GEOTEXTILE REINFORCED OPEN GRADED ASPHALT CONCRETE FOR MITIGATION OF REFLECTION CRACKING

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Abstract: Conventionally new asphalt concrete (AC) overlays are laid over distressed rigid or flexible pavements as one of the rehabilitation techniques. Though this technique is simple and encouraging due to availability of smooth riding surface, it has a major problem of reflection cracking. The reflection cracks reduce designed overlay life of newly laid AC overlay drastically within the first few months and the purpose with which it is laid does not serve to the fullest extent. Not only traffic loads but also thermal loads due to daily / seasonal temperature variations cause pre-existing cracks in the old distressed pavement to propagate in upward direction through newly laid overlay. Variety of techniques has been tried in the last four decades. Field trials of Open Graded Asphalt Concrete (OGAC) as a crack relief layer have shown some potential for the mitigation of reflection cracks. This paper presents the laboratory studies carried out on unreinforced and geotextile reinforced OGAC as a crack relief layer during a newly developed Asphalt Concrete Slab Fatigue Testing Equipment under opening and mixed modes of displacement. The conventional overlay of dense bituminous macadam (DBM) is also evaluated for comparison purposes. Decay of tensile strength and deformations induced in the overlay with number of simulated thermal load cycles are observed and cumulative decay of parameters such as tensile strength, stiffness and shear modulus are computed. Overlay life, fabric effectiveness factor (FEF), decay parameters and base isolation effectiveness factor (BIEF) are also evaluated. It is found that, the unreinforced OGAC overlay performed better than that of DBM as a crack relief layer. The satisfactory performance of geotextile reinforced OGAC overlay in purely opening mode becomes unsatisfactory in mixed mode of displacement.

Keywords: cyclic load, thermal stress, woven geotextile, reinforcement, overlay, laboratory test.

INTRODUCTION

Reflection of existing cracking pattern of old distressed rehabilitated pavement over the newly laid asphalt concrete (AC) overlay are called reflection cracks. Existing cracks propagate through newly laid AC overlay within the first few months due to various crack driving forces (Figure 1). These cracks cause a drastic reduction in overlay life and the purpose with which it is laid does not gets fulfilled for the designed overlay life.

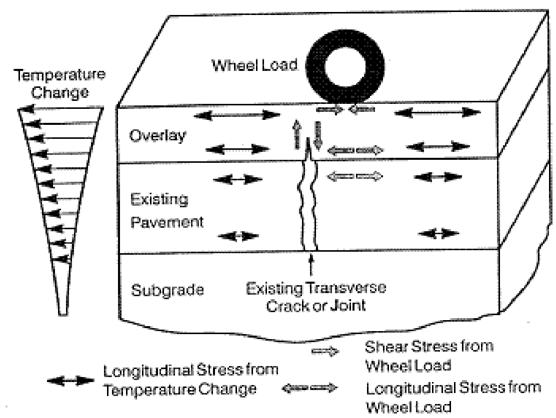

Figure 1. Principal crack driving forces. (After Kim *et al.* 2002)

It is observed that apart from the traffic loads, the thermal loads due to daily / seasonal thermal changes cause the existing crack to propagate in an upward direction through newly laid overlay. Varieties of crack retardation techniques have been studied through various approaches like field trials and laboratory testing (Sherman 1982) and analytical methods like fracture mechanics and numerical techniques using finite element methods (Kim *et al.* 2002). Field trials using open graded asphalt concrete (OGAC) as a crack relief layer (CRL) have shown some potential for the mitigation of crack propagation (Hensley 1980 and Hani *et al.* 2003). However, most of the earlier study of OGAC has been in the form of field trials and no laboratory study with the aim of evaluating base isolation effectiveness factor has been addressed. The laboratory study on geotextile reinforced OGAC overlay is also missing. The term open graded is used since the percentage of air voids is more than 20%, which is much higher than that in the normal AC mixes. These large percentage of air voids, obtained by gap grading an aggregate, avoids stress concentration at the crack tip and checks the crack propagation into the upper layers of an overlay. This may give rise to highly compressible mix if aggregate skeleton with positive contact is not formed. Bailey Method of aggregate gradation

(Vavrik *et al.* 2002) ensures good aggregate interlock that gives virtually incompressible CRL in a confined state. A CRL would therefore serve two purposes, both as a delay mechanism for crack growth as well as a structural layer (Natraj *et al.* 2000). This paper presents the laboratory experimental results performed on the indigenously designed and developed "Asphalt Concrete Slab Fatigue Testing Equipment" (Bhosale *et al.* 2007) for investigating crack retardation performance of the freshly laid unreinforced and woven geotextile reinforced OGAC overlays. These overlays are tested under cyclic simulated thermal (opening mode) and combined thermal and traffic loads (mixed mode) of 5 mm differential deflection with zero load efficiency factor.

ASPHALT CONCRETE SLAB FATIGUE TESTING EQUIPMENT

This indigenously designed and fabricated equipment simulates thermal contraction and expansion phenomena of pavement as well as differential deflection, maximum of 5 mm, with zero load efficiency factors due to traffic loads. Zero load efficiency factors ensure pure shearing of an overlay in a plane of crack propagation. Thus, the equipment facilitates crack retardation performance study of 40cm X 50cm sized AC overlay test slab testing under different displacement modes viz. (a) Purely Opening Mode, (b) Purely Shearing Mode, (c) Combined Opening and Shearing i.e. Mixed Mode. Refer Bhosale *et al.* (2007) for more details of this equipment.

ASPHALT CONCRETE OVERLAY TEST SLAB

The overlay test slab of 500 mm length, 400 mm width, and 75 mm thickness is casted using practical/field AC mixes using MORT&H, (2001) guidelines. Each AC overlay test slab consists of 50 mm thick base course of DBM or OGAC and 25 mm thick surface course of BC. For the basis of comparison, thickness of base course of OGAC is kept equal to that of DBM. Figure 2 shows the typical unreinforced DBM / OGAC overlay test slab.

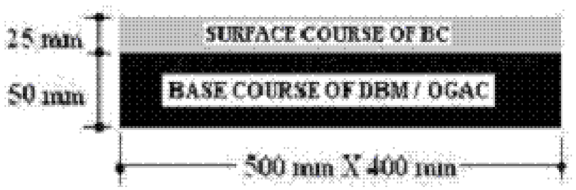

Figure 2. Typical sketch of unreinforced DBM / OGAC overlay test slab.

In geotextile reinforced OGAC overlay the base course of OGAC is reinforced by placing 500 mm x 400 mm reinforcement interlayer (area treatment) of polyester woven geotextile between the base course of OGAC and surface course BC as shown in Figure 3.

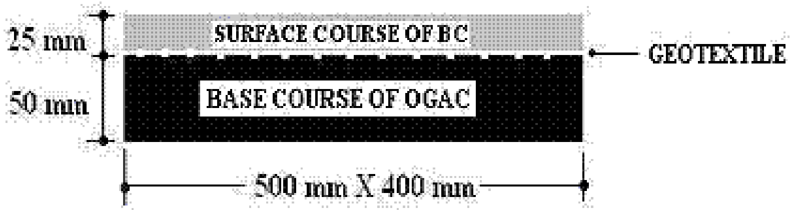

Figure 3. Typical sketch of woven geotextile reinforced OGAC overlay test slab.

Material Characterization

The aggregates of fresh compact basalt rock having the maximum particle size passing 25.4 mm, and retained on 20 mm, and the minimum particle size passing 0.075 mm are used. Paving grade bitumen of 60/70 penetration (Pen 60/70) is selected on the basis of "Guidelines on selection of the grade of bitumen" (MORT&H, 2001). The physical and engineering properties of aggregate and the bitumen are found to satisfy the specified values in the respective Indian standards (Bhosale, 2006). Polyester woven geotextile is used as a reinforcement interlayer. The physical and engineering properties of the geotextile are presented in Table 1.

Asphalt Concrete Mix Design

The optimum bitumen content of asphalt concrete mixes, namely DBM, BC, and OGAC, are obtained using Marshall Stability Method (ASTM Standard D 1559). The aggregate gradation for DBM and Bituminous Concrete (BC) mixes as specified by MORT&H (2001) are adopted. Though DBM and BC mixes have shown higher flow value and voids in mineral aggregates their respective stabilities were found to be 80% and 74% more than the MORT&H specified value. Due to lack of the MORT&H specifications for the OGAC with 25 mm nominal maximum particle size, the "Bailey Method for Gradation Selection" for ensured aggregate packing for resistance to permanent deformation is followed and aggregate gradation of OGAC is finalized with an aim to meet the special requirements of crack relief layer of more air voids and voids in mineral aggregate (Bhosale, 2006). In Figure 4, the gradation adopted by Nagato *et al.* (1996) and Natraj *et al.* (2000) and the gradation of bituminous macadam (BM), a porous AC mix, as specified by the MORT&H, (2001) are also shown for comparison along with the designed gradation curve of OGAC.

Table 1. Properties of polyester woven geotextile.

Characteristic Value	ASTM Standard	Unit	Author's Results	
			MD*	CMD§
Mass per unit area	D 5261	gm / m^2	552.6	
Nominal Thickness	D 5199	mm	0.88	
Tensile Strength	D 1682	kN / m	186.6	45.2
Elongation at break		%	33	18
Initial Tangent Modulus		kN / m	1.45	1.075
Secant Modulus		kN / m	5.075	1.925
Offset Tensile Modulus		kN / m	8.3	2.69
Breaking Toughness		kN / m^3	617200	68800
Grab Breaking Load	D 4632	N	4010	1140
Elongation at break		%	36	20
Trapezoidal Tear Strength	D 4533	N	1355	875
Puncture Resistance	D 4833	N	885	
Permeability	D 4491			
Without Asphalt		liter / m^2 / sec	0.021	
		m / sec	3.74 x 10^{-7}	
With Asphalt Retention		liter / m^2 / sec	0.00149	
		m / sec	0.2615 x 10^{-7}	
Permittivity				
Without Asphalt		per sec	4.25 x 10^{-4}	
With Asphalt Retention		per sec	0.2972 x 10^{-4}	
Asphalt Retention	D 6140	gm / m^2	246.5	258.5
		liters / m^2	0.245	0.257

* MD - Machine Direction

§ CMD – Cross Machine Direction

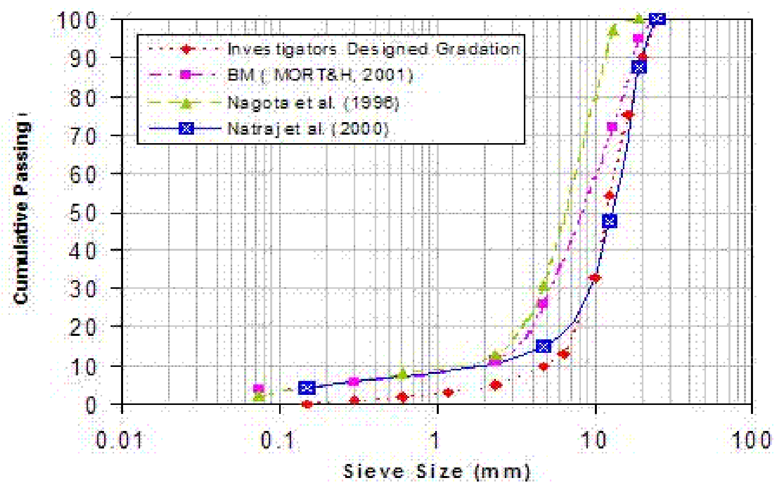

Figure 4. Designed aggregate gradation for open graded asphalt concrete.

Table 2 shows the Marshall Stability test results for the designed OGAC mix with 75 numbers of blows on each of the two faces of the specimen.

Table 2. Marshall Stability test results for open graded asphalt concrete (OGAC).

Parameter	Author's Result
Bitumen Content by mass of total mix (%)	3.85 (4 % of the total dry mix)
Stability at 60 °C (kN)	2.452
Flow (mm)	4.77
Air Voids (%)	25.76
Voids in mineral aggregate (VMA) (%)	33.18
Voids filled up with bitumen (VFB) (%)	22.36
Bulk Density (kg / m^3)	1966.32

Since no standard specifications are available for the OGAC mix, the Marshall Stability test results are compared with the results of DBM and BC, and it is observed that; (a) The optimum bitumen content for OGAC mix is the least.

(b) Stability for OGAC mix is almost one eighth. This may be attributed to the porous ness of the specimen, which allowed the 60°C hot water to easily enter into it and soften the bitumen coating around an aggregate. Therefore, aggregate skeleton of such a hot specimen, when placed on its periphery during stability testing without lateral confinement, might have been disturbed that resulted in low stability value. In the field condition, this base course of OGAC will have lateral confinement as well as will be covered by the surface course. Hence, the field value should be much higher than the laboratory result. (c) Flow value lies within those for DBM and BC. In addition to the above, a little crushing of the aggregates at their contact surfaces during dynamic compaction of Marshall Specimens confirmed strong aggregate skeleton as assured by the Bailey Method.

EXPERIMENTAL CONFIGURATION

The experimental work is performed at a strain-controlled environment with an average room temperature of 29^{o}C. A gap of 5 mm is maintained between two pavement plates, which represented the initial existing crack width in an old distressed pavement. Simulation of daily/seasonal thermal contraction and expansion cycle is achieved by cyclically opening and closing the initial existing crack by 1.83 mm at a strain rate of 4.547 mm/min. For the safety of electric motor and the assembly of gear system, a rest period of 5 sec is kept between pull and push cycle and vice versa. Thus, in purely opening mode of displacement the thermal loading cycle approximately shows resemblance to that with triangular waveform as shown in Figure 5.

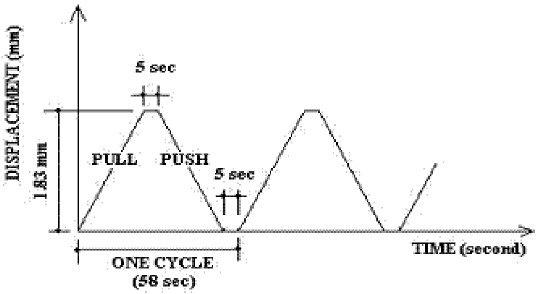

Figure 5. Loading waveform in purely opening mode of displacement simulating thermal contraction and expansion.

In mixed mode of displacement, vertical compressive load, generating contact pressure of 478.7 kPa for a standard axle load of 80 kN is applied using pneumatic jack through 15 mm thick pressure plate which simulated the on highway truck dual tire assembly. The vertical load with a load pulse of 1 sec and a rest period of 4 sec, simulating vehicle speed of 1 mile/h (1.6 km/h), is applied simultaneously with simulated thermal load cycles of opening mode of displacement. Differential deflection with zero load efficiency factors, maximum up to 5 mm magnitude, caused due to the cyclic vertical load, which simulated the traffic load. A present investigation uses four numbers of springs for the flexible base, which simulated modulus of subgrade reaction of 93.16 MPa/m (9.5 kg/cm^2/cm). Gauge length of 80 mm is used for all the potentiometers, symmetric to the existing crack width, to record the deformation in the AC overlay.

TESTING PROCEDURE

In purely opening mode of displacement, the overlay test slab is subjected to cyclic horizontal pull (tension) and push (compression) operation simulating purely opening mode of displacement due to daily/seasonal thermal contraction and expansion. Thus, it is subjected to simulated thermal load cycle. In mixed mode of displacement, the freshly casted similar type of overlay test slab is subjected to mixed displacement mode, simulating field pavement loading conditions of thermal load cycles due to thermal contraction and expansion and the traffic loads. Each test is continued till no further decrease in the tensile load is observed for the large number of load cycles. Data logger is set to scan and log the data for every one-second. The performance of each overlay test slab is independently investigated in opening (O) mode as well as mixed (M) mode of displacement. The unreinforced overlays of DBM and OGAC in purely opening mode of testing are designated as DBM-O and OG-O respectively. While in mixed mode of testing are designated as DBM-M and OG-M. Similarly the geotextile reinforced OGAC overlays in opening and mixed mode of testing are designated as Gtx-O and Gtx-M respectively.

METHOD OF ANALYSIS AND PERFORMANCE INDICATORS

Tensile strength and deformation induced in the overlay just above existing crack, with number of loading cycles is the basic observational data, based on which other engineering parameters viz. stiffness modulus and shear modulus are computed. Decay of each of these engineering parameters with the number of simulated thermal cycle is investigated. The concept of cumulative decay is utilized and the parameter that shows the least number of simulated thermal load cycles for 100 % cumulative decay is selected as critical engineering parameter. The number of simulated thermal load cycles corresponding to 100 % cumulative decay of a critical parameter, hereinafter termed as overlay life, is also evaluated. Using computed overlay life; base isolation effectiveness factor (BIEF) accounting for crack relief of the OGAC and fabric effectiveness factor (FEF) accounting for benefit of geotextile reinforcement are evaluated. Overlay life in terms of the number of simulated thermal load cycles, BIEF and FEF are considered as performance indices. Regression coefficients of trend line equations fitted in power series for the cumulative decay are considered as decay parameters of the overlay material. The basic equation obtained is in terms of "N" i.e., the number of simulated thermal load cycle, and may be rearranged in terms of "D" i.e., cumulative decay, which is a more useful form similar to that of the fatigue law describing crack initiation process. Hence, the equation of cumulative decay as shown in the following form may be used to describe combined phases of crack initiation and propagation:

$N = a\,D^b$

where, N – number of simulated thermal load cycles; D – cumulative decay of either tensile force, stiffness modulus, or shear modulus; a and b – regression coefficients representing decay parameters for the AC overlay. Regression coefficient "a" represents overlay life in terms of number of simulated thermal load cycles for 100% cumulative decay. Regression coefficient "b" is the index of durability of an overlay. The regression coefficients of equation of cumulative decay of critical engineering parameter are proposed as decay parameters of the overlay.

RESULTS AND DISCUSSION

The stiffness modulus based on absorbed tensile strain, which hereinafter will be termed as simply stiffness modulus, is the tensile stress per unit tensile strain absorbed by the AC overlay. Figures 6 and 7 shows a variation of cumulative decay of stiffness modulus with the number of simulated thermal load cycle for opening (O) and mixed (M) modes of displacement respectively.

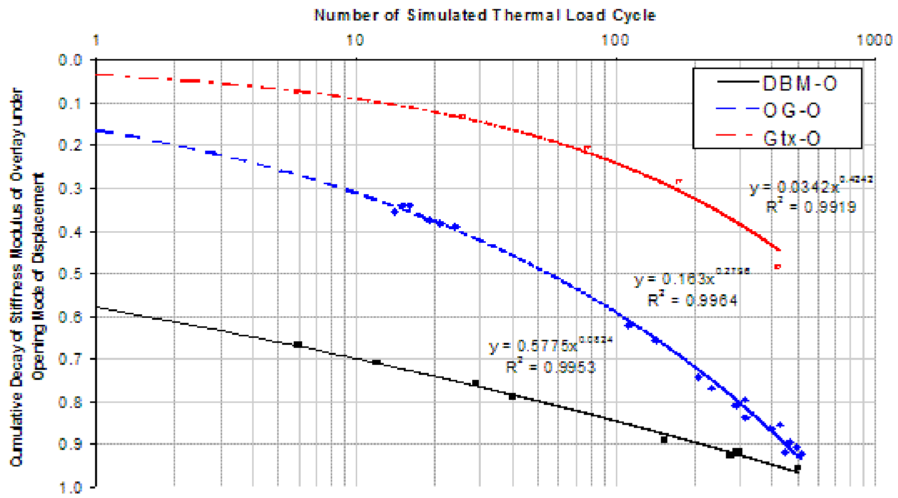

Figure 6. Cumulative decay of stiffness modulus with number of simulated thermal load cycles in opening mode.

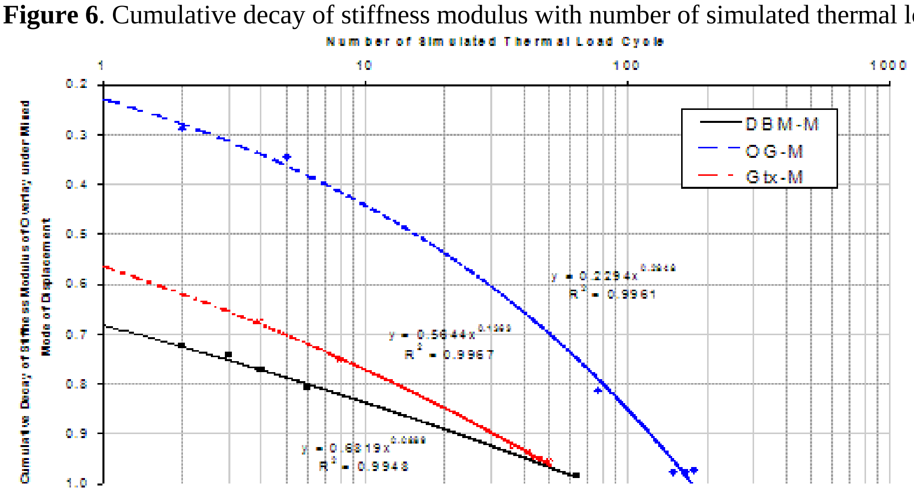

Figure 7. Cumulative decay of stiffness modulus with number of simulated thermal load cycles in mixed mode.

From Figures 6 and 7 it is noted that, (1) the rate of cumulative decay of stiffness modulus under mixed mode (M) of displacement is much higher than that under opening mode (O) of displacement. This may be attributed to the large tensile strain caused due to the differential deflection in mixed mode of displacement and, hence, a large cumulative decay of stiffness modulus. These results confirm the testing sensitivity of the developed experimental system. (2) The differential deflection causes more damage to the DBM overlay than to the OGAC overlay (OG). At the 70th simulated thermal load cycle, DBM-M shows 100 % while OG-M shows only 78% cumulative decay of stiffness modulus. This is due to more air voids in OGAC than in DBM, which acts as a cushion layer. The open structure of OGAC may not be allowing energy at the crack tip to accumulate and, hence, it shows more durability (Hensley, 1980; Nagato *et al*., 1996 and Hani *et al*., 2003). (3) The differential deflection causes the largest detrimental effect on polyester woven geotextile reinforced OGAC overlay (Gtx). Gtx-M initially shows 50% more cumulative decay of stiffness modulus than Gtx-O, which continuously increases and at around the 60th simulated thermal load cycle, Gtx-M shows 100% while Gtx-O shows only 20% cumulative decay of stiffness modulus. This unsatisfactory results shown by Gtx-M under mixed mode of displacement clearly indicate that the condition of differential deflection of 5mm with zero load efficiency factor is unsuitable for the area treatment by polyester woven geotextile over 50mm thick base course of OGAC. Using the trend line equations of cumulative decay as shown in Figures 6 and 7, the overlay lives in terms of simulated thermal load cycles based on 100 percent cumulative decay for opening and mixed modes of displacement are computed and shown in Figure 8.

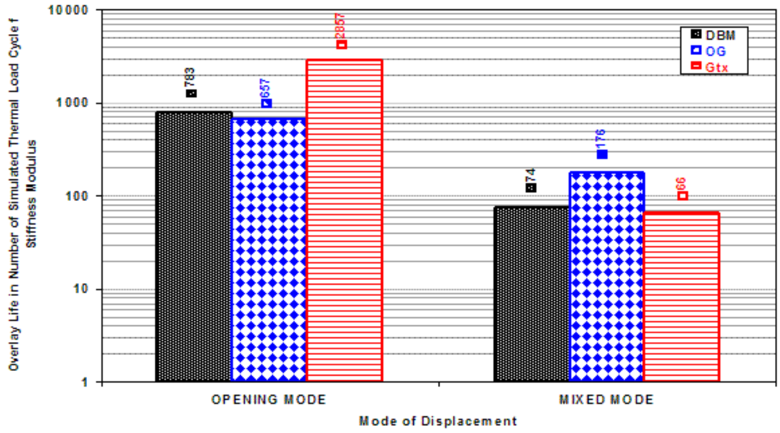

Figure 8. Overlay life in terms of simulated thermal load cycle under opening and mixed mode of displacements.

From Figure 8 it is confirmed that differential deflection under mixed mode of displacement causes overall reduction in the overlay life of all the overlays. Though OGAC is a porous mix with poor tensile strength it has the greatest tensile strain absorption capacity that offers it good “stiffness modulus” which is very well reflected through overlay life of 176 in mixed mode with reduction of only 73.2% with reference to opening mode. Similar observations are also noted for the parameter “shear modulus.” This indicates that consideration of merely tensile strength for investigation of crack retardation performance of overlays may not be the correct approach, particularly for the porous asphalt concrete mix like OGAC. Hence, considering stiffness modulus, OGAC overlay (OG-M) has shown 138% more overlay life than the conventional overlay of DBM (DBM-M) and proved its utility as the crack relief layer. This result has shown that open structure of OGAC mix, though, reduces stiffness modulus of the overlay system, yet, at the same time, it provides a cushioning effect which is advantageous for rehabilitation of old distressed pavement, where differential deflections with zero load efficiency factors are suspected. The OGAC overlay when reinforced with polyester woven geotextile (Gtx-O) shows improvement in overlay life by 265% for the stiffness modulus under opening mode of displacement, which confirms the benefits of reinforcement in purely opening mode of displacement. Contrary to this, the Gtx-M shows unsatisfactory performance with reduction of 99.4% in overlay life under mixed mode of displacement. This is even more than the conventional overlay of DBM. This drastic reduction of overlay life clearly indicates unsuitability of the area treatment of woven geotextile interlayer under the condition of 5mm differential deflection with zero load efficiency factors. These results agree well with the laboratory and field findings of the earlier investigators Maurer (1989), Lytton (1989) and Barksdale (1991). Large percentage reduction in overlay life’s in mixed displacement mode indicates that shearing of overlay due to the differential deflection with zero load efficiency factor is the most fatal kind of action in crack propagation and every possible effort for the reduction of it must be made to ensure more durability of the newly laid overlay.

As explained in the section “Method of Analysis and Performance Indicators,” analysis results of critical parameters showing the least overlay life in the respective modes of displacements are only considered. Based on the concept of base isolation, a new factor, namely, Base Isolation Effectiveness Factor (BIEF), is introduced to quantify the effect of base isolation. The BIEF of an overlay is the ratio of overlay life of an overlay under consideration to the overlay life of conventional overlay of DBM. Figure 9 shows the BIEF of an overlay for opening and mixed modes of displacement.

From Figure 9 it is evident that, (1) In mixed mode, OGAC overlay (OG) has shown increment of only 24% in BIEF, which confirmed that base course of OGAC has performed as a crack relief layer. It is further proved that Bailey method of aggregate gradation selection is a useful tool in designing porous OGAC mix. (2) The polyester woven geotextile reinforced OGAC overlay under purely opening mode of displacement (Gtx-O) has shown the BIEF of 7.871, which indicates that it has performed as a base isolation layer. But under mixed displacement mode it (Gtx-M) shows BIEF of 0.835 that is 16.5% and 63% less than DBM-M and OG-M overlays respectively. Hence area treatment using polyester woven geotextile interlayer is not suitable under a mixed displacement mode having 5mm differential deflection with zero load efficiency factors. (3) Gtx-M has shown the drastic decrement of 89.391 % in BIEF in comparison to Gtx-O, which further indicates that the geotextile interlayer that is used as an area treatment though definitely prevented the surface course of BC from getting mixed with OGAC and maintained the air voids in it, the need for laying binder course over crack relief layer to protect it from getting adulterated due to fines present in the surface course may not be true and can be eliminated. The benefit of fabric reinforcement is measured in terms of

Fabric Effectiveness Factor (FEF). The FEF is the ratio of overlay life of a reinforced overlay to the unreinforced overlay. Figure 10 shows the FEF of an overlay under opening and mixed modes of displacement.

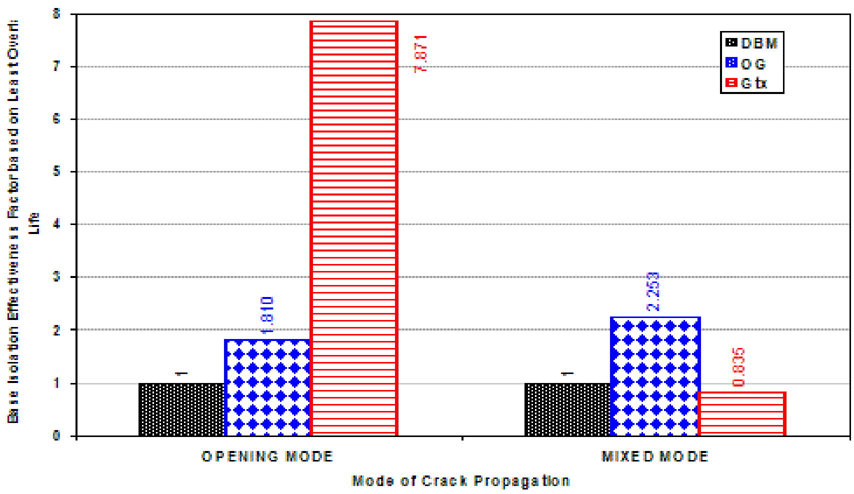

Figure 9. Base isolation effectiveness factors (BIEF).

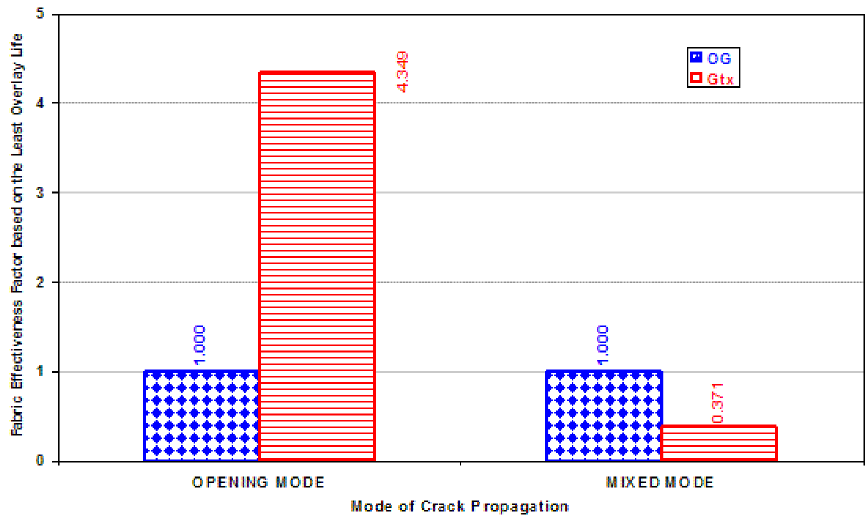

Figure 10. Fabric effectiveness factor (FEF)

Figure 10 clearly indicates that, (1) Polyester woven geotextile reinforced OGAC overlay (Gtx-O) shows the FEF of 4.349 which is more than one and hence confirms its benefit in purely opening mode of displacement. (2) Due to differential deflection of 5 mm, this FEF drastically drops down by 91.5% to 0.371, which indicates unsuitability of geotextile reinforcement interlayer area treatment under mixed mode of displacement having differential deflection of 5mm with zero load efficiency factors.

Table 3 shows critical equations of cumulative decay with regression coefficients as proposed decay parameters for the overlay and overlay life in terms of simulated thermal load cycles for opening (O) and mixed (M) modes of displacement.

Table 3. Critical equation of cumulative decay.

Overlay Test Slab Designation	**Critical Equation of Cumulative Decay**		**Overlay Life** (For the parameter showing lease overlay life)	
	Opening (O) Mode	**Mixed (M) Mode**	**Opening (O) Mode**	**Mixed (M) Mode**
DBM	$N^{*} = 363.316\ D_G^{\ 8.425}$	$N = 78.635\ D_G^{\S\ 11.249}$	363	79
OG	$N = 657.665\ D_S^{\dagger\ 3.577}$	$N = 177.949\ D_G^{\ 3.954}$	657	178
Gtx	$N = 2852.991\ D_S^{\ 2.357}$	$N = 66.467\ D_G^{\ 7.337}$	2857	66

* N – Number of simulated thermal load cycles

§ D_G – Cumulative decay in shear modulus

† D_S – Cumulative decay in stiffness modulus

Results presented in Table 3 shows that (1) The value of decay parameter ‘b’ for unreinforced OGAC overlay is around 4 as found by Majedzadeh *et al.* (1971) through analytical study based on fracture mechanics and hence it may be considered as a material property. Both these values are less than 4 and approximately match. Hence decay parameter ‘b’ is definitely the material property of the material, which is independent of the mode of displacement. These results match well with the findings of Majedzadeh *et al.* (1973), which were based on analytical work of fracture mechanics. (2) The unreinforced OGAC overlay (OG) shows the least increment of 10.54% in ‘b’ and 72.94% in ‘a’, due to differential deflection of 5mm with zero load efficiency factor, in mixed mode of displacement, which indicates that porous AC mix like OGAC works as a base isolation layer and relieves the crack tip energy. Though similar condition exists for polyester woven geotextile reinforced OGAC overlay in mixed mode of displacement, it shows less overlay life than conventional overlay. This anomalous result under mixed mode confirm that laying of geotextile interlayer above 50mm thick OGAC base course though beneficial in purely opening mode of displacement, it makes the overlay system vulnerable under mixed mode of displacement having differential deflection of 5 mm with zero load efficiency factor. The other aspect to be noted is that the area treatment with geotextile interlayer acted as a layer of separator which must have checked the intermixing of surface course of bituminous concrete (BC) with base course of open grade asphalt concrete (OGAC) and helped to maintain the percentage air voids in OGAC. Apart from this, the poorest performance of the Gtx overlay in mixed mode of displacement confirms that the present geotextile interlayer reinforcement over 50mm thick base course of OGAC may be getting delaminated due to the 5mm differential deflection and becoming the source of weak plane in the reinforced OGAC overlay.

CONCLUSIONS

The following conclusions are drawn from the experimental investigation described in this paper. (1) The conventional overlay of dense bituminous macadam (DBM) shows faster rate of decay with number of simulated thermal load cycle than unreinforced and reinforced OGAC overlay and therefore may be concluded that only tensile strength may not be the correct criteria for the selection of crack relief layer. (2) Since OGAC overlay shows BIEF of 1.810 and 2.253 in opening and mixed modes of displacement, respectively, it is confirmed that it works as base isolation layer. (3) Efficacy of OGAC as the crack relief layer is very well confirmed through least increment of 10.54% in material constant “b” under mixed mode of loading, which further confirms that stiffness modulus based on absorbed strain over the interlayer thickness would be a better parameter rather than conventional meaning of stiffness modulus. (4) Since the value of decay parameter “b” match with the analytical findings of Majedzadeh *et al.* (1971 and 1973) it can be considered as the fracture property of the material, which is independent of the mode of displacement. (5) OGAC overlay reinforced with area treatment of polyester woven geotextile interlayer in purely opening mode of displacement (Gtx-O) shows the BIEF of 7.871 and FEF of 4.349. Hence it is emerged out as the most durable overlay in purely opening mode of displacement. However, in mixed mode of displacement (Gtx-M) it has shown BIEF of 0.835 and FEF of 0.371, which are less than one. Hence it may be concluded that it is unsuitable reinforcement alternative for the 50mm thick base course of OGAC, under mixed mode of displacement having 5mm differential deflection with zero load efficiency factors. (6) Though geotextile interlayer definitely helped in maintaining porous OGAC by avoiding adulteration due to fines present in surface course of BC, its poor performance in mixed mode with differential deflection of 5mm confirms its sensitivity towards minimum thickness requirements of base course layer for its stiffness. (7) The agreement of experimentally determined results with those determined using principles of fracture mechanics as well as other investigators’ laboratory and field findings confirm the accuracy and rational use of the designed ‘asphalt concrete slab fatigue testing equipment’.

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