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Analysis on Asphalt Pavement with Contact Stress Distribution for Skid Resistance

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Abstract **In our analysis, ANSYS was used and the model was developed on unigraphics 8.0. In order to verify the present base paper model, the contact stresses with five types of mesh size are compared with the available experimental results present in the base paper and the design of modified asphalt pavements with different materials. In this study, the simulations of different profile modified asphalt pavements and five types of mesh size were analyzed for contact stresses and the configurations of modified asphalt pavement design are proposed.**

The results show that SMA material pavement the increased in a contact stresses and area mean pressure in different mesh sizes. The shear and normal stresses are decreased as compare to SBS asphalt pavement.

Keywords Pavement, Contact stress, Shear stress, Area Mean Pressure, Normal stress, SBS, SMA.

I. I INTRODUCTION

The improvement of car technology supplied a possibility for customers to power at better pace on roads, However such technology requires right avenue situations for higher safety acquisition. The pavement floor must put its users in a secure and relaxed circumstance. Traffic injuries may be the result of an aggregate of many elements but one of the primary safety criterions for asphalt pavements is tire-pavement interaction, and this is at once associated with surface texture tendencies, which contributes to skid resistance and floor drainage. Skid resistance is one of the most crucial traits, which significantly impacts the safety of the use of on pavements and roads and has a extreme effect on the accidents occurrence, mainly in wet floor conditions. The low fee of skid resistance, mainly in wet pavement, ends in unstable driving conditions. Since it isn't always unusual engineering workout to create a notably at ease and at ease situation for customers of centers, it's far obvious why entire emphasis is given to analyze of pavement texture trends. The assessment of texture houses of the pavement ground like skid resistance turned into regularly finished with the conventional tests like sand patch checks, the British pendulum and the drainage assessments. These exams are generally carried out within the field after the pavement manufacturing. Several researchers had been trying to make bigger exceptional strategies for the analysis of the asphalt pavement ground with respect to its skid resistance, that are faster and extra accurate with decrease expenses.

II. EFFECTS OF TEXTURE PROPERTIES ON SKID RESISTANCE

Several studies have targeted on the have an impact on of microtexture and macrotexture on pavement skid resistance. The texture of a pavement floor impacts the tiers of skid resistance that may be received. It has been installation that right microtexture is essential at low speeds and real macrotexture is essential at high speeds (AASHTO 1976). However, some researchers believe that the microtexture of the mixture is important now not only for first rate low speed skid resistance however at high speeds as properly (Dupont 1995).

III. FINITE ELEMENT METHOD

The limited component strategy (FEM) could be a numerical system for finding rough determination of incomplete condition (PDE) in like manner as vital condition. The solution method depends both on shelling out with the condition absolutely (unfaltering nation issue), or rendering the PDE into companion diploma estimate association of ordinary circumstance, that sector unit then numerically incorporated exploitation normal gadget admire Euler's approach, Runge-kutta, and so forth. In willpower halfway differential situations, the major take a look at is to make relate degree situation that approximates the condition to be contemplated, however is numerically steady, that means that blunder inside the info and center of the street be counted do not amass and purpose the subsequent yield to be absurd. Their territory unit a few methods for doing this, all with advantages and detriment. The restrained segment approach may be a first rate determination for willpower fractional situation over troublesome area (like automobiles and oil pipelines), as

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soon as area changes (as throughout a strong state response with a transferring restrict), as soon as and the predetermined exactitude differs over the complete area, once the solution needs smoothness.

IV. MODELING AND ANALYSIS

4.1 Design procedure of tyre and pavement block

The procedure for solving the problem is

- Modeling of the geometry.
- Meshing of the domain.
- Defining the input parameters.
- Simulation of domain.

Finite element analysis of Analysis of modified asphalt pavement

Analysis Type- Static structural analysis

A. 4.2 Preprocessing

Preprocessing include CAD model, meshing and defining boundary conditions.

1) 4.2.1 CAD Model

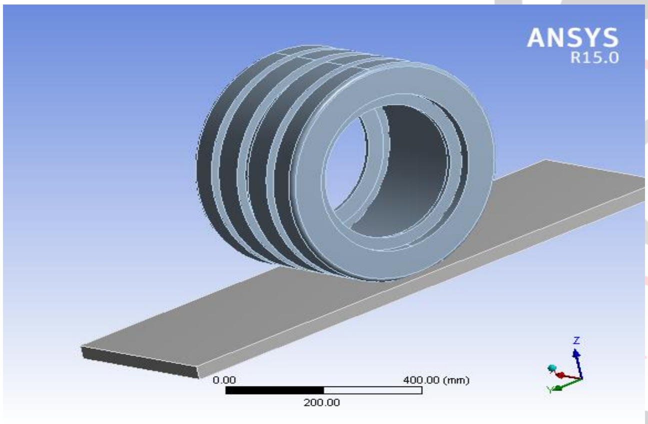

Figure 4.1 *CAD Model of pavement and tire.*

4.3Meshing data for organic coatings on steel pipe.

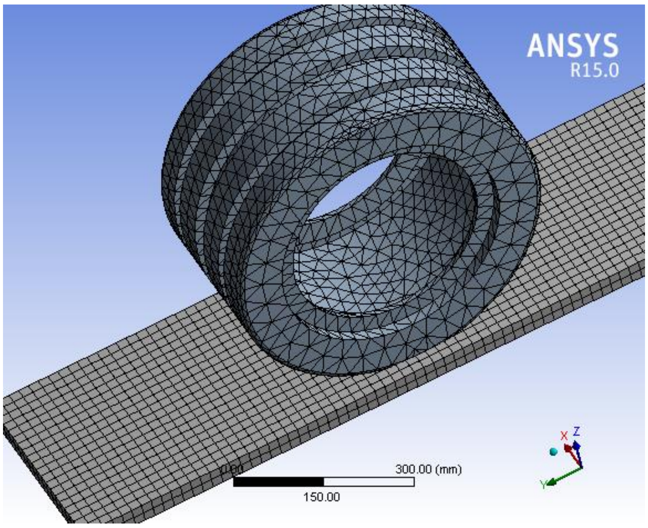

Figure No.:4.2 Mesh domain of pavement and tire of mesh size18.5

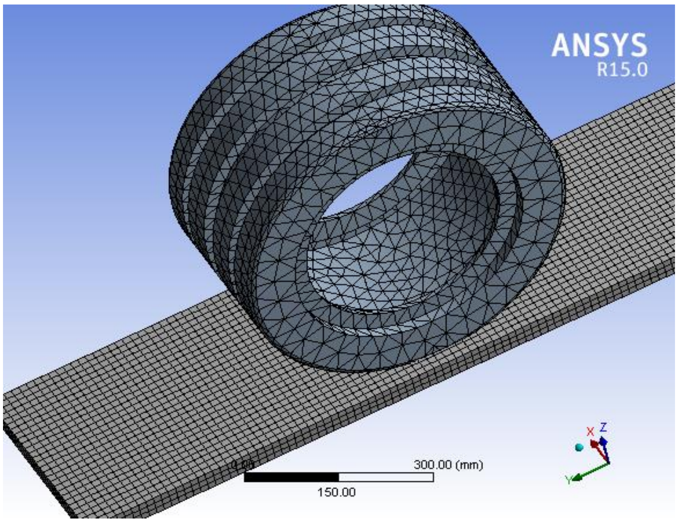

Figure No.: 4.3Mesh domain of pavement and tire of mesh size13.4

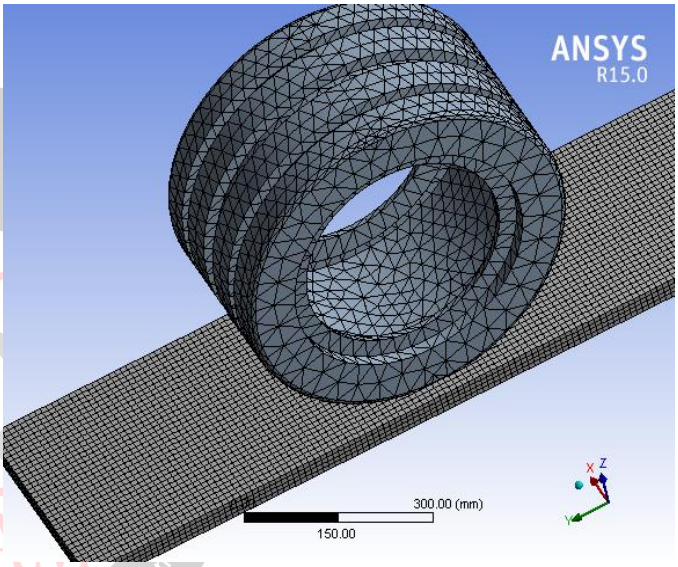

Figure No.: 4.4 Mesh domain of pavement and tire of mesh size10.3

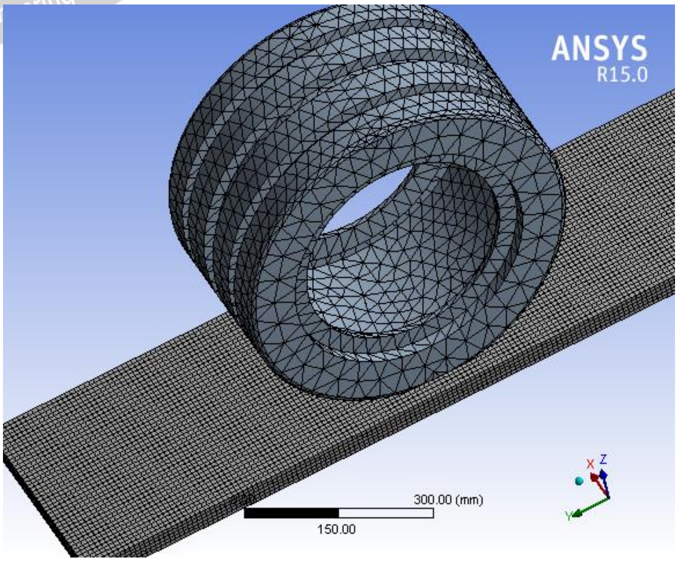

Figure No.: 4.5 Mesh domain of pavement and tire of mesh size8.5

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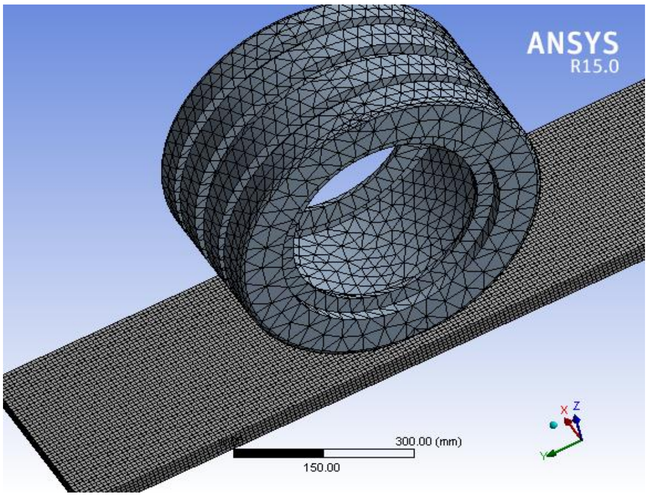

Figure No.: 4.6 Mesh domain of pavement and tire of mesh size7.75

V. RESULT AND DISCUSSION

5.1 Optimization results of Stone matrix asphalt with variable mesh size.

5.2 Stone matrix asphalt (SMA) with mesh size 18.5

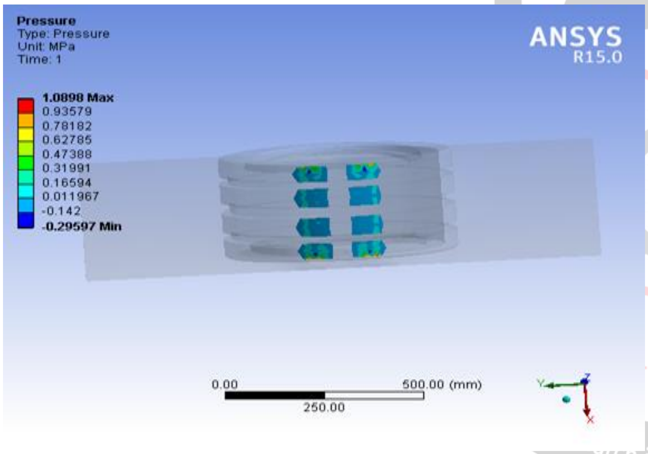

Figure No.: 5.1 Contour plot of contact pressure between tire and pavement (SMA) of mesh size 18.5.

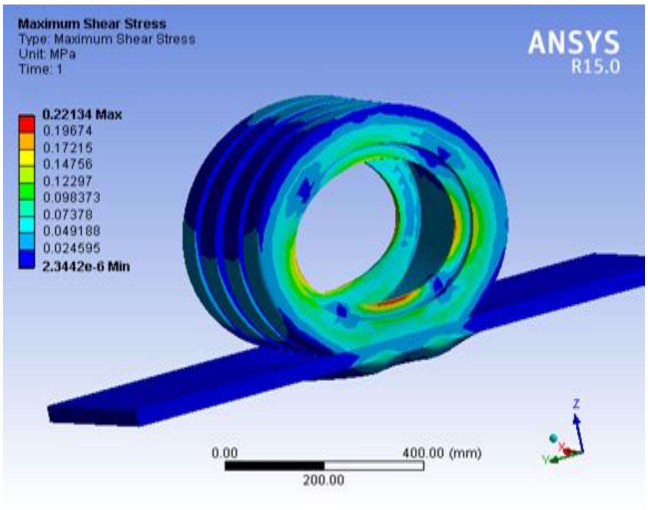

Figure No.: 5.2 Contour plot of shear stress on pavement block (SMA).

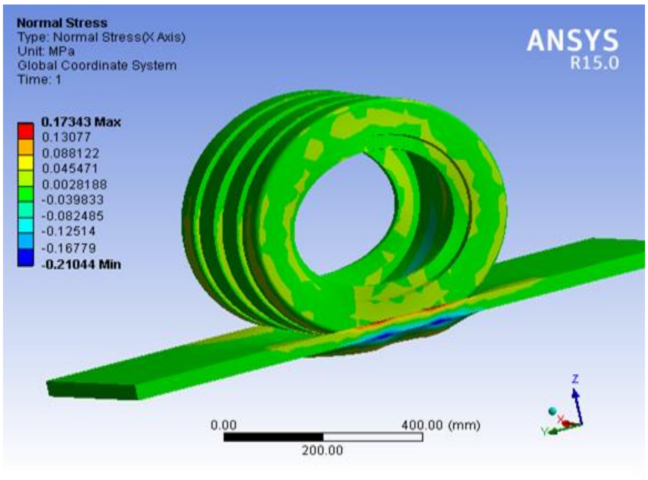

Figure No.:5.3 Contour plot of normal stress of pavement block (SMA).

$$\mu_s = \frac{\tau_{ult}}{\sigma_s}$$

Where, τ_{ult} = maximum shear stress

σ_s = vertical stress (Normal stress)

μ_s = Contact stress

$$\mu_s = \frac{0.19674}{0.13077} => 1.50447$$

Table No.: 5.1 Comparison of area means pressure with base paper.

	Area mean pressure (MPa)	
Mesh size	Base paper	Stone matrix asphalt
18.5	0.465	0.62785
13.4	0.550	0.71145
10.3	0.583	0.75346
8.5	0.602	0.72487
7.75	0.632	0.82154

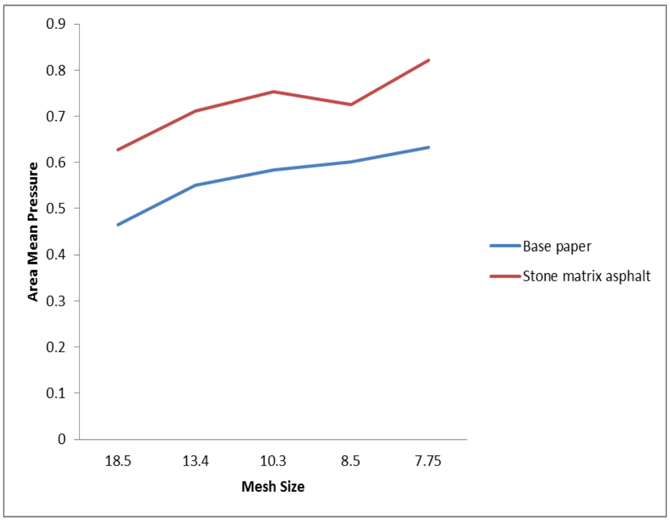

Figure No.:5.4 Graph shows Comparison of area mean pressure with base paper and stone matrix asphalt.

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The above table & graph shows the comparison of area mean pressure of base paper and stone matrix asphalt with respect to different mesh size. We found the stone matrix asphalt values are increases as compared from base paper value.

Table No.: 5.2 Overall comparison of area means pressure with base paper.

Area mean pressure (MPa)			
Mesh size	Base paper	Styrene-Butadiene styrene	Stone matrix asphalt
18.5	0.465	0.48	0.62785
13.4	0.550	0.58	0.71145
10.3	0.583	0.57	0.75346
8.5	0.602	0.65	0.72487
7.75	0.632	0.64	0.82154

Table No.: 5.3 Contact stresses with different mesh size of stone matrix asphalt.

Mesh size	Contact stresses
18.5	1.50447
13.4	1.50451
10.3	1.50445
8.5	1.50437
7.75	1.50445

Table No.:5.4 Comparison of Contact stresses of SMA with SBS.

Contact stress		
Mesh size	Styrene-Butadiene styrene	Stone matrix asphalt
18.5	0.89709	1.50447
13.4	0.89707	1.50451
10.3	0.89706	1.50445
8.5	0.89706	1.50437
7.75	0.89706	1.50445

5.3 Comparison of Shear stress of SBS with SMA

Table No.: 5.5 Comparison of Shear stresses of SMA with SBS.

Shear stress		
Mesh size	Styrene-Butadiene styrene	Stone matrix asphalt
18.5	0.24942	0.19674
13.4	0.26042	0.18161
10.3	0.25308	0.19069
8.5	0.25675	0.21490
7.75	0.25308	0.22096

Table No.: 5.6 Comparison of Normal stresses of SMA with SBS.

Normal stress		
Mesh size	Styrene-Butadiene styrene	Stone matrix asphalt
18.5	0.27803	0.13077
13.4	0.2903	0.12071
10.3	0.28212	0.12675
8.5	0.28621	0.14285
7.75	0.28212	0.14687

VI. VI CONCLUSION

6.1 Influence of different modified asphalt mesh size profiles

- The contact stress along the modified asphalt pavement profiles is found to be maximum for the stone matrix asphalt material profile with mesh size of 13.4mm varies along the contact area of the pavement. The pressure distribution along the area of contact between pavement and tire is maximum for SMA and mesh size for 13.4 shows maximum convergence.
- The shear stresses is minimum in case of stone matrix asphalt material profile with different mesh sizes i.e. 7.75 to 18.5mm. The nature of the shear stresses is maximum near the mesh size 8.5mm.
- The nature of the normal stresses is minimum in case of stone matrix asphalt material profile with different mesh sizes i.e. 7.75 to 18.5mm. The nature of normal stresses is maximum near the mesh size of 7.75mm and minimum near the mesh size of 13.4mm.
- In a comparison of SBS and SMA asphalt material w.r.t different mesh sizes. We found the results in contact stresses and area mean pressure is higher of SMA as compare to SBS asphalt pavement. So SMA pavement is better as compare to SBS asphalt pavement.

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