EXPERIMENTAL STUDY ON BITUMEN MIX USING GEO FABRIC INCREASING THE CALIFORNIA BEARING RATIO OF FLEXIBLE PAVEMENT

Dhavashankaran D[1] Harikannan S[2] Harsha Vardhana[3], Naga Teja B[4], Mukesh Kumar Reddy P[5].

[1,2] Assistant Professor Department of Civil Engineering, Muthayammal Engineering College, Rasipuram

[5,3,4.] UG Student Department of Civil Engineering, Muthayammal Engineering College, Rasipuram

ABSTRACT

Effectiveness of geofabric as an asphalt layer in a flexible pavement system .The study involved laboratory experimental work .geo-fabric mesh pavement were constructed and tested in the laboratory as a part of the experimental study.Geo-Fabrics are used in road construction. Development in usage of modern laying techniques and more diverse application of fabric textile in road construction and other areas of civil engineering a like Road pavement can be considered to be one of the fundamental elements of the transportation system. Significant amounts of bitumen and natural aggregates are used in the construction of asphalt concrete pavement with including the geo-fabric. Results from this study show that geo fabric can be used to improve the performance of flexible pavement systems.

KEYWORDS: Geo-Fabrics, Asphalt, Road pavement

INTRODUCTION:

In this present era the technology in advanced construction has developed to a very large extent. Some parts of construction are still in improving stage which includes road construction. In this chapter, we are going to deal with geo-fabric mesh with bituminous layer. Design of mix is done by manual analysis. Due to excessive traffic loads, many existing pavements have already reached the end of their service life. As a result, surface treatment methods and the use of new pavement reinforcement materials have been explored to improve the performance and service life of flexible pavements. Geo-fabric overlays have been used to improve the performance of deteriorating pavements in the past. The application of geo-fabric materials in highway repairs has become popular in recent years due to their high strength, durability, and ability to relieve stresses by reinforcing the pavements.

SCOPE

The basic Marshall test consists essentially of crushing a cylinder of bituminous material between two semi-circular test heads and recording the maximum load achieved and the deflection at which the maximum load occurs

MATERIALS:

- ✓ Bitumen
- ✓ Geo Fabric
- ✓ Coarse Aggregate (20mm,12.5mm)

Bituminous materials or asphalts are extensively used for roadway construction, primarily because of their excellent binding characteristics and water prolongs properties and relatively low cost. Tars are residues from the destructive distillation of organic substances such as coal, wood, or petroleum and are temperature sensitive than bitumen. Bitumen will be dissolved in petroleum oils where unlike tar. Bitumen is the residue or by-product when the crude petroleum is refined.

MATERIALS COLLECTIONS

Geo Fabric is utilized as the main element in the experiment. It was selected from different textile factories of the heap and mixed thoroughly before using it for laboratory study. Aggregates collected from crusher industry. Use of local soil should be collected and different

layers in field to check Geotechnical properties of Local soil.

UTILIZATION OF GEO FABRIC

Utilization of Geo fabric in pavement projects is a valuable approach for technical, economical and environmental reasons. Processed Geo fabrics have favorable Synthetic properties for aggregate use, including good abrasion resistance, hardness and high bearing strength. Geo fabrics have been successfully used as Additive to the aggregate in surface layers of pavement. The effectiveness of Geo fabric in asphalt mixtures. They conducted Marshall Stability test on the flexible pavement. The result indicated the use of Geo fabric with bitumen efficiency.

CBR

California bearing ratio (CBR) test CBR tests were conducted on selected soil, with a single layer of geo-Fabric. The geo-Fabric was placed in a single layer at different positions: 20%, 40%, 60% and 80% of the specimen height from the top surface. The load penetration curve was drawn for the soil samples with geo-Fabric at different positions and the CBR values were calculated from these curves. It is clear that considerable amount of increase in CBR value of soil with geo-Fabric mesh.

S. No.	Position of geo-grid from top of specimen	With geofabric	Without geofabric
1.	No geo-grid	4.5	2.9
2	0.2H	11.05	9.4
3	0.4H	10.86	7.2
4	0.6H	8.9	5.8
5	0.8H	7.2	3.16

Geo Fabric Membrane Advantages and Disadvantages

The advantages and disadvantages of bituminous applications, as noted in the literature reviewed, are as follows:

Advantages when used in bituminous pavements

- ✓ High skid resistance
- ✓ Resistant to wear
- ✓ High stability
- ✓ Resistant to rutting
- ✓ Higher stiffness
- ✓ Fatigue resistant
- ✓ Resistant to permanent deformation
- ✓ High cohesive strength
- ✓ Electrically conductive
- ✓ Compatible with typical asphalt binders

Disadvantages when used in bituminous pavements

- ✓ High volume expansion potential in the presence of moisture
- ✓ Increased binder demand (24% to 30%) due to its porous structure
- ✓ High specific gravity results in lower volumes of pavement mix and higher transportation costs
- ✓ Overall higher cost of applications

TESTS ON BITUMEN:

SPECIFIC GRAVITY TEST:

Specific gravity test was carried out as per IS 2720 Part 3 (1980).Specific gravity of steel slag and local soil was observed to be 4.28 and 2.10 respectively. Grain Size Analysis Grain size analysis was carried out of slag and local soil as per IS 2720 part 4 (1985). Geo fabric and local soil samples were observed to be coarse grained materials.

DUCTILITY TEST

Ductility is the property of bitumen that permits it to undergo great deformation or elongation. Ductility is defined as the distance in cm, to which a standard sample or briquette of the material will be elongated without breaking. Dimension of the briquette thus formed is exactly 1 cm square.

The bitumen sample is heated and poured in the mould assembly placed on a plate. These samples with moulds are cooled in the air and then in water bath at 27^0 C temperature.

S.NO	INITIAL READING (cm)	FINAL READING (cm)	DUCTILITY VALUE (cm)
1	0	25.2	25.2
2	0	46.8	46.8

DUCTILITY VALUE = FINAL READING – INITIAL READING in cm

= 25.2-0 = 25.2

= 46.8-0 = 46.8

Ductility value = 46.8 + 25.2 = 72 /2 = 36

Ductility value of bitumen is 36 cm.

SOFTENING POINT TEST

Softening point denotes the temperature at which the bitumen attains a particular degree of softening under the specifications of test. The test is conducted by using Ring and Ball apparatus.

A brass ring containing test Sample of bitumen is suspended in liquid like water or glycerin at a given temperature. A steel ball is placed upon the bitumen sample and the liquid medium is heated at a rate of 5^0 C per minute. Generally, higher softening point indicates lower temperature susceptibility and is preferred in hot climates.

S.NO	TEMPERATURE WHEN THE BALL TOUCHES BOTTOM, (^{O}C)	AVERAGE	SOFTENING POINT OF BITUMEN
1	44.5	44.5	44.5
2	44		
3	45		

The softening value of bitumen = 44.5 ^{O}C

VISCOSITY TEST

Viscosity denotes the fluid property of bituminous material and it is a measure of resistance to flow. At the application temperature, this characteristic greatly influences the strength of resulting paving mixes. Low or high viscosity during compaction has been observed to result in lower stability values. At high viscosity, it resists the compactive effort and thereby resulting mix is heterogeneous, hence low stability values. Viscosity of a cutback can be measured with either 4.0 mm orifice at25^{O}C or 10 mm orifice at 25 or 40 ^{O}C.

S.NO	TEMPERATURE, ^{0}C	TIME TAKEN IN SEC	VISCOSITY IN SEC
1	50	84	70
2	70	56	

The viscosity value of given bitumen is = 70 sec.

AGGREGATE

Aggregate is a collective term for the mineral materials such as sand, gravel, and crushed stone that are used with a binding medium (such as water, bitumen, Portland cement, lime, etc.) to form compound materials (such as bituminous concrete and Portland cement concrete).

DESIRABLE PROPERTIES

- ✓ Strength
- ✓ Hardness
- ✓ Shape of Aggregate
- ✓ Durability

STRENGTH

The aggregates used in top layers are subjected to

- Stress action due to traffic wheel load,
- Wear and tear,
- Crushing. For a high quality pavement, the aggregates should posse's high resistance to crushing, and to withstand the stresses due to traffic wheel load.

SHAPE OF AGGREGATE

Aggregates which happen to fall in a particular size range may have rounded cubical, angular, flaky or elongated particles. It is evident that the flaky and elongated particles will have less strength and durability when compared with cubical, angular or rounded particles of the same aggregate. Hence too flaky and too much elongated aggregates should be avoided as far as possible.

HARDNESS

The aggregates used in the surface course are subjected to constant rubbing or abrasion due to moving traffic. The aggregates should be hard enough to resist the abrasive action caused by the

movements of traffic. The abrasive action is severe when steel tyred vehicles moves over the aggregates exposed at the top surface.

ABRASION TEST

Abrasion test is carried out to test the hardness property of aggregates and to decide whether they are suitable for different pavement construction works. Los Angeles abrasion test is a preferred one for carrying out the hardness property and has been standardized in India (IS: 2386 part-IV).

IMPACT TEST

The aggregate impact test is carried out to evaluate the resistance to impact of aggregates. Aggregates passing 12.5 mm sieve and retained on 10 mm sieve is filled in a cylindrical steel cup of internal diameter 10.2 mm and depth 5 cm which is attached to a metal base of impact testing machine.

SOUNDNESS TEST

Soundness test is intended to study the resistance of aggregates to weathering action, by conducting accelerated weathering test cycles. The Porous aggregates subjected to freezing and thawing is likely to disintegrate prematurely.

To ascertain the durability of such aggregates, they are subjected to an accelerated soundness test as specified in IS: 2386 part-V.

USE OF GEO FABRIC IN FLEXIBLE PAVEMENT

A Geo Fabric is produced as a byproduct of various synthetic fabrics in Factory outlets. This by-product that mainly consists of Silicate fabric material is cut down to smaller sizes to be used as aggregates in pavement layers. They are particularly useful in areas where a good quality aggregate

MARSHALL STABILITY TEST

State Highway Department formulated Marshall Stability test – flow test on bitumen and is applicable to hot mix design of bitumen and aggregates of maximum size 2.5 cm.Bituminous concrete mix is commonly designed by Marshall Method. This test is extensively used in routine test programmes for the paving jobs.

MARSHALL MIX DESIGN

The Marshall Stability and Flow test provides the performance prediction measure for the Marshall Mix design method. The stability portion of the test measures the maximum load supported by the test specimen at a loading rate of 50.8 mm/minute. Load is applied to the specimen till failure, and the maximum load is designated as stability. During the loading, an attached dial gauge measures the specimen's plastic flow (deformation) due to the loading.

The flow value is recorded in 0.25 mm (0.01 inch) increments at the same time when the maximum load is recorded. The important steps involved in marshal mix design are summarized next.

Approximately 1000gm of aggregates and filler is heated to a temperature of 90-150 ^{0} C. Bitumen is heated to a temperature of 121−125^0 C with the first trial percentage of bitumen the heated aggregates and bitumen are thoroughly mixed at a temperature of 140−150^0 C. The mix is placed in a preheated mould and compacted by a rammer with 50 blows on either side at temperature of 138 ^{0} C to 149^0 C. The weight of mixed aggregates taken for the preparation of the specimen may be suitably altered to obtain a compacted thickness of 63.5+/-3 mm. Vary the bitumen content in the next trial by +0.5% and repeat the above procedure

MARSHALL STABILITY FLOW

The results of the Marshall test are the average of the specimen which is prepared in optimum bitumen content. The results indicated that the use of Geo fabric is maximum average stability valve of the mixture prepared with the combination of Geo fabric. Use of Geo fabric in preparation of Marshall Bitumen specimen resulted as increase the valve of Marshall Stability. The reason could be due to the hardness of the Synthetic aggregates. It gives high stiffness mixture with the great ability to resist creep deformation. Admixture provides a positive contribution to the overall performance of flexible pavement.

RESULTS AND CONSULION

In the present study, Geo-fabric mesh at different layers of a flexible pavement are evaluated in terms of their strength parameters like, CBR of this research are summarized below:

- The CBR of a soil increases by 50-100%. The amount of improvement depends upon the type of soil and position of geo-Fabric.
- CBR of sub-grade soil is 3.6%, when geo-Fabric was placed at 0.2H from the top, The CBR value increased to 4.7%.
- The stress-strain behavior of sub-grade soils under static load condition improved

considerably when geo-fabric was provided at optimum position.

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