the neat work, and all spaces between the masonry and sheeting carefully rammed with concrete or earth; the remainder of the abutment was built according to plan.

During the excavation of this foundation the pressure on the timbering was enormous. The 12″ x 12″ struts were spaced 6 feet apart longitudinally, and the rings were about the same distance apart vertically; but these were found, in places, to be crushing the timber rings to such an extent as to require many extra ones. There is no doubt but that the building of a spur from the main line at this point, along with the embankment for the main line itself, had put the mountain side out of balance, and the whole mass was pressing on the back of the excavation timbering.

This point is made clear by two facts, which were discovered during the progress of the work: 1st, a bench mark on a very large sound stump 200 feet up the river from the abutment had settled 22-100 foot before being discovered (luckily causing little or no errors); and 2nd, that a deep well about 500 feet down the river from the abutment was 2 or 3 feet out of plumb, although only dug for 2 or 3 years.

The whole country, along the banks of this river and the Monongahela, is in a state of unrest, and needs hardly any provocation to make it move slowly but surely toward the river's edge.

On bringing the embankment forward after the abutment was completed, a slight crack appeared in the flared back wing, but on ceasing to add new material when almost completed, the crack ceased to enlarge, and the abutment is since standing all right. By adding a few cars of coke cinders the load will not be appreciably increased and the embankment completed.

This abutment was thoroughly well built of the very best description of first class masonry facing, with heavy well bonded coursed rubble backing, the average size of stones being about 2½′ x 5′ x 2′.

The work was done under the closest inspection, very few spalls were used, and an abundance of mortar where needed.

By the cross section on Plate X, it will be seen that it was designed for 4-10 height plus front batter, to the ground line, and a pilaster below. On the same plate are cross-sections of a few other abutments built at the same time under supervision of the writer, of good second class masonry throughout (which by B and O specification is almost as good as first class masonry in this region of large sized stones) in which the same rule has been substantially followed.

All of these abutments were subjected to unusually severe conditions; all were loaded with wet, heavy material behind, and had weak supports for their pilasters in front, most of them were partly built in the winter season, and all were loaded soon after completion with a running grade, dump, and entirely untamped. Yet they have stood to their work with slight cracks, which ceased in a few days after the severest strains were over.

Theory has wrestled more or less successfully with the design of earthwork retaining walls, and as it has not positively determined any one of the three conditions necessary to a successful solution of the question, namely, the amount of thrust, its direction, and point of application, it is most interesting to know, not so much, that an abutment has stood the test of time, but that it is, as nearly as possible, the most economical structure for fulfilling a given duty.

Someone has said that: "Those are poorly designed culverts on a "line of railway in which not even an occasional one at widely separated "intervals has failed to carry the rainfall." And in the same way, although not arguing to the point of failure, those are poorly designed abutments that are so needlessly strong as to be far above their requirements at the moment of greatest strain, which moment is when the cement is not fully hardened and the embankment settling rapidly and full of moisture.

Never again will such a structure be called upon for so great a load, as in the first few days or weeks after the embankment has been built.