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A Review on a Comparative Study on Partial Replacement of Various Waste Materials as a Coarse Aggregate

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ABSTRACT: Following a normal growth in population, the amount and type of waste materials have increased accordingly. Many of the non-decaying waste materials will remain in the environment for hundreds, perhaps thousands of years. The non-decaying waste materials cause a waste disposal crisis, thereby contributing to the environmental problems. However, the environmental impact can be reduced by making more sustainable use of this waste. This is known as the Waste Hierarchy. Its aim is to reduce, reuse, or recycle waste, the latter being the preferred option of waste disposal.

Far more concrete is produced than any other man-made material. Annual production represents some ton for every person on the planet. It is incredibly versatile, and is used in almost all major construction projects. Aggregates are used in concrete for very specific purposes. Aggregates typically make up about 60% to 75% of the volume of a concrete mixture. The current concrete construction practice is thought unsustainable because, not only it is consuming enormous quantities of stone, sand, and drinking water, but also two billion tons a year of Portland cement, which releases green-house gases leading to global warming. Experiments has been conducted for waste materials like-demolished concrete constituents, ceramic tiles etc.

Concrete is the mixture of various materials coarse aggregate, fine aggregate, cement & water, each of them is mixed in various proportions to achieve specific strength. Cement being the most important material plays an important role in the manufacturing of concrete. The high cost of Conventional construction materials is a dominating factor effecting constructions cost. This is necessity research for some new kind of alternative materials in the constructions field.

This project briefly discusses the effects of addition of demolished concrete waste, ceramic waste, on the properties of mortar concrete mix of M20 at 28 days four concrete mix with dosages 0%, 10%, 20% & 30% of the weight concrete mix. Combination of these DCW, CW, will used as dosages of mix. Cubes of size 15x15x15cm to check the compressive strength. The result of this concrete for 14days, 28days, curing of concrete. The testing of concrete according to Indian standard specification to identify the effect of workability and mechanical strength properties due to doses of these wastes..

I. INTRODUCTION

Huge quantities of construction materials are required in developing countries due to continued infrastructural growth and also huge quantities of construction and demolition wastes are generated every year in developing countries like India. An estimated 50 million tons of E-waste are produced each year worldwide. India ranks third in coconut shell production. 10,560,000 tonnes coconut is produced in India in year 2012 .The disposal of these wastes is a very serious problem because on one side it requires huge space for its disposal while on the other side it pollutes the environment. It is also necessary to protect and preserve the natural resources like stone, sand etc.



Demolition of old and deteriorated buildings and traffic infrastructure, and their substitution with new ones, is a frequent phenomenon today in a large part of the world. The main reasons for this situation are changes of purpose, structural deterioration, rearrangement of a city, expansion of traffic directions and increasing traffic load, natural disasters (earthquake, fire and flood), etc. Changes in infrastructure planning and needs result in the generation of construction and demolition waste (C&D Wastes): an estimated 900 million tons every year in India, Europe, the US and Japan. It is estimated that the construction industry in India generates about 10-12 million tons of waste annually. In particular, Construction and Demolition (C&D) wastes contribute the highest percentage of wastes worldwide about 75%. Furthermore, ceramic materials contribute the highest percentage of wastes within the C&D wastes about 54%. It is predicted that about 30% of daily production of ceramic materials in India change into wastage and this amount reaches to millions ton per year.

According to an investigation conducted in 2002 by the ministry of land, infrastructure and transport (here in after referred to as MLIT), the amount of construction waste produced in Japan is approximately 83 million tons per year, most of which is recycled in compliance with related laws and ordinances. Of the total construction waste, concrete waste accounts for approximately 35 million tons per year. Although the recycling rate of concrete waste has reached 98%, most of it is used for roadbed gravel. A Comparative Study on Partial Replacement of Various Waste Materials as a Coarse Aggregate . In the USA, the construction waste produced from building demolition alone is estimated to be 123 million tons per year. The use of recycled aggregate concrete as granular base has been increasing rapidly. For example, at Toronto's Pearson airport, 145,000 t of concrete from old terminals and pavements was crushed on site and recycled for use in 500 mm thick granular base layers under new apron and taxiway pavements. Over 75,000 t of RCA were used for this purpose thus saving approximately 4000 truckloads of virgin granular base from being hauled more than 50 km from quarries to the airport and a similar number of truckloads of old concrete being hauled away to landfill. At present, in India 27.8% of the total population living in cities, which is 13.8% more than the year of 1947. There is a shortage of about 55,000 million m³ due to the construction of new infrastructure which shows that the demand of the aggregates in future increases. 750 million m³ additional aggregate is required to fulfill the demand of the road sector . There is a huge gap between the demand and the supply of the aggregates because giant amount of aggregates is required in the housing and transportation nowadays. So recycling of demolished construction waste is very essential. The total number of recycling plants is also estimated as 1000 for Germany, 150 for Austria, 120 for the Netherlands, 100 for the UK and Italy, 92 for Belgium, 50 for France, 30 for Denmark, 10 for Sweden, 8 for Ireland, and 6 for Spain. IL&FS Environment has set up India's first operational large scale construction

II. DIFFERENT TYPES OF WASTES

Concrete Wastes -

When buildings are demolished as a result of disasters, their rubble contains fragmented building components, furnishings and organic matter that are difficult to separate. On the other hand, it is possible to reuse most of the building materials and components, and recycle much of the rubble. According to investigations on the composition of demolition waste in the Netherlands revealed that 20% of the wood, 90% of the steel and 100% of other metals like zinc, lead and copper are being removed from the structure, leaving behind building waste, which on the average is composed of Although the volume of demolition waste is huge, much of it is inert, allowing it to be crushed, processed, and reused as aggregate in building works. Nevertheless, large amounts still end up as landfill rather than being recycled.

Waste containing half-used paint pots, discarded solutions, solvents and chemicals are potentially hazardous, and building waste likely to be contaminated with asbestos must also be treated as dangerous. It has been established that materials and components recovered from demolished buildings are being reused for new construction works as well as renovation projects, especially by low-income communities in developing countries. It has been noted that material, which was not considered worthy of re-use a few years ago, has appeared in the market after the recent global economic crisis. For example, steel reinforcement from demolished buildings used to be recycled back into steel; however, it is now considered worthwhile to adopt measures to facilitate its reuse as a building material. Meanwhile, demolition contractors have also become increasingly aware of the feasibility of recovering as much material as possible, for new construction works. Consequently, they are giving considerable importance to the proper sorting, storing and display of their wares. Rapid industrial development cause serious problems all over the world such as depletion of natural aggregates and creates enormous amount of waste materials from construction and demolition activities. One of the ways to reduce these problems is to utilize recycled aggregate in the new construction concrete components

Ceramic wastes

Utilization of waste materials (i.e., slag, fly ash, plastics, etc.) in concrete construction is one of the prime research interests to reach the goal of achieving sustainable construction. Aggregates impart about 70% to 75% of volume to concrete. In this aspect, consumption of waste tiles or broken tiles as coarse aggregates in concrete manufacturing can be a new scientific sobriety in the field of sustainable concrete. A large number of tiles get broken or wasted in tile industries and on mega construction projects. The residual and unused wastes are disposed into environment as burden without any commercial return. Consequently, huge money is being spent for their disposal reasons as well as environmental pollution occurs. It is well known that addition of these wastes in concrete as a supplement generally reduces the construction cost and more or less maintains the properties of concrete. In addition, waste materials, when properly processed, have shown to be effective as construction materials and readily meet the design specifications. Ceramic tile aggregates are hard having considerable value of specific gravity, rough surface on one side and smooth on other side, are lighter in weight than normal stone aggregates.

Using ceramic tile aggregate in concrete not only will be cost effective, but also will be good from environment point of view. This study focuses on producing concrete of acceptable strength with crushed waste ceramic tiles as coarse aggregate and determining the optimum coarse aggregate mix ratio to achieve this strength. Previous attempts and researches be evidence for that industrial left outs and wastes as well as other ravages have been used in producing concrete to get better its properties, also to reduce cost. Enhancement in the modulus of elasticity of concrete was experimentally observed with partial substitute of coarse aggregate by using crushed vitrified soil aggregate. The principal target of the experimental of program was to conclude the involvement of the waste recycled aggregate type to the enhancement in the strength properties of the enclosed concrete. The study program includes the experimental investigation of the behavioral conducts of fresh and hardened concrete along with ceramic waste coarse aggregate and to compare the relevant properties and behavior with conventional concrete.

III. LITERATURE REVIEW

1.R. Kamala, B. Krishna Rao (2012) studied the reuse of solid waste from building demolition for the Replacement of Natural Aggregates. In their study, they use various mix proportion for partial replacement of conventional aggregate is studied by casting 3 cubes, 3 cylinders and 3 beams for each and every replacement and compressive strength and split and flexural strengths were conducted at the end of 7, 28, 56 days. The compressive strength of the ceramic concrete has been varied from 32.88-46.88 M pa and the split tensile strength is varied from 2.47-3.72Mpa and flexural strength is varied from 5.33-7.82Mpa for 28 days. It is observed that the strength decreases from 50% replacement of coarse aggregate. Hence until 40% we can use ceramic tiles collected from building demolition as replacement of coarse aggregate.

2.Asif Husain, and MajidMatouqAssas (2013) studied the Utilization of Demolished Concrete Waste for New Construction. In their study they replaced coarse aggregate by recycled aggregate at various percentages and perform many tests on them. The minimum 30specimens were cast for each w/c ratio i.e. 0.60, 0.625 and 0.65 for the two mixes (M15 & M20), thereby making more than 180 specimens, Five sets of cubes were cast replacing fresh aggregate by coarse aggregate from demolished waste @ 0%, 25%, 50%, 75% and 100% by weight. With different w/c ratio as recommended in IS456-2000 compressive strength of mix increases by 26.75% when fresh aggregate is replaced by 75% dismantled aggregate, however slump decreases to 2/3rd value. Increasing w/c ratio from 0.60 to 0.625 i.e. by 4.16%, slump increases from 21mm to 60mm when fresh aggregate is replaced by 75% dismantled with 12.68% increase of compressive strength of the mix. For 0.65 w/c ratio (IS 456-2000) compressive strength of M15 & M20mix replacing fresh aggregate by 75% dismantled aggregate , increases up to 40%, however slump decreases to half.

3. R. Sri Rvindrarajah (1987) studied that Utilization of Waste concrete for new construction, in his study he get compressive and flexural strength at full replacement of natural aggregate by recycled aggregate. The value for compressive strength varies from 2833.2 mpa and flexural strength varies from 4.154.88 mpa at 28 days testing.

4.Sudarsana et al. (2013) [Utilization of waste Ceramic Tiles as Coarse Aggregate in conc.] investigated on the influence of water absorption of ceramic waste aggregate on strength properties of ceramic aggregate concrete. M20 concrete is used with 0.48 water cement ratio. Ceramic waste water absorption is 0.08% more than conventional aggregate. Compressive strength is best at 20% replacement reaching 93.45%, 98.84% to that of conventional concrete at 7 and 28 days. There is decrease in density with increase of percentage replacement; at 100% replacement density is 4.43% less when compared toconventional concrete.

5. Veera Reddy (2010) [Utilization of waste Ceramic Tiles as Coarse Aggregate in conc.] Veera Reddy reported on impact value and crushing value of ceramic scrap as 18.2 and 24.7% respectively. These values were within the permissible limits according to IS 383-1970, hence it was safe to use as a coarse aggregate in concrete composition.

6. Marcio (2004) [Studies on Strength Characteristics on Utilization of waste Ceramic Tile Aggregate as Coarse Aggregate in Concrete.] Marcio experimented on compressed stress, water absorption and modulus of elasticity of concrete made with ceramic aggregate. Crushed ceramic blocks were used as coarse aggregate in concrete fabrication. Specific density of aggregate was 2630 to 2310 kg/m³ for 0 to 100% replacement. Up to the replacement of 20%, Compression resistance and modulus of elasticity was equivalent with conventional concrete.

IV. CONCLUSION

The following conclusions are drawn from the experimental study.

1. Demolished concrete waste, ceramic waste and concrete may be an alternative to the conventional concrete.
2. Up to 30% replacement of coarse aggregate by Demolished Concrete Waste concrete was comparable to conventional concrete. Up to this replacement good compressive strength can be achieved using recycled aggregates. Beyond this replacement the strength acquired reduces gradually and does not cross the target strength.
3. Up to 30% of coarse aggregate replaced by demolished concrete waste in concrete gave strength closer to the strength of conventional concrete cubes.
4. Up to 20% of coarse aggregate replaced by ceramic waste in concrete gave strength closer to the strength of conventional concrete cubes.
5. Use of waste materials results in the formation of lightweight concrete and lightweight structure.
6. Use of such waste materials not only cuts down the cost of construction, but also contributes in safe disposal of waste materials.
7. From the present experimental investigation it was found that the recycled aggregates will influence much in hardened properties of concrete.
8. Using demolished concrete waste concrete as a base material for road constructions reduce the pollution involved in trucking material.
9. Use of these wastes in the new concrete reduces the environmental pollution as well as providing an economic value for the waste material.
10. Usage of these wastes can not only preserve the finite raw materials, but also reduce energy consumption and overall construction costs.
11. The reuse of these construction wastes in concrete will help in improvement of overall environment of the region. Firstly by reduction in mining and secondly reduction in air pollution resulting from production of aggregates (dust pollution) and transportation of aggregate from mining to consumption point (vehicular pollution).
13. These recycled aggregates can be used as base layer/sub base layer for roads and used in road side edge drains.
14. These recycled aggregates can be used for making of bricks, kerb stones, pavement blocks and RCC road divider.
15. Due to use of these wastes materials as a coarse aggregate, reduction in overexploitation of quarries, CO₂ and greenhouse gases emission.
16. Economical housing projects will be done.
17. Due to safe disposal of these wastes materials, it helps Clean India Mission.

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