Evaluation of Subbase Performance Using FWD and PLT on Granular Foundations

Degree programme: Master of Science in Engineering
Specialisation: Civil Engineering
Thesis advisor: Prof. Aybike Öngel
Expert: Dr Mehdi Ould Henia (Nibuxs sàrl)

Pavement subbase granular layers bearing capacity should fulfill minimal mechanical requirements before laying the bituminous layer. The reference Plate Load Test is carried out in Switzerland and should meet the requirements of the VSS standard. The Falling Weight Deflectometer test, usually used to assess bituminous pavements, has been evaluated on granular layers as an alternative to the reference test.

Objectives

The study aims to assess the feasibility of using Falling Weight Deflectometer (FWD) test on granular layers for road subbase and subgrade quality evaluation as an alternative to the Swiss standard plate load test (PLT). The main advantage of using the FWD over the traditional PLT is its higher on-site productivity. Recommendations for the optimal use of FWD on granular layers are the main expected results.

Method

A novel test protocol was devised to carry out a comparative analysis of FWD and PLT results with an emphasis on the FWD beam test scheme. Active contribution to data collection allowed practical insights into test procedures and soil characterization, allowing the construction of a comprehensive database for comparative analysis. Boussinesq's soil modeling principles were applied to compute surface moduli, a pertinent indicator, which were subsequently contrasted with standard Swiss PLT outcomes. Signal observations and filtering techniques were utilized to enhance the accuracy of statistical analyses. Signals of geophones with good contact with the soil are presented in Figure 1.

Findings

The investigations suggest that FWD tests on granular layers reveal limited correlations with traditional PLT metric, as it can be seen with the scattered cloud of points in the Figure 2.
Data from 10 construction sites revealed that computed FWD surface moduli exceeding 240 MPa on the third drop consistently surpassed 80 MPa PLT ME1 metric. However, caution is warranted with this result given their sensitivity to the stress history effects, the FWD device, the soil's humidity, etc.

Recommendations

Further insights from additional construction sites are crucial for refining the statistical results. Emphasizing tests with lower loads could capture an accurate stress state and avoid excessive soil compaction under FWD loading, aiming for an elastic response. Longer geophone spikes may result in a consistency in the contact between the device and the tested soil.

Sylvain Freiburghaus
sylvainfreiburghaus@gmail.com

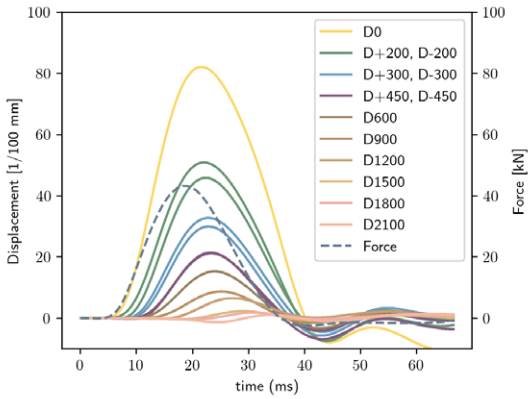

Figure 1: Time series of geophone sensors (same color for equidistant sensor)

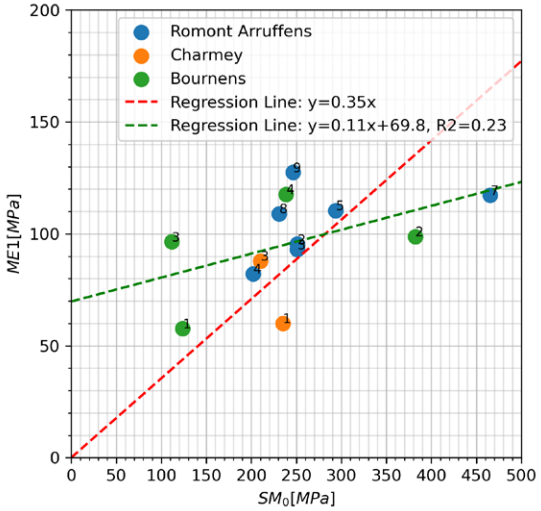

Figure 2: Scatter plot for 3 construction sites (with R2 the coefficient of determination)