The Victorian Chapter of the Australian Geomechanics Society is pleased to announce the 2018 One-Day Symposium “Geotechnics and Transport Infrastructure”, to be held on 24 October 2018.

**Symposium Format - Four Sessions**

**Four Keynote Speakers + 12 Presentations**

**Important Dates**

- **13 April 2018**: Abstract Submission **CLOSED**
- **18 May 2018**: Notification of Accepted Abstracts **CLOSED**
- **17 August 2018**: Full Paper Submission
- **7 September 2018**: Paper Acceptance Notification
- **28 September 2018**: Final Paper Submission + Early Bird Registration Deadline

For details


Or contact the Chair of the Symposium Organising Committee:

Vladimir Lopez Suarez (vladimir.lopez@jacobs.com)
IN THIS PRESENTATION

McConnell Dowell: a little bit about us
Contracting risk profiles: site conditions
Commercial realities: a return for our shareholders
Geotechnical advice: the importance of being informed
Geotechnical design decisions: sensitivities on cost
Design growth risk: our simple tender risk assessment process
PART 1

A LITTLE BIT ABOUT MCCONNELL DOWELL
MCD CENTRES OF OPERATIONS

Contracts with Design Responsibility by Revenue
Over past 5 years

73%
PART 2

CONTRACT RISK PROFILES
KEY HEAD CONTRACT CLAUSES

Civil contractors take on big risks with little recourse to differing conditions.

Head contracts typically have three types of provisions pertaining to geotechnical matters.

1. Contractor shall satisfy itself of the Site conditions.
2. Contractor shall not rely on Principal provided information.
3. Contractor may have entitlement for unforeseen ground conditions.

Design and construct contracts commonly used

Australia
GC21
General Conditions of Contract
AS4300
General Conditions of Contract for Design & Construct

Singapore
PSSCOC
Public Sector Standard Conditions of Contract

New Zealand
NZS3916
Conditions of Contracting for Building and Civil Engineering - Design & Construct
CONTRACTOR TO INFORM ITSELF

GC21 requirements

The Contractor warrants that it has:

i. examined the Site and surrounds and satisfied itself through its own investigation as to the condition and characteristics which may be encountered on, in or under the Site (including sub-surface conditions)……

ii. made its own assessment of the risks, contingencies and other circumstances which might affect the Works and has allowed fully for these in the Contract Price…..
NO ABILITY TO RELY ON PROVIDED INFORMATION

GC21 requirements

The parties acknowledge that:

- Principal has provided in good faith the geotechnical or other information concerning the Site.
- Information does not form part of Contract.
- Principal does not guarantee accuracy, quality or completeness of information.
- Principal accepts no duty of care in connection with information.

The Contractor warrants that it:

- Has made its own inquiries (including checking of information provided) concerning the Site.
- Did not in any way rely on the completeness of the information provided by the Principal.
- Did not in any way rely on the information (which information could contain errors, omissions and other inaccuracies).
- Has made its own interpretations, deductions and conclusions from the information provided.
- Did not in any way rely on interpretations, deductions and conclusions made by or for the Principal.
LATENT OR UNFORESEEN CONDITIONS

**GC21 Requirements**

The Contractor may have cost and time entitlement if the Contractor encounters, in the execution of the Works, Site Conditions which are materially adverse in comparison to the Site Conditions which the Contractor should have reasonably foreseen at the Date of Contract, having regard to the warranties (reliance and satisfying itself).
GEOTECHNICAL BASELINE REPORTS

Singapore and New Zealand governments take the approach of introducing Principal provided Geotechnical Baseline Reports.

1. The Principal produces an interpretive geotechnical baseline report (GBR) and includes that in the contract as a contract document.

2. Baseline Parameters are defined within the GBR. **The parameters however can be very broad.**

3. Differing Ground Conditions are defined as those that differ from the Baseline Parameters.
PART 3
COMMERCIAL REALITIES OF CONTRACTING
SIMPLE CONTRACTING BUSINESS MODEL

Contract lump sums are made up of:

- **Direct Costs**: materials, equipment, labour, etc
- **Indirect Costs**: project staff spread over the project time
- **Risk**: contingent sum to cover probabilistic events
- **Margin**: a percentage which includes profit plus corporate overhead

Risk management is critical to protect small profit margins

- **Common Margin**:
  - Typical business overhead
  - Resulting profit before interest and tax
PART 4

THE IMPORTANCE OF WELL INFORMED GEOTECHNICAL ADVICE
EXAMPLES OF PAST ADVICE RECEIVED

- “Depth of basecourse could be 200mm but will vary depending on the subgrade CBR found on site”.

- “Bored piles to be socketed 3m into the highly weathered basalt. However, final pile depths will be variable depending on the depth to suitably strong rock”

- “Settlement of the embankment will be variable. Contractor to allow for a plate load test in order to determine magnitude of settlement during detailed design.”

- “Geotechnical design is strongly dependent on the knowledge of ground conditions which are inevitably incomplete and which involve interpretation. It is necessary to provide for unexpected or unknown ground conditions which could be better or worse than currently expected.”
PART 5
THE IMPACT OF GEOTECHNICAL DECISIONS ON FINANCIAL RESULTS
ARMY BAY PROJECT
North Island, NZ

Stormwater Outfall
2km Direct Pipe TBM
1000mm diameter steel pipe
Longest direct pipe in the world
ARMY BAY GEOLOGICAL PROFILE

The performance of the TBM cutter head and the speed of machine advancement is dependent on characteristics of the materials and highly influences project costs.
## COST SENSITIVITIES OF OUR ASSUMPTIONS

<table>
<thead>
<tr>
<th>Tender decisions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average rate of TBM advancement</td>
<td>40 mm per min</td>
</tr>
<tr>
<td>Total no. drive days</td>
<td>84 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current productivity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average rate of TBM advancement</td>
<td>30 mm per min</td>
</tr>
<tr>
<td>Forecast no. drive days</td>
<td>111 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitivity on costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional drive days required</td>
<td>27 days</td>
</tr>
<tr>
<td>Daily running costs of machine and crews</td>
<td>$</td>
</tr>
<tr>
<td>Liquidated damages for lateness</td>
<td>$</td>
</tr>
<tr>
<td>Additional cost</td>
<td>$</td>
</tr>
</tbody>
</table>
KIDSTON PUMPED STORAGE HYDRO

- 2 existing disused gold mine pits
- 2 x 125MW reversible turbines
- 250 MW solar farm
- 6 hrs daily power generation
- 200m deep 8m diam. pressure shaft
- 1.6km long 6m diameter main access tunnel
- 8m diam. 250m tail race

Typically raise bore and drill & blast
TUNNEL ROCK SUPPORT 2: Q>10

TEMPORARY DENTAL SHOTCRETE (REFER NOTE 6)

SPOT ROCKBOLT (TYP.) (REFER NOTE 2)
ROCK SUPPORT TYPE 2: $3 < Q < 10$

- 7/8 NO. TEMPORARY ROCKBOLTS 3.0m LONG ON A NOMINAL 2.0m x 2.0m STAGGERED PATTERN (REFER NOTE 3)
- 50mm THICK TEMPORARY STEEL FIBRE REINFORCED SHOTCRETE (REFER NOTE 5)
TUNNEL ROCK SUPPORT 3: \(0.4 < Q < 3\)
TUNNEL ROCK SUPPORT 4: 0.04<Q<0.4

11/12 NO. TEMPORARY ROCKBOLTS 3.0m LONG ON A NOMINAL 1.2m x 1.2m STAGGERED PATTERN (REFER NOTE 3)

150mm THICK TEMPORARY STEEL FIBRE REINFORCED SHOTCRETE (REFER NOTE 5)
## COST SENSITIVITIES OF OUR ASSUMPTIONS

<table>
<thead>
<tr>
<th></th>
<th>Support Type 1</th>
<th>Support Type 2</th>
<th>Support Type 3</th>
<th>Support Type 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most Likely Estimate</strong></td>
<td>43%</td>
<td>38%</td>
<td>12%</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Tunnel Length</strong></td>
<td>688 m</td>
<td>608 m</td>
<td>192 m</td>
<td>120 m</td>
</tr>
<tr>
<td><strong>Risk Estimate</strong></td>
<td>33%</td>
<td>28%</td>
<td>22%</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Tunnel Length</strong></td>
<td>528 m</td>
<td>448 m</td>
<td>352 m</td>
<td>432 m</td>
</tr>
<tr>
<td><strong>Difference in Lineal Metres</strong></td>
<td>(160 m)</td>
<td>(160 m)</td>
<td>160 m</td>
<td>160 m</td>
</tr>
<tr>
<td><strong>Direct Cost Installation Rate/m</strong></td>
<td>$ per m</td>
<td>$ per m</td>
<td>$ per m</td>
<td>$ per m</td>
</tr>
<tr>
<td><strong>Risk Exposure</strong></td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

Total direct cost risk = $
PORT CAPACITY PROJECT
WEBB DOCK WEST (WDW)
AUTOMOTIVE WHARF

666 steel tubular piles
750 square precast concrete piles
WDW STRUCTURAL SOLUTION

CONCRETE DECK
- Acts as a lateral load tie
- High density concrete mix

EXISTING SOILS
- Retained
- Facilitates construction

TUBE RAKING PILES
- Resist lateral loads

PRECAST PILES
- Founded in dense sandgravel
- Supports deck
- Prevents settlement
- High density concrete mix

CONTINUOUS WALL
- Eliminates revetment
- Protects soffit of deck
- Protected corrosion allowance and paint
- Marine grade steel for sheet piles
WDW CONSTRUCTION ACTIVITY
WDW DIFFICULT GEOTECHNICAL CONDITIONS
WDW PILE SETUP – EXPECTATION VS REALITY

Pile Shaft Capacity Versus Time

3 days  60 days
WDW SOLUTION DRIVEN BY DELAY COST

Project costs and exposures
  Site running costs and staff = $ per week
  Exposure to Liquidated Damages = $ per week

Cost risk of waiting for piles to achieve capacity
  7 weeks x $ 600 000 per week = $

Direct cost of remediation
  Pile material plus driving, etc $
PART 6
TENDER DESIGN
GROWTH RISK ASSESSMENT
# Break Down The Design Elementally

<table>
<thead>
<tr>
<th>Design Package</th>
<th>TAN #</th>
<th>TAN Title</th>
<th>Pricing Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TAN 01.1</td>
<td>Stripping and subgrade preparation</td>
<td>Plans, sections and tabulated areas for vegetation cut by ramp/road section</td>
</tr>
<tr>
<td></td>
<td>TAN 01.2</td>
<td>Bulk Earthworks</td>
<td>Plans and sections</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Subgrade preparation requirements</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cut and fill volumes by ramp/road section</td>
</tr>
<tr>
<td>2</td>
<td>TAN 02.1</td>
<td>Soil nailed wall</td>
<td>Elevations showing layout of soil nails</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tabulations detailing nail lengths</td>
</tr>
<tr>
<td>2</td>
<td>TAN 02.2</td>
<td>Post and Panel Walls</td>
<td>Elevations showing wall extents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tabulations detailing post depths and panel heights</td>
</tr>
<tr>
<td>3</td>
<td>TAN 03.1</td>
<td>Road pavements</td>
<td>Plans and sections with accompanying Quarry and asphalt product volumes by:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Road/ramp/path section, then by;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Pavement type, then by;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Layer within the pavement profile;</td>
</tr>
<tr>
<td>3</td>
<td>TAN 03.2</td>
<td>Subsurface pavement drainage</td>
<td>Sketches showing subsurface drain details</td>
</tr>
<tr>
<td>3</td>
<td>TAN 03.3</td>
<td>Bridge surfacing</td>
<td>Included in pavement above</td>
</tr>
<tr>
<td>4</td>
<td>TAN 04.1</td>
<td>Bridge Piling</td>
<td>Pile layout drawing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pile types and diameters</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Table of pile depths</td>
</tr>
<tr>
<td>4</td>
<td>TAN 04.2</td>
<td>Bridge Structure</td>
<td>Sketches showing piers, headstocks and superstructure elements.</td>
</tr>
</tbody>
</table>
Risks & Assumptions

- No bore logs exist in the immediate vicinity of the piled wall therefore the material parameters have been inferred from the nearest bore log 50m away. Given the rock variability observed across the site, it could be reasonably expected that the pile lengths could be between 10% to 20% longer than those shown in this advice.

- The length of the soil nails is nominated at 5m in length and at grid spacing of 2.5m x 2.5m. There are indications of sand lenses in the strata which could locally impact the soil nail design for an estimated 30% of the wall area. There is a possibility that the density of the nails could increase to 1.5 x 1.5m over this extent.

- The survey provided by the client is a lidar based survey and inherently has a large vertical inaccuracy. The top soil stripping volumes could be up to 100mm deeper on average. Suggest make allowance for this possibility.
COLLATE ALL OF THE RISKS FROM THE TANS
WORKSHOP TO ASSESS MITIGATIONS AND DETERMINE RESIDUAL RISK
SUMMARY

1. Head Contracts place significant risks on Contractor’s and there is very little commercial relief.

2. Contractor’s margins are small compared with the risk profile adopted.

3. Contractor’s seek good quality design advice from geotechnical professionals.

4. Contractor’s recognise that geotechnical engineering is a difficult science and need design partners to engage in deliberate risk assessments to achieve price confidence.