A REVIEW ON REUSE OF DEMOLISHED CONSTRUCTION WASTE

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ABSTRACT

Rapid urbanization and population growth have increased the demand for new housing, urban environments and infrastructure. While roads, buildings and bridges are renovated and renewed, massive amounts of construction and demolition waste is generated around the world. To cope with both rising stockpiles of waste and yet growing need for raw materials, we need to impose new environmental regulations encouraging to use recycled materials instead of natural resources. This paper focuses on the necessity of reusing demolition waste for different construction purposes and thereby improving the environmental impact caused by demolition wastes. Construction waste have been effectively used as replacement for both fine aggregates and coarse aggregates.

INTRODUCTION

Construction and demolition waste, or C&D waste, is the term used to describe the debris generated by all kinds of construction and demolition projects. As C&D materials are produced by undertakings ranging between the construction of private homes and the deconstruction of international airports, they represent an enormous source of waste. C&D materials are generated when new building and civil-engineering structures are built and when existing buildings and civil-engineering structures are renovated or demolished (including deconstruction activities). Civil-engineering structures include public works projects, such as streets and highways, bridges, utility plants, piers, and dams. Construction and demolition waste comprises multiple economically valuable materials such as reusable aggregates, bitumen, brick, cardboard, concrete, metals, mineral wool and wood, many of which can be sold directly or used in new products, construction materials or in energy production. In an optimal case this waste is processed near the demolition site, making the discarded matter a continuous stream of raw materials for new roads, buildings, bridges and urban landscape. Approximately 90 percent of C&D waste is generated from demolition, and 10 percent from construction. Recycling of Construction and demolition waste has many benefits such as reduction in transportation cost, it keeps environment clean and reduces natural resource exploitation. To promote recycling and reuse of waste, awareness about its effects and benefits should be communicated with people, contractors, engineers and architects. More numbers of recycling plants should be installed and allowing the use of recycled aggregate instead of natural aggregate for some purpose.

LITERATURE REVIEW

A K Padmini et.al [1] conducted study on 'Influence of parent concrete on the properties of recycled aggregate concrete' in the year 2009. This paper discusses the properties of recycled aggregates derived from parent concrete (PC) of three strengths, each of them made with three maximum sizes of aggregates.10 mm, 20 mm and 40 mm of fresh crushed granite aggregates, ordinary portland cement,

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recycled aggregates were used. The water absorption of recycled aggregate increases with an increase in strength of parent concrete from which the recycled aggregate is derived. For achieving a design compressive strength, recycled aggregate concrete requires lower water–cement ratio and higher cement content compared to concrete with fresh granite aggregate. Strength increases with an increase in maximum size of recycled aggregate used. The split tensile and flexural strengths are lower for RAC than parent concrete. The modulus of elasticity of RAC is lower than that of parent concrete. Higher percentage of reduction in modulus of elasticity was obtained for concrete made with smaller sized aggregates.

Faiz Uddin Ahmed Shaikh et.al [2] conducted study on 'Properties of concrete containing recycled construction and demolition wastes as coarse aggregates' in 2013. Portland cement, 5 kg sample of RCA was obtained from a local C&D waste recycling plant in Perth, were used. Three series of mixes were considered: natural coarse aggregates only, 25% and 50% RCAs. The recycled aggregate concretes contain 25 and 50% RCA as replacement of NA. The compressive strength of recycled aggregate concretes decreased with increase in RCA contents. The recycled aggregate concretes also exhibit poor water absorption, and chloride ion permeability compared to concrete containing NA. Tensile strength of concrete containing 50% RCA exhibited about 10% average reduction compared to natural aggregate concrete. The concrete containing 25% RCA maintained its flexural strength to that of natural aggregate concrete. Strength increases with an increase in maximum size of recycled aggregate used. The split tensile and flexural strengths are lower for RAC than parent concrete. The modulus of elasticity of RAC is lower than that of parent concrete. Higher percentage of reduction in modulus of elasticity was obtained for concrete made with smaller sized aggregates.

P Revathi et.al [3] conducted 'Investigations on fresh and hardened properties of recycled aggregate self compacting concrete' in 2013. Five series of mixture were prepared with 0, 25, 50, 75, and 100 % coarse recycled aggregate. Ordinary Portland cement and fly ash were used as the cementitious materials and crushed granite (20 mm maximum size) and locally available river sand were used as natural coarse and fine aggregate. Recycled aggregates were obtained from a demolished concrete waste of 35 years old building in Puducherry. Demolished concrete waste was crushed and screened to obtain recycled aggregate of size between 5 and 20 mm. The slump flow, passing ability and passing ability of the recycled RASCC mixes are decreased with the increase in recycled aggregate content. The compressive strengths of Recycled Aggregate Self Compacted Concrete (RASCC) mixes decreased with an increase in recycled aggregate content. A reduction of about 16 % was observed in compressive in RASCC100 when compared with Natural Aggregate Self Compacted Concrete (NASCC). The tensile strength reduction of about 58 % is observed in RASCC 100.

Surya M et.al [4] in 2013 experimented on 'Recycled aggregate concrete for transportation infrastructure'. Ordinary Portland Cement of grade 43, calcium fly ash as an admixture, Crushed granite natural aggregate (NA) of 20 mm size and 10 mm size, recycled aggregates were used. Three recycled aggregate concrete: 50%, 75% and 100% recycled aggregates mixes with fly ash, and two natural aggregate concrete mixes with and without fly ash are produced. The recycled aggregate used in the present study fulfilled the codal requirements for RCA but for natural aggregates. The natural aggregate concrete mixes and RAC mixes R50, R75 and R100 exhibited similar behavior in compression, split tension and flexure. The elastic modulus of RAC decreased with increase in percentage of RCA. The water absorption of RAC increased with increase in percentage of recycled aggregates. Detailed investigation on long term performance of RAC is needed before their actual use in transportation infrastructure.

Bibhuti Bhusan Mukharjee et.al [5] conducted experiment on 'development of construction materials using nano silica and aggregates recycled from construction and demolition waste' in the year 2015. Ordinary

Portland Cement (OPC) of 43 Grade, Nano Silica was between 8 to 20nm, Crushed dolerite of 20mm size as Natural Coarse Aggregates and RCAs were prepared from a 30-year-old demolished building of West Bengal. Fully natural and recycled aggregate concrete mixes are designed by replacing cement with three levels (0.75%, 1.5% and 3%) of nano-silica. The Compressive Strength (CS) of RA concrete at 3, 7 and 28 days was lower than that of the control concrete. The addition of 3% NS led to an increase in CS of RAC and a reduction in water absorption. The reduction of elastic modulus by RA concrete was in the order of 30%. Increase in water absorption and volume of voids, and reduction of density was observed for RA concrete mixes prepared without Nano Silica (NS). The volume of voids of RAC without NS is 16.1%, which is higher than that of the control concrete.

M Adamson et.al [6] studied 'durability of concrete incorporating crushed bricks as coarse aggregate' in 2015. Both crushed bricks and natural aggregates were sieved and the 12.70 mm size was used as the coarse aggregate size. The natural coarse aggregates can be replaced by crushed bricks, without significant change in the durability of concrete when the steel is not present. 100% natural granite aggregate, 25% crushed brick aggregate and 75% natural granite aggregate (25%B); 50% crushed brick aggregate and 50% natural granite aggregate (50%B) were used. Brick aggregates had a higher porosity and absorption than natural aggregates. Concrete with brick aggregates showed an increase in its workability compared to that in concrete with natural aggregate. Concrete with brick aggregates showed slight improvement in compressive strength. By increasing the brick content, the resistance to chloride penetration decreases.

Yadhu G et.al [7] conducted an innovative study on reuse of demolished concrete waste in 2015. Ordinary Portland Cement, Coarse aggregate which passes through 80 mm and retained on a 4.75 mm sieve, Fine aggregate which passes through 4.75 mm and retained on 75 micron sieve were used. Crushed stone was used as coarse aggregate; river sand and crushed C&D wastes were used as fine aggregate. M20 mix is considered. The concrete made using crushed C&D wastes gives almost as much as strength as normal concrete. The fineness of the C&D wastes is more than the latter. The crushed C&D wastes can be used as a replacement for natural fine aggregate. Crushed C&D wastes concrete have enough workability to use in construction purposes.

M. F Akhtar et.al [8] in 2018 studied on the 'use of different types of aggregate vis-à-vis demolition wastes as an alternate material for concrete'. Ordinary Portland cement of 43 grade, river sand is used as the fine aggregate, quartzite, granite, and recycled concrete aggregate (RCA) were used as coarse aggregate. RCA used in the study was obtained from the demolition of 25-30-year-old building. The construction and demolition waste (CDW) can be used to produce concrete with compressive strength up to 30 MPa with 100% replacement of natural aggregate with RCA. As water absorption of RCA is higher hence, we may require slightly more water in making concrete. Due to through texture of RCA, the workability of concrete with it found low as compared to natural aggregate concrete. More work to be done on construction and demolition waste because of its varied macro and micro composition of the waste. RCA can be a good replacement for natural aggregate by adding some additives. N K Dhapekar et.al [9] conducted study on 'efficient utilization of construction and demolition waste in concrete' in 2018. Fresh concrete material (FCM), waste concrete material (WCM), and waste concrete material with admixture (WCA) are used for the work. Masterpolyhhed- 8311, non-chloride mid ambit baptize abbreviation admixture is acclimated to ensure above workability and bigger durability. 50%,70% and 90% of aggregates are replaced with recycled ones. Concrete mixes in proportion 1:1.5:3 are used. Waste concrete material (WCM) and waste concrete material with admixture (WCA) are giving bigger compressive strength as compared to fresh concrete material. Workability decreases with increase of recycled aggregates. Construction and demolition waste material can be efficiently utilized to achieve comparable compressive strength and durability relative to concrete using natural coarse.

T Sathish et.al [10] conducted 'comparative study on addition of carbon fibre in concrete with partial replacement of demolished concrete in structural concrete' in 2019. Cement, Fine aggregate, Coarse aggregate, recycled coarse aggregate, Carbon fibre were used. Mix proportion used in this study was 1:1.87:3.2 (M30) with water cement ratio of 0.42. Compressive strength is 23.46% increase for the replacement of 20% of recycled aggregate with 0.8% carbon fibre. Maximum split tensile strength of M5 mix of M30 were 2.77 N/ mm2 as compared to control mix of 2.42 N/mm2. Split tensile strength increase for the replacement of 20% of recycled aggregate with 0.8% carbon fibre. When compared to the conventional concrete, the RC beam containing 0.8% of carbon fibre with 20% of recycled aggregate shows the high flexural strength.

CONCLUSIONS

From the study we could see that demolished crushed bricks and demolished concrete waste can be used s substitute for coarse aggregate and fine aggregate in concrete. Even though we are not able to replace 100%, partial replacement is possible to attain the required compressive strength and flexural strength. By using admixtures we can improve the workability as well as strength of the concrete. It is also found that by adding carbon fibres we can increase the strength. As we increase the size of crushed concrete aggregate the strength increases. Further scope of study is how much percentage of coarse and fine aggregate can be replaced with crushed concrete coarse aggregate and fine aggregate. The use of suitable admixture for improving the strength and workability in crushed concrete need to be found out.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest regarding this research

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