



What is a cone penetration test (CPT)?

A cone penetration test is used to determine geotechnical properties of soils.

The cone penetration test has become internationally one of the most widely used and accepted test methods for determining geotechnical soil properties. In Canterbury the data gained from a cone penetration test can be used to assess whether soil layers are likely to liquefy under different levels of earthquake shaking.

How is a cone penetration test undertaken?

The cone penetration test can be completed from the ground surface.

Cone penetration test rigs vary in size – from small portable rigs to large truck-mounted rigs. Each rig has benefits and limitations but they all conduct the same test. A cone penetration test rig pushes a steel cone (about 32mm wide) into the ground, generally up to 20m below the surface or until the cone reaches a hard layer. The steel cone contains an electronic measuring system that records tip resistance and sleeve friction.

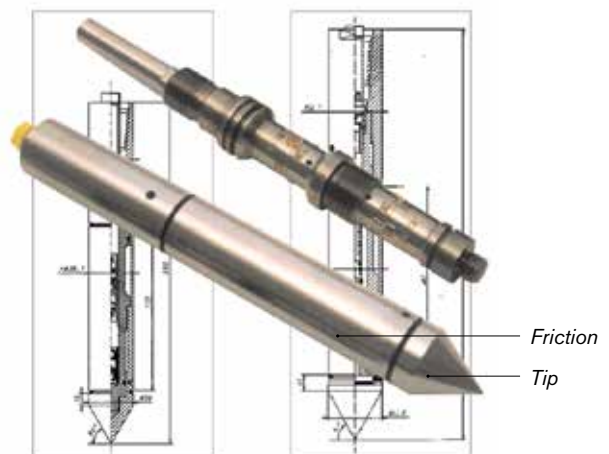
As the cone is pushed into the ground, the soil responds with differing degrees of resistance. This resistance is recorded using force sensors in the tip.

At the same time as the sensors are recording resistance at the cone tip, sensors in the friction sleeve are recording sleeve friction along a 100mm length. Some cones also have a pore water transducer, which records water pressure in the soil. These readings can be used to determine ground water responses as the cone is pushed through the soils.

A cone penetration test typically takes between 30 minutes and three hours. As the cone goes into the ground, measurements are constantly sent back to the rig and recorded on computer.



A cone penetration test



A penetrometer cone



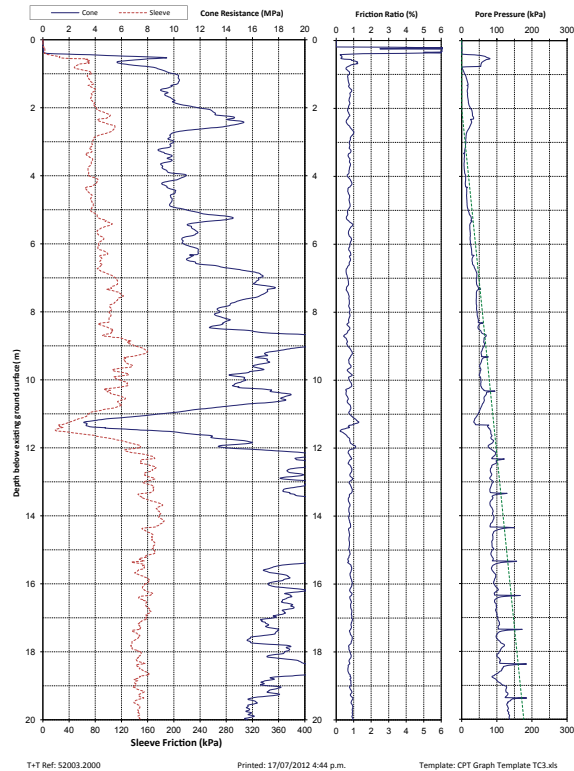
This data gives a profile of the subsoil layers, often called a 'trace'. Examples are shown to the right.

What do the test results tell us?

Cone penetration test results are used by geotechnical engineering specialists to understand the soil properties (the relative density of the soil and the soil behaviour type, both of which are calculated from the cone penetration test cone tip resistance and sleeve friction) and how the ground is likely to behave under different levels of earthquake shaking. This information can help in the design of foundations and ground improvements.

In Canterbury, cone penetration test results are commonly used to determine the liquefaction-triggering resistance of each soil layer. These assessments commonly use computer software to determine if soil layers are predicted to liquefy for different levels of earthquake shaking.

By doing a test before and after ground improvement works, cone penetration test results can also be used to determine how much strength a soil has gained following ground improvement works.



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An example of cone penetration test measurements

The cone penetration test is internationally one of the most widely used and accepted test methods for liquefaction assessment