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Management of Building Demolition Waste by Partial Replacement of Coarse Aggregate with Broken Bricks in Concrete and Construction of Road

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Abstract*— Issue related to the scarcity of good and quality of coarse aggregate has kept the construction industries into a crisis in findings an alternative to overcome this situation. The issue is worsening as the current aggregate used in the construction industries are non-renewable aggregates from the quarrying activities. Fast development in the recent years indeed has increased the need of coarse aggregate in the alarming rate. Besides that, the growth of the construction industry has also produced lots of product mainly the waste materials. The high amount of construction waste generated from the construction industries has caused a scarcity of the landfill area. The aim of this study is to determine the suitability of broken bricks as partial replacement of coarse aggregate in concrete production. Furthermore, to investigate the mechanical and physical properties of broken brick used concrete, and to compare the performance of broken brick as partial replacement of coarse aggregate in concrete with the conventional concrete. In order to fulfil the objective, there are tests that were conducted to determine concrete performance, such as compressive strength test, slump test and impact test. With the different mix proportion in percentages of the broken bricks as coarse aggregate replacement of 10% and 20% in the equivalent strength of grades 25 was done and the results were analysed. From the results, we found that the optimum strength was achieved at 20% brick waste mix proportion and was higher compared with the conventional concrete of grade25.

Keywords*— quarrying activities, waste material, partial replacement, broken bricks, conventional concrete

I. INTRODUCTION

In a developing country, consumption of different materials such as fine aggregate and coarse aggregate is high due to developing infrastructure for the development. Sand has been used as a fine aggregate since ages and is definitely one of the oldest and most widely used construction materials in today's world. Fine aggregate is available easily and is also economically feasible. The concrete industry, on the other hand, is one of the major consumers of natural resources. The yearly production of concrete is estimated as ten billion metric tons, in which 60–70% of the quantity is aggregate (natural rock), 18% is water, and 15–20% is cementations binder. Conventionally, the coarse aggregates used in concrete productions are gravel, crushed stone, granite, and limestone. Aggregates properties are playing a big role in concrete as it can affect the strength, the durability and workability of plastic concrete, and density of hardened concrete. The stripping of the land by quarrying process that keeps widespread without supervision has caused to a depletion of natural aggregate. Thus, it is affecting the environment to landslide, land erosion and also to global warming. Other than that, the cost of construction materials that keeps increasing day by day due to high demand, high price of energy and inadequacy of raw materials. Moreover, the increase in transportation cost due to raw materials, demand, environmental restrictions etc., it is necessary to search functional replacement for conventional building materials in the construction industry. The scarcity of good and quality coarse aggregates has now become an issue that keeps pressing hard to construction sector mostly in many construction processes.

For conservation of natural resources, the consumption of alternative component in construction materials has become a necessity now and also for the bright future prospect. This resulting the development and extensive research works towards discovering new ideas that is required for inventing a sustainable and environment friendly construction materials. In this project we have utilized broken bricks as a partial replacement of coarse aggregate, considering various factors like environmental aspects, ease of availability, cost of construction etc. Materials used in the construction of the concrete blocks are cement, fine aggregate, course aggregate and water. Here cement is a substance which binds the other components together and ordinary Portland cement is used for construction of the cubes.

The fine aggregate used is natural sand. The properties of these aggregates depend upon their stream. The fine aggregates were passed through 600micron IS sieve. The broken bricks were passed through 20mm IS sieve and retained on 16mm IS sieve. We have utilized broken bricks as 10% of the coarse aggregate in the first case and in the second case broken bricks used were 20% of coarse aggregate for testing purpose. Water is used for the purpose casting and curing of specimen.

1.1 ECONOMY

Any construction to be done should be economical. Concrete is the base material for construction industries. Coarse aggregate filled almost 70% of volume in concrete. The cost of coarse aggregate is rapidly increasing and also the availability of the aggregate is getting reduced. The major cost of the concrete is belonged to the aggregate. Various quarrying processes which have resulted in significant depletion of natural aggregate and are also contributing to severe environmental issues like soil erosion. Therefore, it is essential to develop profitable construction materials. Keeping this in view, replacing various percentage of coarse aggregate with broken bricks, the use of broken bricks is one of the good alternatives to overcome the problems like soil erosion and protecting various natural resources so that they can be used in a sustainable manner.

Advantages

1. Readily available and economical for poor areas.
2. Less waste is generated.
3. Exploitation of natural resources is reduced.

Disadvantages

1. Strength of concrete is highly dependent on the class of the bricks chosen.

1.2 RESEARCH IMPORTANCE

With the construction project is keeps increasing years after years, the production of natural resources has been affected to depletion. Construction waste has become a global issue. The waste that been generated through every year have resulted in environmental troubles and global warming problems in the world. As a developing country, India also has been affected by this construction waste problem in the same situation with the rapid development of the construction sector. The statistics of construction waste that's been produced have shown that almost 10 to 30 percent originate from construction and demolition activities. The existing aggregate used are non-renewable coarse aggregate and also the reason for the scarcity of aggregate. It takes many years for a natural coarse aggregate to be reformed again after being excavated. With the lack of coarse aggregate, it will significantly affect the production of good concrete. India produces about 15-20 million of constructional waste annually. With only a few landfill sites in India, dumping has become a major issue along with growing environmental issues related to it. With the help of this project, we have tried to find the possibilities of using broken bricks in concrete as a coarse aggregate. The results about strength, workability, different properties were compared with conventional cement concrete.

The partial replacement of coarse aggregate by broken bricks may reduce the exploitation of natural aggregate and various environmental issues.

1.3 OBJECTIVES OF STUDY

1. To study the influence of partial replacement of coarse aggregate by broken bricks.

2. To carry out a comparative study to optimize the quantity of broken bricks with the partial replacement of coarse aggregate.

3. To carry out the comparison between the different properties when replaced by the various percentages of broken bricks in road construction.

4. The work involved testing of concrete made with 10% and 20% replacement of coarse aggregate with broken bricks and comparison of properties used in road construction on partial replacement of coarse with broken bricks. The aim waste determines whether partial of coarse aggregate with broken bricks could give the desired strength of M25 concrete.

1.4 LIMITATION OF THE STUDY

1. Only OPC-43 grade cement was used in the study.
2. The brick used is of second class.
3. Tests were carried out in temperature controlled environment.

II. CONCLUSIONS

From the project study, it can be concluded that demolished waste aggregate (broken bricks) can be satisfactorily utilized as a constituents of concrete of grade M25 by using it as a replacement of natural coarse aggregate at 10%, 20% of the total weight of coarse aggregate. By comparing the results obtained from the study, it can be seen 20% of replacement coarse aggregate by demolished waste aggregates (broken bricks) gives slightly higher strength of concrete than 10% replacement of coarse aggregate. The use of 20% of waste aggregate as coarse aggregate for M25 concrete will ensure that waste aggregate are put to large scale use, thus enabling reuse of waste materials instead being dumped in landfills.

We have also compared the different properties of coarse aggregate used in road construction on 10%, 20%replacement with waste aggregates (broken brick). From the impact value test, it can be concluded that both10% and 20% replacement of coarse aggregate with waste aggregate can be used for both road construction and concreting purposes. As the impact values 16.2% and 14.5% for 10% and 20% respectively are in range of 10-20%. The aggregates having impact values in this range are classified as ‘strong ‘and they are easily able to withstand high stresses due to traffic load, wear and tear etc. The impact value obtained is 22.7% and therefore can be used in bituminous concrete pavement as recommended by Indian Road Congress.

Thus from the experimental investigation carried out it can be concluded that waste aggregates of broken bricks can be satisfactorily used in concrete as replacement of coarse aggregate in concrete and in road construction aggregate.

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3. IS 1199:1959 – Indian Standard Methods of Sampling and Analysis of Concrete. Clause 3, Clause5.1.2, Clause 5.1.3, Clause 5.1.5
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