In addition to the topographical work, extensive subsurface exploration was necessary. This included about 3,400 ft. of wash-boring and core-boring. Samples were carefully taken, labeled and preserved for reference. The rock found at varying depths consists of a shale.

Owing to the high unit stresses which the main piers of the proposed structure will impose on the shale, tests were made to determine as accurately as possible its safe carrying capacity. As the cores obtained by the use of the diamond drill were too small for compression tests, samples were selected from the quarry of the Don Valley Brick Works, in comparatively close proximity to the site. Care was taken to select the softest pieces obtainable and of the same character as the softest shale encountered in the boring operations. On account of the nature of this shale it was impossible to obtain good specimens.

Six test blocks, however, were obtained, of approximately cubical form, 2 inches to the side. These were tested to destruction, failure occurring under loads of 1,381, 831, 535, 1,500, 862 and 362 pounds per square inch respectively.

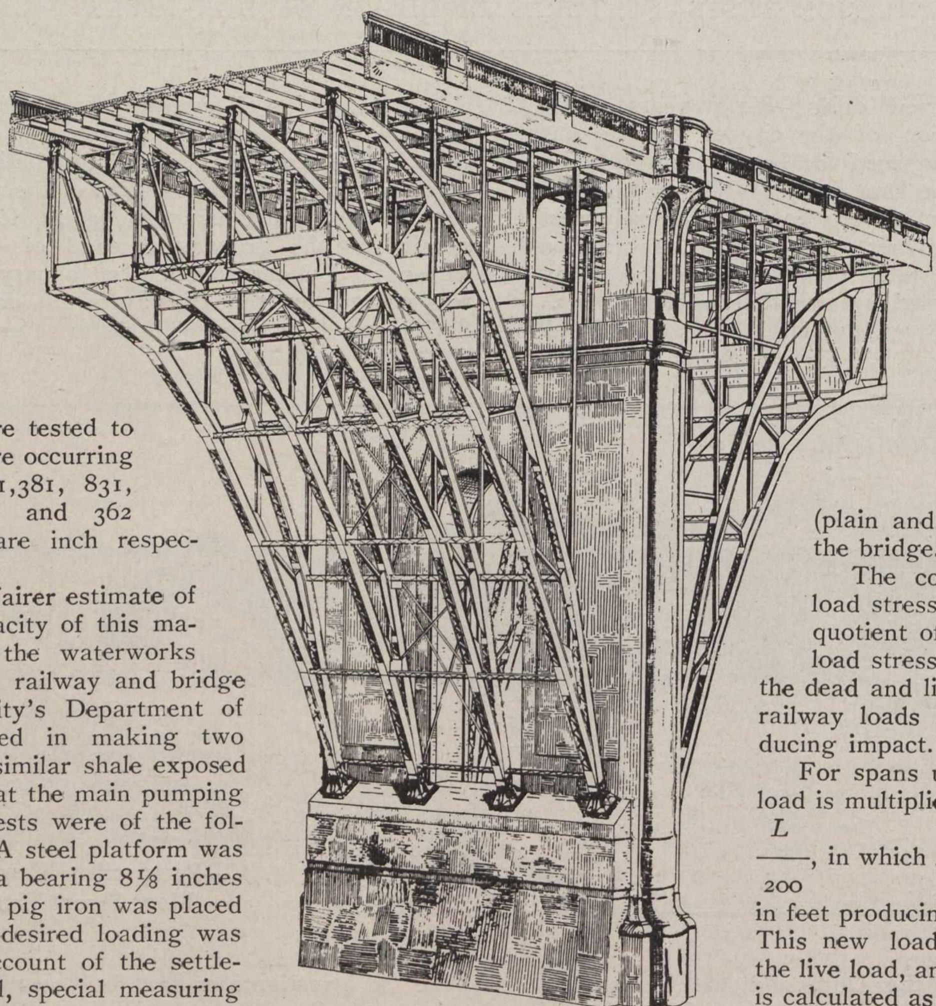

Fig. 2.—Perspective View of Pier "D."

To acquire a fairer estimate of the carrying capacity of this material in place, the waterworks sections and the railway and bridge section of the city's Department of Works co-operated in making two loading tests on similar shale exposed in an excavation at the main pumping station. These tests were of the following nature: A steel platform was constructed with a bearing 8⅛ inches square. Weighed pig iron was placed upon it until the desired loading was obtained. On account of the settlements being small, special measuring devices were used and the total settlement checked by means of the level and target rod. In the first test a settlement of .45 inches was recorded under a unit pressure of 986 lbs. per square inch. Careful examination of the rock after the removal of the platform was made and the shale was found to be crushed only to such a degree as to have lost its characteristic structure for a depth of about 3 inches, while the shale immediately surrounding the loaded area showed no sign of injury.

In the second loading test a unit pressure of 402 lbs. per square inch was imposed, resulting in a settlement of .08 inches. Examination after the test showed that its effect on the texture of the shale could scarcely be observed.

The design of the Don section of the viaduct shown in Fig. 1 is based upon a steel structure with approaches and piers of reinforced concrete. It is a three-hinged, four-ribbed arch construction of five spans with footings carried down to rock foundation. The floor system is of concrete slabs supported on steel. The whole structure is 1,618 feet in length with a height of 130 feet above water level. The river span is 281½ feet, with a span of 240 feet, on either side, and on the outer side of these again, spans of 158 feet. The western approach will include a span of 80 feet. The specifications call for 26,175 cu. yds. and 3,050 cu. yds. of excavation for the east and west approaches respectively, and 20,000 cu. yds. for the piers. About 5,500 tons of structural steel and 43,000 cu. yds. of concrete will be required. As will be noted in the cross-section (Fig. 3) the design provides for a 20-ft. roadway on either side of car tracks, placed 11 ft. 11 in. c. to c. On either side, also, is a cantilevered sidewalk 10 ft. 9 in. in width, making a total width of 86 ft. Provision is made for the installation of a lower deck to connect with a future system of underground railways. A 42-in. water main will also be carried on either side under the main floor structure.

The following are among the assumptions governing the design of the concrete (plain and reinforced) portions of the bridge.

The combined dead and live load stresses are increased by the quotient of the square of the live load stress, divided by the sum of the dead and live load stresses. Only railway loads are considered as producing impact.

For spans under 80 feet, the live load is multiplied by the factor $1.40 - \frac{L}{200}$, in which L is the loaded distance in feet producing the maximum stress. This new loading is then considered the live load, and the impact allowance is calculated as above.

The rails and ballast are assumed to distribute each wheel load uniformly over a length of 5 feet. The load on each track is assumed to be distributed over a width equal to the length of ties plus one foot.

In calculating bending stresses produced in the slab by the 20-ton truck, each wheel load is assumed to be distributed over a square, each side of which is equal to 9 inches, plus the effective depth of the slab. In calculating punching shear produced in the slab by the 20-ton truck, the area of contact is considered as a square 9 inches to the side.

The length of span for reinforced concrete subjected to bending shall, in general, be considered to be the distance centre to centre of supports.

All slabs are considered, unless otherwise shown on the drawings, to be partially continuous and shall have reinforcing in the upper portions at the supports. In all