Cairngorm funicular railway:Supplementary written submission from Gordon Bulloch, 8 January 2026

In response to your questions on the paper concerning the tilting of the funicular support pillars, please note:

1. I am the author of the paper (Gordon Bulloch). I have studied geography and geomorphology at Glasgow University. In a previous employment some of my staff were environmental geologists carrying out ground investigations and geotechnical investigations.
2. The 4 illustrations are not technical drawings, but my illustrations of the effect that soil creep has on the funicular support structure.
3. The description of what soil creep is and its effects is based on an article in the Institute for Environmental Research and Education (IERE) (https://iere.org/what-is-a-soil-creep/).

I hope this background information is of assistance.

Kind regards

Gordon Bulloch

Note: supplementing the evidence submitted by Graham Garfoot and Graham Nugent

Cairngorm Funicular – the problem of tilting of the support pillars (pillar rotation)

One of the significant problems with the structural failure of the funicular which resulted in its closure in 2018 was the tilting of most of the concrete support pillars – referred to as pillar rotation. The issues around this structural failure (in particular the causes) have not been well publicised. This paper aims to demonstrate that the remediation work on the pillars has only had at best limited success and has not solved the problem. Consequently, there are likely to be significant further costs to prevent further tilting of the concrete support pillars. This significant cost risk needs to be understood by the Committee.

Steel struts installed on the uphill side to limit pillar rotation

The problem and the chosen solution are depicted and described in the diagrams Fig 1 to 4. The cause of the pillar rotation is soil creep - a well-known and understood geomorphological phenomenon.

So, what is soil creep?
Soil creep is the slow, gradual, and almost imperceptible downslope movement of soil (including the glacial till found in Coire Cas) and other unconsolidated materials under the influence of gravity.

Characteristics of Soil Creep:
Slow Movement: Soil creep occurs at a very slow rate, often measured in mm to cm per year. This makes it difficult to observe in the short term, but its long-term effects can be significant. Unlike sudden events like landslides, soil creep is a continuous process that subtly reshapes landscapes over extended periods.

Causes of Soil Creep
1. Gravity: The primary driving force behind soil creep is gravity, which exerts a constant downslope pull on soil particles.
2. Water Content: Water acts as a lubricant, reducing friction between soil particles and allowing them to move more easily. Freeze-thaw cycles can exacerbate this effect, causing soil particles to shift incrementally.
3. Temperature Fluctuations: Changes in temperature can cause soil particles to expand and contract, contributing to their gradual movement downslope.
4. Biological Activity: Activities from burrowing animals and root growth can disrupt soil structure, making it more susceptible to creep.

Effects of Soil Creep
Landscape Changes: Over time, soil creep can lead to noticeable changes in the landscape, such as curved tree trunks, tilted fences, and terracettes (small step-like features on slopes).

Infrastructure Damage: The slow movement of soil can compromise the stability of buildings, roads, and other structures, leading to costly repairs and potential structural failure.

Conclusion
Please note that installation of the steel struts has not corrected the pillars tilting from the vertical. The repair work of installation of the steel struts will not stop further pillar rotation, only slow it down. Consequently, pillar rotation will continue to be a cost issue limiting the life of the funicular by stressing the scarf joints above the pillars which connect the concrete beams supporting the funicular track.

Funicular pillar structural support issue

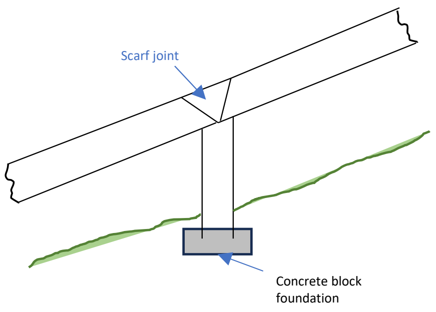


Fig 1: Original (as built)

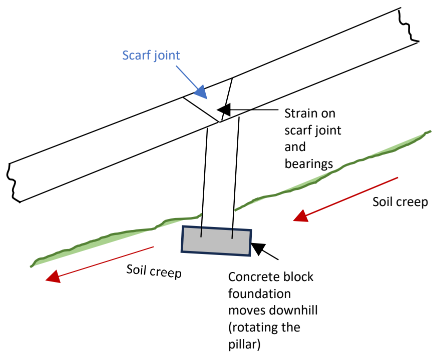


Fig 2: Pillar rotation – part of reason for closure in 2018

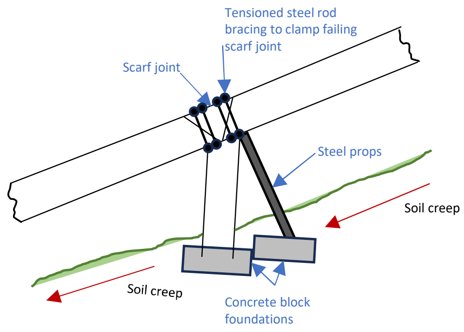
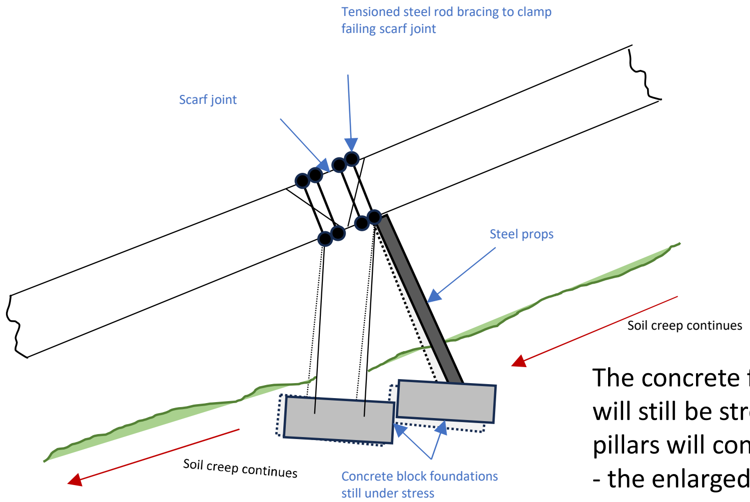


Fig 3: Repair solution designed to prevent further pillar rotation

Note:

1. All except up to about 6 of the 92 funicular structural pillars have foundations which float within the glacial till. If the pillars had been founded on bedrock, then pillar rotation would not have occurred.
2. The glacial till found in Coire Cas is granular and porous, resulting in considerable groundwater flow which exacerbates soil creep.
3. There is a known problem that much of the bedrock is broken and crumbling due to weathering, including effects of water erosion over the millennia. Consequently, fixing to sound bedrock would have been very difficult and expensive.
4. From the evidence available, it seems that geotechnical investigations undertaken to technically support the funicular design were inadequate. COWI did undertake some minimal geotechnical investigations prior to the major repairs which commenced in 2020.

Fig 4: Continuing issues after repairs to limit further pillar rotation



The concrete foundations of the pillar and steel props will still be stressed by soil creep, and is likely that the pillars will continue to rotate although:

- the enlarged concrete foundation will offer more resistance and slow the process down
- the steel prop will reduce, but not eliminate the downward moment (perpendicular to the beams carrying the funicular track) caused by pillar rotation.

Continued stressing from soil creep will continue to increase stress on the scarf joint and the tensioned steel bracing.