In this case study, Slide³ was used to determine the likely behaviour of an open cut coal mine excavated slope. As the slope's actual performance was known, this was an ideal case study to test the reliability of the slope stability analysis methodology in Slide³.

This case is sourced from an open cut coal mine in Queensland, Australia. The excavated slope (i.e. highwall) under review was excavated using a dragline for the main overburden, and then truck and shovel for coal removal. The highwall under review was pre-split to a design of 65 degrees and consisted of a light-coloured sandstone upper band approximately 10 to 15 m thick followed by an interbedded sandstone and siltstone horizon down to the target coal seam. The coal was excavated 12 hours prior to the highwall failure. The geological model indicated no major structure within the failed area; however, seismic lines have located large faulting (approximately 20 to 50 m in displacement) east of the failure area (approximately 80 m away). Pre-failure dimensions and conditions are illustrated in Figures 1 and 2.

Pre-failure, as built slope geometry (acquired from Maptek (2017) i-site scans, three days prior to the failure event) and surfaces of significant units (i.e. coal roof and floors exported from the geological model) were input into the Slide³ model. Anisotropic material strengths were assigned, with weaker strengths assigned in the directions of orthogonal jointing previously measured in the area. Material strengths used in Slide³ modelling are typical of those applied in the Bowen Basin, where the case study is located, as shown in Table 1.
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNIT WEIGHT (KN/M$^3$)</th>
<th>COHESION (KPA)</th>
<th>FRICTION ANGLE (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Coal Measure Rock</td>
<td>24</td>
<td>110</td>
<td>30</td>
</tr>
<tr>
<td>Fresh Coal</td>
<td>15</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>Joint</td>
<td>15</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>
| Jointed Coal Measure Rock      |                        | Joint set 1: Dip = 81°; Dip Direction = 132°  
|                                |                        | Joint set 2: Dip = 74°; Dip Direction = 49°    |

Table 1. Case study: Modelled material strengths

Groundwater conditions were not well defined by operations prior to the failure event. The site had significant rainfall associated with regional weather event Tropical Cyclone Debbi approximately two months before the slope failure. The site had no groundwater monitoring stations located within the vicinity of the failed slope and therefore could not quantify any build-up of pore pressure behind the slope as a result of this rain event. However, no evidence of water seepage out of the face was present in the days leading up to slope failure. Highwall conditions were therefore initially modelled as dry, understanding the FOS calculated would be over-estimated if increased pore pressures were present behind the excavated slope face.

$Slide^3$ model settings were as follows:
- Slip surface = Ellipsoid
- Search method = Cuckoo Search with Surface Altering Optimization
- Analysis methods = Janbu.

Without applying slope search limits, the critical failure surface as calculated by $Slide^3$ is presented in Figure 3.

![Figure 3. Case study: $Slide^3$ model output displaying the location of the critical (lowest FOS) failure surface and contours of Base Normal Stress (kPa)]
Actual failed conditions are shown in Figure 4.

By comparing the location of the calculated critical failure surface, Figure 3, with actual slope failure conditions, there is a good correlation between the Slide3 predicted critical area and where failure occurred, Figure 5.

**Acknowledgements**

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**References**