

USE OF THE DYNAMIC CONE PENETROMETER (DCP) ON THE Mn/ROAD PROJECT

A large part of the research to be conducted on the Mn/ROAD project involves studying the cold regions behavior of sub grade and base materials. Many common testing devices and sensors will be used in this study to ensure a full understanding of a test section's behavior during its lifetime.

During the construction of each test section, two types of non-destructive tests were conducted on both the finished sub grade and the finished base course surfaces. One set of tests utilized the Falling Weight Deflectometer (FWD). The other tests were conducted using a Dynamic Cone Penetrometer (DCP).

The Dynamic Cone Penetrometer (DCP) is a simple testing device used to measure the insitu shear strength of soil and granular materials used in roadways and other construction related projects. Due to its small size and simplicity, both the equipment cost and operating costs are very reasonable. Test results can be analyzed quickly with relatively little experience and correlated to a number of widely known strength measurements (ex. CBR).

The DCP used by Mn/DOT on the Mn/ROAD project is based on the Central African Standard design as modified by the Transvaal Road Department and Mn/DOT. The device consists of two 0.63 in. (16 mm) diameter rods, with the lower rod serving to measure the penetration of the device, and the upper rod containing a 17.6 lbs. (8 kg) sliding drop hammer used to provide the driving force. A replaceable 600-cone tip is used on the lower rod to reduce side friction. All materials (except the drop hammer) are stainless steel for corrosion resistance.

Operation of the DCP requires two persons, one to drop the hammer and the other to record the depth of penetration. The operator lifts and drops the hammer either one or more times depending upon the strength of the soil at a test location. Following each sequence of hammer drops, a penetration reading is taken. This process continues until the desired depth of testing is reached, or the full length of the lower rod is buried (approx. 40" (100 cm)). At that time, a specially adapted jack is used to extract the device.

Data from a DCP test is processed to produce a penetration index (PI), which is simply the distance the cone penetrates with each

drop of the hammer. The PI is expressed in terms of inches per blow or millimeters per blow. The penetration index can be plotted on a layer strength diagram, or directly correlated with a number of common pavement design parameters.

Over 800 tests were conducted on the Mn/ROAD project. Data from these tests has been input into the Mn/ROAD database. Work is now underway to supplement this data by conducting other DCP tests throughout the state of Minnesota in soil types not found in the Mn/ROAD test sections. The research objective is to understand the relationship between the DCP's penetration index (PI) and soil type, density, and moisture content. Laboratory work is also being conducted (Univ. of Illinois) to study to the correlation between PI and shear strength.