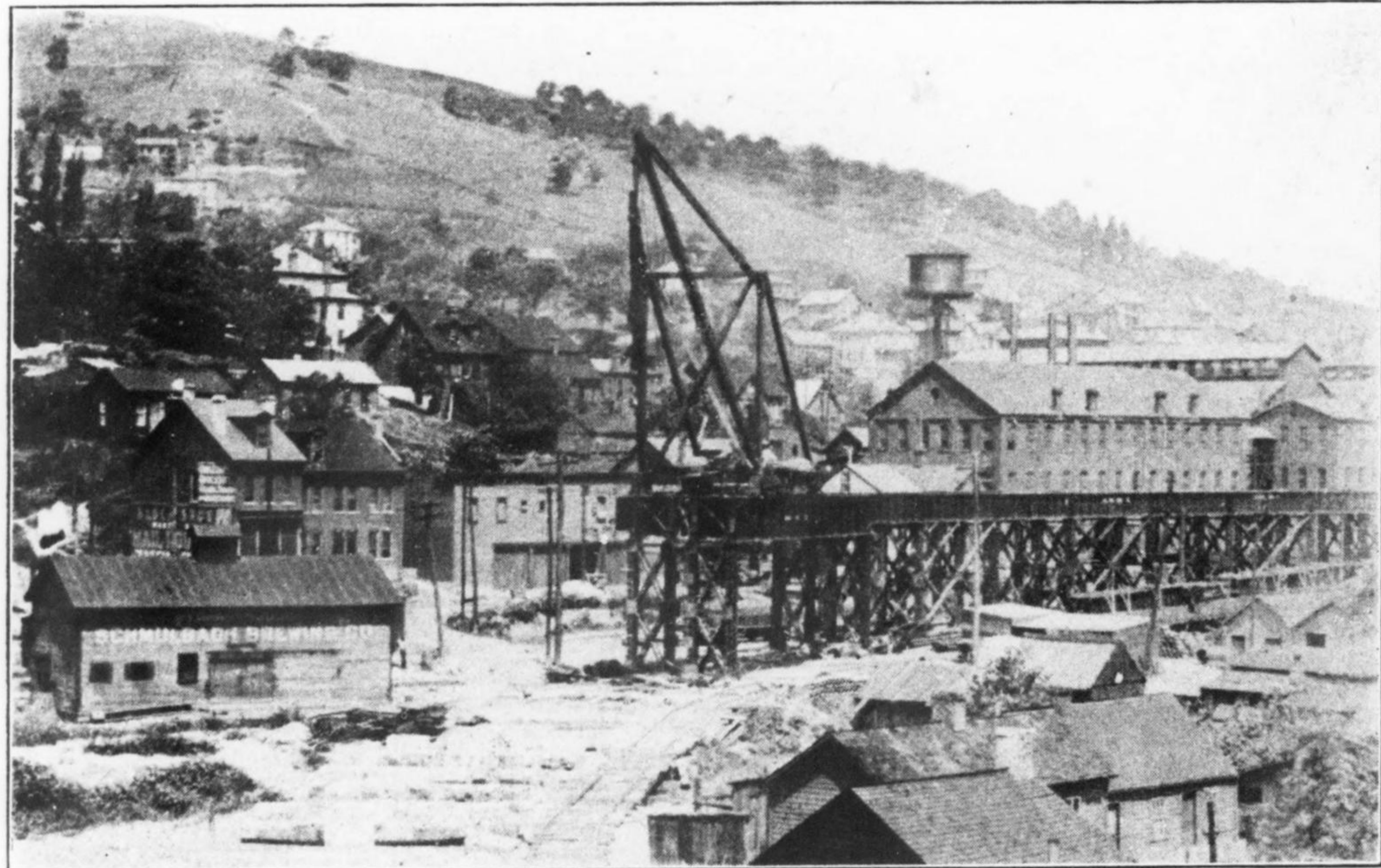


tire length of the structure, and although completed nearly a year ago, no cracks from temperature changes have appeared in the concrete. Also, during this time the railroad has been constantly in operation and the streets above have been in use as before its construction. The original estimates called for 3.41 cu. yds. of concrete per lineal foot and 72.64 lbs. of corrugated bars, at a total cost of \$29.82.

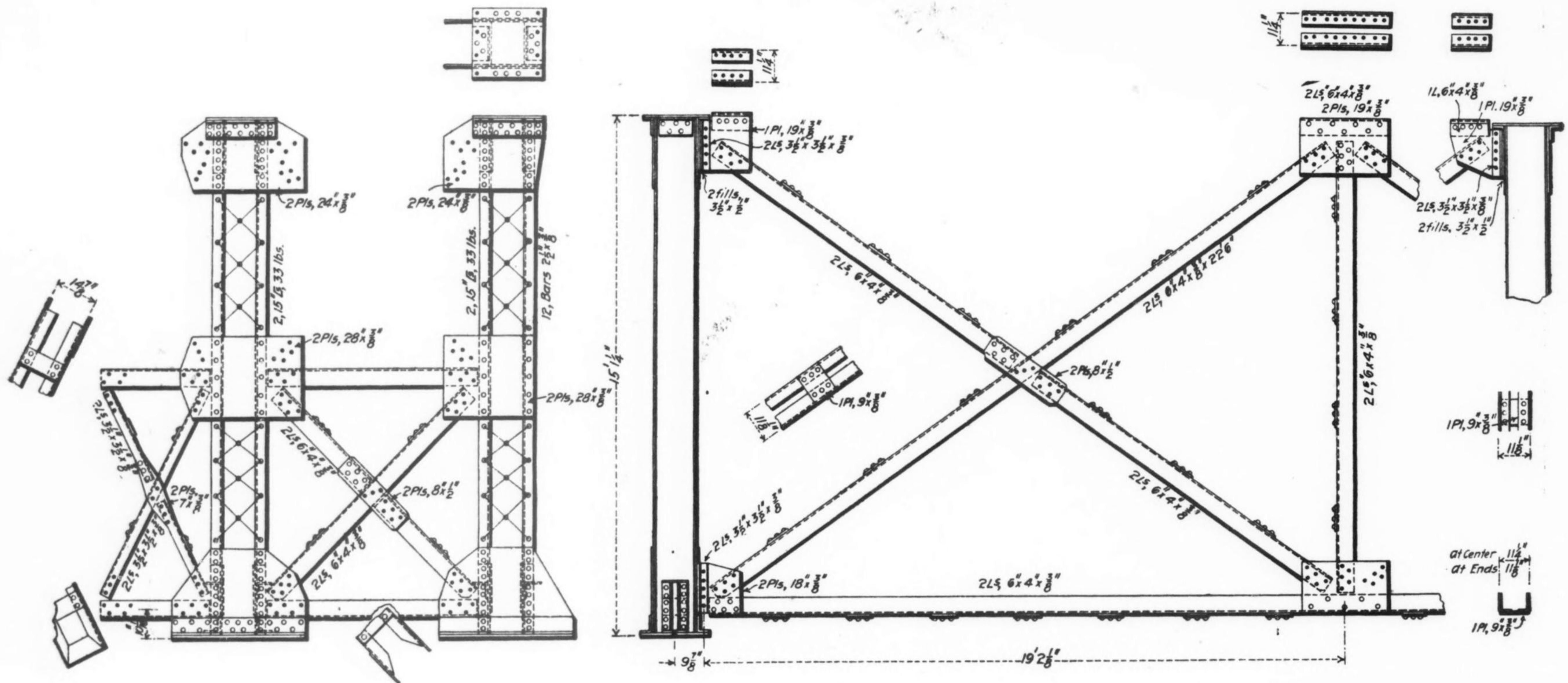
The work was under the direction of Mr. W. B. Crenshaw, Resident Engineer of the Southern. Mr. D. Meriwether, Jr., was Assistant Engineer.

Improvements on the Cleveland Division of the B. & O.

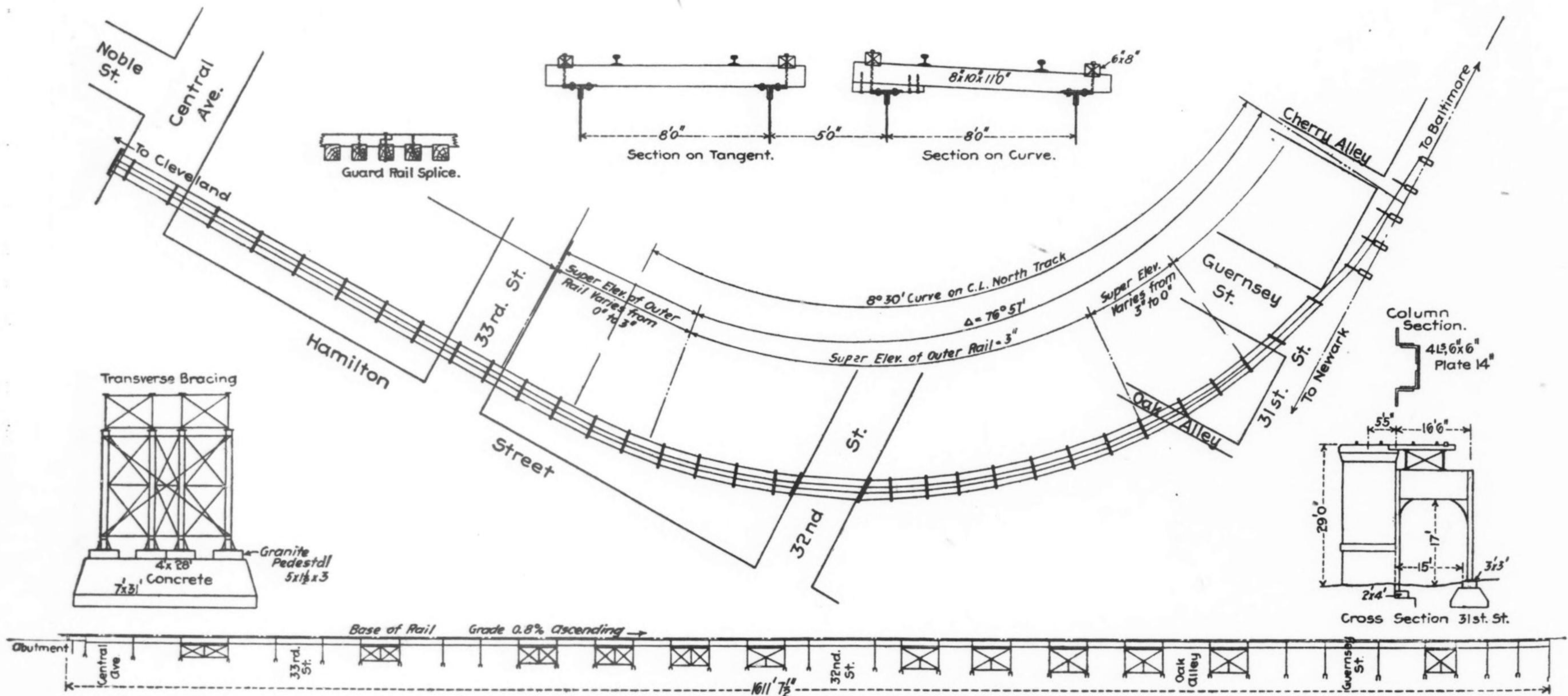
The Baltimore & Ohio has just completed extensive improvements on its Cleveland Division. The new work practically involved the rebuilding of the southern portion of the old Cleveland, Lorain & Wheeling line, straightening the line, reducing grades and



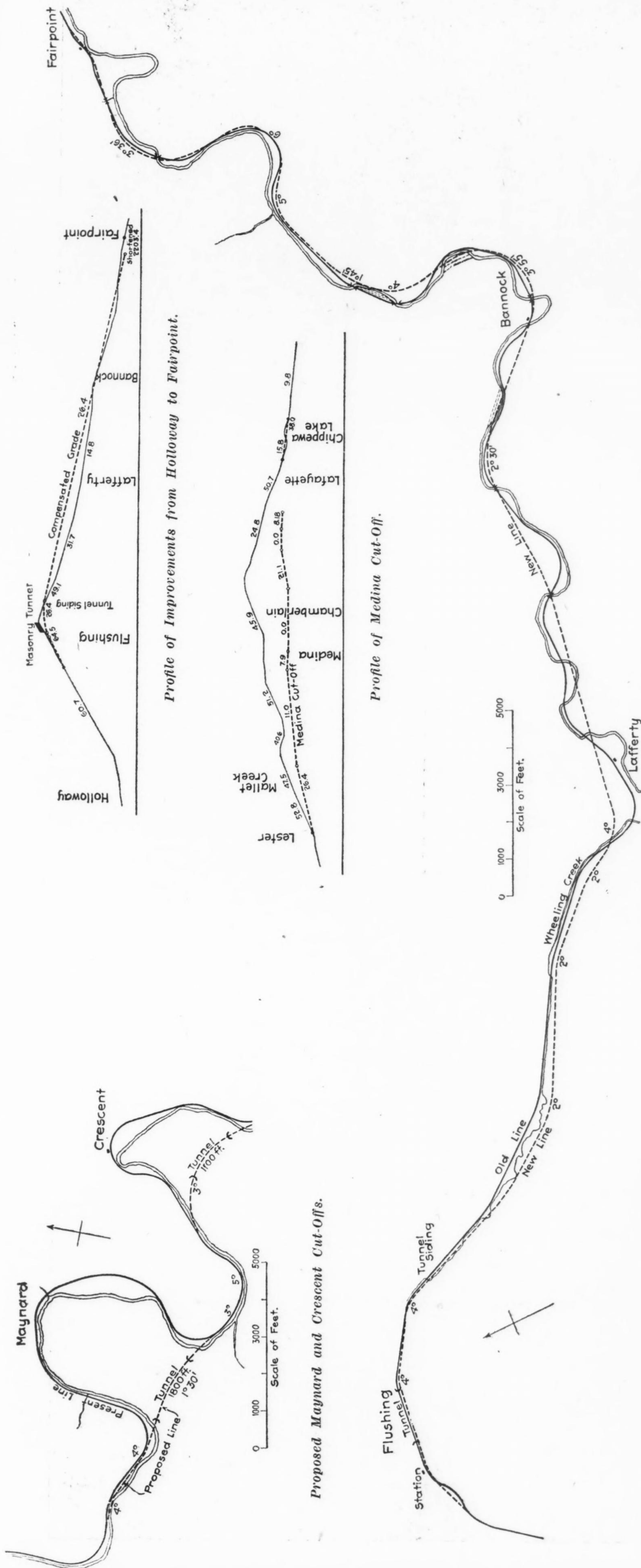
Bellaire Viaduct—C. L. & W.



Details of Bents—Bellaire Viaduct.



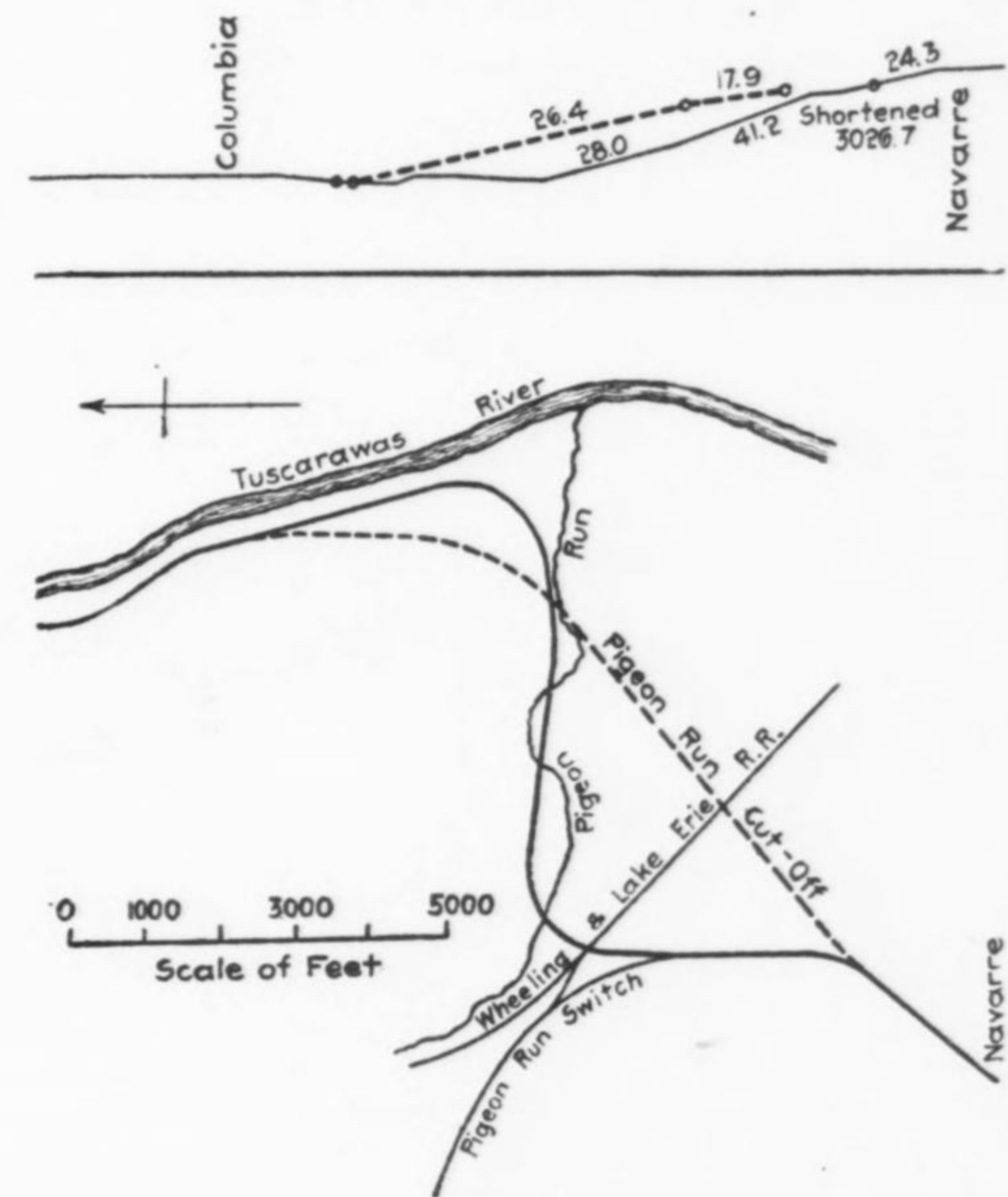
General Plan and Elevation of Bellaire Viaduct.



Change in Line between Holloway and Fairpoint.
Improvements on the Cleveland, Lorain & Wheeling.

changing from single to double track. The work was started about two years ago and the total cost of the improvement was about \$4,000,000. The average maximum grade on the division is now 0.3 of 1 per cent. (15.8 ft. per mile) northbound from Holloway to Lorain and .5 from Bellaire to Holloway, and 0.5 of 1 per cent. (26½ ft. per mile) southbound, with the exception of 3.35 miles between Holloway and Flushing, which is a helper grade of 1.15 per cent.

To make a connection with the main line of the Baltimore & Ohio at Benwood, W. Va., it was necessary to build a line a distance of about one mile from the end of the bridge across the Ohio river at Bellaire to come to grade with the Cleveland, Lorain & Wheeling, the old line of which terminated considerably below the bridge tracks. A steel viaduct was erected over the streets of Bellaire and across the Cleveland, Lorain & Wheeling yard, and the Ohio river bridge was replaced by a new and heavier structure. These improvements permit a direct movement of trains going west with the Cleveland Division. Trains can now go directly from Wheeling and the Fairmont, W. Va., coal region via Benwood Junction across the Ohio river and down over the new line to the Cleveland, Lorain & Wheel-



Pigeon Run Cut-off—C., L. & W.

ing and on to Cleveland and Lorain, or out over the Central Ohio road to Zanesville.

The most important work done on the Cleveland, Lorain & Wheeling was the new line between Bellaire and Flushing, a distance of about 30 miles. Nearly all of this is new work and new right of way had to be obtained. This improvement includes the viaduct at Bellaire, the double tracking of the Barton tunnel, the new double-track tunnel at Flushing, and a deep cut one mile east of Bannock. Starting at the south end of the line, the first important piece of work is the Bellaire viaduct. This is 1,612 ft. long, 990 ft. of which is on an 8 deg. 30 min. curve. It is a steel structure, with steel work furnished by the American Bridge Company. The viaduct is made up of a number of 40 to 60 ft. spans supported on steel bents, the details of which are shown in the accompanying engraving. The 60 ft. girders are 5 ft. 3¼ in. deep. They are made up of two angles 8 in. x 8 in. x 5/8 in., and three cover plates; one 18 in. x 1/2 in. x 60 ft., one 18 in. x 7/8 in. x 36 ft. 9¾ in., and one 18 in. x 7/16 in. x 26 ft. 11¾ in. The web plate in the 60 ft. span is 63 in. x 7/16 in. The 40 ft. girders are 5 ft. 3¼ in. deep and are made up of two angles 6 in. x 6 in. x 5/8 in. and one cover plate 16 in. x 1/2 in. x 39 ft. 5 in. The web plate in the 40 ft. girders is 63 in. x 3/8 in. A number of bridges were also erected in Bellaire involving the use of up-

wards of 18,270 yds. of masonry on 2,200 lineal ft. of track.

The next important piece of work was the widening of Barton tunnel. This tunnel is 455 ft. long and the method used in double-tracking it and keeping traffic open at the same time is shown in the accompanying illustration. The roof and sides of the old tunnel were timbered to prevent caving in, before the excavation for the new section was begun. As the work on the new section progressed, the roof inside was shored up as shown, and as soon as a section of the new tunnel was completed, tracks were laid to facilitate the removal of excavated material. It took 15 months to complete this improvement. The James F. McCabe Co. were the contractors, at a contract price of \$140 per lineal foot, including the portals. The west end of this tunnel was extended 14 ft. to accommodate the Wheeling & Western Railroad Company (Electric) which desired an overhead crossing at this point. The Baltimore & Ohio preferred to extend the tunnel rather than to have a bridge built directly over its portal. The electric company stood the expense of the extension, which amounted to \$3,528.



Double-Tracking the Barton Tunnel—C. L. & W.



Gosset Cut—C. L. & W.

Between Barton and Fairpoint, two cut-offs are proposed. These are known as the Maynard and Crescent cut-offs, respectively, and are shown in the illustrations. The proposed Maynard cut-off includes a 1,850 ft. tunnel. This cut-off will shorten the distance about 1½ miles and will reduce curvature about 401 deg. The proposed Crescent cut-off includes a tunnel 1,170 ft. long and will shorten the distance about 4,240 ft. and reduce the curvature about 219 deg.

From Fairpoint to Flushing, a distance of 10 miles, the line has been shortened 2,203 ft., and the grade reduced from a maximum of 49.1 ft. per mile to a compensated grade of 26.4 ft. per mile. The curvature between Bridgeport and Flushing has been reduced 912 deg. 36 min., leaving the maximum curvature 6 deg.

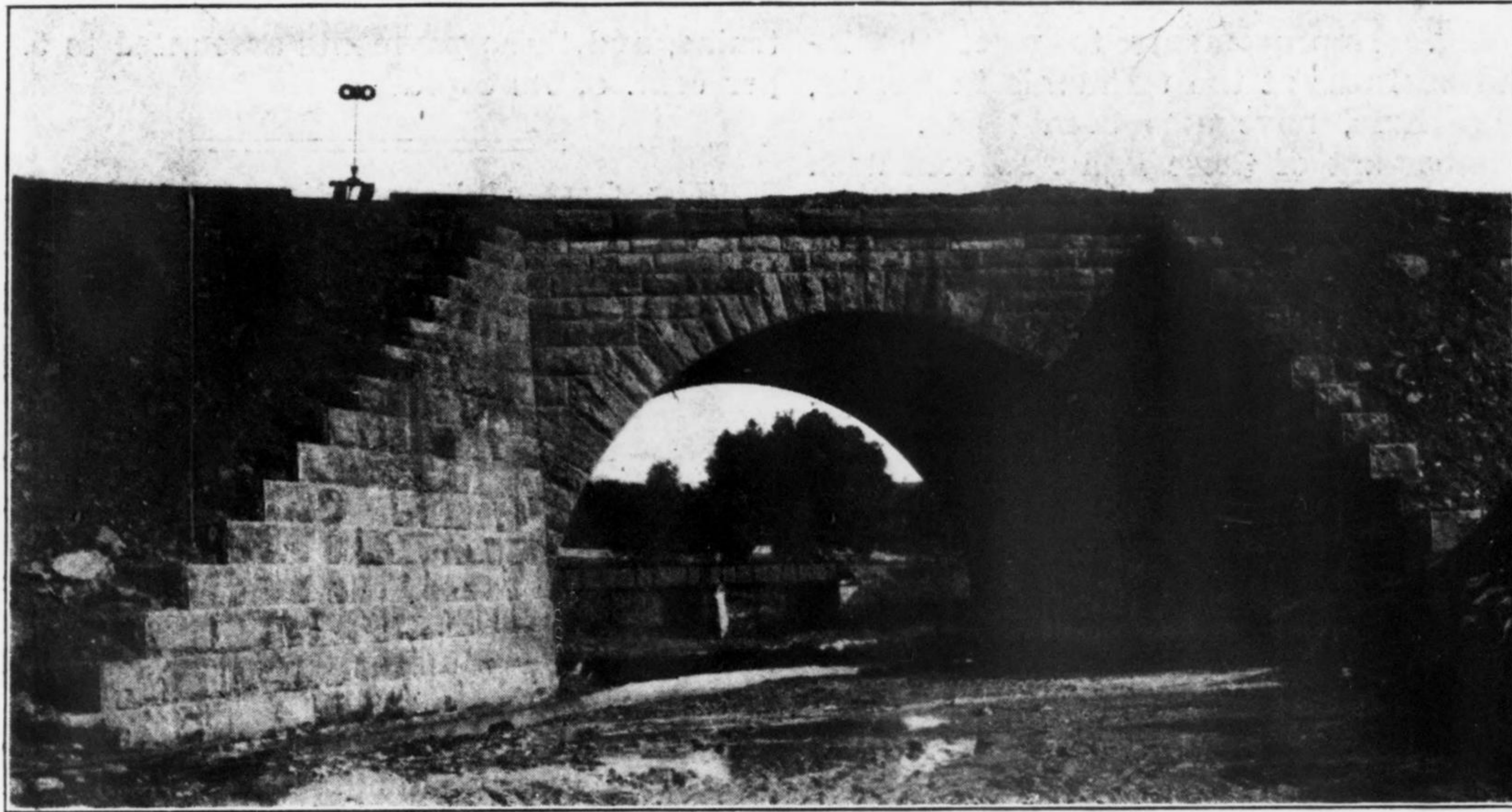
One of the illustrations show the Gosset cut one mile east of Bannock. This cut is 900 ft. long and it was made through solid layers of limestone ranging from 2 in. to 2 ft. thick. Upwards of 73,026 cu. yds. of material was taken from this cut, which is 46 ft. deep by 41 ft. wide, and is the deepest cut on the line. The majority of cuts on the new line were contracted for at from 45 cents to 57 cents per yard. An illustration is also shown of a 44 ft. arch at Lafferty, about

two miles west of Bannock. This shows the typical type of masonry arch used throughout the line. Practically no concrete was used in the improvements, since it was believed that masonry work could be put in almost as cheaply, with sandstone procured along the line of improvements. The new road at Lafferty is located about 300 ft. from the old line, and in the illustration of the 44-ft. arch the girder bridge on the old line can be seen in the background. This bridge has been taken down and the old line at this point has been entirely abandoned. All new bridges and arches were designed for the E 50 loading. The drawing of the Walker's undercrossing shows an interesting solution of the way to span a stream and a roadway at the same time.

Another heavy piece of work is that of the new tunnel at Flushing. The length of the old Flushing tunnel was 1,452 ft. It was single-tracked, and owing to the 1.15 per cent. grade in it, it was apt to become full of gas and hard to ventilate. This tunnel was abandoned, as it was decided that it would be cheaper to put through an entirely new tunnel than to double track and reduce the

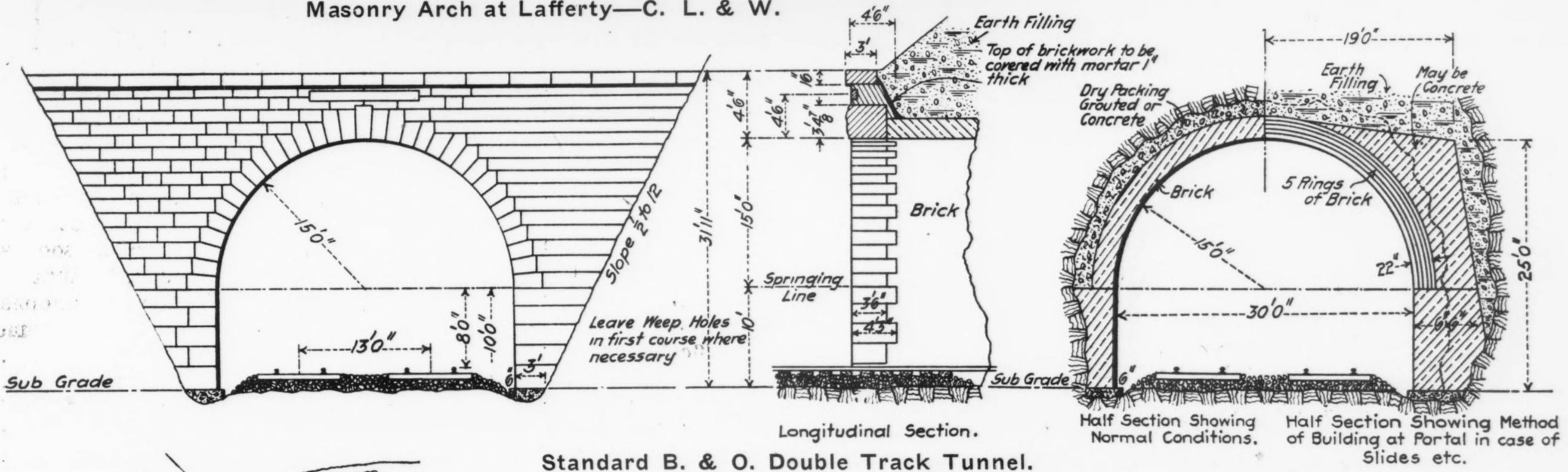


Walker's Undercrossing—C. L. & W.

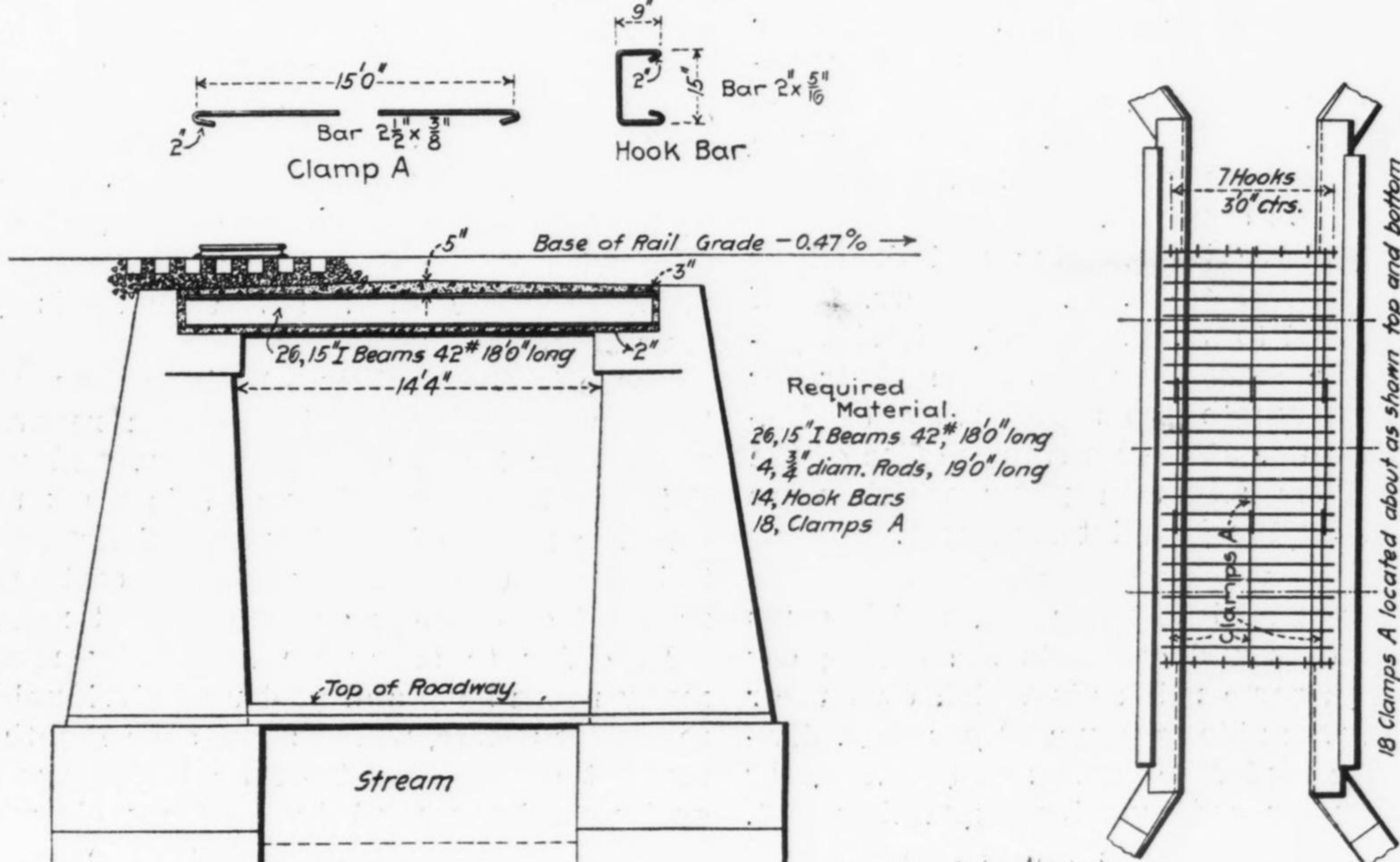
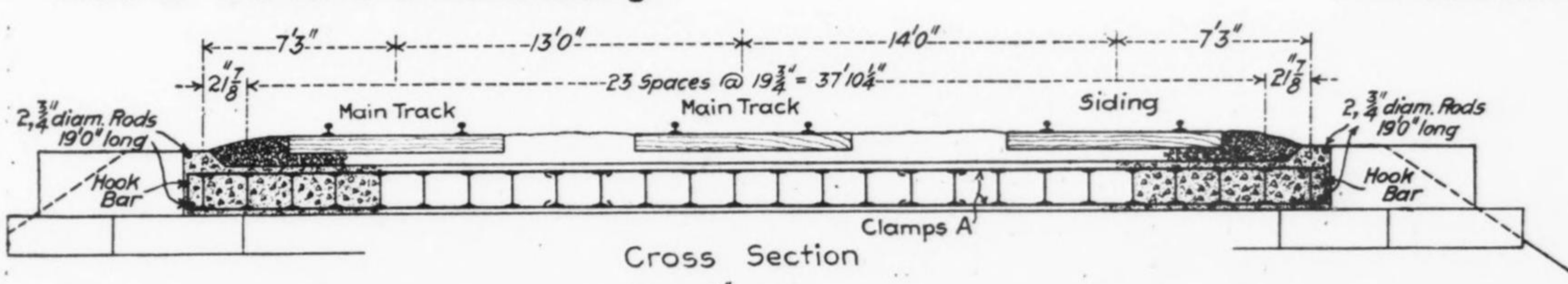
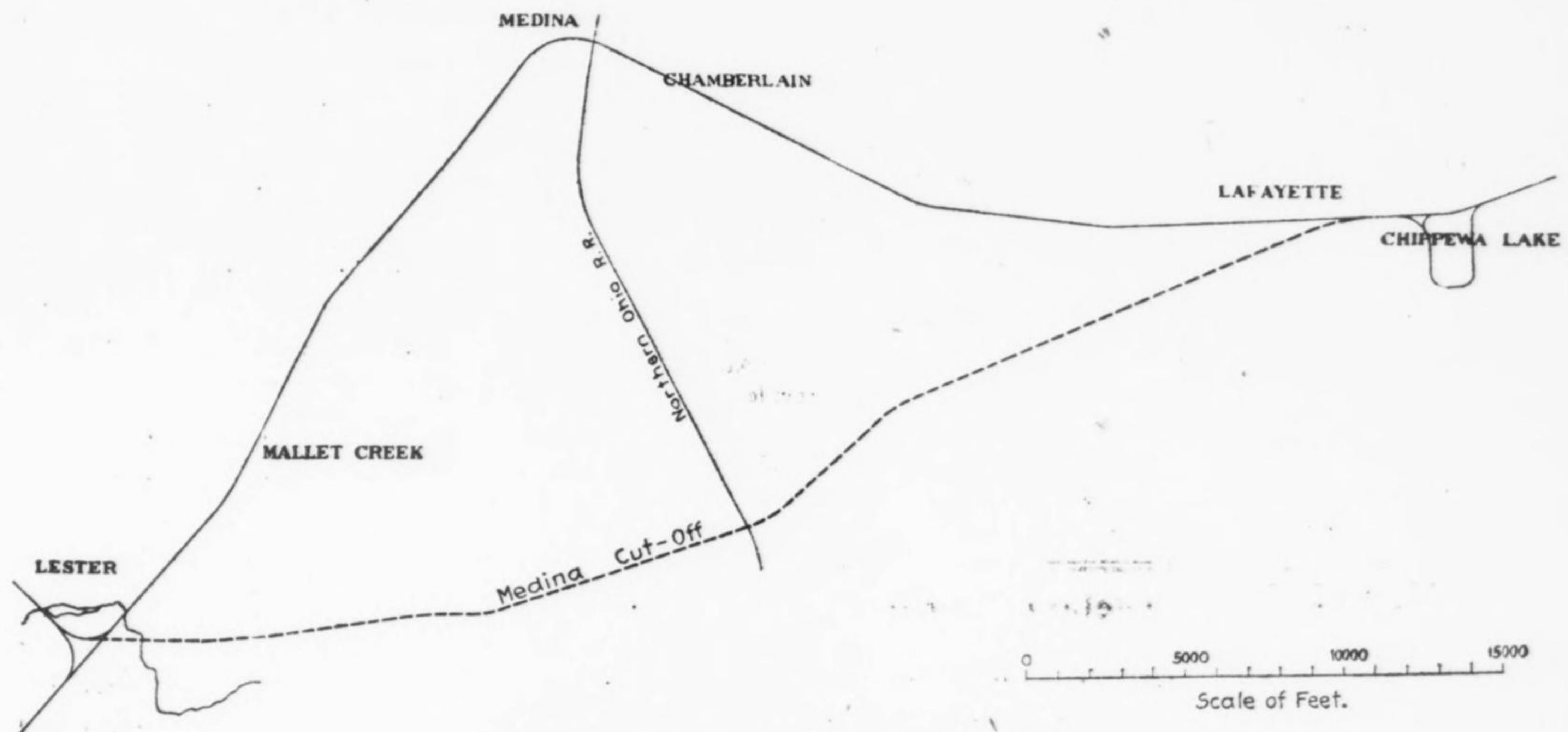
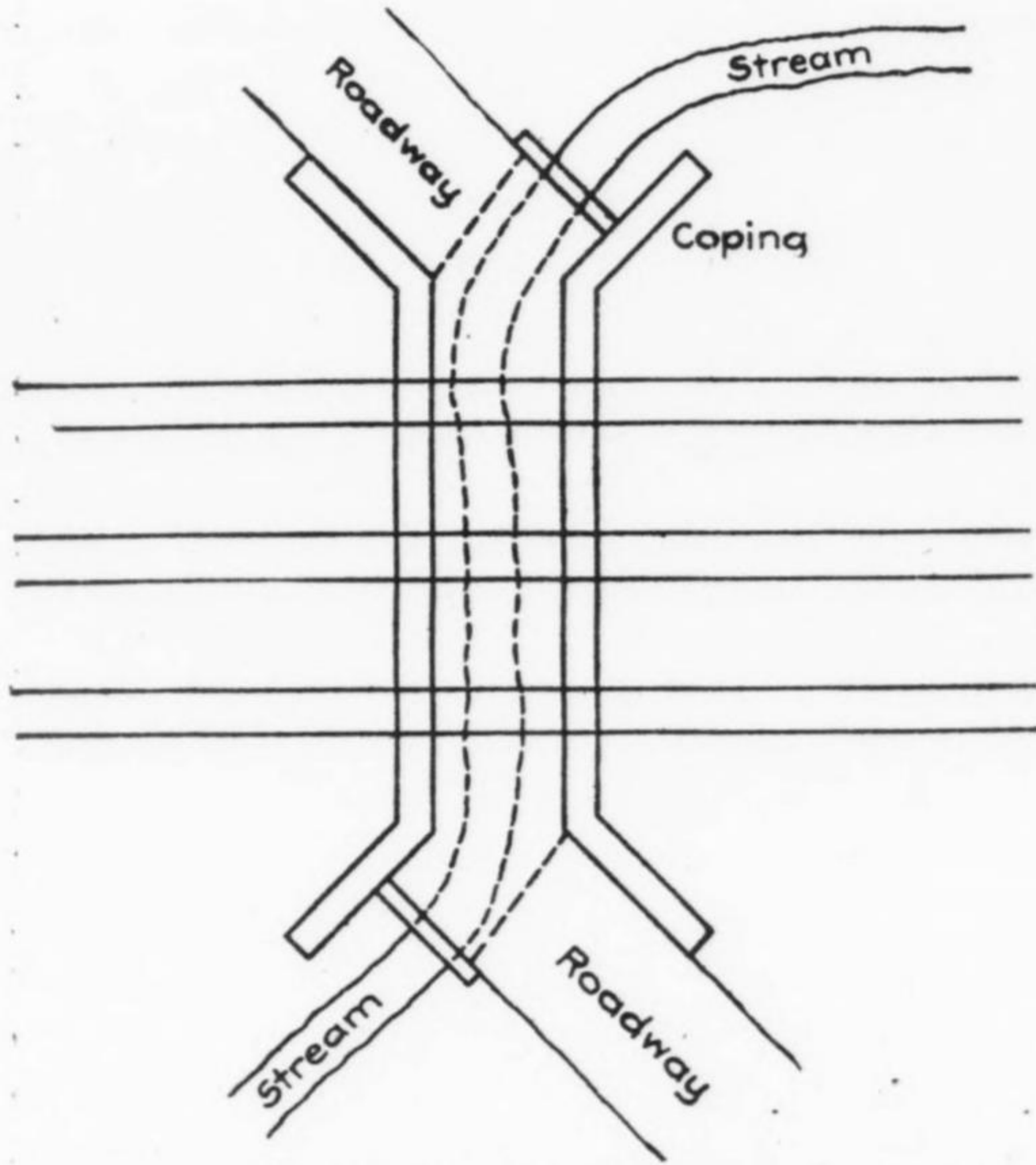


Masonry Arch at Lafferty—C. L. & W.

grade in the old one. The new tunnel is double-tracked and is 1,545 ft. long, built of masonry lined with brick, and is of the standard B. & O. section, as shown in the accompanying illustration. It is 45 ft. from the old tunnel and has a 0.3 per cent. grade. It took 20 months to drive this tunnel as blasting was necessary all the way through. Considerable trouble and delay was also experienced on account of running into some old coal mine rooms. This necessitated shoring up and strengthening the tunnel at these points. Bennet & Talbott were the contractors, the contract being at \$145 per lineal foot. It is rather amusing to note that the railroad company had offers to lease the old tunnel for raising mushrooms, but these offers were declined and the old tunnel is now bricked up at both ends so as to prevent its becoming a harboring place for tramps.



Standard B. & O. Double Track Tunnel.



It was also thought that a better draft could be obtained in the new tunnel by closing the old tunnel, because of its proximity to the new one.

The longest fill on the line commences about half a mile east of the Flushing tunnel. It is 4,200 ft. long, with a maximum height of 20 ft. The permanent way on this fill is for three tracks and contains 148,000 cu. yds. of material, most of which was taken from the east approach and heading of the Flushing tunnel.

A new division terminal was made at Holloway, where modern facilities have been provided for handling locomotives and trains. At Holloway, four miles west of Flushing, the Cleveland Division and the Wheeling Division meet and train crews are run from this point north and south. The terminal improvements consist of a large freight yard, two miles long, a machine shop, a 22-stall frame roundhouse, two water tanks, an ash pit and a large reservoir. The reservoir has a capacity of 59,000,000 gallons and it will be used to supply the engines with water and to prevent a famine during the dry season. The Holloway yard has a capacity for about 1,200 cars, distributed as follows: Westbound receiving yard, 195

cars; westbound distributing yard, 520 cars; eastbound receiving yard, 450 cars. The east and west main line track of the C., L. & W. run on each side of the yard and all westbound cars are distributed over a hump. All yard switches are thrown by hand.

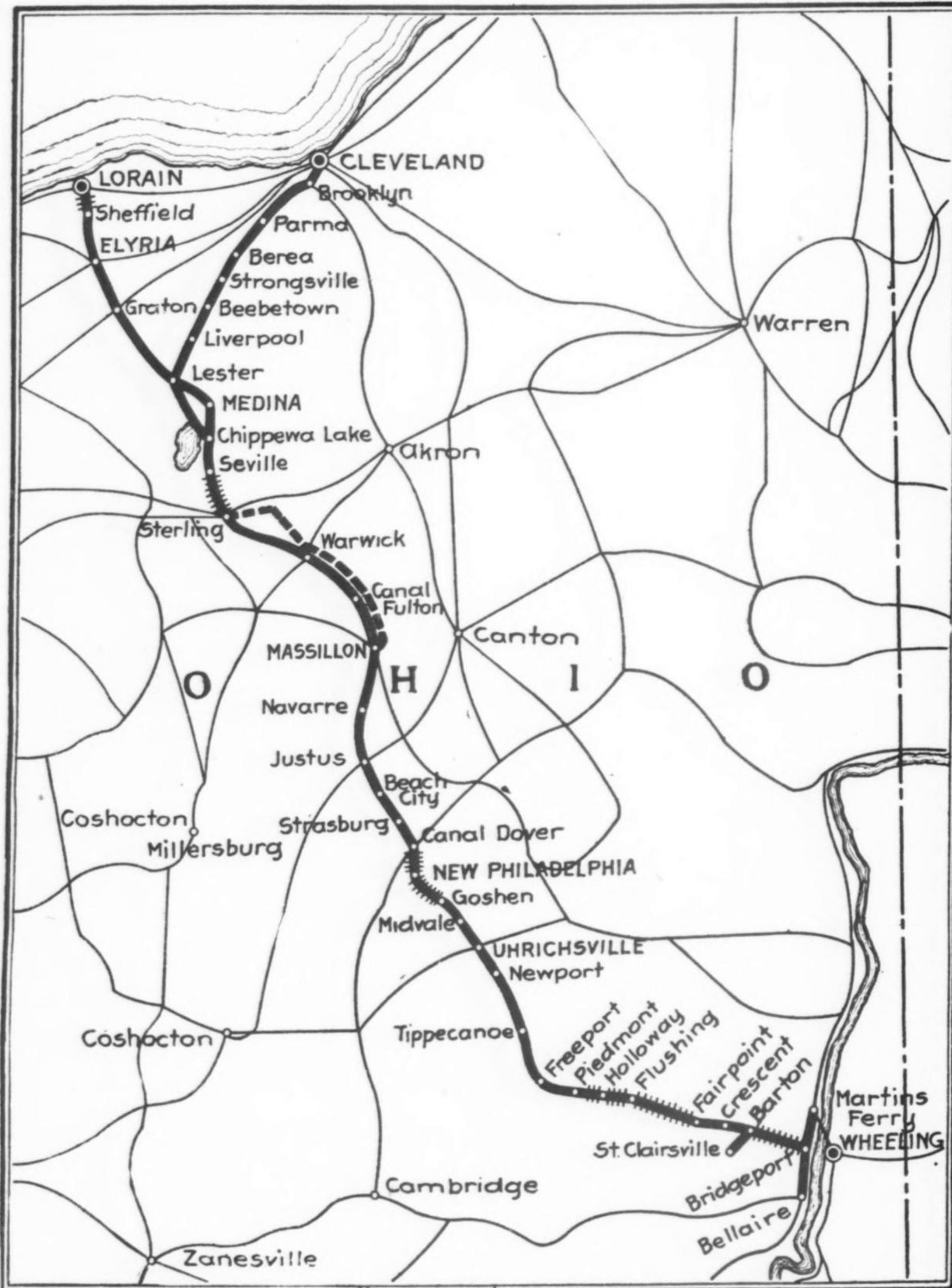
During the progress of the work, upwards of \$120,000 was expended in changing the channels of the Stillwater and Wheeling creeks. The channels of each of these creeks were changed at two points. These changes eliminated eight bridges, and by change of line four additional bridges were done away with, making a total of 12 bridges in all

of 2 deg. Improvements to meet the increased business at the terminals in Lorain, on Lake Erie, have also been made. The most important of these is a new coal dock 700 ft. long.

This dock has been equipped with a Link Belt conveyor, telescopic chutes and chute tower and a new engine and boiler. New track was laid and a considerable amount of dredging had to be done so that vessels could get up to the dock. The property used for the dock improvements was bought by the Baltimore & Ohio over a year ago at a cost of \$130,000, and the new dock cost about

\$90,000. This work, with the new terminals at Holloway and the improvements on the Cleveland, Lorain & Wheeling, gives the Cleveland Division of the Baltimore & Ohio a low grade line to the Great Lakes, which permits of a prompt and easy movement of the large volume of coal from West Virginia points. The Cleveland, Lorain & Wheeling now has 57 miles of double track between Cleveland and Wheeling, a distance of 162 miles. For eastbound traffic it runs over its own right of way from Cleveland to Wheeling, and for westbound traffic from Wheeling to Cleveland, it uses both its own line and that of the New Castle Division of the B. & O. as well as part of the Massillon & Cleveland. The accompanying map shows the C., L. & W. line and the lines over which the C., L. & W. has traffic rights.

The heavy line shows the C., L. & W. Division of the B. & O., and the cross-hatched portions shown at different points along the line indicate the portion of the line



Map of the Cleveland, Lorain & Wheeling.

that were eliminated along the new line. A number of passing sidings were also put in. These are of the standard B. & O. length of 6,700 ft.

Between Holloway and Navarre the old line was in fair condition and no heavy work had to be done, but between Navarre and Columbia, a distance of 2½ miles, the line has been shortened about 3,026 ft. This improvement is known as the Pigeon Run cut-off and the maximum grade between the above points has been reduced from 41.2 ft. per mile to 26.4 ft. per mile. The curvature has been reduced 179 deg., and the maximum curvature is 2 deg. It is claimed that this improvement has increased the hauling capacity of the engines about 60 per cent. In all grade revisions, either double track is laid or provision is made in permanent work for laying double track in the future. It was thought best to grade to the full width while at work rather than to build up the grades when it comes time to double-track the line, later on.

An important piece of work was done between Chippewa Lake and Lester, known as the Medina cut-off, and consisting of about ten miles of track. It shortens the old line by about 1½ miles and the maximum grade between the above points has been reduced from 52.8 ft. per mile to 26.4 ft. per mile. The curvature between these two points has been increased 5 deg., with a maximum curvature

which is double-tracked. The heavy dotted line between Sterling and Warwick indicates the part of the New Castle Division of the B. & O. which is used as the C., L. & W. westbound main line, and the heavy dotted line between Warwick and Massillon shows part of the Pennsylvania line known as the Massillon & Cleveland, which is also used as westbound main line by the C., L. & W. The total double track on the C., L. & W., as stated above, is about 57 miles. Twenty-four miles of this is made by using the two foreign lines as indicated, and 33 miles of it is C., L. & W. track proper. By using the Medina cut-off about 8½ miles additional double track is obtained.

For the above information and drawings we are indebted to D. D. Carothers, Chief Engineer, and to W. B. Hanlon, District Engineer. The masonry and bridge plans for the improvements from Holloway to Bellaire were made at the Baltimore office of the B. & O. from situation plans which were furnished by the District Engineer.

The German Dining Car Co., which owns 45 dining cars and conducts the dining car business on some railroads which own their own cars, was able to pay a 10 per cent. dividend on its moderate capital of \$476,000, for the fiscal year ending with September last. The company pays some of the railroads for the privilege of having its cars in their

trains, and these payments amounted to 5.85 per cent. of its capital.

The Cost of Locomotive Operation.

BY G. R. HENDERSON.

(Continued from page 191.)

FUEL.

Firing.—When the coal has been placed upon the tender, the uncertainty regarding its value for generating steam has by no means come to an end. It is now used for two purposes; for getting up steam in the house, and for hauling trains on the road. The first proceeding is unremunerative and very uncertain, depending largely upon how long and where the engine stands after the fire is lighted. Ordinarily it should be a very simple matter to say how many pounds of coal would be required to bring the weight of water in the boiler and the material of the boiler itself up to a temperature corresponding to the steam pressure carried. In some tests made upon the Santa Fe, locomotives of quite a large size consumed from 1,200 to 1,660 lbs. in firing-up, the time occupied being from four to six hours, but how often does an engine go on duty as soon as fired-up to the proper pressure? What a common sight if we go to a large roundhouse on a winter's night, to find 10 or 20 locomotives standing outside, perhaps in a storm, their gages all near the working pressure, and nearly one-half of them blowing off through the safety valves! In his anxiety not to delay trains, the despatcher has perhaps ordered all the locomotives available, and while the trains for which they are intended may not all be in for five or six hours, in the meantime fuel is burnt without producing any useful work. The amount of steam escaping through a 2½-in. safety-valve every minute that it is relieving pressure represents the evaporation caused by burning 15 lbs. of coal—sufficient to haul 100 tons for one mile on a road of easy grades, and it is therefore not to be wondered at that enginemen who are interested in their coal record, ask for allowances to their credit when engines are compelled to stand under steam, and the fuel used is reckoned against their ton-mileage. Even when not blowing off, radiation alone will require from 25 to 50 lbs. an hour. As soon as the locomotive starts on its trip the fireman's efficiency becomes a factor in the problem, and a very important one. If he fills the air with clouds of black smoke; if he throws in large lumps without breaking them, or fires six or eight scoopsful at a time instead of two or three; if he allows the engine to blow off; if he fires aimlessly, not observing where the coal is needed, or carries a very heavy fire; if he neglects the proper use of dampers or disregards the actions of the engineer in handling the engine, it cannot be expected that anything like the full value of the fuel will be obtained, and a great deal more coal will be used in doing a certain amount of work than with a man who fires intelligently and practices none of the bad methods just enumerated.

There is practically no limit to the various books and articles of instruction regarding the proper firing of locomotives, and while it is not in the province of this work to go into the detail of making a good fireman, it is important to explain the great cost to any railroad of careless or incompetent men.

In order to stimulate a healthy rivalry, many roads keep and post up individual performance sheets, which show each month the amount of fuel per ton-mile which the several men have used in different classes of work on the division. Unless these be properly grouped for comparison, they are worse