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# Advances in Structural Mechanics and Applications

Proceedings of ASMA-2021 (Volume 2)

**Editors:** [José António Fonseca de Oliveira Correia](#),  
[Satyabrata Choudhury](#), [Subhrajit Dutta](#)

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## About this book

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The proceedings of the conference is going to benefit the researchers, academicians, students and professionals in getting enlightened on latest technologies on structural mechanics, structure and infrastructure engineering. Further, work on practical applications of developed scientific methodologies to civil structural engineering will make the proceedings more interesting and useful to practicing engineers and structural designers.

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## Keywords

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**Structural Mechanics**

**Sustainable and Resilient Structures**

**Smart Structures**

**Fluid-Structure Interaction**

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## Study on the Effect of Wheel Load and Temperature on Rutting Damage of Composite Flexible Pavement Using Finite Element Method

[Arijit Kumar Banerji](#) , [Pijush Topdar](#) & [Aloke K. Datta](#)

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### Abstract

Rutting is a significant type of damage that reduces the serviceability of flexible pavements. The main reasons for rutting are the loss of stiffness of the asphalt mix as a result of high temperature in the pavement surface and densification under repetition of heavy wheel loads. As a result, depressions are created on the pavement surface in the wheel path under heavy traffic loads. Most of the existing studies have focused on predicting the rutting failure due to heavy wheel loads only. However, the effect of environmental temperature

on rutting failure is not explored much in literature. Hence, the present work makes an effort to investigate the influence of pavement temperature, in addition to the impact of wheel loads on rutting failure of the pavement. For this purpose, a finite element model of flexible pavement is simulated, where, in addition to the conventional layers, an extra inter-layer membrane is also introduced across the pavement thickness. In order to study the critical strain and deflection, a three-dimensional finite element model formulated with ANSYS software is used for the analysis. Under the application of static loading, linear material parameters for the asphalt layer, WMM base, and granular sub-base are characterized, and the subgrade is simulated by Drucker Prager non-linearity. Rubber asphalt composite having 1cm thickness is used as interlayer and the thickness of pavement layers is used according to the provision of Indian Roads Congress (IRC: 37-2018). The result prediction of rutting failure shows realistic responses when the effect of temperature is considered. With increasing pavement surface temperature, the maximum number of repetitions required to cause rutting decreases. Furthermore, the combination of temperature and wheel loading model yields a higher damage induced maximum number of repetitions than the finite element model of wheel load.

Keyword

**Rutting      Flexible pavement      Wheel load**

## Temperature Rubber asphalt composite

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Alkaissi, Z.A.: Effect of high temperature and traffic loading on rutting performance of flexible pavement. *J. King Saud Univ. Eng. Sci.* **32**(1), 1–4 (2020).

<https://doi.org/10.1016/j.jksues.2018.04.005>.

Accessed 26 April 2018

Biswas, S., Hashemian, L., Bayat, A.: Investigation on seasonal variation of thermal-induced strain in flexible pavements based on field and laboratory measurement. *Int. J. Pavement Res. Technol.* **9**(5),

354–362 (2016).

<https://doi.org/10.1016/j.ijprt.2016.08.008>.

Accessed 19 Aug 2016

---

Hadi, M.N., Bodhinayake, B.C.: Non-linear finite element analysis of flexible pavements. *Adv. Eng. Softw.* **34**(11-12), 657–662 (2003).

[https://doi.org/10.1016/S0965-9978\(03\)00109-1](https://doi.org/10.1016/S0965-9978(03)00109-1).

Accessed 18 Sep 2003

---

IRC: 37: Guidelines for the Design of Flexible Pavements, 4th Revision. Indian Road Congress, November 2018, New Delhi, India (2018)

---

Jadidirendi, K.: Evaluation of the properties of rubberized asphalt binders and mixtures, Doctoral dissertation, November 2018. University of Nevada, Las Vegas (2017).

<https://doi.org/10.34917/11156731>. Accessed 27

Nov 2017

---

Mirzapour Mounes, S., Karim, M.R., Khodaii, A., Almasi, M.H.: Improving rutting resistance of pavement structures using geosynthetics: an overview. *Sci. World J.* (2014).

<https://doi.org/10.1155/2014/764218>. Article ID

764218. Accessed 08 Jan 2014

---

Mugume, R.B.: Effect of unstable mix under severe traffic loading on performance of asphalt pavements in tropical climate. *Adv. Civil Eng.*

(2020). <https://doi.org/10.1155/2020/8871094>.

Article ID 8871094. Accessed 29 Nov 2020

---

Saad, B., Mitri, H., Poorooshab, H.: Three-dimensional dynamic analysis of flexible conventional pavement foundation. *J. Transp. Eng.* **131**(6), 460–469 (2005).

[https://doi.org/10.1061/\(ASCE\)0733-947X\(2005\)131:6\(460\)](https://doi.org/10.1061/(ASCE)0733-947X(2005)131:6(460)). Accessed 01 June 2005

---

Santucci, L.: Rut Resistant Asphalt Pavements. Institute of Transportation Studies, Tech Topics, University of California, Berkeley (2001)

---

Zaghloul, S.N., White, T.D.: Use of a three-dimensional, dynamic finite element program for analysis of flexible pavement. *Transp. Res. Rec.* **1388**, 60–69 (1993). Accessed 28 Sept 1993

---

Zhang, Q.S., Chen, Y.L., Li, X.L.: Rutting in asphalt pavement under heavy load and high temperature. In: *Asphalt Material Characterization, Accelerated Testing, and Highway Management*, Geo-Hunan International Conference, August 2009, pp. 39–48 (2009). [https://doi.org/10.1061/41042\(349\)6](https://doi.org/10.1061/41042(349)6). Accessed 16 Apr 2012

---

Yoder, E.J., Witczak, M.W.: *Principles of Pavement Design*, 2nd edn. Wiley, New York (1975)

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