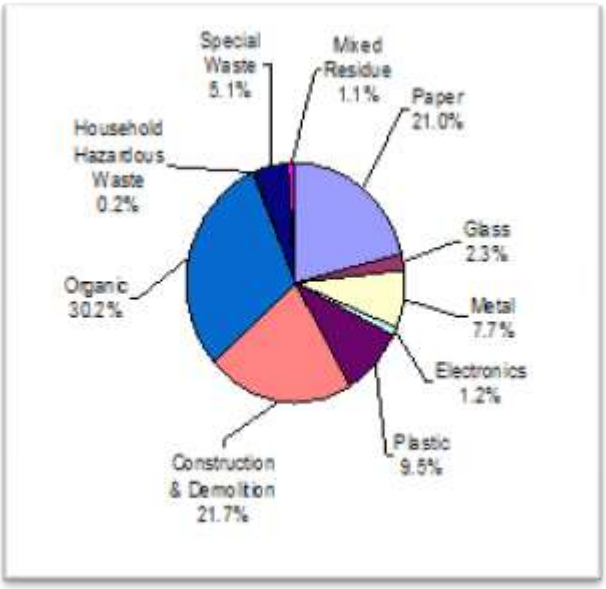


Fig. 1: Waste Characterization Study (Year 2015).

Amidst growing awareness on protection of environment and conservation of natural resources and this study is an attempt to explore recycled concrete as a material of hope for 21st century. Demolished waste obtained from a structure mainly made up of concrete. Demolished waste has several foreign matter such as various type of finishes, cladding materials, lumber, dirt, steel, hardware's, woods,

plastics etc, attached to them directly or indirectly. The process of removal of impurities and crushing of rubble into suitable and desirable aggregate particle size can be carried out in a continuous and sequential manner using appropriate mechanical devices such as jaw crushers, impact crushers, swing hammer crushers etc. There are three processes, for processing of demolished waste: Dry, Wet and Thermal, which are used individually or in combination with one another. Due to high water absorption of recycled aggregates, it is sometimes suggested to use pre-soaked aggregates for production of recycled aggregate.

1.2 Use of Recycled Fine Aggregate in Concrete

In major cities there is a surge in construction and demolition concrete waste (CDCW) quantities causing an adverse effect on the environment. The use of such waste as Recycled fine-aggregate in concrete can be useful for both environmental and economical aspects in the construction industry. This study discusses the possibility to replace natural/crushed fine aggregate with demolished concrete waste (crushed fine aggregate "Reucrete Sand") in structural concrete. An investigation into the properties of recycled concrete as a fine aggregate is made by using a method of crushing & grading of concrete rubble collected from different demolition sites and locations around the locality. A total of 45 concrete mixes cubes forming nine groups have been casted. Groups has be designed to study the effect of demolished concrete waste (crushed fine aggregates "Reucrete Sand") quality, content, cement dosage, use of admixture and partial replacement of natural/crushed sand etc. Tests have been carried out for different grade of concrete. The concrete rubble could be transformed into useful recycled fine aggregate and used in concrete production with properties suitable for most structural concrete applications in India. A significant reduction in the properties of Recycled fine aggregate concrete made of 100% was seen when compared to natural/Crushed fine Aggregate.

Durability, reliability and adequate in service performance of these reused waste materials over the stipulated design life of designed structures are of paramount importance to structural designers. The production techniques of recycled aggregate, the mixture proportion, the physical property, the durability, the basic mechanical behavior and the structural performance of recycled aggregate concrete are mainly investigated. The results indicate that it is feasible to reuse waste concrete and the recycled aggregate concrete which can be adopted in both self-bearing members and load-bearing members in civil engineering.

Concrete is the main material used in construction in the Gulf Cooperation Council (GCC). Therefore, it makes economic and environmental sense to use recycled materials in the making of new concrete for different applications. The scope of the study is a comparative analysis of the experimental results of the properties of fresh & hardened concrete with different replacement ratios of natural/crushed sand with demolished concrete waste (crushed fine aggregates "Reucrete Sand"). Fine aggregates "Reucrete Sand" can be manufactured by crushing the waste demolished concrete manually or by stone crusher machine.

1.3 Characteristics of Recycled Aggregates

The global consumption of natural sand is very high, due to the extensive use of natural sand as a fine aggregate in the production of concrete. In general, the demand of natural sand is quite high in developing countries to satisfy the rapid infrastructure growth, in this situation developing country like India facing shortage in good quality of natural sand.

1.4 Definition:

REUCRETE: *The Word Itself Indicate,* ***"REU"*** *Means Reuse &* ***"CRETE"*** *Means Concrete.*

Reucrete May Also Be Defined As Concrete Which Is Been Mixed By Replacing Crushed Sand/River Sand By Crushed Demolished Concrete Waste.

1.5 Pre-Requisites of Ideal Fine Aggregate are:

- It should be sharp.
- Clean.
- Durable.
- Angular.
- Fine.
- It should give minimum voids.
- No silt and clay.
- The sand must be of proper gradation.
- It should have particles from 150 microns to 4.75 mm in proper proportion.

1.6 Concrete recycling

When structures made of concrete are demolished or renovated, concrete recycling is an increasingly common method of utilizing the rubble. Concrete was once routinely trucked to landfills for disposal, but recycling has a number of benefits that have made it a more attractive option in this age of greater environmental awareness, more environmental laws, and the desire to keep construction costs down.

Concrete aggregate collected from demolition sites is put through a crushing machine. Crushing facilities accept only uncontaminated concrete, which must be free of trash, wood, paper and other such materials. Metals such as rebar are accepted, since they can be removed with magnets and other sorting devices and melted down for recycling elsewhere. The remaining aggregate chunks are sorted by

size. Larger chunks may go through the crusher again. After crushing has taken place, other particulates are filtered out through a variety of methods including hand-picking and water flotation

1.7 Uses of Recycled Concrete

Smaller pieces of concrete are used as gravel for new construction projects. Sub-base gravel is laid down as the lowest layer in a road, with fresh concrete or asphalt poured over it. The US Federal Highway Administration may use techniques such as these to build new highways from the materials of old highways. Crushed recycled concrete can also be used as the dry aggregate for brand new concrete if it is free of contaminants. Also, concrete pavements can be broken in place and used as a base layer for an asphalt pavement through a process called Rubblization.

II. METHODOLOGY

2.1 Materials & Methods :Demolished waste

As our project is on Reuse of demolished waste concrete i.e. By Sand, the Sand which we are going to utilize for preparation of concrete by replacing River Sand/Crushed Sand. Demolished waste was collected from a Residential building which was already demolished for redevelopment purpose. And the site was found near locality at bus stop no 15, next to water tank, Hatkesh, Mira Road. Thane 401107. Maharashtra. The collected material needed to be crushed as our project is on Replacement of fine aggregate by demolished waste concrete. Then we crushed the material by Rammer and Hammer. Then we sieved all the crushed material to get the required Quality and the property of sand which would be known by the name "Reucrete Sand". Finally we got an adequate quantity of material for the further proceeding of our goal.

2.2 LABORTARY TEST

2.2.1 VARIOUS TESTS ON CEMENT**:**

- Fineness.
- Consistency.
- Initial and Final setting time.
- Soundness.

2.2.2 VARIOUS TESTS ON FINE AGGREGATE:

- Sieve Analysis Test
- Moisture Content Test
- Water Content Test
- Specific Gravity Test
- Silt Content Test
- Bulking of Sand Test

2.2.3 VARIOUS TESTS ON COARSE AGGREGATES:

- Sieve Analysis
- Moisture Content Test
- Water Absorption Test
- Specific Gravity Test
- Bulk Density 20

2.2.4 TESTS ON FRESH CONCRETE:

- Slump Cone Test.

2.2.5 TESTS ON HARDENED CONCRETE:

- Compressive Strength.

III. MIX DESIGN

Grade of Concrete M25 (100 % Crushed Sand) (IS 10262 – 1982 / IS 456: 2000)

Grade designation	**M25**
Characteristic compressive strength at 28 days (fck)	25 MPa
Type of cement	Ultratech OPC 53 grade
Maximum nominal size of aggregate	20 mm
Standard deviation for good control of specified grade (s)	4.0 MPa
Minimum cement content	300 kg/m3
Maximum water-cement ratio	0.50
Workability for pumping at site as per IS-4926	170 – 180 mm
Tolerance factor (t)	1.65
Exposure condition	Severe
Method of concrete placing	Manually
Chemical admixture type	Polygel
Degree of supervision	Good
Type of aggregate	Crushed angular
Grading of fine aggregate	Zone II

TEST DATA FOR MATERIALS.

a. Specific gravity of cement	3.15
b. Chemical admixture	As per IS-9103
c. Specific gravity of admixtures	1.254
d. Specific gravity of C.A 1 (20mm)	2.84
e. Specific gravity of C.A 2 (10mm)	2.80
f. Specific gravity of F.A (Crushed Rock Sand)	2.75
g. Water absorption coarse aggregate	1.93
h. Water absorption fine aggregate	1.94

OUR SAMPLES

- Sample 1: Portland cement + Coarse aggregate + 100% Crushed sand + Admixture + Water
- Sample 2: Portland cement + Coarse aggregate + 90% Crushed sand + 10% Reucrete sand + Admixture + Water
- Sample 3: Portland cement + Coarse aggregate + 80% Crushed sand + 20% Reucrete sand + Admixture + Water.
- Sample 4: Portland cement + Coarse aggregate + 100% Reucrete sand + Admixture + Water
- Sample 5: Portland cement (Min as per I.S) + Coarse aggregate + 100% Reucrete sand + Water

IV. DATA, RESULT AND COMPARISION

Trial Nos.	Description	3 Days Result (N/SQMM)	7 Days Result (N/SQMM)	28Days Result (N/SQMM)
Trial 266	100% Crushed Sand	25.77	38.51	48.88
Trial 267	90% Crushed Sand + 10% Reucrete	23.55	35.40	43.55
Trial 268	80% Crushed Sand + 20% Reucrete	27.69	31.25	45.03
Trial 269	100% Reucrete Sand	19.96	25.18	28.58
Trial 270	100% Reucrete Sand (Without Admixture)	12.57	16.69	21.62

4.1 Effective Cost

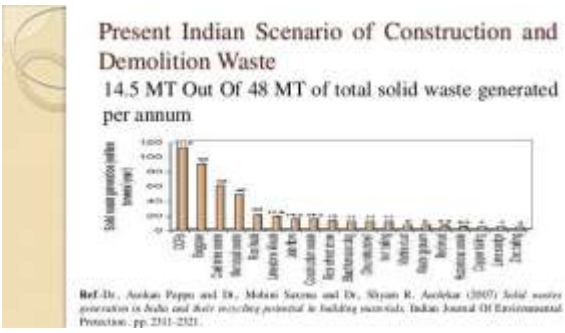
- Cost of River Sand is Around Rs (9000 to 12000) per Brass.
- Cost of Crushed Sand is Around Rs (5000 to 7000) per Brass.
- But Reucrete Sand will cost Approx. Rs (2000 to 3000) per Brass.
- It will cost 65 -75% less than All Other Sand

V. ENVIRONMENTAL CHALLENGES

5.1 It is recognized, both nationally and on a global scale, an increased miss balance between the need for fine aggregates in the society and the availability of traditionally suitable geologic sources. We can estimate that close to 80% of the Natural sand and gravel ever taken out of the nature, has been consumed in our generation. The availability of materials will be one of the important global market drivers in the years to come. As a consequence there is a strong need for developing and implementing technology that can enable the use of alternative resources, reduce the need for transport and present zero waste concepts for the aggregate and concrete industry.

Increasing extraction of natural sand from river beds is causing many problems like:

- Loosing water retaining sand strata.
- Deepening of the river courses.
- Causing bank slides.
- Loss of vegetation on the bank of rivers.
- Exposing the intake well of water supply schemes.
- Disturbs the aquatic life as well as affecting agriculture due to lowering the underground water table.
- Due to dredging of the sand from river bed reduces the water head.
- Lesser percolation of rain water in ground.
- Dredging of the sand from river bed results in lower ground water level.



5.2 OTHER ISSUES OF CONSIDERATION IN THEIR FORECAST:

• Recycled concrete will continue to play an important role in urban areas; however, recycled materials will remain a small part of the total aggregate supply.

• Community relations issues in the future will remain important and will likely place additional restraints on locating and operating aggregate facilities.

5.3 SUSTAINABILITY AND ENVIRONMENTAL CHALLENGES

Fine Aggregates are important construction materials, both for new constructions and maintenance. Fine Aggregates are a valuable natural resource and it is our obligation to use it sensibly, in particular in highly populated areas where the demand is great and costs may increase due to long transportation distances. Good understanding of the basic material properties, usage possibilities and quality is significant for sensible use. It is further important for

authorities to be up to date with locations and details of existing and potential quarries.

The concrete industry is presently facing a growing, public awareness relating to the environmental profile of their activities. Important areas of concern are:

- The non-renewable character of the natural resources, especially in regions facing a coming shortage of adequate local materials.
- The environmental impact on neighborhood and society (noise, pollution, effect on bio diversity) of the quarrying and of the materials transport related to the quarrying activities.
- Land use conflicts between quarrying and e.g. agriculture, recreation, building sites, archaeology - especially in densely populated regions.
- A lack of sustainability in production, characterized by inferior mass balance (i.e. high percentages of e.g. surplus fines to be deposited) and a high energy consumption needed pr. ton aggregate produced.
- The potential environmental or health impact of the very materials produced, due to e.g. leaching of heavy metals, radioactivity, and to special minerals suspected to have hazardous health properties.

These questions in the relation between the aggregate industry and its surrounding society will by far be determinant for the industry's survival.
The real challenge will be to merge the environmental issues with the industrial ones; to create industrial plants, which are at the same time environmentally friendly and economically profitable, which integrate quarrying and industrial production, and finally – for which there exist plans for restoration and area use after completed quarrying period.
Knowledge of material properties may aid in the selection of aggregate use to ensure optimum use of the resource, for instance high quality (and valuable) aggregate may be used for the more expensive constructions whereas aggregates with lower quality may be selected for massive fills where quality demands are not as strict. Unnecessary damages to the nature may be prevented; optimum exploitation of the resource may be achieved. Environmental effects may be better estimated. All these are important goals on the way towards sustainable development.

5.4 ENVIRONMENTAL IMPACT – ENERGY AND TRANSPORTATION

It is also claimed that the transport of fine aggregates is more than 20% of all heavy truck transportation, and at transport distances longer than 50-100 km, the cost of the transport is more than the price of the fine aggregate itself. As a consequence they claim that when introducing manufactured sand it is important to ensure that length of transportation does not increase.

5.5 TECHNICAL CHALLENGES

One of the main challenges in fine aggregate production is to obtain a satisfactory mass balance. Any excess fraction that has to be kept on stock – or even more; deposited – will create an economic as well as an environmental problem. Rapidly depleting sand resources this implies the need for developing useful alternatives, e.g. crushed/manufactured hard rock, recycling, subsurface quarrying etc. A change to alternative materials sources will then also necessitate the development of new technologies for the end materials and structures, a part of this being the materials and construction standards. Economically, reduced transport costs will more or less balance higher cost relating to local quarrying and to a more expensive end product (e.g. higher cement requirements and need for additives in some concretes.

VI APPLICATION AND BENEFITS

Applications:

- Crushed demolished concrete waste can be used in plain cement concrete.
- It can be used in a RCC framed structure.
- It can also be used in a load bearing structure.
- It can also be used for the construction of the concrete road.

Benefits:

1. **Benefits related to Demolished Waste concrete:** Demolished concrete (Reucrete) will produce high strength, greater durability, greater workability, eco-friendly and economy.
2. **Benefits related to Industry**: Reduced cost of sand thereby reducing overall cost of concrete with less transportation cost.
3. **Benefits related to environment:** Demolished waste fine concrete will reduce the construction waste in very large volume hence reducing air pollution, with healthy and natural environment for development and growth of communities.
4. **Benefits of Concrete:** Concrete is one of the oldest and widely used of construction materials and possesses many inherent qualities which can be used to benefit the client, designer and contractor.

- **Variety of Specification -** Concrete can be manufactured to an inexhaustible range of specifications to suit all applications. This is possible by using different proportions of the natural ingredients or by the use of different materials.
- **Variety of Surface Finish -** Building in concrete provides an extraordinary range of surface finishes that can be applied either when the concrete is still wet or once it has hardened, providing the opportunity for architectural expression to go hand in hand with structural integrity.
- **Flexibility of Shape and Form -** Concrete can be moulded into any shape by using appropriate formwork. This capability can be used to provide be spoke design solutions to specific problems and also aesthetically pleasing finishes which often eliminate the need for further fixings, e.g. false ceilings.
- **Durability -** Well designed and well placed concrete offers exceptional durability and long life in any structure. Concrete structures built over 100 years ago, indeed as long ago as the Romans, are still in active service today.

- **Environmentally Friendly -** Concrete consists of naturally occurring materials, produces no emissions and needs no toxic preservatives. This is becoming an increasingly important issue.
- **Fire Resistance -** Concrete is naturally and inherently fire resistant and needs no additional application of fire protection.

VII CONCLUSION

 Concrete will continue to be a dominant construction material.

 Environmental impact can be reduced through design.

 Notably Our Experimental study established that Reucrete Sand satisfied the requirements of fine aggregate from the physical and mechanical properties such as specific gravity, Fineness Modules, Moisture Content, Silt content, Bulk Density and Gradation.

 The Mechanical properties of Reucrete sand depend on the source of its raw material hence selection of a good quality of Demolished waste is very important for obtaining quality fine aggregate.

 The Concrete cubes made out of combination of Crushed Sand and Reucrete Sand

 Reucrete Sand therefore offers a viable alternative to the Natural/Crushed sand.

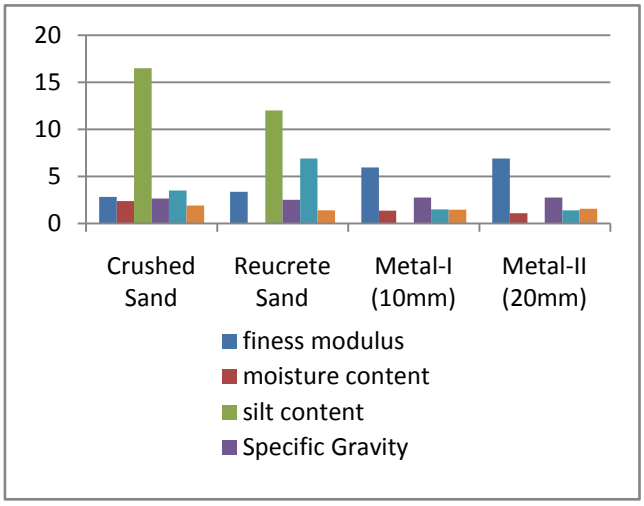
Property	**Crushed Sand**	**Reucrete Sand**	**Remark**
Shape	Cubical particle	Cubical particle	Satisfied
Fineness Modulus	2.828	3.359	Within the Limit
Moisture Content	2.39	0.00	Fully Absent in Reucrete
Silt Content	16.50	12.00	More than Limit
Specific gravity	2.67	2.51	Within the Limit
Water absorption	3.50	6.90	More than Limit
Bulk Density	1.90	1.38	Within the Limit
Organic impurities	Absent	Present (Retard the setting & Compressive Strength)	Limit of 5% for Uncrushed & 2% for Crushed sand
Particle passing 75 micron	Presence of dust particle shall be less than 15%	Presence of dust particle shall be less than 12%	Limit 3% for uncrushed & limit 15% for crushed sand

CUBE TESTING REPORT.

Description	3 Days Result (N/SQ MM)	7 Days Result (N/SQM M)	28 Days Result (N/SQ MM)	Remark
Trial 266 100% Crushed Sand	25.77	38.51	48.88	Water Saved 450ml
Trial 267 90% Crushed Sand + 10% Reucrete	23.55	35.40	43.55	Water Saved 150ml
Trial 268 80% Crushed Sand + 20% Reucrete	27.69	31.25	45.03	Water Saved 00ml
Trial 269 100% Reucrete Sand	19.96	25.18	28.58	Extra Water added 400ml
Trial 270 100% Reucrete Sand (With Min cement content as per I.S	12.57	16.69	21.62	Extra Water added 1000ml

Code, Without Admixture)				

RESULT FOR FINE AGGREGATE



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Assistant Professor, Department of Civil Engineering, A.S.L. Pauls college of Engineering & Technology, Coimbatore – 642 109, Tamilnadu, In