

Ministry of Higher Education
and Scientific Research
Al-Muthanna University
College of Engineering
Department of Civil Engineering



Development of Three-Dimensional Modeling to Predict Rutting Behaviors of Asphalt Concrete Pavement

A thesis submitted to the council of the College of Engineering at Al Muthanna University in partial fulfilment of the requirements for the degree of Master of science (M.Sc.) in Civil Engineering

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Summary

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Rutting is one of the critical and common forms of deformation that occur to flexible pavements. It is a longitudinal depression that occurs under the tire of vehicles and is formed as a result of several reasons, including loads, vehicle speed, temperature, and other factors that contribute to its formation. Despite the efforts made to predict permanent deformation of the pavement before using various methods, there are some problems related to the process of predicting permanent deformation before road construction, and thus the appearance of deformation early in the road construction process. However, this process is of great importance in the transportation and research infrastructure fields. The primary purpose of this research is to obtain a model capable of predicting permanent deformation of flexible pavements before construction and below different conditions (real road conditions) such as temperatures, number of layers, vehicle loads, and loading speeds. One of the common methods used to measure the rutting depth of pavement, which is used in the laboratory before construction, is the wheel tracking test to know the extent of the pavement resistance to rutting. Despite the widespread adoption of this test, it contains problems including the number of layers, speed, loads, and temperatures.

This study describes the creation of a model that has the potential to measure the rutting depth of pavement before construction and under realistic pavement conditions. This is done by verifying different models to examine wheel tracking and at different conditions, including visco-plastic and elastic behavior at different temperatures, loads, and speeds, as well as adding layers to the user model to check wheel tracking. This is done by adopting a three-dimensional finite element model (Abaqus

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program). This program is adopted by the engineering field to simulate various model's due to its effectiveness in this field.

The results of Abaqus program showed good agreement between the results predicted by the program and those measured in the laboratory examination of the viscous-plastic response at 45°C and 60°C for the hot asphalt mixture (AC layer), the results after adding the layers to the AC layer also showed that the values of resistance to rutting are lower than the results of the wheel tracking test. The deformation of this examination is exaggerated because it is limited to one layer within an iron mold. In addition, the model is considered successful because of its ability to predicting the permanent deformation of the road before construction, as well as simulating the realistic conditions of the road in terms of the number of layers, speed, applied loads, and temperatures.



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بإشراف

أ.م.د حيدر كامل شنبارة