SURFACE STRAINS CAUSED BY UNIFORM AND NON-UNIFORM CONTACT PRESSURES

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My Background

- I am from Co. Louth in the Republic of Ireland.
- My primary degree is a BA/BAI in Civil, Structural and Environmental Engineering from Trinity College, University of Dublin.
- I have been based at the University of Nottingham for 2 years now.
Project Background

- This Project is part of a Marie Curie Initial Training Network (ITN) called Training in European Asset Management TEAM
- The individual project this paper is connected to is based in the University of Nottingham at NTEC
- The overall goal is to assess the impact that non-uniform contact pressures have on surface distress.
Research Background

- The traditional representation of a tyre is a circular contact patch with a constant vertical load.
- The materials are represented by a multi-layer linear elastic system.
- The methods usually have two modes of failure in the pavement, fatigue cracking at the base of the asphalt package and rutting at the top of the subgrade.
Specific Goals of this Paper

- To establish the variation in the strain induced on the surface and the near surface by non-uniform contact pressure in comparison with uniform contact pressure.
- To illustrate how the effects of the non-uniform contact pressure reduce rapidly with depth and/or distance from the contact area.
- To highlighting the shear strains that the non-uniform contact pressure induce under the contact area.
Set-up and Process of Research

- The mesh was set-up as shown on the right and was validated against BISAR.
- The material model was linear elastic for all layers with full bonding between layers.
- The Materials all had a possion ratio of 0.35. The subgrade Young's modulus was 100 MPa, Subbase 700 Mpa, 4500 for the ashphalt layer.
Original Vertical Stress

Tyre 315 / 80 R22.5 (G391)

- Inflation Pressure = 825 kPa
- Vertical Load (HVS) = 40.5 kN
- Measured Vertical Load (SIM) = 37.7 kN
- Wheel speed (HVS) = 1.0277 m/s
- Max Stress = 1.08 MPa
Set-up and Process of Research

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Results: Strain at 2.5mm

X-axis strain

- Strain values are shown on a logarithmic scale.
- The graph compares uniform and non-uniform strain.
- The x-axis represents distance in mm, ranging from 0 to 600.
- The y-axis represents strain in 10^-5 units, ranging from -1.20E-04 to 0.00E+00.
Results: Strain at 2.5mm

Y-axis strain

- Strain values are shown for both uniform and non-uniform conditions.
- The graph illustrates the strain distribution along the Y-axis from 0 to 600 mm.
Results: Strain at 2.5mm

![Graph showing strain values at different YZ positions.](image-url)
Results: Strain at 27.5mm
Results: Strain at 27.5mm

Y-axis strain

- Strain: -1.00E-04, -8.00E-05, -6.00E-05, -4.00E-05, -2.00E-05, -4.00E-19, 2.00E-05, 4.00E-05, 6.00E-05

Strain vs. mm

Uniform and Non-uniform strain plotted.
Conclusions

- The peak strain levels are recorded for the non-uniform contact pressure for the principal axes for both the 2.5mm depth and the 27.5mm depth.
- The non-uniform contact pressure creates significant non-uniformity of strain under the contact area for the principal axis at both depths.
- Non-uniform contact pressure creates a largely varying shearing strain under the contact area. This is completely different than the uniform contact pressure case and not accounted for in current design procedure. The maximum of this strain is comparable in magnitude to the maximum principal axes strain.
- A highly complex strain state is created under the contact area of the non-uniform contact case in comparison to uniform contact pressure.
Current Research
Current Research
Current Research
Thank you very much for your attention.

Go Raibh Míle Maith Agaibh