

4.11 S15 – CROWNEST LAKE

Background

The background information on this site has been documented in a number of previous reports to AIT and is summarized as follows:

- A rockfall hazard was been identified around a gully outlet in a rock cut slope along Highway 3 on the southeast shore of Crowsnest Lake, AB. The site is located west of Coleman, AB and approximately 4 km east of the Alberta/British Columbia border.
- A geotechnical assessment of this site was performed for AIT by another consultant in 1999. This assessment led to the construction of a 2 layer, concrete lock-block wall downslope of the outlet of the gully in the rock cut slope and the scaling of the adjacent rock slopes in the fall of 2000. It is understood that scaling of portions of the adjacent cut slopes was performed at the same time as the construction of the existing wall.
- An increased volume and frequency of rockfalls at this site was noted by the maintenance contractor personnel during the summer of 2003. The observed maximum size of rock particles reaching the wall at the toe of the slope were up to small boulder size, and on several occasions boulders were deposited on the southeast shoulder of the road and in the eastbound lane. AMEC inspected the site and recommended that the existing concrete lock-block wall be replaced with a rockfall barrier net in order to better manage the current rockfall risk at this site.
- During the week of April 26, 2004, a boulder measuring approximately 2.2 m x 1.3 m x 0.9 m fell and was deposited on the centerline of the highway.
- The concrete lock-block wall was replaced with a rockfall barrier net in November 2005.

Site Assessment

The site assessment was performed on May 30, 2006. The weather at the time of the site assessment was sunny and clear.

The assessment involved a walk-around of the rockfall barrier net and visual observations (from the highway) of the slope above the crest of the rock cut.

Observations

The following points summarize the observations made during the site assessment. Please also refer to Appendix S15 for annotated photos of the site.

- A boulder measuring approximately 2 m x 1.8 m x 1.1 m was retained behind the barrier, as shown in Photo S15-1. This boulder struck the barrier on April 4, 2006, and AMEC responded to a call-out request by AIT to inspect the barrier condition after the rockfall. The boulder struck and destroyed one of the barrier's support columns and there was also some damage to the barrier ring net and the line of concrete jersey barriers between the barrier net and the edge of the highway. Please refer to AMEC's call-out report¹ for details on the damage and required repairs.
- A large amount of standing water was noted observed in the ditch around and upslope of the rockfall barrier net, as shown in Photo S15-2. Groundwater springs were noted in the talus slope and rock cut slope behind the rockfall barrier. These springs were consistent with previous seasonal groundwater discharge from the slope. There also appeared to be a groundwater spring around the east anchor pile along the barrier net, although this location was below some of the standing water and the spring flow could not be verified.
- The east anchor pile for the rockfall barrier net appeared to have been pulled laterally to the west (i.e. towards the barrier net) since installation. Photos S15-2 and S15-3 illustrate the pile location relative to the barrier and the apparent displacement. It appeared that the pile head had moved approximately 50 mm towards the barrier net. The anchor cables attached to this pile head were slightly slack as a result of this movement. The braking rings in these anchor ropes had not been triggered by the impact of the April 2005 rockfall, therefore it is judged that any movement of the pile head was not the result of the rockfall impact but instead due to the steady tension from the anchor ropes possibly exacerbated by groundwater upwelling along the pile shaft.
- In general, the tension in the cables holding the barrier net up appeared to be less than after installation in November 2005 and also observed during the previous inspection in April 2006.

Discussion

The rock fall barrier net installed in November 2005 has successfully managed the rockfall risk to the highway to date. However, as discussed in the report on the April 15, 2006 call-out, there remains a risk of a rockfall that exceeds the design case for the barrier that cannot be quantified with the available information on this site. Please refer to Section 6.2 of the report on the April 15, 2006 call-out for a discussion of this issue and AMEC's recommendations for ongoing inspection and documentation of rockfall debris accumulation at the barrier in order to monitor

¹ "Report on April 15, 2006 Call-Out Request, Crowsnest Lake Rockfall Barrier Net, Highway 3:02, West of Coleman, AB", submitted to AIT on April 28, 2006.

and review the rockfall risk at this site in a proactive manner rather than simply assuming that the existing barrier is sufficient unless proven otherwise by the barrier failing to retain a large rockfall in the future.

The standing water around the barrier net is likely not a significant concern because the barrier net components are corrosion protected. However, periodic inspection of the barrier net condition as per the manufacturer's instructions will need to be performed to confirm this.

The damage to the barrier net from the April 2006 rockfall needs to be repaired in order to restore the barrier net capacity. The recommended repair and maintenance work is listed in the report on the April 15, 2006 call-out request. AMEC understands that these repairs are to be completed during the week of July 17, 2006.

Assessment and Risk Level

The overall assessment and risk level for this site is unchanged since the April 15, 2006 call-out request.

Based on the Risk Level Criteria for rockfalls (Table A2 in Appendix A), the recommended Risk Level for this site is as follows:

- Probability Factor of 15 to reflect the active rockfall conditions at this site, with ongoing and persistent rockfalls during specific times of the year and where the area producing rockfalls is expanding.
- Consequence Factor of 1 because the existing barrier will retain the rockfalls.

Therefore, the recommended Risk Level is 15.

Note that the Consequence Factor of 1 is contingent upon cleaning of the debris accumulation from behind the barrier as necessary and no damage to the barrier that would reduce its capacity.

For comparison, the recommended Risk Level for this site before the barrier was constructed was 112.

Recommendations

AMEC recommends the following future work for this site:

Repair of the rock fall barrier net and removal of the large boulder should take place as soon as possible. AMEC understands that this work is to be completed during the week of July 17, 2006.

Periodic inspections of the barrier net condition as per the manufacturer's installation, service and maintenance instructions should be performed by the maintenance

contractor. These inspections are required to confirm and maintain the barrier capacity. Copies of the manufacturer's instructions were attached to AMEC's report on the April 15, 2006 call-out request.

The anchor ropes attached to the east anchor pile should be re-tensioned. The tension in these ropes should be checked during future inspections of the barrier net. If the head of this anchor pile continues to move laterally towards the barrier net it may need to be replaced to maintain tension in these anchor ropes.

The annual geotechnical inspections of this site should be discontinued – provided the above-noted inspections are carried out by the maintenance contractor.

The recommendations from the April 15, 2006 call-out request report for additional work to estimate the probability of a future rockfall exceeding the barrier capacity and therefore provide a greater assurance that the existing barrier capacity is sufficient to maintain an acceptably low level of rockfall risk to the highway should be implemented. This procedure will allow the risk with the existing barrier to be monitored and reviewed in a proactive manner, rather than simply assuming that the existing barrier is sufficient unless proven otherwise by the barrier failing to retain a large rockfall. In summary, these recommendations consist of quarterly inspections of the debris accumulation behind the barrier, documentation of when the debris accumulation behind the barrier is cleaned out and how much volume is removed, and documentation of any occasions when a rock gets past the barrier. Please refer to the April 15, 2006 call-out request report for a more detailed discussion.