PARTIAL REPLACEMENT DONE WITH SURKHI AS FINE AGGREGATE IN RIGID PAVEMENTS - REVIEW

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Abstract - utilization of waste is basic need for a healthy environment conditions. It is a duty of all of us that we try to utilize all utilizable wastes. Highways growth rapidly with the growth of country so the utilization of waste in highways is most powerful weapon to waste utilization. In this study the waste material shall be used surkhi, which obtained from brick factory. In road construction two types of pavements mainly used i.e. flexible pavements and rigid pavements in which the use of concrete layers is in rigid pavements. Concrete made up with the combination of cement, fine aggregate, coarse aggregate and water, in this study we try to utilization of surkhi as partial replacement of fine aggregate.

Key Words: Surkhi, rigid pavements, fine aggregate, road construction.

INTRODUCTION

Nowadays concrete has been the leading road pavement material since it was first used and is bound to maintain its significant role in the upcoming future due to its durability, maintenance free service life, adaptability to any shape and size, wide range of structural properties plus cost effectiveness. The concrete is the most important construction material which is manufactured at the site. It is the composite product obtained by mixing cement, water and an inert matrix of sand and gravel or crushed stone. It undergoes a number of operations such as transportation, placing, compaction and curing. The distinguishing property of concrete is the ability to harden under water. The ingredients can be classified into two groups namely active and inactive. The active group consists of cement and water, whereas the inactive group consists of fine and coarse aggregates. The inactive group is sometimes also called inert matrix. Concrete has high compressive strength but its tensile strength is very low.

An ideal pavement should meet the following requirements:

I Sufficient thickness to distribute the wheel load stresses to a safe value on the sub-grade soil.
II Structurally strong to withstand all types of stresses imposed upon it.
III Adequate coefficient of friction to prevent skidding of vehicles.
IV Smooth surface to provide comfort to road users even at high speed.
V Produce least noise from moving vehicles.
VI Dust proof surface so that traffic safety is not impaired by reducing visibility.
VII Impervious surface, so that sub-grade soil is well protected.
VIII Long design life with low maintenance cost.

Types of pavements

The pavements can be classified based on the structural performance into two, flexible pavements and rigid pavements. In flexible pavements, wheel loads are transferred by grain-to-grain contact of the aggregate through the granular structure. The flexible pavement, having less flexural strength, acts like a flexible sheet (e.g. bituminous road). On the contrary, in rigid pavements, wheel loads are transferred to sub-grade soil by flexural strength of the pavement and the pavement acts like a rigid plate (e.g. cement concrete roads). In addition to these, composite pavements are also available. A thin layer of flexible pavement over rigid pavement is an ideal pavement with most desirable characteristics. However, such pavements are rarely used in new construction because of high cost and complex analysis required.

Pavement can be classified into two types:
I Flexible pavement
II Rigid pavement

I Flexible Pavements

Flexible pavements can be defined as the one consisting of a mixture of asphaltic or bituminous material and aggregates placed on a bed of compacted granular material of appropriate quality in layers over the sub grade.

II Rigid pavement

Rigid pavements have sufficient flexural strength to transmit the wheel load stresses to a wider area below. A typical cross section of the rigid pavement is shown in Figure 1.1. Compared to flexible pavement, rigid pavements are placed either directly on the prepared sub-grade or on a single layer of granular or stabilized material. Since there is only one layer of material between the concrete and the sub-grade, this layer can be called as base or sub-base course.

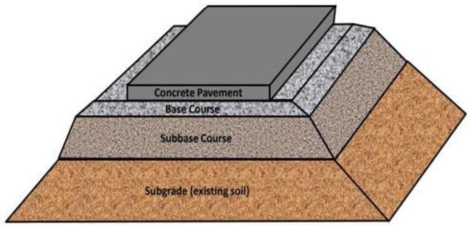

Fig. 1.1 Cross section of rigid pavement

LITERATURE REVIEW

Following are some of the important studies and researches already done regarding the replacement of aggregate in rigid pavements:

Katz, (1999) [1] examined the bond mechanism of Fiber Reinforced Polymer (FRP) rebar to concrete. Five different types of 12.7mm and 12.0 mm rebar subjected to different surface treatments were tested, and the bond mechanism was compared with that of untreated FRP rods and ordinary deformed steel. They observed different pre- peak and post-peak behavior for the various rods when the entire set of P-s (Pullout load vs. slip) curves was compared. Brittle behavior was apparent wherever the external layer of the rod exhibited large deformations formed in a stiff matrix. Where the surface was rough, more ductile behavior was detected. It was observed that the wedging of particles into the surface can alter the load-slip behavior, from slip-weakening to slip-hardening.

Buyle-Bodin, et al., (2002) [2] drew a comparison between the behavior of RAC and that of ordinary natural aggregate concrete. The influence of both the composition and the curing conditions was discussed. It was observed that durability of RAC is controlled by flow properties of high total W/C ratio and air permeability. The diffusion of the carbon dioxide is faster, that leads to a weaker resistance of RAC to environmental attacks.

Hendriks, et al., (2003) [3] developed the approach called Design for Recycling can be used to optimize design of constructions for later reuse and the Design for Disassembly can be used for demolition. For the technical aspects two models were developed concerning degradation processes and high-graded applications. These models were based on Life Cycle Assessment method.

Levy, et al., (2004 [4] studied three properties water absorption, total pores volume and carbonation of recycled concrete. They made concrete with recycled aggregate (0%, 20%, 50% & 100% replacement) from recycled sources and achieved compressive strength in the range of 20-40 MPA at 28 days which is same as natural aggregate. It was found that the carbonation depth decreased when the replacement was 20% or 50%
which shows that carbonation depth depends strongly on the chemical composition of the concrete and not only on the physical aspects.

Pan, et al., (2006) [5] investigated the effect of aggregates on the bond capacity. Ten different compositions of concrete have been used to prepare specimens for the direct shear test. An empirical expression was derived to calculate the interfacial fracture energy in the shear test using ANN. The bond capacity can then be calculated according to fracture mechanics based model. Good agreement was obtained between the simulation and experimental results.

Zhang, et al., (2007) [6] developed a formula for additional water requirement in recycled concrete. They found that the specific absorption of coarse aggregate increases as the time of absorbing water goes on. In the first 10 minutes, the water absorption speed is the greatest and then it decreases and changes very little. The specific absorption and water absorption speed of RCA are greater than those of crushed stone and pebble, within the same time. The findings of various researchers and scholars which are mentioned above are very helpful in this study

MATERIALS TO BE USED

Various materials to be used in this research include Cement, Aggregates, Surkhi, and water.

CEMENT

Cement can be defined as a binding agent who is used for construction purpose that helps in binding the other materials together. The basic ingredients of cement are calcareous which means calcium carbonate and argillaceous which means clay.

AGGREGATES

There are mainly two types of aggregates:
1) Fine Aggregate
2) Coarse Aggregate

1) FINE AGGREGATE: Fine aggregates are essentially any natural sand particles obtained from land through the mining process. The grain size of fine aggregates lies between 4.75mm and 0.15mm. Filling up the voids and acting as a workability agent is the main function of fine aggregate.

2) COARSE AGGREGATE: Coarse aggregates can be defined as irregular broken stone or naturally-occurring rounded gravel used for making concrete. Coarse aggregates are retained on the sieve of mesh size 4.75mm. It act as a volume increasing component and is responsible for strength, hardness and durability of concrete.

SURKHI

Waste material to be used for replacement is surkhi. Surkhi makes cement mortars and concretes more water proof, more resistant to alkalies and to salt solutions than those in which no surkhi is used.

WATER

For concrete construction, potable clean water is essentially to be used and curing is to be done according to IS code.

OBJECTIVES OF THE STUDY

The main objectives of this research are as under:
- To find out the comfort percentage of replacement of surkhi as fine aggregate in concrete for rigid pavements.
- To safely utilization of waste material i.e. surkhi in concrete.
- To conduct a series of tests as per IS specifications on casted specimens with/without replacement.

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