ABSTRACT

Initially for a long period concrete was considered as a durable material which requires a little or no maintenance and it was true except a test subjected to very hostile or aggressive environments. Concrete is the premier construction material across the world. It is most widely used in all types of civil engineering infrastructure and environment protection, local/domestic developments. Concrete is a manufactured product, consisting of cement, aggregates and water. Among these, aggregates, i.e. sand, crushed stone or gravel form the major part. Now a day’s the use of aggregates from natural resources has been questioned at an international level. This is mainly because of the greater awareness of environmental protection. A large proportion of potentially useful material i.e. recycled coarse aggregate disposed of as landfill. The results of this experimental program aimed at examining the performance of cement concrete produced with natural and recycled coarse aggregates.

Concrete is one of the most versatile construction materials of the 20th century because of its popularity, which include its easy mouldability, excellent fire and water resistance, cost effectiveness and aesthetics. Without concrete it would have been almost impossible to contemplate modern day structural marvels. Therefore, it is imperative to ensure intended performance of concrete to safeguard huge amount of investment sunk into civil engineering infrastructure.

Sustainable development is gaining popularity around the globe in present’s era. Most of policy makers are under pressure, on many fronts, to embed sustainable development in policies, practice, and operations to secure the planet’s future.

For the conservation of natural resources, reuse and recycling of Construction and Demolition (C&D) waste are the most obvious way to achieve sustainability in the construction sector. Currently, recycled aggregate (RA) is produced from C&D waste in modern recycling facilities, under good quality control provisions which could lead to improve its performance compared with the earlier days of recycling. A concrete produced with recycled aggregate concrete (RAC) is obviously more sustainable and economical than conventional natural aggregate concrete (NAC).

Although there is a critical shortage of virgin aggregate, the availability of demolished concrete for use as recycled concrete aggregate (RCA) is increasing. Using the waste
concrete as RCA conserves virgin aggregate, reduces the impact on landfills, decreases energy consumption and can provide cost savings. Recycled aggregates are the materials for the future. The application of recycled aggregate has been started in many Western countries and Asian countries for construction projects.

The effects of up to 100% recycled coarse aggregate concrete on a range of durability properties have been established and assessed its suitability for use in a series of various applications.

An experimental research study has been conducted for comparing and studying the effect of replacing natural coarse aggregate with recycled coarse aggregate with 20%, 40%, 60%, 80% and 100% by weight in M20, M25, M30, M35, M40, M45, M50, M55 and M60 grade concrete. The testing is just carried out for 28 and 56 days of casting. The resting specimen was prepared for M20, M25 and M30 grade low strength concrete, for M35, M40 and M45 grade medium strength concrete and nearly at 40% replacement of recycled coarse aggregate the strength is achieved. For M50, M55 and M60 grade high strength concrete and at 20% replacement of recycled coarse aggregate the strength is achieved. The comparison has been made on the basis of Compaction Factor Test, Compressive Strength Test, Flexural Strength Test, Split Strength Test, Modulus of Elasticity, Water Absorption Test and the effect of Sea Water Attack Test, Alkali Attack Test, Sulphate Attack Test and Chloride Resistance Test for durability. The effects of up to 100% recycled coarse aggregate concrete on a range of rheological properties, mechanical properties and durability properties have been established, which can be used in various applications like pavement, mass concrete work, foundation work etc.

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 advanced development in the infrastructure area. In order to reduce the usage of natural aggregate, recycled aggregate can be used as the replacement materials. Recycled aggregates are comprised of crushed, graded inorganic particles processed 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.

The aim of this research work is to determine the strength characteristic of recycled aggregates, for application in structural concrete, which will give a better understanding of
the properties of concrete with recycled coarse aggregate, as an alternative material to natural coarse aggregate in structural concrete.

Concrete is the most widely used construction material across the world. It is used in all types of civil engineering works like infrastructure, low and high-rise buildings, defense structure, and environment protection structure. Concrete is a man-made product, essentially consisting of cement, coarse and fine aggregates, water and/or admixture(s).

Recycling of concrete is needed from the viewpoint of environmental preservation and effective utilization of resources. At present, utilization of recycled aggregate is limited mainly to sub bases of roads and backfill works. A large portion of concrete waste ends up at disposal sites. It is anticipated that there will be an increase in the amount of concrete waste, a shortage of disposal sites, and depletion of natural resources especially. This leads to the use of recycled aggregate in new concrete production, which is deemed to be a more effective utilization of concrete waste. However, information on concrete using recycled aggregate is still insufficient, and it will be advisable to get more detailed information about the characteristics of concrete using recycled aggregate.

COMPARISON OF RECYCLED AND NATURAL AGGREGATE:

• TEXTURE: Recycled aggregate has the rough – textured, angular and elongated particles where natural aggregate is smooth and rounded compact aggregate. The properties of the freshly mixed concrete will be affected by the particle shape and surface texture of the aggregate. The rough – texture, angular and elongated particles require much water than the smooth and rounded compact aggregate when producing the workable concrete. The void content will increase with the angular aggregate where the larger sizes of well and improved grading aggregate will decrease the void content.

• QUALITY: The quality is different between recycled aggregate and natural aggregate. The quality of natural aggregate is based on the physical and chemical properties of sources sites, where the recycled aggregate is depended on contamination of debris sources. It also stated that natural resources have suitable for multiple product and higher product larger marketing area, but recycled aggregate have limited product mixes and the lower product mixes may restrain the market.
• DENSITY: The density of the recycled concrete aggregate is lower than natural aggregate. Density of recycled aggregate is lower than the fresh aggregate because of the porous and less dense residual mortar lumps that is adhering to the surfaces. When the particle size is increased, the volume percentage of residual mortar will increase too.

• STRENGTH: The strength of recycled aggregate is lower than natural aggregate because of the weight of recycled aggregate is lighter than natural aggregate. This is the general effect that will reduce the strength of reinforced concrete.

The major challenges of our present society are to protect the environment. Some important elements are to reduce the consumption of energy and natural raw materials. This research is getting considerable attention under sustainable development nowadays. The use of recycled aggregates from construction and demolition wastes is showing positive application in construction as an alternative to natural aggregates. It conserves natural resources and reduces the space required for the landfill disposal.

A durable concrete is one that performs well and satisfactorily under different aggressive and hostile environment during its long life service span. Concrete is a well-known building material obtained by mixing the cement paste with aggregates and water.

Sometimes material other than traditional like admixture is added to concrete before or during mixing, to provide a more economical solution and enhanced concrete properties. It is difficult to imagine the modern infrastructure development without concrete. It finds wide application in buildings, roads, bridges and dams, among others.

The most important properties of hardened concrete are its compressive strength and durability. The factors that favor concrete strength usually benefit its durability except the thickness of concrete cover. Factors that affect the strength and durability of concrete include quality and quantity of cement used in a mix, grading of aggregates, maximum nominal size, shape and surface texture of aggregate, water/cement ratios, curing method, the presence or otherwise of clay particles and organic matter in the mix, as well as aggressive agent that attack concrete externally or internally.

Other factors affecting concrete durability include the use of admixtures, employment of cement, concrete compaction, bacteria, chloride ions, carbon dioxide, alkali reactive particles and abrasive action attack etc. by reacting chemically with various components.
The scope of this project is to determine and compare the strength of concrete by using different percentage of recycled coarse aggregates.

The investigation is carried out using workability test, Non Destructive testing (NDT) (Rebound hammer test), Compressive strength, Split strength, Flexural strength. There were total of fifty four batches of concrete mixes, consist of every 20% increment of recycled coarse aggregate replacement from 0% to 100% for M20, M25, M30, M35, M40, M45, M50, M55 and M60 Grade of Concrete.

The proposed experimental work is aimed for comparative study of various design mix inclusive of low strength, medium strength and high strength with different proportion and partial replacement of coarse aggregate.