Water cascading over the wall by the west tower of Derwent Dam

Geology

When Howden and Ladybower Dam walls were being constructed, the geology of the area was soon discovered not to be favourable to massive, water-holding structures due to the presence of Yoredale rocks which are a combination of broken shale and sandstone. The problem in the Upper Derwent Valley (UDV) is that the surrounding hillsides press down on and squeeze the bottom of the valley. This causes the rocks to fracture and extensively crumple upwards as inverted Vs known as wrinkles which are neither watertight nor stable. Furthermore, the underlying shale beds suffer from

considerable reversible compression depending on their water content. The walls of Howden and Derwent Dams resemble icebergs; only a small proportion of the total structure is visible above ground. Concrete-filled 30m trenches were necessary to provide a "curtain" to hold back water passing through the shale. In addition, it was realised that water could escape around the sides of the dam walls. The problem with by-pass at Howden almost led to the abandonment of the construction of Derwent Dam. At Howden, "wing trenches" of concrete some 914m long follow the sides of the reservoir. At Derwent, "wing walls" continue the dam up to 244m straight into the hillside. No impervious bedrock was ever found at Derwent Dam to tie in the wing walls so they were filled with concrete in the hope of the hillside being watertight. This did not prove to be the case and gauges immediately downstream of Derwent Dam indicated that water was escaping around and/or under the wing walls

Earlier attempt

Previously, there was an attempt to raise Howden Dam wall. The technique was to employ pretensioned hawsers anchored to the bedrock from the 2 towers. For a 20m rise in wall height, this method would rely upon the hawser’s tensile strength and the condition of the original wall. In addition and most importantly, the fixings because an extra 13 million tonnes of water would be acting against the new wall some 60-80m above them. Work was commenced but it was soon realised that there were problems both with poor concrete adhesion to the now weathered stone and instability problems which could result in movement of the dam wall. Issues were also recognised with the area's shale-rich geology. Work was abandoned and the only visible evidence of this attempt now is a concrete slab in the west tower.

Wall instability

Howden and Derwent Dam walls are enormously heavy structures and it was never intended that they should be subjected to further strain by raising them. In the early part of the twentieth century, winters were more severe but work was not stopped. There are areas in both dam walls where the mortar did not set but froze and crumbled so water does

escape through them as is visible by the stains on the gritstone. The weight of the walls combined with cracks which both follow the mortar and also go through the facing stones have created instability. Inevitably, raising a dam’s height will increase the weight of water pressing down upon the weaknesses. Settlement is also evident. Although not visible to the naked eye, the walls actually flex, bulging downstream in winter and upstream in summer. Derwent Dam wall flexes at the centre of the weir. Since 1988, both dam walls have been monitored to anticipate potential failure. Visitors will have noticed the brown concrete posts where equipment is sited to take measurements.

To date, Severn Trent Water (STW) have not announced whether they are proposing to raise the dams in concrete or earth. In addition to obliterating the iconic walls, placing extra strain on them is fraught with danger. The area contains many landslips due to shale deposits which continue from the valley under the Snake Pass where they cause the road to subside frequently (as in 2022) and as at Mam Tor, known as the "Shivering Mountain" due to it's instability.

Raising the dam walls might well employ revisiting the failed system of hawsers tried previously. Currently, Howden Reservoir holds 9000 million litres of water weighing 9 million tonnes. Derwent Reservoir holds 9500 million litres weighing 9.5 million tonnes and Ladybower 28,600 million litres of water weighing 28.6 million tonnes. At the moment, the above ground wall of Howden Dam is above the top water level of Derwent Reservoir. If Derwent Dam were to be raised, Howden's wall would be under water and subject to wave action from the reservoirs on both sides possibly leading to further destabilisation. If new dam walls were constructed in front of the existing ones, the latter would be submerged and in part if not wholly demolished so as not to impede water flow to the new structures. New higher dam walls on what is already known to be both unstable geology and imperfect old dam walls could be fraught with risk.

New structures

Howden Dam wall is 36m high, Derwent 35m and Ladybower 43m. If concrete, over 1 million tons of material would be required to raise both Derwent and Howden walls. Concrete would probably be delivered dry and mixed on site using

powder tankers for cement and HGVs for sand and ballast. Raising Derwent and Howden dam walls by 20m would each require thousands of the very largest powder tanker loads and tens of thousands of HGV 25 tonne loads which would travel across the Peak District and through Bamford or from the direction of Sheffield (not the Snake Pass due to the 7.5 ton weight limit). To date, STW say that they have made no attempt to source suitable facing stone. If Derwent Dam wall was raised by 30m as was investigated previously, then only the very tops of Howden's current towers would be visible across the water.

It is not impossible that a new 60m high, 250m deep and 400m long wall made of earth, clay and concrete could be constructed in front of Derwent Dam. The huge structure would require a massive amount of earth and this would apparently be obtained from "borrow pits". These are in effect simply enormous holes which ideally are situated as close as possible to where the material is required. When investigated previously, a figure of 3 million cubic metres of material was quoted and would be delivered by 25 tonne HGVs.