A Review Paper on Study on Partial Replacement of Solid Plastic Waste Material with Course Aggregate in Rigid Pavements

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Abstract— This study is based on the tests which are perform on version replacements which can done with course aggregates in concrete.

Keywords: Course Aggregate, Rigid Pavements, Solid Plastic Waste Material, Cement

I. INTRODUCTION

Concrete has been the leading building material since it was first used and is bound to maintain its significant role in the upcoming future due to its durability, maintenance free service life, adaptability to any shape and size, wide range of structural properties plus cost effectiveness. The concrete is the most important construction material which is manufactured at the site. It is the composite product obtained by mixing cement, water and an inert matrix of sand and gravel or crushed stone. It undergoes a number of operations such as transportation, placing, compaction and curing. The distinguishing property of concrete is the ability to harden under water. The ingredients can be classified into two groups namely active and inactive. The active group consists of cement and water, whereas the inactive group consists of fine and coarse aggregates. The inactive group is sometimes also called inert matrix. Concrete has high compressive strength but its tensile strength is very low. One of the major challenges of our present society is the protection of environment. Some of the important elements in this respect are the reduction of the consumption of energy and natural raw materials and consumption of waste materials. These topics are getting considerable attention under sustainable development nowadays. The use of recycled aggregates from construction and demolition wastes is showing prospective application in construction as alternative to primary (natural) aggregates. It conserves natural resources and reduces the space required for the landfill disposal. Any construction activity requires several materials such as concrete, steel, brick, stone, glass, clay, mud, wood, and so on. However, the cement concrete remains the main construction material used in construction industries. For its suitability and adaptability with respect to the changing environment, the concrete must be such that it can conserve resources, protect the environment, economize and lead to proper utilization of energy. To achieve this, major emphasis must be laid on the use of wastes and byproducts in cement and concrete used for new constructions. The utilization of recycled aggregate is particularly very promising as 75 per cent of concrete is made of aggregates. In that case, the aggregates considered are slag, power plant wastes, recycled concrete, mining and quarrying wastes, waste glass, incinerator residue, red mud, burnt clay, sawdust, combustor ash and foundry sand. The enormous quantities of demolished concrete are available at various construction sites, which are now posing a serious problem of disposal in urban areas. This can easily be recycled as aggregate and used in concrete. Research & Development activities have been taken up all over the world for proving its feasibility, economic viability and cost effectiveness. The new replaces the old and same follows with the buildings. Older buildings require reconstruction for better and higher economic gains and on account of obsolescence on structural or functional grounds and also due to the damages inflicted on them by natural disasters and wars. The rate of demolition showed an upward trend which in turn increased the dumping costs due to unavailability of appropriate sites nearby. Thus efficient use of the demolished concrete would reduce the costs and definitely lead to conservation of the invaluable non-renewable sources of energy and hence must be given due importance. The demolished concrete could be used as aggregate for concrete resulting in large consumption of the material. Recycling is the act of processing the used material for use in creating new product. The usage of natural aggregate is getting more and more intense with the development in infrastructure area. In order to reduce the usage of natural aggregate, recycled aggregate can be used as the replacement materials. Recycled aggregate comprise of crushed, graded inorganic particles obtained from the materials that have been used in the constructions and demolition debris. These materials are generally from buildings, roads, bridges, and sometimes even from catastrophes, such as wars and earthquakes.

II. LITERATURE REVIEW

Nixon (1978) was the pioneer for using recycled concrete as aggregate for concrete. Water absorption of the recycled concrete aggregate is significantly higher, because cement paste adhering to the old aggregate particles absorbs water.

Walker, P.R. et. al. (1996) studied the effect of lateral pressure on the bond strength of deformed reinforcement set in normal weight concrete. A large number of tests were undertaken in which the main variables affecting bond strength were investigated. The variables were concrete strength, reinforcing bar diameter, concrete cover, lateral pressure, position of casting and bar spacing. It was observed that the bond strength of single top cast bars is less than that for bottom bars, which is probably caused by the formation of laitance, plastic settlement and shrinkage of concrete around the bars in case of the top cast bars. The bond ratio is approximately constant with bar diameter for lower strength concrete and decreases with bar diameter for higher strength concrete. The bond ratio increases with cube strength although, for the larger sizes commonly employed as main reinforcement, this increase is small. The results of the tests on beams showed that the bond strength developed at the supports was generally greater than that in the pull-out tests.

Hamad, B. S. et al. (1998) observed the effect of transverse reinforcement on the bond-slip characteristics of tension lap slices in high performance silica fume concrete. They tested twelve beam specimens, each beam specimen included two bars in tension, spliced at the centre of the span. The beams were designed in a way that bars would fail in bond, splitting the concrete cover in the splice region, before reaching the yield point. The beams were loaded in positive bending with the splice in a constant moment region. The variables used were the percentage replacement by weight of cement by silica fume and the amount of confinement over the splice region. The test results indicated that silica fume decreased the bond strength. Specimens containing silica fume, without transverse reinforcement in the splice region had a brittle, sudden and noisy mode of failure. The use of transverse reinforcement in the splice region increased the bond strength and the ductility of the mode of failure of the beam specimens.

Hamad, B. S. et. Al. (1999) studied the effect of silica fume on bond-slip characteristics of deformed bars in high performance concrete. The effect of transverse reinforcement on the bond-slip behaviour of tension lap splices in silica fume concrete was also investigated. Transverse reinforcement was recommended in order to increase the bond strength and improve the ductility of mode of failure. Top cast specimens developed slightly more bond strength than bottom cast specimens when no silica fume replacement was used. However, when 8% or 16% of Portland cement was replaced by silica fume, top and bottom cast specimens developed nearly similar bond strength values. Based on the results of this study and the earlier study by Hamad et al., it was recommended to remove the ACI limit of 70 Mpa on fc (Compressive Strength of concrete in Ib/sq. inch) while computing development length of bottom or top cast reinforcement. The removal should be completed by providing minimum transverse reinforcement in the anchorage or splice region.

Katz, A. (1999) studied the bond mechanism of Fiber Reinforced Polymer (FRP) rebar to concrete. Five different types of 12.7mm and 12.0 mm rebar subjected to different surface treatments were tested, and the bond mechanism was compared with that of untreated FRP rods and ordinary deformed steel. They observed different pre-peak and post-peak behavior for the various rods when the entire set of P-s (Pullout load vs. slip) curves were compared. Brittle behavior was apparent wherever the external layer of the rod exhibited large deformations formed in a stiff matrix. Where the surface was rough, more ductile behavior was detected. It was observed that the wedging of particles into the surface can alter the load-slip behavior, from slip-weakening to slip-hardening.

Hamad, B. S. et. al. (2000) investigated the effect of silica fume, bar size, and concrete confinement on the bond-slip characteristics of bottom cast reinforcing bars anchored in eccentric pullout silica fume specimens. Forty-eight eccentric pullout specimens were tested. The variables were the percentage replacement by mass of cement by silica, the concrete cover over the reinforcing bar, and bar size. Failure of the specimens was governed by splitting of the concrete cover over the anchored bar. The test results indicated that as the percentage silica fume increased, the maximum load capacity and the stiffness of the load-slip curve of the bottom cast bar decreased regardless of bar size or the concrete cover used. The reduction in the ultimate load due to presence of silica fume was independent of casting position. Companion bottom and top cast anchored bars developed similar ultimate load capacity regardless of the percentage replacement silica fume.

Buyle-Bodin, F. et. al. (2002) drew a comparison between the behaviour of RAC and that of ordinary natural aggregate concrete. The influence of both the composition and the curing conditions was discussed. It was observed that durability of RAC is controlled by flow properties of high total W/C ratio and air permeability. The diffusion of the carbon dioxide is faster, that leads to a weaker resistance of RAC to environmental attacks.

Hendriks, F. Ch. et. al. (2003)developed the approach called Design for Recycling can be used to optimize design of constructions for later reuse and the Design for Disassembly can be used for demolition. For the technical aspects two models were developed concerning degradation processes and high-graded applications. These models were based on Life Cycle Assessment method.

Chenet al. (2003)study, washed RA is used as coarse aggregate. They found that washed RA comprised higher strength than that of unwashed RA. Greater bond effects were produced when impurities, powder and harmful materials on aggregate surface in RA are washed away. They also identified that at low w/c ratio, the compressive strength ratio of recycled concretes to normal concretes are decreased. Main factor which lead to this result is strength of the paste is increase at low w/c ratio. Based on composite material theory, they revealed that RA will become a weak material and its bearing capacity become smaller which influenced to decrease in strength.

Poon et. al. (2004)studied Influence of moisture states of natural and recycled aggregates on the compressive strength of concrete, and concluded that the concrete mixtures prepared with the incorporation of recycled aggregates, the air dried (AD) aggregate concretes exhibited the highest compressive strength. The surface dried density (SSD) recycled aggregates seemed to impose the largest negative effect on the concrete strength, which might be attributed to ‘‘bleeding’’ of excess water in the pre-wetted aggregates in the fresh concrete. Based on the results of his study, aggregates in the ADstate and contain no more than 50%recycled aggregate should be optimum for normal strength recycled aggregate concrete production.

Levy, Salomon M. et. al. (2004) studied three properties water absorption, total pores volume and carbonation of recycled concrete. They made concrete with recycled aggregate (0%, 20%, 50% & 100% replacement) from recycled sources and achieved compressive strength in the range of 20-40 MPA at 28 days which is same as natural aggregate. It was found that the carbonation depth decreased when the replacement was 20% or 50% which shows that carbonation depth depends strongly on the chemical composition of the concrete and not only on the physical aspects.

III. METHODOLOGY

Different %ages of plastic waste with concrete mix are used for determine the various changes in the concrete with respect

to its strength. Some important tests who proposed for this study are listed below:
1) Different tests on cement
2) Different tests on aggregate
3) Compressive strength test

IV. STUDY AREA

Solid Plastic waste will be carried out from Chandigarh waste industries. These materials will be mixed partially with concrete, and various tests will be performed in the college laboratory.

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