Analysis and Design of Rigid Pavement on Collapsible and Expansive Soils

Kongan Aryan & A.K. Gupta & Mamta Tiwari,
Department of Civil Engineering, DTU,
New Delhi, India

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ABSTRACT *Earth quack expansive and collapsible soil susceptible to expansion and shrinkage with chance of different moisture content are a constant source of trouble in the design and construction of foundation such soils popularly known as earth quake block cotton soil occur extensively in Asia like India, Thailand, Japan, Hong Kong, Singapore, America like California, Alaska UK like London, Germany like Berlin and Bonn, Italy like Rome Africa like Blue Nile and White Nile and great rift valley region and type of world building constructed on such soils adopting the type of foundation commonly employed for the other type of soils strata are observed to crack extensively within a short period of third construction in spite of every reasonable precaution. Systematic laboratory and field investigation to solve this critical soils problem have been carried out in India during the past 24 years and the results have led to the introduction of under reamed pile foundation and raft foundation. This modern technique paper give a review of the development of this method and the design and construction technique employed.*

Keywords:

Introduction

The main concrete roadwork for city roads was started in Mumbai in 1924. Marine drive was constructed in 1983-1939 and was reclaimed on soil in coastal area and the road is still performing well even after 63 years of service despite of unfavourable environmental conditions.

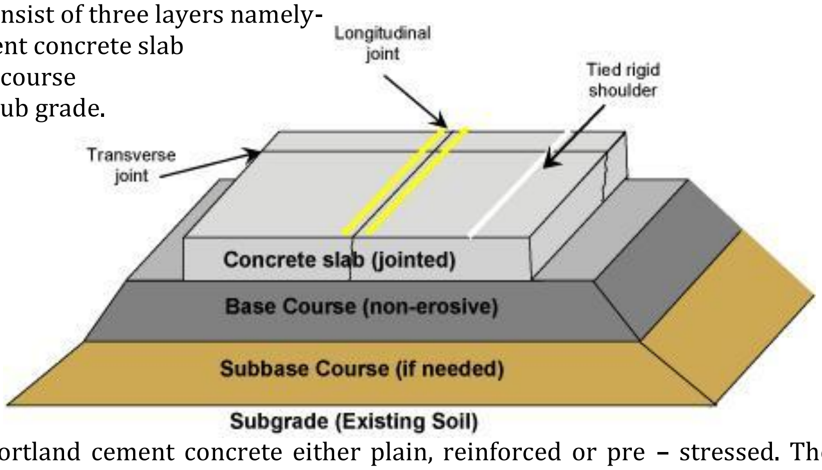
Many of our airfield pavements have been made with as rigid pavement especially at the apron and runway ends. In India, first mechanized road was for two additional lanes for 56 Km stretch of Delhi Mathura road – major concrete pavement project. The Mumbai-Pune expressway is the first international –standard six lane expressway constructed in India and that too in concrete.

Methodology

Rigid pavements are constructed of Portland cement concrete. The first concrete pavement was built in Bellefontaine, Ohio in 1893.They consist of three layers i.e. surface layer, base layer and the sub grade. The rigid pavements have high flexural strength and can resist very high tensile stresses. Rigid pavements possess note worthy flexural stiffness or flexural rigidity.

These pavements transfer load through slab action but not grain to grain transfer as in case of flexural pavements. These consist of three layers namely-

1. Cement concrete slab
2. Base course
3. Soil sub grade.



They are made of Portland cement concrete either plain, reinforced or pre – stressed. The plain cement concrete are expected to take up about 40kg/cm^2 flexural stress. These are designed using elastic theory, assuming pavement as an elastic plate resting over an elastic or a viscous foundation.

They are analyzed using plate theory. Plate theory is a simplified version of the layered theory that assumes the concrete slab to be a medium thick plate. It is assumed that a plane before bending remains plane after bending.

Rigid pavements are analyzed by the plate theory, instead of the layered theory. Plate theory is a simplified version of the layered theory that assumes the concrete slab to be a medium thick plate with a plane before bending which remains plain after bending.
Rigid pavements are placed directly on the prepared sub grade or on a single layer of granular or stabilized material. Because there is only one layer of the material under the material under the concrete and above the sub grade, some call it a base course.

EXPERIMENTAL WORK AND CALCULATIONS

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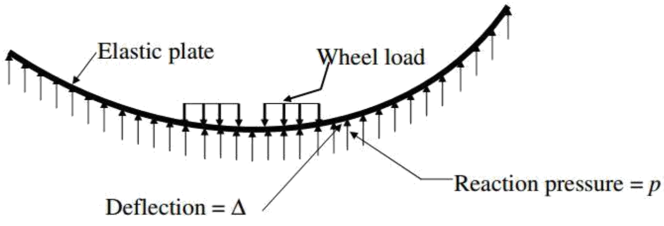
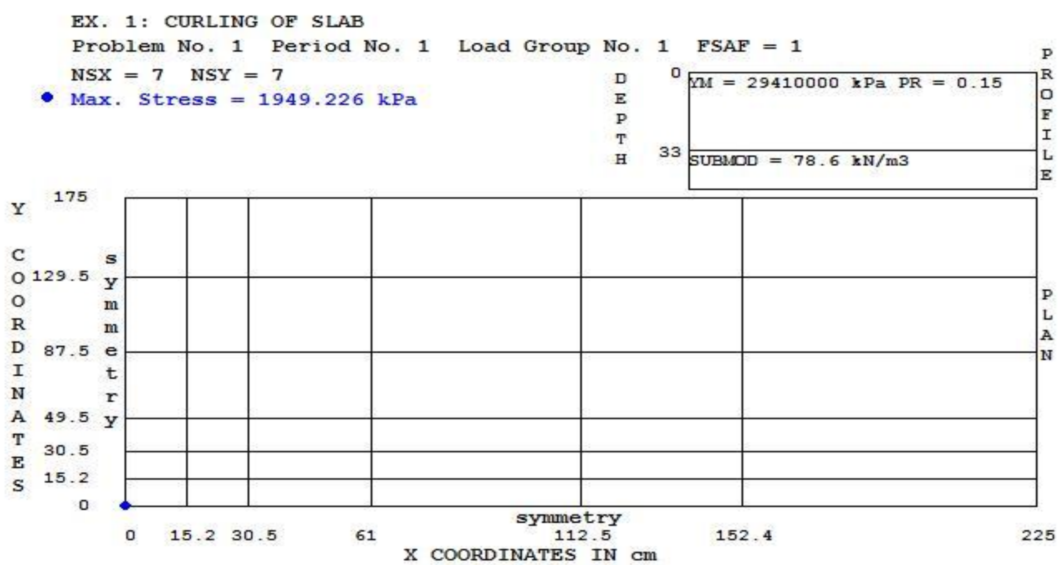


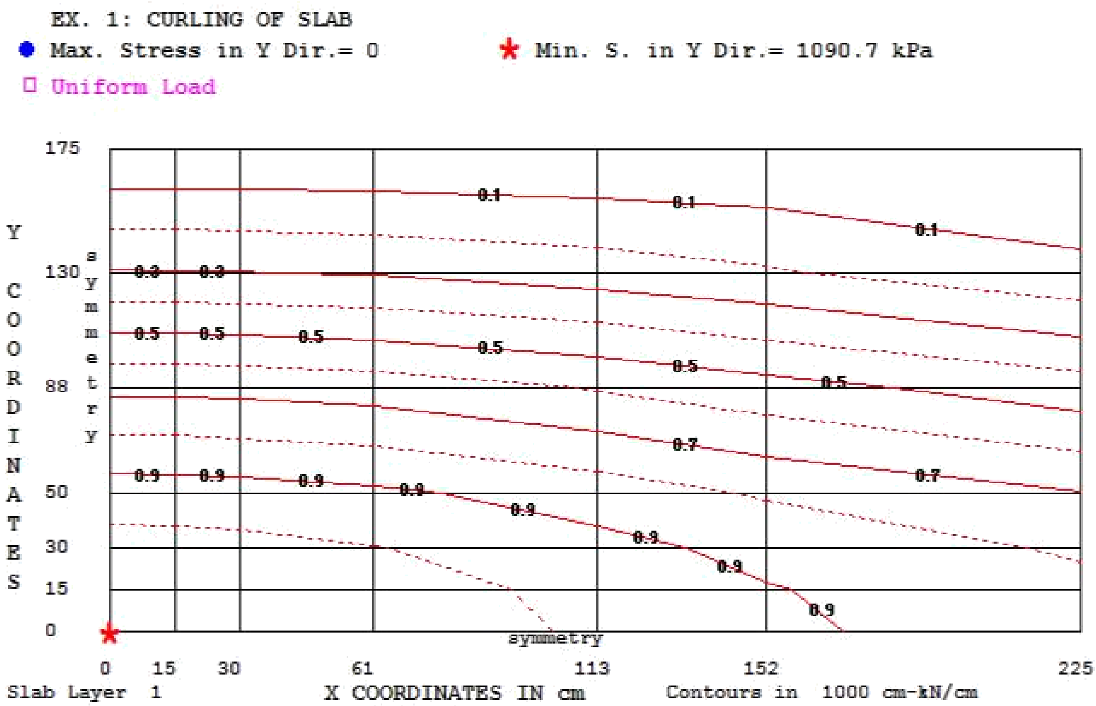
$p \propto \Delta$ or $p = k\Delta$

Rigid pavements are analyzed by the plate theory, instead of the layered theory. Plate theory is a simplified version of the layered theory that assumes the concrete slab to be a medium thick plate with a plane before bending which remains plain after bending .if the wheel load is applied in the interior of the slab, either plate theory or layered theory can be used because both should yield nearly the same flexural stress or strain. The wheel load is applied near to the slab edge, say less than 0.61m from the edge, only the plate theory can be used for rigid pavements.
The reason that layered theory is applicable to flexible pavements but not to rigid pavements is that PCC is much stiffer and it distributes load to a much wider area. The existence of joints in rigid pavements also makes the layered theory inapplicable. Rigid pavements are placed directly on the prepared sub grade or on a single layer of granular or stabilized material. Because there is only one layer of the material under the material under the concrete and above the sub grade, some call it a base course.

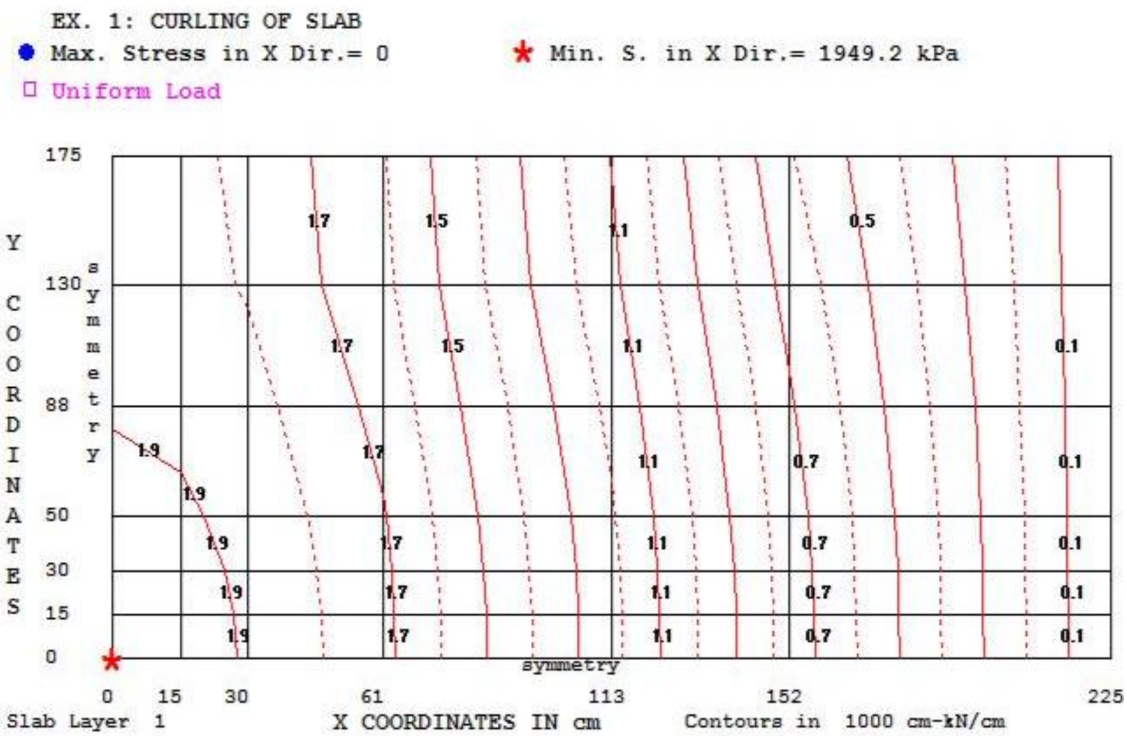
ANALYSIS USING KENPAVE

(i) Maximum stress calculated for consideration of temperature stresses in rigid pavement is 19.88 Kg/cm^2

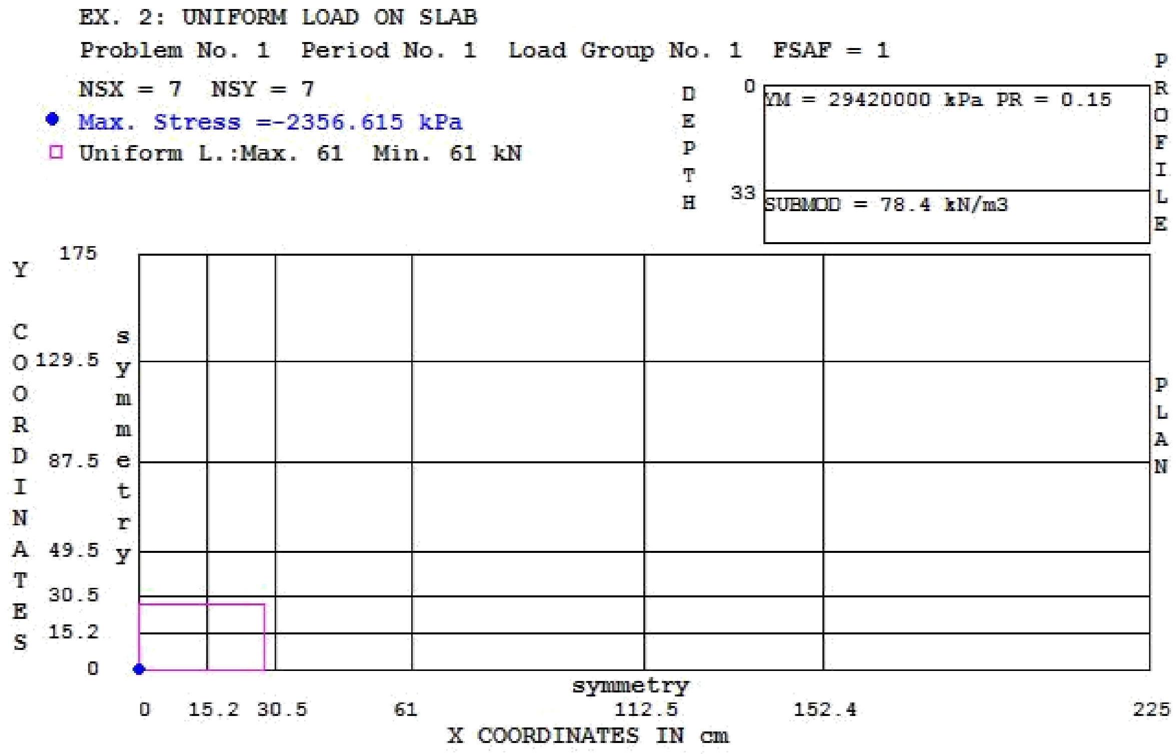




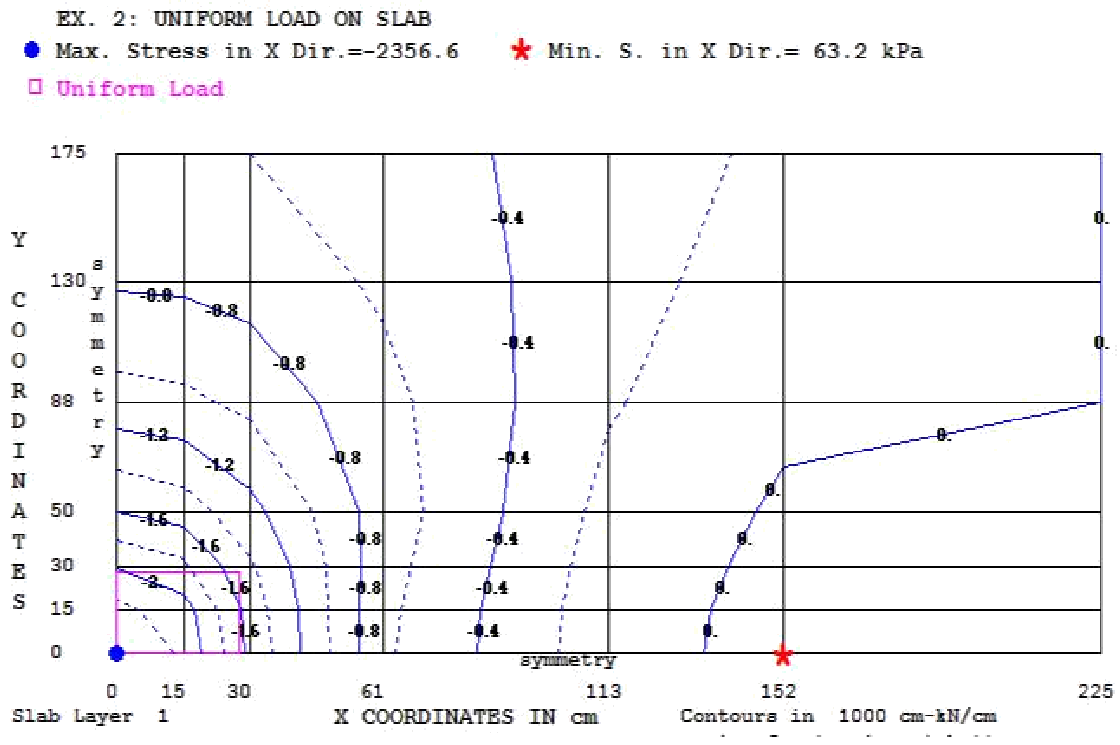
The value of warping stresses as calculated from the irc method is 17.33 kg/cm^2. Thus the value obtained from the software can be relied much on as it is based on finite element method and the calculated value is on the higher side which is 19.88 Kg/cm^2.



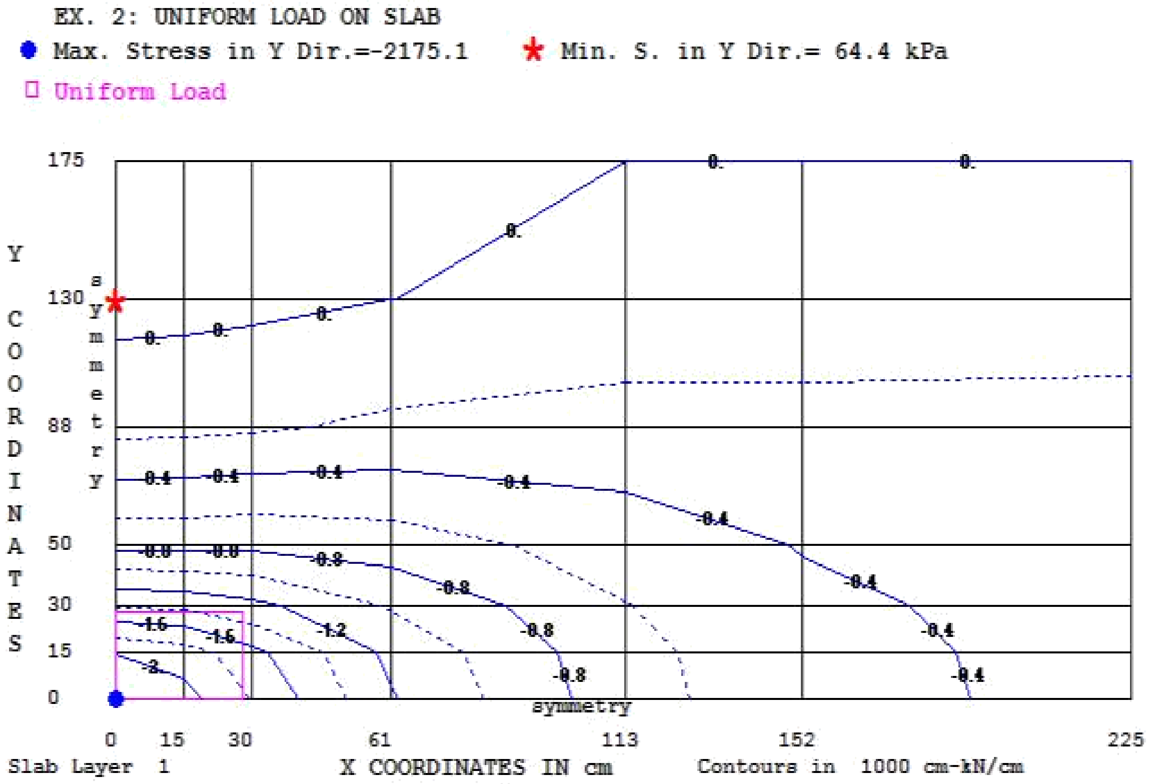
Contours, showing the distribution of curling stresses along X-direction of the slab.
The largest concentration of the stress being at node 0.

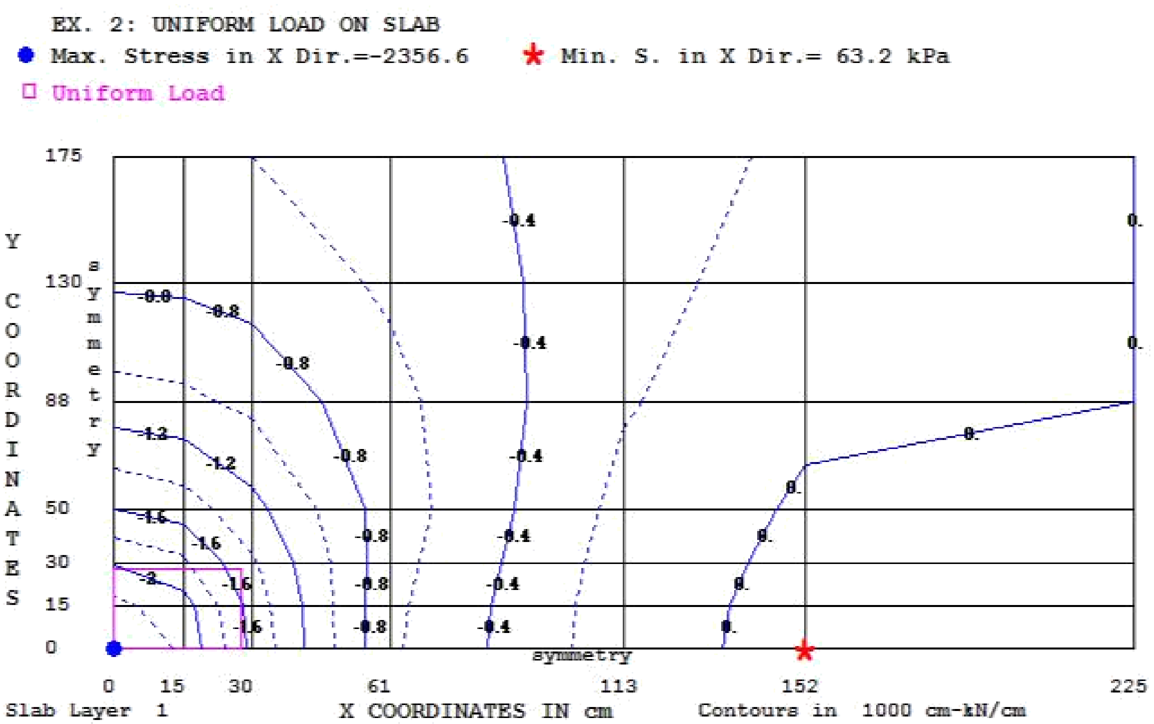


Contours, showing the distribution of curling stresses along Y-direction of the slab. Maximum stress is at the node 0.



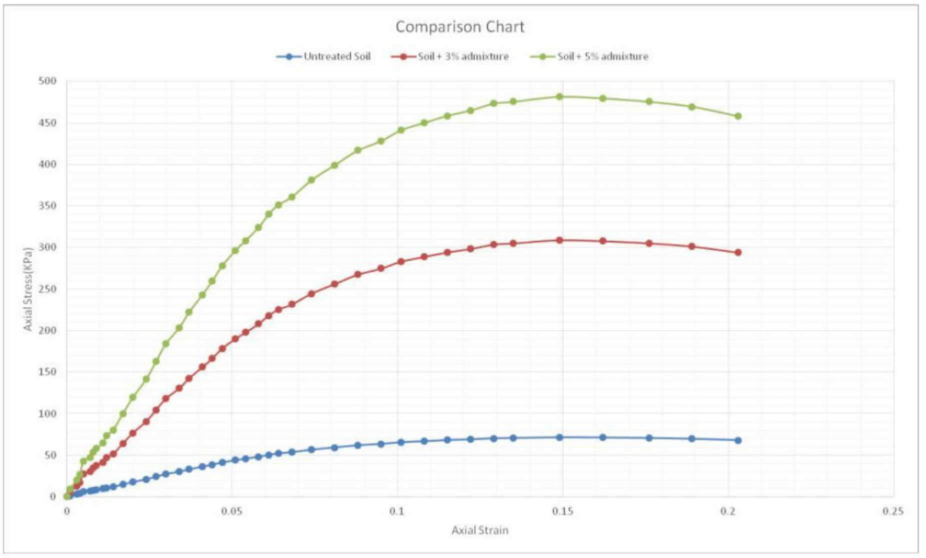
The maximum stress due to uniform tyre pressure axle load is 23.56 Kg/cm^2. The stress is concentrated in 14 cm of radius of contact area.

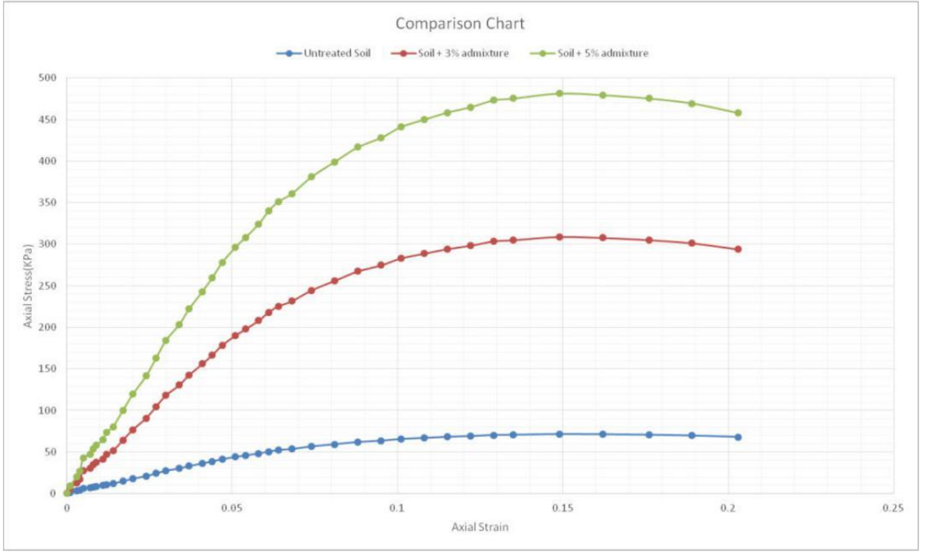




The maximum stress in x- direction is -23.56 Kg/cm^2 and the minimum stress being 0.0632 Kg/cm^2.

The maximum stress due to uniform load -21.75 Kg/cm² and the minimum stress in Y-direction.





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