Optical and Acoustic Televiewer Borehole Logging – Improved Oriented Core Logging Techniques

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THE PROBLEM:

- Highly fractured zones and soil filled joints – four episodes of folding and faulting
- Folded rock fabric within cut
THE PROBLEM:

- Maintaining core orientation difficult in highly fractured rock – soil seams up to 4” to 6” thick, significant core loss

- Local drillers not accustomed to double-or triple-tube coring methods

15-foot rockfall boulder in Route 9 ditch
LIMITED BEDROCK EXPOSURES:
PROJECT APPROACH:

- Collect joint and discontinuity data with a coordinated field mapping and coring program.
- Geophysical borehole logging using optical or acoustic methods.
- Measurement and assessment of joint planes and laboratory testing of core samples.
Early logging developed in the 1960’s in the oil patch – recent advances in data processing and field equipment have yielded highly mobile and practical applications.

Good core drilling and sampling is still vital – for verification, lab samples and to assess joint planes.
BOREHOLE TELEVIEWERS:

- Can replace Oriented Coring with an oriented image of the borehole wall
- Enhance geotechnical data with high-resolution *in situ* images
- Can be a cost effective investigation technique
The Logging System

- Small, Portable
- Laptop controlled data collection - QC on site
- Operates independently of the drill rig
# TelevIEWERS: Optical and Acoustic

### Optical:
- High-resolution digital image of borehole wall

### Acoustic:
- Sonar image of borehole wall

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<tr>
<th>Depth (m)</th>
<th>Optical Televiewer</th>
<th>Acoustic Televiewer</th>
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<tr>
<td>16.8</td>
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Plane Slice Through a Cylinder Produces Sinusoid in the ‘Unwrapped’ Televiewer Image
Optical Images in Fault Zones: Collecting Data in Poor Rock

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<th>Depth (m)</th>
<th>Optical Image - Fault Zone</th>
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<tr>
<td>230 m</td>
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<td>230.5 m</td>
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- **Granite**
- **Shale**

- Broken Core: 18.0 m
- Missing Core: 19.0 m
INTEGRATION WITH GEOTECHNICAL DATA
Geotechnical Data and Televiewer Images: One Log Sheet
Route 9 Improvements, Vermont:

- All Terrain Vehicle w/ Gen-Set & Tools
- Winch, Data Processor and Laptop
- Caliper Tool
- Optical Televiewer Tool
- Acoustic Televiewer Tool
Route 9 Improvements, Vermont:
Route 9 Improvements, Vermont:
I-93 Improvements, New Hampshire:
I-93 Improvements, New Hampshire:
Route 9 Improvements, Vermont:

Optical Televiewer Log
Route 9 Improvements, Vermont:

Acoustic Televiewer Log
Televiewer Logging in New York City:

Getting there is half the battle....
Freedom Tower, World Trade Center Site:
Diavik Diamond Mine
Diavik Diamond Mine

• Geotechnical drilling for pit slope stability investigation
• Televiewers introduced – oriented coring phased out
Advantages: Structural data where it’s most needed

Televisioner interprets data reliably in fracture zone

Zone of Broken Core
Primary Benefits:

- **Costs reduced** – fewer staff, fewer hours on site, faster, more accurate core logging

- **Improved results** – greater confidence in structural orientations, *in situ* images, comprehensive log sheets
Tuen Mun Road - Hong Kong

- Acoustic and impression packer core orientation – foam coring
- Six major sheet joints in micro fractured granite
- 9000 vehicles/hr – Six Lanes
WellCad Televviewer Tools:

- Virtual cores can be developed from televviewer images and viewed from all angles.

Virtual Acoustic Core - NYC

Virtual Optical Core - VT
Example “Virtual Core” plots from OPTICAL Televiewer

- Soft Clay Interval Within a Fault Zone
- Calcite Veins in Fault Zone
- Fractures with Alteration
- Calcite Veins in Fault Zone

Valuable for:
- Design Assessment
- Data Interpretation
- Contractor bidding
Televiewer Project Considerations:

OPTICAL TELEVIEWER
- Borehole diameter 3 – 12 inches
- Clean borehole – clear fluid or air filled
- Logging has produced excellent results in diamond drill and good results in air rotary boreholes

ACCOUSTIC TELEVIEWER
- borehole diameter 3 – 12 inches
- Fluid need not be clear but must be present in borehole
- Logging has produced excellent results in diamond drill and good - fair results in air rotary boreholes
Borehole Televiewers: What can be gained?

- Accurate structural orientations of features in vertical and inclined boreholes
- Image of rock conditions in situ leading to improved geotechnical information
- Significant cost savings when compared to traditional oriented core methods
Challenges Ahead

- Merge the Geotechnical and Televiewer Information; and
- Automate Stereronet Production and Joint Set Data Synthesis.
The best part about trees in Vermont ....