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Castleton Cut-Off of the New York Central R. R.

Comprising a Notable Yard, a New High-Level Bridge Across the Hudson and 20 Miles of New Road

Description of one of the most extensive and important pieces of railroad construction work that has been started in this country in recent years. The yard alone would be notable for its magnitude, the bridge is a striking piece of bridge engineering, while the effect of the improvement on economy and efficiency of operation of this part of the New York Central system is of the utmost importance. The work has been referred to in a preliminary way on previous occasions in the Railway Review.

The New York Central R. R. is working, this season, on the concluding stages of construction work on its great Castleton cut-off. The project is one which involves a total of more than $20,000,000, and work has been in progress since last spring. It comprises some 20 miles of new double-track railroad, parts of which involve heavy cuts, fills and concrete culvert work; there is a new steel bridge over the Hudson river which, in itself, will be a notable structure, and it includes a double three-unit yard with related mechanical facilities, all of the latter comprising one of the largest improvements of that character in the country. As a whole, therefore, the enterprise is one of unusual magnitude and importance.

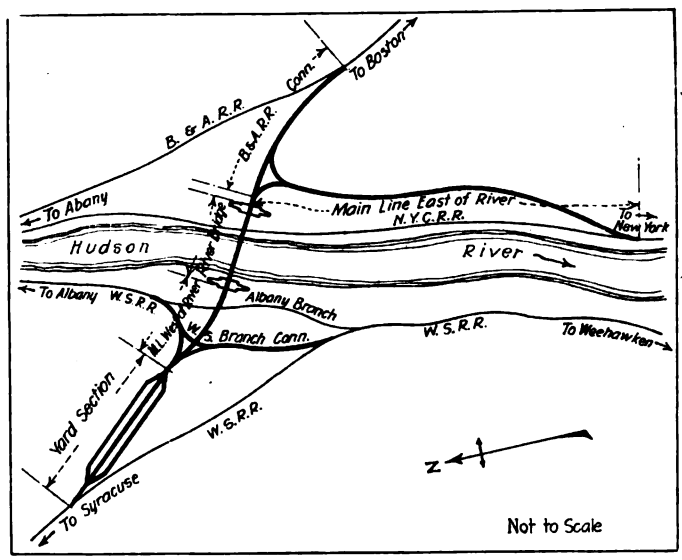
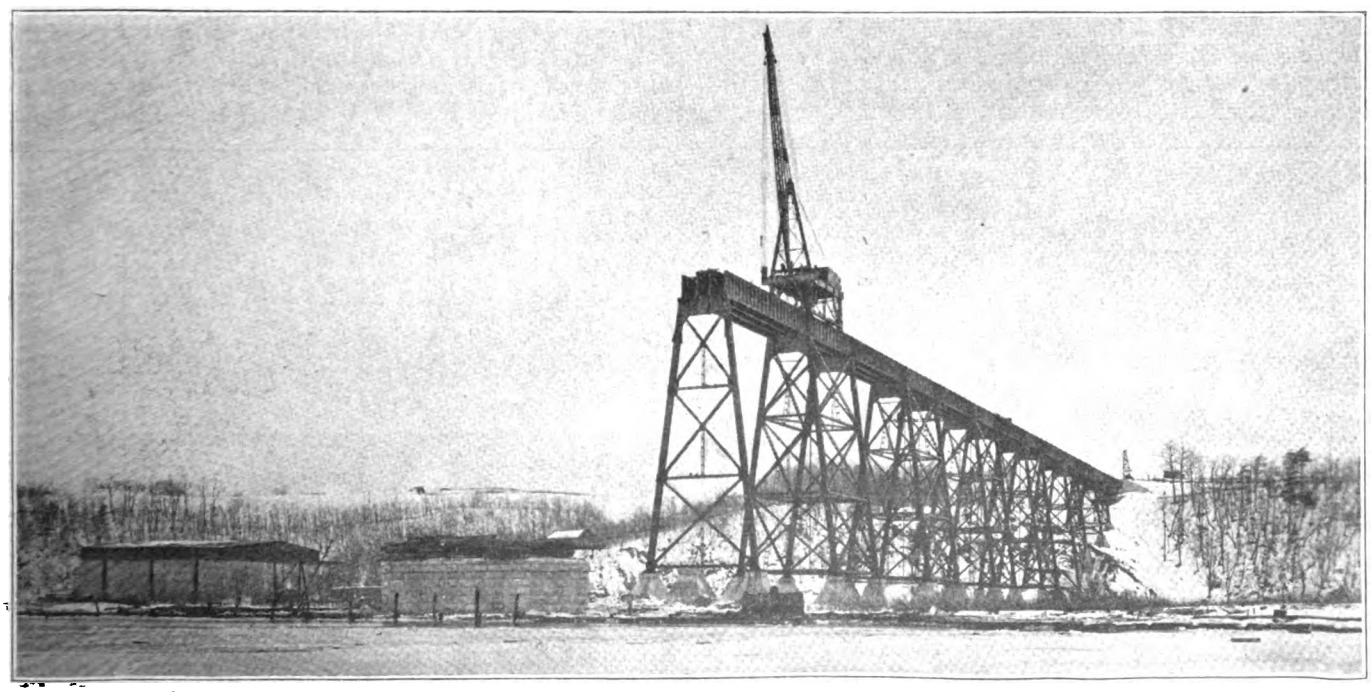
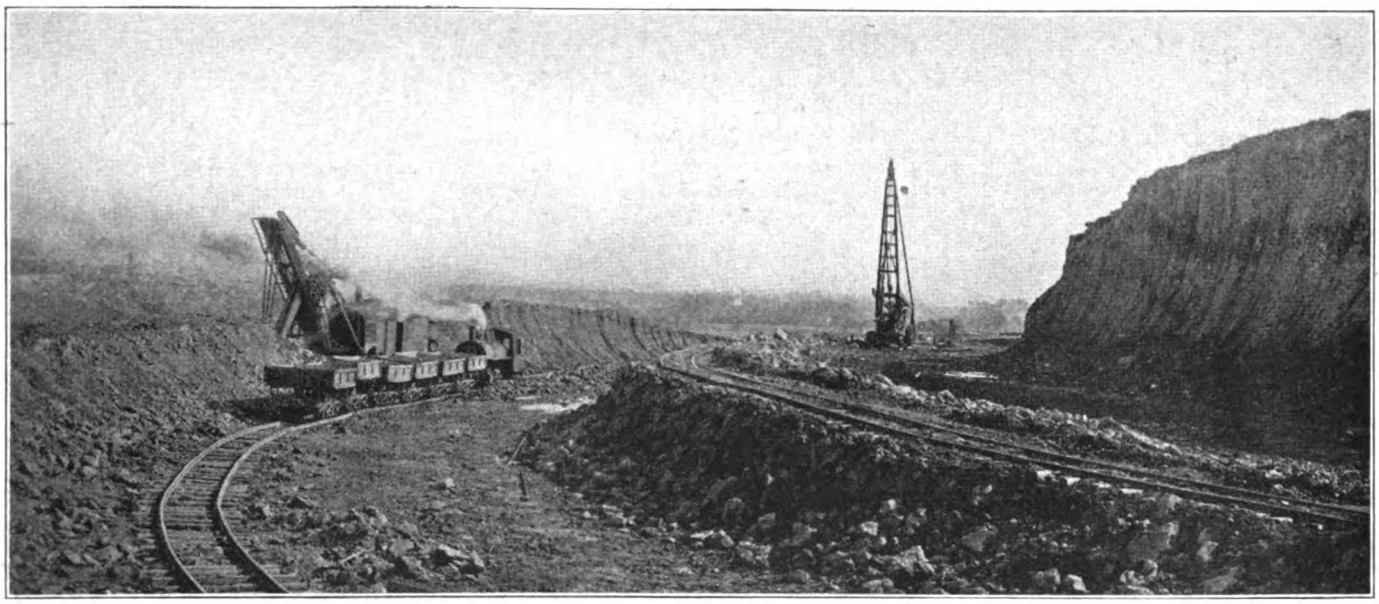


Diagram of Location of Castleton Cut-Off and Connections, New York Central R. R.



West Approach to Hudson River Bridge, View Showing Erection of Steel in Progress, and Foundation of West Pier in Foreground.



Excavation at Hoffmire's Cut, Castleton Cut-Off of the New York Central R. R.

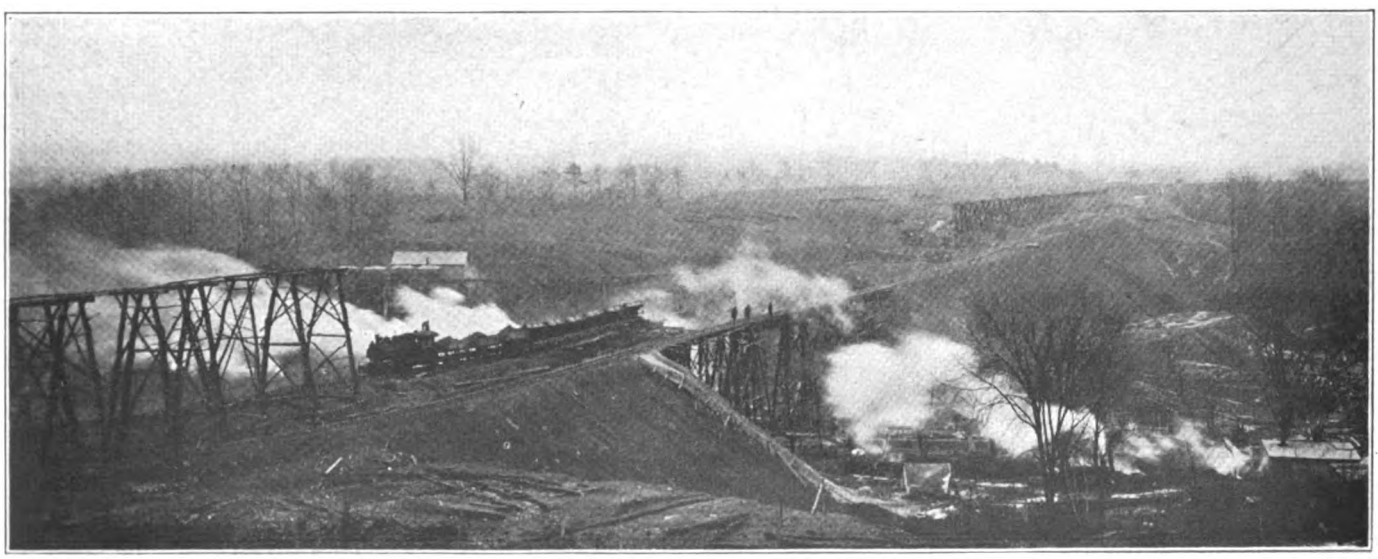
Speaking in general terms, the improvement will cut off the corner at Albany, N. Y., for through freight traffic. The purpose is three-fold: To relieve congestion at the Albany gateway; to avoid interruption and delay to traffic on account of the frequent opening of the drawbridges over the Hudson river, and to obviate the long and steep grades which must be overcome in crossing the Hudson valley at this point.

The Albany gateway of the New York Central is comparable to a small neck of a large bottle. From West Albany to Karner, N. Y., eight miles, is a severe grade which requires "pusher" service for the heavier trains. Freight trains of 80 cars can be brought solid from New York city for 140 miles on the water level route along the Hudson, but before crossing the low drawbridge at Albany, they have to be cut into parts, involving switching and other delays, and each section supplied with an extra "pusher" locomotive for the long 95-ft. grade westward to Karner. A score of "pusher" and switch engines have been employed in this work. Likewise there is a heavy grade eastward from the Hudson river drawbridge.

During the busy navigation season the Albany drawbridges are frequently open 40 times a day, and occasionally at intervals of 15 minutes, and remain open from five to seven minutes each time. Thus the railroad system is frequently cut in two from 25 to 40 minutes in a single hour, and the utility of the much-needed tracks seriously reduced. Often trains have been held up half an hour at the drawbridges, with traffic banked up on both sides.

In normal years there is an average interchange of 1,000 freight cars each way between the west and the Boston & Albany every day, and a daily interchange of 600 cars with the Hudson River division of the New York Central, all of which must be moved through West Albany, which is the "neck of the bottle," every 24 hours. In addition, there is the West Shore traffic through Ravena yard, averaging 600 cars per day. In busy periods this traffic record is considerably increased.

In the "Castleton cut-off," the New York Central is not only taking care of immediate necessities, but is planning for the future and the anticipated growth of transportation demands that will create need for the enlarged capacity, improved grades and more economical and efficient operation. The new piece of road is expected in the future to carry a burden of freight equalled by few stretches of track in the world, and all necessary contributing facilities have been planned with this in view.



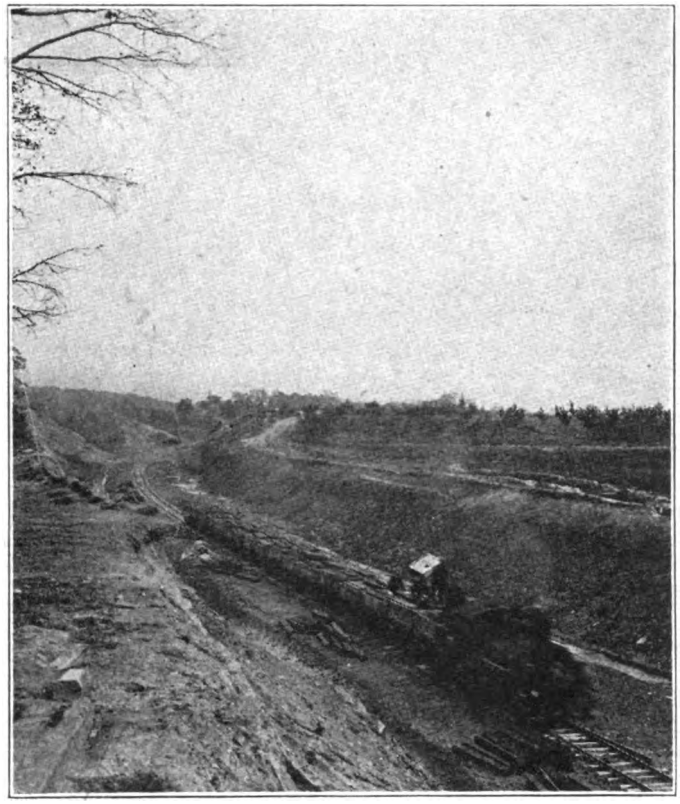
Fill at Muitze's Kill, Castleton Cut-Off of the New York Central R. R.

The beneficial results of the improvement will practically double the freight carrying capacity through this territory, and likewise increase the passenger carrying capacity of the existing main line in the Albany territory, and owing to relief from freight interference will possibly reduce the average time in transit of freight between the north Atlantic seaports and the middle west by from two to five days.

The Castleton cut-off was definitely planned by the New York Central as far back as 1910. During succeeding years it was continuously before the public commissions, the courts or other authorities seeking the necessary official sanction. Surveys were made in 1910-11. In March, 1913, the New York Central organized the Hudson River Connecting Railroad Corporation, as a subsidiary company, in whose name construction work has since been carried on.

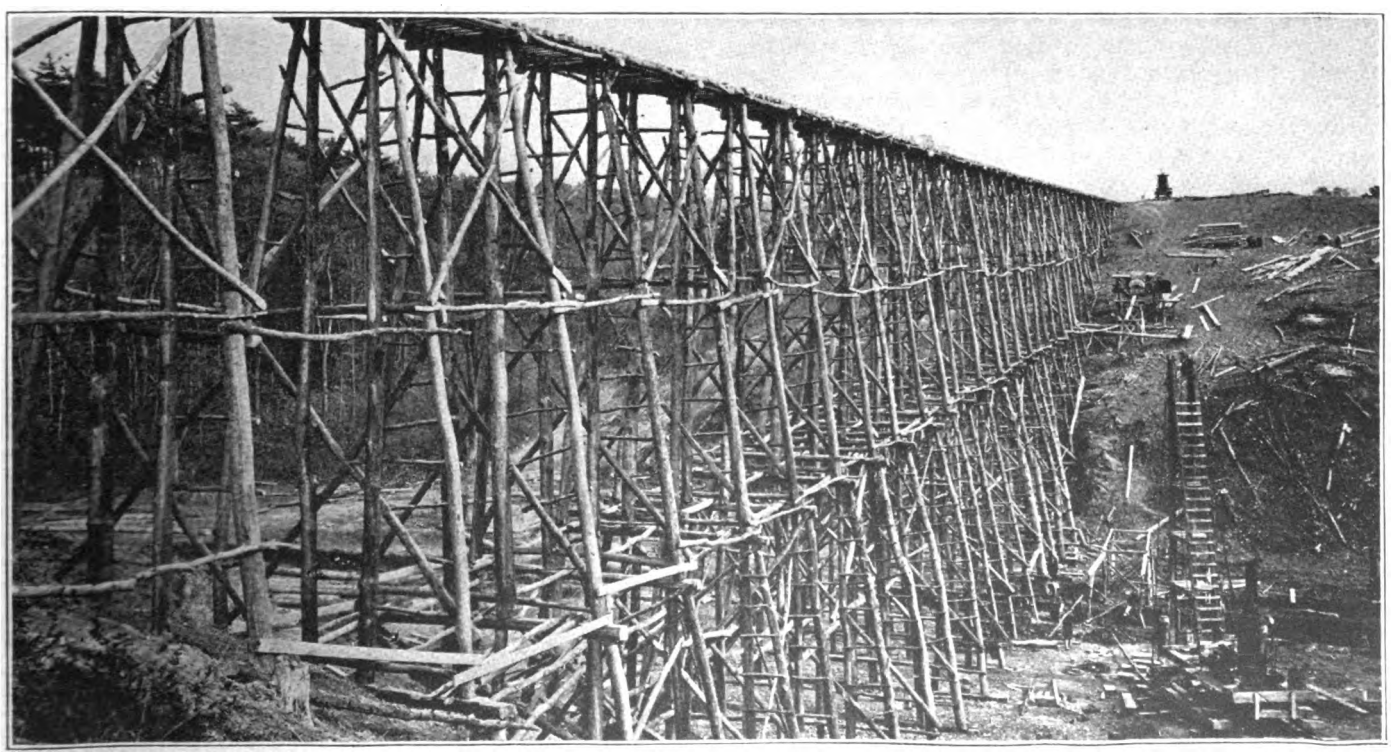
The map of the New York Central, it will be recalled, includes a line up the east bank of the Hudson river which crosses the river at Albany and thence continues directly west. The Boston & Albany is a controlled property of the New York Central R. R. which comes into Albany from New England points. The West Shore R. R., also owned by the New York Central, occupies the west bank of the Hudson river and also has several lines and branches lying, in general, south of the New York Central's line across New York state. This new Castleton cut-off utilizes the favorable relation of both the West Shore and the Boston & Albany railroads. The new route leaves the main line of the New York Central R. R. at Hoffman's, which is 26 miles west of Albany. From this point it utilizes the existing line of the West Shore R. R.

At Feura Bush the new construction begins, and the first portion is what will be known as the Selkirk yard, six miles in length. From the eastern end of the Selkirk yard, the Castleton cut-off continues in a southeasterly direction, directly across the Hudson river on the new high-level steel bridge. The continuation of this line connects with the Boston & Albany R. R., which is one of the objects of the cut-off. To gain its connection with

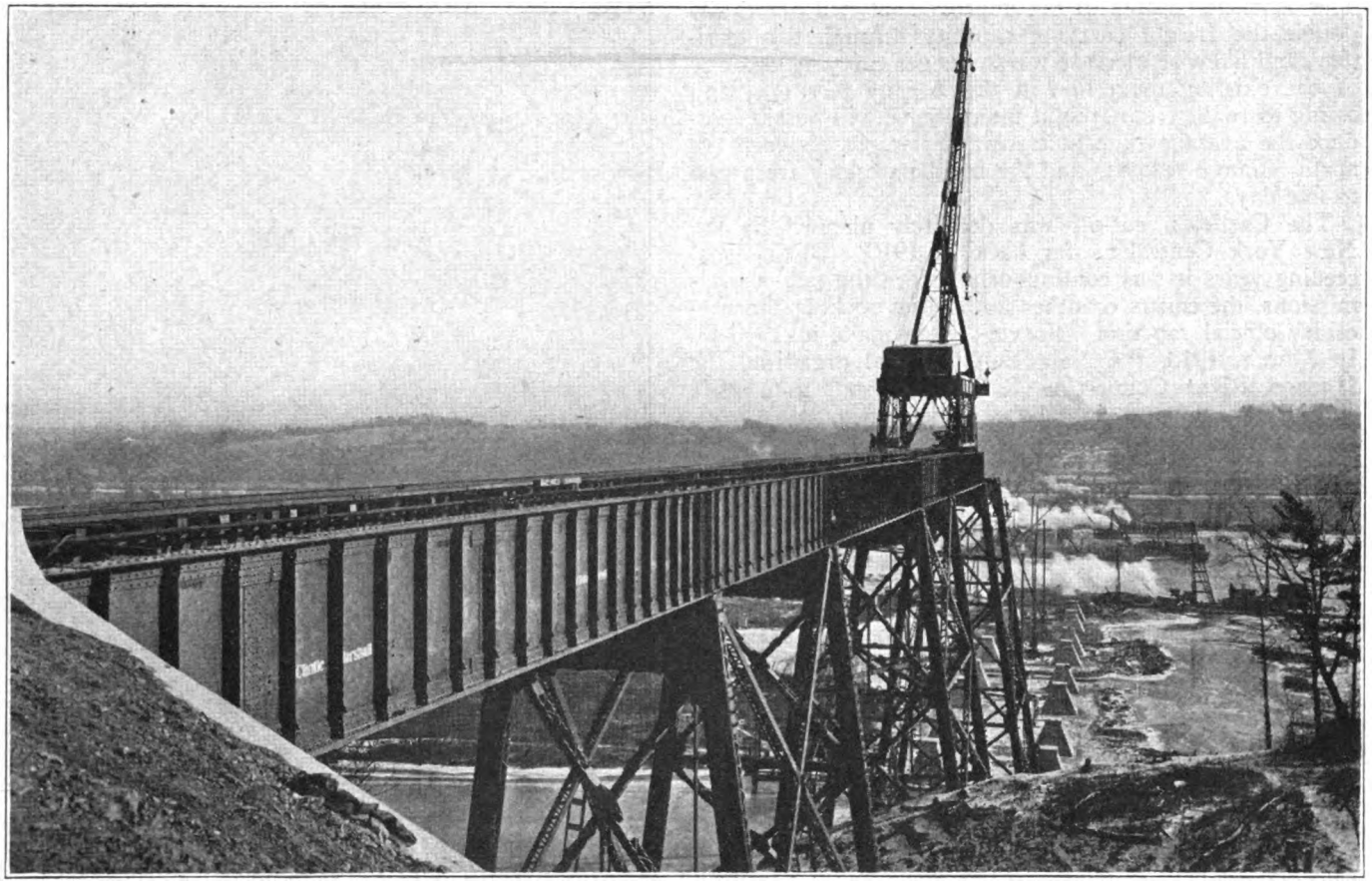


Excavation at Paark's Cut, Castleton Cut-Off of the New York Central R. R.

the main line of the New York Central, the new cut-off line turns directly south and continues to Stuyvesant, 18 miles below Albany, where it gradually comes down from its high level west of the river to meet the water-level grade of the main line of the New York Central. To give the necessary connections to the Albany branch of the West Shore R. R., which follows the west bank of the Hudson river, two branch connections are necessary which leave the main line of the new cut-off at the east-



Trestle at Baker's Fill, Castleton Cut-Off of the New York Central R. R.



Steel Erection in Progress, Hudson River Bridge, View Looking East from West Abutment.

ern end of the Selkirk yard and turn respectively north and south. The map reproduced herewith shows diagrammatically the location of all these lines.

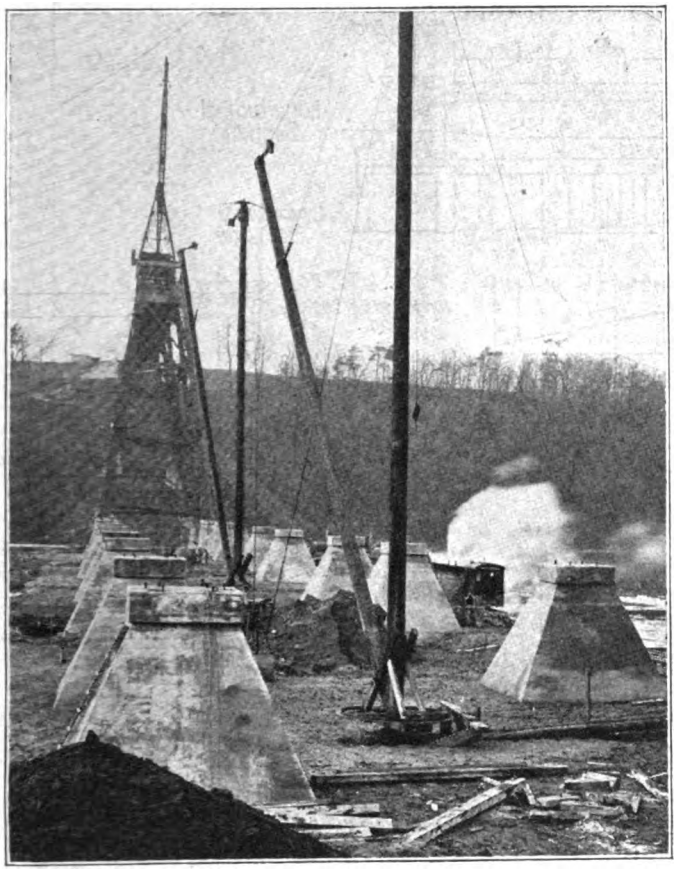
Selkirk Yard

In the Selkirk yard will be concentrated classification work now carried on in the smaller and inadequate yards of West Albany, Karner, Ravena and other points. It will consist of a hump yard in each direction, with receiving, classification and departure units, and complete mechanical facilities. It will also, in addition to the provision for hump operation, enable fast freight and other similar operation to be conducted where inadvisable to handle the cars over the hump. It is one of the most exacting tasks of railway engineering to determine the yard layout that will meet the requirements of future traffic, the exact density and characteristics of which are not known, and at the same time provide for the necessary expansion, without spreading out all over the country so that in its initial stages operation will be expensive and satisfactory.

In order to prosecute the construction work with a minimum of later interference of operation and attendant increased cost, it was decided to complete the grading for an 11,000-car yard which it is deemed will in the initial development be sufficient to provide for the operation with the Boston & Albany, the Hudson division of the New York Central and the West Shore. The first stage

Tabulation Showing Proposed Capacities of Selkirk Yard, Castleton Cut-Off of the New York Central R. R.

Name of Yard	Number of Tracks and Car Capacities in Yard											
	Ultimate Development						Initial Stage					
	East Bound Yard			West Bound Yard			East Bound Yard			West Bound Yard		
	No. of Tracks	Cars per Track	Total Cars	No. of Tracks	Cars per Track	Total Cars	No. of Tracks	Cars per Track	Total Cars	No. of Tracks	Cars per Track	Total Cars
Receiving (Tonnage)	18	80 to 125	2050	24	70 to 110	2300	9	115 to 125	1100	13	80 to 110	1300
Receiving (Fast Freight)	6	80 to 95	550	8	55 to 80	550						
Classification (Tonnage)	36	60 to 110	3000	28	75 to 125	3000	22	70 to 100	2000	28	75 to 125	3000
Classification (Fast Freight)	20	55 to 85	1400	20	60 to 95	1800						
Re Classification	16	11	176	10	11 to 16	135						
Advance	28	60 to 110	2650	25	70 to 125	2800	15	60 to 90	1050	10	125	1250
Caboose	5		80	10		110	5		40	5		30
Repair	8	8 to 34	170	22	22	484	8	8 to 34	170	13	22	280
Repair (Storage)	7	55 to 75	450	7	40 to 60	350				7	40 to 60	350
Transfer	11		400	15		500						
Icing	5	20 to 60	260									
Live Stock	4	40	160									
Coal Stocking												
Totals	164		11346	169		12029	59		4360	76		6210



Looking West from Top of West Pier, West Approach to Hudson River Bridge.

of the development, however, will include the construction of tracks for approximately an 8500-car yard, which as a first step will accommodate the Boston & Albany traffic and that of the West Shore. This, it will be noted, comprises an extremely extensive yard layout, and naturally a yard of this extent will require complete mechanical facilities, for which ample space has been provided.

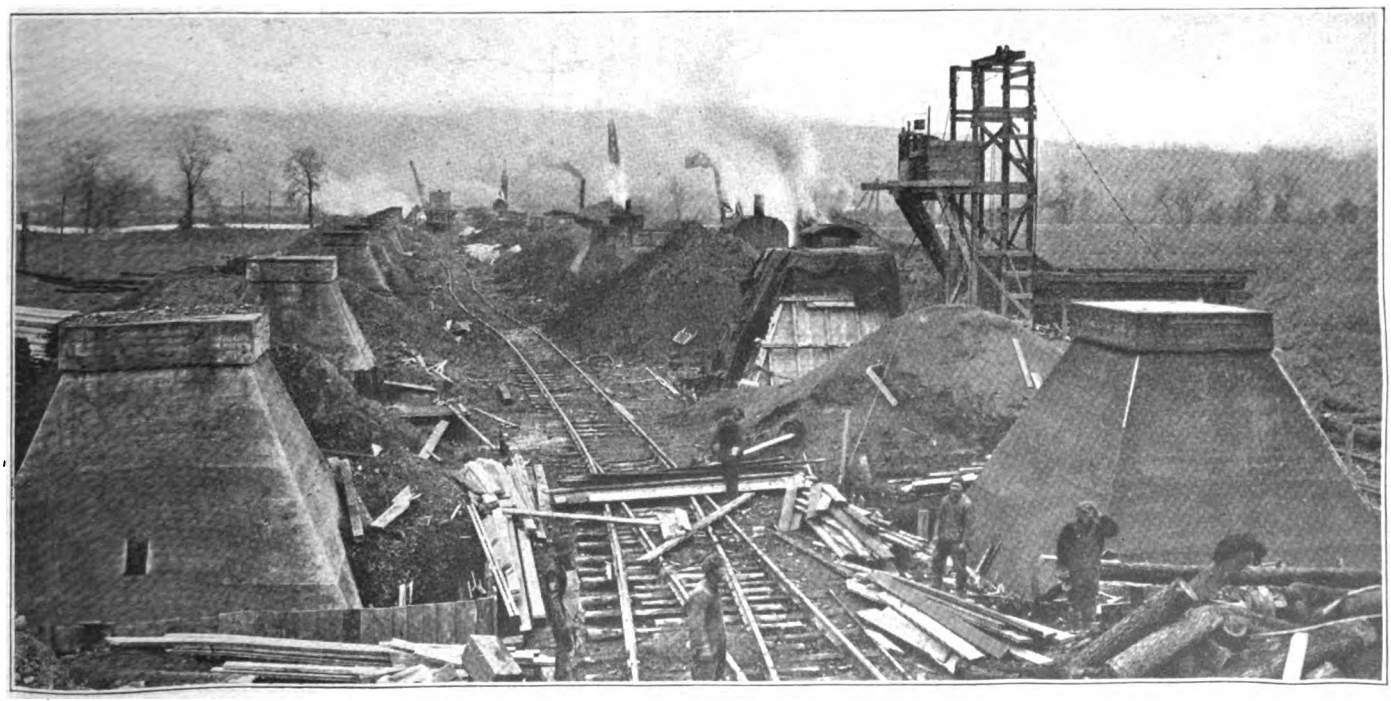
The site of the Selkirk Yard was such that the cuts and fills were very nearly balanced so that within the 6-mile site, practically all the necessary material was available. There is, however, some heavy grading in parts of the yard layout. Accompanying illustrations show some of the work in progress. The track work is also under way at this time.

Concrete Culverts

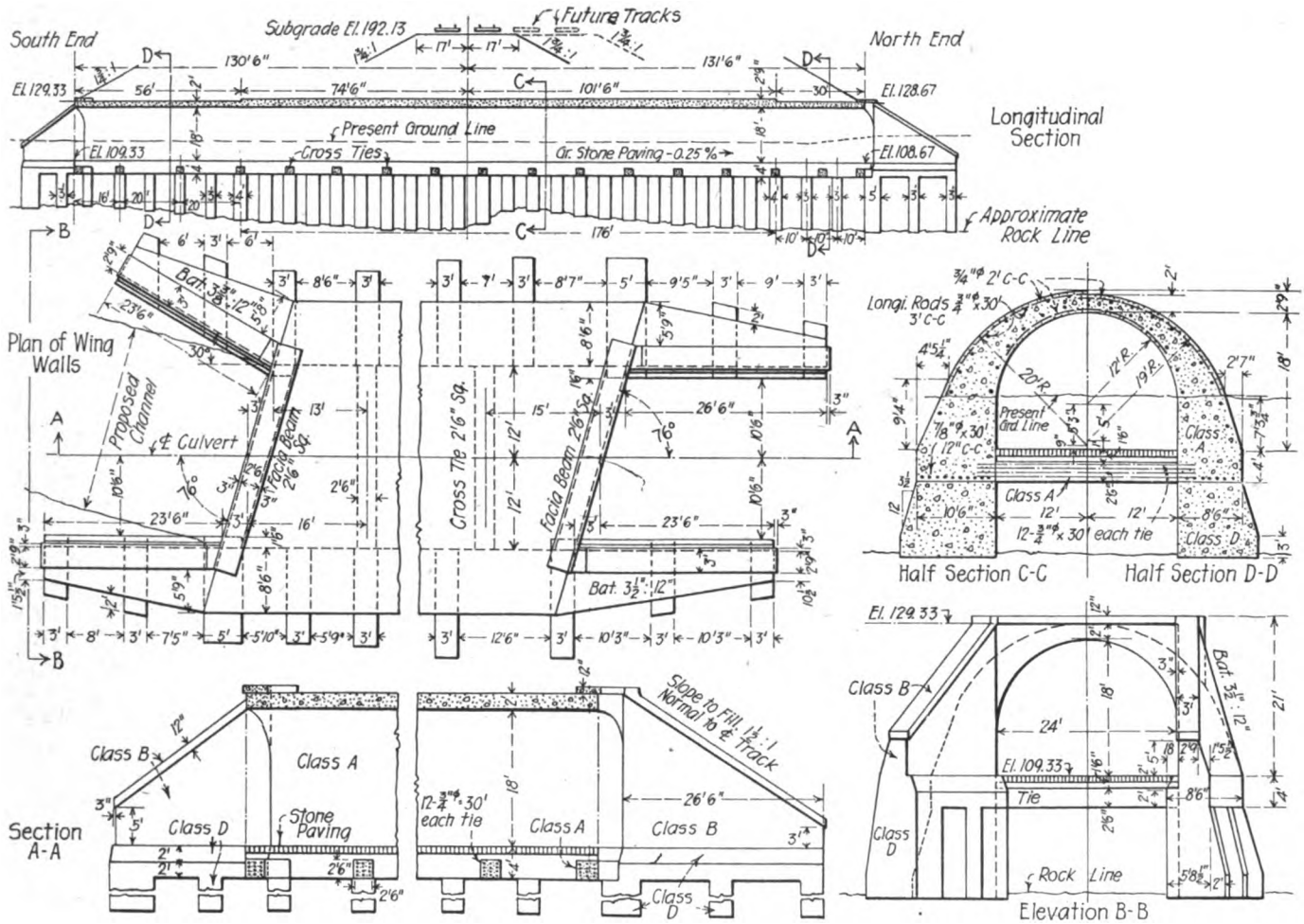
Some of the typical concrete structures of the new line are within the yard limits. In the 26 miles of new road there are 17 highway intersections, of which 10 are east of the river and 8 west of the river. Grades will be separated at all of these crossings; at those within the yard limits the highway will be carried overhead.

The typical concrete structures in this piece of work are culverts, for the purpose has been to carry the line on heavy fills, with culverts to carry the water openings, rather than to build more extensive bridge structures. In the accompanying illustrations we show plans of three typical culverts which are extremely interesting as to their size. On the main line, at station 47-552, which is just beyond where the West Shore branches take off from the main line, is located the 6x6-ft. arch culvert shown in the accompanying illustration. This structure is located on a skew and is about 212 feet long. The arch is heavily reinforced and is built upon a reinforced slab foundation 12 ft. wide and about 2 ft., 10 in. thick. The arch is 12 in. thick at the crown and 3 ft. thick at the base. There is another 6x6-ft. culvert at station 40-610, which is at approximately the middle of what will be the west bound receiving yard. At this place the layout requires a culvert 410 feet long. There is a 4x4-ft. box culvert at station 49-712. At station 31-511, which is approximately at the middle of the west bound classification yard, and which takes in also a part of the west bound repair storage yard and east bound advance storage yard, is a 10x10-ft. culvert 1,250 feet in length. This structure is on a pile foundation of 12-in. piles driven on 3-ft. centers. The footing of the structure is a reinforced slab 18 ft., 6 in. wide, and the height of the culvert over all is 14 ft., 4 in.

The New York Central Railroad's standards for culverts of this kind include water-proofing on the top and

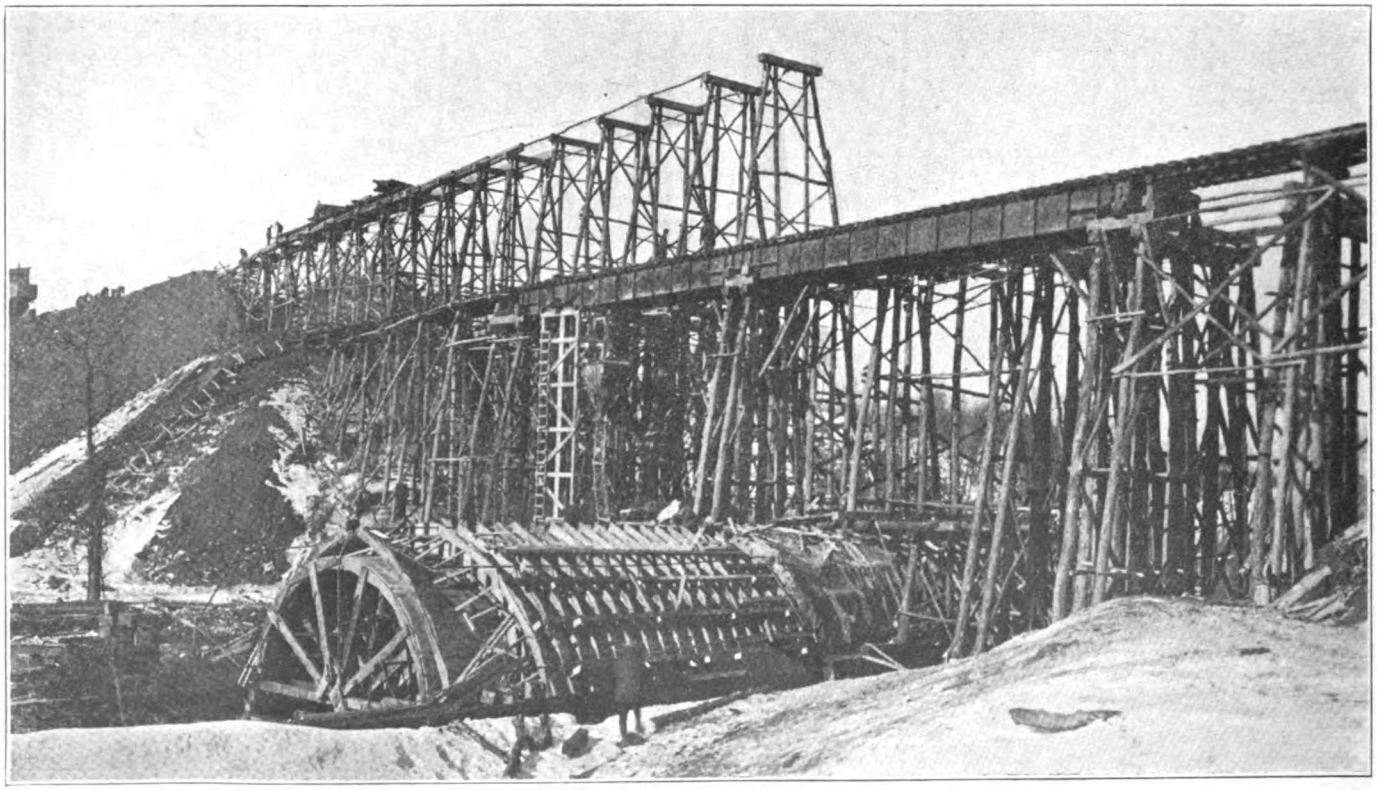


Building Foundation Piers for Steel Towers of East Approach to Hudson River Bridge, View Taken on Schodack Island, Looking East.

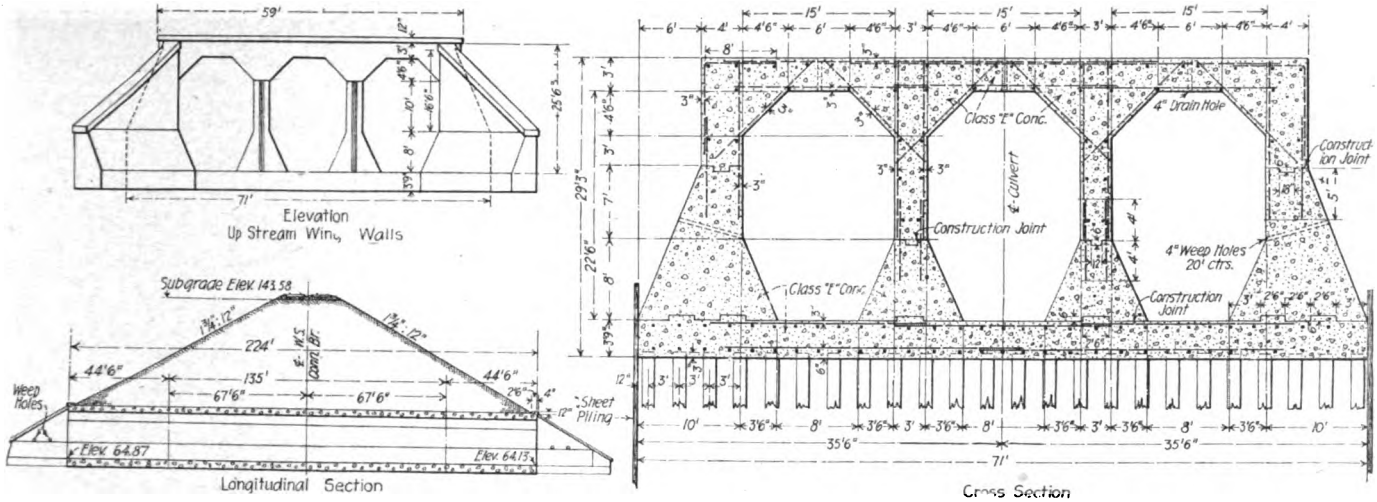


Plan, Elevation and Sections of 18 by 24-ft. Arch Culvert at Multze's Kill, Castleton Cut-Off of the New York Central R. R.

sides of the culvert and back of the wings, with straight run coal tar pitch at least ⅛ inch thick. The standard mixtures of cement are: For the arch 1:2:4 of cement, sand and stone, the maximum size stone being ¾-in.; for the foundation slab 1:2½:5, the maximum size stone being ¾-in.; for the wing walls 1:3:6, the maximum size



Fill at Multze's Kill, Forms for Culvert in Place, Castleton Cut-Off of the New York Central R. R.

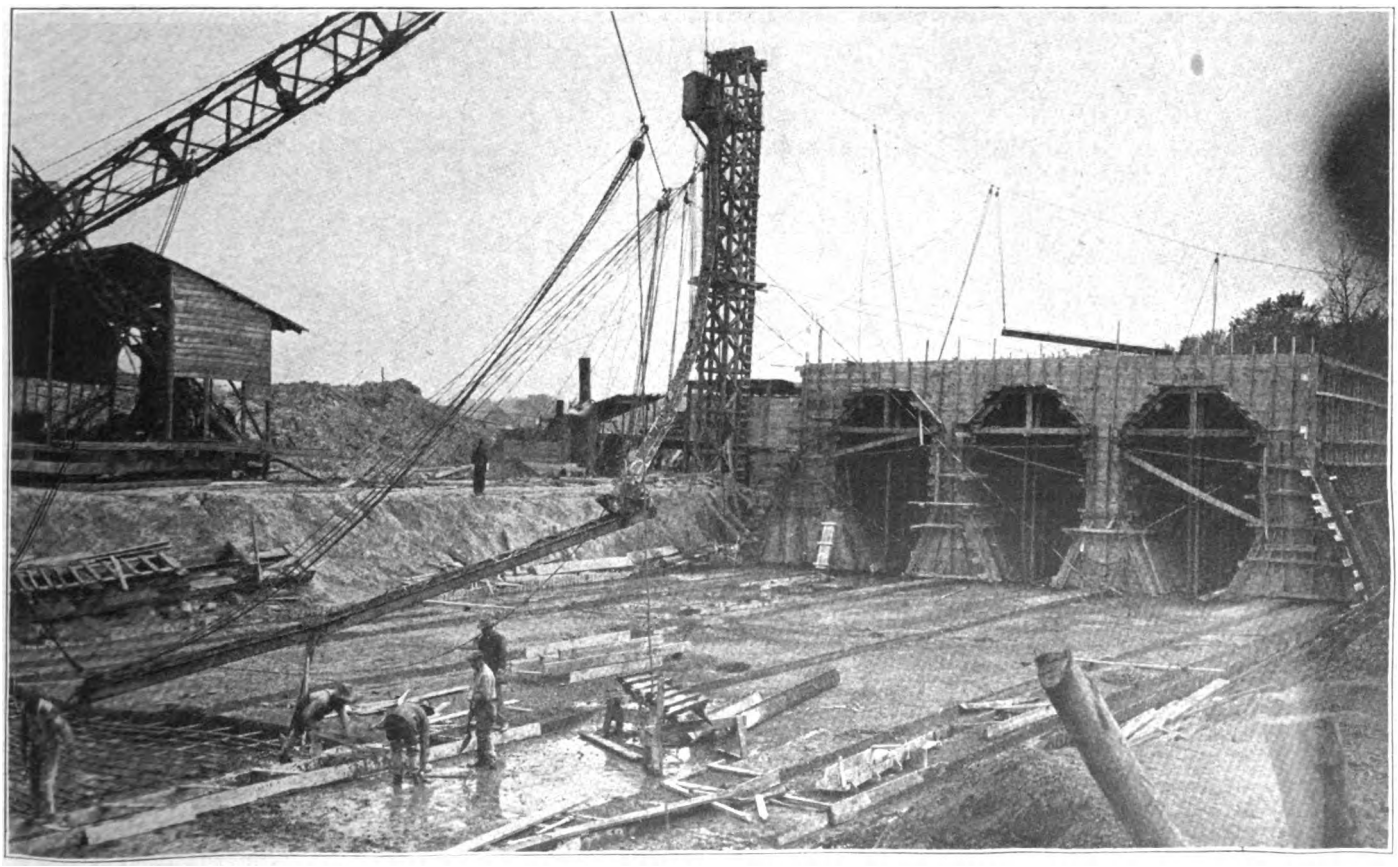


Plan, Elevation and Section of Coeyman's Creek Culvert, Castleton Cut-Off of the New York Central R. R.

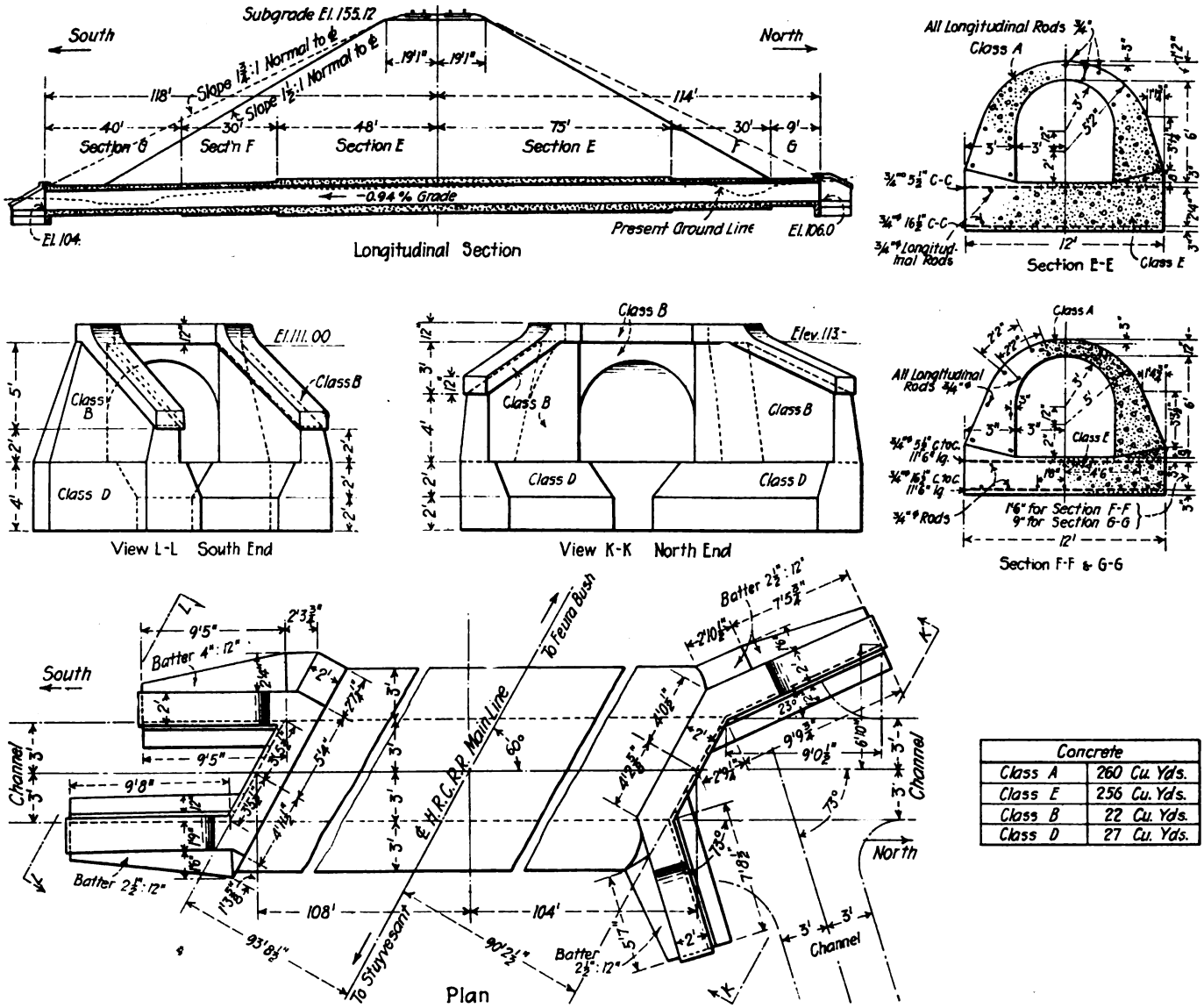
stone being 1½-in., and for the foundation of the wing walls 1:4:7⅛, the maximum size stone being 2½-in.

A much larger culvert is that at Muitze's Kill, which is on the branch connecting with the Boston & Albany R. R. at station 70-175. This is a notable structure of this type, for at this place there is a fill of about 80 feet, which was done by dumping from trestles in two lifts, as shown in the accompanying illustration. The steel girders used in the temporary trestle were some of the material for the Hudson river bridge. A fill of this magnitude calls for a length of culvert of about 262 feet The accompanying illustrations show the design of this structure. The arch is 24 feet wide by 18 feet high. Its base is a concrete slab which is carried down in the form of concrete piers to rock, which was at a depth requiring piers varying from about 12 to 20 feet. The base of the arch is 10 ft., 6 in. wide and its thickness at the crown is 2 ft., 9 in. The concrete mixtures are the same as noted above.

The largest of the concrete culvert structures, however, is that at Coeyman's Creek, which is on the branch which runs south from the main line of the cut-off to connect with the West Shore R. R. It is located at station 53-486. This is really a notable structure, for it is a three-barreled culvert, each opening being 15 ft. wide by 22 ft., 6 in. high. The fill at this point is about 70 feet, and the length of the culvert is 224 feet. The accompanying illustrations show the details of the design, also views during the progress of construction. This culvert is built on a pile foundation on which is laid a reinforced concrete slab 3 ft., 9 in. thick by 71 ft. wide. The partitions between the openings are 3 ft. thick, the outside

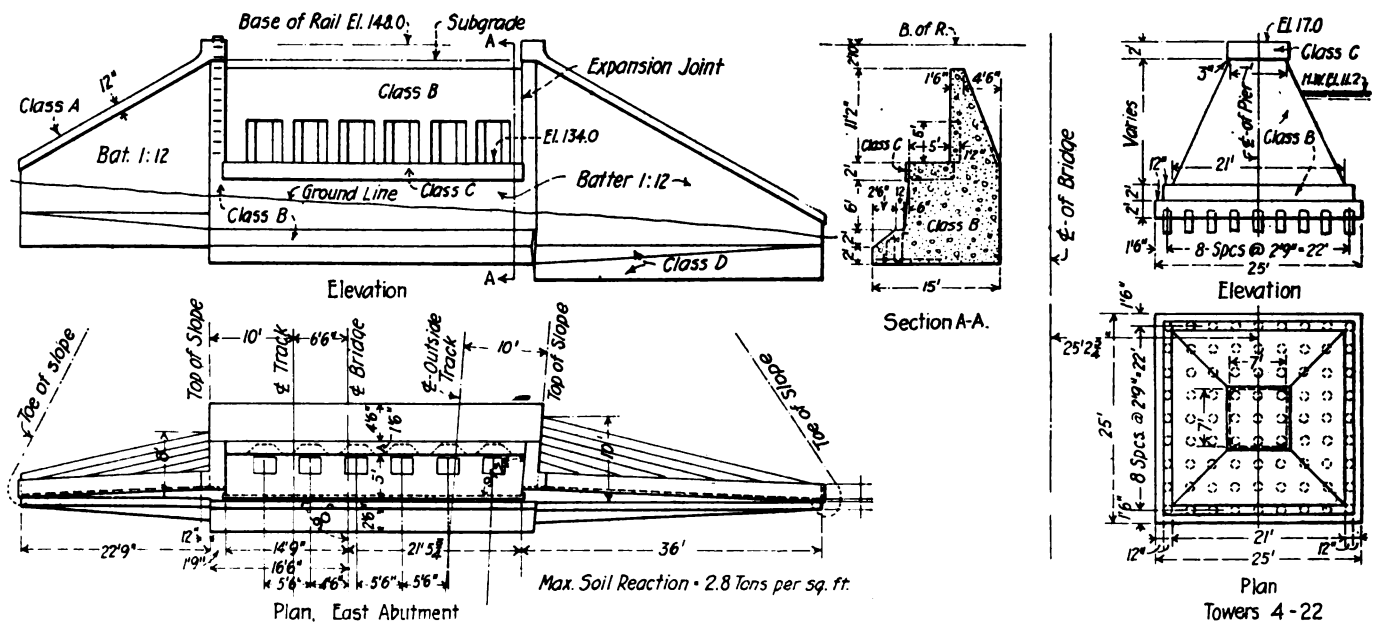


Culvert at Coeyman's Creek, Foreground Shows Operation of Pouring Concrete for Foundation Slab.



Concrete	
Class A	260 Cu. Yds.
Class E	256 Cu. Yds.
Class B	22 Cu. Yds.
Class D	27 Cu. Yds.

Plan, Elevation and Section of Standard 6 by 6-ft. Arch Culvert, Castleton Cut-Off of the New York Central R. R.



Plan, Elevation and Section of East Abutment and Plan and Elevation of Concrete Piers for Tower Foundations, Castleton Cut-Off of the New York Central R. R.

walls are 4 ft. thick, and the top 3 ft. thick. The structure is 29 ft., 3 in. in height over all. The concrete mixtures are the standard.

The Hudson River Bridge

The new bridge crosses the Hudson river at a point 1.8 miles south of Castleton, from which place the new cut-off takes its name. Castleton is 8.6 miles south of Albany. This will be only the second bridge to span the Hudson between Albany and the sea, the other being the famous Poughkeepsie bridge, which has five river piers. The Castleton bridge consists of a west viaduct bridge, 1,251 ft. 8 in. long, which comprises seven steel tower spans 64 ft. long, and eight steel deck girder spans each 100 ft. long. The channel spans consist of two steel through trusses, 598 ft., 6 in. long and 403 ft. 8 in. long, respectively, center to center of bearings. The larger of these trusses is 100 ft. deep. The east approach is a viaduct consisting of 18 steel tower spans 64 feet long, and 17 steel deck girder spans about 100 ft. in length, and two girder spans 67 ft. in length. The total length of the bridge is 5,255 ft., which is just 25 ft. short of an even mile.

The elevation of the base of the rail is 148 feet, which is approximately the same distance above mean high water. The clearance is 138 ft. above mean high water, which is 3 ft. higher than the clearance of the Poughkeepsie bridges and the bridges over the East river at New York city.

Both abutments are founded on rock, and the design of these concrete structures is indicated in the accompany drawing. The concrete mixture is: 1:4:7½ for the foundations of wing walls; 1:3:6 for the wing walls and the foundation body and backwall of the abutments. The backs of the abutments and wing walls are coated with straight run coal tar pitch at least ⅛ in. thick, and the fill back of the abutments is of cinders or other coarse material.

The steel towers in the approaches stand on concrete foundation piers which are generally of one design, except as the varying height of the piers required corresponding variations in the dimensions; for the base of the steel towers is kept at a uniform level and the inequalities of the grade of the surface of the ground are taken up by the variations in the height of the piers. The piers were carried to a rock foundation where the depth was not excessive, but at other places, which in fact was true of the majority on both approaches, they were founded on piles. The concrete is 25 ft. square at the base, 7 ft. square at the top, and the height ranges from 21 ft. to 47 ft.

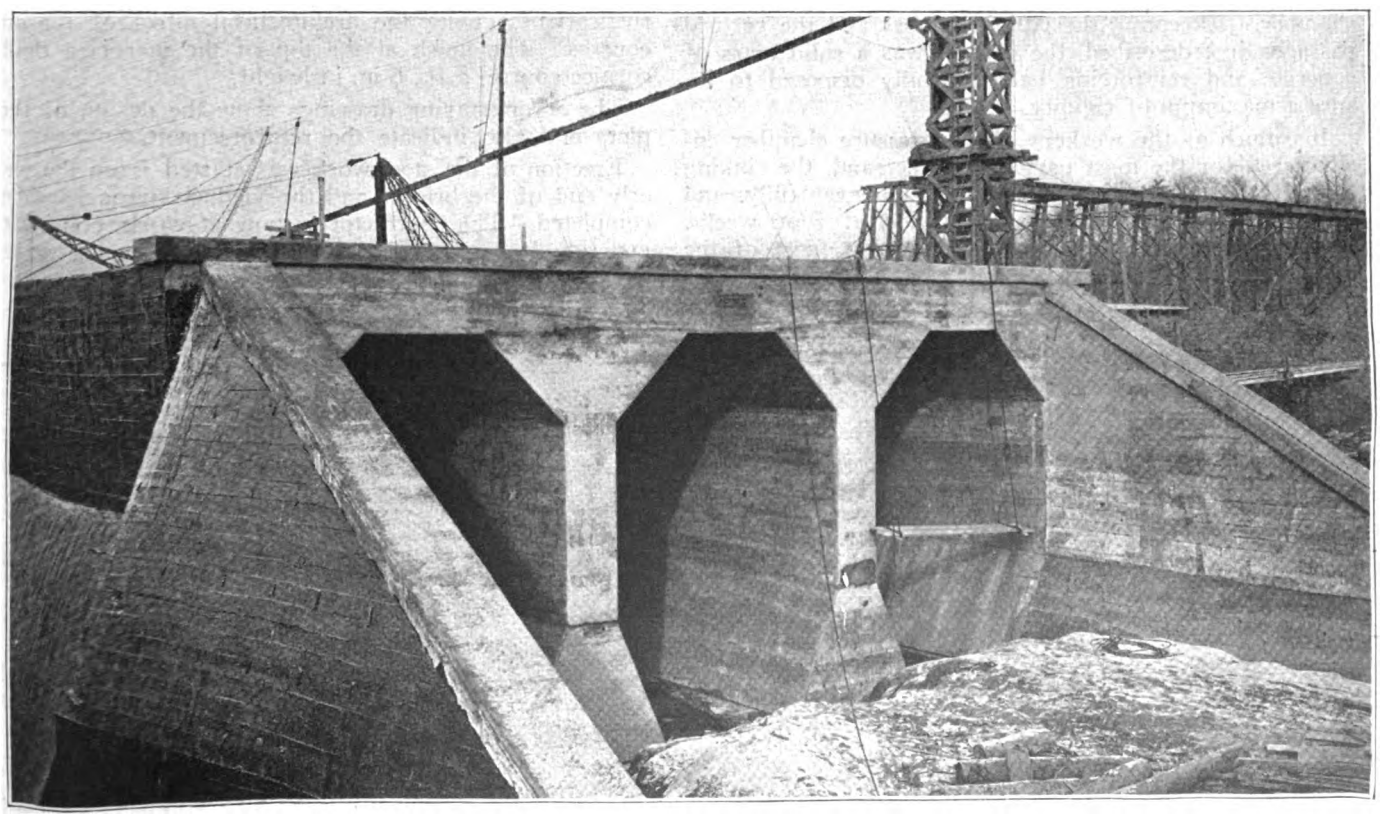
On the west side of the main course of the Hudson, the viaduct crosses an estuary in which the water is about 11 ft. deep, and it was necessary to construct four of the piers at that location. This work was done inside of a single cofferdam, built of steel sheet piling, which was kept drained until the piers were well above the normal water level. Excavation in this instance was carried to rock.

The concrete mixture in the piers is 1:3:6. It will be recalled that there are 7 seven towers in the west approach and 18 towers in the east approach, making a total of 25 towers, which call for 100 piers.

The two channel spans rest on three concrete piers carried to an elevation, at the top of the masonry, of 133.75 feet. This makes the piers, in the case of the east one about 165 feet, and in the case of the west one top. In each pier the foundation course is mass concrete about 180 feet, from the base of the foundation to the resting on rock. On the west pier this makes a foundation 41 ft., 6 in. deep and 80 ft. long by 32 ft. wide. For the east pier this foundation is 21 ft., 6 in. deep, by the same length and width.

For the east pier, which is shallowest, the foundation was carried down by excavation in steel sheet piling cofferdam. Incoming water was effectually held in check by steam pumps, and no troublesome conditions arose.

The foundation for the center and west piers, how-



Culvert at Coeyman's Creek, Concreting Finished and Forms Removed, Castleton Cut-Off of the New York Central R. R.

ever, was placed in pneumatic caissons. The problem entailed getting down to 45 and 50 feet below the river level in order to secure a satisfactory footing upon the shale rock. The central caisson was the deeper, but the sinking of the west caisson was the more exacting engineering task because it involved breaking through a stretch of the dike flanking the main channel on the west side of that navigable waterway. The dike was formed of a backbone of piling supported by riprap. The caisson at this point was the first to be sunk.

The initial step consisted of building an elliptical cofferdam, of Lackawanna sheet piling, having a major axis of 102 ft. and a minor axis of 55 ft. Owing to the wet and unstable character of the enveloped area, sand from without the cofferdam was turned into the confined space for the purposes of providing a foundation for the caisson at the start and for equalizing the soil under the cutting edges of the caisson which was to be sunk within the cofferdam. With this work completed, the construction of the caisson was taken in hand on the spot.

The original plan called for steel caissons, but it was later concluded that a saving in time and expense could be effected by substituting caissons of reinforced concrete. The west caisson, 80 ft. by 32 ft. by 17 ft., is practically a duplicate of the center caisson, which latter is 86 ft. by 35 ft. by 14 ft. Steel forms were used for the exterior, and wooden forms were employed for the interior of the caisson; and the structure was made up of superimposed sections cast successively from five to ten feet in vertical thickness.

The working chamber was divided into four compartments by three interposed, heavy, transverse bulkheads of reinforced concrete having openings in them to facilitate the free movement of the sand-hogs. The cutting edge was reinforced by ⅜-in. steel plating. Each of the compartments had its own mucking shaft and excavating lock, the shafts having an internal diameter of 3 ft. There was a fifth shaft which was used by the men in descending to or coming up from work in the pressure chamber. Excepting the latter chamber and the vertical passages just described, the caisson was a solid mass of concrete and reinforcing bars carefully disposed to insure a maximum of rigidity.

Inasmuch as the workers in the pressure chamber encountered for the most part only river sand, the sinking of the caisson proceeded steadily and uneventfully, and the total period of descent was inside of four weeks. Some mucking was done by blowing, but most of the excavated material was carried up through the air-locks. In order to insure satisfactory lodgment, some soft shale was removed by drilling and blasting before the cutting edge came to rest upon a stratum of hard rock. Twenty sand-hogs constituted a shift, and their time under pressure varied from eight hours, in the earlier stages of the job, to six hours when the second zone was reached. The work was carried on continuously, night and day.

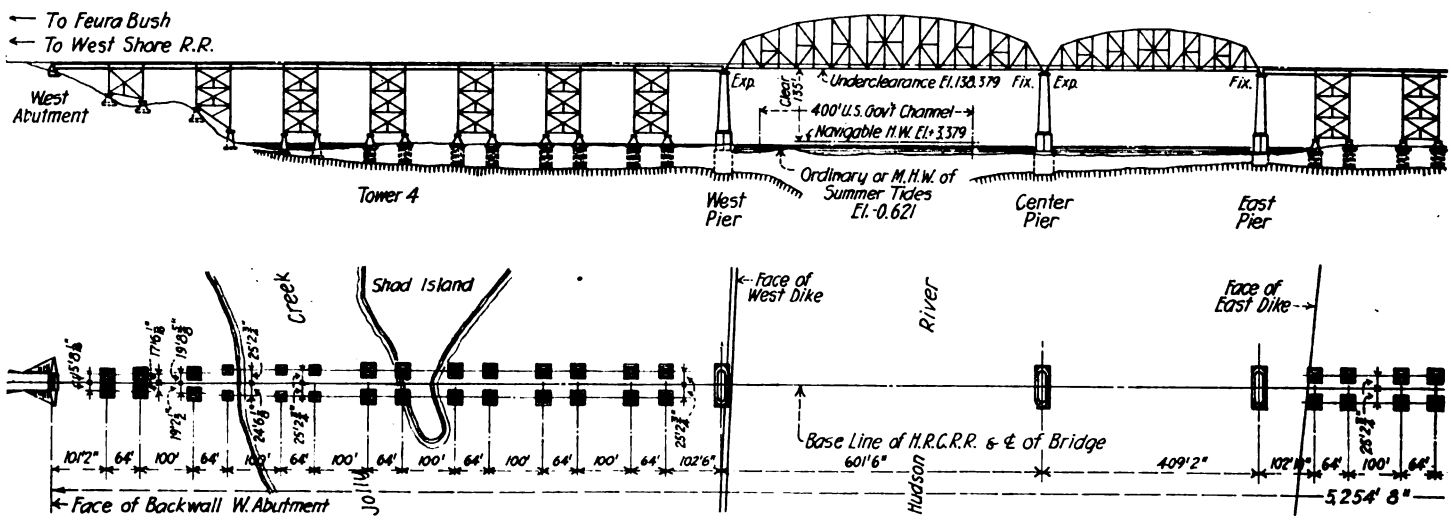
When the excavating was finished, the regular air-locks were removed and concrete locks were secured in their stead to the mucking shafts. In this way, the four compartments of the working chamber were filled with concrete, which was thoroughly distributed by hand. Finally, the remaining cavities immediately beneath the shafts and in the shafts, themselves, were closed with concrete, which settled in place by gravity. Thus the caisson in the end became a single, solid, granolithic mass bound securely to the supporting ledge of shale.

The procedure in the case of the center caisson was, for all practical purposes, a repetition of that employed in dealing with the west caisson. It has its footing on shale 50 ft. below mean high water. The foundation of these piers is 1:3:6 concrete, except the working chamber, which is 1:2:4 concrete.

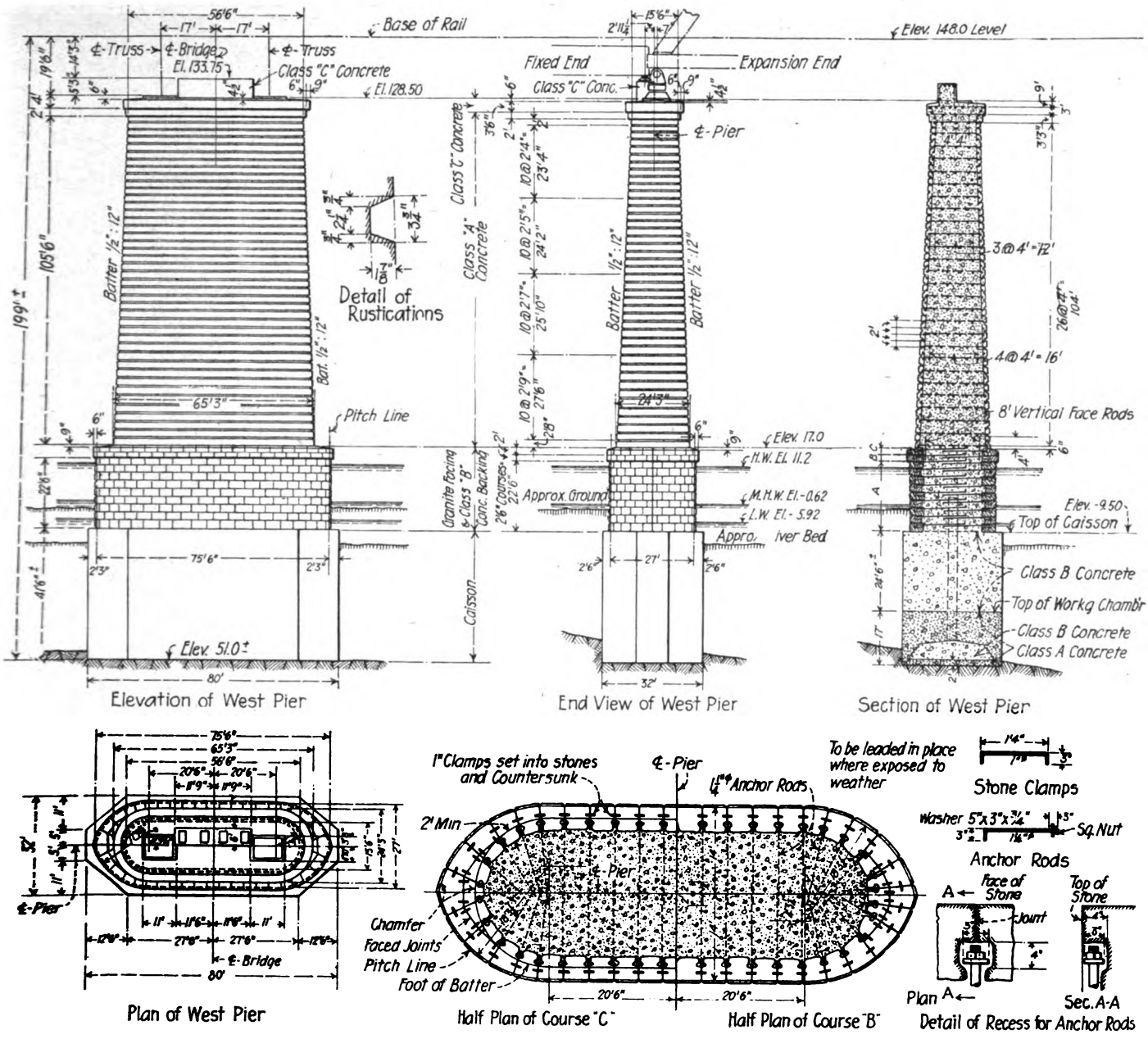
Above the foundation is a course 22 ft., 6 in. high with a granite facing. This part of the pier is without batter and is elliptical in section 75 ft., 6 in. on the major axis, by 27 ft. on the minor axis. The stone facing is composed of cut blocks laid in courses, both the courses and the adjoining blocks being anchored together with steel clamps. The stone work is also anchored into the concrete masonry by anchor rods, which are embedded at each joint. This stone work is finished by a belt course 4 ft. in height, and surmounting this is the main body of the pier, of reinforced concrete, 110 ft., 9 in. in height. It is also elliptical in section, 65 ft., 3 in. long by 24 ft., 3 in. wide at the base, and 56 ft., 6 in. long by 15 ft., 6 in. wide at the top. This is a batter of ½ in. in 1 foot. The outside face of this part of the pier is finished in rustications, giving the architectural effect of masonry courses. The finish at the top of the pier is a double cornice course, 5 ft., 6 in. in height.

The accompanying drawings show the design of these piers and also indicate the reinforcement.

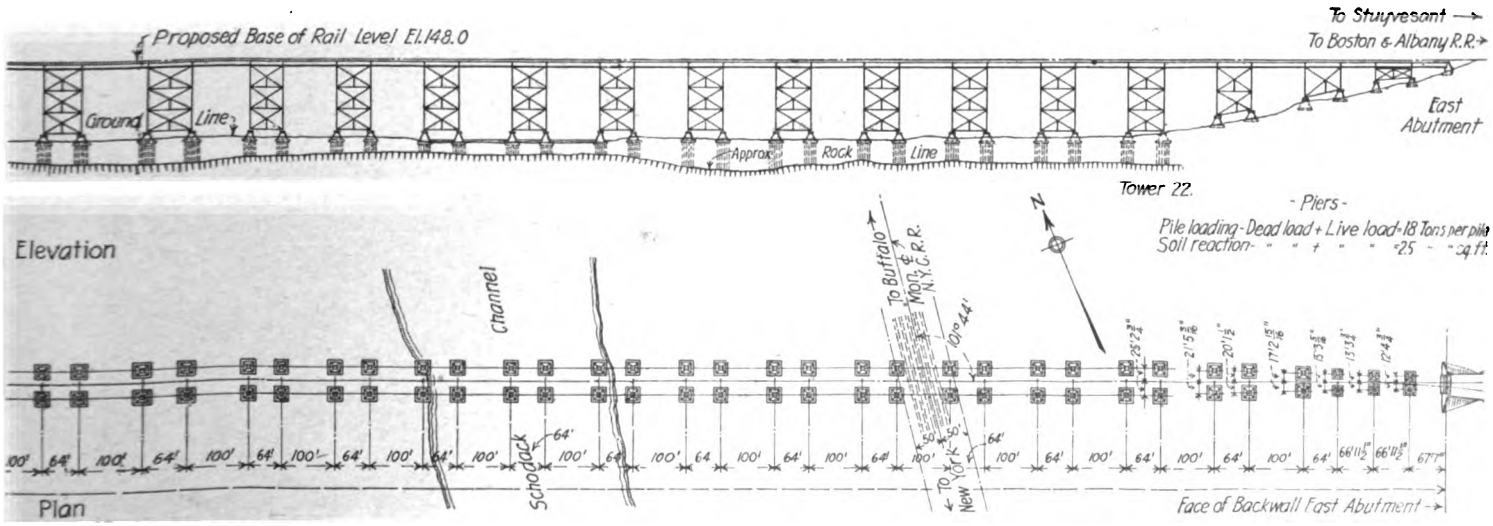
Erection of the steel work was started from the westerly end of the bridge, and the viaduct spans have been completed. The contractor is now at work pouring the concrete deck and transporting material over the westerly



Plan and Elevation of the New High-Level Bridge Across the Hudson River, Castleton Cut-Off of the New York Central R. R.



Plan, Elevation and Section of West Pier of Hudson River Bridge, Castleton Cut-Off of the New York Central R. R.



Plan and Elevation of the New High-Level Bridge Across the Hudson River, Castleton Cut-Off of the New York Central R. R.

viaduct spans for handling into the westerly pier of the main river spans. The steel viaduct spans are now progressing rapidly on the east side of the river.

This important piece of work was awarded by the Hudson River Connecting R. R. in two contracts. The Walsh Construction Co. of Davenport, Iowa, has a contract for all the grading, both east and west of the river; the erection of all the highway over-crossings; the building of the sub-structures, and likewise the concrete work for the river bridge, and the building of all culverts. The work of that company is under the supervision of H. C. Kahl and David Small, vice presidents. This firm sublet the caisson work to Arthur McMullen & Co., 50 Church street, New York city. The only other contractor, so far as the Hudson River Connecting R. R. is concerned, is the McClintic Marshall Co., of Pittsburgh, Pa., which has the contract for furnishing and erecting all the steel for the river bridge.

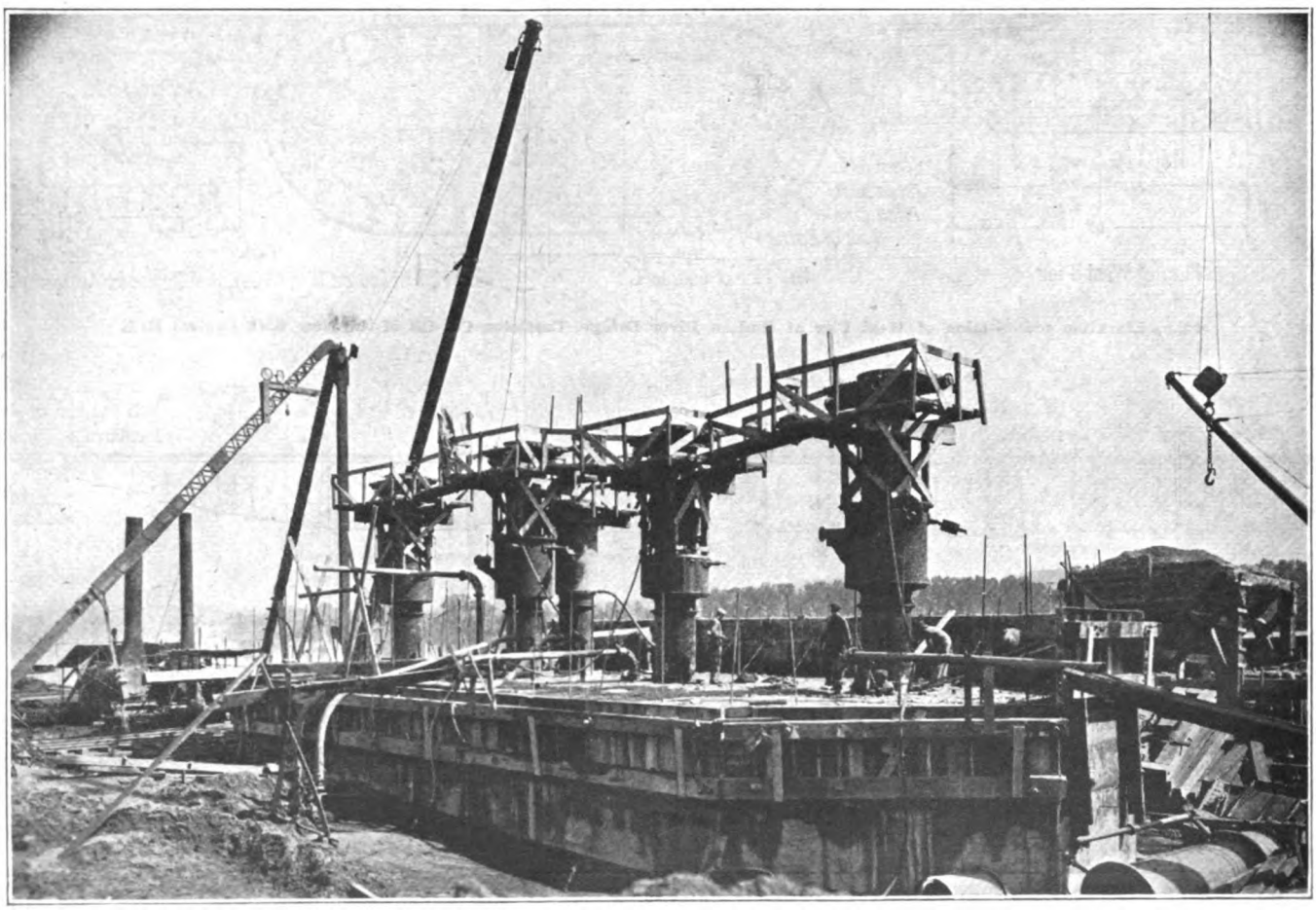
In the engineering department of the Hudson River Connecting R. R., G. W. Kittredge is chief engineer. J. W. Pfau engineer of construction, R. E. Dougherty designing engineer and H. T. Welty engineer of structures. Olaf Hoff is consulting engineer on the river bridge. The active supervision of the entire construction work is in charge of W. F. Jordan, principal assistant engineer, who is for this work, located at Albany, with B. C. Martin, resident engineer, in charge of the river bridge and work east of the river, and B. W. Farnham, resident engineer on the remaining work west of the river, including the yard. The Railway Review acknowledges the courtesy of Mr. Kittredge and Mr. Jordan in giving the opportunity to describe this work.

"Every time I come back from a foreign journey, whether from the Orient, or from the western nations, or from those that lie south of us, I have a deepened sense of appreciation of the unique and stupendous service rendered by the railways of America to the upbuilding of the life of our nation. The American people do not realize the great contribution of our railways in preventing some of the great ills and perils that have well-nigh undone other nations."—John R. Mott, Secretary International Committee, Y. M. C. A.

Railway Bridge Specifications Submitted for Approval as Standards

Specifications have recently been submitted by the American Railway Engineering Association for approval by the American Engineering Standards Committee as American standards. They are as follows: General specifications for steel railway bridges for fixed spans less than 300 feet in length, 1920, revised to May, 1923; specifications for movable railway bridges, 1922.

A large special committee will be appointed by the American Engineering Standards Committee to determine whether these specifications are suitable for adoption as national standards in this country. All the principal organizations concerned in the subjects will be invited to appoint representatives on this special committee. These specifications were prepared by committee XV on iron and steel structures, of the American Railway Engineering Association. This is a standing committee and it has prepared all specifications for steel bridges adopted by the association. The American Engineering Standards Committee, 29 West 39th street, New York city, would be very glad to learn from those interested of the extent to which these specifications are considered to meet the requirements of bridge building practice and railway service.



Caisson for West Pier, Hudson River Bridge, Showing Air Locks, Castleton Cut-Off of the New York Central R. R.