Belt Conveyor Handles Concrete for Large Aqueduct

Covered Drain Replaces Scajaquada Creek in Buffalo—Gasoline Car Handles Steel Forms—Conveyor Travels on Top

CONSTRUCTION of the second section of the large covered drain by which Scajaquada Creek in Buffalo, N. Y., is being put underground, has developed novelties in form handling and concrete placing which are giving a notable progress record. Under normal conditions a section 75 ft. long of 33½x14-ft. reinforced-concrete conduit (about 5¼ cu.yd. per foot) is being completed in a day and on occasion this rate has been doubled. In 80 working days 7,200 ft., 35,000 cu.yd., were completed. Backed by an excellent plant, good direction and a trained crew, two factors are primarily responsible for the record. They are: Expeditious form handling and belt distribution of concrete.

The section of drain being built by the methods to be described is 7,200 ft. long. It continues a section 6,022 ft. long previously constructed of substantially the same design. The cross-section is shown by Fig. 1 which is a strengthened section under a building; the dotted line indicates the normal arch ring. Except at a few points the drain follows the alignment of the creek and at one end of the section there results a succession of curves. This crooked part is being built first so that the records so far represent the most troublesome portion of the contractor's task. The creek channel has a capacity of some 1,500 sec.-ft. The dry-weather flow is 5 to 20 sec.-ft., but between Nov. 1 and May 1 there are normally several floods of 500 to 1,000 sec.-ft. In flood the stream overflows a section of the city and besides it becomes a sort of catch-all and calls for many street bridges. When the drain is finished it will be backfilled to city grade.

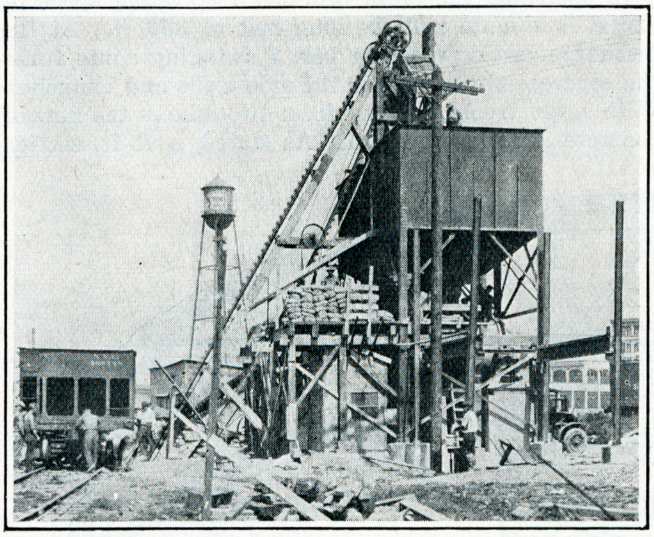

FIG. 2—UNLOADING MATERIALS AT MIXING PLANT

Excavation—The creek channel is in earth overlying rock. It had to be widened and deepened for the drain, the excavation volumes being 122,000 cu.yd. of earth and 90,000 cu.yd. of rock. A steam shovel first made a stripping cut of the earth overburden, loading it into cars which ran up the bank, and built spoil bank alongside ready for backfilling the drain. It is planned to equip this shovel with a drag bucket for backfilling.

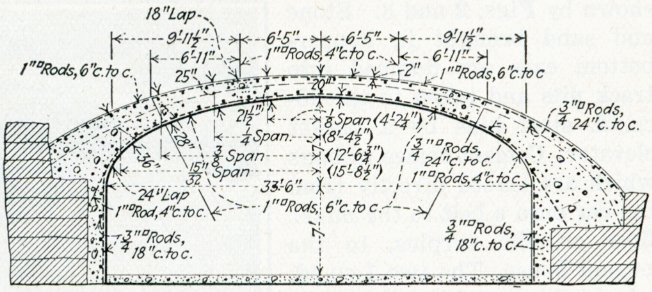

FIG. 1—SCAJAQUADA CREEK CONDUIT IN BUFFALO, N. Y.

There is from 1-ft. to 14-ft. cut in the rock which is a hard limestone in 1- to 2-ft. strata. Except that the stone has been wearing on drills and dipper teeth it has offered no exceptional obstacles. A cut to subgrade and about 24 ft. wide is first made along the center line in the usual manner of taking out rock bench. Two side cuts finish the channel. In taking out the side cuts the shoulders for the arch are cut in the

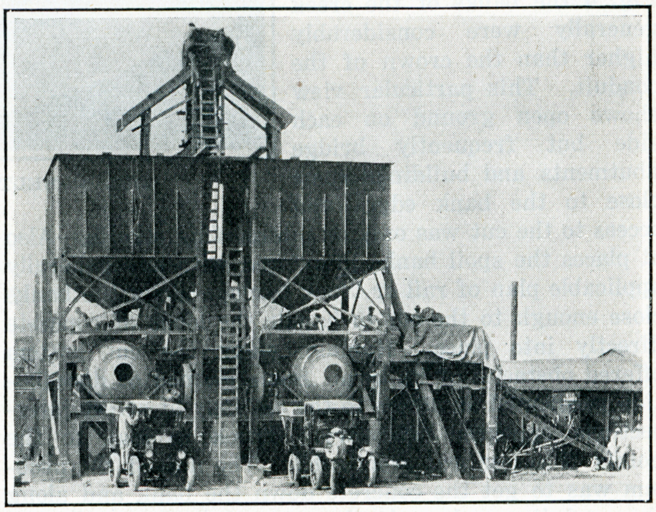

FIG. 3—MOTOR TRUCKS TAKING LOAD AT MIXING PLANT

same operation. The side holes are put down 9 in. apart —virtually line drilling—and alternate holes are fired. Generally the rock breaks cleanly. The steam shovel loads the blasted rock into cars to a rock storage pile whence it is being hauled to the contractor's crushing plant and there worked up for the crushed stone market by an 18x30-in. jaw and a No. 5 gyratory crusher. About 200,000 tons had been marketed as of Oct. 1, 1924. None of this stone is used in the drain concrete. Five 7-ton gas locomotives are doing the earth and rock hauling.

Concrete Construction—The concrete structure of the drain is shown clearly by Fig. 1. Its dimensions are to be noted; this is an exceptionally large continuous conduit. The floor or invert is separate and the side-walls and arch are one piece. In the 7,200 ft. about 37,862 cu.yd. of concrete and 3,464,674 lb. of reinforcing steel are estimated. This gives 5¼ cu.yd. of concrete and 481 lb. of steel per foot which are figures to be remembered in considering the 75 ft. progress in a day. The specifications called for a 1:6 concrete and 14 turns of a 22 r.p.m. mixer. A slump of 8 in. in an 8x16-in. cylinder was required. No concrete could be laid under 32 deg. F. and between 32 and 40 deg. F. the mixing water must be heated to 120 deg. The reinforcing bars are deformed.

A particularly well fitted mixing plant was put up as

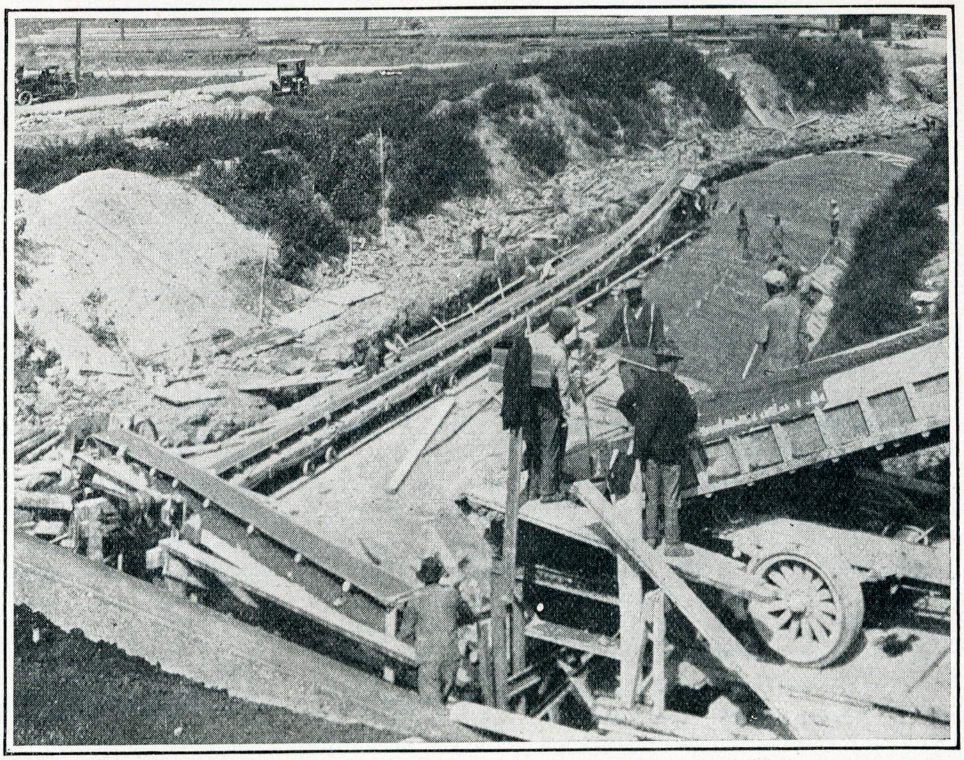

FIG. 4—BELT CONVEYORS HANDLE CONCRETE INTO FORMS

shown by Figs. 2 and 3. Stone and sand brought in hopper-bottom cars are dumped into track pits and taken to the 90-cu.yd. steel bins by a bucket elevator. Cement comes in bags which are loaded directly from the car onto a belt to the mixer floor or, the surplus, to the cement house. The two 1-cu.yd. mixers dump out-board into 2-cu.yd. trucks, two 25-cu.ft. batches to a truck-load. Seven trucks take the concrete to the bank hoppers, which, as is described later, feed to the belt conveyors. The maximum truck haul has been 3,000 ft. and was made in 12 min.

Belt Conveyors—As shown by Fig. 4 the banks of the creek generally were considerably higher than the crown of the conduit. This particular view shows open ground on each side but frequently bridge abutments and buildings come close to the bank edges and access to the cut was only at intersecting streets. Also at places the spoil banks interfered with any generally applicable plan of rail or truck haulage along the banks close enough to the cut to handle the loads of concrete directly into place. Haulage along the cut bottom offered obstacles of its own. Some method of distribution predicated on access to the cut only at street intersections appeared necessary. Truck haulage to the points of access was practicable. The nub of the problem was to get the concrete down the bank and along the conduit anywhere in the approximately 300-ft. distance between streets.

Consideration of the problem by Frank L. Cohen, the contractor, with the engineers of the Conveying Weigher Co., developed the belt conveyor system shown by Fig. 4. From a bank hopper into which the trucks dump a 40-ft. cross-conveyor extends to the crown of the conduit. Here a 310-ft. conveyor mounted on carriages takes the concrete along the conduit. The long conveyor is pulled along the structure—finished concrete and forms—as the concrete placing advances. Except that the long conveyor is mounted on carriages, both conveyors are of regulation design for conveying concrete. Both conveyors are electrically driven—a 3-hp. motor for the cross-conveyor and a 10-hp. for the long belt.

In operation the cross belt has a traveling speed of 320 ft. a minute and the long belt of 350 ft. At the discharge end of the long belt a swinging chute turns the concrete either way to the side walls and haunches. With seven trucks hauling from two mixers the flow of concrete is fairly constant. As stated, a 75-ft. section

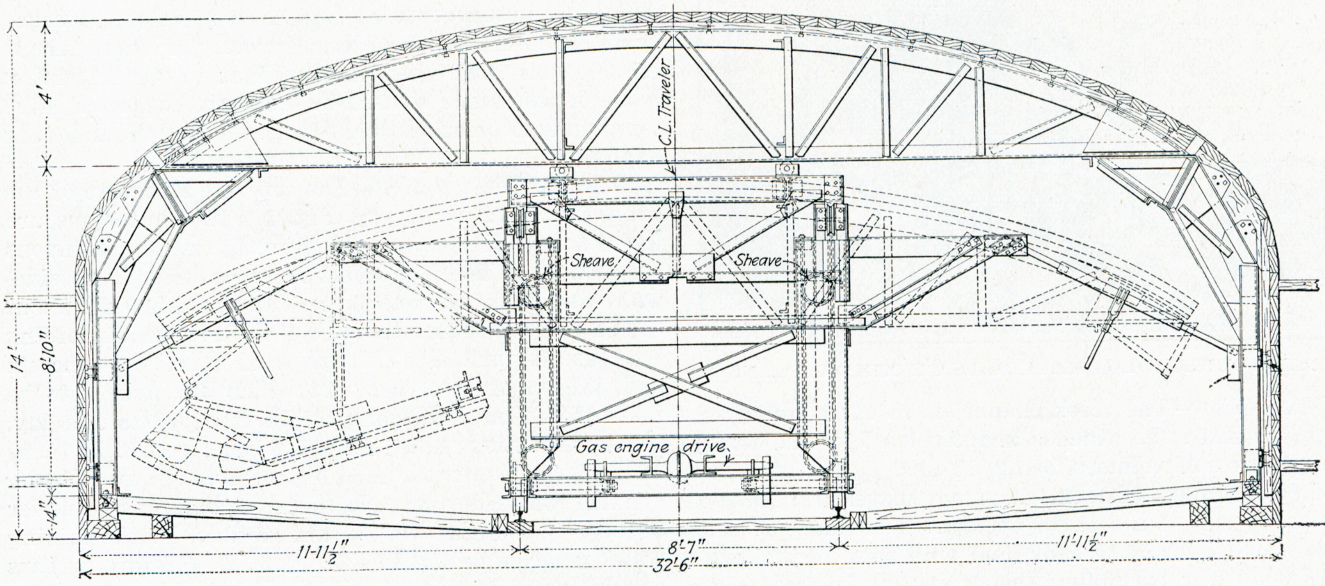

FIG. 5—DETAILS OF FORMS AND TRAVELER

is the regulation 8-hour day's stint but often this progress has been exceeded and on occasions doubled. A 75-ft. section calls for an output of something less than 375 cu.yd. The delivered concrete has at all times met the city inspector's requirements governing segregation.

Only side walls and arch are placed by belt conveyor. The invert, Fig. 1, is built ahead using trucks from the mixer and chuting the concrete down the bank to hand carts operated along the bottom. Approximately the schedule is one day concreting invert and five days concreting walls and arches, but this arrangement has been varied when delay on arch has left a crew free to push the invert ahead of schedule. On arch and side wall the normal schedule is: 3 days forms under arch, 1 day erecting forms, 1 day placing reinforcement and 1 day pouring concrete.

Form Handling—A vital factor in the fast schedule is form handling. The method was worked out in conjunction by the city engineers, the contractor and the Blaw-Knox Co. engineers. It involved agreement on a remarkably quick striking period for arch forms. Figures 5 and 6 show clearly the form construction. Three 25-ft. sections of the form were erected in a day. In all the contractor had 18 sections of 450 lin.ft. of forms. The figures are noteworthy.

As shown in Figs. 5 and 6 the form is of the telescopic type of sufficient strength to carry the load without being supported on the traveler, the sole purpose of which is to move the forms from the rear up to the front. For raising and lowering the forms the traveler has a telescopic platform raised and lowered between four corner guide posts by means of chain blocks on the posts. Outriggers on each side of the platform carry heavy ratchets which attach to the side posts of the forms and which are used to pull in and push out the sides of the forms when collapsing and erecting them. These details are best seen from Fig. 5. Turning back to the traveler, it will be noted that to set 75 ft. of form a day the traveler had to make three trips from front to rear and return or about 3,000 ft. of travel. A motor traveler was necessary. A Ford car motor and driving axle met the requirements by the arrangement shown by Fig. 5. Another structural detail is that a sliding arrangement was provided at the ends of the top truss making it possible to widen or narrow the form as the cross-section changes. Also the forms were made in such a manner that they could be sprung out on curves and follow the contour of the exact curve as closely as desired. It was found possible by this arrangement to work the forms up in 25-ft. units, which could be bolted together on straight work along the edges and on curved work along the side wall on the inside curve, and, with a filler piece or overlapping plate covering the opening in the arch and the opening in the side wall on the outside of the curve.

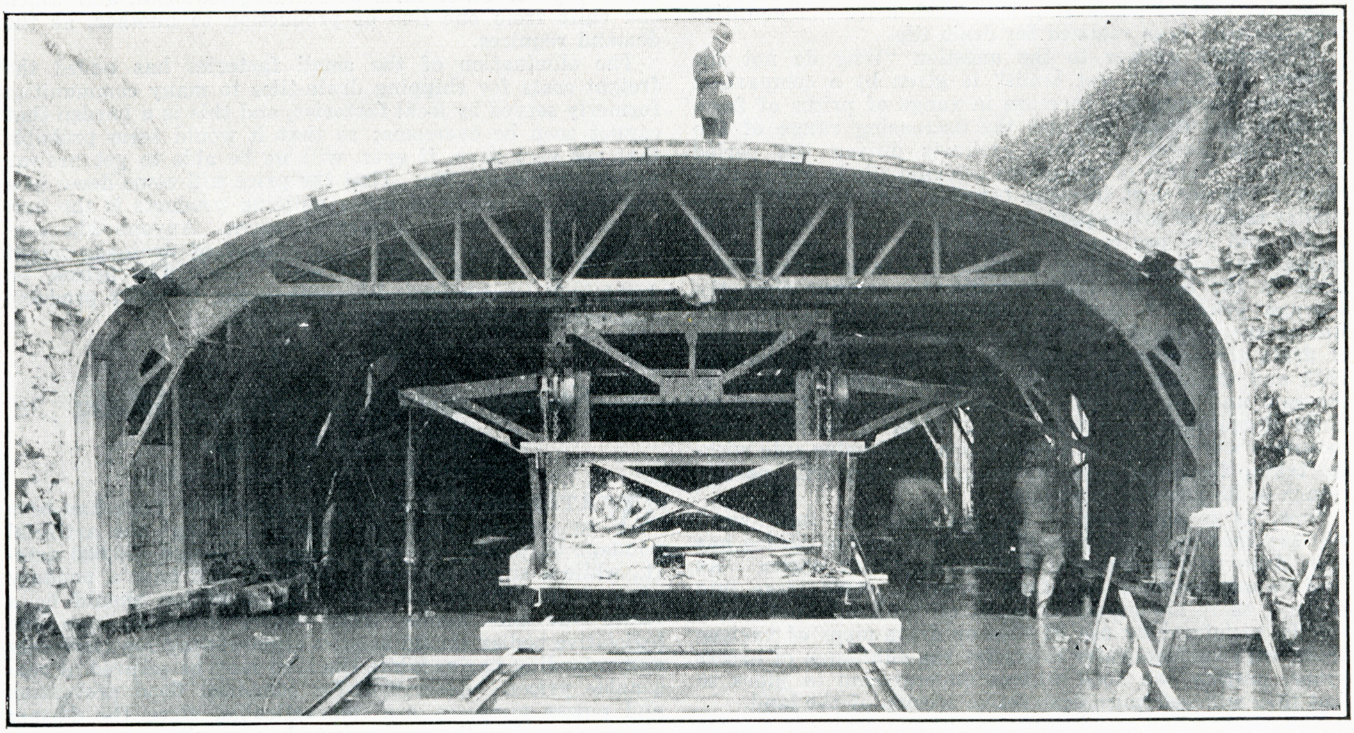

FIG. 6—FORM READY FOR CONCRETING

The notable feature is, however, not so particularly the structure and mechanism of the forms as it is the small total length of forms, 450 ft., and the quick action in erection. Both were made possible by the decision to allow form removal in three days. This came from consultation. Originally the idea of the city engineers was that the wall should be cast up to the spring line before the arch was put on. Next it was stated that the forms over the arch should be left in place three weeks. This would necessitate having about 400 ft. of wall form and about 1,500 ft. of arch form, which again would increase the stretch of work on which the contractor had to work to more than 2,000 ft. and make a railroad necessary and not a track and traveler. Consideration of the facts led to the change in plans, which have proved successful.

The conduit work is being done under the direction of William F. Swartz, commissioner of public works, E. E. P. Babcock, city engineer, and Carl Howell, assistant city engineer. The contractor is Frank L. Cohen with Bill Reiman as superintendent.