To STUDY OF REPLACEMENT OF QUERRY DUST WITH SAND

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Abstract
This investigation aims to come up with a mix proportion for concrete class 20 by the use of quarry dust instead of normal river sand for concrete mix.India has currently undertaken a major initiative on development of infrastructures such asexpress highways, power projects, industrial structures, the construction of buildingsand other structures, in order to meet the requirements of globalization in itsVision2030.Concrete plays the key role towards this development and a large quantum ofconcrete is being utilized in every construction practice. River sand, which is one of the major constituents used in the production of concrete, has become very expensiveand also becoming scarce due to the depletion of river beds. uarry dust is a waste obtained during the quarrying process. Quarry dust has very recently gained good attention to be used as an effective filler material instead of sand. The use of quarry dust as a fine aggregate decreases the cost of concrete production in terms of the complete replacement and even partial replacement of natural river sand.The environmental impact of river sand mining on river beds, the expensive and rising cost ofmanufactured sand, the cheap and good accessibility of quarry dust, are the main motivationsbehind the undertaking of such a project.This research will report the experimental study which investigates the proportion by weightof quarry dust to acquire similar concrete strength with 20%, 40%, 50%, 60%, 80% and

keywords- sand, concrete ,structure, environmental

1 INTRODUCTION

Concrete is a composite construction material made primarily with aggregate, cement, andwater. There are many formulations of concrete, which provide varied properties, and concrete is the most-used man-made product in the world. Concrete is widely used for making architectural structures, foundations, brick/block walls, pavements, bridges/overpasses, motorways/roads, runways, parking structures, dam s, pools/reservoirs, pipes, footings for gates, fences and poles and even boats.

Concrete is a manmade material used in the building and construction industry and consists of aggregates which are bonded together by cement and water. The major constituent of concrete besides the cement is the aggregate. Various types of aggregates that may beused include sand, crushed-stone, gravel, slag, ashes, burned shale, and burned clay. Fine aggregates refer to the size of aggregate used in making concrete slabs and in providing smooth surfaces. Coarse aggregates are used for massive structures or sections of Concrete. Historically the word concrete comes from the Latin word "concretus" (meaning compact or condensed). During the Roman Empire, Roman concrete (or opus caementicium) was made from quicklime, pozzolana and an aggregate of pumice. Its widespread use in many Rom an structures, a key event in the history of architecture termedthe Roman Architectural Revolution, freed Roman construction from the restrictions ofstone and brick material and allowed for revolutionary new designs in terms of both structural complexity and dimension. Concrete, as the Romans knew it, was a new and revolutionary material. Laid in the shape of arches, vaults and domes, it quickly hardened into a rigid mass, free from many of the internal thrusts and strains that troubled the builders of similar structures in stone or brick. Modern structural concrete differs from Roman concrete in two important details. First, its mix consistency is fluid and homogeneous, allowing it to be poured into forms rather n than requiring hand-layering together with the placement of aggregate, which, in Roman practice, often consisted of rubble. Second, integral reinforcing steel gives modern concrete assemblies great strength in tension, whereas Roman concrete could depend only upon the strength of the concrete bonding to resist tension. Since the discovery of concrete as a revolutionary building material, there has been no looking back for concrete since its modern development. Known as the strongest building material, concrete has found major uses in dams, highways, buildings and many different kinds of building and construction. The Romans made many developments in concrete technology including the use of light weight aggregates as in the roof of the Pantheon, and embedded reinforcement in the form of bronze bars. There are so many types of concrete with different applications in the constructions; for example pre-stressed concrete and reinforced concrete for carrying enormous loads. Different types of concrete are produced depending upon the required end application. The modern types of concrete include cellular or aerated concrete which is light weight and durable, making it easy to be handled. Another material used in the formation of concrete is quarry dust as replacement material of sand. Quarry dust is classified as fine material obtained from the crushing process during quarrying activity at the quarry site. In this study, quarry dust will be studied as replacement material of river-sand as a fine aggregate for concrete.Quarry dust has been in use for various

activities in the construction industry such as for road construction and manufacture of building materials such as lightweight aggregates, bricks, tiles and autoclave blocks.

1.1 PROBLEM STATEMENT

Concrete plays the key role in construction and a large quantum of concrete is being utilized in every construction practice. River sand, which is one of the constituents used in the production of concrete, has become very expensive and also becoming scarce due to the depletion of river beds. Due to size specification, the material selected to substitute this purpose is Quarry Dust since it is a fine waste material and its utilization as sand replacement could perhaps increase the Strength of concrete to enhance the properties of concrete at the same time resulting in a cheaper concrete mix.

1.2 COST OF CONCRETE

The cost of concrete stems from the costs of its constituent materials such cost can be reduced by using easily available resources which have the desired properties but can be obtained locally and in abundance. The continued over exploitation of the of the materials results in straining of the available sources which has a direct impacting the construction industry translating as a rise in material prices. This explains the upsurge in the cost of construction in the recent years. This high material cost prompts the need for an alternative material that will still have similar or better qualities but is cheaper in terms of availability and cost of material per ton. Much research has been done on the on the use for alternatives for cement such as rice husk ash and pozzolana but a lot is still required in finding a local replacement for the fines used in concrete production yet they form a high percentage of the concrete mix by volume. Of major interest in this project is the replacement of sand with a locally available alternative.

1.3 NEED FOR ALTERNATIVE MATERIAL

Currently, India has taken a major initiative in developing its infrastructure such ashighways, dams, industrial structures and power projects to meet its globalization requirement. Concrete thus plays a big role and large quantities are being utilized, so there is high demand like resources like river sand which has become highly expensive and scarce, transportation of river sand from its sources also an increase the cost of producing concrete.

There is thus a need for alternative materials from industrial waste to act as sand replacement and thus address the problems inherent in the use of sand as fine aggregate. In such a case, quarry dust can be an economical alternative to river sand. Quarry rock dust can be defined as residue or other non-voluble waste materials that are products of the extraction and processing of rocks to form particles less than4.75mm. The ready availability of the dust and its effect when left to accumulate leads to the need to use it as sand replacement material. Though it can also be used as a surface finishing in highway construction works.

1.4 DEMAND FOR CONSTRUCTION PRODUCTS

With an increasing demand for construction products, comes the obvious depletion or strain of these limited resources. So there arises a necessity to develop and produce the construction products in a manner that ensures minimal input in terms of cost and expenses but still be able to achieve same or even better results than the conventional methods of concrete production. Modern day has enabled cutting edge technological advances to be applied in the construction industry thus accurate test can be done on different types of specimen without much effort. Experiments have thus been done involving the replacement of locally available material like rice husk ash and pozzolana to reduce production cost while at the same time making proper use of these material that would be otherwise be considered as a waste. Because cement is mostly produced in factories, its extraction and exploitation are done in a controlled environment, but constituents like sand and ballast have to be extracted from there unregulated sources like quarry sites, river beds, sand quarries etc. During the processes of extraction and exploitation of the needed raw material, effects occur to the immediate environment where these raw materials are extracted. These effects are mostly destruction of land used for mining through defacing and generally gullies and holes that make an otherwise productive land lose its natural usability. In cases of exploitation of river sand, so much destruction is done to our marine life that the environment starts giving us negative results and leads to loss of whole species of aquatic life. The exposure of the river banks can act as easy target to erosion agents.Cement consumption in India over the years

1.5 SIGNIFICANCE OF THE STUDY

The study seeks to determine the suitability of quarry dust to be used in concrete and come up with optimum mixes the concretes. Different cubes and cylinders will be made containing varying proportions of quarry dust and sand, and the mix proportion yielding the maximum compressive and tensile strength shall be selected as the ratio for the optimum mix.

1.6 MAIN OBJECTIVE

To make full use of the advantages offered by quarry dust and to minimize river bed exploitation due to sand mining, and form a basis for design of other mix proportions for
other classes of concrete. To make use of the waste material (quarry dust) and save the environment from pollution.

1.7 SPECIFIC OBJECTIVES

1. To obtain a mix proportion for concrete class 20 for concrete and thus quantify the optimum usage of quarry dust in the replacement of river sand. To observe the

effect of quarry dust proportions on the compressive and tensile strength and workability of concrete.

1.8 SCOPE OF THE STUDY.

This research shall focus on the production of concrete cubes and cylinders by considering factors such as material used in context (sand: quarry dust ratio). The scopes of this study are as entailed below:

A: Variation in compressive and tensile strength of concrete

The compressive strength of concrete is taken as the maximum compressive load that
the concrete can carry per unit area. This is achieved by making cube samples with different
proportions of sand and quarry dust i.e.

- 100% replacement of sand
- 80% replacement of sand
- 60% replacement of sand
- 50% replacement of sand
- 40% replacement of sand
- 20% replacement of sand
- 0% replacement of sand (control experiment) The cube test samples measuring 150mmx150mmx150mm and cylinder test samples measuring 150mm in diameter and 300mm in height are cast and the Compressive strength and tensile strength for each mix was tested for 14days and 28 days strength.

B: Water cement ratio

The water cement ratio was maintained at 0.5 for all the samples throughout the experiment, this was done to achieve a common reference base to compare the results obtained from the test done. Then for each sample mix the strength characteristic was tested.

C: Workability studies

The workability of each concrete mix ratio in its fresh state was determined by subjecting each fresh concrete mix to slump tests and compaction factor tests. These tests are important because they help in how workable a mix will be when used in the site to prevent cases of loss of material due to premature setting of the mix.

D: Cost benefit analysis

A cost benefit analysis study was done on each sample used, this is to establish the cost of each material proportion so as to ascertain whether it will be more economical in terms of cost to replace sand fully with quarry dust or a partial replacement can lead to a more economical mix.

2.0 LITERATURE REVIEW

2.1 GENERAL

This chapter presents an overview of literature on the various experiments conducted by many authors on the replacement of fine aggregate by quarry dust, manufactured sand and the results thereof highlighting the significance of using the manufactured sand for replacing the natural sand in concrete. It includes the literature about mix design, fresh concrete properties, strength, durability aspects, micro structures and the structural behaviour of concrete with the replacement of fine aggregate by manufactured sand. Common river sand is expensive due to excessive cost of transportation from natural sources. Also large-scale depletion of these sources creates environmental problems. As environmental transportation and other constraints make the availability and use of river sand less attractive, a substitute or replacement product for concrete industry needs to be found. River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Whose continued use has started posing serious

3.0 QUARRY DUST AND ITS APPLICATION

3.1 INTRODUCTION

3.1.1 CONCRETE PRODUCTION

The escalating consumption of concrete as indicated by the steady rise of cement
consumption has led to an increase in the world wide use of sand as fine aggregates. As a result of this, several developing countries ; like ours, have encountered some strain in the supply of natural sand to meet the increasing needs of infrastructural development in recent years . This situation has led to the increase in the price of sand and this translates directly to an increase in the cost of concrete. River sand is expensive, for example taking the current cost of sand in India as Rs 700 per tonne while that of quarry dust is Rs 550 per tonne. These margins though small have considerable effects on the material costs where large quantities are involved. Also large scale exploitation of river sand creates adverse environmental effects to the environment while the large scale exploitation of quarry dust will lead to the removal of
environmental load and help reduce the effects posed by accumulation of this dust.

3.1.2 NEGATIVE EFFECTS OF RIVER SAND MINING

For thousands of years, sand has been used in the construction of roads and buildings.

Today, demand for sand and gravel continues to increase. Excessive sand mining causes the degradation of rivers. Sand mining lowers the stream bottom, which may lead to bank erosion. Depletion of sand in the streambed and along coastal areas causes the deepening of rivers and estuaries, and the enlargement of river mouths and coastal inlets. It may also lead to saline-water intrusion from the nearby sea. The effect of mining is compounded by the effect of sea level rise. Any volume of sand exported from streambeds and coastal areas is a loss to the system. Sand harvesting along a river bank

Excessive stream sand mining is a threat to bridges, river banks and nearby structures.

Sand mining also affects the adjoining groundwater system and the uses that local people make of the river.Sand mining results in the destruction of aquatic

and riparian habitat through large changes in the channel morphology. Impacts include bed degradation, bed coarsening, lowered water
tables near the streambed, and channel instability. These physical impacts cause degradation of riparian and aquatic biota and may lead to the undermining of bridges and other structures. Continued extraction may also cause the entire stream bed to degrade to the depth of excavation. Sand mining generates extra vehicle traffic, which negatively impairs the environment. Where access roads cross riparian areas, the local environment may be impacted. Sand mining can have other costly effects beyond the immediate mine sites. Many hectares of fertile streamside land are lost annually, as well as valuable timber resources and wildlife habitats in the riparian areas. Degraded stream habitats result in lots of fisheries productivity, biodiversity, and recreational potential. Severely degraded channels may lower land and aesthetic values. Erosion of river banks due to sand mining. Destroyed River bank due to sand mining.

3.2 QUARRY FINE DEFINITION AND PRODUCTION

Quarry fines refer generally to undersized materials typically finer than 4mm from crushing plants. They receive no further processing and are generally considered as of no economic value thus accumulated as unwanted waste. Quarry fines are produced from crushed rocks to obtain coarse aggregates. The proportions of fines vary according to the rock material used on the crushing process.
Fine aggregates use in asphalt is define as materials passing the 4.75mm IS test sieve (IS 2386(PART III)-1963) and fine aggregates for other uses including concrete, is materials passing 4.75mm sieve. Therefore from (IS 2386(PART III)-1963),quarry fines are define as fraction passing 4.75mm and materials passing 0.075mm.In this project quarry fine is a 13
term referring to fine aggregates, fines and filler materials of less than 0.3mm which will be used as portion replacement of natural sand of same sizes. Crushing of quarry rock is carried out in different stages. First stage known as primary, second stage being secondary and third stage refers as tertiary. Different types of crusher are employed in different stages of crushing to reduce rocks sizes from blocks as big as 1.5m to successively smaller sizes ultimately finer than 20mm.In general the greater the number of crushing stages the higher the proportions of fines produce as proportion of total plant throughout.In India quarry fine materials are produced as result of rocks crushed in various quarries sites. Required aggregates are sieve from the total crushed materials and from
which finer materials are treated as waste. This finer materials cause environmental
concern on how to dispose it. Each quarry produces fines with particular qualities, depending
on the rock type and crushing plant that is used.

3.3 ENGINEERING PROPERTIES OF QUARRY FINES

Essential engineering properties of quarry fines that are of particular importance When
quarry fines are used in concrete include;

a. Gradation

Gradation is process of categorizing particles according to their sizes distribution. This is done by sieve analysis method. Gradation is important from the perspective of comparing the gradation of commonly used materials such as sand with potentials replacement materials. Screening is done to obtain fines of 3mm BS test sieve and having low percentages of filler materials. This is basically processed to obtain well graded medium to fine sand-sized materials with a small amount of silt-sized particles.

b. Moisture content

Quarry fines are stockpile the open and can have a fairly wide range of moisture content within the same stockpile or from one quarry to another. Moisture content gives direct indication on water holding capacity of quarry fines

c. Unit weight

Unit weight of quarry fines may vary according to the type of rock processed, but is expected to be within the same range as the rock source from which it was derived.

3.4 APPLICATIONS OF QUARRY DUST

There are many applications of quarry dust. Discussed below are applications in construction, processing, and landscaping and recreational applications: Application of quarry dust in construction In the construction industry, quarry dust is used as an aggregate substitute especially for sand in a concrete mixture. The application of quarry dust can reduce the cost of construction. In Seth Sihla (Malaysia), the Centre for Housing Planning and Building built a number of low cost houses using quarry dust. The research done for the cost of construction proved that using quarry dust is cheaper than sand. Quarry dust is also used in the construction of sub base in highways. Application of quarry dust in processing In India, quarry dust issued to produce concrete blocks. It is mixed with chalk and gypsum to produce blocks. The used of quarry dust in producing concrete blocks is also applied in South Africa. Quarry dust is also used to produce tiles. Application of quarry dust in landscaping and recreational
The United States of America, Australia and New Zealand have applied the use of quarry
dust for landscaping. For recreational use, quarry dust is used as a fertilizer for planting and
for walkways.

4 CONCLUSIONS

The experimental data shows that the addition of the quarry dust improves the concreteproperties. These results are of great importance because this kind of innovative concreterequires large amount of fine particles. Due to its high fines of quarry dust it provided to be
very effective in assuring very good cohesiveness of concrete. From the above study it isconcluded that The quarry dust may be used as a replacement material for fine aggregate. Quarry dust has been used for different activities in the construction industry such as for roadconstruction and manufacture of building materials such as light weight aggregates, bricks, tiles and auto clave blocks.
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