Will the repair of the Cairngorm Funicular railway Work (5)?

Description

Ellmau Funicular – Photo Credit Funimag

Continuing this series of posts (see here), the idea for funicular at Cairn Gorm was I believe inspired by the Ellmau funicular. A comparison between the two railways is instructive and raises further questions about whether the proposed repairs to the Cairngorm Mountain funicular.

The most outstanding difference is the viaduct itself, steel piers and beams of a much reduced volume, not the massive concrete support used on Cairn Gorm. The original design for the Cairn Gorm Funicular was for steel to be used, but when Morrison's Construction won the contract they proposed the supports should be constructed out of concrete. This change appears to have been prompted by the initial costings for the funicular construction coming in £2m over budget and was therefore a cost-cutting measure:

George Foulkes: Where was the major cost overrun?

Keith Bryers: The major difficulty probably related to the replacement of the proposed steel beams on the ra
challenging engineering issue, given the weather conditions, the altitude and the various environmental consi

George Foulkes: Morrisons proposed changes to both those aspects of the original tender specification.

Keith Bryers: That is correct.

George Foulkes: Having won the contracts out of 14 companies in one case and four companies in the othe

Sandy Brady: That was done as part of a cost-saving exercise.

George Foulkes: A cost-saving exercise?

Sandy Brady: We agreed to merge the two lots and to seek savings because Morrisons had won the two co

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the buildings, removing the proposed middle station building and considering suggestions from Morrisons ab
advisers at the time.

George Foulkes: Had Morrisons constructed a funicular before?

Keith Bryers: Nobody had constructed the civil works for a funicular before, but the funicular manufacturers
important for the selected civil contractor to feed into the tender documentation for the award of the train worl

Extract UK Select Committee. Note too the final line, nobody involved had experience of funicular co

The change to concrete was approved by designers A.F.Cruden, seconded by Bullen Consultants and finally approved by Highlands and Islands Enterprise (HIE).

The change from steel to concrete was significant, a “major difficulty” as Keith Bryers described it, because the two materials have very different properties, with steel for example better able to disperse vibrations (see here). As these posts have also shown, the COWI Report suggests that there could have been major flaws in the construction of the concrete bases, piers and beams. This may explain HIE’s pursuit of a legal case on the *“design and build aspects of the funicular railway”* (as reference in Audit Scotland’s report last year on the funicular). It would be in the public interest to know how much of the current £16m repair bill can be attributed to that initial £2m cost-cutting measure but so far HIE has remained totally silent about this.

It can also be seen from the funimag photo that because the main supports are slimmer and much further apart there is much less of a “snowfence” effect than occurs on Cairn Gorm, a problem that is only going to increase with the proposed propping arrangement.

Propping proposals

While HIE has not revealed the reasons why the concrete funicular supports have failed, we do know part of their proposed solution involves propping up many of the piers.

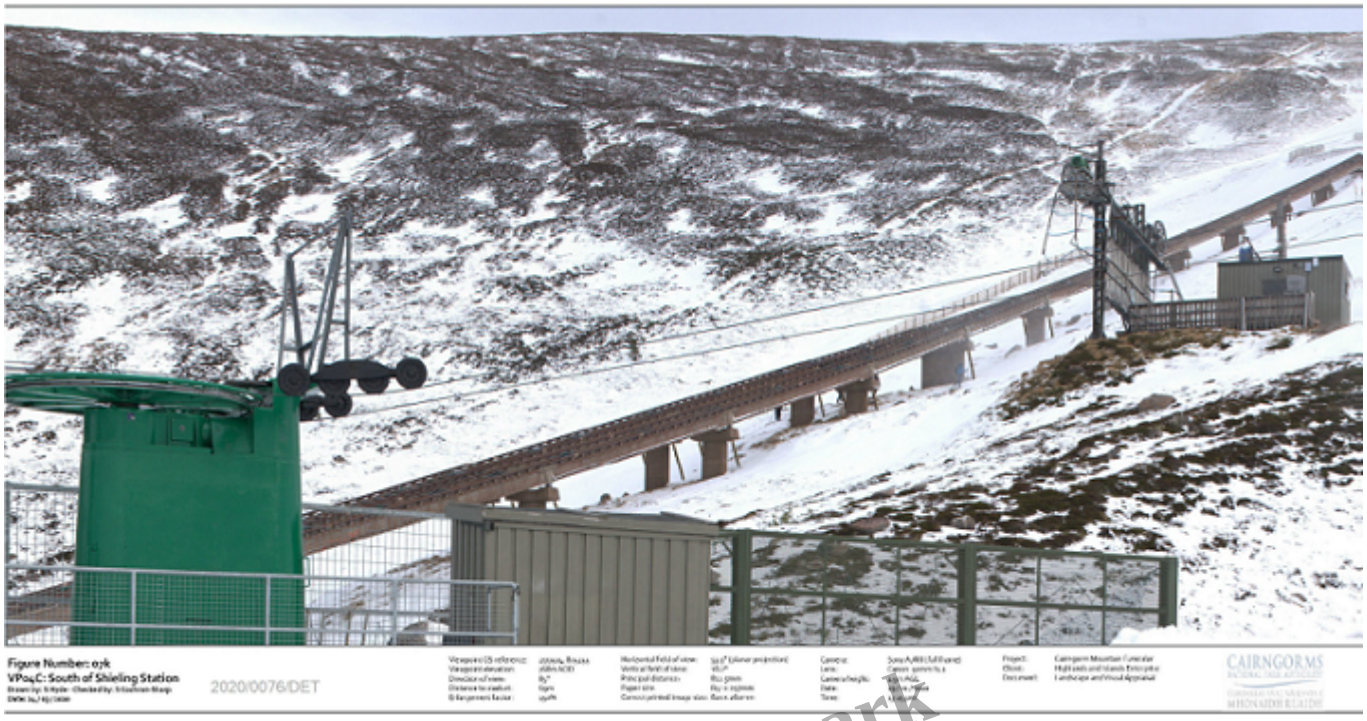
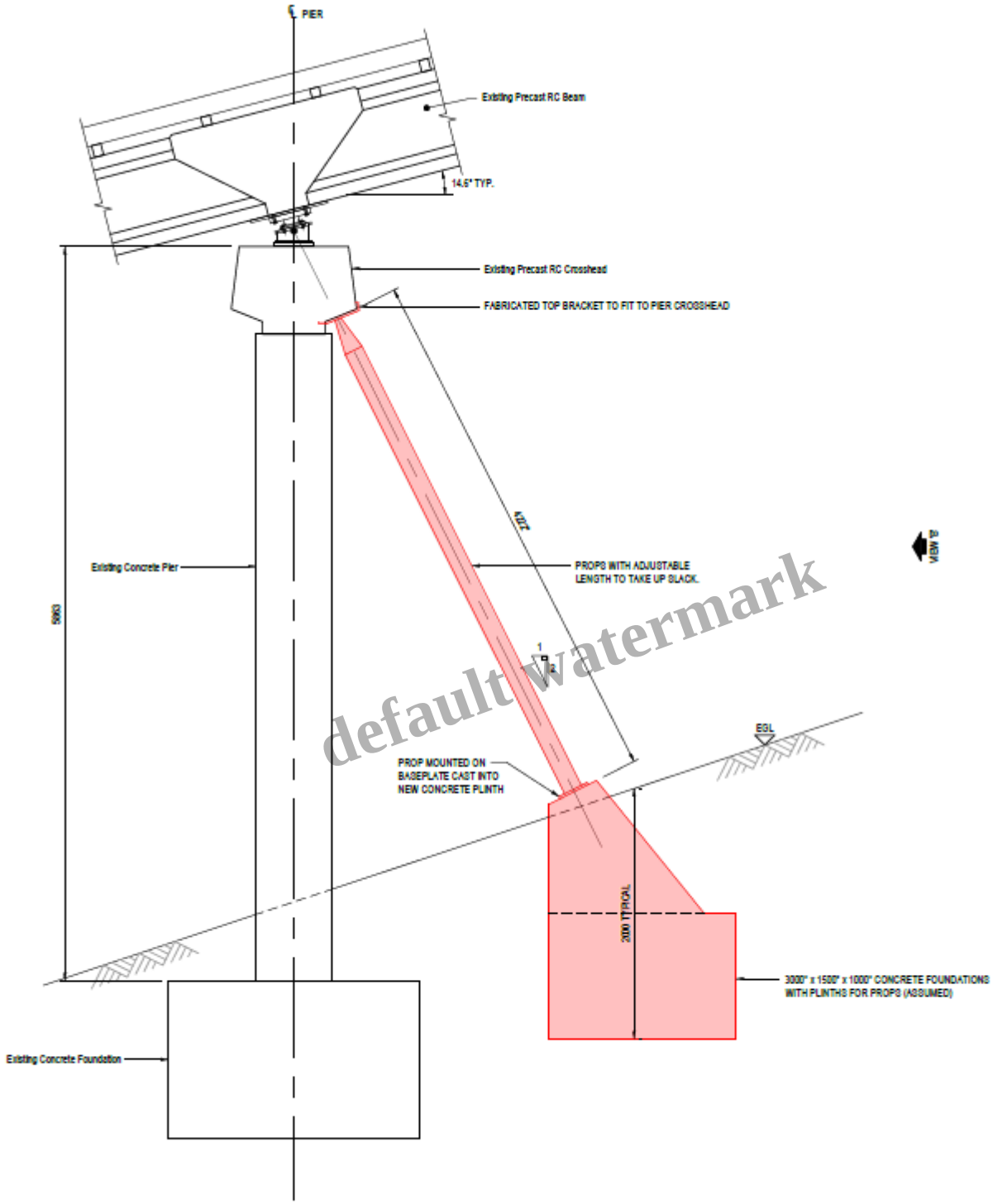


Photo montage showing how the metal props (the thin lines on the uphill side of the concrete piers) will appear. Credit: document LVA FIGURE 07K VP04C from National Park planning portal

There is currently little information as to what the “propping” entails, apart from the diagrams in the planning application which indicate props of adjustable length will be used.



TYPICAL SECTION

I have therefore looked at what is available:

(1) Steel Acrow type props as shown in the next photo.

Photo credit Brandon Hire Station.

These are adjustable and are the kind of props that are often used on house building projects, e.g. propping up floors when installing patio doors or larger windows. Their use on the Funicular is probably not ideal due to the weight of the track, train etc.

(2) The second type is a combination of the Acrow prop shown above and a hydraulic jack as shown in the next picture:-

Photo courtesy of Uni-Prop.

This is a basic model which is obviously not suitable to carry the weight of the funicular, but gives you

an idea of what I suspect will be used. They are the only type that appears to meet the specifications in the planning application and COWI report.

There is another major challenge for the propping, apart from the size of the props that will be required, and that is their maintenance and we all know how well that is carried out on Cairn Gorm.

These props and the hydraulic jacks are made of steel which expands and contracts depending on temperature and, as anyone who has skied Cairn Gorm can tell you, there can be quite dramatic changes in temperatures even over the course of a couple of hours. When the sun is out those steel props could be warm to the touch, but if an hour later the temperature has dropped below freezing your hand would stick to them.

The question is will there be a pressure guage in the system so that the jacking pressure exerted on the piers can be monitored and there will be safe limits for that pressure? Too much pressure will push the piers over backwards while not enough and the props will not be doing their job. That is where a major problem arises, even if expansion/contraction was only ¼ ins that would rock the already insecure piers! The answer to that would be to have pressure guages which will need to be monitored on a regular basis, either manually or by an automated system.

Manual monitoring would necessitate a team checking and adjusting the pressures, when necessary, of every propped pier at least every morning before the funicular opens and possibly several times throughout the day! Not too much of a problem when there is snow on the ground as working from the tunnel down, two men on a skidoo, a minute to check each of 65 piers is just over an hour to check all the piers, BUT, what happens when there is no snow? 4 wheel drive vehicles to be used, creating new tracks? Walking the 2000m of the funicular would not be feasible, unless lots of staff were employed to do this.. For a 9.00am opening, staff would have to start checking at 8.00am! But on days when temperatures fluctuated wildly these checks and adjustments would have to be carried out several times a day, an increase in staff hours and therefore maintenance costs.

A fully automated system appears therefore the only sensible option, requiring a system of pipes, valves and electrics running the whole length of the viaduct with automatic shutdown in case of a pipe or fitting failure to avoid a serious ecological incident. It is not clear if HIE has included this in its strengthening/repairs proposals and, if not, how long it expects the repairs to work. It's hard to see how the piers could possibly last another 30 years if the props are constantly expanding and contracting and the other problems have not been addressed.

What else should HIE have learned from Ellmau?

The Ellmau funicular was removed in 2015 and the article in Funimag, a magazine specifically about Funiculars since 06/01/1996, explains the background and reasons why.

In its 40 years of use, which ended with its removal in 2015, the Ellmau funicular had carried circa 34,000,000 passengers. The Cairngorm Funicular in its 16+ years has carried an average, let's be generous, of 300,000 people per a year. Even if it carried on at that rate after repair, this would come to a projected total of 12,000,000over 40 years, about 1/3rd of the number carried by the Ellmau

funicular!

The Funimag article goes on to explain:-

The reasons for the closure of the funicular and its replacement by Doppelmayr 10-EUB gondolas:
– Costs of revisions (over 750,000 euros per year)
– Repair parts (60 % of special manufacture – 40 years old)
– Ratio carriage passenger capacity/customer waiting time
– No handicapped accessible
– Ratio Capacity / time to wait too low
Pro gondola:
– Even with a modern cable car, the hourly capacity does not exceed 1,600 passengers. Doppelmayr 10-EUB gondola with its hourly capacity of 3,200 passengers will be removing the waiting time.
– Wide choice of cabin designs and options
– Maximum availability
– Maintenance-friendly thanks to easy access to all components

Screenshot courtesy of Funimag

What this says is that a funicular is not an economically viable alternative to a gondola, or even the cheaper chair/ gondola hybrid. Yet despite this information and and its own conclusions in the Full Business Case about the repair costs of the Cairngorm funicular, HIE is insisting that it is returned to service.

The questions that need to be answered

The whole financial and structural failure of the funicular needs to be properly investigated, before any more work is carried out, by financial and civil engineering consultants independent of HIE and its control.

Among the questions that need to be answered are:

1. What has caused the structural failure, including the cost-cutting decision to replace steel with concrete?
2. How long are the repairs guaranteed to work, or will the public be facing yet another large bill in say 10 or 20 years time?
3. The proposals and costs of maintenance going forward, including how the metal props will be adjusted?
4. Why HIE has ignored the experience from elsewhere in the world where funiculars are being replaced by other forms of uplift?

Category

1. Cairngorms

Tags

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