**CORK FILLED DAM JOINT**

The large 6 unit powerplant had been in operation for over 40 years, and was now being rehabilitated with new controls and at the same time the units were being re-aligned. The powerhouse was built on the toe of a 50m. high concrete dam, and over the years, the powerhouse had tilted slightly downstream, with horizontal movement at the generator floor being recorded at about 15-20mm. downstream of the turbine at turbine guide bearing level.

George had been asked by the owner to determine the cause of the movement, and whether the movement was likely to continue. On arrival at the plant, John, the operating engineer had given George a quick tour of the plant, where the only visible effect of the movement were 45 degree cracks in all generator plinths at the top of the concrete archways which were located on the centerline of the units. The cracks were inclined upstream, indicative of translational horizontal movement. George was then shown into the conference room, where all the powerplant drawings had been assembled, along with the records of movement. He spent the next couple of hours going over the data, and then for over an hour thoroughly inspecting the plant, looking for other signs of movement, such as 45 degree cracks and buckled or sheared floor tiles at joints. None could be found, and he returned to John's office for a discussion.

George advised that he was at a loss to explain the movement. The effect of thrust from the dam had been anticipated by the designers, who had included a vertical expansion joint in the concrete near the toe of the dam. The joint was shown on the drawings to be 25mm. wide and filled with cork. The upstream half of the powerhouse rested on the triangular wedge of concrete at the toe of the dam, and the vertical joint was located well upstream of the turbine steel spiral casings. If the expansion joint was functioning as designed, there should be no thrust on the powerhouse. George had tried to find the joint on his inspection, but there were no lower level galleries which traversed the joint, and at generator floor level, where the joint should be exposed, the floor had been tiled, and none of the tiles showed any cracking.

From George's review of the drawings, it was evident that the powerhouse had been conservatively designed, and that there was ample concrete and reinforcing to contain the hydraulic and structural forces. Yet the powerhouse had moved. A review of the movement records indicated that no movement had ocurred over the past 10 years. George asked whether glass slides had been glued over the 45 degree plinth cracks to see if movement was continuing, but was advised that this had been tried, but all slides had broken due to vibration from the operating turbines. George then mentioned that there had to be an explanation for the movement,

and the only one was that it was induced by the dam, and this was only possible if the cork-filled expansion joint had either been omitted or had never been filled with cork. The only way to find out was to inspect the joint.

George and John then walked over to the location of the expasion joint on the generator floor, where a cable trench from each unit was found to traverse the joint. The steel checker plate covers were removed, but the joint could not be seen due to the accumulation of dust. The maintenance crew were asked to clean out the trenches and install some portable lighting. After this work it was possible to inspect the expansion joint, where it was found that it was completely closed, with no evidence of the cork filling. The reason for the movement had been found.

George then advised that with thrust obviously coming from the dam, the movement was due to a combination of concrete creep and elasticity. With no further movement in the past 10 years, the powerplant and dam had now reached a state of equilibrium, hence the units could be re-aligned and no further movement should be expected, which proved to be the case.

**Lesson learned.**

Do not assume that the project has been built as shown on the drawings. Consulting engineers have a protocol to follow for project drawings. These are usually either stamped or issued as "Approved for construction". During construction, small changes are often required and these are supposed to be marked on a copy of the drawing which is then returned to the design office, where the original is revised and re-issued with either a stamp or a note indicating "As built". Often this last drawing issue is omitted to save the expense. None of the above project drawings had a note indicating that they represented the work "as built".