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Used Of Recycled Aggregate in Road Pavement

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ABSTRACT - *Used of recycled aggregate in road pavement is a pretty modem from of construction which take advantage of both conventional & traditional methodology of constructions. It is a why evolving technology which is not popular amongst the masses especially in the country like India where is greatly serve the purpose.*

In the project our main aim will we be to study the features or various constructions materials conduct test on them which will be used full for our project development we will be conceptualizing the term recycled aggregate in road pavements through this project.

I- INTRODUCTION

A road pavement structure is made of multiple layers of processed and compacted materials, in different thicknesses and in both unbound and bound forms, which together form a structure that primarily supports vehicle loads as well as providing a smooth riding quality. There are three types of pavements:

Flexible pavement - in which bituminous bound materials are placed over granular base and sub-base layers and supported by sub grade. The load is absorbed and distributed with depth.

Rigid pavement - in which a concrete layer is placed over a sub grade with or without a sub-base layer. The rigid slab spreads the load over a large area.

Composite pavement - in which the upper layers of bituminous bound materials are supported by a hydraulically bound layer underneath.

Many old buildings, concrete pavements, bridges and other structures have overcome their age and limit of use due to structural deterioration beyond repairs and need to be demolished. The structures, even adequate to use are under demolition because they are not serving the needs in present scenario

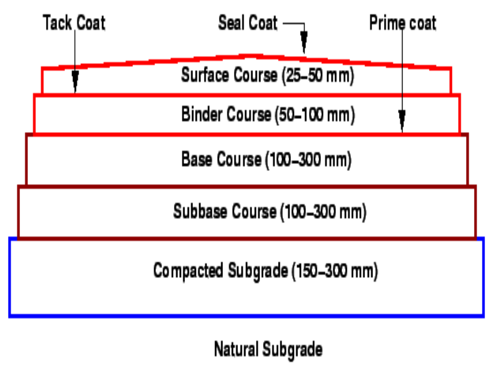


Fig.-1 layer study pavement in material thickness

II-OVERVIEW

A highway pavement is a structure consisting of superimposed layers of processed materials above the natural soil sub-grade, whose primary function is to distribute the applied vehicle loads to the sub-grade. The pavement structure should be able to provide a surface of acceptable riding quality, adequate skid resistance, favourable light reflecting characteristics, and low noise pollution. The ultimate aim is to ensure that the transmitted stresses due to wheel load are sufficiently reduced, so that they will not exceed bearing capacity of the sub-grade.

Two types of pavements are generally recognized as serving this purpose, namely flexible pavements and rigid pavements. This chapter gives an overview of pavement types, layers, and their functions, and pavement failures. Improper design of pavements leads to early failure of pavements affecting the riding quality. The concept of pavement study as per the name suggest is to harness the best out of any prevalent method of construction to be best of our advantage from the engineering point of view. Saying it simply in road pavement there no specific set of rules for an overall construction each component of a broken in to very small modules which make it easier o implement the required mode and material of construction for that specific module.

III- OBJECTIVE OF THE PROJECT

The aim of road pavement construction is to find a middle path which leys some ware between conventional and traditional method of construction making it more suitable for road pavement in country like India. we in this project will study the various aspects of pavement of study in following steps:

Resourcing – in this step we study various materials which easily available for the construction to be carried out. Rigorous test are conducted on each of the materials because at this point we do not know how the particular material will be used.

Material choose – the material choose road pavements in west and unused of aggregate in road construction in recycling used in pavement. It is critical to look out for the adaptability of each work as a single unit.

Primary Planning – in this step are roughly plan out the road pavement study to be constructed conventionally as it would have been done normally.

Final planning – in the step the in work of recombined to create the aggregate on all types are neighbour, and its ability to work as a singular unit

IV-METHOLOGY

If recycling is chosen as a rehabilitation alternative, there is a variety of recycling methods available for rehabilitation of HMA pavements. The primary options are hot mix recycling, hot in-place recycling (HIR), cold in-place recycling (CIR), and full depth reclamation (FDR). These recycling methods offer a number of advantages, which include the following. Allow the use of existing material with the elimination of disposal problems.

- The asphalt mix may be improved through changes to the aggregate and/or asphalt binder.
- The pavement profile may be corrected and the ride improved.
- Cost reductions may be achieved over conventional rehabilitation methods.

The following section is divided into two parts. In the first part, each of the different recycling methods is discussed along with its advantages and disadvantages. In the next part, general guidelines for selection of a recycling process are presented.

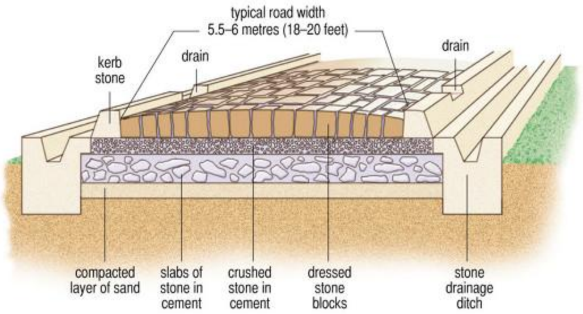
Hot mix recycling or hot recycling is a method in which the RAP is combined with new aggregate and an asphalt cement or recycling agent to produce hot mix asphalt (HMA). Both batch and drum type hot mix plants are used to produce recycled mix. The RAP is obtained from pavement milling with a rotary drum cold planning machine and may be further processed by ripping and crushing operations, if needed. The mix lay down and compaction equipment and procedures are same as for conventional HMA. The ratio of RAP to new aggregates depends on the mix design, on the type of hot mix asphalt plants, and on the quality of stack emission generated. Typical RAP to aggregate proportions vary between 10:90 to 30:70, although a maximum of 50:50 have been reported for drum mix plants. The use of microwave technology has allowed the use of a higher amount of RAP, because the RAP can be preheated. The advantages of hot mix recycling are as follows.

- Significant structural improvements can be obtained with little or no change in thickness by improving the existing asphalt materials.
- Additional right-of-way is not needed.
- Surface and base distortion problems can be corrected
- Performance of recycled mix is as good as conventional HMA mix.

V- PAVEMENT DESIGN

A highway pavement is a structure consisting of superimposed layers of processed materials above the natural soil sub-grade, whose primary function is to distribute the applied vehicle loads to the sub-grade. The pavement structure should be able to provide a surface of acceptable riding quality, adequate skid resistance, favourable light reflecting characteristics, and low noise pollution.

The ultimate aim is to ensure that the transmitted stresses due to wheel load are sufficiently reduced, so that they will not exceed bearing capacity of the sub-grade. Two types of pavements are generally recognized as serving this purpose, namely flexible pavements and rigid pavements. This chapter gives an overview of pavement types, layers, and their functions, and pavement failures. Improper design of pavements leads to early failure of pavements affecting the riding quality.



VI- DETAILED STUDY OF MATERIALS

The result of sieve analysis carried out as per IS 2386 for different types of crushed recycled concrete aggregate and natural aggregates. It is found that recycled coarse aggregate are reduced to various sizes during the process of crushing and sieving (by a sieve of 4.75mm) which gives best particle size distribution. The amount of fine particles (<4.75mm) after recycling of demolished were in the order of 5-20% depending upon the original grade of demolished concrete.

The best quality natural aggregate can obtain by primary, secondary & tertiary crushing whereas the same can be obtained after primary & secondary crushing in case of recycled aggregate. The single crushing process is also effective. In the case of recycled aggregate. The particle shape analysis of recycled aggregate indicates similar particle shape of natural aggregate obtained from crushed rock. The recycled aggregate generally meets all the standard requirements of aggregate used in pavement sub base

Particle Size Distribution

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The particle shape analysis of recycled aggregate indicates similar particle shape of natural aggregate obtained from crushed rock. The recycled aggregate generally meets all the standard requirements of aggregate used in concrete.

Specific Gravity and Water Absorption-The specific gravity (saturated surface dry condition) of recycled concrete aggregate was found from 2.35 to 2.58 which are lower as compared to natural aggregates. Since the RCA from demolished concrete consist of crushed stone aggregate with old mortar adhering to it, the water absorption ranges from 3.05% to 7.40%, which is relatively higher than that of the natural aggregates.
The Table 4 gives the details of properties of RCA & natural aggregates. In general, as the water absorption characteristics of recycled aggregates are higher, it is advisable to maintain saturated surface dry (SSD) conditions of aggregate before start of the mixing operations.

Bulk Density- The specific gravity (saturated surface dry condition) of recycled concrete aggregate was found from 2.35 to 2.58 which are lower as compared to natural aggregates. Since the RCA from demolished concrete consist of crushed stone aggregate with old mortar adhering to it, the water absorption ranges from 3.05% to 7.40%, which is relatively higher than that of the natural aggregates. The Table 4 gives the details of properties of RCA & natural aggregates. In general, as the water absorption characteristics of recycled aggregates are higher, it is advisable to maintain saturated surface dry (SSD) conditions of aggregate before start of the mixing operations.

Crushing and Impact Values – The specific gravity (saturated surface dry condition) of recycled concrete aggregate was found from 2.35 to 2.58 which are lower as compared to natural aggregates. Since the RCA from demolished concrete consist of crushed stone aggregate with old mortar adhering to it, the water absorption ranges from 3.05% to 7.40%, which is relatively higher than that of the natural aggregates. The Table 4 gives the details of properties of RCA &

natural aggregates. In general, as the water absorption characteristics of recycled aggregates are higher, it is advisable to maintain saturated surface dry (SSD) conditions of aggregate before start of the mixing operations.

Compressive Strength – The average compressive strengths cubes cast are determined as per IS 516 using RCA and natural aggregate at the age 1, 3, 7, 14, 28, 56 and 90 days and reported in Table 5. The table 4 shows that the target cube strength was achieved at 28 days for all types of concrete. As expected, the compressive strength of RAC is lower than the conventional concrete made from similar mix proportions. The reduction in strength of RAC as compare to NAC is in order of 2- 14% and 7.5 to 16% for M-20 & M-25 concretes respectively

VI- TESTS ON AGGREGATES

Physical Properties – Prior to testing the aggregates were graded by dry sieving following the method described in BS 812 Part 103 (1985). Having obtained the particle size distribution for each aggregate the material ware-combined into the following fractions; Coarse (10-20mm), Medium (5-10mm), and Fine (<5mm).

Relative density - The relative densities of the coarse and medium fractions of each aggregate were determined following the method described in BS 812Part 2: (1975). In this paper the relative density on an oven-dried basis and the apparent relative density are reported since the ratio.

Two values reflects the volume fraction of open voids in the aggregate which can be directly related to the moisture absorption of the aggregate in the saturated surface dry condition.

Moisture Absorption -The moisture absorption of an aggregate is defined as the mass of water absorbed into the capillary pores of the saturated surface dry aggregate as a percentage of the dry mass of the aggregate. The weight of water absorbed into the capillary pores of the aggregate can be used to give an indirect measure of the volume fraction of pores present in the aggregate.

10% fines value - the 10% fines value for the recycled and natural aggregates were determined in accordance with BS 812 Part 3: (1975). This value is the load, in kilo Newton (KN), required to produce 10% fines, defined as material below 2.3 mm, from aggregate particles in the size range10 to 14 mm. Values in excess of 100KN are usually required for aggregates for the production of conventional concrete with values in excess of 150KN being necessary for the production of concrete for hard granolithic floor slabs. Aggregates with a 10% fines value of less than 50KN would be unacceptable for the production of any cement bound layer or material.

Durability - The durability of the coarse and medium fractions of each aggregate, when subjected t o freeze-thaw condition s , was monitored using the following simple test. A known weight of saturated surface-dry aggregate was sealed into a plastic bag with an excess of water and subjected to alternate freezing at -25 °C for 24 hours followed by thawing under water at 25°C. After 7 cycles the aggregate was removed from the plastic bag and sieved over a 2.5mm size sieve and re-weighed. This process was repeated and the weight of aggregate retained on the sieve was monitored as a function of the number of freeze-thaw cycles.

Recycling of waste aggregate has become an important issue worldwide due to the continued increase of construction wastes. Also, the growing global construction activities urge to find sustainable resources to replace natural materials for the production of concrete. In the past few decades, many re-searches have been carried out on the use of recycled aggregate derived from construction and demolition wastes to produce concrete products. This paper reviews the previous findings on the effects of use of RA on durability of concrete.

In general, the amount of adhered mortar and the quality of the original concrete have a significant effect on the properties of resulting concrete. The increase of RA content and w/c ratio results in poorer durability of concrete. In comparison, the negative effect of recycled fine aggregate is more obvious than that of recycled coarse aggregate. The use of pozzolanic materials either for surface coating of RA or intermixed within the concrete are effective and feasible to improve the overall durability of concrete. Recent researches on CO_2 treatment indicate that it can enhance the properties of recycled aggregate and durability of road significantly

VII- ENGINEERING CONSIDERATION

The choice of a rehabilitation technique should be based primarily on the condition and performance history of the existing pavement. The major factors should include the following:

- The present condition of pavement, based on ride quality and type.
- The type, extent and severity of distress.
- The structural condition of the pavement
- The environmental conditions of the region, primarily temperature and rainfall
- Drainage conditions of pavement, including surface and subsurface drainage
- Construction considerations, including restriction imposed by bridges (limited overhead clearance), and other structures such as curbs and gutters, drainage structures, shoulders, median barriers and guardrails
    - The design life required for treatment
    - The material used in original construction and planned for overlays
    - The age of the pavement
    - The type, frequency and cost of past maintenance activities.

The most common factors considered are (1) the present condition of pavement with regard to distress, (2) traffic in terms of equivalent 18-kip axle loads estimated for design period, and (3) structural capacity of existing pavement.

Before choosing a rehabilitation alternative, the designer must evaluate environmental and drainage factors, and practical limitations imposed by contiguous structures. Since different rehabilitation techniques can produce pavements with different life cycle, the designer should consider the expected life of the pavement as well as funds available and user convenience. Design considerations are also dependent on the type of original surface (for example, PCC or asphalt) on which the new overlay will be placed. There is also the question of whether to use a separating course between the old surface and the new overlay. And finally, perhaps the most important consideration should be made of the type, amount and severity of distress conditions of the existing pavement. Since different recycling techniques can remedy different

TYPES OF DISTRESSES, THE MOST APPROPRIATE METHOD SHOULD BE CONSIDERED.

Overlay design methods for improving the structural capacity of the existing pavement are discussed in chapter 18. These methods, together with methods for the design of new pavements, are also used to determine thickness requirements for recycled pavements.

CONSIDERATIONS FOR FINAL SELECTION

The following factors should be considered prior to final selection of the rehabilitation alternative:

- Availability of equipment.
- Availability of experienced contractor.
- First cost.
- Life cycle cost.
- Traffic control.
- Length of construction.
- Impact on adjacent business.
- Utility relocation and interference.

RECYCLED MATERIALS

Recycled materials according from engineering, industrial and transport structures to be used in construction must not contain undesirable organic substances and substances which in contact with water and climatic influences vary excessively in volume, strength and shape, and/or chemical changes occur (wood, gypsum, masonry unit and plaster, metal waste, etc.). Recycled material used for the earth construction, application of unbound and bound layers must meet the requirements.
Specified the standard defines recycled aggregates as the aggregate resulting from the processing of inorganic or mineral material previously used in the construction. If the requirements in [4] are satisfied the recycled aggregates can be used in the same way as natural aggregate.

CBR	Design elasticity modulus Ed [MPa]	The coefficient of transverse deformation
15%	**50**	**0.40**
30%	**80**	**0.35**
50%	**120**	**0.30**

- The tests given in are divided into three groups to test the geometrical, physical and chemical properties. Properties of the recycled aggregate are influenced mainly by its composition and own processing, which takes place on the recycling line. A manufacturer of the recycled aggregate shall document the basic information as an input control by defining

- Concrete, concrete product, mortar, concrete masonry units.
- Un bound aggregate, natural stone, hydraulic bound aggregate,
- clay masonry unit, calcium silicate masonry units, aerated non-floating concrete,
- bituminous materials,
- glass,
- floating material,
- Other material (clay and soil, metals, wood, plastic and rubber).
- The first three figures represent the value of compaction CIV (Clegg Impact Value). The letters IV stand for Impact Value; last number represents the number of falls of hammer since switching on the device. Based on this information, the degree of compaction in the form of CBR value can be evaluated. The fourth value of compaction is possible to convert according to the manual of the device to CBR equivalent using the following equation:
  (124.0=×+CIV CBR Clegg),
  Where-CBR clergies CBR value according Clegg [%].
  2211924.0124.0=×CBR=×+CIVCBRClegg% 31=&Clegg CBR

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This device provides almost immediately the results for the degree of compaction of assessed soil, thus removes the greatest disadvantage of other methods to control the quality of compaction

IX-CONCLUSIONS

In this study, the natural aggregate used in road paving in Trinidad and Tobago was replaced by SSA, a waste material from the steel industry. The effectiveness of substituting the natural aggregate by SSA was measured by changes the physical and mechanical properties attributes of the various blends. The physical properties of SSA basically satisfy the requirements of Marshall Specification for design of HMA at the 15% SSA addition which offered similar properties to the 0% formulation. The amount of binder used could be varied for the SSA modified formulation to determine its optimal content.

The SSA improved the porous surface in comparison to the natural aggregate. Under these conditions, SSA appears to be especially beneficial for aggregate substitution for road paving applications in Trinidad and Tobago. From the economic point of view, utilizing SSA reduces the dependency on naturally occurring aggregate and reduces the cost of extracting and processing naturally occurring aggregates. It will also result in a reduction of the cost for treating and disposing the huge number of steel slag stockpiles. If implemented such a strategy for the reuse of SSA will foster the movement of Trinidad and Tobago towards sustainable development that will result in a more efficient management of waste materials and preservation of environment.

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