International Journal of Advance Research in Science and Engineering
Vol. No.5, Special Issue No. 01, March 2016
www.ijarse.com
IJARSE
ISSN 2319 - 8354

RECYCLED AGGREGATE-SUSTAINABLE SOLUTION

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ABSTRACT

Unprecedented population pressure and demand of society on scarce land, water and biological resources and the increasing degradation of these resources is affecting the stability and resilience of our ecosystems and the environment as a whole. Kolhapur isan upcoming metropolitan city with industrial efficient approximately producing exports of foundry products, with a value of 21 billion rupee per year, generating construction and demolition waste to the tune of approximate 7000 tons annually and these figures are likely to double fold in the next 2 years with an Annual municipal budget of (2015-16) 1.8 billion. Concrete has been seen as a resource in developed countries. Availability of raw material required for manufacturing of cement and production of concrete are limited in nature. This increased demand will lead to fast depletion of natural resources and will cause thread environment. This project is carried out to produce a low- cost and eco-friendly Cement Concrete Block with study on Recycled Aggregate in concrete. This project demonstrates the use of waste foundry product (foundry sand slag, Construction Demolished aggregates and recycled waste water C.E.T.P. Kagal). The goal of this study is to demonstrate the possibility of using foundry wastes, demolished waste as substitute natural aggregates in concrete production in personage. The experimental work consists of casting of cubes concrete, taking into account adhered mortar and thus calculating mix composition needs to be developed. Literature survey reveals that compressive strength primarily depends upon adhered mortar, water absorption, Los Angeles abrasion, size of aggregates, strength of parent concrete, age of curing and replacement ratio, interfacial transition zone, moisture state, impurities present and controlled environmental condition. Some of the studies have suggested the mix design procedure for recycle an approach for use of recycled concrete aggregate without compromising the strength.

Keywords: Foundry sand slag aggregates and recycled waste water C.E.T.P., demolished concrete.

I. INTRODUCTION

Kolhapur Construction industry growth is substantial in size. Predicts an increase in construction spending from of 48% in theyear2015 [2]. These figures indicate a tremendous growth in the construction sector and could be almost one and a half times in the coming 5 years [7]. Concrete is the premier construction material across the world and the most widely used in all types of civil engineering works, including infrastructure, low and high-rise buildings, defense installations,environment protection and local/domestic developments. Concrete is a manufactured product, essentially consisting of cement, aggregates, water and admixture. Among these, aggregates.

Until quite recently, and despite years of experience in the field, the construction industry has seemed quite oblivious to worries about managing the waste produced. Construction is not only one of greatest generators of waste; it also consumes around 40% of all extracted natural resources [7]. It is thus essential to intervene to encourage more sustainable construction practices. Studies on the use of recycled aggregates have mostly focused on their coarse fraction and ignored the fine fraction. This is basically because the extreme porosity of fine recycled materials leads to reductions in the performance of any composites containing them. The most important characteristics of hardened mortar for wall covering are: mechanical strength, water permeability, adhesive strength and resistance to weathering, and those of fresh mortar are workability, and water retentively. Several mortars with recycled aggregates are assessed based on these characteristics and by comparison with a reference conventional mortar, in order to verify their performance as renderings.In fact many governments throughout the world have now introduced various measures aimed at reducing the use of primary aggregates and increasing reuse and recycling, where it is technically, economically, or environmentally acceptable.

II. MOTIVATION

Now-a-days disposal of different wastes produced from different Industries is a great problem. These materials pose environmental pollution in the nearby locality because many of them are non-biodegradable. The construction sector is exploring rapidly on a large scale and also involves new techniques for rapid and comfort works on the field. Concrete as a building material plays an important role in this sector. The consumption of natural resources as an ingredient of concretecosts high . These problems force us to recover the natural resources or to find its replacement. Disposal of Wastewater is also posing various problems on environment and treatment of which comes costly and low cost treatment has very less efficiency. So, combining the foundry waste from foundry as well as wastewater will help to mitigate treatment of both the waste. To reduce environmental hazards-Concrete is the most widely used construction material in the world, with demand being continually driven through the growth of emerging economies. In fact, concrete is so widely used that global cement and aggregates production contributes about 5% to annual greenhouse gas emissions, a level comparable to the aviation sector[3]. Greenhouse gases released into the atmosphere, such as carbon dioxide, significantly affect the Earth's temperature. Concrete production can also contribute to a progressive depletion of natural resources, resulting in serious environmental damage if left unchecked. Recycling of aggregates was first carried out after II World war in Germany to tackle the problem of disposing large amount of demolition waste caused by the war and simultaneously generate raw material for reconstruction. Recycling of aggregate material from construction and demolition waste may reduce the demand supply gap in this sector. Apart from mounting problems of waste management, other reasons which support adoption of recycling strategy are- reduced extraction of raw materials, reduced transportation cost and reduced environmental impact because during their excavation manufacturing, transportation tremendous amount of dust particles are produced.

III.NEED TO RECYCLE

Waste arising from Construction Demolition and Foundry Waste constitutes one of the largest waste streams within India many other countries. For example, it is estimated that core waste (described as those types of materials which are obtained from demolished building or civil engineering infrastructure) amounts to around 520kg/person/yr in India. This ranges from over 700 kg/person/yr in Germany and the Netherlands to under 200 in Sweden, Greece and Ireland. This is in addition to large quantities that are dumped illegally. Thus, construction demolition waste has become a global concern that requires sustainable solution.

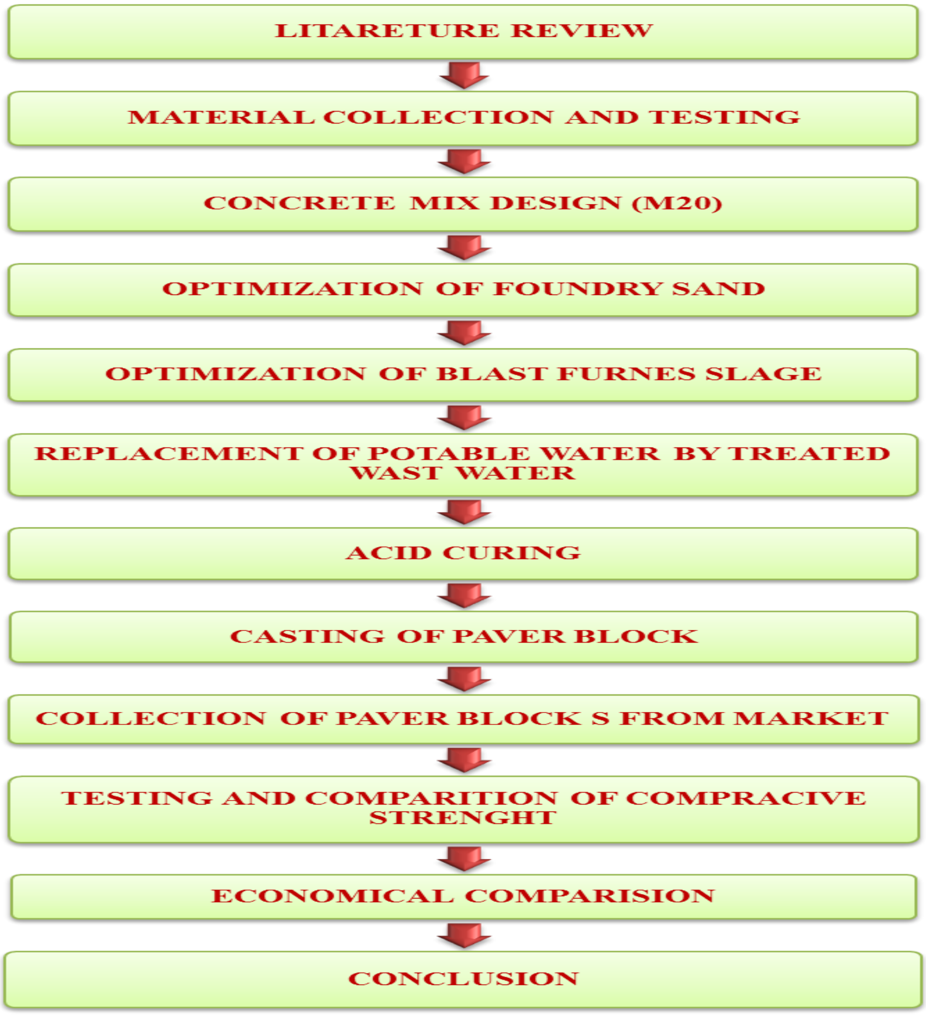
It is now widely accepted that there is a significant potential for reclaiming and recycling demolished debris for use in value added applications to maximize economic and environmental benefits. As a direct result of this, recycling industries in many parts of the world, including South Africa, at present converts low-value waste into secondary construction materials such as a variety of aggregate grades, road materials and aggregate fines[2]. Often these materials are used in as road construction, backfill for retaining walls, low grade concrete production, drainage and brickwork and block work for low-cost housing. While accepting the need to promote the use of RCA in wider applications, it must be remembered that the aggregate for concrete applications must meet the requirements set in relevant specifications for its particular use. The gap between these interests has to be reduced in steps that are manageable and the use of RCA in structural concrete has to be promoted gradually. Similarly, considerable attention is required to the control of waste processing and subsequent sorting, crushing, separating and grading the aggregate for use of the concrete construction industry. In some developed countries C & D waste is now regularly recycled and reused, albeit mainly as fill, drainage and sub-base materials, and there is considerable scope for increasing this market and the use of these materials.

In addition, there is an urgent need for legislative or regulatory measures to implement sustainable C & D waste management strategy and encourage recycling for use in value added applications.

IV. SCOPE

The scope of this pilot project is based on the replacement of conventional coarse aggregate (100%) with recycled concrete aggregate. The reason for using only coarse aggregates in recycling is that the fine aggregate replacement in terms of concrete dust increases the water demand of concrete which results in decrease of strength. Due to the presence of cement powder around the recycled aggregates, the water requirement for desired workability increases.

V. METHODOLOG



VI. OBJECTIVES

1) To study the physical and chemical properties of foundry waste, blast furnace slag treated waste water, demolished waste.

2) To study the compressive strength cement concrete blocks available in market and blocks casted using foundry waste and treated wastewater.

3) To study the durability aspect of plain cement concrete blocks available in market and blocks casted using foundry waste and treated wastewater, like acid effect, etc.

4) To compare cost analysis of plain cement concrete blocks available in market and blocks casted using foundry waste and treated wastewater.

VII. TESTS ON RECYCLED AGGREGATE

In the present study various tests on material such as cement, fine aggregate, coarse aggregate and the waste material industries foundry waste and treated wastewater were performed as per the Indian Standards.

For Foundry Waste

Cement-PortlandPozzolanic Cement of 43 grades was purchased from the local supplier and used throughout this project. The properties of cement used in the investigation are presented below.

Coarse and Fine Aggregate

Locally available river sand, basalt stone chips were used for preparation of concrete. Machines crushed locally available hard basalt, well graded 10.00 mm and down size were used.

Blast Furnace Slag Aggregate

Air-cooled blast furnace slag (ACBFS) has been used as a coarse aggregate in concrete pavements since at least the 1930s.By definition; blast furnace slag is the non-metallic product, consisting essentially of silicates and alumina silicates of calcium and other bases, that is developed in a molten condition simultaneously with iron in a blast furnace. It is important to recognize that ACBFS aggregates are distinct, unique materials, possessing a number of characteristics and properties that must be considered during the design and construction process to ensure long-term performance. For example, ACBFS typically exhibits the following characteristics when compared to natural aggregates

Foundry Sand Foundry sand used for the centuries as a molding casting material because it's high thermal conductivity, the physical and chemical characteristics of foundry sand will depend in great part on the type of casting process and the industry sector from which it originates. In the casting process, molding sands are recycled and reused multiple times. Eventually, however, the recycled sand degrades to the point that it can no longer be reused in the casting process. At that point, the old sand is displaced from the cycle as byproduct, new sand is introduced, and the cycle begins again.

Water: The potable water from supply mains was used for the preparation of concrete and its subsequent curing.

Treated Water: Characterization of KagalPanchTarankit C.E.T.P. Co-Op Association Society Kasaba-Sangav, Kagaltreatment plant water used in the laboratory experiments for Construction Demolished waste.

Cement: The cement used in all mixtures was commercially available. Ordinary Portland Cement of 43 grade manufactured by Ultratech cement company confirming to IS 8112:1989 was used in this study. The compressive strength of cement was 45 MPa. The initial and final setting time were found as 65 minutes and 385 minutes respectively.

Fine aggregate: Locally available sand confirming to grading zone III as per IS 383:1970. The sand was air-dried and sieved to eliminate any foreign particles before mixing. Sand passed through4.75mm IS sieve is used as fine aggregate. The specific gravity of sand is 2.128 and fineness modulus of 2.72. The loose and compacted bulk density values obtained are 1530 Kg/m^3 and 1600 Kg/m^3.

Coarse aggregate: The coarse aggregate with a maximum size 20mm having a specific gravity 2.104%and fineness modulus of 7.25.The loose and compacted bulk density values obtained are

1480Kg/m3 and 1610 Kg/m3 respectively, and water absorption of For Recycled aggregate 7.2%, and natural aggregate 1% the aggregate crushing value (%) Recycled Aggregates 17.42% and Natural Aggregates-16.4% and aggregate impact value (%) of coarse aggregate is Recycled Aggregate 16.73% and Natural Aggregate 12.5%.

Results and Tables

The results obtained from the investigation carried out for structural and non-structural properties on trial basis are as follows

Nonstructural properties

The physical properties of gravels and recycled aggregates are furnished For Foundry Waste

Sr.no	Properties	Foundry	Recycled	Natural
1	Water Absorption	3.05	7.2%	1%
2	Specific Gravity	3.44	2.104	2.47%
3	Crushing Value	.5%	17.42%	16.4%
4	Impact Value	18.02%	16.73%	12.5%
5	Abrasion Value	32.5%	38.68%	5.5%

Properties of Treated Water

Parameters	**Inlet-Effluent**	**Outlet-Effluent**
PH	8.24	7.70
COD mg/lit	528mg/lit	168
BOD mg/lit	152 mg/lit	26
TSS	628	96
DO	Nil	2.8
Sulphides	Nil	Nil
Chlorides	698.6	531

Mix Design Proportion Used

For Foundry Waste-M20 1:1.76:4.62:1.67:0.56:1%

For Demolished Waste-M20-1:1.62:3.40:0.50M25-1:2.34:4.23:0.50

VIII. STRUCTURAL PROPERTIES

Compressive test on cubes

The average compressive strengths of cubes cast are determined as per IS 516 using RCA, Foundry waste and natural aggregate at the age 3, 7, & 28days and reported. As expected, the compressive strength of RAC is slightly lower than the conventional concrete made from similar mix proportions. The reduction in strength of RAC as compare to NAC replaced 30% 70% and 100%for M-20 & M-25 concretes respectively.

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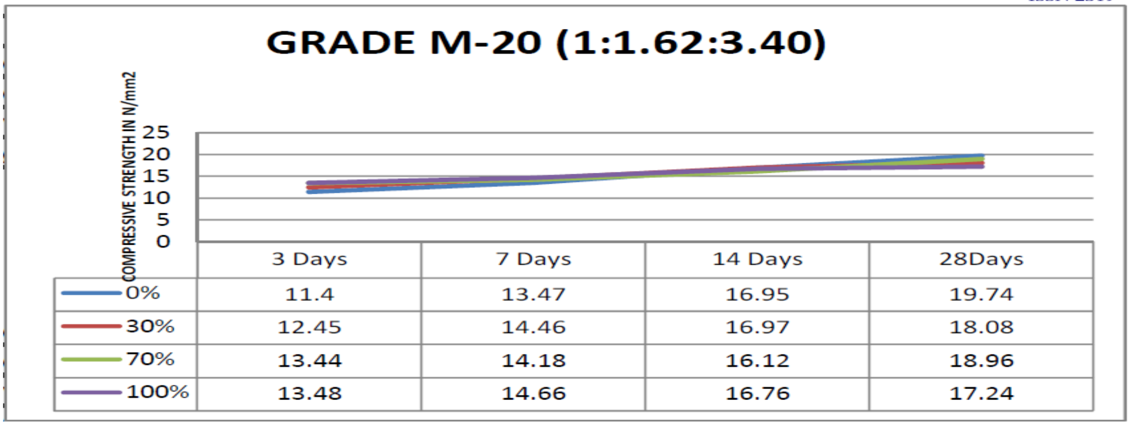
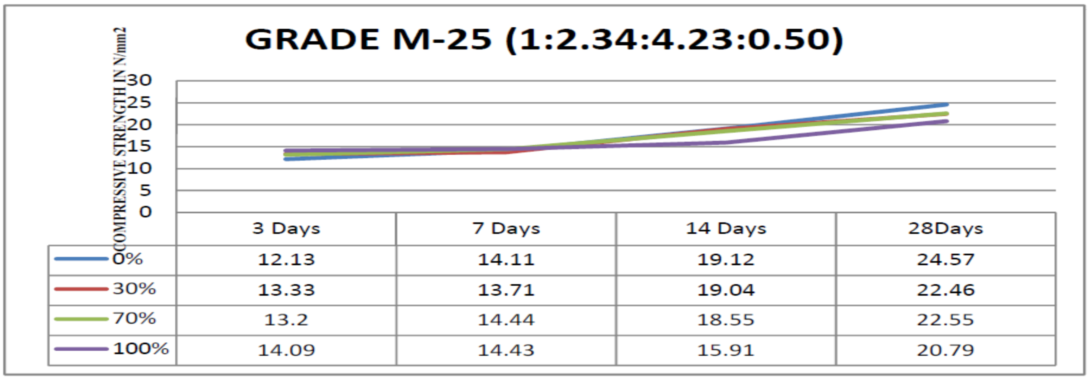


	3 Days	7 Days	14 Days	28Days
0%	11.4	13.47	16.95	19.74
30%	12.45	14.46	16.97	18.08
70%	13.44	14.18	16.12	18.96
100%	13.48	14.66	16.76	17.24

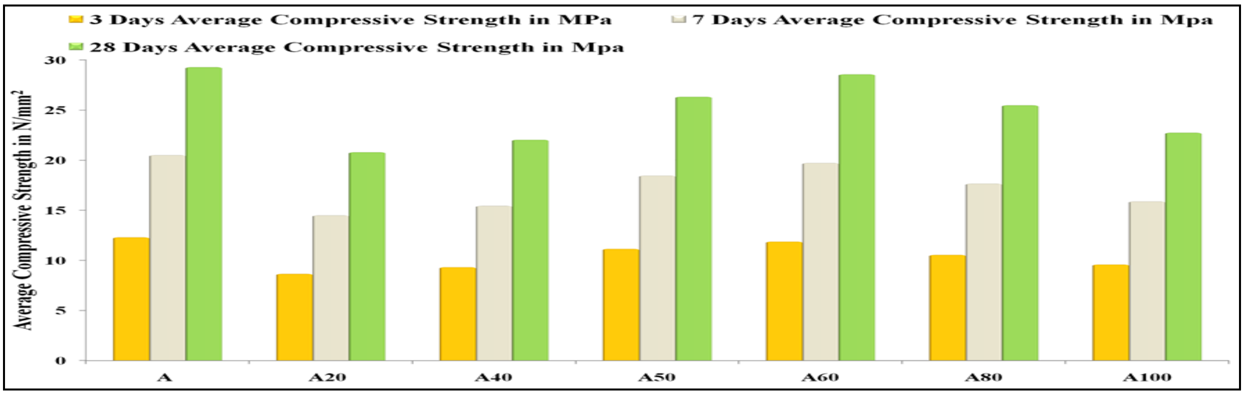
Compressive strength For Recycled Aggregate



	3 Days	7 Days	14 Days	28Days
0%	12.13	14.11	19.12	24.57
30%	13.33	13.71	19.04	22.46
70%	13.2	14.44	18.55	22.55
100%	14.09	14.43	15.91	20.79

The hardened concrete properties were tested in the laboratory and are furnished in table.

For Foundry Waste Analysis



IX. COST ANALYSIS

Paver Blocks in Conventional Concrete =Rs 2.92/-

Paver Blocks with replacement in ingredients= Rs. 2.15/-

Aggregate normal=3600/- Per Brass

Recycled Aggregate=Processing charge +transport (175+1000) =1175/-Per Brass.

X. CONCLUSION

It can be conclude that the compressive strength of concrete with 60% replacement Natural Sand (NS) and 40% replacement Course Aggregate (CA) with potable water was increases by 7.137 N/mm2 (35.69 %) than the design compressive strength of Convention concrete (20 N/mm2), whereas the compressive strength was increased by 5.166 N/mm2 (25.83 %) while treated water was used instead of potable water. It can be concluded that the cost of M20 grade conventional concrete is Rs. 4175.56/- per m3 and the cost of concrete with 60% replacement of Natural Sand(NS) by Foundry Sand (FS) & 40% replacement of Course Aggregate (CA) by Blast Furnace Slag (BFS) and construction demolished waste is Rs. 3073.69/- per m3. Concrete mixture is found to have strength in close proximity to that of natural aggregate and can be used effectively as a full value component of new concrete.

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