Will the repairs to the Cairn Gorm funicular railway work (8)?

Description

Introduction to the current problems

Prior to the funicular returning to service on 27th February (see here) Highland and Islands Enterprise (HIE) made this announcement on 5th February (see here):-

â??Staff at Cairngorm Mountain have today (Wednesday 5 February) begun a series of maintenance activities on the electrical, mechanical and hydraulic systems that govern the movement of the two funicular carriages up and down the 1.8km viaduct.

Later this week, an engineer from Swiss funicular specialist Garaventa, who supplied and maintain the carriages and control system, will join the local team to carry out scheduled annual inspections of the mechanical systemsâ?¦â?¦â?¦â?¦â?¦â?¦

Meanwhile, remediation works are continuing on the viaduct structure, led by Balfour Beatty on behalf of mountain estate owner Highlands and Islands Enterprise (HIE).

Although the remediation programme was substantially completed before Christmas, inspections identified a range of items requiring further work and teams from Balfour Beatty returned to the site early in January.â?•

This was followed by a further announcement on 2nd May (see here):-

â??The funicular is due to be out of service from Monday 12 May until Monday 2 June 2025 while the companyâ??s in-house engineering team carries out works including rail grinding, gearbox repairs, undercarriage lubrication, and testing and inspection of the rail welds.

At the same time, Balfour Beatty, working on behalf of estate owner Highlands and Islands Enterprise (HIE), will return to complete their programme of remediation works on the railway viaduct.

CMSL usually carries out annual maintenance on the funicular in November, but has brought the timescale forward this year to run in parallel with the remediation programme and minimise inconvenience to visitors.â?•

Note how HIE aimed to *â??minimise inconvenience to visitorsâ?•* by closing for a period which included a holiday week!

Then, more recently, this announcement on the Cairngorm Mountain (Scotland) Ltd website of 10/09/2025:-

Funicular Railway Gearing Up For Snowsp

September 10th, 2025.

Funicular Closed To Public For Two Brief Periods This Autumn

The Cairngorm Mountain Funicular is set to be closed to the public for two brief periods in September and
ready for the coming snowsports season.

- **21st – 23rd September**

This three-day closure is to enable Balfour Beatty to carry out a short period of work on behalf of Highland
that will enhance the long-term durability of the viaduct.

- **3rd – 9th November**

During the first week in November, we will undertake essential routine maintenance to ensure the highest
standards. Specialist engineers from Garaventa, Frey, Bosch Rexroth, alongside our own team, will carry ou
and testing of the mechanical, hydraulic, and electrical systems in preparation to winter arriving.

It would appear that the once a year maintenance has now become twice a year or possibly even three times a year maintenance! Maintenance costs doubling or even trebling?

If *â??inspections identified a range of items requiring further workâ?•* why were these not completed in the May shutdown, or is it that more *â??itemsâ?•* have been *â??identifiedâ?•* since May?

The design of the repairs

The initial proposals from COWI, who designed the repairs, was that the concrete beams supporting the funicular should be replaced by steel, which is how the funicular was designed in the first place (see here). But HIE dismissed this and asked them to come up with another option, hence the multiple metal brackets designed to hold the concrete beams and is situ joints.

In several conversations I have had with John Carson and other civil engineers the general consensus of opinion is that the strengthening brackets were appropriately designed by COWI to hold the

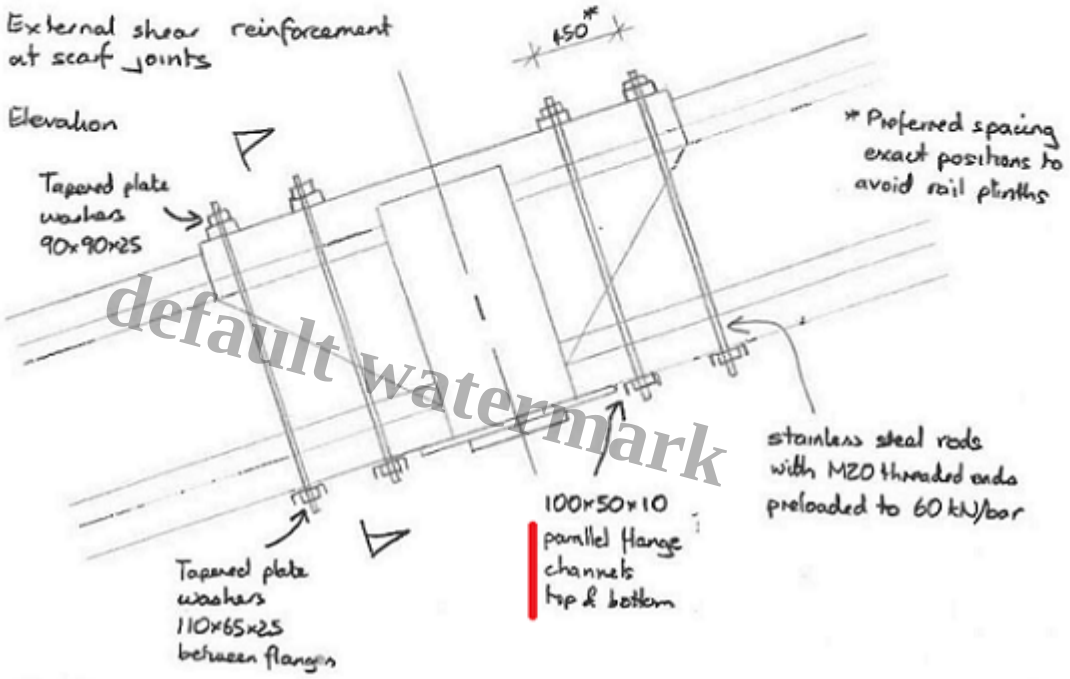
crumbling concrete together. It appears, however, that they are not doing what they were designed to do, so what is going wrong? I believe there are several issues which I will explain in two posts picking up on my series on â??Will the repairs to the Cairngorm funicular work?â?• from four years ago (see here).

On 03/09/2020 I sent a Freedom of Information request to HIE for the COWI report and finally received a response on 11/12/2020 after appealing against an earlier refusal. The report I received showed the repair design as follows:

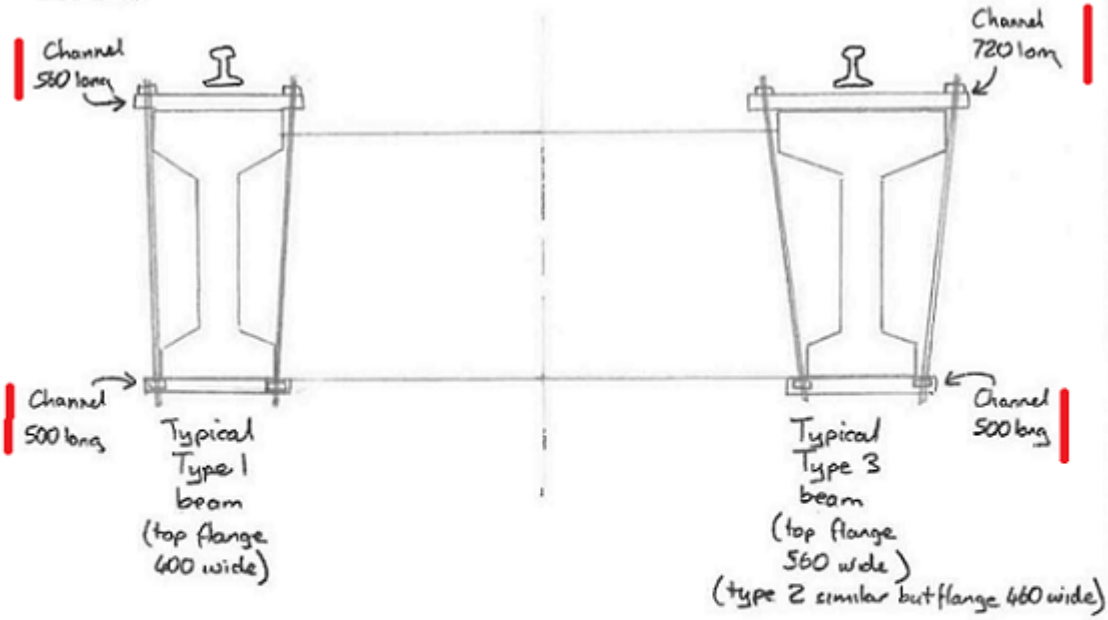
COWI	Project: CAIRNGORM RAILWAY	Doc Nos: SK14	Rev:
			Page:
	Subject: STRENGTHENING	Prepared: [redacted]	Date: 12/3/19
Office/Discipline: BRISTOL / BRIDGE		Checked:	Date:
	ATR/Job: A116993	Approved:	Date:

External shear reinforcement at scarf joints

Elevation



Section



Stainless steel rods grade A4-70
Steel channels and washers grade S355J2 galvanised

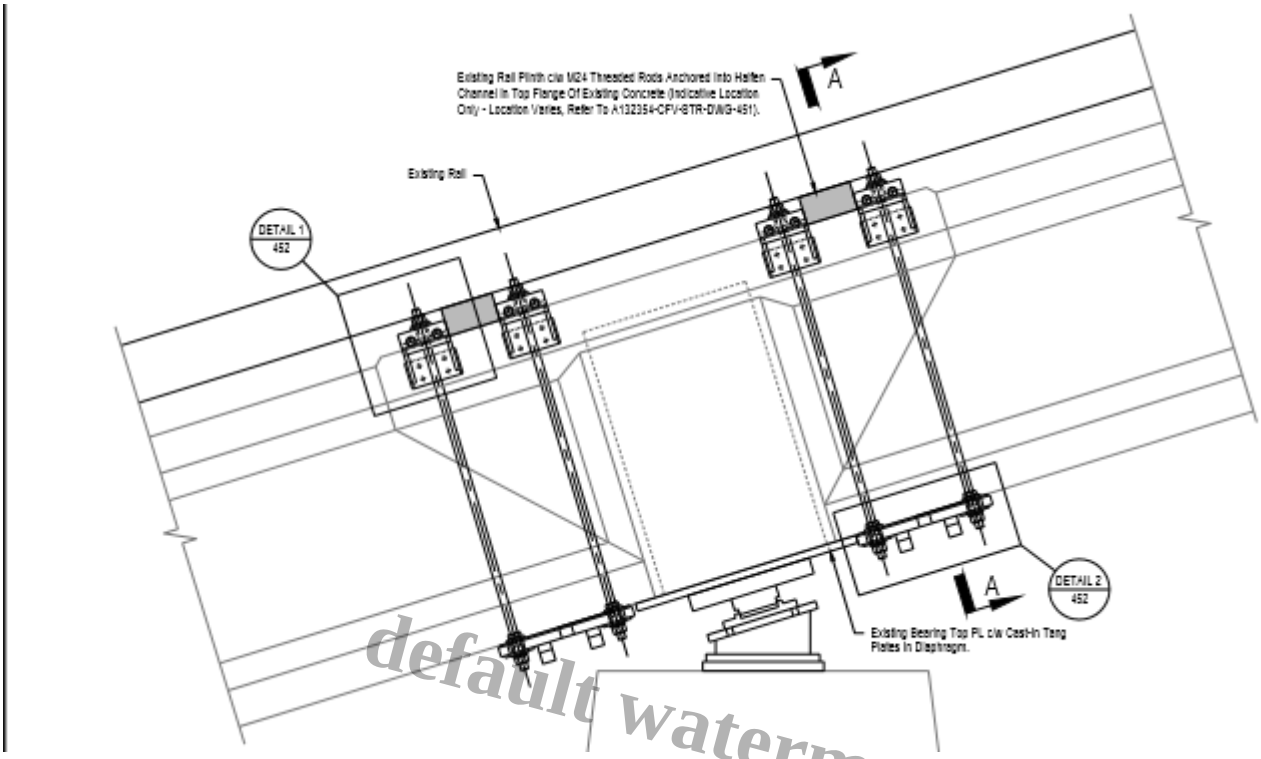
The COWI design on 18/03/ 2019 with top diagram showing â??100x50x10 flange channels top & bottomâ?• and lower diagram showing different length channels for Type 1 and Type 3 beams

Note the use of channel.

The picture is of 100mm x 50mm steel channel, one component of the brackets COWI originally designed for the repairs. Each end of the channel would be drilled to accept the studding with one length on top of the insitu joints/ beams and the other underneath. The widest part of the channel, 100mm, to sit against the concrete to spread the load as the studding is tensioned.

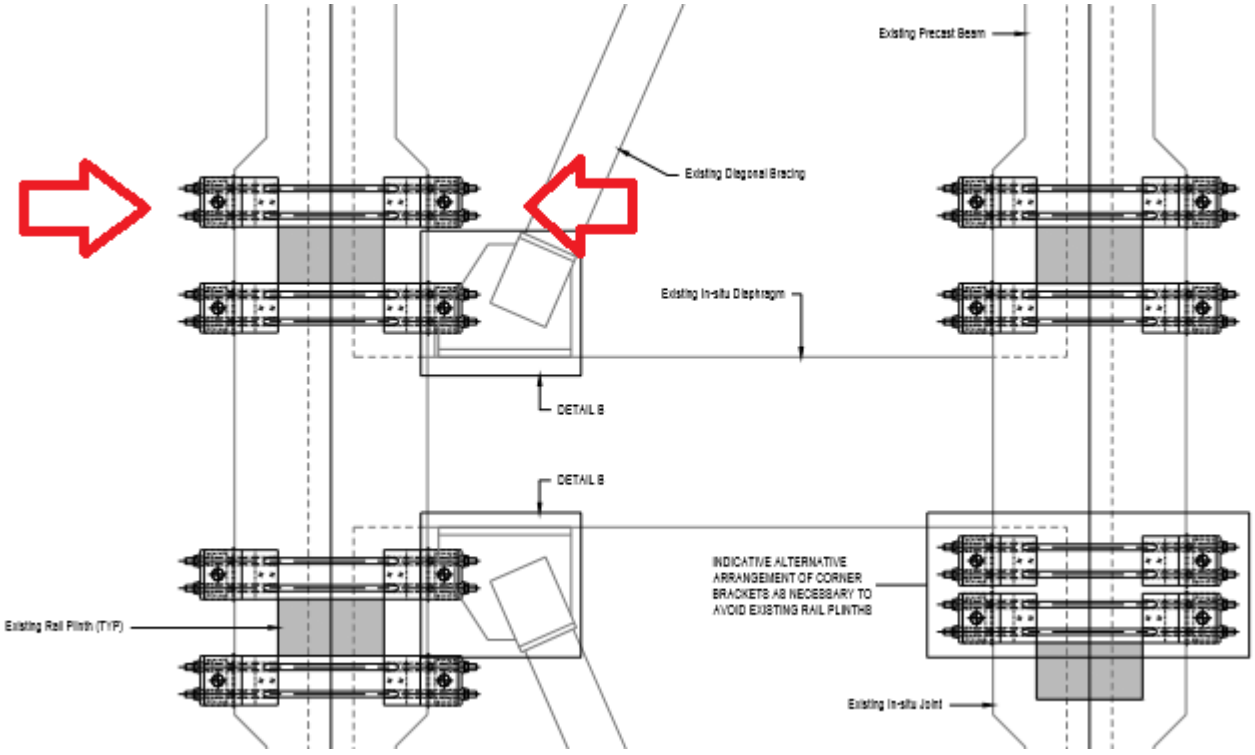
However, after visiting the funicular this year the actual repairs appeared significantly different to this design so 08/05/2025 I made another FOI request to query the design of the repairs and what had been actually done. HIE initially denied any changes had taken place, but, on 09/06/2025 I appealed their decision and on 09/07/2025 HIE finally released the drawings. These showed the brackets and studding which are fitted to the insitu joints plus associated instructions which were included in a report by COWI dated 26/10/2021. I have numbered them (a) to (d):

(a) Side on view



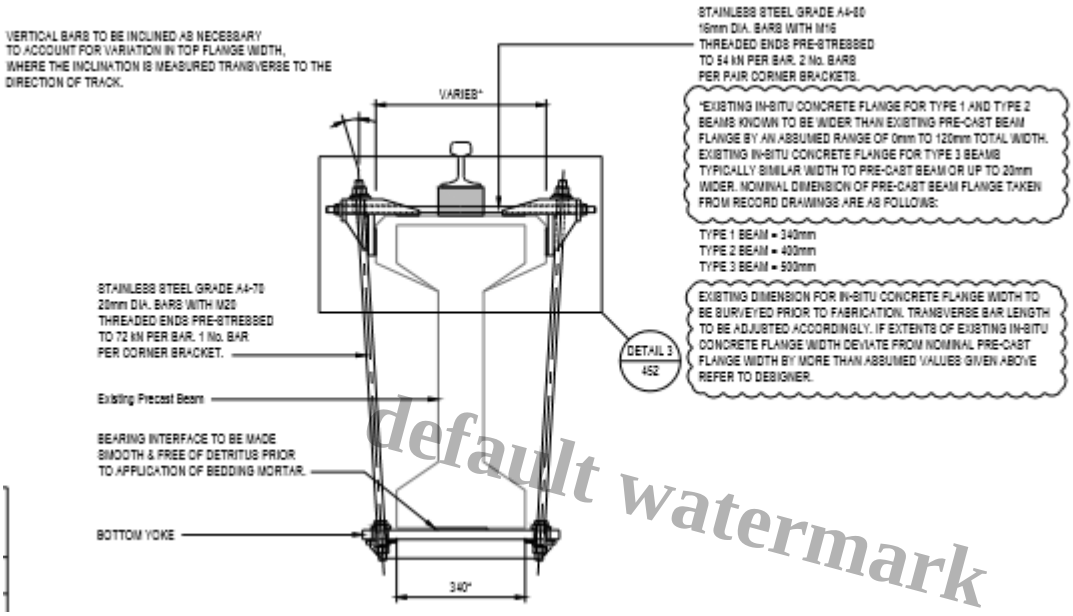
This shows metal plates instead of channel at the bottom of the in-situ joints and brackets at the top which are joined together across the beam by two further pieces of metal studding

(b) Birds eye view down onto top of insitu joint

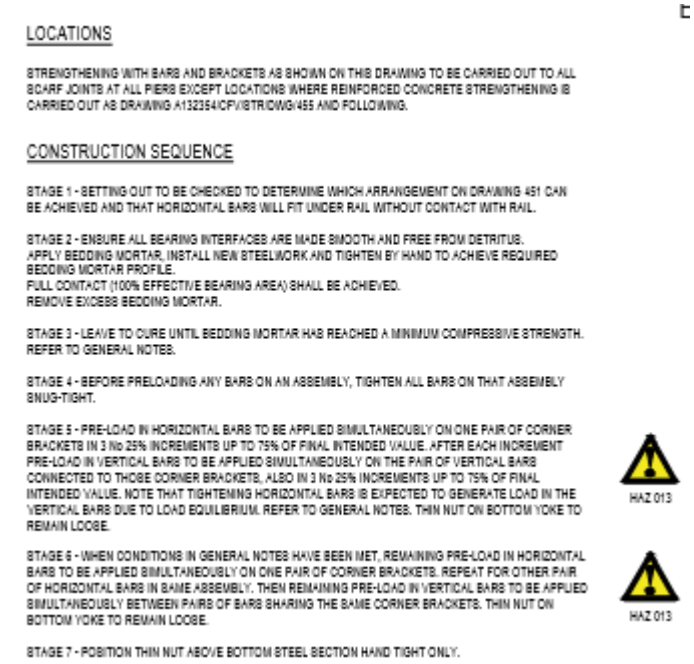


This clearly shows how the brackets at the top of the joint were to be connected by two lenghts of studding

(c) Section view



(d) Construction sequence



LOCATIONS

STRENGTHENING WITH BARS AND BRACKETS AS SHOWN ON THIS DRAWING TO BE CARRIED OUT TO ALL SCARF JOINTS AT ALL PIERS EXCEPT LOCATIONS WHERE REINFORCED CONCRETE STRENGTHENING IS CARRIED OUT AS DRAWING A132354/CFV/STR/DWG/455 AND FOLLOWING.

CONSTRUCTION SEQUENCE

STAGE 1 - SETTING OUT TO BE CHECKED TO DETERMINE WHICH ARRANGEMENT ON DRAWING 451 CAN BE ACHIEVED AND THAT HORIZONTAL BARS WILL FIT UNDER RAIL WITHOUT CONTACT WITH RAIL.

STAGE 2 - ENSURE ALL BEARING INTERFACES ARE MADE SMOOTH AND FREE FROM DETRITUS. APPLY BEDDING MORTAR, INSTALL NEW STEELWORK AND TIGHTEN BY HAND TO ACHIEVE REQUIRED BEDDING MORTAR PROFILE. FULL CONTACT (100% EFFECTIVE BEARING AREA) SHALL BE ACHIEVED. REMOVE EXCESS BEDDING MORTAR.

STAGE 3 - LEAVE TO CURE UNTIL BEDDING MORTAR HAS REACHED A MINIMUM COMPRESSIVE STRENGTH. REFER TO GENERAL NOTES.

STAGE 4 - BEFORE PRELOADING ANY BARS ON AN ASSEMBLY, TIGHTEN ALL BARS ON THAT ASSEMBLY SNUG-TIGHT.

STAGE 5 - PRE-LOAD IN HORIZONTAL BARS TO BE APPLIED SIMULTANEOUSLY ON ONE PAIR OF CORNER BRACKETS IN 3 No 25% INCREMENTS UP TO 75% OF FINAL INTENDED VALUE. AFTER EACH INCREMENT PRE-LOAD IN VERTICAL BARS TO BE APPLIED SIMULTANEOUSLY ON THE PAIR OF VERTICAL BARS CONNECTED TO THOSE CORNER BRACKETS, ALSO IN 3 No 25% INCREMENTS UP TO 75% OF FINAL INTENDED VALUE. NOTE THAT TIGHTENING HORIZONTAL BARS IS EXPECTED TO GENERATE LOAD IN THE VERTICAL BARS DUE TO LOAD EQUILIBRIUM. REFER TO GENERAL NOTES. THIN NUT ON BOTTOM YOKE TO REMAIN LOOSE.

HAZ 013

STAGE 6 - WHEN CONDITIONS IN GENERAL NOTES HAVE BEEN MET, REMAINING PRE-LOAD IN HORIZONTAL BARS TO BE APPLIED SIMULTANEOUSLY ON ONE PAIR OF CORNER BRACKETS. REPEAT FOR OTHER PAIR OF HORIZONTAL BARS IN SAME ASSEMBLY. THEN REMAINING PRE-LOAD IN VERTICAL BARS TO BE APPLIED SIMULTANEOUSLY BETWEEN PAIRS OF BARS SHARING THE SAME CORNER BRACKETS. THIN NUT ON BOTTOM YOKE TO REMAIN LOOSE.

HAZ 013

STAGE 7 - POSITION THIN NUT ABOVE BOTTOM STEEL SECTION HAND TIGHT ONLY.

There were seven stages to the construction sequence making the repairs far more complicated

The design around the insitu joints was probably changed from channel to brackets as there was not enough clearance under the rails for the depth of the channel which was 50mm.

Photo showing the low clearance under the rails at the top of the insitu joints and how the brackets and steel plates all had to be joined together by metal studding.

In order to work the studding needs to be tensioned correctly, too much and the concrete breaks as here, too little and the brackets donâ??t do the job they are supposed to do.

The changes and issues are further illustrated by the following photos taken on Wednesday 24/09/2025 by Dr Gordon Bulloch and respected civil engineer John Carson.

The four brackets (upper arrow shows two on the right of insitu joint with the rear part hidden on the inside of the track) and the bottom plates (lower arrow points to the one on the right) (Photo 1/228)

The brackets and studding which replaced the channel makes assembly and tensioning more complicated. There are **eight** lengths of studding around this insitu joint instead of **four** and each has to be properly tensioned in increments and in a specific order. This increases both repair and maintenance costs.

The design also requires a greater degree of understanding of how to fit the brackets. The change from channel to the bottom plate (lower arrow) results in studding sloping in more than one plane. This increases the risk of the strengthening brackets around the insitu joint coming loose. Moving the right-hand bottom plate to the right would have removed the sloping angle! In contrast the fitting of the uphill bracket (with the signage) is more likely to work because both the top and bottom brackets butt up against other fittings.

The COWI report of June 2019 included a works schedule proposed by bam Infrastructure advisory:-

- ***Squad Type 2:***

o Bearing replacement

o Scarf joint mechanical strengthening

o Cross beam mechanical strengthening

o 7 No. squads required

Seven. squads all working at once! What could possibly go wrong for quality control? There is however an even more significant quality control issue which I will come back to in post 9 in this series.

(Photo 2/232)

The red arrow indicates a calcite bleed and a crack in the â??Iâ?• beam! That is likely to require more beam strengthening by further brackets in due course. Again, the L/H bracket on the insitu joint shows a lack of understanding of the repair design. To stabilise the brackets the left-hand studding (blue arrow) should have been through the middle hole of the three in the base plate. (Moving the top bracket to the left would put too much stress on the end of the insitu joint).

Although the studding does not appear perpendicular, this is probably due to camera distortion. Note there is at least one crack in the upper concrete flange (blue arrow).(Photo 3/449).

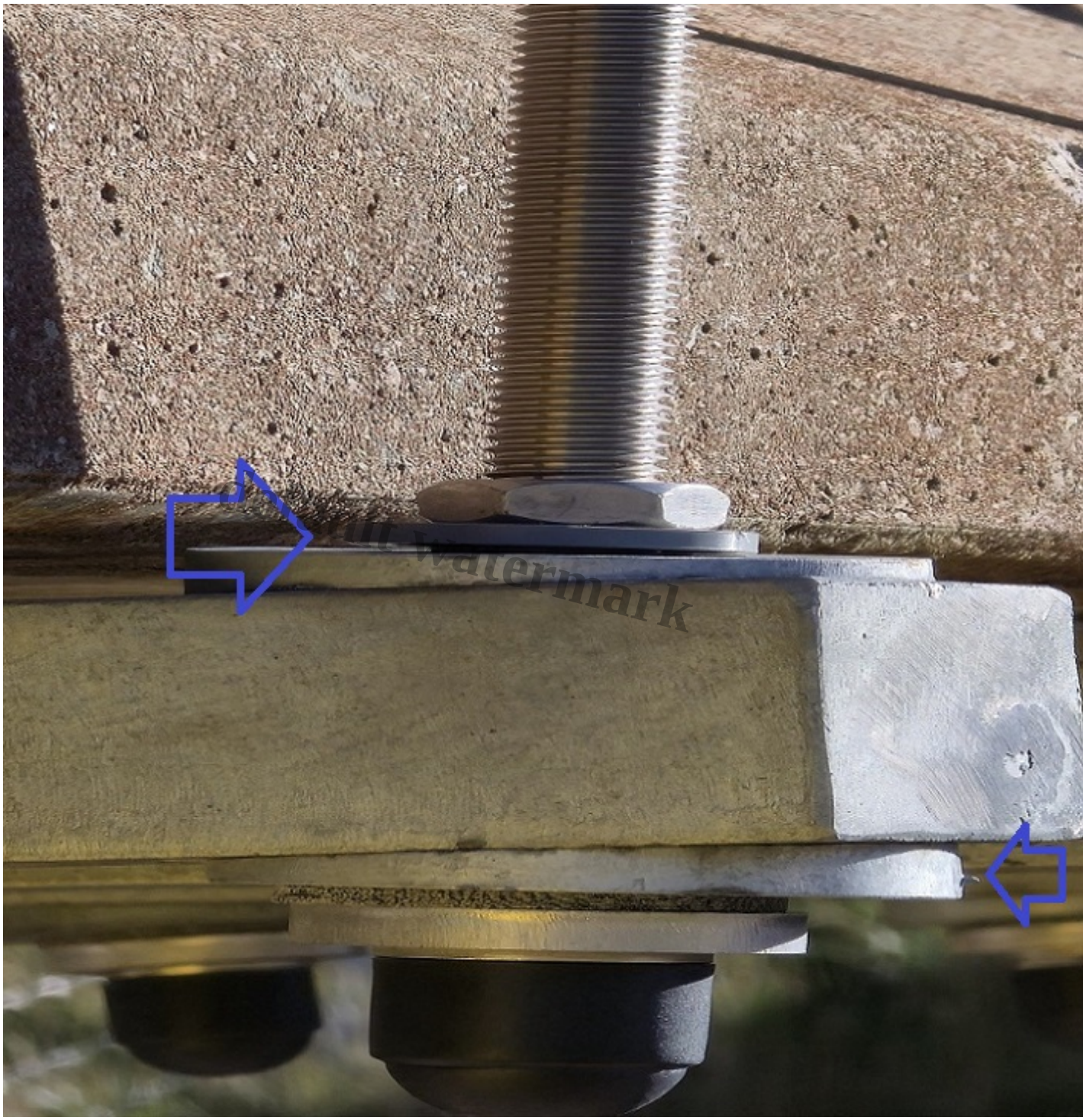
This photo shows how the brackets around the I-beams are designed differently and use metal bars at top and bottom instead of brackets and plates. The top flanges of all type 2 & 3 â??Iâ?• beams are wider than the bottom ones. This means the metal studding slopes inwards from top to bottom and tapered washers (green arrows) have to be fitted under the nuts to compensate for the angle.

This again takes a degree of understanding from those fitting the brackets about how washers work. The tapered washer on the top bracket should have the thick edge facing in so it faces in the exact OPPOSITE direction to the one BELOW on the bottom bracket where the thick edge should face out (see below).

Yet more complications!

You can also see in the photo below TWO flat stainless washers under one nut when ONE will do the job

Besides too many washers there also appear to be a crack in the top flange, red arrow (Photo 4/706).



Bottom arrow shows tapered washer appears to be facing out, in the right direction (Photo 5/919)

This photo shows how the bottom metal bar, tapered washer, flanged bush and nut with capping should be fitted (bottom arrow). The nut, plastic washer and tapered washer on the top of the metal bar are superfluous only serving to complicate the fitting of the brackets. The plastic washer has probably been damaged by someone trying to tighten the nut with a spanner contrary to the Stage 7 fitting instructionsâ?¦HAND TIGHTâ?¦â?¦â?¦â?¦â?¦..but it was pointless as the nut was superfluous.

Also compare the size of the upper nut with the one in the next picture â?? more evidence that it was superfluous!

The red broken line highlights a crack from the underside of the beam up the bottom flange- although it is hard to see how far it then goes .(Photo 6/126)

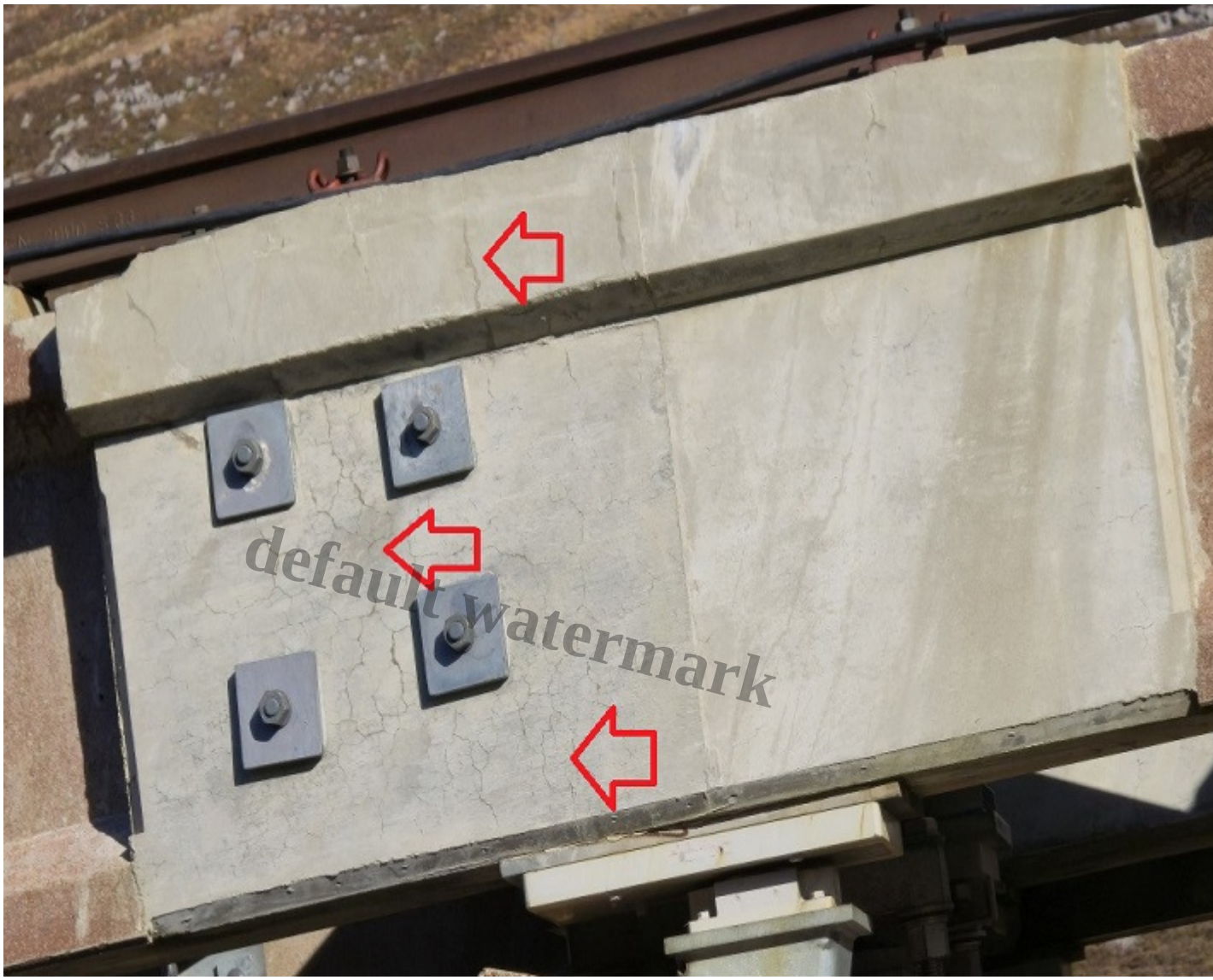
The next photo is of Pier 52 and the beams on either side:

(Photo 7a/923)

The downhill â??Iâ?• beam brackets have ALL been fitted with black plastic caps but the uphill long lengths have no such no protection. We gave another example in August (see hereâ?? third photo)

It is not possible to see from this photo but on the 4th length of studding on the uphill side, a superfluous nut is 100 â?? 150 mm up the studding. Remember the post (see here) showing it was loose nuts which led to the closure of the funicular again in August 2023?

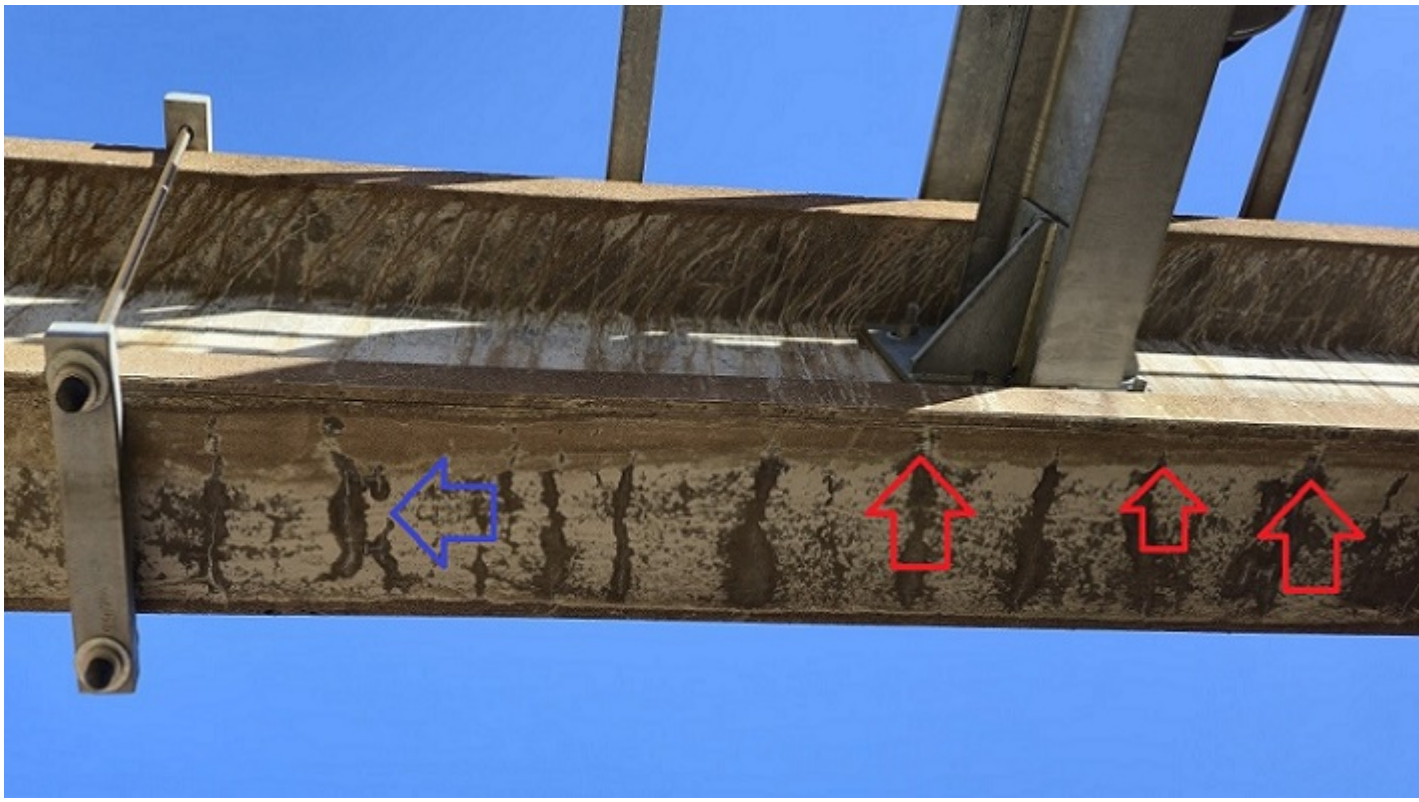
Further cracking in the concrete



This is a picture of Pier 52 (Photo 7b/929).

Note all the spider cracks on the left side of the new concrete.

Left arrow shows exposed metal rebar, right a crack (Photo 8a/404)



(Photo 8b/444)

The dark patches on the underside of this beam show either cracks or in places where the rebar (metal inside the concrete) strengthening is exposed. Several of the cracks, including the three arrowed in red,

are travelling up the flange edge with the left one appearing to continue into the web of the beam. Rather than repair should this beam have been replaced?

Post 9 in this series will give a possible explanation as to why the strengthening works have gone wrong.

Category

1. Cairngorms

Tags

1. funicular
2. Governance
3. HIE

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