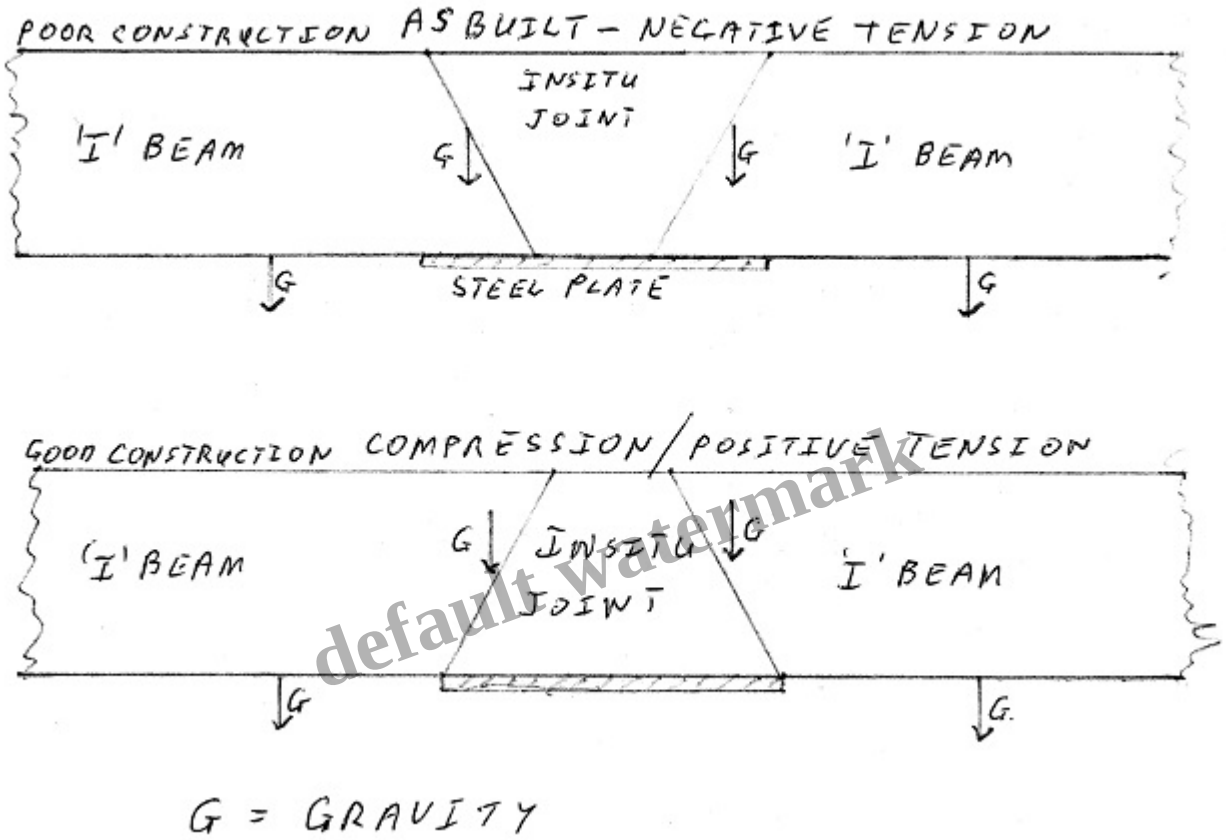
HIE, concrete and the death of Cairn Gorm as a ski resort (2)?

Description

After my last post I had conversations with a couple of people about my conclusions that the insitu stitch/ joints are the wrong way up, i.e. instead of the joint being wedge shaped, as in the pictureabove, it should be more of a pyramid, as in my drawing below.



There were a number of civil engineers who supported my theory and two that didn't. I am not a civil engineer so at times I struggle to understand the technical information that they use, it's like trying to do a degree course in weeks/ months rather than years and understanding a lifetime of experience.

The case against my argument that the scarf joints should have been formed the other way up was:-

(A) The joint would be hard to form

Because of the length of the bottom of the in-situ joint the mould would need either,

(1) A strengthened steel plate longer than the distance between the ends of the "I" beams, probably strapped to the "I" beams to support it, or,

(2) If a shorter plate, as in the original design, was used the rest of the joint would require substantial

support underneath because of the weight of concrete pressing down. That “solution” would also leave the lower corners of the pyramid joint unsupported when completed.

(B) The joint would be weak.

When pouring the concrete into the pyramid shaped mould it would tend to slump away from the “I” beams and air could be trapped between the new concrete and the “I” beams bweakening the structure and allowing water ingress (see description of a cold join below). But that is exactly what is happening with the wedge shaped insitu as confirmed by the next screenshot from the ADAC Structures report of July 2018:-

“2 The majority of precast beams have slightly larger cracks at their junction with the in?situ concrete of the crossheads. Usually the cracks are larger at the upper flange, tapering to zero by mid?web. Typical crack widths vary upto 1.0mm, with an average of 0.5mm. In a significant number of cases, these cracks are associated with rust?coloured deposits on the surface of the precast concrete web, indicating that some corrosion has occurred of the reinforcing steel which originally protruded from the precast beam prior to being surrounded by in?situ concrete.

BS 8110?2 section 3 clause 3.2.4.2 states that to prevent corrosoin in aggressive environments the crack width should not exceed 0.3mm. There are many instances where this limit is exceeded and it is no surprise that rust staining is being seen.

The possibility of ongoing corrosion of the reinforcing steel should be considered, together with the long?term consequences of this, should it be left uncorrected. It is recommended that measures should be taken to seal any cracks where rust?staining is apparent, so as to eliminate oxygen and water ingress.

A detailed assessment of what has caused this cracking has not been carried out, but it seems likely that there is more than one cause.”

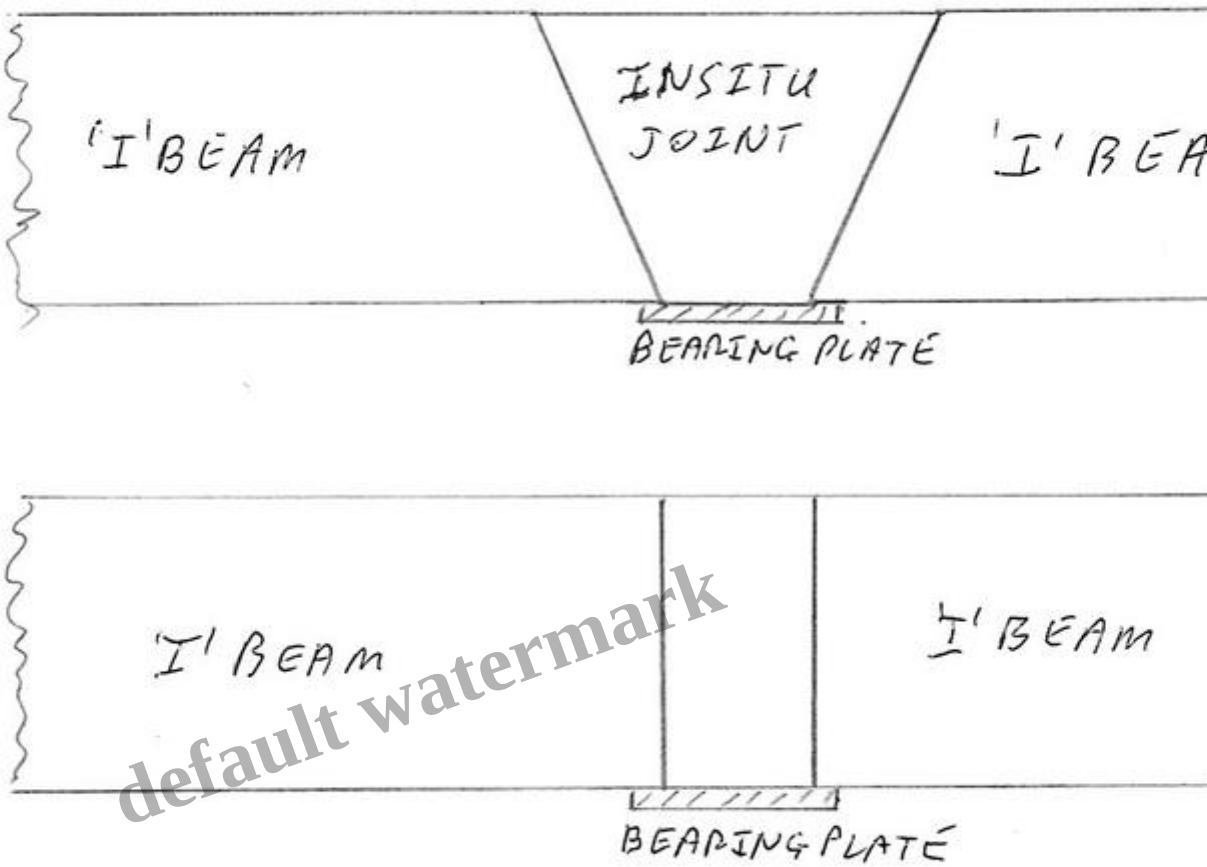
While self – compacting concrete would overcome the problems in (B), the more awkward problem is (A). I therefore partly agree with the people who were against my original argument, not that it wouldn’t work as that depends on the quality of workmanship (as shown in the photo and comments below), but that it would be a lot more awkward, labour intensive and therefore expensive especially in a mountain environment. Of course, all these points would have been academic if the “I” beams had been pre-stressed when they were made.

Photo [12] Pier 8, one of the poorer insitu infills. Showing joints opening between Insitu and precast plus cracking within the mass of the Insitu, both inclined and near vertical.

Photo [13] Pier 8 from above.

Photo courtesy of the ADAC Structures report Nov 2015 (Strangely Pier 8 appears to have become Pier 9 in the 2018 report)

Having said that, there is a third option, the beams could have been made with straight, vertical ends, as shown below,



The bearing plate is the same length but supporting the whole end of each beam. A better design wo
longer

A rectangular insitu joint would have been much easier and cheaper to form than either the wedge or the pyramid and appears to be what Balfour Beatty have done at Pier 51 at the passing loop as shown below.

Notice what appears to be a V shaped calcite bleed near the centre of this insitu joint under the meta

This joint may be not as pleasing visually but probably more effective.

Not one of these options for joints is a good idea as they are all known as “cold” joints. The screenshot is from this link:- https://www.structuralguide.com/cold-joint-concrete/.

Key Facts about Cold Joints in Concrete

Let’s discuss the key factors to be aware of the cold joints in concrete.

- **Lack of Bonding**

The formation of a concrete cold joint creates a weak bond between two concrete pours. It is due to the placement of concrete on concrete at has started hardening (setting).

NOTE the last three sentences which possibly explain the current problems with the funicular.

My second conversation with civil engineers was enlightening, exposing yet more flaws in using concrete for the “I” beams.

The temperature range on Cairn Gorm can vary between -29C and + 30C and because of this the steel reinforcing in the “I” beams will expand and contract more than the concrete. This has the effect of destroying the tensioning within the beams. Micro cracks will start to appear ,allowing water ingress to start corroding the steel work. These micro cracks will then increase in size due to the freeze/ thaw process.

The beam above Pier 51,see photo below, is an example of how quickly the size of these cracks can become a major problem, increasing from a few centimetres in 2016 to half its length in July 2017.

View of side face of Beam 51/R

Photo and text below courtesy of the ADAC Structures report July 2017.

“5 Conclusions:

5.1 It was concluded that the observed crack were a developing situation, due to the fact that it was only first noticed in 2016 and that the calcite bleed is more developed at one end.

5.2 It is thought that the problem is a latent defect within the original fabrication of the beams, most likely due to a cold joint within the concrete pour.

5.3 It was concluded that there is no imminent danger of the beams collapsing.

5.4 If left the beams will continue to deteriorate and stability issues would arise."

6 Recommendations:

6.1 Having halted train operations whilst this situation was assessed it was recommended that the train could resume operating, but under a reduced scope– until remedial action is taken:

- The maximum number of passengers and luggage allowed in the operating and maintenance manual is 10050kg, or 120 people. This should be reduced to 5000kg or 60 people, evenly distributed through the compartments.
- It is understood that the train operates at 4m/s during the summer months. This should not be exceeded.

6.2 In the short term temporary supports should be installed under the pair of beams above pier 51. These should be braced in both directions. A suitable scaffolding or temporary works contractor should be appointed to carry this out under the guidance of your Engineer. This support will be required both to enable resumption of normal operations and for the period of time when the permanent solution is implemented. This arrangement should be suitable for being left in place through the winter and until next summer when the permanent solution should be implemented.

6.3 During the 2018 summer shut down beam 51/R should be repaired by removing the entire top flange, which will necessitate the removal of all the rail supports, and re-cast using a suitable product. These works should be planned ahead and suitable contractors appointed ahead of time to enable them to guarantee their availability come the time.

6.4 The beam should be inspected on a regular basis, including particular daily observations, for any deterioration in its condition or negative impacts on the plinths.

Signed.... [redacted]

Dated.....15th July 2017.....

While cracks can also occur in a steel structure they are usually discovered before they become an issue and can be quickly repaired by welding.

A crack in the vertical plane of one of the concrete “I” beams is unlikely to be noticed and could cause an instant and catastrophic failure of the beam as a carriage crosses it, the result of which you can imagine! Is this next picture of a beam about to collapse? Unless it is an optical illusion that beam has dropped as the train went onto it.

I have been informed by some experts that no construction company would contemplate using concrete in such a hostile environment and yet it was recorded in the Public Audit Report into the funicular in 2010 that Morrison Construction suggested the change from steel to concrete for the “I” beams! If Morrisons didn’t suggest the change in specifications then who did??

Earlier this week it was reported that the funicular will remain out of service for the whole of December and there is no definitive date for re-opening (see here). As all the “snagging and inspection” works have become more and more extended, it increasingly appears the defects in the structure, which have now become a “public safety issue”, are unrepairable. Has someone told HIE that the funicular could cause loss of life if operations are allowed to resume?

If that is the case, HIE is left with three options.

Option 1. Do nothing.

HIE could just leave the funicular as it stands, a white elephant which has so far cost the public purse in excess of £50m. But legally they can’t do that. Part of the conditions for the build was that if the funicular ceases permanent operation then demolition (Option 3) is necessary.

Option 2. Replace the concrete “I” beams with steel.

"Alternatives to strengthening exist. Options include operating under reduced loading after partial strengthening, load testing to reduce the extent of strengthening, and whole or partial replacement of the viaduct."

(Extract from the COWI report June 2019).

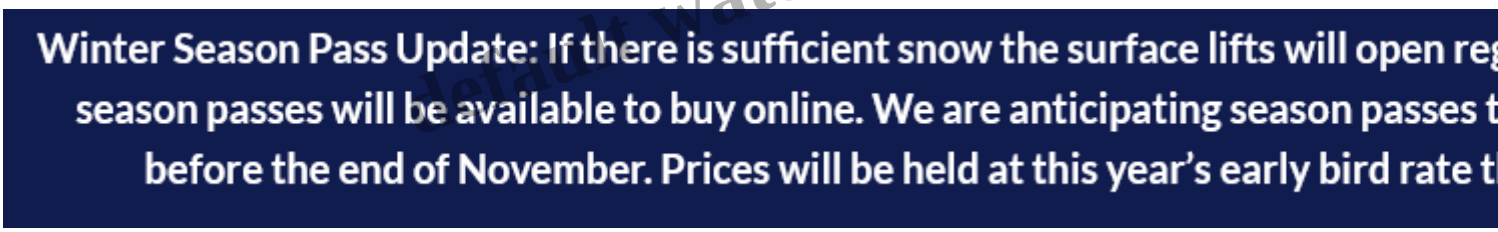
To proceed with this option HIE would again have to go cap in hand to the Scottish Government for yet another multi million pound taxpayer hand out and a further loss of income to the business, Cairngorm Mountain Scotland Ltd while that work is carried out. Three months ago (see here), I costed the steel "I" beams at £7990 per pair. There are 93 bays so a total cost to replace the concrete "I" beams would be approx. £750K. Not much you may think, BUT, that cost will rapidly escalate with the additional cost of new rails, demolition and removal of the concrete "I" beams, labour, transport costs etc.

Option3. Demolish the funicular.

In their heavily redacted business case for the funicular being repaired, the cost of demolition was estimated between £8 – £13m.

The question then arises where would that leave the rest of the business and its employees?

The CM(S)L website recently had this announcement.



Notice there is no mention of using the 13 snow cannon despite them being provided at even more expense to the taxpayer!! Despite the collapse of uplift infrastructure at Cairn Gorm CM(S)L have had ample opportunity to "snow proof" what is left:

(1) the lower slopes by positioning snow cannons in the most useful positions, and,

(2) the Car Park and Fiacaill ridge towpaths using the same matting as plastic slopes.

What does this say about the commitment of the management to the public?

Conclusion.

The implication of the ongoing and unending "snagging" work is that the funicular is beyond repair! HIE are now between a rock and a hard place. A situation of their own making. The taxpayer will have to bail them out whichever option they decide to go for. If thus doesn't convince the Scottish Government of the need to remove HIE from the mountain and for a judicial enquiry into the funicular farce what will?

Category

1. Cairngorms

Tags

1. Cairn Gorm
2. funicular
3. Governance
4. planning
5. Scottish Government

Date Created
November 16, 2023
Author
graham-garfoot