STRENGTH – DYNAMIC CONE PENETROMETER (DCP)

General Description

The Dynamic Cone Penetrometer (DCP) is a simple testing device used to estimate the insitu shear strength of soil and granular materials used in roadways and other construction related projects. The DCP consists of a lower rod with an anvil and 60 degree cone tip and an 8 kg hammer on the upper rod. The hammer falls a distance of 575 mm where it strikes the anvil and drives the tip into the soil. Penetration measurements can be made using a detached ruler.

COLLECTION FREQUENCY

Procedure

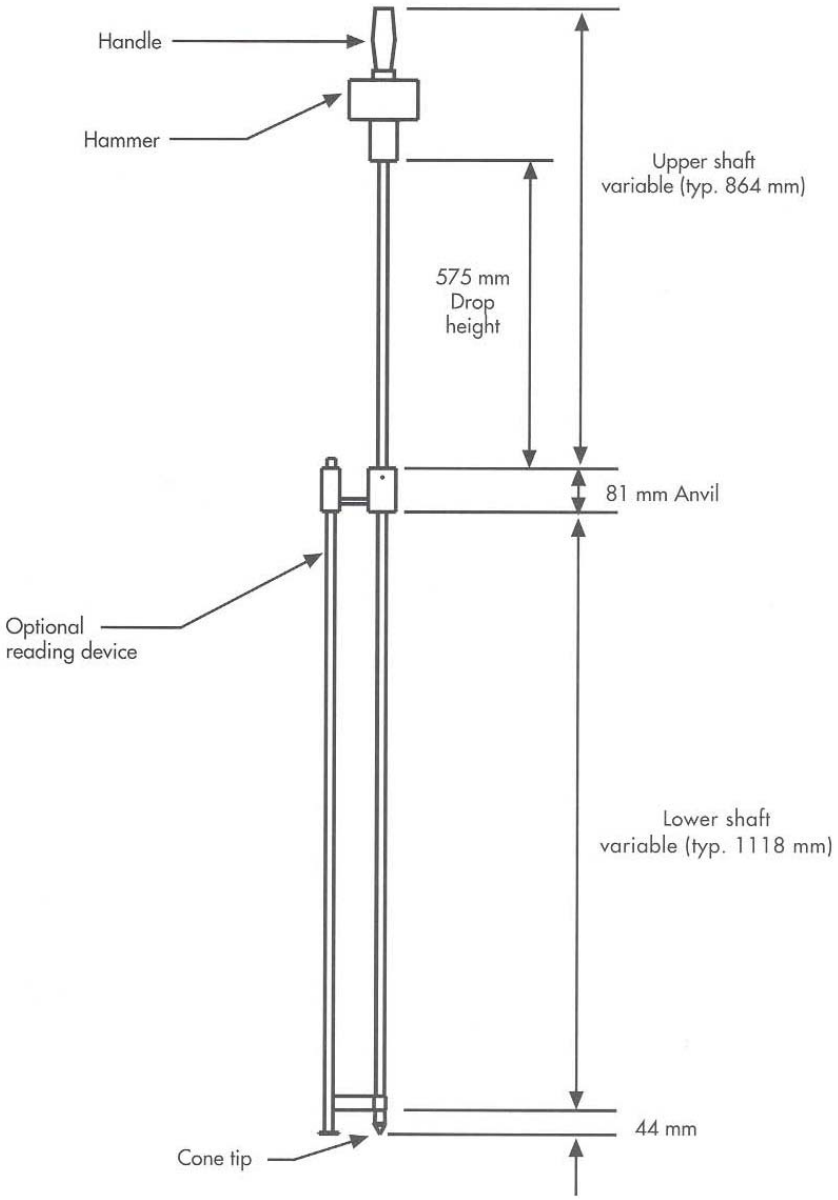
PREPARATION FOR TEST

DCP is not intended to be driven through concrete or bituminous layers. If you intend to test beneath these surfaces a core hole at least 50mm in diameter must be made. If a water-cooled coring device is used, the DCP test should be conducted immediately after coring to limit the saturation of the soil below. Excess surface water must be removed before testing. A DCP collection data sheet contains test location, type of soil being tested and test date.

CONDUCTING THE TEST

Ensure that there is a flat, level testing surface. Carefully place the DCP on the surface. If testing through a core hole center the DCP so the lower shaft will not make contact with the wall of the hole. Any friction from contact may invalidate the results.

Step1: With one hand placed on the top handle place the other to seat the cone tip by lifting and dropping the sliding hammer from a partial height. Stop the seating process once the widest part of the cone is below the testing surface.



Step 2: Establish a reference point for reading the penetration of the lower shaft. If a second person is reading the lower shaft a straight edge position on the ground next to the shaft will make a good reference point. A reference point must remain constant throughout the test. If a remote scale is being used, the top of the remote scale tube guide will serve as the reference point.

Step 3: On the test sheet record the current shaft or remote scale reading as the penetration for below zero.

Step 4: Maintaining a hand on the top handle use the other to raise the hammer to the handle and release hammer allowing it to fall freely to the anvil. Use caution not to lift the entire DCP which might break contact between the soil and the cone tip. Be careful not to influence the drop by forcing the hammer down or griping the top handle to tightly.

Step 5: Using the reference point record on data sheet the penetration reading of the shaft or the remote scale. Record this as below number one.

Step 6: Repeat steps 4 and 5 increasing the blow number with each hammer drop. The raise and drop sequence is repeated until the entire lower shaft is buried or until the desired testing depth is reached. If the soil is very dense you may drop the hammer several times between penetration readings and record the corresponding blow counts. If the total penetration is less than 3mm for 10 consecutive hammer drops, stop the test to prevent damage to the DCP.

Step 7: If the lower shaft has penetrated its full length lift the DCP using a special equipped farm purpose jack. Begin the extraction by placing the jack tongue under the DCP handle. Pump the jack until the jack handle can be placed under the DCP anvil. Then lower the jack and finish the extraction. It is recommended that the DCP not be extracted by forcefully striking the hammer against the DCP top handle. That will damage the DCP in a short amount of time. The only exception would be in a situation where the test was performed in a very soft material or the total test penetration was shallow.

Step 8: Clean the lower shaft and cone tip by wiping with a clean rag. Inspect the cone tip for excessive damage and replace when its widest section diameter is less than 18mm.

Step 9: As best you can fill the hole left in the soil by the DCP and restore the test surface to its original state.

Specifications

Refer to construction specifications for DCP testing. DPI reading requirements are given.

Formulas

DCP Penetration Index (DPI)-the amount of vertical movement of the DCP cone produced per drop of the hammer (mm/drop).

$DPI = (PR_2 - PR_1) / (DN_2 - DN_1)$
PR = penetration reading
DN = drop number

For more information:

For more information contact:

Rebecca Embacher
Office of Materials & Road Research
Phone: 651-366-5525
E-mail: Rebecca.Embacher@dot.state.mn.us

John Siekmeier
Office of Materials & Road Research
Phone: 651-366-5417
Email: John.Siekmeier@dot.state.mn.us

www.dot.state.mn.us/mnroad