Cave and Karst Management in Australasia 16
Proceedings of the 16th ACKMA Conference, Westport, NZ, 2005

Te Anau Glowworm Caves redevelopment

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Introduction

Rediscovered in 1948 by a local tour operator, the Te Anau Glowworm Caves have operated since that time as a commercial show cave.

Being situated within the confines of Fiordland National Park the caves are privately operated by Real Journeys on a concession issued by the Department of Conservation.

In recent years the need to upgrade the original 1950s infrastructure has provided many challenges. Visitor expectations have also changed during this time.

This paper is non scientific and aims to share our practical experiences upgrading the infrastructure, interpretation and safety aspects of this small but dynamic cave.

Background

Real Journeys is pleased to be a supporting sponsor of this conference. Real Journeys is a privately owned company that operates a wide range of sightseeing excursions in the Southern Lakes and Fiordland regions. The company has been operating for over 50 years. Our connection to the caves stem back to the original Fiordland Travel Company. It was one of the founders of the original company that made the first documented re-discovery of the caves in 1948. Since that time tours have been operating and today the company has a concession granted by the Department of Conservation to operate the caves. The caves are situated within the confines of the Fiordland National Park. Because of the company's long history at the caves the concession is basically a lease of the caves and surrounding area, with all the infrastructure and development being privately owned.

Our concession requires us to liaise with the Department of Conservation with regards to any caves matters and over the years an excellent working relationship has been developed them.

Location

Situated on the Western Shore of Lake Te Anau the caves are accessed by boat, or helicopter. The location presents a number of challenges with regards to development, however overall the remote nature of the caves is a bonus for caves management. The catchment area for the caves is not only National Park, it is pristine virgin land which has never been logged, never had any roads put through it and even today 30000 hectares surrounding the caves is a restricted area in terms of public access as the last natural habitat of a rare and endangered bird *Porpyhrio mantelli* or Takahe.

Originally the development was very much hands on, with management having vision to open the caves. With limited visitation, short seasons and lack of cashflow a hands on approach by the company owners was required to build the structures.

Early cave walkways were basic, and infra-structure was often built of materials collected in the immediate area. Walkways were made of wood collected from the beach, caves punts left a lot to be desired, and even the dams required a collection of moss to plug the holes to facilitate daily tours. Pioneering tours no doubt left visitors with a far greater sense of adventure. Flooding resulted in damage to structures. Often a full rebuild was required and inevitably the damage occurred just prior to the summer rush. There were numerous occasions during the first few years that management considered walking away from the venture.

Persistence paid off and after a few years cashflows increased sufficiently to allow for new and improved walkways to be built. By the mid 1990s, 50 years on, the original 1950s structures were beginning to show signs of deterioration and we found ourselves asking "where to now?"

Redevelopment options

Looking around we found that new and improved methods of cave walkway construction were

being talked about, however materials for the construction were topical, wood versus concrete, versus recycled plastic, versus steel. Each cave situation required a different approach and after visiting the best part of 40 show caves Australia and New Zealand wide I still hadn't seen a system that would work in our cave. The dynamic nature of the Te Anau Glowworm Caves required a new approach with walkways built to withstand regular flooding with the location also being a factor. Materials just couldn't be trucked in.

The caves also were also to remain operating during the redevelopment so this required the work to be done in bite size pieces that would let tours through. A higher priority was to ensure the construction had no negative effects on the glowworms, so investigation focused on construction methods that minimised dust and engineering (welding, cutting) etc.

What we came up with was basically a giant Meccano set, walkway sections were built to plans based on a centre line survey of the existing walkways route.

The choice of materials was the next challenge. Again there seemed to be mixed messages out there as to the best material to use. Obviously with difficult access we wanted something light, but strong enough to withstand the flooding. Over the years the punts in the caves had progressed from wood, to steel, to marine grade alloy. The alloy punts had been in the caves for over 15 years and had proved to be totally durable in the caves environment (series 5000 or higher).

This material could also be combined with stainless steel, and with appropriate isolation from other materials including steel we felt confident to give it a go.

The engineers developed a truss system that would enable spans of up to 8metres to be used. The longer spans reduced the number of attachments or mounting points. With further consideration of lateral loadings from flooding the longest spans installed were 7metres.

Because tours were going to continue during construction we needed to ensure each span also facilitated the demolition of the old and establishment of the new during a 10 hour window.

Once the material was chosen a key aim was to minimise the visual impact of the shiny alloy and stainless steel. Lighting was to play a key role in minimising the impact.

We wanted lots of curves, but reality requires trusses to be straight. This was a concern to begin with but we found even a slight off set between 2 spans actually reduced the impact.

The other considerations we looked into were the need to contain any sediment carried in on visitors footwear. For our cave natural flooding seemed to negate the need for this feature.

From our experiences building boats we knew drumming was possible from visitors walking along the flat alloy surface. In our noisy river cave we didn't think it would be too much of a problem.

To test all of this and to convince ourselves we were going down the right path, we built a 3 metre section of walkway, positioned it temporarily in the cave so that we could jump up and down on it, check for drumming and look at the effects of lighting. This proved worthwhile and gave us the confidence to proceed with the first 70 metres of new walkway.

It was clear lighting was going to play a crucial part in helping disguise the walkway. The lighting plan was developed to ensure no lights shined directly onto the alloy.

Because we required visitor acclimatisation to the dark for the purposes of seeing glowworms we also wanted to maintain the lowest levels of lighting possible. Lighting which is 12 volt is reflected off the stream and bounces back of the walls with the limestone colours being absorbed by the alloy. Take a flash photo of the new walkway and it looks bloody terrible!

The spans were all delivered to the caves under the helicopter built up, and as required each span was dismantled, carried into the caves in pieces and reassembled adjacent to its required position. Levels and angles could be adjusted to get the walkway just where we wanted it. The assembly consisted simply of nuts and bolts. Minimal engineering was required in the caves with welding, and grinding totally eliminated.

A range of mountings were developed and used in different locations. The key to getting everything lined up was to slot all mounting holes so that exact matches for bolts holes were not required.

Where we connected alloy to steel rubber insulation was used to isolate the dissimilar metals although to a degree moisture negates the effectiveness.

With regard to the authorities we required to obtain resource consent for this work, dismantling and assembling structures over the bed of a stream.

The walkway also met the requirements of the building code. A key dispensation was granted in relation to the railings. Because we were above water we normally would have been required to install swimming pool type railings with vertical bars rather than horizontal wires. Because of flooding we didn't want to put lots of close bars in and because we were operating a guided cave tour the council were happy that risks associated with visitors climbing the rails were suitably controlled.

A second section of the original walkways which was built more recently and was in much better condition and presented us with new challenges. The structure seemed solid, but we had no plans and had no idea of how it was attached to the cave walls. To help us make a decision on this section we commissioned a structural engineer to complete deflection testing. A temporary reaction beam was installed between the cave walls. A hydraulic jack was used to apply pressure and deflections were measured using dial gauges supported by the rock below on both kerbs of the walkway. Loadings were thus established, measurement taken and certification gained. The positioning of the load application was limited by the practical positioning of the reaction beams between the cave walls.

It was decided to retain the original structure in this part of the caves. New compliant handrails would be added. These have now been fitted. Due to the variable mounting off the old concrete a few of the posts have ended up on odd angles and at present things looks a little messy (a bit agricultural!) A new plaster surface and cable conduit is still to be added and when this is done we will adjust lighting to best highlight the cave and hide the walkway.

With the above work completed we again asked ourselves "where to now?"

Currently plans are in place to add in a final section of new walkway to replace the first punt ride.

The original punt ride in this section of the caves was substantially shortened in the late 1960s with the establishment of a Cathedral Landing and a waterfall walkway. 29metres separate the Bottom and Cathedral landings. The punts are an obstacle to visitor access and smooth flows through the caves. This is doubly so given that visitors are required to travel in the bottom punt twice, doubling the chances of trips and falls.

We currently have application in to remove the lower dam, and replace it with a walkway. The highlight will be reverting the stream back to its natural flow. This will re-expose a spectacular section of the river, and create a bigger space, currently around one third of the cave at this point is filled with water from the lake behind the original 1950s dam.

It is with interest that recent articles relating to caves and earthquakes have recently appeared in the ACKMA journal. As some of you will be aware Te Anau and the Fiordland region experience a 7.1 magnitude earthquake in August 2003. Numerous slips and landslides occurred throughout the region. The caves appeared to come off without damage. Walkways were checked. OPUS International were requested to complete a geo-technical inspection. Scaling work was required to rectify the geologists concerns with two features in the caves. A specialised civil works contractor was engaged to complete this work.

Following this we again found ourselves "where to now?"

OPUS suggested it would be prudent to set up and complete an Annual General Inspection. This is now been completed and we have 17 features in the show cave that the geologist has ranked for risk with the view to future monitoring.

Observations and recommendations were made for each site with a preliminary Risk Ranking made for each feature.

The risk factor was established by ranking number of criteria. This included Fracture Aperture, Fracture Age, Fracture Extent, Feature accessibility, Seepage, Fracture Roughness, Fracture Orientation, Vulnerability, Size of Feature.

In each area there were a range of specifications/categories that would be considered to help describe the feature and rank the risk.

Example: Fracture Age

Historic = Calcite cemented, rounded edges

Mature = Rounded edges, in filled with erosion/flood debris

Recent = Sharp edges, in filled with erosion/flood debris

Fresh = Sharp edges, no infill present

Vulnerability: The level of exposure that staff and visitors would have to each feature.

Very Low = Feature located above a rarely visited area

Low = Feature above area sometimes used by visitors

Medium = Feature above walkway or boat route

High = Feature above area where visitors are stationary for more than 2 minutes

The other criteria also had a different range of choices which when all calculated together gave the ranking of each feature.

Low Risk features are now inspected annually.

Medium Risk features are also part of the annual inspection but where practical telltale monitors have been installed. The telltales consist of either microscope slides across cracks held in place with epoxy resin or sliding rod devices located between rock surfaces.

These monitors are checked monthly or following seismic activity and will hopefully show incremental movement.

High Risk features have required detailed investigation and remedial action. Tourist activities OK to proceed but risk exposure should be minimised by avoiding traveling under the feature.

Very High risk features required more urgent investigations with tourist activity avoiding these features.

Guides now complete the monthly checks and record these in a log-book, with the first 12 month review due in August 2005.

The one high-risk feature that was identified required remedial works. A large feature ($10m^2$) above one of the busiest parts of the caves required wire strapping to secure. 8 anchors were installed with 10mm wire straps connected across the feature. These were tensioned to 100kN and now in the event this block moves the wire straps should hold it.

From a management perspective the program we now have in place provides the basis for ongoing monitoring and mitigation. We have taken all practical steps. Along with guide involvement in the monthly checks, we have also updated our general earthquake awareness and updated guides manuals and emergency plans.