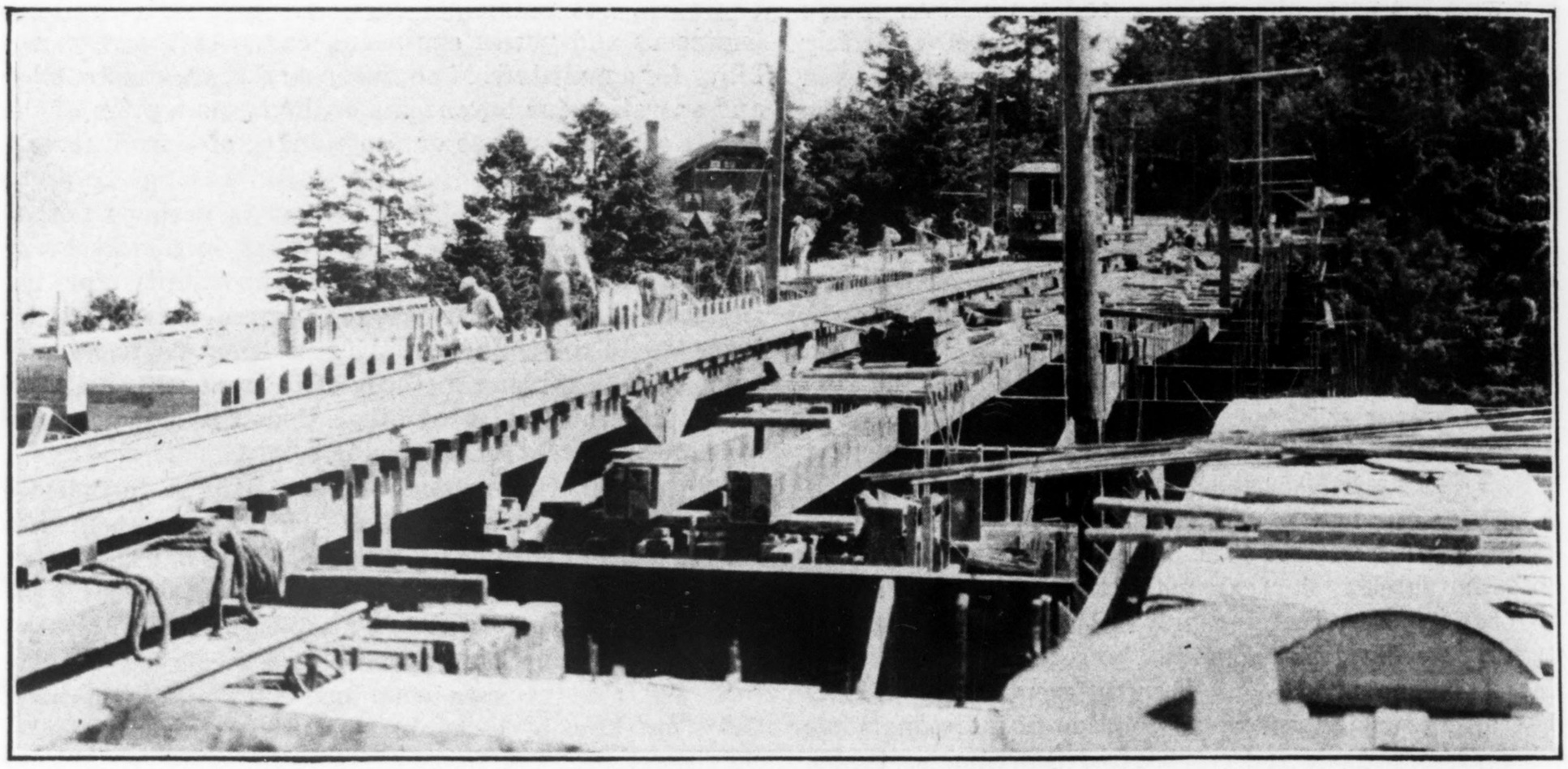
Concrete Arch Replaces Viaduct at Portland, Ore.

Design and Construction Adapted to Requirements That New Bridge Be Built Without Interrupting Railway Service—Vibration in New Structure Prevented During Concreting

THE steel viaduct on Vista Avenue over Jefferson St. Canyon in Portland, Ore., which was built by the Portland Electric Railway Co. in 1905, is being replaced by a modern reinforced-concrete arch bridge with a span of 248 ft. In recent years not only has the 33-ft. roadway width on the old viaduct become inadequate but in a high-class residential district there was serious objection to the noisy timber deck and plank roadway. A wider roadway would have necessitated strengthening the structure at prohibitive cost and instead an entirely new bridge was decided upon.

During the construction period vehicular traffic could be diverted over other streets but the bridge is essential to even the present heavy grade of the street-car line serving the thickly settled Council Crest residential district and hence one of the primary considerations was a design and construction plan that would make it possible to carry out the work without interrupting the street car service.



DECK VIEW DURING CONSTRUCTION
Track temporarily supported while half the concrete floor system is being poured.

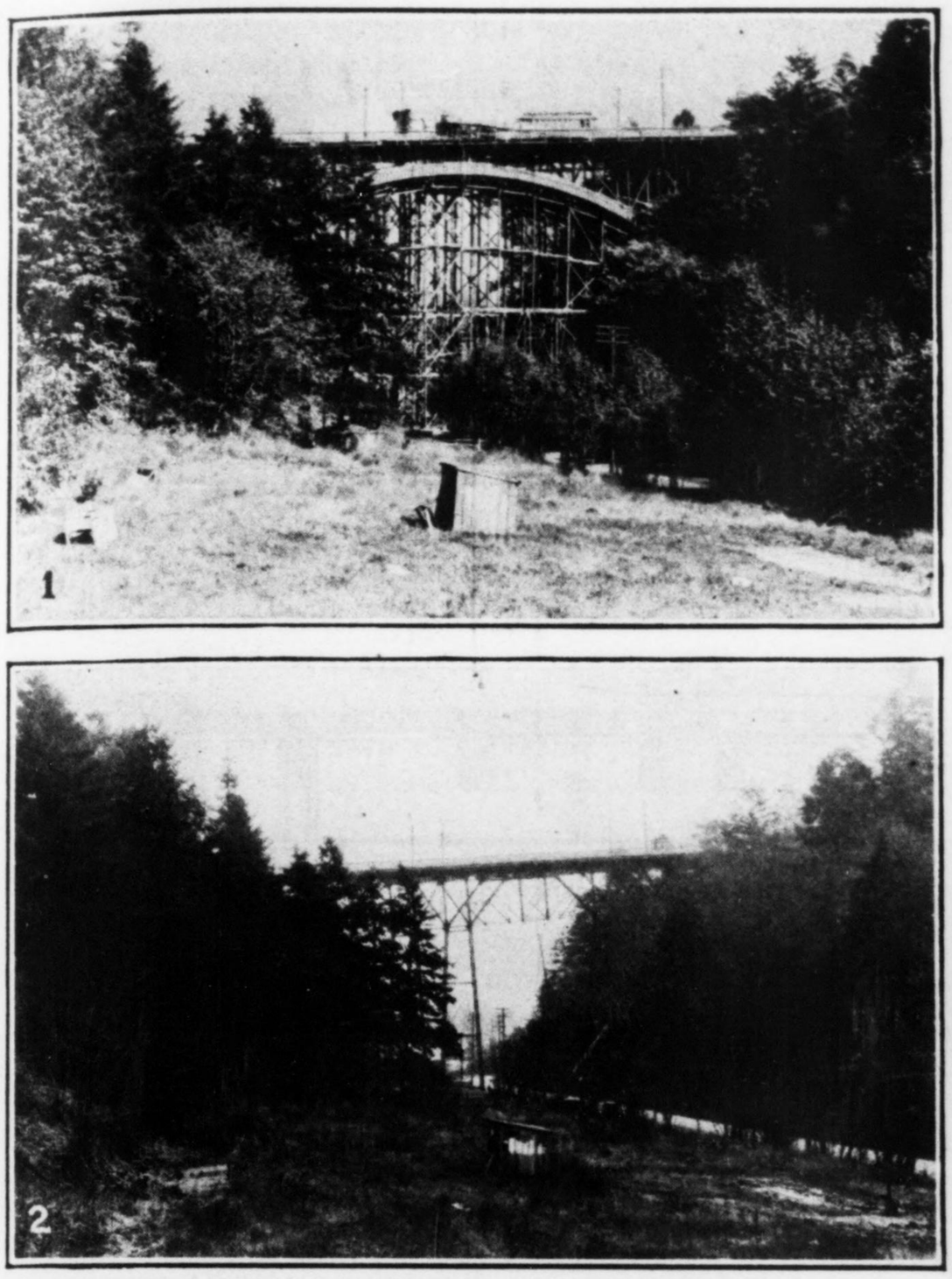
Under these conditions requirements that were important factors were (1) a floorbeam layout in the new bridge that would not interfere with the old steel floorbeams which were on 22½-ft. centers; (2) avoiding any tie between old and new structure that might transmit vibration to concrete during the setting period; (3) a design and construction program for the floor system such that all of the roadway for the full length of the bridge except the portion occupied by one existing track could be completed at one time, thus allowing one railway track to be continuously in service on one side or the other; and (4) temporary supports to replace those few members of the old structure with which interference could not be economically avoided.

By close figuring the arch ribs were so located that it was necessary to move only one steel bent of the old viaduct. For the two batter posts of this bent which was near the south abutment, two 12x12-in. timbers, each 60 ft. long, were substituted. By placing these timbers in a vertical position they carried the load without interfering with the arch forms and the steel batter posts were then moved in at the bottom and steel wedges driven at the tops so that they would still carry a portion of the load. After taking their load the 60-ft. timbers shortened about ½ in., due, doubtless, to compression of the wood fibers at the column ends.

Some of the diagonal bracing of the viaduct was allowed to go through spandrel posts or tower forms. Where these were merely tie-rods they were cut off one inch under the surface of the concrete after the forms were removed and the holes pointed with mortar. Where structural members were involved they were incased in a board framing before concrete was poured so they could be pulled out intact after the concrete had set. The hole in the concrete was then poured full. A spacing of 20 ft. 8 in., center to center, was selected for the new floor-beams when this was found to divide the span equally as well as to miss the steel floor-beams.

The concrete used was a 1:2:4 mix in abutments, footings and towers. Elsewhere a 1:1:2 mix was used, the comparatively rich mix being considered advisable on account of limited clearance over the deck of the old structure.

With the forms set up and supported on timber bents, each arch rib was completed in four successive pours, each pour comprising a yardage that could be placed in one day. All pours except the one at the crown of the arch were made in duplicate, that is, segments of equal length were poured simultaneously on opposite sides of

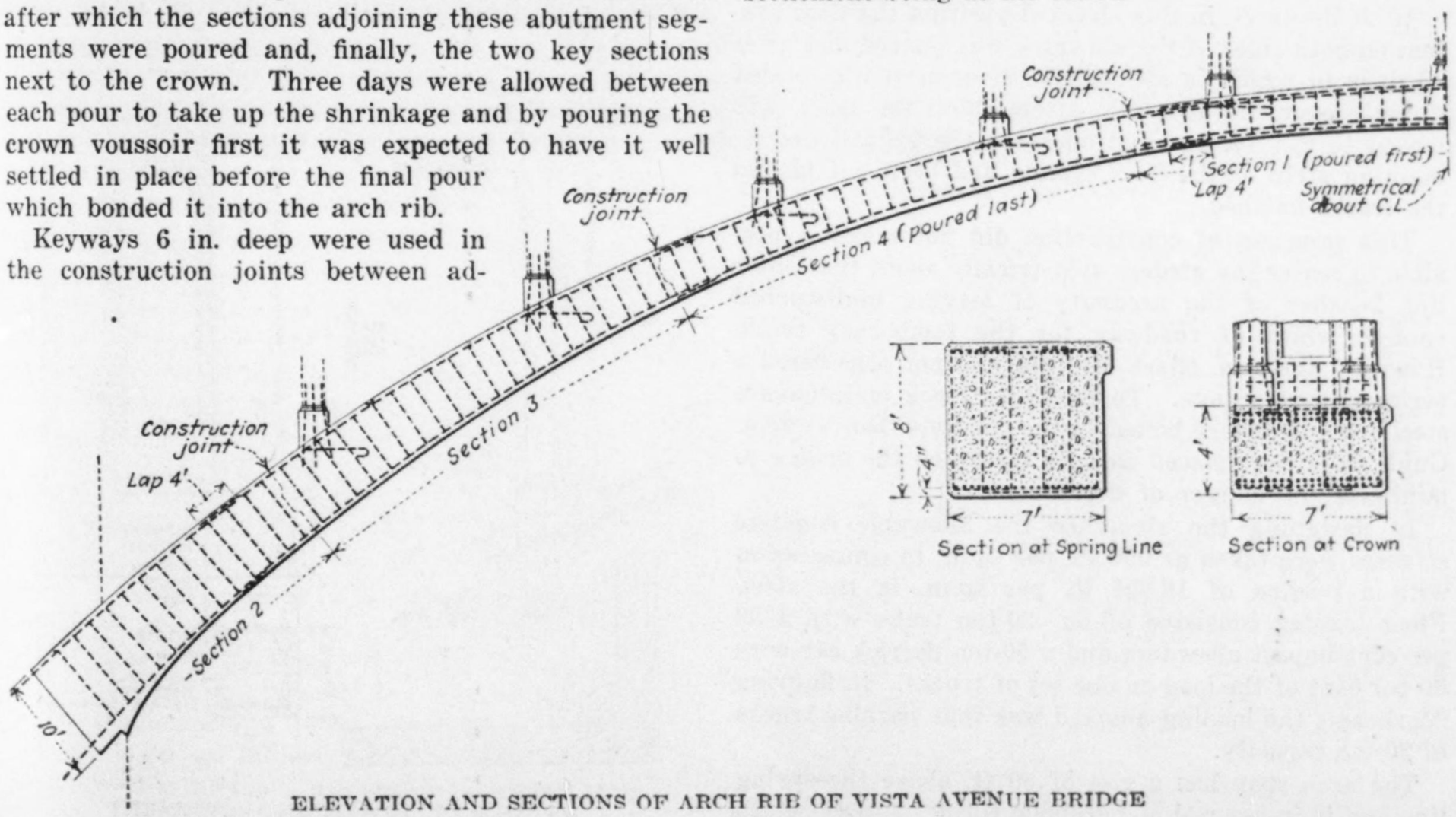


VISTA AVENUE VIADUCT AT PORTLAND

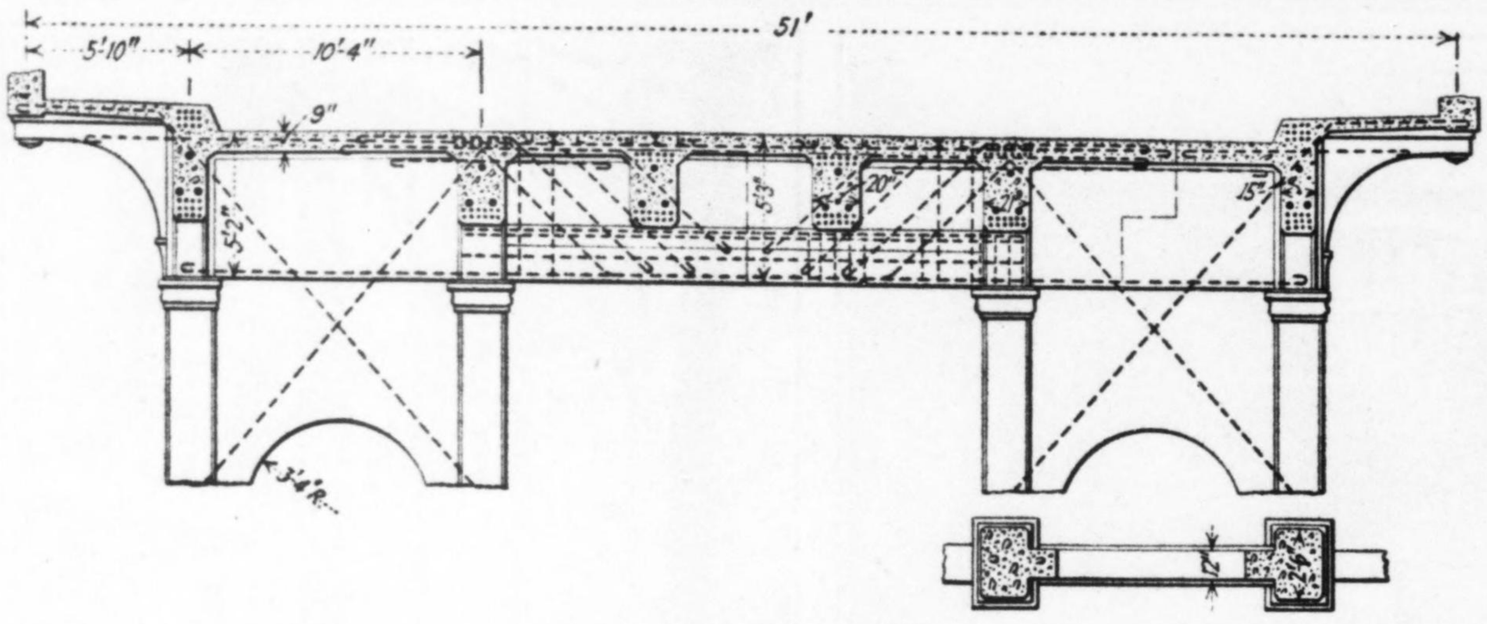
1—Forms for concrete arch. 2—Old viaduct. 3—Wood plumb posts that temporarily replaced the steel batter posts of the only bent that interfered with the arch

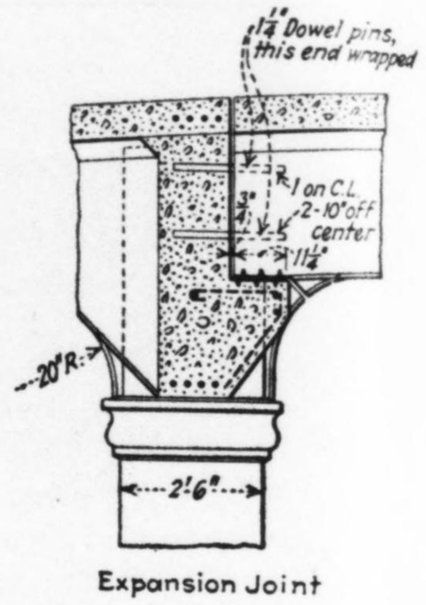
the arch crown. The first pour was made at the crown where a length of about 60 ft. was put in in one day. The second operation placed a section at each abutment after which the sections adjoining these abutment segments were poured and, finally, the two key sections next to the crown. Three days were allowed between each pour to take up the shrinkage and by pouring the crown voussoir first it was expected to have it well settled in place before the final pour which bonded it into the arch rib.

Keyways 6 in. deep were used in the construction joints between adjoining voussoirs. Under this plan of pouring a maximum settlement of 0.15 ft. occurred in the forms, this settlement being at the crown



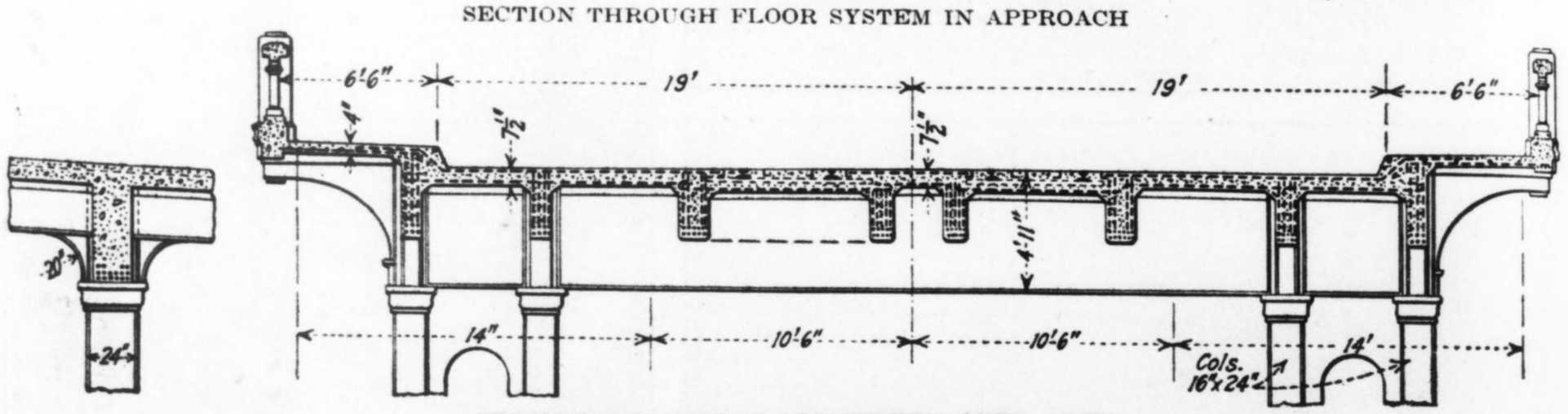
ELEVATION AND SECTIONS OF ARCH RIB OF VISTA AVENUE BRIDGE





Expansion Joint

SECTION THROUGH FLOOR SYSTEM IN APPROACH



SECTION THROUGH FLOOR SYSTEM OVER ARCH

The roadway on the old viaduct was on a 7 per cent grade and this same grade with the floor raised 2 ft. to clear the old floor system was adopted on the new structure. The original construction consisted of three 8x16-in. stringers under each rail. These stringers were raised 1 ft. and a transverse 12x12-in. beam was put on the old steel floorbeams and held in place by 4-in. planks bolted to the steel beam. It was then possible to place the forms for the concrete floor-beams of the arch span 20 in. deep, extending entirely across the roadway. The floorbeams on the approach spans were cut entirely in two with a stepped joint to allow clearance for the old track.

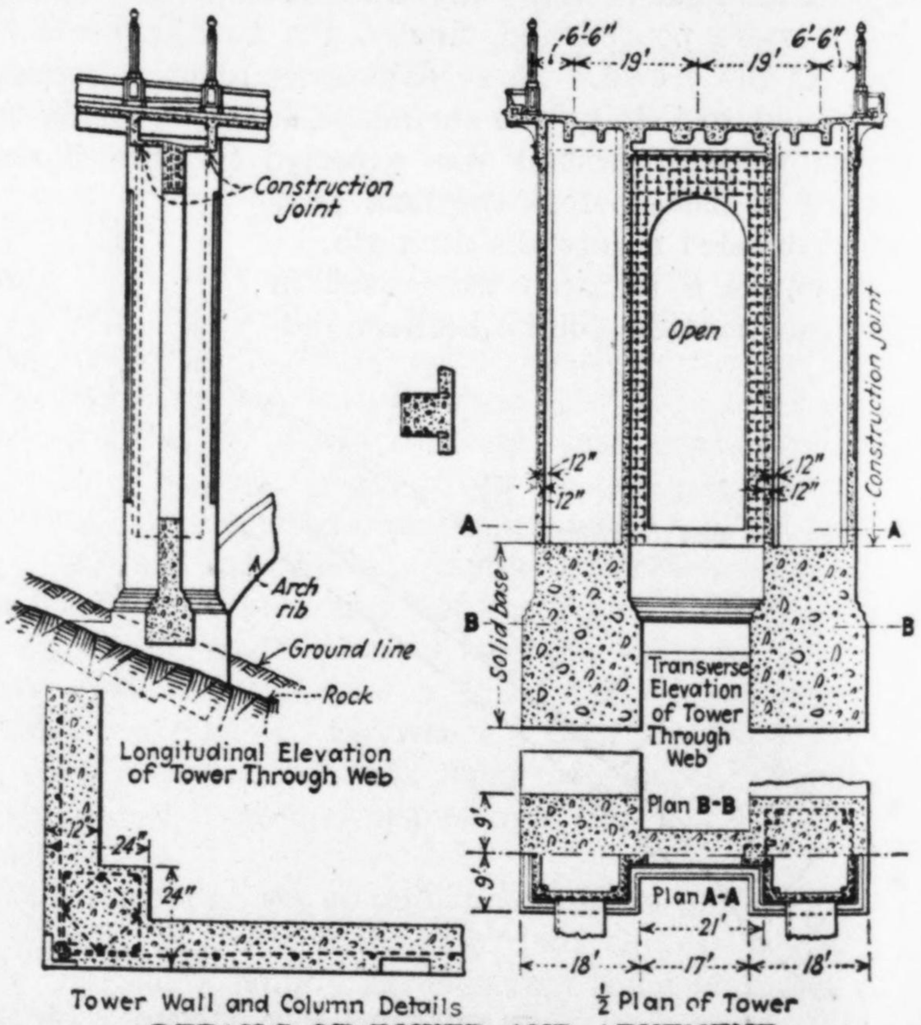
With the track in this elevated position the floor system on both sides of the old track was poured and after 28 days in which to set, ballast 6 in. deep was placed directly over the arch rib, after which the track was moved to this located and operated there until the remaining strip of the floor system had been put in and the tracks finished.

This program of construction did not make it possible to center the girders symetrically about the center line because of the necessity of leaving undisturbed enough width of roadway for the temporary track. However, the 6-in. offset involved was not considered a serious disadvantage. To facilitate track maintenance steel cross-ties were bolted in the concrete floor system. Guide rails were placed on both tracks on the bridge to minimize the danger of derailment.

In designing the structure the allowable concrete stresses were taken as 900 lb. per sq.in. in compression with a tension of 16,000 lb. per sq.in. in the steel. Floor loading consisted of one 20-ton truck with a 30 per cent impact allowance and a 50-ton derrick car with 60 per cent of the load on one set of trucks. In figuring floorbeams the loading adopted was four parallel trucks of 20-ton capacity.

The arch span has a rise of 50 ft. above the spring line and is in general of parabolic form. A deck width of 52 ft. provides for a 38-ft. roadway with two 6-ft. sidewalks. Some of the special features of the Vista Avenue arch are: Double spandrel posts and approach columns to cut down floorbeam spans; the allowance of one inch of additional concrete in the deck thickness as a wearing surface; hollow wall abutments, precast art stone made with white cement and white sand for balusters, seats and decorative features; precast "hollow-spun" concrete trolley poles; decorative illuminated portal posts and small plots for shrubbery and flowers in the entrance bays.

There is no exposed steel on the bridge; where metal is required on trolley poles or lighting standards bronze is used exclusively. Careful consideration was given to



DETAILS OF TOWER AND ABUTMENT

architectural features of the bridge because of the fact that it was located in a high-class residential district.

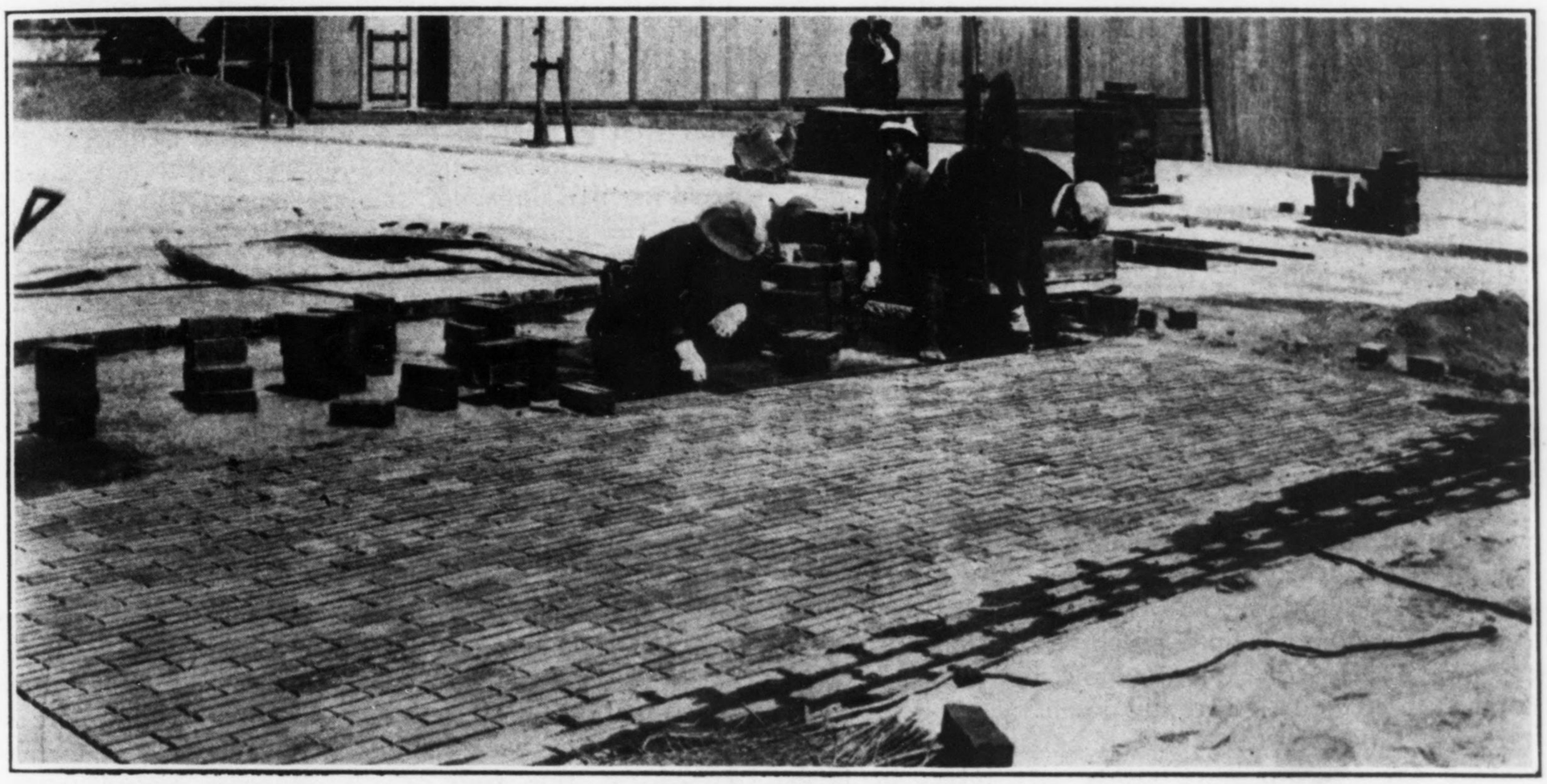
The design of the new structure was worked out by the city's engineering department; O. Laurgaard, city engineer, F. T. Fowler, bridge engineer. Contract was awarded to Parker & Banfield, Portland, for $174,870. This price included the removal of the old steel structure which then became the property of the contractor.

Grooved Brick Pavement for Grades in Tokyo, Japan

Japanese City with Prevalence of Horse Haulage Experimenting with Hillside Brick on Concrete Base

BY H. SAKAKIBARA
Tokyo, Japan

A PAVEMENT of grooved brick has recently been completed on a steep heavy-traffic street leading from the central railway station in Tokyo, Japan. The bricks are 8x4x3½ in., lugless, with a longitudinal groove in the 4-in. side on top. They are laid with mortar filler on a mortar cushion on a concrete base. Care in the mortar bed and concrete base construction are the particular features of the construction.



JAPANESE PAVER LAYING GROOVED BRICK PAVEMENT IN TOKYO

The subgrade of clay was graded and rolled to profile and on this the 1:3:6 concrete base was laid to crown and finished with all the exactitude of a concrete pavement using a finishing machine. Templets and straightedges were used to check the surface both transversely and longitudinally. The 1:3 mortar bed was laid ½ in. thick; a templet riding ½ in. high on the side forms struck off the mortar bed. The bricks were laid by hand, as shown by the view, using trowels and lines and filling the joints with a 1:1½ mortar. The bed mortar was machine mixed and wheeled to the work. Other details are indicated by the view. Tests of the pavement for foothold using heavy horse-drawn loads indicate that it will meet the situation.

New Water Supply for Sao Paulo, Brazil, Brought 42 Miles

A NEW water system now under construction for the city of Sao Paulo, Brazil, has its source of supply at the head waters of the Rio Claro, 42 miles from the city and about 180 ft. above the distributing reservoir. The project includes a 50-mile supply line of which 2.5 miles are tunnel, 27.5 miles are concrete aqueduct, all on the flow line, and 20 miles, some distance of which is in siphon, are riveted iron pipe, a dam impounding a lake at the upper end of the supply line, and a reservoir at the lower end. The distribution system from the reservoir into the city will be enlarged and improved.

Sao Paulo is the second city of Brazil and has a population of about 600,000. It is situated some 250 mile southwest of Rio de Janeiro, and about 30 miles northwest of the coast city of Santos.

The reinforced-concrete aqueduct which has been designed by the New Works Commission of the Sao Paulo Water Supply will be a gravity line. Three Brazilian engineering firms have been awarded contracts for constructing this part of the work, namely, the Companhia Constructora de Santos, Companhia Mechanica e Importadora de Sao Paulo, and Soares de Sampaio and Cia. Ltda. Of the 20 miles of riveted iron pipe 5 miles under 57 lb. per sq.in. pressure are 8.2 ft. in diameter and ½ in. thick, 15 miles under 114 lb. pressure are 5.9 ft. in diameter and ⅜ in. thick. Braithwaite & Co., Engineers, Ltd., Westminster, England, have been awarded the contract for supplying the pipe, which aggregates some 20,000 tons. The plates, varying in length from 19 to 26 ft., will be rolled in England, where the drilling, planing and scarfing will also be done. They will be shipped flat to the port of Santos and from there brought by rail to a fabricating plant erected near Sao Paulo by Braithwaite & Co. Fabrication will consist in rolling and riveting the pipe in lengths of 20 to 25 ft.

In those sections of the supply line which are in tunnel and under pressure a lining patented by Braith-