Will the repair of the Cairngorm Funicular Railway work (2)?

Description

In the first part of this series of articles (see here), about whether the repairs Highland and Islands Enterprise (HIE) has planned for the funicular will work, the following picture was thought to be that of a pier base.

Photo credit. G.Paton.

It is now believed to be that of Anchor Block(AB) 48. Notice there are no steel reinforcing rods cast into the foundations on which the Anchor Block would have been constructed. In the COWI report (see here) it is assumed that the Anchor Blocks are held in place by rock bolts or studs. An example is shown in the next picture:-

A hole is drilled into the concrete base, the anchor bolt/stud is put in the hole and as the nut is tightened, it expands the collar which locks the bolt/stud in place. Smaller versions of this are used by many D.I.Y'ers around the home.

Although this is only one type of bolt, other types could have been used which would have been concreted into holes drilled in the base foundation, with nuts and washers placed on top and tightened to hold the Anchor Blocks in place.

"Some rock bolts at anchor blocks can be loosened by hand. [New observation by COWI/ADAC, Aug 2018] (Page 11, para 2.2.7). The next picture, courtesy of the COWI report (page 13) is of one of those anchor bolts.

Figure 2-10 Loosened rock bolt in anchor block (refer defect 7)

Question (1) Where was the routine maintenance schedule that should have been carried out by maintenance staff that allowed this to happen?

Question (2) Is it possible to tighten this bolt taking into account the corrosion on the threads?

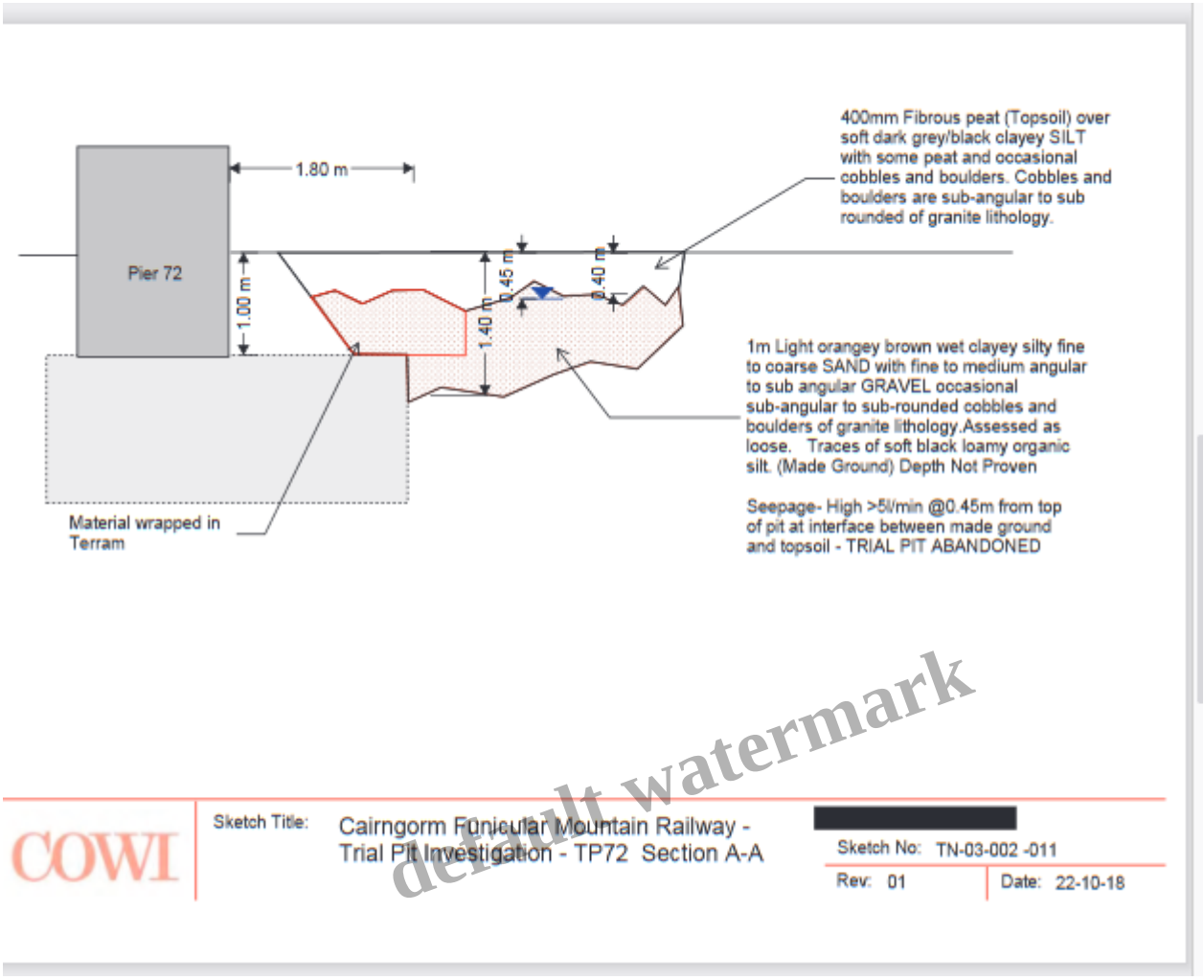
It is not known which of the Anchor Blocks this is, or how many of its securing bolts were loose, but these bolts are there for a reason. These Anchor Blocks take the weight/ strain of the approx. 2 x 300m of uphill concrete beams, which are continually trying to slide downhill under the force of gravity. They should be checked on a regular basis and the nuts torqued to a specific setting. Depending on how many of the bolts on any one Anchor Block were loose, the one below it could have been carrying the full weight of 600m of track! You can see from the corrosion on the rock bolt that the nut has been loose for some time.

Question (3) Why was this not noticed at previous inspections?

Under Para 6 Conclusions and Recommendations of the COWI report (page 311):

“Poor workmanship appears to have been consistent throughout the build and subsequent maintenance”.

As part of the production of the COWI report several test pits were excavated .The next drawing is of the test pit at pier 72.



Sketch courtesy of the COWI report Page 201.

Looking at the sketch it shows that the pier is offset on its base. It is not the only one. I would assume that for maximum effect the weight of a pier should be dead centre on its base. Unless the weight is evenly distributed there could be an overturning motion on the base end with the heaviest weight on it which could help explain why they now need propping up.

Question (4) Was this offset positioning of the piers deliberate or was it due to inaccurate surveying either when the foundations were laid or the piers erected? While I have been told by an engineer that it may not be a really a major problem, without the original plans and calculations, which my last post show appear to have been lost, it is difficult to see how one can be certain about this. (I will return to factors which might impact on pier stability in a further post).

The COWI report also states that test pit 72 was abandoned due to high water seepage, presumably from the spring above the pier. It is also not the only pier with a natural spring above it, pier 41 is the same.

Question (5) Has this water seepage been washing out the ground material from underneath the piers? We don't know the answers to this because, according to Highlands and Islands Enterprise (HIE), no investigation of the ground beneath the pier bases has been carried out.

COWI report page 192 shows pier 57 was even further out of alignment with its base edge being 2.15m from the corresponding edge of the foundations. If reinforcing bars had been cast into the foundations of this pier they would have been so far out of place when the pier was cast that they would have been totally ineffective! The COWI report has assumed that the anchor blocks are anchored with rock bolts and it looks as though therefore that the piers are anchored in the same way.

The next four pictures, again from the COWI report, three from pages 277/8 and the fourth from page11, show the in situ joint of pier 9 in what appears to be very poor condition with numerous cracks and damage. The first three are from the outside of the structure, the fourth from the inside!

Plate 5 – General view of surface markings to Pier 9 Right Beam up/down.

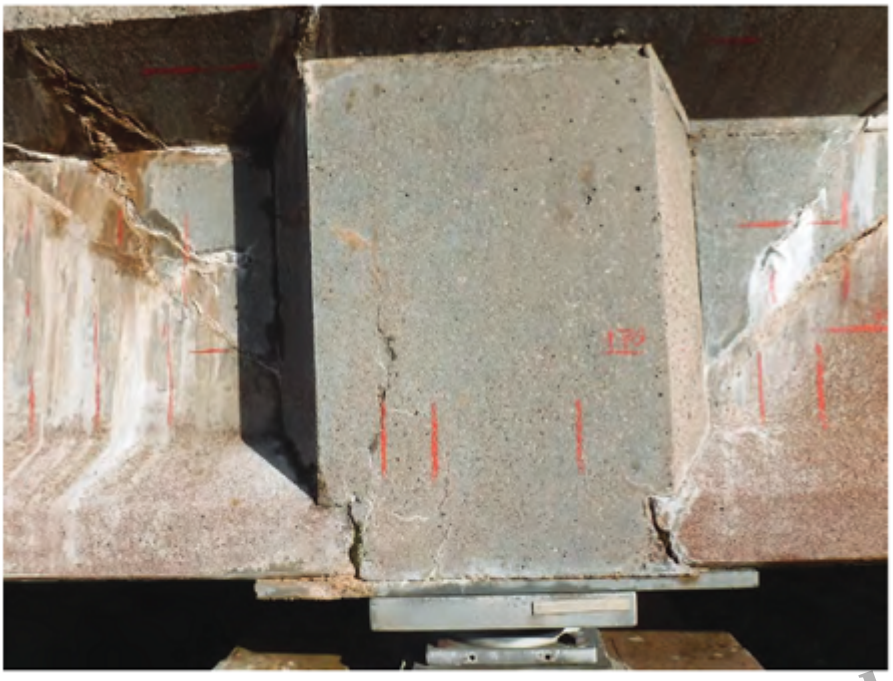


Plate 8 – General view of surface markings to Pier 9 Right Beam up/down.

Figure 2-6 Cracking at a pier 9 (refer defect 1)

Figure 2-7 Crack repair at pier 9 (refer defect 1)

Question (6) If this is the kind of damage that has occurred in 18 years, unless that joint is completely recast , then how much longer will it survive?

Question (7) Has the reason for such extensive damage been investigated?

It is not clear from HIE's business case what repair work, apart from pier propping – which is in the public realm because it required planning permission – will be undertaken by Balfour Beatty

So far as I know, too, information has not been released by HIE as to why the engineers think that the failure of the Funicular has been so catastrophic.The work that HIE has asked Balfour Beatty at a cost of £16m appears to be about repairing and strengthening funicular up and running again as soon as possible without any investigation of what has caused the problems or the consequences of all the propping, e.g what impact the new structures will have on snow retention.

In my next post, I will attempt to show how these problems may have occurred, why the repairs will not work long term without other repairs and why the funicular should be scrapped now before more money is wasted on HIE's folly.

Category

1. Cairngorms

Tags

1. Cairn Gorm
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