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PERFORMANCE OF RECYCLED CONCRETE WASTE FOR RE-USE AS ROAD BASE MATERIAL

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***Abstract*:** Any construction activity requires several materials such as concrete, steel, bricks, stones, glass, clay, mud and wood. However, the cement concrete remains the main construction material used in construction industry. For its suitability and adaptability with respect to the changing environment the concrete must be such that it can conserve the sources, protect the environment, economize and lead to proper utilization of energy. To achieve this, major emphases must be laid on to the use of wastes and by-products in cement and concrete used for new constructions.

The utilization of recycled concrete waste is particularly very promising as 75% of concrete is made up of aggregates. In that case the aggregates considered are pavement, recycled concrete, quarrying wastes, culvert and burnt clay.

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 aggregates and used in new constructions.

Research investigation conducted by the Environmental Resources Ltd (1979) for European Environmental commission (EEC) envisages that there will be enormous increase in quantities of Construction and Demolition concrete waste from 55 million tons in 1980 to 302 tons by the 2020 in the EEC member countries.

The main reasons for increase of volume of demolition concrete and masonry waste are as follows:

i. Many old buildings, concrete pavements, bridges, and other structures have overcome their age and limit of use to structural deterioration beyond repairs and need to be demolished.
iii. New construction for better economic growth.
iv. Structures are turned into debris resulting from natural disasters like earthquakes, cyclones and floods.
v. Creation of building wastes resulting from man- made disasters.

Key words: masonry waste , recycled concrete waste, man – made disasters, quarrying wastes and Demolition concrete waste.

I.INTRODUCTION

Western Kenya is considered to be a region with very high agricultural and economic potential. This region is endowed with rich and fertile hinterland which has enabled the inhabitants to undertake large scale sugarcane, tea and maize farming activities.

Several sugarcane and tea factories and maize milling industries are located in this region.. There are quite a large number of trucks and factors involved in either delivering or supplying agricultural products and inputs to the farmers or factories in the region. High volume of traffic and movement of associated activities in this region have contributed to high rate of deterioration of roads.

In 2022/2023 the Kenyan Government spent up to Kshs 61.8 billion on road maintenance and rehabilitation countrywide. About 50% of this amount was spent on rehabilitation of roads in western region.

The objective of this study is to determine the sustainability of recycled concrete waste materials as a road base material to provide economic and environmental solution to this critical infrastructure problem.

World Bank studies estimates that Kenya generates 3000 to 4000 tons of solid waste and materials per day and majority of these wastes originate from construction sites where old buildings and structures are found. This study aims at confirming that recycled wastes are as good as fresh and virgin aggregates excavated from quarries. They possess all the necessary engineering properties and their usage within the civil engineering environments can save the government considerable amount of money which can be used into expansion of more roads.

There are a wide range of benefits that accrue from use of demolished concrete waste which include;reduced haul off costs, minimal negative environmental effects arising from fill disposal and quarrying activities which contribute to pollution effects and also saving the energy sector several billions of fuel.

II. METHODS AND MATERIALS

These are largely inert particles that are bound together by a cementing agent. The critical property of aggregates that influence the strength, durability and work-ability of concrete are grading, hardness, shape and cleanliness.

The demolished concrete wastes were obtained from Kakamega and Bungoma towns.

concrete debris from demolished structures

The concrete waste materials were further crushed into smaller particles using rubber mallets and exposed to open air.

concrete debris being crushed

2.2.Riffling

This activity was necessary and it involved splitting of the samples into halves using a riffle box.The sample was discarded into the riffle over its full length and the two halves collected into two boxes on each side.
One half was discarded, and riffling of the other half was repeated until the sample .was reduced to the desired quantity for testing.

riffling of aggregates

2.2.2 Sieve Analysis of the materials.

The crushed materials are said to be graded when they contain different sizes of particles in suitable proportions. Grading of aggregates is important as it helps to provide minimum voids created by the larger particles. It also improves work ability considerably. Sieve analysis therefore enables us to determine the proportion of different particles in an aggregate sample. The results of sieve .analysis are given in terms of % of the total aggregate passing through each of the sieve size.

The sieve sizes used according to BS 1377

weighing of the crushed concrete aggregates

2.2.3 Weighing of the sieved aggregates

Ten different samples of Sieved aggregates were weighed and analysis of the sieved aggregates tabulated and graphs plotted indicating the values obtained.

2.2.4 Compaction and Unconfined Compression Tests

After sieving 10 samples of the sieved materials are then used for testing of the Optimum Moisture Content (OMC) and Dry Density Content (DDC). This is done after some water is added to the samples and placed into the moulds.

compaction process

UCS tests are done using vibrating hummer machine.

III. RESULTS AND DISCUSSIONS

The tables and graphs below show the results obtained from the particle size distribution tests, Dry Density Content tests(DDC), Optimum Moisture Content tests(OMC) and Unconfined Compression Soil Tests(UCS

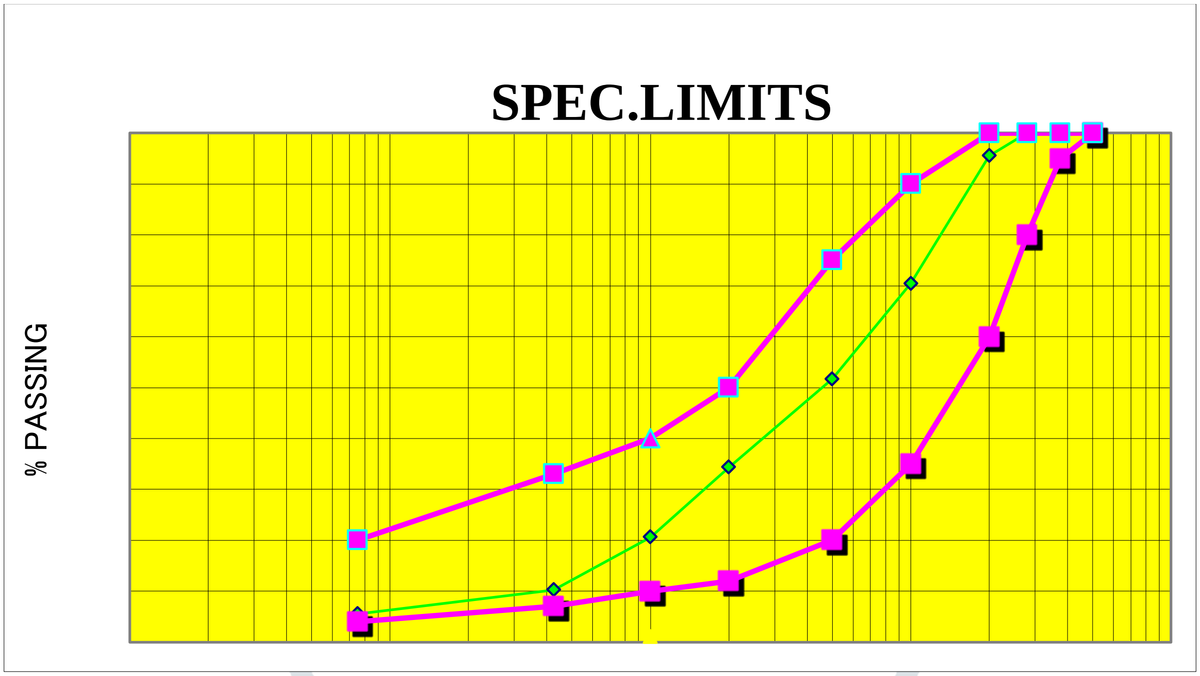

Figure 1 particle size distribution of the Recycled Concrete Waste materials

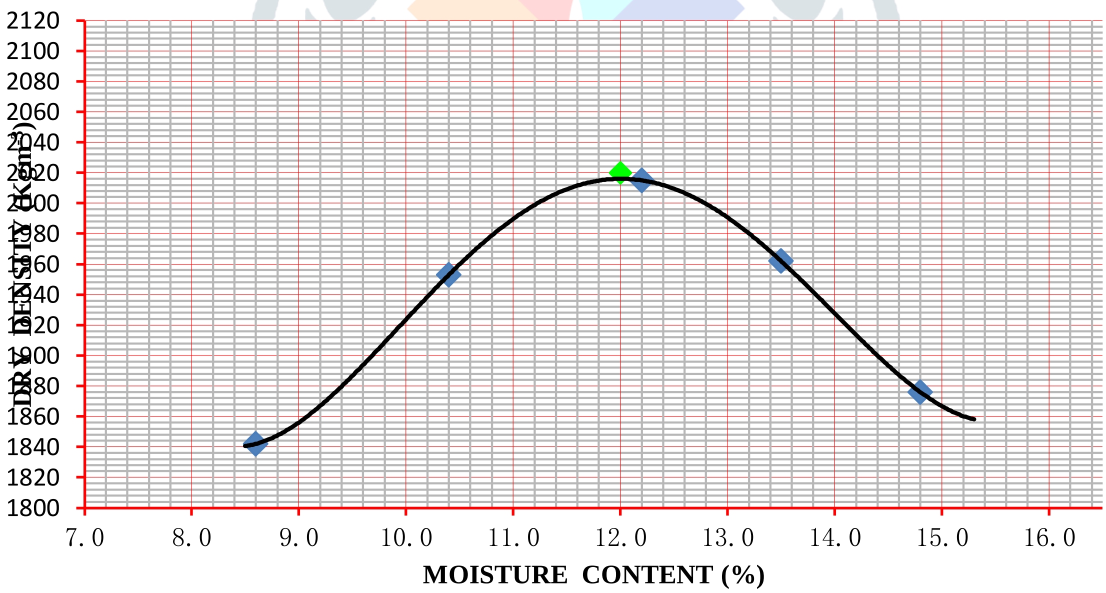

Figure 2 Maximum Dry Density Content and the Optimum Moisture Content of the Recycled Concrete Waste material

IV. RECOMMENDATIONS AND CONCLUSIONS

Based on the investigation carried out on this study on the properties of demolished concrete waste materials from various civil engineering structures the following conclusion was arrived at.

That whatever is considered as waste from demolished concrete structures has very high potential for re-use as Base Material for road construction in Kenya and many other developing countries.This is because of the high level of compressive strength that these waste materials posses.

However further research is required to ascertain if additional material can be added into recycled material to improve its properties as a road base material for heavy traffic loads.

There are many environmental and economic benefits of recycling concrete waste rather than dumping it or burying it in a landfill. Governments will save lot of money from road construction by recycling concrete wastes as a road base material. There will be cheaper source of aggregates than having newly mined aggregates obtained from quarrying activities.There is reduced need for landfill for concrete debris thus reduction on pollution and environmental degradation.Using recycled material as gravel reduces the need for gravel mining..

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