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Vancouver's New Harbor Crossing

Burrard Bridge connects residential and business districts—Approach contains Canada's longest concrete girders—Location near city park and proposed civic center influences architectural treatment

By J. R. Grant
Consulting Engineer, Vancouver, B. C.

CONNECTING the principal business and residential sections of Vancouver and crossing the entrance of False Creek, which is the city's secondary harbor, the Burrard Bridge provides an important link in the boulevard system of that city. With a total length of 2,317 ft., the bridge has long reinforced-concrete viaducts and a symmetrical central section consisting of four steel deck-truss spans and a main channel span of 294 ft. Provisions were made for a future lower railroad deck that would be provided with a swing span in the channel. The location is prominent from the harbor and from the city, is closely associated with the municipal park system and adjoins the location for the proposed civic center. For these reasons the design of the structure was modified, with a tendency toward a monumental type, and architectural treatment was an important consideration.

Viaduct Approaches — The concrete viaduct approaches, with a combined length of 1,647 ft., provide a 60-ft. roadway and two 8½-ft. sidewalks supported by three lines of longitudinal girders 27 ft. c. to c. and secondary beams at the ends of the cantilever brackets. The usual system of cross-beams and concrete slab completes the deck structure. Supports consist of concrete column bents, except where the south viaduct crosses extensive tracks and shops of the B.C. Electric Railway, where column spacing was modified as necessary.

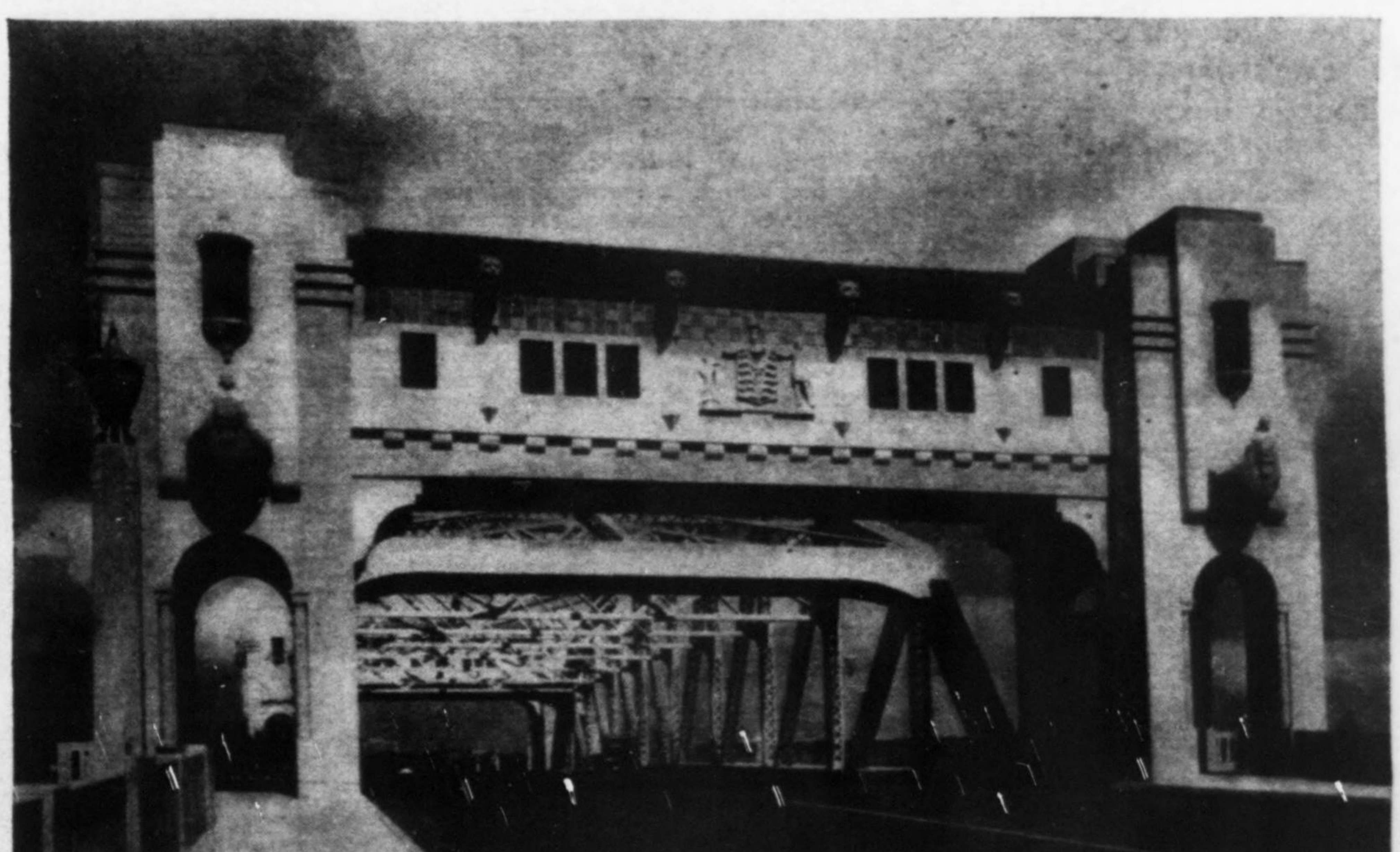


Fig. 1—Architectural pylons were provided because the site is conspicuous and near the location of the proposed civic center.

The maximum girder span in this approach system is 89 ft. c. to c. of columns, which is considered to be the longest reinforced-concrete girder span in Canada. This span is the center of a three-span unit with 76 ft. 9-in. end members. The girders are 29 in. wide, and the one along the center line is 7 ft. 3 in. deep at mid-span and 12 ft. 4 in. over the columns, with curved haunches reaching to the quarter points. Reinforcing of the center-line girder (Fig. 2) consists of 27 1½-in. round bars in the end spans and 23 similar bars in the center. The curb girders are 3 in. shallower. Where girders are continuous over columns they are fixed with vertical steel. The free ends of girders are supported by pin or rocker bearings; the latter are contained in reservoirs packed with grease.

Timber falsework was used for the viaduct construction, and concreting of the deck and upper sections of the bents was carried on with a timber tower 158 ft. high mounted on heavy timber skids. The tower was moved along a plank roadway as the work progressed.

Main Pier Foundations—The main piers on either side of the navigation channel are founded on sandstone about 43 ft. below mean-high-water elevation. Foundations are 42 by 102 ft., and excavating was done by a dipper dredge; some shooting was required to loosen the sandstone in preparing the sites. Timber cribs with steel cross-bracing were then anchored in position, filled and sunk. The foundation areas were cleaned and the concrete seals placed by tremie.

A timber frame 26 ft. high was built over the crib to support two 10-ft.-square hoppers and eight 10-in. tremies, each hung by cable attached to the drums of four hoists on the crib platform. Concrete was supplied from two 1-yd. paving maxers at the site and from a central mixing plant. By the aid of a hoisting tower the concrete was distributed by chute to the hoppers. Secondary chutes from each hopper led to the four tremies. The 2,900 cu.yd. of concrete required for the seal of the south pier was poured in 28 hours of continuous operation, and the 3,400 yd. in the other main pier in 47 hours.

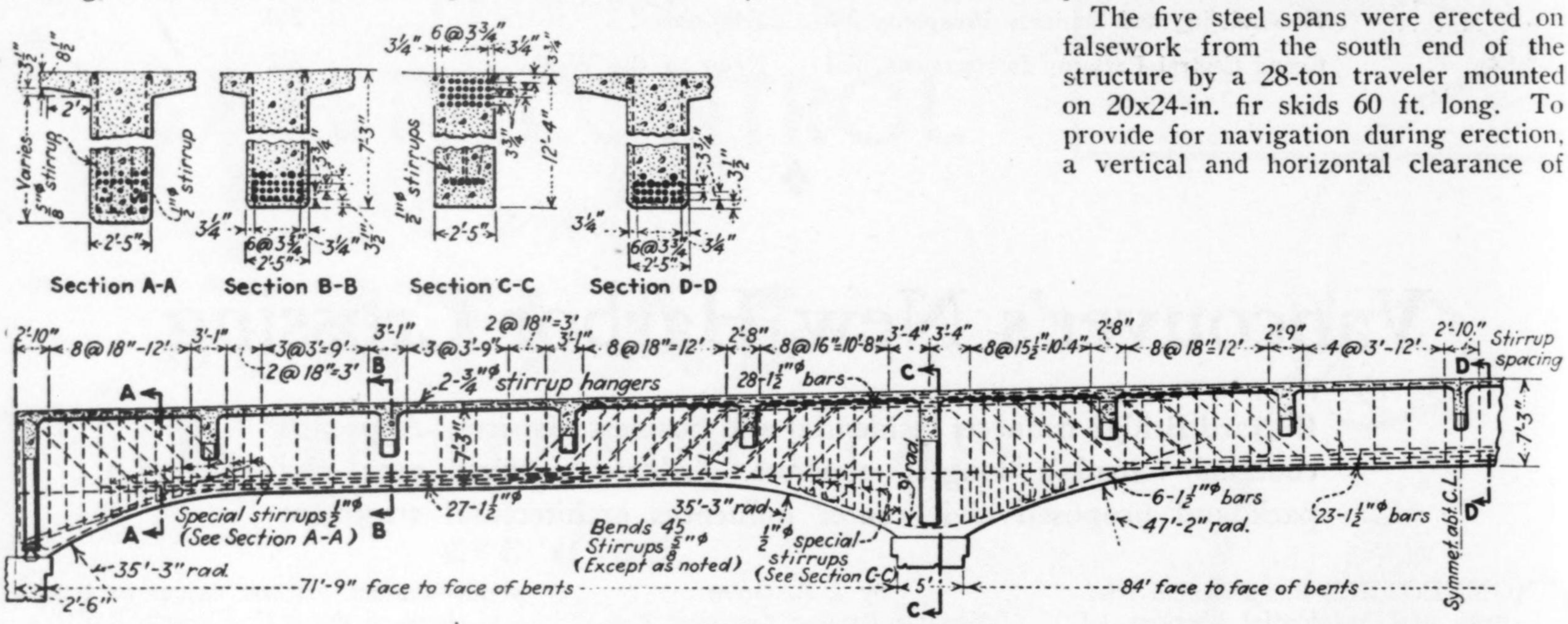


Fig. 2—Details of concrete girders in the approach viaduct to the Burrard Bridge, Vancouver, B C.

Above the footing each pier is 96x33 ft. in section, with a 3½-ft. projection on the channel side for the support of the future railway swing span. Above this elevation the piers have a slight batter and consist of two towers connected above the required railway clearance by a 24-in. cross-wall. The towers are hollow, with deep wells extending from the deck to the pier footing. Total concrete in the two piers is about 23,500 yd. Creosoted timber fenders protect the channel side of each pier from navigation and particularly against booms of logs.

Steel Truss Spans—The main channel span is 294 ft. 2 in. between centers of bearings. The trusses are of Pratt type with curved upper chords, and are spaced 65 ft. apart. To avoid excessive bending in the vertical truss members due to deflection of the long floor beams, the end connections were set and milled for vertical reaction under full dead load.

On either side of the main span is a 216-ft. 8-in. Warren deck truss flanked by 176-ft. similar truss spans. These trusses are 30 ft. deep and are spaced 43 ft. apart, with the floor beams supported on top of the chords and cantilevered out to support the 80-ft. total width of deck.

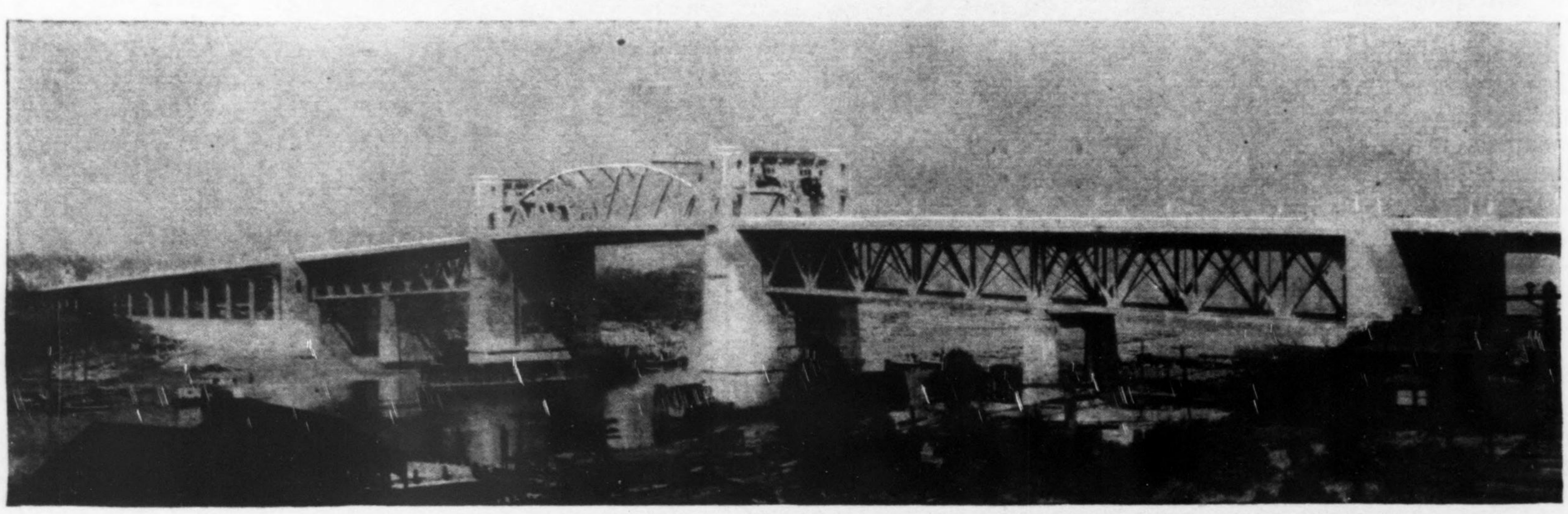
Rockers of 6-in. diameter, immersed in oil, are used for all truss expansion bearings. A depth of 7 in. of oil is specified to insure complete immersion of the tops of rockers and to avoid excessive condensation of water vapor within the reservoir. The end plates are fastened with tap bolts to the masonry plates, which have sufficient length to permit movement of the sole plates inside the oil reservoirs.

The five steel spans were erected on falsework from the south end of the structure by a 28-ton traveler mounted on 20x24-in. fir skids 60 ft. long. To provide for navigation during erection, a vertical and horizontal clearance of 90 ft. was required, which necessitated the cantilever erection of the four north panels of the channel span.

The pylons over the channel piers are 48 ft. high above the deck, or 146 ft. above high-water elevation. They are 16x24 ft. in section, with barrelled and cross-vaulted ceilings over the sidewalks. Architectural treatment is shown in Fig. 1. Cross-galleries are provided above the roadway supported on hollow reinforced-concrete girders. Over each sidewalk entrance is the precast concrete prow of a boat mounting the busts of Captain Vancouver and Captain Burrard. Floodlights for the pylons are provided.

The fill for the railway embankment under the south approach extends a

Fig. 3—Burrard Bridge is an important link in Vancouver's boulevard system. Note provisions for future railroad crossing at lower level, for which a swing span over the channel is contemplated.



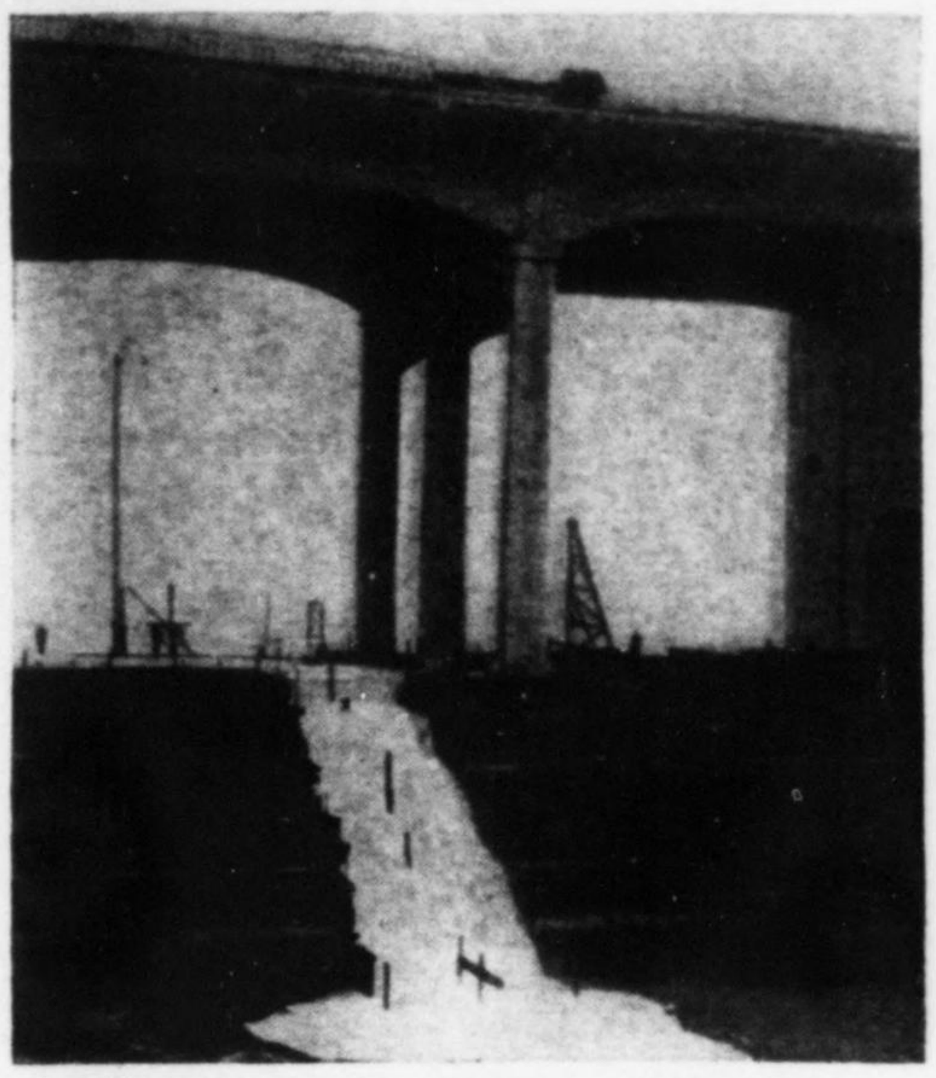


Fig. 4—Fill for the future railroad level under the south approach was placed hydraulically behind timber bulkheads.

distance of 700 ft., with a top width of 62 ft., side slopes of $1\frac{1}{2}$:1 and a maximum depth of 30 ft. The material, consisting of sand, gravel and some clay, was pumped by a 21-in. hydraulic dredge that placed a maximum of 6,000 cu.yd. in 24 hours. The bulkhead required and the overflow from the hyraulic operations are shown in Fig. 4.

At the south approach it is necessary to provide for cross-street traffic, and three islands are used to effect the separation of traffic lines (Fig. 5). Four lanes are provided in each direction, with the width on curves increased to $11\frac{1}{4}$ ft. The lanes are marked by longitudinal through and dummy joints in the 9-in. concrete paving. Through transverse joints are at 90-ft. intervals, with intermediate dummy joints at 15-ft. spacing. Automatic traffic lights provide for control at this intersection.

Costs and contracts

The total cost, exclusive of work done directly by the city and land damages, was $1,844,932. The general contract was held by the combined firms of Hodgson, King & Marble and Dawson, Wade & Co., Ltd.

Fig. 5—Broad sweeping approach, with islands to help direct traffic, is a feature of the Burrard Bridge.

Structural steel was fabricated at the local plants of the Dominion Bridge Co., Ltd., and the Western Bridge Co., Ltd., who were also subcontractors for erection of steel.

C. Brackenridge is city engineer, and Sharpe & Thompson were collaborating architects. The writer was consulting engineer, and A. J. Leamy was his resident engineer.

Record Cement-Pumping Lift Used at Pine Canyon Dam

Bulk cement trucked to site is pumped up to mixing plant 302 ft. above

A RECORD installation for pumping bulk cement, as shown by the drawing below, will lift bulk cement at the Pine Canyon Dam from the silo at the end of the truck haul 302 ft. to the mixing plant above the site. This vertical lift is double that of any previous similar installation. The rate of delivery is 150 bbl. per hour; the cement supplies two 4-yd. mixers.

The 245-ft. concrete dam is being built by Pasadena, Calif., to provide a storage reservoir on the San Gabriel River. Bulk cement is trucked directly from the mills in special truck and trailer units carrying a 21-ton combined load.

The contents of trailers and trucks are dumped directly into a hopper and lifted into a 4,000-bbl. steel silo that is used for storage. The silo is located on the highway below the dam and across the river from the plant, which is situated high on the left abutment above the site. Cement is withdrawn from the silo into the cement pump and discharged through a 5-in. line 730 ft. long across the river and up 302 ft. to the cement bin at the mixing plant. A two-way valve is provided near the discharge end so that the excess above the use of the mixing plant is delivered into another steel storage silo near the plant. This arrangement reduces rehandling to a minimum.

The installation is part of the construction plant of Bent Bros., Inc., Winston Bros. Co. and W. C. Crowell, joint holders of the contract for the construction of the Pine Canyon Dam. S. B. Morris is chief engineer and general manager of the water department. The cement pumping installation was designed and installed by the Fuller Co.

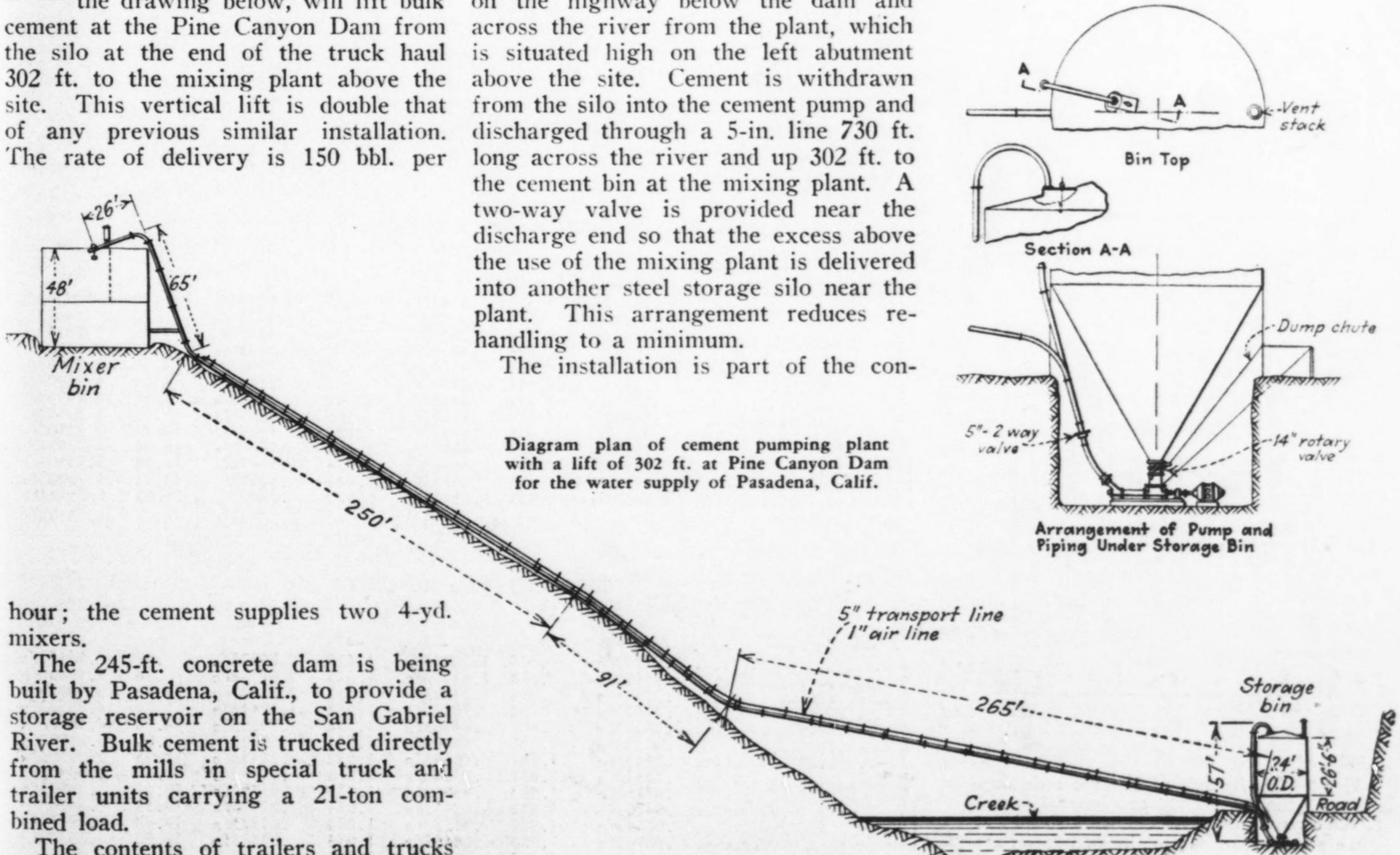


Diagram plan of cement pumping plant with a lift of 302 ft. at Pine Canyon Dam for the water supply of Pasadena, Calif.