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Optimizing the Performance of Construction Using Demolished Waste Concrete

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Abstract: In refurbishment projects a great deal of the water from existing structure is generated at the demolition stage. The study applies the waste concrete from construction and demolition waste in concrete and provide a case example for the construction industry to implement the recycle, reuse, and reduce principal to after the management policy of waste concrete.
Experimental investigation was carried out of to study various engineering properties such as workability, compressive strength, qualitative and quantitative study. It highlights various combinations of recycled aggregate to match with normal grade concrete. Research project investigation the influence of different percentage of recycled coarse aggregate obtained from demolished building 30 years old on the properties of construction and demolished waste concrete. Experimental result are holds good and shows better strength as compared to normal concrete cured 28 days. This study conducts the performance analysis and optimize the overall calculation for mix design. The result indicated that larger fractal dimension of aggregate would lead to the worse appeal performance of concrete.
Keywords: Concrete performance, recycle coarse aggregate, construction, and demolished waste overall calculation for mix design, recycle

I. INTRODUCTION

Construction and demolition waste can be defined as waste which arises from construction, renovation and demolition activities including damaged products and materials arising from construction works. Construction industry is one of the biggest waste producers across the world. Landfill is the best traditional disposal method Construction and demolition wastes, but in accordance with the current exhaustive pressures on landfill space, recycling should be the main route for the waste management. Sustainable waste management involves managing waste in an environmental favourable and socially satisfactory manner. Importance of management of waste generated from construction and demolition activities are sustainable environmental improvement and pollution control, conservation of land, material, and energy resources. This is because of the absence of regulatory compulsions Construction and demolition waste management in India is not well designed as no separate designed action plan is available with municipal corporations. Use of construction and demolition materials meeting requirements of quality for the use should be made obligatory for new constructions subject to prices being competitive. Utilization of Construction and demolition waste in construction industry is a relatively new practice. Use of Construction and demolition waste concrete will promote and encourage green construction for sustainable developments. Use of Construction and demolition waste material will lower the embodied energy within the buildings which will make them more energy efficient.

II. LITERATURE REVIEW

C. S. Poon, S. C. Kou and L. Lam investigated that the recycling of construction and demolition (C&D) waste as a source of aggregates for the production of new concrete has attracted increasing interests from the construction industry. While the environmental benefits of using recycled aggregates are well accepted, some unsolved problems prevent this type of material from wide application in structural concrete. One of the major problems with the use of recycled aggregates in structural concrete is their high water absorption capacity which leads to difficulties in controlling the properties of fresh concrete and consequently influences the strength and durability of hardened concrete. This paper presents an experimental study on the properties of fresh concrete prepared with recycled aggregates Concrete mixes with a target compressive strength of 35MPa are prepared with the use of recycled aggregates at the levels from 0 to 100% of the total coarse aggregate. The influence of recycled aggregate on the slump and bleeding are investigated. The effect of delaying the starting time of bleeding tests and the effect of using fly ash on the bleeding of concrete are explored. [Ref.2]

M. Chakradhara Rao A. S. Bhattacharyya et al. has investigated the influence of different amounts of recycled coarse aggregates obtained from a demolished RCC culvert 15 years old on the properties of recycled aggregate concrete (RAC). A new term called ‘‘coarse aggregate replacement ratio (CRR)’’ is introduced and is defined as the ratio of weight of recycled coarse aggregate to the total weight of coarse aggregate in a concrete mix. To analyze the behavior of concrete in both the fresh and hardened state, a coarse aggregate replacement ratio of 0, 0.25, 0.50 and 1.0 are adopted in the concrete mixes. The properties namely compressive and indirect tensile strengths, modulus of elasticity, water absorption, volume of voids, density of hardened concrete and depth of chloride penetration are studied. From the experimental results it is observed that the concrete cured in air after 7 days of wet curing shows better strength than concrete cured completely under water for 28 days for all coarse aggregate replacement ratios. The volume of voids and water absorption of recycled aggregate concrete are 2.61 and 1.82% higher than those of normal concrete due to the high absorption capacity of old mortar adhered to recycled 23 aggregates. The relationships among compressive strength, tensile strengths and modulus of elasticity are developed and verified with the models reported in the literature for both normal and recycled aggregate concrete. In addition, the non¬ destructive testing parameters such as rebound number and UPV (Ultrasonic pulse velocity) are reported. The study demonstrates the potential use of field recycled coarse aggregates (RCA) in concrete. [Ref. 3] Fabiana da Conceicao Leite, Rosangela dos Santos Motta et al. has projected the worldwide production of construction and demolition waste and its illegal deposition are serious current problems in Brazil. This research proposes to evaluate the feasibility of using aggregate from recycled construction and demolition waste (RCDW) in pavement applications. A laboratory program was conducted by geotechnical characterization, bearing capacity and repeated load triaxial tests. The results show that the composition and the compactive effort influence on the physical characteristics of the RCDW aggregate. The compaction process has promoted a partial crushing and breakage of RCDW particles, changing the grain-size distribution and increasing the percentage of cubic grains. This physical change contributes to a better densification of the RCDW aggregate and consequently an improvement in bearing capacity, resilient modulus and resistance to permanent deformation. The results have shown that the RCDW aggregate may be utilized as coarse base and sub¬ base layer for low-volume roads. [Ref.11]

Prof. N. K. Dhapekar has highlighted the applicability of X-ray diffraction method to evaluate the true and effective modulii of concrete ie; Young’s modulus of elasticity, Bulk modulus of elasticity and modulus of Rigidity at different temperatures along with compressive strength or compressive stress and strain. The aim of this study is to explore the possibilities of structural health monitoring of concrete structures in different temperate regions through X-ray diffraction technique as compared to the normal Non-Destructive methods like Rebound Hammer, Ultrasonic pulse velocity tests or destructive lab methods used in practice today. This paper consolidates the variation in true and effective modulii along with compressive strength and strain at very low temperate regions (upto 5 degree Celsius), moderate temperate regions (up to 25 degree Celsius) to high temperate regions (upto 50 degree Celsius). [Ref. 4] Prof. N. K. Dhapekar and Prof. D. M. Chopkar has studied and performed powder ordinary Portland cement concrete samples using X-ray diffraction (XRD) which reveals a promising approach for structural health monitoring of concrete structures.Conventional X-ray diffractometer was used for XRD analysis of concrete in hardened ordinary Portland cement concrete structures can be determined by X-ray diffraction analysis. This approach may replace the traditional chemical analysis of hardened concrete which is tedious and time consuming but also evaluates 28 compressive strength of ordinary Portland cement concrete structures. Further, an attempt has been made to quantify the phases present in reinforced cement concrete (RCC) structures and compressive strength has been determined. The results of phase quantification and compressive strength obtained from XRD analysis have shown good agreement with the experimental values. [Ref. 5]

Mohamed Marzouk, Shimaa Azab has projected use of construction and demolition wastes in environmental, social, and economic realms.

There is no coherent framework for utilization of these wastes which are disposed both legally and illegally. This harms the environment, contributes to the increase of energy consumption, and depletes finite landfills resources. The aim of this paper is to evaluate the impacts of two alternatives for the management of CDW, recycling and disposing. The evaluation is carried out through developing a dynamic model with aid STELLA software by conducting the following steps: (1) quantifying the total cost incurred to mitigate the impacts of CDW landfills and uncollected waste on the environment and human health; (2) quantifying the total avoided emissions and saved energy by recycling waste; (3) estimating total external cost saved by recycling waste and; (4) providing a decision support tool that helps in rethinking about waste disposal. The proposed evaluation methodology allows activating the stringent regulations that restrict waste disposal and developing incentives to encourage constructors to recycle their wastes. Furthermore, the cost of mitigating the impact of disposal is extremely high. Therefore, it is necessary to recycle construction and demolition wastes. [Ref. 1]

III. METHODOLOGY

Mix Proportions and Materials Two different types of water cement (W/C) ratios of 0.5 and 0.6 are adopted in this research work along with various types of recycled aggregates (RCA) derived from demolished construction site located at Bhilai at various different intervals of time. Various percentages of recycled aggregates are mixed with virgin aggregates namely 50%, 70% and 90% in M 20 concrete grade and following tests were carried out to study the optimized performance of concrete.

Strength of concrete

Mixing Concrete - The concrete shall be mixed by hand, or preferably, in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials, each batch of concrete shall be of such a size as to leave about 10 percent excess after moulding the desired no. of test specimens. The concrete batch shall be mixed on a water- tight, non-absorbent platform with a shovel, trowel or similar suitable implement, using the following procedure:

1) The cement and fine aggregate shall be mixed dry until the mixture is thoroughly blended and is uniform in colour.
2) The coarse aggregate shall then be added and mixed with the cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch, and
3) The water shall then be added and the entire batch mixed until the concrete appears to be homogeneous and has the desired consistency. If repeated mixing is necessary, because of the addition of water in increments while adjusting the consistency, the batch shall be discarded and a fresh batch made without interrupting the mixing to make trial consistency tests.

Size of Test Specimens -Test specimens cubical in shape shall be 15 X 15 X 15 cm. If the largest nominal size of the aggregate does not exceed 2crn, 10 cm cubes may be used as an alternative. Cylindrical test specimens shall have a length equal to twice the diameter. They shall be 15 cm in diameter and 30 cm long. Smaller test specimens shall have a ratio of diameter of specimen to maximum size of aggregate of not less than 3 to 1, except that the diameter of the specimen shall be not less than 7·5 32 cm for mixtures containing aggregate more than 5 percent of which is retained on IS Sieve 480.

a) *Cube Moulds:* 'The mould shall be of metal, preferably steel or cast iron, and stout enough to prevent distortion. It shall be constructed in such a manner as to facilitate the removal of the moulded specimen without damage, and shall be so machined that, when it is assembled ready for use, the dimensions and internal faces shall be accurate within the following limits: The height of the mould and the distance between opposite faces shall be the specified size + 0·2 mm. The angle between adjacent internal faces and between internal faces and top and bottom planes of the mould shall be 90°+/-0.5°. The interior faces of the mould shall be plane surfaces with a permissible variation of 0·03 mm. Each mould shall he provided with a metal base plate having a plane surface. The base plate shall be of such dimensions as to support the mould during the filling without leakage and it shall be preferably attached to the mould by springs or screws, The parts of the mould when assembled shall be positively and rigidly held together. and suitable methods of ensuring this, both during the filling and on subsequent handling of the filled mould, shall be provided. In assembling the mould for use, the joints between the sections of mould shall be thinly coated with mould oil and a similar coating of mould oil shall be applied between the contact surfaces of the bottom of the mould and the base plate in order to ensure that nowaterescapes during the filling.the interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the concrete. . Fig.3.1 Preparation of concrete cube in moulds Fig.3.1 Preparation of concrete cube in moulds
b) *Tamping Bar:* The tamping bar shall be a steel bar 16 mm in diameter, 0·6 m long and bullet pointed at the lower end.

- Compaction - The test specimens shall be made as soon as practicable after mixing, and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete shall be filled into the mould in layers approximately 5 cm deep, In placing each scoopful of concrete, the scoop shall he moved around the top edge of the mould as the concrete slides from it, in order to ensure a symmetrical distribution of the concrete within the mould. Each layer shall be compacted either by hand or by vibration.

  After the top layer has been compacted, the surface of the concrete shall be finished level with the top of the mould, using a trowel, and covered with a glass or metal plate to prevent evaporation. a) Compacting by Hand - When compacting by hand, the standard tamping bar shall be used and the strokes of the bar shall be distributed in a uniform manner over the cross-section of the mould.

  The number of strokes per layer required to produce specified, conditions will vary according to the type of concrete. For cubical specimens, in no case shall the concrete be subjected to less than 35 strokes per layer for 15 cm cubes or 25 strokes per layer for 10 cm cubes. The strokes shall penetrate into the underlying layer and the bottom layer shall be rodded throughout its depth. Where voids arc left by the tamping bar, the sides of the mould shall be tapped to close the voids.

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- *Compacting by Vibration* - When compacting by vibration, each layer shall be vibrated by means of an electric or pneumatic hammer or vibrator or by means of a suitable vibrating table until the specified condition is attained.

➢ *Curing* - The test specimen shall be stored in a place, free from vibration, in moist air of at least 90 percent relative humidity and at a temperature of 27° ± 2°C for 24 hours ± l hour from the time of addition of water to the dry ingredients, After this period, the specimens shall be marked and removed from the moulds and, unless required for test within 24 hours, immediately submerged in clean, fresh water or saturated lime solution and kept there until taken out just prior to test. The water or solution in which the specimens are submerged shall be renewed every seven days and shall be maintained at a temperature of 27° ± 2°C. The specimens shall not be allowed to become dry at any time until they have been tested.

Testing-

➢ *Testing Machine* - The testing machine may be of any reliable type, of sufficient capacity for the tests and capable of applying the load. The permissible error shall be not greater than ± 2 percent of the maximum load. The testing machine shall be equipped with two steel bearing platens with hardened faces. One of the platens (preferably the one that normally will bear on the upper surface of the specimen) shall be fitted with a ball seating in the form of a portion of a sphere, the centre of which coincides with the central point of the face of the platen. The other compression platen shall be plain rigid bearing block. The bearing faces of both platens shall be at least as large as, and preferably larger than the nominal size of the specimen to which the load is applied. The bearing surface of the platens, when new, shall not depart from a plane by more than 0·01 mm at any point, and they shall be maintained with a permissible variation limit of 0·02 mm.

Fig. 1 cube cast

Fig. 2 Compressive strength of cylinder

Fig. 3 A split tensile test

Fig. 4 Compressive strength test of cube

Workability by Slump Cone Test Procedure to determine workability of fresh concrete by slump test.
1) The internal surface of the mould is thoroughly cleaned and applied with a light coat of oil.
2) The mould is placed on a smooth, horizontal, rigid and nonabsorbent surface.
3) The mould is then filled in four layers with freshly mixed concrete, each approximately to one-fourth of the height of the mould.
4) Each layer is tamped 25 times by the rounded end of the tamping rod (strokes are distributed evenly over the cross section).
5) After the top layer is rodded, the concrete is struck off the level with a trowel.
6) The mould is removed from the concrete immediately by raising it slowly in the vertical direction.
7) The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.
8) This difference in height in mm is the slump of the concrete.

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Fig. 5 A Slump cone test

Fig. 6 A Slump cone test

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Examples of reference items of different categories shown in the References section include:

a) Advance Concrete Technology” John Newman, Ban Seng Choo, Elsevier Ltd., 2003 [1]
b) Concrete Technology “Indian Building Congress”, 2013. [2]
c) Concrete Technology” Neville and Brooks. [3]
d) Concrete Technology, Theory and Practice”. M.L. Gambhir, Tata Mc GrawHill Education Pvt.Ltd,2009. [4]
e) Concrete Technology, Theory and Practice”. M.S. Shetty, S.Chand and Company Ltd., 2013 example of a website in [5]

IV. CONCLUSIONS

The conclusion of optimizing the performance of construction and demolished waste concrete using construction chemical would depend on the specific results of the study.If the study found that the use of construction chemicals improved the performance of construction and demolished waste concrete, the conclusion might state that the use of these chemicals is a viable solution for enhancing the properties of such concrete. It might also discuss the potential benefits of this approach, such as increased durability and reduced environmental impact.If the study found that the performance of the concrete was not significantly improved using construction chemicals, the conclusion might suggest further investigation into alternative methods for enhancing the properties of this type of concrete. Overall, the conclusion of this study should summarize the key findings and provide recommendations for future research or application of construction chemicals in optimizing the performance of construction and demolished waste concrete

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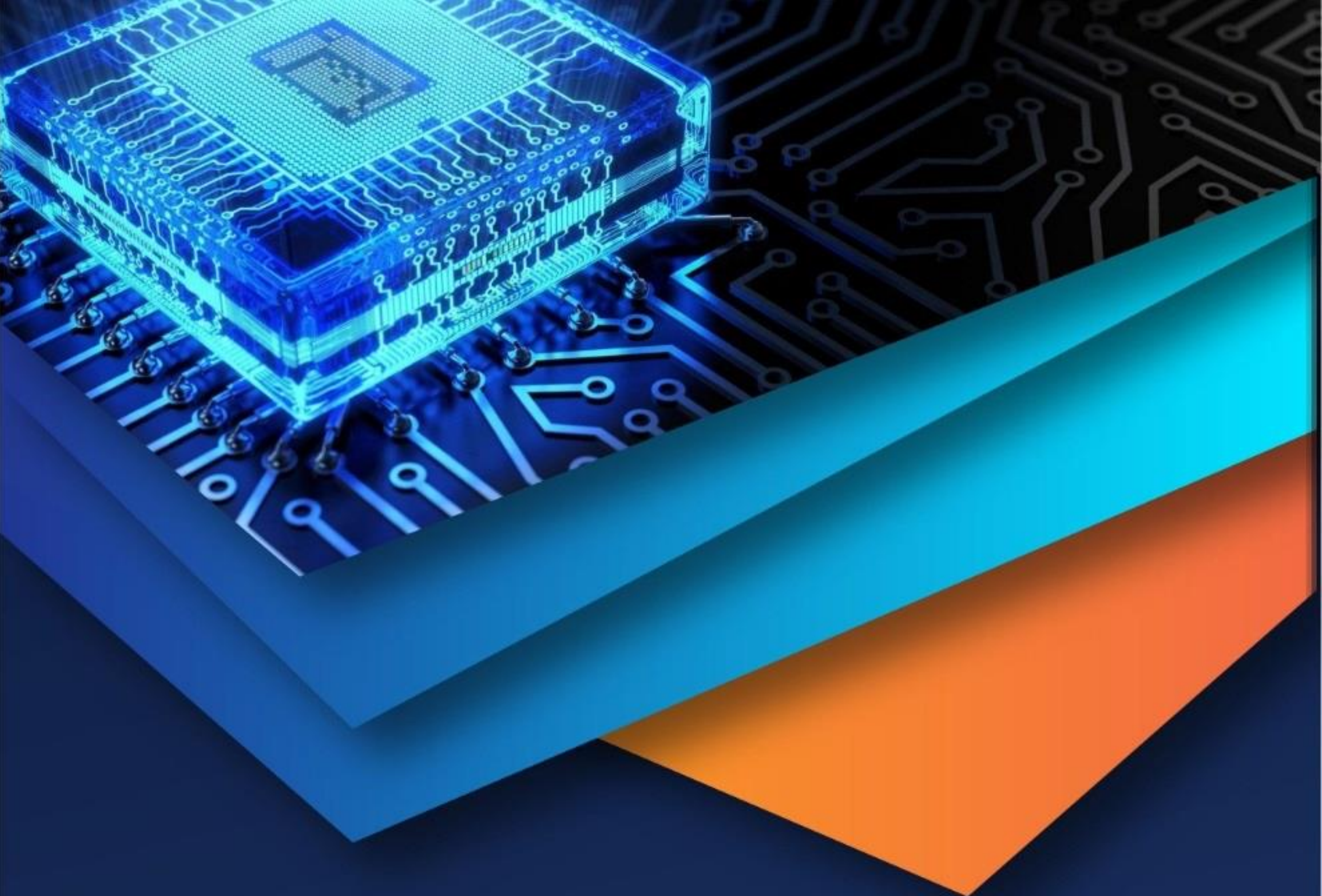

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