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PARTIAL REPLACEMENT OF FINE AGGREGATE WITH BRICK DUST: A REVIEW

Anayat Ali[1], Shamshad Alam[2]
[1]*M.Tech student, Department of Civil Engineering, Sharda University,*
[2]*Assistant Professor, Department of Civil Engineering, Sharda University,*

Abstract- The widely used material in infrastructure development and construction throughout the world is concrete and mortar. A significant role in the mix design is played by fine aggregate and coarse aggregate which are the prime material used for the preparation of mortar and concrete. River sand is becoming a scarce commodity nowadays. Hence the manufactured sand is playing a major role in the construction industry nowadays. The natural resources due to excessive use are also exhausting very rapidly. Shortage of fine and coarse aggregate may affect construction industry directly, therefore there is a need to find an alternative material which can replace fine aggregate or coarse aggregate fully or partially so that the damage due to excessive erosion to the environment is prevented.

Thus the replacement of fine aggregate and coarse aggregate became a necessity in the recent times and this partial or complete replacement will contribute a lot to nature and environmental problems created due to excessive use and dumping of brick debris or construction waste. This research review will discuss the partial replacement of fine aggregate with brick dust and how to reduce the dependency on the natural resources such as sand used as fine aggregate and provide a new way to dispose of waste brick debris. Different replacement levels 10%, 15%, and 20%, will be checked. Different tests showed that the compressive strength is enhanced by using optimum percentage replacement of natural fine aggregate with brick debris compared to conventional mortar and concrete.

Keywords: Fine aggregate, brick dust, sand, mortar.

I. INTRODUCTION

India is 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. Sand has a big value in concrete and the construction industry. The widely used material in the construction industry is concrete and mortar. 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.

Fine aggregate and coarse aggregate are used enormously in the construction of different projects like airports, highways, skyscrapers, nuclear plants, dams, etc. Also, the demand for these materials is high in privatization and globalization. To meet this high demand for coarse and fine aggregate the increased extraction from the natural resources is required. Fine aggregate is one of the important constituents in concrete and mortar. Natural resources are also getting exhausted in meeting this high demand for fine aggregate in the construction industry. The construction industry will be directly affected due to the shortage or non-availability of the natural sand, as natural resources are depleting, finding an alternative material for the partial or complete replacement of natural sand is needed, such that we can prevent the damage to the environment. Else this will lead to an ecological imbalance due to the increasing use of natural fine aggregate. Thus, the need of an hour is to find the partial replacement of fine aggregate for construction industries. Many Researcher's and Engineers are working with their ideas to find an alternative way to partial or complete replacement of fine aggregate so that the natural resource consumption can be decreased. These days sustainable infrastructural development needs an alternative material that can satisfy technical properties of fine aggregate and should be available easily economically, domestically with a great amount.

Bricks are an integral part of the house and are widely used in the construction of houses in rural areas. Bricks can be used as a fine aggregate and recyclable construction material. People are using bricks from decades that time bricks were only dried in sunlight and used for construction purposes, due to which the sundried bricks don't have sufficient strength compared to fire dried bricks. Fire dried bricks have very high strength and resistance compared to the sun-dried bricks. Technology has changed everything these days different types of machinery are available by the help of machinery different types of bricks with different material and shape are made. But the most preferred material for fire bricks till now is clay. Different variety of materials is available now but clay is the most preferred on the industry level. The most common building material used since decades are bricks for the construction of houses and different structures. A replacement need occurred as natural sand is a limited natural resource and brick debris can be crushed in a crusher and used as fine or coarse aggregate. Brick is a commonly used construction material and can be found in different types. Spent fire bricks are the bricks which are disposed of after the use. This Spent Fire Brick waste should be disposed of properly without creating environmental and different problems in the area. Commonly these brick wastes are dumped of by landfilling. Bricks are also used as landfilling material. Brick waste used as fine or coarse aggregate is easily available, cheap and enhances strength in mortar and concrete. It also affects the different properties in the fresh state and hardened state of the concrete and mortar.

II. LITERATURE REVIEW

Development and construction of different structures are directly associated with civil engineering construction of any structure needs construction material like sand, stones, bricks, cement, concrete, steel, glass, and wood, etc. The demand for these materials is high in the construction industry for sustainable development, which means using renewable resources so that natural resources are saved and environmental pollution is prevented. Keeping this thing in mind reuse and recycle of waste material from the demolished building site is needed. Finding an alternative replacement for natural fine aggregate and coarse aggregate has been inattention of many scholars and researchers recently. Different materials have been tried already such as glass waste, wooden waste, plastic, and other waste materials.

Gamashta and Gumashta (2006) experimented by using concrete and masonry waste material to check different properties and suggested some useful comments for further research and enhancement of the life of the structure considering the cost of the structure to be economical [1].

Lakshmi and Nivedhitha (2015) did experiments and investigated the changes in compressive strength, flexural strength and tensile strength by replacing the natural fine aggregate and natural coarse aggregate with the recycled fine and coarse aggregate [2]. Different partial replacements were made 10%, 20%, and 30% of natural fine aggregate and coarse aggregate with recycled fine and coarse aggregate. Tests were done on the concrete and results were compared. They found out that the compressive and tensile strength increased at 20% replacement of fine and coarse aggregate with recycled aggregate. And the flexural strength was decreasing with the increase in percentage replacement of natural fine aggregate and coarse aggregate.

Nili et al. (2012) made a study on the concrete to use different type of waste materials as a partial replacement for aggregates and even cement, potentially as a friendly environmental construction material Six type of waste materials include: recycled concrete aggregate (RCA), waste glass of all kinds mostly (container glass, thin film transistor liquid crystal display [TFT-LCD], crushed clay brick aggregate, polyethylene (PET), scraped PVC pipes, rubbers various plastic types, recycled ceramic materials from sanitary installation and recycling ornamental stones (Granite and Marble) [3]. Different properties were recorded for all the categories of recycled materials, to determine the use and importance of these materials in the concrete and mortar. The material should be economical and environmentally friendly; this has been kept in view.

Sriharsha and Murthy (2014) made a study on different samples by replacing the aggregate with demolition debris from old structures, blast furnace slag from iron ore industries [4]. Various tests were done on the physical and mechanical properties of the concrete. Strength at different replacements was recorded and compared to the different concrete mix.

Kumar and Siva (2015) focussed on the usage of demolition waste like ceramic tiles, crushed bricks as partial replacement of natural coarse aggregate in concrete [5]. Different tests like compressive strength, workability test were done on the resultant concrete and compared with the conventional concrete. The workability of the concrete decreases to some extent but the strength enhancement and light weight of the concrete can be seen considerably.

Finding a partial replacement for sand with demolition waste as an aggregate without altering the properties of the conventional concrete is effectively studied and utilized so that it can contribute towards environmental problems and solid waste management.

Kumar et al. (2016) in this research replaced the natural fine aggregate (sand) partially with the coal bottom ash by different percentages 10, 20, 30, 40, and 50% [6]. The grade of concrete was M25 and different properties were studied. Bottom ash forms 25% of the total ash and the remaining 75% is formed by fly ash. The workability of the concrete reduced to an extent due to the replacement of fine aggregate by bottom ash in the concrete. It was concluded that coal bottom ash can be used as a partial replacement to the fine aggregate in concrete up to a limit of 15%-20% by weight of the aggregate.

Samanth and Prakhar (2016) replaced coarse aggregate and fine with the recycled and demolition debris in the concrete to study the different properties of concrete [7]. The test was performed to study the property of concrete prepared by replacement of cement. So that without polluting the environment these wastes can be utilized.

III. FUTURE SCOPE

- Dependency on natural sand will be reduced due to the replacement of fine aggregate.
- There will be strength enhancement by using an optimum percentage of brick dust compared to the conventional mortar and concrete.
- Bricks are easily available in India, due to which partial replacement is possible and economical too.
- Fine aggregate and coarse aggregate are the natural resources and are limited in nature, thus fire bricks can be the best alternative for fine aggregate.

IV. CONCLUSION

Based on the literature, brick debris or construction waste can be used as partial replacement of fine aggregate. We get a lot of waste material from the demolition site causing environmental pollution that construction waste can as partial replacement to fine aggregate or coarse aggregate. Therefore we need to find the optimum percentage replacement of fine aggregate so that the durability may not get affected.

We can get environmental friendly mortar and concrete by partial replacement of fine aggregate with brick dust as brick debris waste from demolished structures can be consumed by this method without causing the environmental problems.

As per literature, results indicate that there is a strength enhancement at 15% replacement of fine aggregate with brick debris. Therefore we can say that 15% is the optimum replacement that can be achieved compared to conventional mortar and concrete.

Also, other waste material from industries and agriculture can be appropriately utilized in construction work after the proper durability check to save our environment from the pollution caused due to these wastes. Our environment can be less polluted also the mining can be reduced to some extent by introducing recycling of wasted bricks and stone. Earth can be saved from ecological disturbances caused due to these activities. The study will minimize the overall pollution of the environment.

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