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GEOTECHNICAL

Tauranga City Council
91 Willow Street
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19 November 2007
Job No: 07123

For the attention of [REDACTED]

Dear [REDACTED]

Please find set out below some notes which I hope will be of use:

TDC Mauao Blasting; Area stability

The proposal is that the explosive charges be set both in the open joint between the boulder and the rear outcrop and the open fractures are available within the boulder itself.

The portion of the blast detonated between the outcrop and boulder is designed to push the marginally stable boulder into the unstable position, from which it will then fall. This blast will clearly send an equal and opposite force into the outcrop and will induce some ground vibration; however, such effects will be extremely short lived and will dissipate very quick as one moves away from the blast site. Ground vibration to distance follows an inverse cube relationship.

The explosives set within cracks in the boulder itself will aim to split the lower part of the boulder, removing support and again helping induce toppling failure.

A series of millisecond delay detonators will be used to initiate a firing sequence designed as far as is possible to minimise vibration and airblast.

The vibration generated by the blast should be considered in context of the frequent natural seismic activity in the region, alongside which it should be insignificant.

Following the blast an amount of hand scaling (and possible secondary blasting) will be required in the immediate vicinity to tidy up the site and bring all rocks into stable and safe rest positions.

Once scaling is complete we do not anticipate the blast having had any destabilising influence on the remaining outcrop.

The site following the blast will of course consist of 'fresh' loose sandy colluvium and rock outcrop. The falling rock will obviously impact and cause some 'temporary damage' to the slope areas between the blast site and shoreline.

The final results can be expected to look like any similar area of Mauao following a natural rockfall/slip which is, after all, simply what we are triggering at a time of our choosing. The alternative is our accepting the possible consequences of failure and large volume rockfall crossing the Oruahine and Base Tracks at high speed on a busy Sunday afternoon.

TDC Mauao Blasting; Alternatives

As per our report dated 31st July the options then identified were:

Leaving the rock stack and setup a monitoring programme

An option to leave the rock stack and monitor it on a gradually extended time scale i.e. start off fortnightly and then depending on results push it out to monthly and biannually could be seen as an option.

This could be seen as taking a considered proactive response that could produce concrete evidence either way as to remove or not. The potential drawbacks with this are that we do not know how much movement the stack has undergone from the point of release until now. If the stack has experienced some movement then it could already be close to it's tipping point.

For this reason leaving the rock stack could be a gamble that we have no way of knowing the size of.

Removing the remaining rock stack by blasting

Options for dealing with this marginally stable rock mass are limited. There are many points to consider due to the high profile nature of the Mauao with local and regional public interest.

Mauao would appear to be as popular as ever, this both increases the need to listen to public opinion (regarding blasting and changing the face of Mauao) and the need to deal with a potentially very dangerous hazard. It is possibly a situation of damned if you do and damned if you don't.

Avalon is acutely aware of the sensitivity surrounding Mauao and would not jump to suggesting such measures as blasting so easily. If the blasting option is adopted then we will carry out the work with all due care and diligence.

No quantitative monitoring has been carried out since 31st July.

As professional Engineering Geologists we always review all other options, even briefly considering those which are clearly impracticable. We believe blasting is the only practicable option to manage the hazard presented by this particular boulder.

A longer list of options, including the clearly impracticable/politically unacceptable could include:

Unconfined blasting

Unconfined charges placed in natural joints and fractures within the rock, simply choosing the time of the otherwise natural rockfall. This is the option chosen by TDC which was planned to be implemented today.

- Very low cost s 7(2)(b)(ii) - Commercial Position
- Relatively certain outcome (although follow up scaling and possible secondary blasting accepted as a possibility).
- Minimal public disruption.
- Minimal risk exposure to Avalon team.

Drilling and blasting

Deck blasting in drilled holes (as per 2003's blast operation) minimises airblast and the quantities of explosive required, however, at this site it comes with a number of possible disadvantages.

- Medium cost s 7(2)(b)(ii) - Commercial Position
- Some uncertainty of outcome; failure may be triggered by drilling works.
- Site hazard management; failure may be triggered by drilling works.
- Longer term disruption to public during works.

Rock reinforcement

Drilling, rockbolting, concreting, strapping, meshing etc.

- Very high cost s 7(2)(b)(ii) - Commercial Position
- Uncertainty of outcome; failure may be triggered during works.
- Site hazard management; failure may be triggered by drilling works.
- Long term disruption to public during construction.
- Visual appearance of permanent physical works.
- Site hazard management.

Breaking up using drilled holes & expanding grout

A large number of holes are drilled and filled with a 'super expanding grout'. This generates extremely high internal stresses and fractures the rock, hopefully triggering failure.

- High cost s 7(2)(b)(ii) - Commercial Position
- Uncertainty of outcome; failure may be triggered by drilling works.
- Site hazard management; failure may be triggered by drilling works.
- Long term disruption to public during construction.
- Visual appearance of permanent physical works.

Hand scaling

Slowly chipping away with hammers etc to get the rock to its toppling point.

- Contractor \$ cost unpredictable.
- Site hazard management; failure will be triggered by the works.
- Risk to workers would be impossible to justify and reconcile with HSE Act/OSH Guidelines re 'all practicable steps'.
- Potential very high labour cost.
- Long term disruption to public during construction.

Machine removal

Excavating a new track to access the boulder by machine (digger) is clearly extremely unlikely to be acceptable, even if the track and slope were to be remediated.

Hopefully the may help resolve the outstanding issues and give the Iwis leadership greater confidence that Avalon/TDC/the Steering Group have attempted to deal with these issues in a timely and profession manner, having taken into account the interests and responsibilities of all concerned.

Please give me a call if you have any queries.

Regards,

s 7(2)(a) - Privacy

For Avalon Industrial Services Ltd