

Robertson's Remarks

- Myths of the CPT: "It's too expensive" -

Welcome to Robertson's Remarks! The previous 'Robertson's Remarks' covered a pet peeve of mine, that engineers/geologist often state: "*The disadvantage of the CPT is that it does not collect soil samples*". Hopefully, you now know that this is not necessarily true! If not, please review the last newsletter.

In this 'Remarks', I would like to discuss another misconception - "*The CPT is too expensive*". Traditionally the cost for site investigation was calculated as the cost per foot of drilling or testing. However, the unit of cost will influence the approach taken by the contractor. For example, when a site investigation is contracted based on a unit cost of drilling per foot there is a tendency for the contractor to want to drill as quickly as possible to maximize their revenue. They tend to dislike stops for sampling and/or testing, since this slows the drilling production. In some circumstances this may be acceptable, however, many investigations are a process of discovery where the goal is to identify the detailed stratigraphy and to determine the physical and mechanical properties of the individual soil layers. A better approach for this type of investigation may be a unit of cost per day of drilling. This would allow flexibility to stop and sample and/or test where and when appropriate, based on the risk of the project and the information gained during the investigation. Flexibility is often a key ingredient for a good site investigation. With a day rate, the client gets greater flexibility and control and the site investigation contractor gets greater certainty over the expected revenue for the work.

In California, typical day rates for hollow-stem auger drilling for geotechnical investigations are around \$2,400 to \$3,200 per day, depending on the size of rig and number of samples. Cone Penetration Testing (CPT) using a customized truck can range from \$3,000 to \$4,000 per day depending on size of equipment and any special testing requirements, for example, seismic CPT or other special CPT modules.

A simple conclusion is that the CPT looks expensive compared to auger drilling based on the day rate. However, when you compare the production rate, data quality and other costs, the CPT is typically more cost effective. A typical production rate for customized CPT trucks is around 400 to 600 feet per day, depending on ground conditions, depth of soundings, distance between sounding locations and number of special tests (e.g. dissipation tests). A typical production rate for hollow-stem auger drilling with sampling at 5 foot intervals is around 160 feet per day, again depending on various factors. Hence, for an auger rig to complete 400 feet of investigation it may take 3 days at a total cost of around \$8,000, plus any additional cost for laboratory testing on the approximately 80 samples. Keep in mind that many of those 80 samples will be in soil layers that are of little importance to the project, since they were obtained at regular 5 foot intervals rather than based on the actual soil stratigraphy. This also does not account for the lack of detail from sampling every 5 feet along with the known poor quality of the Standard Penetration Test (SPT) results. On the other hand, the total cost for 400 feet of CPT along with plots and computer interpretation would be around \$3,500. This would include high quality, reliable data with over 2,400 data (sample) points from three independent measurements (tip, sleeve and pore pressure). As described in the previous newsletter, this could also include a small number (say 10) of selected soil samples. Therefore, you get high quality, near continuous CPT data along with selected soil samples in a more cost effective manner.

Since typical mud rotary drilling rates are more than auger rates, the CPT is significantly more cost effective than mud rotary drilling, at least in ground that is suitable for CPT. In hard formations, mud rotary maybe the only method available.

Based on these numbers, it is clear that for large site investigation projects (many days of field work) in suitable ground conditions, the CPT is highly cost effective. For large projects, it maybe more effective, based on cost and data, to mix a lot of CPT with a small amount of selective drilling and sampling. For example, if a project requires somewhere in the order of 1,000 feet of geotechnical investigation (say 20 holes to 50 feet depth), a good approach

is to first perform about 16 CPT's over a two day period to define the detailed soil stratigraphy and to identify critical zones/regions appropriate for the project. This could then be followed by one day of either hollow-stem (about 4 holes) or mud rotary drilling (about 2 holes), depending on ground conditions and project needs. The drilling would be carried out at selected locations (often close to completed CPT's) with selected sampling based on the detailed information from the CPT's. The drilling and sampling could then be used to verify the CPT interpretation and obtain a small number of high quality samples based on the ground conditions and project requirements. The most suitable sampling technique can also be selected based on the CPT results.

Where the CPT can appear more expensive than drilling and sampling is on small projects where only 1 to 4 holes are specified. In these cases, the CPT is often completed in less than a full day, but the contractor may wish to charge a full day. Ways to avoid this are to either arrange for the CPT truck to visit more than one project in the same day or to collect more data than you had originally planned, which is often a good idea!

Contact Peter with any questions or comments regarding Robertson's Remarks at: probertson@greggdrilling.com