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pavement evaluation and application of glass fibres in flexible pavement

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***Abstract* –In the case of flexible pavement, maintenance cost is a greater factor in comparison of construction cost due to continuous deterioration of pavement. This study emphasizes the influence of glass fibre in regards to achieve the desirable properties of bituminous mixes. We studied the influence of feasibility assessment in flexible pavement using glass fiber. We will obtain Optimum Bitumen content (OBC) and Optimum Fibre Content (OFC) in regards to the shrewd usage of glass fibre. Parameters like ductility, tensile strength , stiffness, cracking, marshal stability, drainage, skid-resistance will be stressed on. For the flexible pavement, optimum glass fibre content of 3% , 5% and 7% are considered. The required replacement materials are easily available, environmental friendly, economical and easy to use. To obtain the required strength and increase the life span of the pavement and SPT will be adopted. The outcome of analysis of different parameters like tensile strength, life span, ductility values are obtained.**

***IndexTerms* – glass fiber, bituminous mix, strength.**

I. INTROD UCTION

A 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 reacting characteristics, and low noise pollution. A pavement structure can be designed either as a flexible pavement or rigid pavement. Importance of flexible pavement in a developing country like India is still intact.

II. PROBLEM IN FLEXIBLE PAVEMENT

In the case of flexible pavement, maintenance cost is a greater factor in comparison of construction cost due to continuous deterioration of pavement. Flexible pavements have low or negligible flexural strength and are fairly flexible in their structural action under higher volume of traffic and load. Flexible pavements are often afflicted with problems of cracking and rutting due to repeated traffic loads, steps must be taken to increase the life of the bituminous pavements. Some undesirable effects can occur mainly due to high number of vehicles imposing repetitive higher axle loads on roads, environmental condition and construction errors. These usually cause permanent deformation (rutting), fatigue and low temperature cracking, service life of the road pavement is going to be decreased. At present, addition of fibre is one of the common methods applied for binder modification. It is widely believed that the addition of fibre will enhance materials strength and fatigue characteristics.

III. EXPERIMENTAL INVESTIGATION

A. MATERIALS

1. Coarse Aggregate Crushed aggregate confirming to IS: 383-1987 was used. Aggregates of size 20mm, 16mm and 12.5 mm of specific gravity 2.74 and fineness modulus 7.20 were used.
2. Bitumen of grade 80/100 was used. As per IRC: code 37; Penetration value were found out to be in range of 75-80 and Ductility value were in range of 75-82
3. Glass fibre consisting of silica based thin stranded glass extruded in fibres of grid form.

B. *Advantages of Glass Fibre*

- It can be molded into any shape.
- It has mechanical strength that is so strong and stiff for its weight that it can out-perform most of other materials.
- It can last a long time, can be colored, shiny or dull.
- It requires low maintenance, and is anti-magnetic.
- Fire resistant, good electrical insulator and weatherproof.

C. Test for Penetration Value

a) Preparation of test specimen: Soften the material to a pouring consistency at a temperature not more than 60°C for tars and 90°C for bitumen above the approximate softening point and stir it thoroughly until it is homogeneous and is free from air bubbles and water. Pour the melt into the container to a depth at least 10mm in excess of the expected penetration. Protect the sample from dust and allow it to cool in an atmosphere at a temperature between 15° to 30° C for one hour. Then place it along with the transfer dish in the water bath at 25° ± 0.1 °C, unless otherwise stated.
b) Fill the transfer dish with water from the water bath to depth sufficient to cover the container completely, place the sample in it and put it upon the stand of the penetration apparatus.
c) Clean the needle with benzene, dry it and load with the weight. The total moving load required is 100 ± 0.25 gms, including the weight of the needle, carrier and super-imposed weights.
d) Adjust the needle to make contact with the surface of the sample. This may be done by placing the needlepoint in contact with its image reflected by the surface of the bituminous material.
e) Make the pointer of the dial to read zero or note the initial dial reading.
f) Release the needle for exactly five seconds.
g) Adjust the penetration machine to measure the distance penetrated.
h) Make at least 3 readings at points on the surface of the sample not less than 10 mm apart and not less than l0mm from the side of the dish. After each test return the sample and transfer dish to the water bath and wash the needle clean with benzene and dry it. In case of material of penetration greater than 225, three determinations on each of the two identical test specimens using a separate needle for each determination should be made, leaving the needle in the sample on completion of each determination to avoid disturbance of the specimen.

Table: 1

Penetration dial reading	Test 1	Test 2	Test 3
(a) Initial	0	0	0
(b) Final	75	80	76
Penetration Value	75	80	76

- FOR 1% Binder modifier (GLASS FIBRE)

Table: 2

Penetration dial reading	Test 1	Test 2	Test 3
(a) Initial	0	0	0
(b) Final	46	45	46
Penetration Value	46	45	46

Mean Value: 45.66

- FOR 3% Binder modifier (GLASS FIBRE)

Table: 3

Penetration dial reading	Test 1	Test 2	Test 3
(a) Initial	0	0	0
(b) Final	40	41	40
Penetration Value	40	41	40

Mean Value: 40.33

- FOR 5% Binder modifier (GLASS FIBRE)

Table: 4

Penetration dial reading	Test 1	Test 2	Test 3

(a) Initial	0	0	0
(b) Final	35	35	36
Penetration Value	35	35	36

Mean Value: 35.33

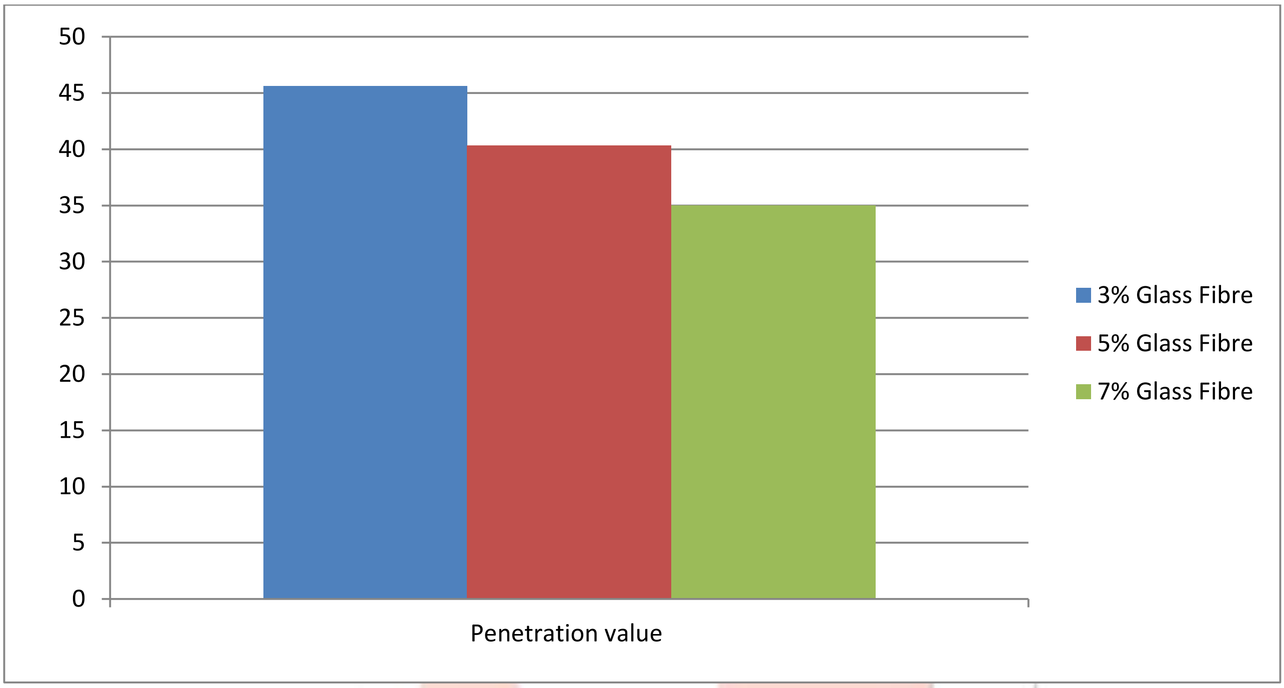

Figure: 1

D. Test for Ductility Value

1. Melt the bituminous test material completely at a temperature of 75°C to 100° C above the approximate softening point until it becomes thoroughly fluid.
2. Strain the fluid through IS sieve 30.
3. After stirring the fluid, pour it in the mould assembly and place it on a brass plate. In order to prevent the material under test from sticking, coat the surface of the plate and interior surfaces of the sides of the mould with mercury or by a mixture of equal parts of glycerin and dextrin.
4. After about 30-40 minutes, keep the plate assembly along with the sample in a water bath. Maintain the temperature of the water bath at 27° C for half an hour.
5. Remove the sample and mould assembly from the water bath and trim the specimen by levelling the surface using a hot knife.
6. Replace the mould assembly in water bath for 80 to 90 minutes.
7. Remove the sides of the mould.
8. Hook the clips carefully on the machine without causing any initial strain.
9. Adjust the pointer to read zero.
10. Start the machine and pull clips horizontally at a speed of 50 mm per minute.
11. Note the distance at which the bitumen thread of specimen breaks.

Table: 5

	1	2	3
(a) Initial Reading	0	0	0
(b) Final Reading	75	80	81

FOR 1% Binder modifier (GLASS FIBRE)

Table: 6

	1	2	3
(a) Initial Reading	0	0	0
(b) Final Reading	95	96	95

FOR 3% Binder modifier (GLASS FIBRE)

Table: 7

	1	2	3
(a) Initial Reading	0	0	0
(b) Final Reading	117	116	105

FOR 5% Binder modifier (GLASS FIBRE)

Table: 8

	1	2	3
(a) Initial Reading	0	0	0
(b) Final Reading	105	103	104

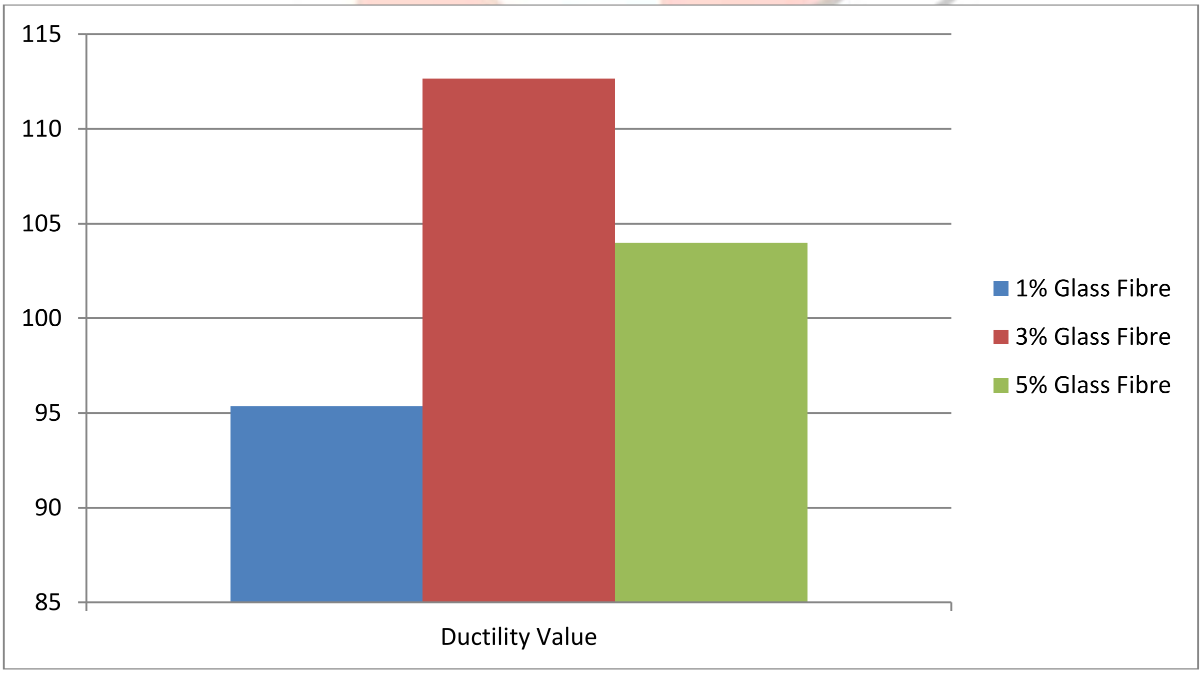

Figure: 2

IV. CONCLUSION

Flexible pavement depends upon the strength of its bitumen binder. Addition of glass fibre in flexible pavement improves different values such as penetration, ductility and stability values. After adding glass fibres in proportion of 1%, 3% and 5%, we noticed the penetration value improves by 40% to 55% as per recommended value of IRC: 80/100 which results in increased strength. Penetration Value was obtained maximum at 5% addition of glass fibre at 35.33, while it was lowest at 1% addition of glass fibre at 45.66.

Ductility value improved significantly by 30% to 65%. Recommended value is around 70. Ductility value was found out to be highest at 3% addition of glass fibre at 113 while it was lowest at 1% fibre addition at 96. This indicates the durability and the strength that it could provide during excessive loads on pavement results in better performance and life of pavement.

Hence at an addition of 3% fibre, the most desirable results considering different parameters like penetration value, ductility values were obtained.

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