and slab. The surface of the latter is 5 feet above the crown of road and runs into the grade of the road, therefore, at points 125 feet from the sides of the superstructure. (See Fig. 5.) In general, the retaining wall sections are similar to the abutments, proportionate

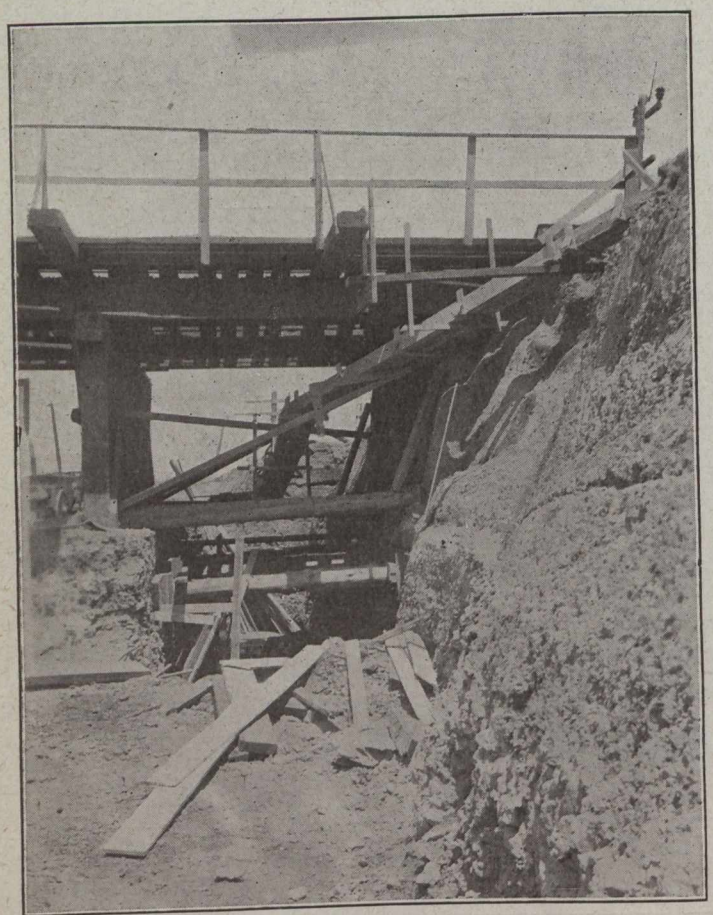

Fig. 3.—Trench for Double-track Section of East Abutment.

allowance being made for absence of superstructure and live loadings. Footings are stepped up at intervals along the grade, and expansion joints provided at 25-foot intervals.

The expansion joint, though very necessary, is often a source of much trouble, particularly through disfigurement by seepage of drainage water. In the spring season, especially, walls are frequently rendered very unsightly by seepage discolorations spreading out from the joints, and this notwithstanding the provision of weeping pipes. To prevent this, each joint was doubly waterproofed, as shown in Fig. 7. The 25-foot sections of wall were poured alternately, strips of felt (similar to that used in waterproofing the bridge floor, see below) being set in as required, and later bent to their final position when the intervening sections were poured. When the whole was set and the forms removed the backs of all walls were painted from top of wall to top of footing with the following mixture: 3 parts of kerosene oil with 4 parts of Portland cement and 16 parts of refined coal tar. Over the back of each expansion joint a strip of felt about 2 feet wide was placed with an additional coat of coal tar pitch on top. When backfilling, a layer of rubble stone about 9 inches thick at top of wall to 18 inches thick at top of footing was placed behind the walls. At the base of this stone a tile drain (6 inches diameter at centre, 4 inches at ends of walls) was laid to carry drainage water to the weeping pipes, of which there is one to every 25-foot section of wall. Although only one winter and spring has passed since the completion of this work, the conditions then were unusually severe, but so far no sign of seepage has shown at any of the joints. Although perhaps seemingly elaborate, the cost of this work was but a small item of the total, the obtaining of watertight joints being justification for the additional work.

By arrangement between the city and the railway it was agreed that the rough excavation for the road cut and retaining walls should be done by the city, who would also undertake the permanent drainage arrangements and the street and sidewalk paving. The railway company was to take care of falsework, complete the foundation excavation, do all other concrete work, and erect and complete the superstructure.

Pile-driving for falsework commenced on May 28th and at once indicated that shale would be met with higher than anticipated, only 12 feet of penetration below base of rail being obtainable. The depth of excavation required from base of rail to foundations was approximately 20 feet, so that unless some other plan were adopted it would be necessary to underpin the pile bents as the excavation proceeded—a tedious and expensive operation considering the security demanded by the heavy railway traffic. Instead of doing this, it was decided to carry on the excavation as far as possible, and then dig out trenches to take lengths of abutments and centre column footing sufficient to accommodate the existing two tracks, and complete the

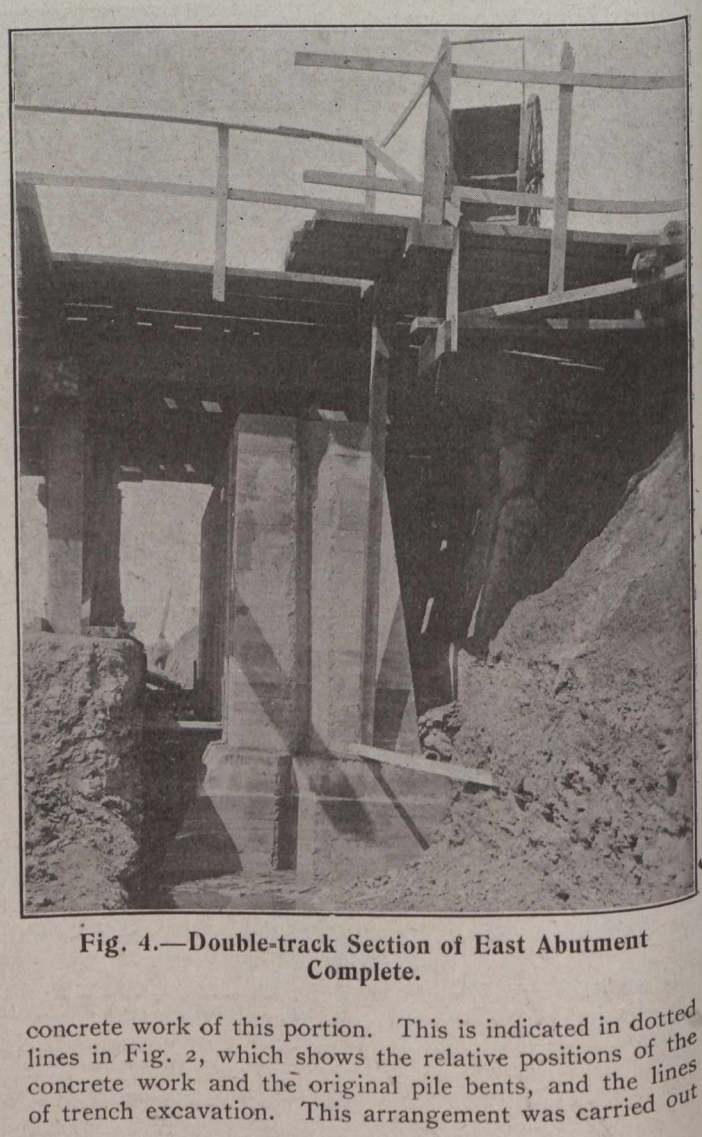

Fig. 4.—Double-track Section of East Abutment Complete.

concrete work of this portion. This is indicated in dotted lines in Fig. 2, which shows the relative positions of the concrete work and the original pile bents, and the lines of trench excavation. This arrangement was carried out