Available online at www.elixirpublishers.com (Elixir International Journal)

Civil Engineering

Elixir Civil Engg. 80 (2015) 31185-31189

ISSN: 2229-712X

Glass grid as high tensile strength layer in rigid pavements/ overlays of runway–An experimental studies on Srinagar international airport Jammu and Kashmir India

Mubashir Rasool Dar and Javeed Ahmad Bhat
National Institute of Technology, Hazratbal, Srinagar, India.

ARTICLE INFO
Article history:
Received: 9 February 2015;
Received in revised form:
28 February 2015;
Accepted: 20 March 2015;

Keywords
Geo Textiles,
Cracks,
Glass Grid, Runway,
P.C.C(Plain Cement Concrete).

ABSTRACT

Effect of glass grid as high tensile strength layer in rigid pavements /runways has been studies using model slabs of low slump value and high strength concrete M40 (40N/mm2) with flexural strength of 4.4 N/ mm2,desighned for 1800kg gross load with 1200 repetition casted over the same sub grade on which runways was to be reconstructed .The slabs after subjected to loads shows that there occurs least number of cracks with less width and propagate to lesser depths and non –continues in nature by the use of glass grids as secondary reinforcement also there is considerable arrest of reflective cracks in case of rigid overlays over cracked pavement.

© 2015 Elixir All rights reserved.

Introduction

Geotextiles being widely used in many civil engineering projects, because of its functions of soil-reinforcement, road-separator, filtrating reverse drain for water, anti-osmosis and protection [1]. Asphalt glass-grid is a new Geotextile product. Comparing with polymer Geotextiles, glass-grid shows its outstanding advantages of high strength, dimension stability, thermal resistance and durability. It also has the properties of large elastic modulus, high tensile strength and less elongation at break. Now various types of glass-grid Geotextile products manufactured by different manufacturers across globe[2] .Glass grids being high tensile strength material are widely used in hot mix asphalt and yet their use in rigid pavements are silent though the mechanical properties of glass grids revealed that they can be use in rigid pavements in runways as an additional reinforcement. The Glassgrids System capitalizes on the high tensile stiffness of fiberglass. Its grid configuration features fiberglass strands coated with an elastomeric polymer. Each strand has a remarkably high modulus of elasticity that makes Glassgrids stronger. This paper presents the result of test slabs of runway pavement subjected to heavey dynamic loads which are reinforced with glass grid as secondary reinforcement.

Methodology Used For Placement Glass grids& Casting of Test Slabs with experiments.

The Glassgrids with 10mm down stone chips ,which acts as stress absorbing membrane interlayer (SAMI) are most commonly used in the resurfacing of the flexible runway, but the same is not used for the resurfacing of the rigid pavements, therefore the application of Glass grids in rigid pavements are yet silent. The experiments with complete procedure of placing and laying of glassgrids has been evaluated by casting different test models of slabs. Model are casted on same subbase condition with compaction requirement of about 90-100% achieved by Tendon rollers shown in fig 1(a) and fig 1(b).

Fig 1.(a) Subbase preparation

Fig 1(b). The subase for the model slab being compacted with Tendon roller

There is a broad consensus among airfield pavement engineers that a uniform and durable base is essential for ensuring the long-term performance of a rigid pavement [4]. The main functions of the base layer are as follows:

- Provide a stable construction platform.
- Provide a uniform, long-term support for the pavement while in service.
- Distribute applied loads to the underlying layers including the pavement subgrade.
- Aid in providing subsurface drainage due to infiltration of precipitation or ingress of frost-melt or spring-thaw bleed water (in the case of permeable bases).

Tele:
E-mail addresses: mubashirrasool96@yahoo.com

© 2015 Elixir All rights reserved

- Provide frost protection (where required).

The FAA [4] requires the use of stabilized bases (CTB: cement treated bases econocrete) for all new rigid airfield pavements that will be required to support aircraft weighing 100,000 lbs (45,250 kg) or greater. The various departments of the military (Army, Air Force, Navy, Marine Corps) also allow the use of stabilized layers in pavement structural design (UFC, 2001) The CTB layers are designed for a minimum 7-day compressive strength of $8N/mm^2$. This strength requirement was established because at this strength level, the long-term durability of the CTB layer when subject to repeated cycles of wetting and drying or freezing and thawing is virtually assured, as shown in figure 2 [5].

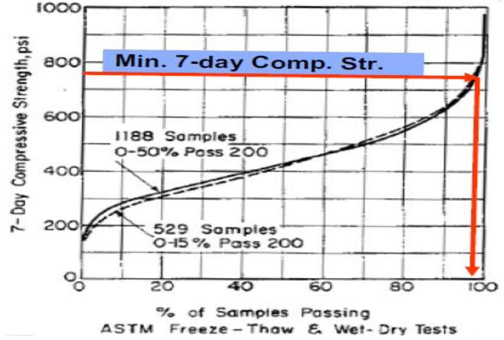

Fig 2. Strength requirement for the cement treated base (CTB)

High strength bases increase the slab support value (k), leading to higher curling stresses in the slab. These higher curling stresses have a more damaging impact when the concrete is relatively young. CTB layers with greater than 4 to 5 percent cement also tend to develop shrinkage cracks[6],later reflect into PCC slabs, therefore low strength PCC with cement content of $150kg/m^3$ were used for the cement treated bases shown in the fig 3(a) and fig 3(b).

Fig 3(a). Base preparation

Fig 3(b). PCC of M-15 grade used as cement treated base for the model slabs

The concrete placed in the rigid pavements of the runways must be weigh batched and the placement of the concrete in slab panels must be done by using transit mixer with gunny bags covered over the surface in case of hot climate [7],therefore concrete with fiber and without fiber of M-40 grade design mix has been mixed using weigh batching plant and is placed using ready mix concrete mixers shown in the fig 4(a) and fig 4(b) in order to assure homogeneity of the mix and segregation

Fig 4(a). Concrete mix

Fig 4(b). Placement of concrete with transit mixers of slump of 25 mm

The glassgrids beign high tensile strength layers are placed at vrious depths across the section of the slab in order to study the effects of the glassgrids in model slab.The fig 5(a), fig 5(b) and fig 5(c), shows the various locations of glassgrid placed in concrete test slab of thickness 250mm.

Fig 5(a). Glass grid at 100mm from bottom.

Fig 5(b). Glass grid at 175mm from bottom

Fig 5(c). Glass grid at 200 mm from bottom.

After placing the concrete, the slabs must cured well and non destructive tests for compressive strength must be conducted before allowing load to be pass over the slabs in order to ensure that data collected from the test slabs are credible [8],hence non destructive tests on the slabs were conducted by using concrete hammer as shown in fig. 6.

Fig. 6(a). Non destructive test (NDT)

Fig. 6(b). Non destructive tests conducted on the slabs

After conducting the NDT on test slabs the load of magnitude 1800 kg is passed over the each slab with designed repetition of 1200 per slab as shown in the figure 7.

Fig 7. Load of 1800kg gross weight passing over the slabs.

Results & Discussion Of Model Slabs With & Without Glass Grids

In order to better understand the impact of glass grids in rigid pavements, loads are passed over the slabs at various depths of glass grid locations, it has been observed that the crack width decreases as the glass grids are shifted toward top from bottom as shown in fig 8.From figure 8 it has been also observed that the crack width is maximum in first 12 observation points in all the three types of models, these 12 points in actual represents the corner points of the slab as shown in fig 9, which shows that the stresses are more in corners compared to the other points in slab. This may be the reason that corner cracks are most common type of cracks in l most concrete panels of the rigid pavement.

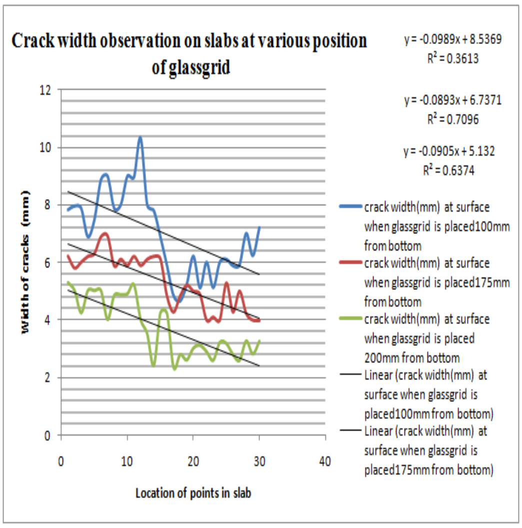

Fig 8. Crack widths at various depths of glass grids in slab

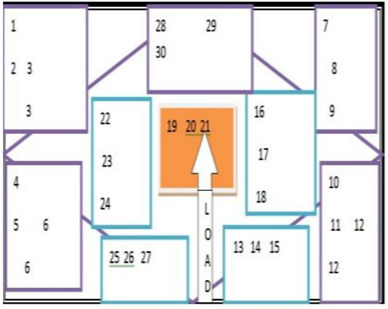

Fig 9. Location points on test slab

The continuity/ length of cracks is basically a symbol of structural failure, therefore least the cracks are continuous stronger is the structure . From fig 10 it has been observed that the cracks are least continuous in model slab with glass grids at 200mm from bottom of slab, further it has been also observed that the continuity of cracks are maximum from 0-12 in all model slabs with least continuity in case of model slab, with glass grids at the top.

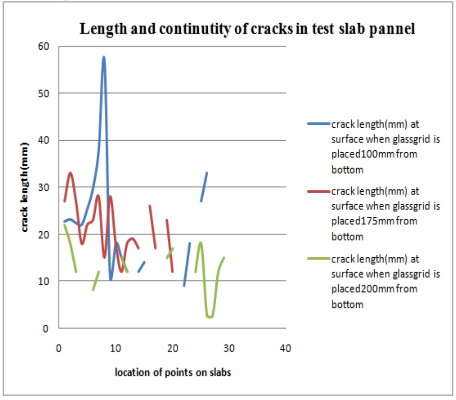

Fig10. Length and continuity of cracks at various depths of glass grids in slab

When loads were applied on slab without glass grids, it has been observed that width of cracks increases considerably then those slabs with glass grids as shown in fig 11 .Cracks upto 20mm have been observed in the corner points

It has been also observed ,that the length and continuity of cracks is more in case of slabs without glass grids as shown in fig. 12, which reveals the fact that the incorporation of high strength tensile layer in concrete stops the continuity of cracks and reduce them to smaller in lengths.

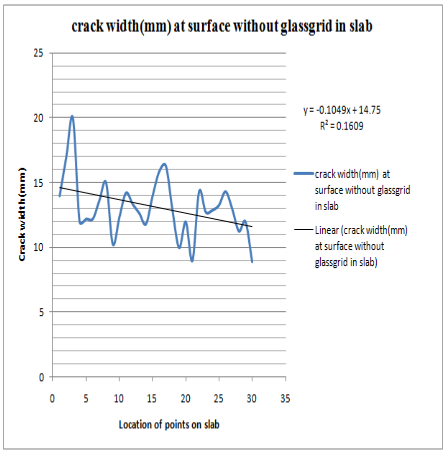

Fig 11. Crack widths in slab without glass grids

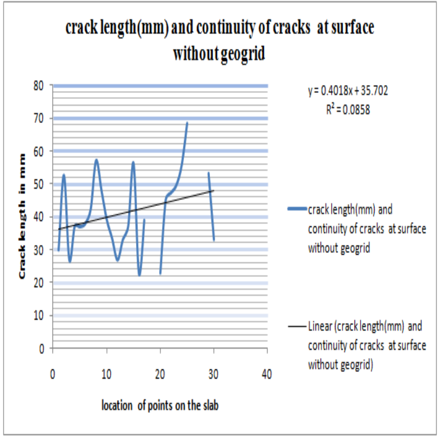

Fig 12. Length/ continuity of cracks in slab with no glass grids

From the observation and inspection carried out on test slabs it has been observed that the cracks propagating to full depth been blocked by high tensile strength layer at their respective locations as shown in fig 13 The maximum crack depth is 40mm in case of test slab with glass grids at 50mm from top while as the cracks propagate 220mm in case of slabs without glass grid as shown in fig. 13, which almost is the loss of structural integrity.

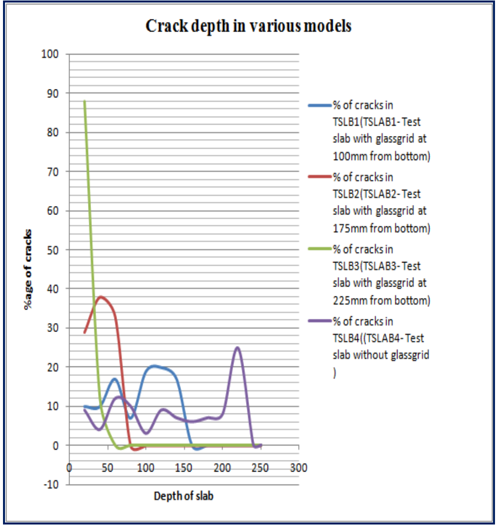

Fig 13. Crack depth in various models

The objective of this research paper was also to evaluate the results, when glass is grid placed under concrete overlay to reduce the severity or delay the appearance of reflection cracks. Slabs were casted and a tack coat was applied on top of the grid to minimize slippage problems. Results from Fig. 14 shows that there occurs cracks of more width in case of slabs without Glassgrids and less in case of slabs with Glassgrid. The phenomenon of reflective crack which are the main causes for damage in new overlays [9] has been controlled to extensively large extent as shown in fig.15, by placing Glassgrids as high tensile strength layer in between the two low tensile strength concrete layers the crack depth from bottom of overlay in case of slabs with glassgrids falls 100% within the depth zone of about 5mm, while the cracks propagate upto depth of 160mm in case of slabs without glassgrid.

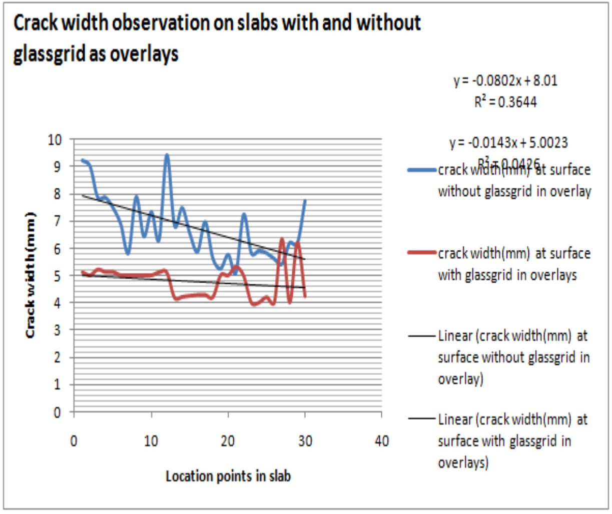

Fig 14. Crack width observation on slabs with and without Glass grid as overlay

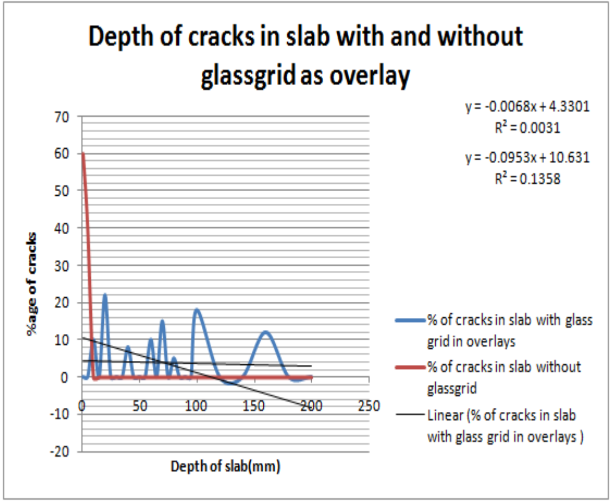

Fig 15. Crack width observation on slabs with and without glassgrid as overlay

Conclusion

The crack length, crack width and number/continuity of cracks are least in case of slabs with glassgrids compared to slabs without glassgrids, this reveals that the serviceability and design life of the pavement get increased to considerable time.The use of glassgrid in rigid overlays with bituminous macadam layers as intermediate layer between the two adjacent overlays reveled the fact that reflective cracks can be arrested to considerable amount and hence safeguards the rigid overlay from the reflective cracking process.

References

[1] Barksdale, I., L., Kamel, T. L., Valentine, R. J., Lacina, B. A.,and Smith, T. E. (1991).,"Laboratory Evaluation of Geosynthetic Reinforced Pavement Sections," Transportation Research Record 1439, pp. 25-31.

[2] Barksdale, R.D. Fabrics in Asphalt Overlays and Pavement Maintenance. NCHRP Synthesis 171, National Cooperative Highway Research Program, National Research Council,

Washington, D.C., 1991b.

[3] Anderson, M. Torres, H. Barzegar, M. Thompson, and J. Naughton. 2003. Best Practices for Airport Portland Cement Concrete Pavement Construction (Rigid Airport Pavement), Report IPRF-01-G-0021, ACPA Document No. JP007P, Innovative Pavement Research Foundation (IPRF), Washington, D.C.

[4] FAA, 1995. Airport Pavement Design and Evaluation, Advisory Circular No. 150/5320-6D, Federal Aviation Administration, U.S. Department of Transportation.

[5] PCA, 1971. "Methods for Reducing Friction Between Concrete Slab and Cement Treated Subbases," Unpublished Report for FHWA, Cement and Concrete Research Institute, September.

[6] Grogan, W.P., Weiss Jr., C. A., and Rollings, R.S., 1999. Stabilized Base Courses for Advanced Pavement Design, Report 1: Literature Review and Filed Performance Data, Report No. DOT/FAA/AR-97-65, Federal Aviation Administration, U.S. Department of Transportation.

[7] G.F., 2002. "Early Cracking of Concrete Pavement – Causes and Repairs," Presented for the 2002 Federal Aviation Administration Airport Technology Transfer Conference, Atlantic City, New Jersey. 196

[8]Bradbury, R. D., 2004. "Reinforced Concrete Pavements," Wiree inforcement Institute, Washington, D.C.

[9] Lytton, H., Titi, H.H., and Berry, D. (2006). "Study of Best Practices for Pre-Overlay Repair and Asphalt Overlay," Proceedings of the 2006 Airfield and Highway Pavement Specialty Conference, American Society of Civil Engineers, Atlanta, GA, pp 815-823.