Automatic Monitoring of Drilling Process (DPM) for Mechanical Profiling of Both Soil and Rock Grounds

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@ International Geotechnics Symposium cum International Meeting of CSRME 14th Biennial National Congress November 14-17, 2016, Hong Kong
Construction projects are in mountains & in depth. These grounds always comprise both soils and rocks.
The Issue & Need

A test tool is needed for continuously and automatically measuring and profiling the in-situ mechanical properties of both soil and rock grounds.
An Ideal Solution in High-tech Times

1) The formation of drillholes requires mechanically detaching & removing geomaterial from the cut face of drill bit.

2) It is a mechanical failure process of the in-situ geomaterials with depth and

3) It can be used to delineate the geomaterials’ strengths & distribution.
Automatic Drilling Process Monitoring

Existing Drilling Machine Equipped with DPM

air-driven rotary-percussive drilling machine with down-the-hole hammer

1 Manual Control Panel  4 Straight Sliding Beam  8 Down-The-Hole Hammer
2 Pneumatic Thrust Motor  5 Steel Loop Chain  9 Drill Bit
3 Swivel Drill Chuck with Rotation Motor  6 Shank Adaptor  10 Rod Clamp
  7 Hollow Rod  11 Screw Connection
12 Air Hose-Forward Rotation  13 Air Hose-Reverse Forward Rotation
14 Air Hose-Forward Thrust  15 Air Hose-Backward Thrust
16 Air Hose-Percussion

100 Position Transducer  103 Pressure Transducer-Reverse Forward Rotation  106 Pressure Transducer-Percussion
101 Rotation Transducer  104 Pressure Transducer-Forward Thrust  107 DPM Data Logger
102 Pressure Transducer-Backward Thrust  105 Pressure Transducer-Forward Rotation  108 — 114 Wires for DPM Signals
115 Memory Card or Computer  116 Direction of Signal Transmission
117 Steel Ring
DPM data in time series
Linear Zones for Geomaterial Strength in Depth

Soil & rock strength in depth can be identified by DPM!
Automatic Drilling Process Monitoring

Hydraulic drilling machine

- Hoist wire movement monitor
- Rotation speed monitor
- Chuck head position
- Down Pressure
- Up Pressure
- Flowmeter
- Torque & Force measurement
- Data Flow
- Datalogger
- Computer
Drilling rate \[ \frac{\Delta h}{\Delta t} \]  
= Slope gradient of time-depth curve for a linear zone
Cavities in Marble

Drilling rate v.s. Depth

Cores and cavities along drillhole
The Finding

Modern High Technology Based Automatic Drilling Process Monitoring (DPM) in Real Time

Continuous Measurement of In-situ Strength and Distribution of Ground Geomaterials Comprising Both Soils and Rocks
Linear zones of bit-depth vs drilling time!
Constant drilling rates at individual zones!

Knowing the weak and strong zones for quality geotechnical engineering!
DPM : Applicable to Various Drills

Air-driven rotary-percussive drilling machines equipped with down-the-hole hammer & hydraulic drills
Automatic monitoring of conventional drilling works can upgrade the drilling works to become an in-situ technique of choice for assessment and measurement of the continuous quality & strength distribution of geomaterials in grounds composing both soils and rocks.