THE

Engineering Record

BUILDING RECORD AND SANITARY ENGINEER

VOLUME 58

July—December, 1908

McGraw Publishing Co.
239 West 39th St.
New York

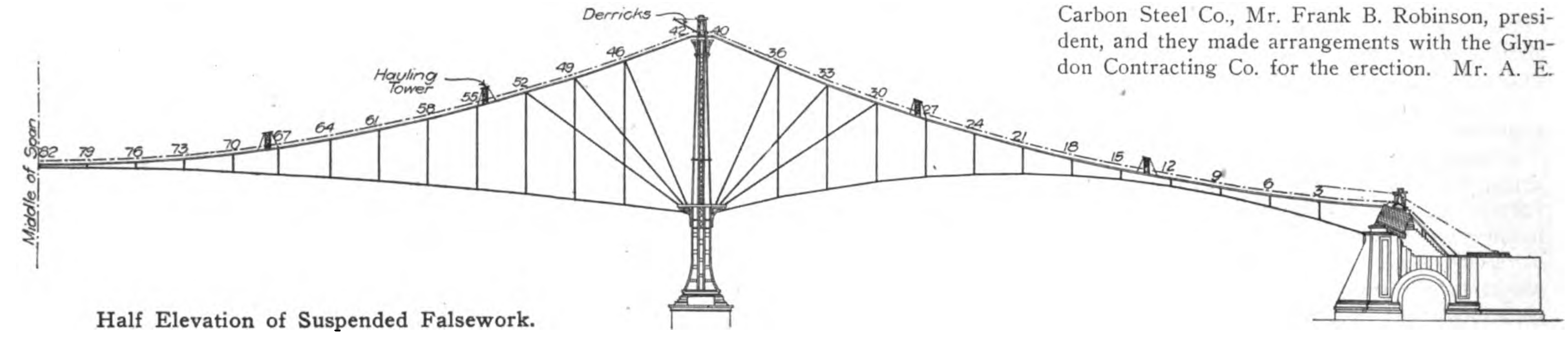
THE SUSPENDED FALSEWORK FOR THE MANHATTAN BRIDGE.

The Manhattan Bridge, across the East River, between the Williamsburg and the Brooklyn Bridges, New York City, will have the third longest suspension span in the world and a capacity greater than that of any other suspension bridge, thus making it second to no bridge in the world. Its main span of 1470 ft. will carry four suspended stiffening trusses, one lower and two upper decks, will have a width of 120 ft., a clear height of 135 ft. above mean high tide for a distance of 400 ft. at the middle of the span, and an extreme height of about 336 ft. to the tops of the tower pinnacles. It will carry four elevated railroad tracks, four electric car tracks, one 35-ft. roadway and two 10½-ft. sidewalks. It will have two suspended side spans of 725 ft. each, which, together with the steel viaduct and masonry approaches, increase the total length between terminals to about 6500 ft. Construction was commenced on the substructure in 1901, and it is hoped that the entire structure may be completed and opened to traffic about the middle of 1910.

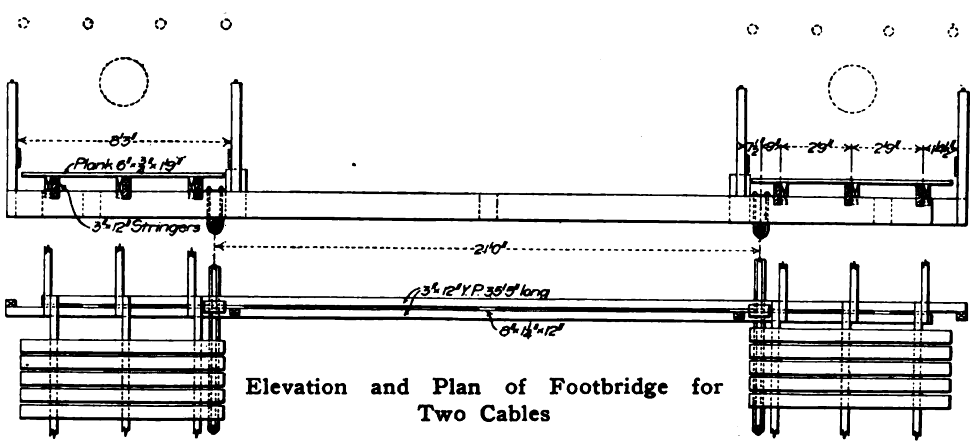
The substructure for the three main spans, including the two 6250-ton steel towers, about 415 ft. high to the center of the cable bearings, has been described from time to time in The Engineering Record, and operations are now well advanced for the commencement of the construction of the main cables.

The main cables will be in vertical planes 20 ft. and 48 ft. from the axis of the bridge. Each of them will be 21½ in. in diameter and about 3230 ft. long over all between connections to the anchorage eyebars. Each cable will have an ultimate strength of at least 55,000,000 lb. and a maximum working stress of about 16,000,000 lb. and will be composed of 37 strands, each containing 256 wires, making 9,472 wires in each cable. The wires are parallel, straight, continuous wire 0.192 in. in diameter before galvanizing, made of galvanized steel with a unit strength of at least 200,000 lb. per square inch. The wires are manufactured in lengths of at least 3000 ft. and shop spliced with right and left sleeve nuts, which develop from about 95 to 98 per cent of the strength of the wire. The wire is received at situ on reels each containing about 80,000 ft. or about four tons of wire per reel. The details of the cables and their connections were illustrated in The Engineering Record of July 21, 1905.

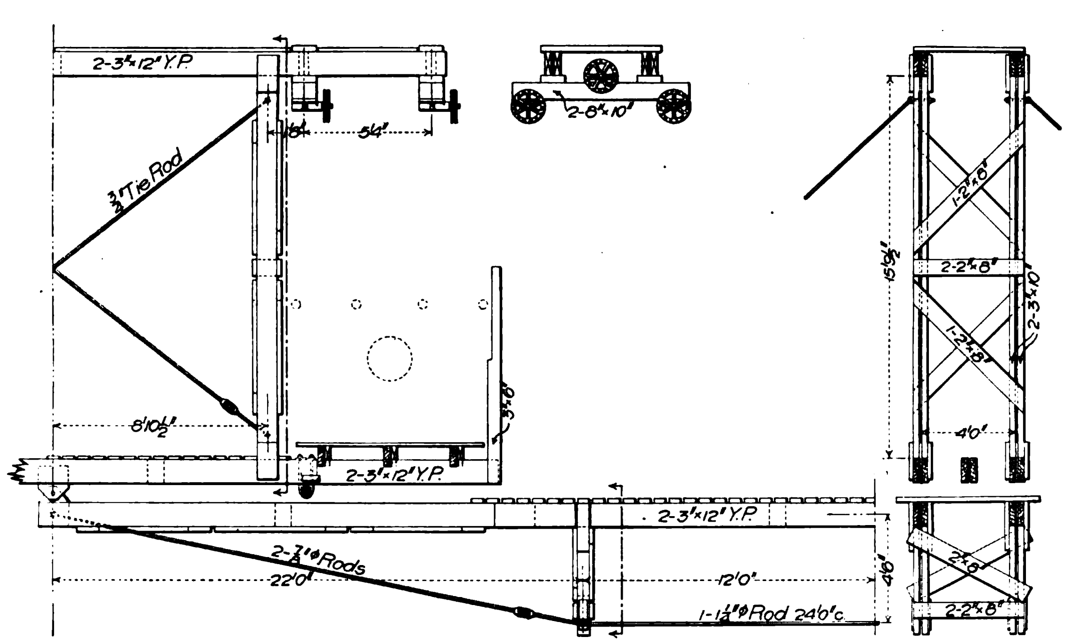
The general contract for the superstructure of the three main spans was awarded to Ryan & Parker, and in their investigation of construction methods, a system was proposed for making the cable strands complete on a horizontal platform on shore, and transferring them bodily to their positions on the towers where they would be combined to form the finished cables. A subcontract for the cables was afterward awarded to the Carbon Steel Co., Mr. Frank B. Robinson, president, and they made arrangements with the Glyndon Contracting Co. for the erection. Mr. A. E. Aeby is president of the latter company, and Mr. Holton D. Robinson, chief engineer. Mr. Holton D. Robinson, as assistant engineer of the Department of Bridges, New York City, had previously been in charge of the designs of this bridge, and determined to construct the cables entirely in their final positions by methods similar to those previously used for the cables of the 1600-ft. span of the Williamsburg Bridge, but with special plant and improved details of operation intended to secure great accuracy and much greater rapidity than ever before attained in cable making. The contract calls for the completion of the cables ready for the erection of the stiffening truss spans within 12 months after the towers and anchorages are ready for cable making, and pre-



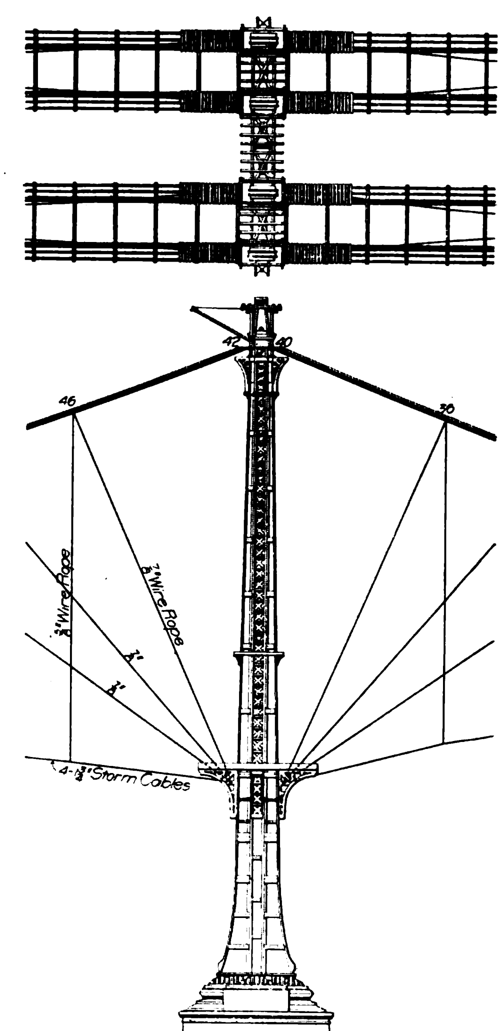
Half Elevation of Suspended Falsework.



Elevation and Plan of Footbridge for Two Cables



Half Front Elevation of the Hauling-Rope Tower and Cross-Bridge at the Middle of the Main Span.



Back Stays at Towers.

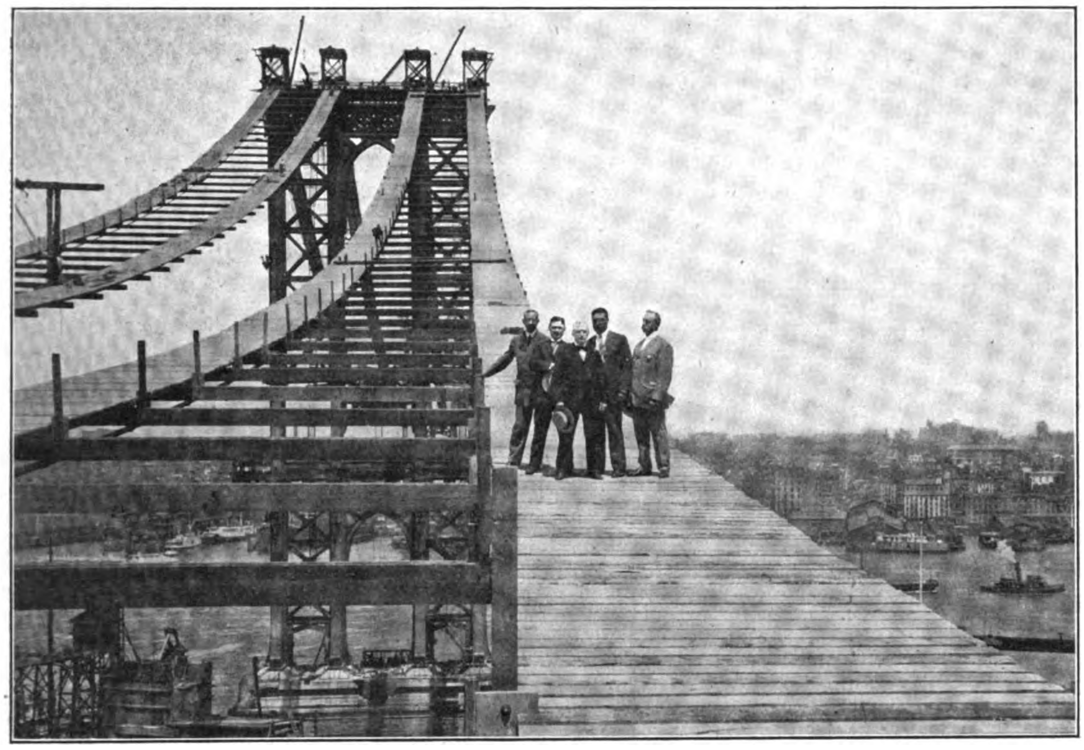
liminaries are now so far advanced that it is believed the work will be completed on or before schedule time.

The cable wires will be carried back and forth across the river, in bights, each loop being secured to the permanent shoe for subsequent connection to the anchorage eyebars, and the process being maintained continuously from both sides of the river, will provide for placing sixteen wires simultaneously. When the 80,000 ft. of wire is unwound from a reel its end is coupled to the end of the wire on the adjacent full reel in the reel frame on the anchorage and the operation of stringing and adjusting continues until the 256 wires of the strand are in place. The successive loops will be squeezed together to form the strands, seized with wire at frequent intervals and finally lowered a few feet vertically from their temporary positions, placed in the permanent saddles and on the anchor chain pins and adjusted to their correct deflection for position in the unloaded cable. When all the strands of cable are completed in place, they will be assembled into one solid mass to make the finished cable.

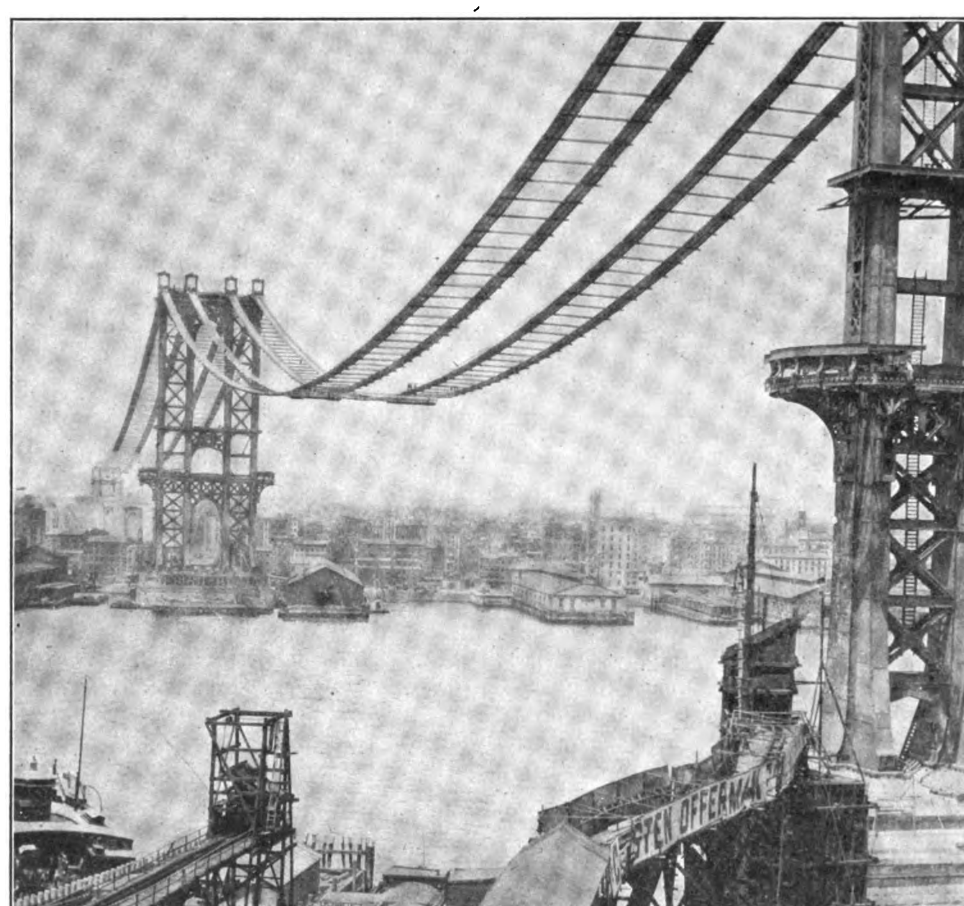
These operations will require workmen at all points of the length of the cable between anchorages, and although the cable will be at all times self-supporting, working platforms must be provided for the men. As the men work at the cables in situ, the working platforms must conform in elevation to the catenary curve of the cables, and, as great rigidity is not essential, a suspended platform is obviously most convenient, economical and suitable. A platform has, therefore, been built on light temporary cables parallel to and just below the main cables which will serve as a convenient support for the workmen, and after the completion of the cables will be removed before the erection of the trusses and floor platforms of the permanent span.

The falsework consists essentially of four platforms, 8 ft. wide, concentric with the main cables and about 30 in. in the clear below them. On each side of the bridge axis the two platforms, 28 ft. apart on centers, are carried by double cantilever floorbeams, 35½ ft. long, which are clamped to the upper sides of the temporary cables, 21 ft. apart on centers. Access from one platform to another can be had only at the anchorages, at the tops of the towers, and by a single transverse bridge at the center of the channel span. Each platform carries nine approximately equidistant small towers to support the sheaves of the carrying and hauling cables used for the placing of the strand wires. The platforms are braced against excessive deflection and against wind pressure by back stays from each tower and by storm cables curved upward and connected to them at intervals of about 54 ft. by suspender ropes.

The details of construction are very simple.



Near View of the Temporary Footbridges on the Manhattan Bridge.



Temporary Construction Footbridges across the Main Span.

Special care was exercised in the design to combine the greatest practical lightness and strength. Everything except the wire ropes is made of light wooden planks of a maximum cross-section of 3 x 12 in. Details are very carefully designed and all connections are thoroughly bolted with washer bearings. Each working platform is protected by a pair of wire rope hand rails, secured to substantial vertical posts on every floorbeam. The floor boards, 1½ in. apart in the clear, are laid on three lines of stringers overlapping and bolted together at the ends where they are dapped 3 in. and carefully fitted to the floorbeams thus materially stiffening the cables. The floorbeams are tightly secured by U-bolt clamps to the temporary cables, each of which is made with four 1¾-in. steel-wire ropes.

At the tops of the towers the falsework cables pass over cast-iron saddles riveted between the webs of pairs of 15-in. channels, 14 ft. long, which form temporary girders rigidly connected to the steel work of the towers. At the anchorage piers where these cables deflect from the curves of the catenaries to approximate tangents, leading to their fastenings, they are deflected horizontally and are supported in cast-iron saddles provided with curved grooved bearings, which are seated on the top flanges of built girders. The latter are composed of a pair of 15-in. channels 35½ ft. long, with top and bottom flange cover plates, which are secured to the masonry and will be removed after the completion of the cables. The ends of the cables are socketed, in the usual standard way, to clevises with pin connections to the anchorages.

The transverse bridge connecting the four platforms at the center of the main span consists merely of a horizontal platform 6 ft. wide laid on the top chords of a pair of queen post trusses with pin-connected suspension at the ends to special floorbeams in the working platforms. The trusses, weighing only about 2600 lb. each, are 68 ft. long and 4 ft. 6 in. deep on centers, and are entirely of wood, except for the bottom chords, which are round steel rods with pin connections and sleeve-nut adjustments. The top chords and the vertical posts are X-braced with 2 x 8-in. planks, spiked on, and the other connections are very simply detailed and thoroughly bolted, as indicated in the drawings.

The sheave tower at this point is a simple framework made with four light wooden vertical posts, diagonal rods, X-braces and adjustable steel-rod guys. It has overhanging caps, with two carrier sheaves and one alignment sheave between them, at each end. Intermediate towers are substantially the same except for variations required to correspond with the varying inclination of the stringers.

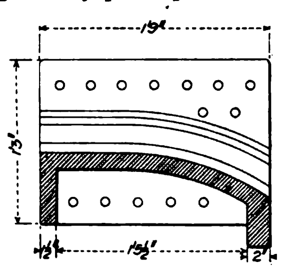
The sixteen 1¾-in. ropes required for the falsework cables are each 3300 ft. long, weigh about 17,000 lb. and were received coiled on separate reels delivered at the foot of the New York tower where each of them was painted with red lead as it was unwound from one reel and wound on another reel. Afterwards the reels were each mounted on an axle and the end of each rope reeled off and hauled over the top of the tower and back to the anchorage, where the ends were socketed with bridge sockets and attached to the anchor bars.

Everything being in readiness and the tide being slack, at flood, four of the reels were lifted by a floating derrick, loaded on a barge and towed across the river to the opposite tower pier, the ropes unwinding and dropping to the bottom of the river as the barge advanced. This operation required about 10 minutes, during which time the river at this point was practically closed to navigation by police patrol and United States harbor boats. The barge was towed by three tugs, two at one end and one at the other. After being thus placed, all of them were unwound from their reels and coiled on the deck of a barge moored to the Brooklyn tower pier. The ends of the ropes were then pulled up to the tops of the tower by a hoisting engine located on the anchorage pier, were led through the tower saddles and were pulled down to the anchorage pier by a two-part tackle made by a line having both ends carried to separate drums of the hoisting engine. The bight of this line engaged a sheave supported from a ⅞-in. carrier rope, stretched at an angle of about 30 deg. from the top of the tower to the anchorage pier. As the falsework rope had an excess of length it was necessary to take up about 135 ft. of it, which was supported from the carrier rope as the line was hoisted about 230 ft. from the river bottom, to the required position at a clear height of 170 ft. above the water.

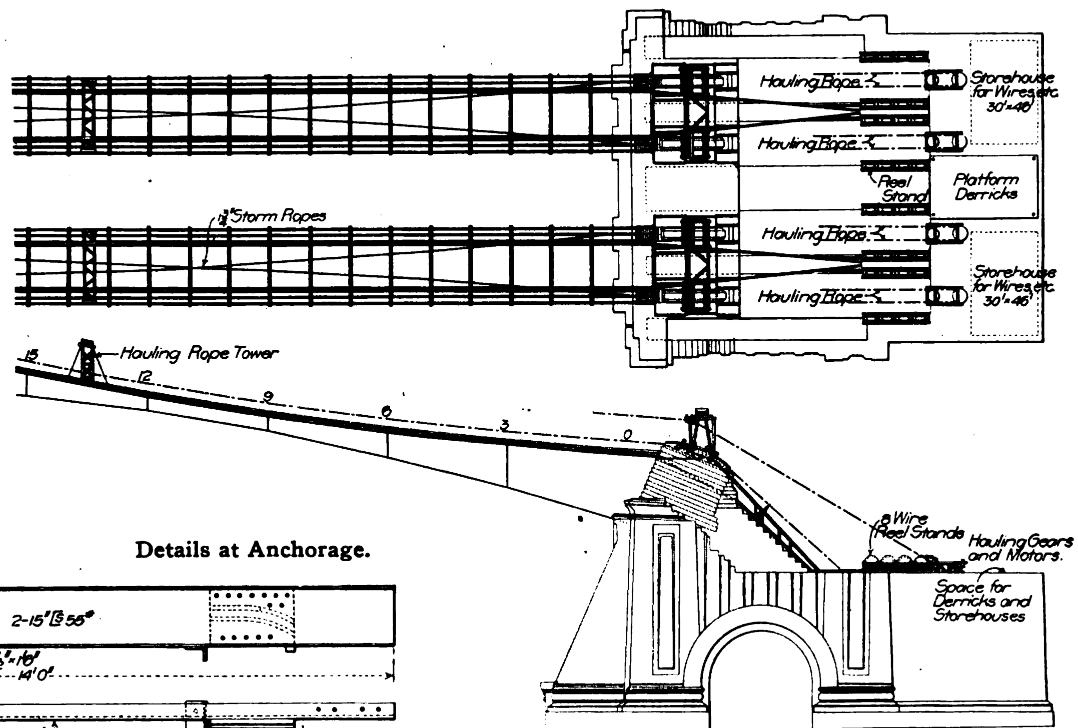
After the end was taken to the anchor pier about 20 ft. was cut off and the socket leaded on. The rope was then very carefully adjusted by pulling it into the exact catenary required as determined by elevations previously computed, and checked by levels given by instruments located in the main towers. The adjustment was made with such precision that the ropes in each cable are exactly uniform and probably do not vary more than an inch from their calculated positions. Additional checks were secured by taking angles with transits located on the piers. About 1½ to 2 minutes were required to hoist each rope from its position on the river bottom to the required elevation, during which time, of course, the river traffic was again interrupted under control of the patrol and harbor boats, as mentioned in a preceding paragraph.

After the ropes for each of the four cables were adjusted and connected together, the construction of the platforms on them was immediately commenced and rapidly prosecuted. All the woodwork had been previously cut to length, framed, bored and marked and was hoisted to the tops of the towers by two derricks located on each tower. The floorbeams were slipped down on the cables toward the center of the span and toward the anchorages, spaced and maintained in position by the stringers connected to them, after which the sheave towers were erected on the platforms, practically completing the falsework.

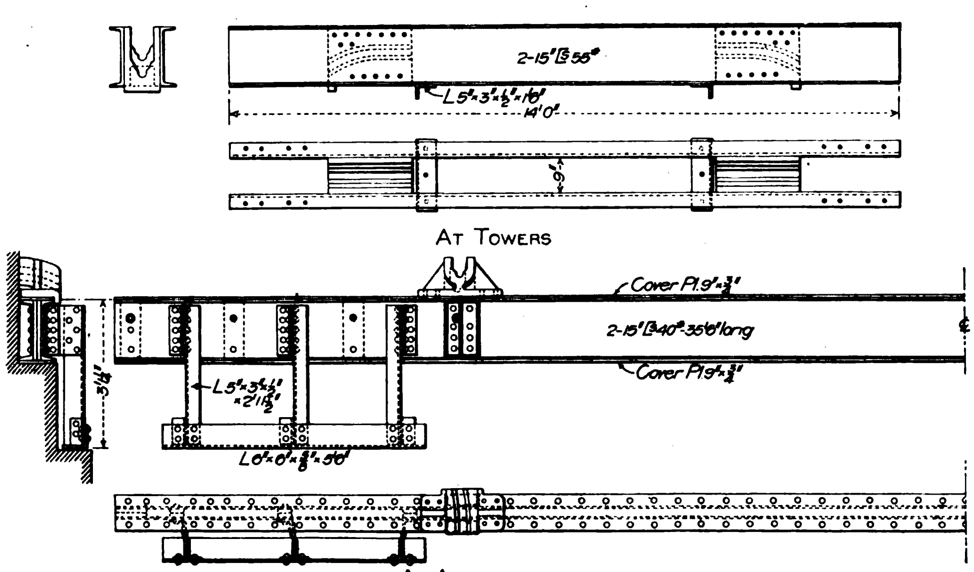
The bridge is being built under the direction of the Department of Bridges of the City of New York, Mr. J. W. Stevenson, commissioner; Mr. C. M. Ingersoll, Jr., chief engineer; Mr. Alexander Johnson, consulting engineer; Mr. D. E. Baxter, assistant engineer in charge of construction, and Mr. A. I. Perry, assistant engineer in charge of design. Mr. L. N. Gross is superintendent of erection for the Glyndon Contracting Co.



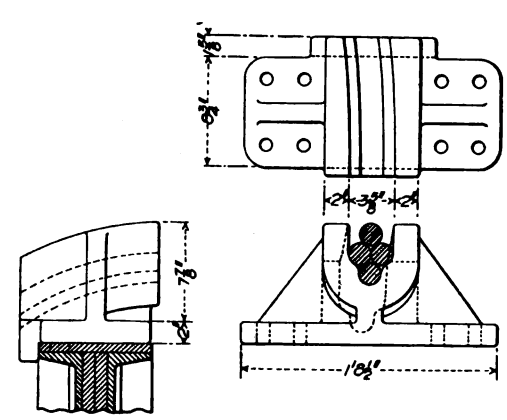
Footbridge Cable Saddle at Tower.



Details at Anchorage.



Supporting Beams for Footbridge Cable Saddles.



Footbridge Cable Saddle at Anchorage.

Simplifying School Heating and Ventilating Apparatus.

The purchase of additional apparatus to secure uniform and reliable operation has sometimes become necessary with certain classes of designs of heating and ventilating apparatus for school buildings, and studies along these lines have resulted in the development of a new arrangement of equipment by Mr. S. R. Lewis, which was discussed by him in a paper, from which the following notes are taken, before the recent Niagara Falls meeting of the American Society of Heating and Ventilating Engineers.

Mr. Lewis states that if there is any such thing as a standard type of heating and ventilating apparatus for school buildings in this country, the equipment would perhaps be described as follows: The boilers are of the ordinary horizontal return tubular type, and are operated at comparatively high pressure. The fan is engine-driven, and the exhaust steam from the engine is used in the heating system. The customary pressure-reducing valve, back-pressure valve, grease extractor, etc., are installed, and the water of condensation is returned to the boilers by an automatic pump and receiver. The air is tempered for cool air supply to the building by approximately one-third of the heating coils prior to admission to the fan, and heated for warming the building by approximately two-thirds of the heating coils set in the fan outlet.

This system, Mr. Lewis states, when carefully designed and intelligently operated, is probably more economical in operation than any other. If, however, for any reason the fan cannot be operated, the warm air will all go to the nearest and warmest rooms, and those with the greatest ex-