SHORT COMMUNICATION

The analysis of shear stress in clay-asphalt solid tray composites under increased loading

Abodunrin Olutayo Wale*, Ajayi Ayodeji Akintunde

Pandey VK. The analysis of shear stress in clay-asphalt solid tray composites under increased loading. J Environ Geol. 2021;5(6):1-2.

ABSTRACT

Compressive loading helps to confirm the rutting of the load-induced distresses found in Clay-asphalt trays. Interestingly, the mechanism of rutting is associated with shear deformation rather than densification. Recently, uniaxial cracking and its propagation is probably attributed to shear failure. Clearly, shear stress is one of the critical factors affecting clay-asphalt performance. Conventionally, laminar design methodologies assume the compressive machine stress is equivalent to tire inflation pressure under loading and uniformly distributed over a circular contact area. In fact, the compressive loading pressure is non-circular and contact pressure is not uniform and the same as tire inflation pressure. This study evaluates the shear stress in asphalt mixture layers produced by non-uniform stresses applied to the laminar surface, in a simulation of field conditions. Then a concrete analysis is carried out for Clay asphalt laminar. The calculated results indicate the maximum shear stress occurs at a point approximately 50 mm under the compressive loading. The loading distinctly affects shear stress. Bonding at the interface between the asphalt mixture layer and the clay-base course obviously affects shear stress as well.

Key Words: *Shear stress, Rutting, Uniaxial cracking, Method Analysis of shear stress in Asphalt clay composites.*

INTRODUCTION

Rutting in asphalt structure includes densification and shear flow of hot-mix asphalt, but the majority of severe unstable rutting results from shear flow within the asphalt mixtures which is usually found in longitudinal path, has become more common in asphalt embodiment is also considered as a shear-related failure [1]. As a result, shear stress is confirmed to be one of the critical factors affecting laminar performance, and it is necessary to well understand shear stress in asphalt solid tray [2].

However, traditional methods of asphalt analysis assumed that contact pressure is the same to tire inflation pressure and that it is uniformly distributed over a circular contact area and acts in the vertical direction [3]. To have empirical understanding of the effect of shear stress on pavement performance, a laboratory method of applying compressive pressure is employed in this paper. The results are compared for differing loading conditions [4]. The effects of pressure and stress components in terms of vertical and horizontal stress on shear stress are comprehensively investigated. In addition, the effects of asphalt layer thickness and interface conditions are also discussed [5].

MEASUREMENT OF ASPHALT-TRAY CONTACT PRESSURE

In order to measure the Asphalt-Clay contact pressure distribution under realistic condition, a static laboratory test device was developed. In this Instron loading device, the Asphalt-Clay concrete specimen is subjected to the stress induced which is similar to the stress produced by the tire. All measurements are automatically recorded using a data logger. Though this method may seem simple and may result in slight inaccuracy as compared with an actual tray, the results are undoubtedly much more reliable than when uniform contact pressure is assumed (Figure 1).

In the tests, tire inflation pressure ranged from 0.45 MPa to 1.00 MPa, while tire loading varied from 20 kN to 50 kN. In all, five combinations of tire pressure and tire loading are studied in this paper, that is, 0.45/25, 0.50/25, 0.80/20, 0.81/25 and 0.81/50, in which the first item meant tire pressure

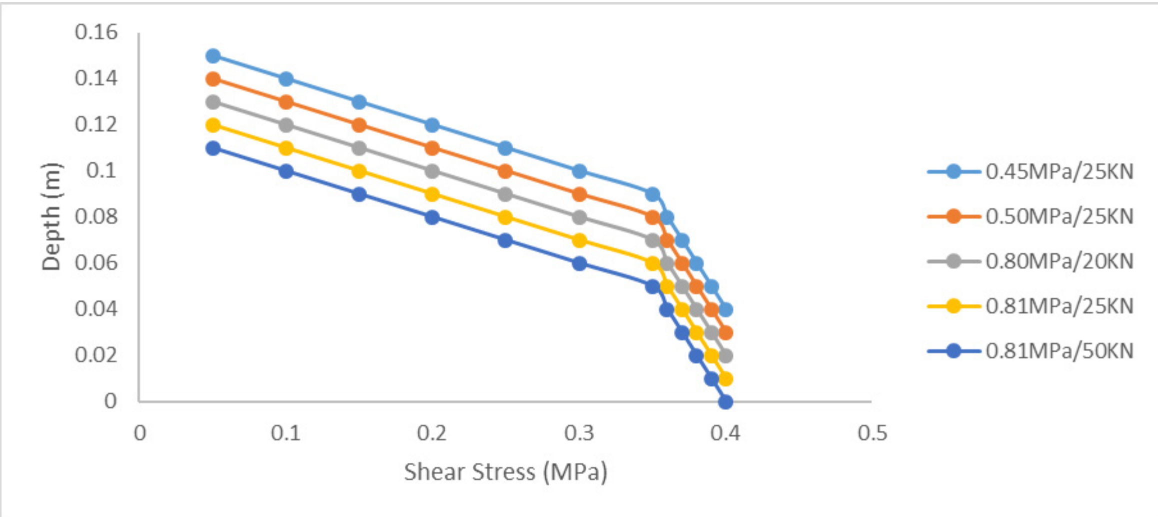

Figure 1) *Depth against the shear stress for asphalt-clay composites*

Department of Mathematical and Physical Sciences, Afe Babalola University, Ekiti State, Nigeria

Correspondence: Abodunrin Olutayo Wale, Department of Mathematical and Physical Sciences, Afe Babalola University, Ekiti State, Nigeria, E-mail: tayoabodunrin@yahoo.com
Received: October 29, 2021; Accepted: November 05, 2021; Published: December 30, 2021

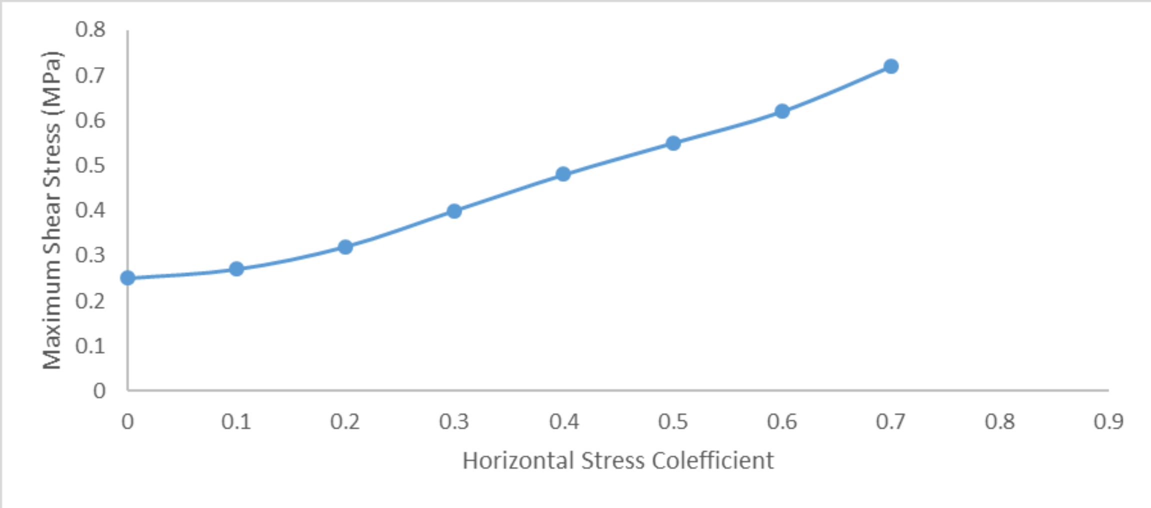

Figure 2) *Maximum shear stress against horizontal stress coefficient for asphalt-clay composites*

(MPa) and the later item symbolized the tire load (kN).

RESULTS AND DISCUSSION

In a multi-layered Asphalt-Clay system, the condition of the interfaces between layers makes an important contribution to tray performance. Here, the effect of interface condition on shear stress is evaluated, focusing on the cases of no bonding and full bonding between the asphalt mixture layer and the clay base course. Both the range and magnitude of shear stress where there is no bonding are greater than where there is full bonding. Correspondingly, poor bonding at the interface, which means a situation somewhere between no bonding and full bonding, would result in higher shear stress than the full bonding case. That is, inadequate bonding between the asphalt mixture layer and the base course is detrimental not only in the sense that slippage failure may be induced, but also because it can lead to rutting (Figure 2).

CONCLUSION

- Horizontal stress significantly affects shear stress
- The thickness of the Asphalt-Clay mixture layer has little influence on shear stress
- Poor bonding between Asphalt-Clay mixture layer and base course can lead to an increase in shear stress, and this in turn increases the risk of rutting

REFERENCES

1. Wang LB, Myers LA, Mohammad LN, et al. Micromechanics study on top-down cracking. Transp Res Rec. 2003;1853(1):121-33.
2. Huang YH. Pavement Anal Des. 1993.
3. De Beer M, Fisher C, Jooste FJ. Determination of pneumatic tyre/ pavement interface contact stresses under moving loads and some effects on pavements with thin asphalt surfacing layers. InProceedings of the 8th international conference on asphalt pavements.1997;1:10-14. Lino Lakes, Minn: International Society for Asphalt Pavements.
4. Himeno K, Kamijima T, Ikeda T, et al. Distribution of tire contact pressure of vehicles and its influence on pavement distress. In Eighth International Conference on Asphalt Pavements Federal Highway Administration 1997;1.
5. Sun L, BI Y, Hu X, et al. Tpo-down cracking analysis and control for asphalt pavements. In 10th International Conference on Asphalt Pavements-August 12 to 17, 2006, Quebec City, Canada 2006.