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.

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, designed 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.
- Provide frost protection (where required).

The FAA [4] requires the use of stabilized bases (CTB: cement treated bases econcrete) 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/mm². 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/m³ 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 being high tensile strength layers are placed at various 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 be cured well and non-destructive tests for compressive strength must be conducted before allowing load to be passed 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)](image1)

![Fig. 6(b). Non destructive tests conducted on the slabs](image2)

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.](image3)

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 towards top from bottom as shown in fig 8. From figure 8 it has been also observed that the crack width is maximum in the 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 most concrete panels of the rigid pavement.

![Fig 8. Crack widths at various depths of glass grids in slab](image4)

![Fig 9. Location points on test slab](image5)

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](image6)

When loads were applied on slab without glass grids, it has been observed that width of cracks increases considerably than those slabs with glass grids as shown in fig 11. Cracks up to 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.
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.

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.

**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 revealed the fact that reflective cracks can be arrested to considerable amount and hence safeguards the rigid overlay from the reflective cracking process.

**References**
