Pavement surface deflection measurements are the primary means of evaluating the bearing capacity of a pavement. The most common type of device used for measuring pavement surface deflections is the Falling Weight Deflectometer (FWD). However, increasing attention has been given to the Rolling Wheel Deflectometer (RWD) type of device due to its ability to measure deflections continuously while driving at traffic speed. To be able to properly interpret deflection measurements from an RWD device, more knowledge about the structural behavior of a pavement when subjected to transient dynamic loads moving with different speeds is needed.

In this thesis a new Finite Element formulation for transient dynamic loading of a layered half space is developed. Equations are derived in 2D and 3D and include efficient absorbing boundary conditions in the form of the Perfectly Matched Layer (PML) which ensures capability of long time simulations without disruptions from the boundaries. The equations are formulated in a moving frame of reference such that the domain is following the load, which ensures that the size of the model is kept small regardless of simulation time frame.

A parametric study for finding optimal PML parameters is conducted [P1]. The efficiency of the PML formulation is tested in a half space and in a layered halfspace. The effect of load speed is investigated as well as the influence of modulus ratio between surface layer and the underlying soil for different load speeds. Wave propagation is illustrated for various load speeds in both 2D and 3D. The differences in response magnitude and attenuation rate of 2D and 3D waves are illustrated as well.

The model is applied for backcalculation of mechanical properties from FWD experiments with load-time histories of various pulse durations and load magnitudes [P2]. For this purpose, a method for backcalculation of layer moduli and damping as well as geometric nonlinearity in the subgrade is developed.

General information
Publication status: Published
Organisations: Department of Mechanical Engineering, Solid Mechanics
Contributors: Madsen, S. S.
Number of pages: 148
Publication date: 2016

Publication information
Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
ISBN (Electronic): 978-87-7475-462-6
Original language: English
(DCAMM Special Report; No. S210).
Electronic versions:
S210_Stine_Skov_Madsen_PhD_Thesis.pdf