LIVELIHOODS OF OBLITERATED CONCRETE AND SQUARE SUMS AS ELECTIVE MATERIAL IN DIFFERENT DARK TOP LAYERS

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ABSTRACT:

While usage of destroyed materials in road improvement is extending bit by bit, various associations are up 'til now reluctant to consider elective materials as a fitting substitute for materials already being used. This is generally a result of freshness to the planning properties of elective materials and a nonappearance of suitable sources that deftly reused materials. This report will explain the couple of properties of elective materials through lab testing. Exploration focus tests recall fundamental tests for sums, Marshall mix plan, indirect unbending nature test, Atterberg's cutoff focuses, compaction test and California Bearing Ratio (CBR) test. Specifically, this report will investigate the quality and clamminess thickness characteristics of various elective materials blended in with typical aggregates for use as road advancement materials.

A commonsense study has been directed to investigate the opportunity of using destroyed strong aggregates and crushed mud hinder as sums in base and sub base layers exclusively. The results showed that the use of destroyed strong aggregates satisfy the basic requirements of base course layer, up to 75 % superseding with virgin sums. Of course, crushed earth square aggregates extended the perfect moistness content and lessened the best dry thickness of the sub-base materials diverged from those of typical sub base materials. What's more, the replacement of crushed earth square grows the perfect sogginess content and lessened the most extraordinary dry thickness. This was basically attributed to the lower particle thickness and higher water maintenance of crushed soil square sums. The CBR regards increases with the replacement level of crushed earth square aggregates increases.

I Introduction

1.1 GENERAL:

Large scale infrastructure road development is being carried out in our country. Due to these developments, natural construction materials like soil, aggregates etc. are getting depleted, forcing the authorities to search for alternative road construction materials. In India there is a pressure to increase the use of option materials in road construction. This reduces the amount of natural aggregates that have to be used and enables the alternative materials to be used constructively instead of being sent to landfill. Civilization also produces waste products. Disposal issue of the waste products is a challenging task. Some of these materials are not biodegradable and often leads to environmental pollution.

It is estimated that the construction industry in India generates about 10 to 12 million tons of waste annually as per 2001 statistics. While retrievable items such as bricks, wood, metal, titles are recycled, the concrete and masonry waste, accounting for more than 50% of the waste from construction and demolition activities, are not being currently recycled in India.

Recycling of concrete and masonry waste is, however, being done abroad in countries like U.K., USA, France, Denmark, Germany and Japan. Concrete and masonry waste can be recycled by sorting, crushing and sieving into recycled aggregate. This recycled aggregate can be used to make concrete for road construction and building material. The quantity of waste materials is generated from construction activity in India is given in table 1.1.

Constituents	Quantity generated (million tons/year)
Soil, sand, and gravel	4.20 to 5.14
Bricks and masonry	3.60 to 4.40
Concrete	2.40 to 3.67
Metals	0.60 to 0.73
Bitumen	0.25 to 0.30
Wood	0.25 to 0.30
Others	0.10 to 0.15

Table 1.1 Quantities of waste generation in India (2001)

1.2 SOURCES AND USES

The main origins of demolished materials are given as follows,

i. Construction debris
ii. Bridges
iii. Fly over
iv. Building roads
v. Remodeling

The following are the uses of demolished materials in road construction:

i. Aggregate in bituminous mixtures
ii. Granular base and sub-base courses
iii. Embankment or filling.
iv. Manufacture of concrete and concrete products like bricks.
v. Shoulder construction

1.3 ENVIRONMENTAL BENEFITS

The following are the environmental benefits from building demolition waste (demolished concrete aggregate, demolished brick aggregate).

i. Reduced land disposal and dumping: The use of recycled concrete pavements eliminates the development of waste stockpiles of concrete. Also, as recycled material can be used within the same suburban area, this can lead to a decrease in energy consumption and can help improve air quality through reduced mobile source emissions.
ii. Reconstruction of urban streets and expressways results in an enormous waste concrete, creating a massive disposal problem. Recycling can eliminate many of these issues.
iii. The demand for disposal space for concrete debris is high in and the recycling plants are reaching their stock capacity and the disposal costs are increasing. This demand is considerably diminished when RCA has an engineered use in projects.

1.4 OBJECTIVES AND SCOPE OF THE PRESENT STUDY

The main objectives this work are listed as follows:

i. To determine optimum proportion of demolished concrete aggregate replacing virgin aggregates to be used in binder course layers.
ii. To determine optimum proportion of demolished brick aggregate to be used in granular sub-base layer.

The experimental investigation considered the demolished aggregate obtained from a single source. The use of DCA and DBA are limited to binder course and granular sub-base layers respectively.

2. REVIEW OF LITERATURE

Aljassar et al. (2004) evaluated the feasibility of building demolition concrete aggregates in pavement layers. Building demolition waste constitutes a major component of municipal solid waste in Kuwait. Over 90% of this waste is currently land filled, causing extreme pressure on the available landfills sites. At the same time, the sources of natural aggregates are almost depleted, and there is an increasing demand because of the increased construction and maintenance activities. They observed that a large number of concrete buildings in Kuwait are being demolished. Most of the demolition debris is currently disposed of in landfill sites. These sites have limited capacities and are required for other competing types of wastes which cannot be recycled. Moreover, sources of natural aggregates are becoming depleted in Kuwait, and hence aggregates are imported at higher costs. Recycling the building demolition waste can provide a timely opportunity to reduce the problems of disposing off the demolition waste and the aggregate scarcity. They evaluated the use of aggregates obtained from building demolition waste in a local mix of asphalt concrete. They conducted a detailed laboratory study, which included Marshall method of mix design, immersion compression ratio test, loss of stability test and wheel track test. The results obtained from their study showed that the asphalt concrete mix produced using aggregates from demolition waste can meet the requirements of specifications for flexible pavement.

Almutairi et al. (2005) reported that, there is an increasing pressure on the construction industry to reduce the cost and improve the quality of our environment. The fact is that both of these goals can be achieved at the same time. Although construction and demolition (C&D) constitutes a major source of waste in terms of volume and weight, its management and recycling efforts have not yet seen in Kuwait. In this regard they focused on recycling efforts leading to the minimization of the total C&D waste that is currently landfilled in Kuwait. They identified the potential problems to the environment, people and economy. Then, they investigated alternative solutions to manage and control this major type of waste in an economically efficient and environmentally safe manner.

Blankenagel (2005) conducted a detailed study on the use of recycled concrete material (RCM) as pavement base material. The author evaluated the physical properties, strength properties and durability characteristics of both demolition and haul-back sources of RCM for use as a pavement base material. The study included extensive laboratory and field testing. Laboratory tests included California bearing ratio (CBR), unconfined compressive strength (UCS), stiffness, freeze-thaw cycling, moisture susceptibility, abrasion, and salinity and alkalinity evaluations. The testing included a dynamic cone penetrometer, ground-penetrating radar, a heavy Clegg impact soil tester, a soil stiffness gauge, and a portable falling-weight deflectometer. The laboratory testing indicated that the demolition material exhibited lower strength and stiffness than the haulback material and reduced UCS loss after freeze-thaw cycling. However, the demolition material received a moisture susceptibility rating of good in the tube suction test, while the haul-back material was rated as marginal. Both materials exhibited self-cementing effects that led to approximately 180 percent increases in UCS over a 7-day curing period. Seven-day UCS values were 1260 kPa and 1820 kPa for the demolition and haul-back materials, respectively, and corresponding CBR values were 22 and 55 %. The field monitoring demonstrated that the RCM base layer was susceptible to stiffness changes primarily due to changes in moisture. In its saturated state during spring testing, the site experienced CBR and stiffness losses of up to 60 percent compared to summer time values.

Carl Reller (2006) studied on the best practice guidelines for the use of alternative materials and associated processes in road construction. The author mainly focused on runoff or leachate water that has been in contact with alternative materials is not able to discharge to ground water or adjacent water courses. Discharges to the atmosphere are also important but are not the main focus of the guidelines. The author selected the most alternative materials, this means that appropriate processing, stockpiling and transportation procedures must be observed, and in general, the materials should be located above the water table. Encapsulation and sealing of the materials is also desirable, as is provision of appropriate drainage systems. For most alternative construction processes, the main focus is on establishment of appropriate plans and contingency measures to divert water around the site and to contain any water that is collected on the site as a result of heavy rain or a construction mishap such as rupturing a water main. Adequate monitoring carried out to ensure that the water collected at the site is fit for discharge either during the construction operation, or at a suitable juncture following an emergency situation. If discharge is not appropriate the collected water should be removed by vacuum equipment and disposed of appropriately. It is important to recognize that sound environmental management is required for construction activities in general, not only for those involving alternative materials or processes. In many instances the environmental credentials of traditional materials may be more questionable than those of alternative materials, especially considering that a major source of contaminants is deposition by vehicles, a process that occurs irrespective of the composition of the pavement surface.

Csiro (2004) reported that class 1 RCA, which is a well graded, good quality RCA with no greater than 0.5% brick content, had the potential for use in a wide range of applications, subject to appropriate test or performance requirements. Applications include partial replacement (up to 30% of coarse RCA) for virgin material in concrete production for non-structural work such as kerbs and gutters. Current field experience with the use of recycled concrete aggregates for structural applications is scarce. It was suggested that Class 1 RCA could be incorporated into 30 to 40 MPa concrete exposed to benign environments but with some penalties in mix adjustment, permeability and shrinkage properties. There were no visual detrimental effects in the concrete and it was expected that the cost of the increase in cement content could be offset by the lower cost of recycled concrete aggregates. RCA has a lower specific gravity (2.44 – 2.46) and higher water absorption (4.5 – 5.4) than most natural aggregates. Fine RCA, in particular, has an even lower SG of around 2.32 and very high water absorption of 6.2 %. RCA concrete has unit weight in the range of 2240–2320 kg/m. It has higher water demand and gave lower compressive strength than control concrete made from natural aggregate at equal water to cement ratio RCA concrete has similar flexural strength but lower elastic modulus than control. RCA also resulted in higher drying shrinkage and creep but comparable expansion to control. The adherence of mortar to the surface of RCA was the main cause of higher water absorption, lower specific gravity and poor mechanical properties. Excessive expansion or swelling can be caused by contamination by plaster and gypsum. Adjustments of the mix design would be necessary to offset the effect of RCA on workability, absorption, strength and shrinkage. In terms of durability properties, RCA concrete has higher rapid chloride ion permeability but similar carbonation rate accelerated carbonation in 4 % CO2 at 50 % RH to control concrete.

3. MATERIAL AND METHODOLOGY

3.1 Methodology:

- ***Material selection***
- ***Laboratory tests***
- ○ ***For DCA***
- ***Basic desirable properties***
- ***Marshall stability test***
- ***Indirect tensile strength test***
- ***Index retained strength test***
- ○ ***For BA***
- ***Basic tests***
- ***Compaction test***
- ***CBR test***

3.2 Marshall Mix Design

Asphalt mixes are used in the surface coarse of road and airfield pavement, some type of asphalt mixes are also used in base and/or binder course of flexible pavements. The desriable asphalt mix properties include (i) stability (ii) density (iii) durability (iv) flexibility (v) resistance to skidding and (vi) workability during contruction. Stability is defined as resisitance of the paving mix to deformation under load is thus a stress level which causes strain depending upon anticipated field condition. Density is directly realted to voids in the compacted mixtures. Stability and density in general are related terms. Durabillity is defined as the resistance of the mix against weathering which causes hardenging and this depends upon loss of volatiles and oxidation.

4. RESULTS AND DISCUSSION

4.1 Aggregate Gradation

The demolished aggregates used in this study were broken and graded in such a manner as to follow the mid values of blended DBM grading-II curve as shown in figure 4.1.

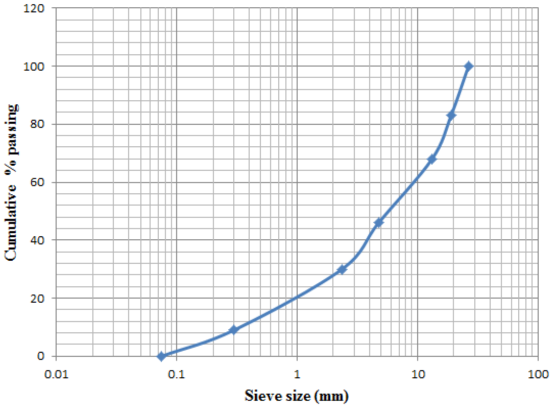

Fig. 4.1 Blended gradation curve for DBM grading-II as per MORTH

Table 4.1 Marshall Test results using virgin aggregates.

% of Bitumen	Stability kg	Flow mm	% of Air Voids (Vv)	% of Voids Filled with Bitumen	Density (g/cm^3)	VMA (%)
4.0	2152.802	1.535	5.83	50.85	2.240	11.87
4.5	2738.25	2.71	2.95	70.76	2.298	10.05
5.0	2596.1	3.54	2.44	76.89	2.299	10.48
5.5	2360.07	4.37	2.93	74.36	2.287	11.42

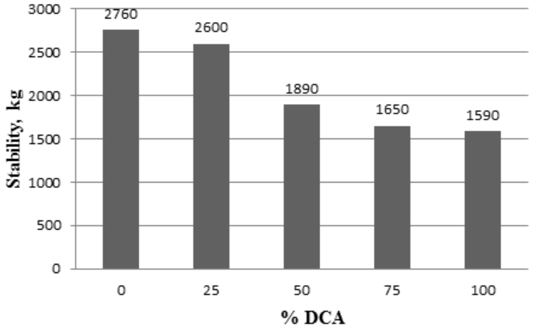

Fig.4.2 Variation of stability with DCA replacement

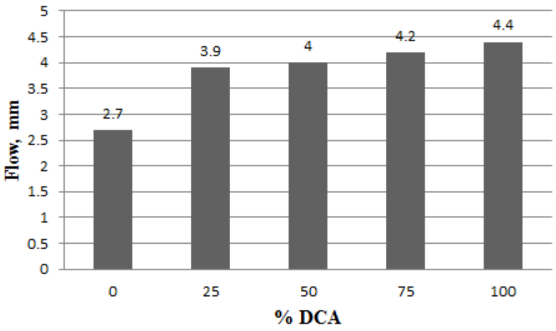

Fig. 4.3 Variation flow with DCA replacement

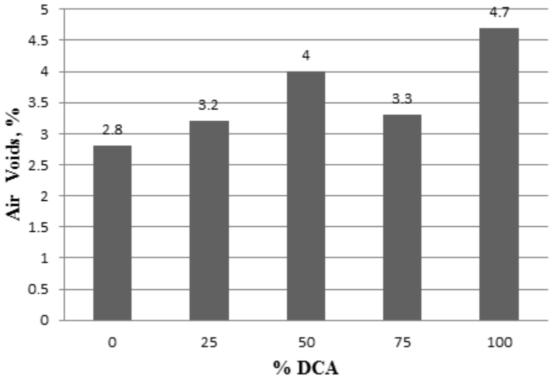

Fig.4.4 Variation of air voids with DCA replacement

Table 4.2 Tensile Strength Values For Demolished Concrete Aggregates Replacements.

DCA Replacement, %	0	25	50	75	100
ITS Values for control specimens, kPa	875.86	801.48	734.73	637.47	487.207
ITS Values for conditioned specimens, kPa	809.49	566.58	642.97	484.20	338.55
RTS Values, %	92.68	88.11	87.51	75.95	69.48

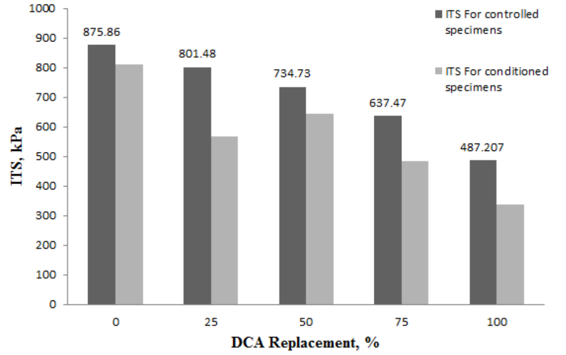

Fig.4.5 Variation of indirect tensile strength value with DCA replacement

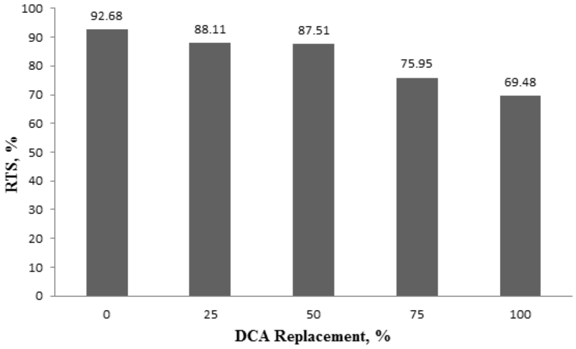

Fig. 4.6 Variation of retained tensile strength value with DCA replacement

Table 4.3 OMC and MDD values variation with BA replacement.

BA Replacement (%)	0	20	40	60	80	100
OMC, %	18	24	30	36	42	46
MDD, gm/ cm^3	1.903	1.801	1.553	1.401	1.291	1.203

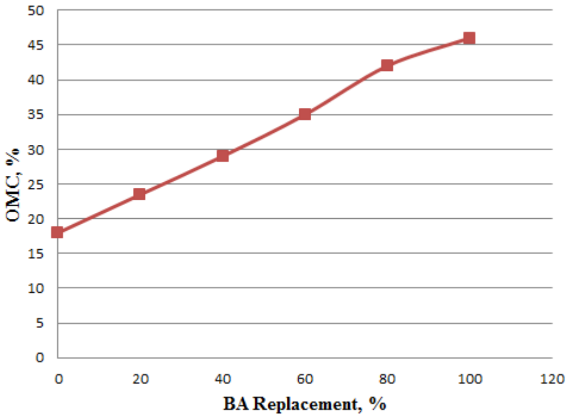

Fig. 4.7 Variation of optimum moisture content with crushed brick aggregates.

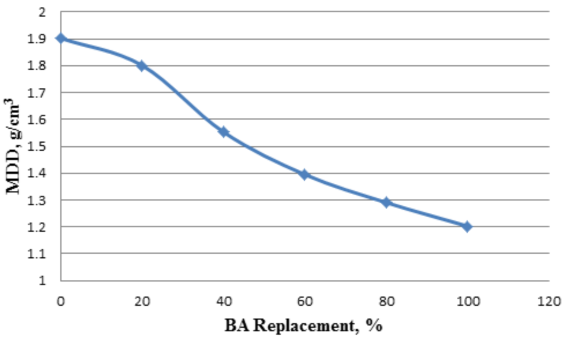

Fig. 4.8 Variation of maximum dry density with crushed brick aggregates.

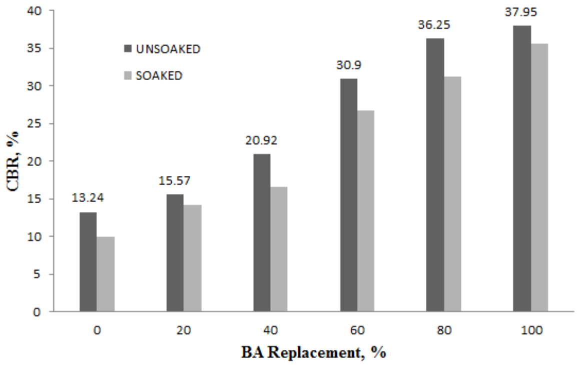

Fig. 4.9 CBR values (unsoaked and 4-day soaked) for each subbase material

CONCLUSION

The following are the conclusions drawn from this study:

- The observed physical properties of blended DCA with original aggregates upto 75% replacement of DCA can be suitable for base coarse construction.
- From the stability point of view all the replacements of DCA were within the specified value, it means all combinations can satisfied the basic requirement.
- Based on the flow value upto 75% DCA can be suitable for base coarse construction. From the air voids in total mix results one can conclude that all the replacements are suitable for base coarse preparation.

- Voids filled with bitumen results proved that up to 50% replacement can satisfy the basic requirements of base coarse. A decreasing trend was observed in density values as DCA replacement increased.
- Decreasing trend was observed from indirect tensile strength test values and the same trend was recorded in retained tensile strength values. This shows that upto 50% DCA replacement will give satisfactory results.
- Crushed clay brick had the highest water absorption value, followed by demolished concrete aggregate and natural aggregate.
- Natural aggregate had the highest density, followed by demolished concrete aggregate and crushed clay brick aggregates.
- As the coarse crushed clay brick content increases the maximum dry density decreases and the optimum moisture content increase. The increasing trend was observed with the increase in replacement of coarse crushed clay brick content.
- Replacement rate upto 20% of crushed clay brick aggregates is suitable for low trafficked rural roads and from 40% to 100% of crushed clay brick aggregates replacement are suitable for traffic upto 2 msa. Replacement rates from 80% to 100% of crushed clay brick aggregates can satisfy the requirements of road traffic exceeding 2 msa.

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