8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

Experimental and numerical simulation of loading impact on modified granular pavements

Markus Oeser[1], *Sabine Werkmeister[4] Alvaro Gonzales[2] and David Alabaster[3]

[1] University of New South Wales School of Civil and Environmental engineering Sydney 2052 Australia Markus.Oeser@unsw.edu.au

[2] University of Canterbury Department of Civil Engineering 4800 Private Bag Christchurch New Zealand ago30@student.canterbury.ac.nz

[2] Transit New Zealand 123 Victoria Street Christchurch New Zealand David.Alabaster@transit.govt.nz

[4] Dresden University of Technology Institute of Pavement Engineering 01062 Dresden Germany Sabine.Werkmeister@tu-dresden.de

Key Words: *Modified granular pavements, Dynamic analysis, Accelerated testing facility, Foam bitumen, Cement.*

ABSTRACT

Over the past 7 years Transit New Zealand has undertaken a number of accelerated pavement tests on unbound granular pavement structures that comprise over 90% of New Zealand's roads. The objectives of these tests have ranged from studying the effects of proposed vehicle mass limit changes to examining the behaviour of low noise surfaces placed directly on unbound granular pavement structures.

Recently, an accelerated pavement test has been finished that was focused on the pavement performance/deterioration of Foam Bitumen and Cement modified pavements. The accelerated pavement tests have been undertaken at the Canterbury Accelerated Pavement Testing Indoor Facility (CAPTIF) in Christchurch, New Zealand. The testing facility is owed and operated by Transit New Zealand.

CAPTIF (Figure 1) is a 58 m long circular track (contained within a 1.5 m deep by 4.0 m wide concrete tank) where the wheel paths of two vehicles can be separated to assess the relative damaging effect of loading parameters on pavements and surfaces. Mounted on a centre platform is a sliding frame that can move in radial direction. This radial movement enables the wheel path to be varied laterally to simulate vehicle wander and can be used to have the two 'vehicles' operating in independent wheel paths. The two 'vehicles' at CAPTIF were configured with identical suspensions and axle loads.

Different pavement test sections (unbound, cemented and foamed bitumen stabilised) were constructed at CAPTIF within this project. The aim was to access the the amount of pavement damage relative to the pavement cross sections, stabilised aggregate characteristics, traffic loading and elastic strains within the modified/stabilised layers at different locations. The pavements tested were thin-surfaced (30 mm asphalt concrete) granular pavements using the same subgrade materials and with a basecourse/stabilised

layer thickness of 200 mm. In order to measure the vertical elastic strains in the basecourse and subgrade, strain coils were installed in the pavement at different depths. In addition, pressure cells were placed at top of the subgrade. The pavement was loaded to 40 kN to simulate the current 8-tonne axle load limit within New Zealand, while later on the test pavement was loaded to 50 and 60 kN to simulate an increase to a higher axle load limit.

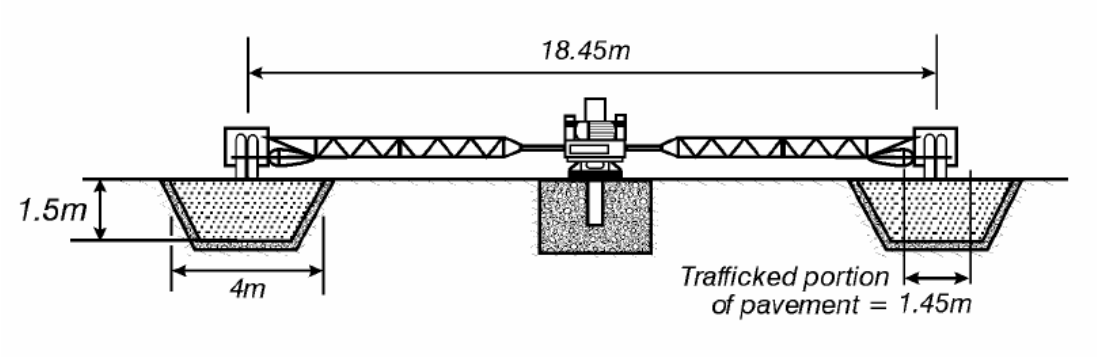

Figure 1: CAPTIF elevation

The elastic strains were measured under the prevaling load at (40, 50 or 60 kN) at frequent intervals. In addition, the structural condition/deflection of the pavement was measured using the Dynatest Falling Weight Deflectometer (FWD). Simultaneously to the field tests at CAPTIF, the unmodified, modified and stabilised materials used for the basecourse layer as well as the subgrade material were tested at the laboratory using the Repeated Load Triaxial test. Based on the laboratory test results, the parameters for the Universal model [1] were determined. The parameter formed input values for the numerical simulations using the finite element method.

In this paper, the results of numerical simulations of 3 different test sections and at two different loading conditions (static wheel load and the dynamic FWD impulse) are presented. Furthermore, an enhancement of the finite element model by means of a meso-macro approach is discussed in the paper. The meso-macro approach takes into account the inhomogeneous structure of the different pavement materials where necessary. This approach requires a partitioning of the structure into regions with small displacement gradients and regions with elevated displacement gradients. In pavements regions with elevated displacement gradients are usually encountered in the wheel path, while the displacements apart from the wheel path are mostly small. The meso-macro approach is applied to simulate static wheel loads as well as dynamic FWD impulse. This approach is meant to be a first step towards a sophisticated computational model for pavements that realistically simulates the structural behaviour of pavements under in-service conditions.

REFERENCES

[1] J. Uzan, *Characterization of Granular Materials,* Transport Research Record 1022 TRB, National Research Council, Washington, D.C., pp. 25-59, 1985