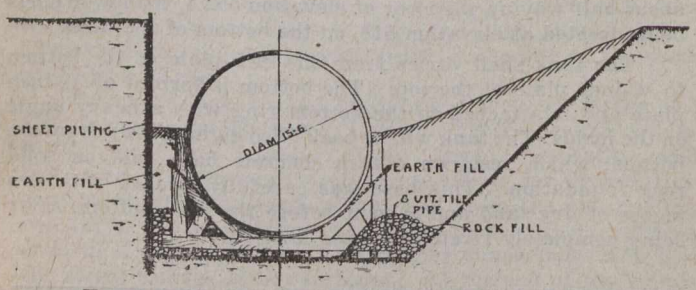
as to insure that the band will break in the body or shank before breaking in the threads.

"The shoes to connect the ends of the rods shall be of malleable cast iron of the most tenacious character, such as will stand a great amount of hammering without fracture, and shall have a tensile strength of not less than forty thousand pounds to the square inch of section. They shall be sound, smooth castings of the size and form as required for the purpose, and shall be well adapted to receive the strain induced by cinching on the bands.

"All steel bands and malleable cast iron shoes shall be



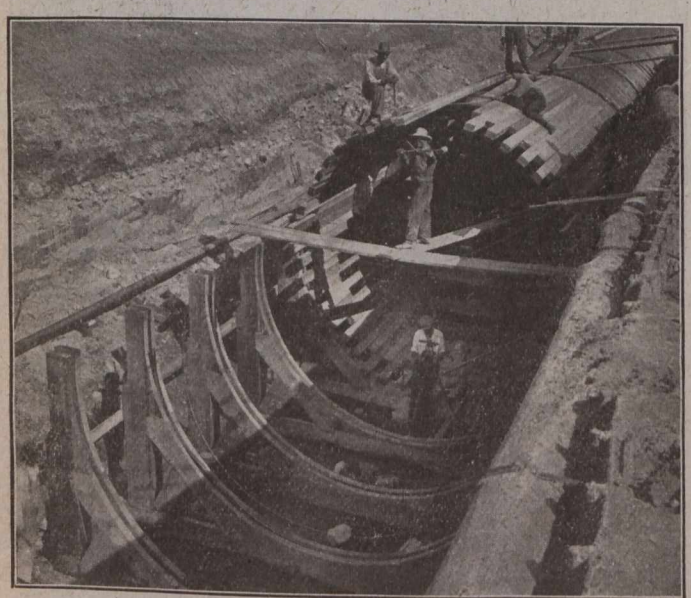
TYPICAL SECTION OF PIPE TRENCH IN EARTH

thoroughly coated prior to shipment with manufacturers' standard protection coating."

Construction of Wooden Conduit

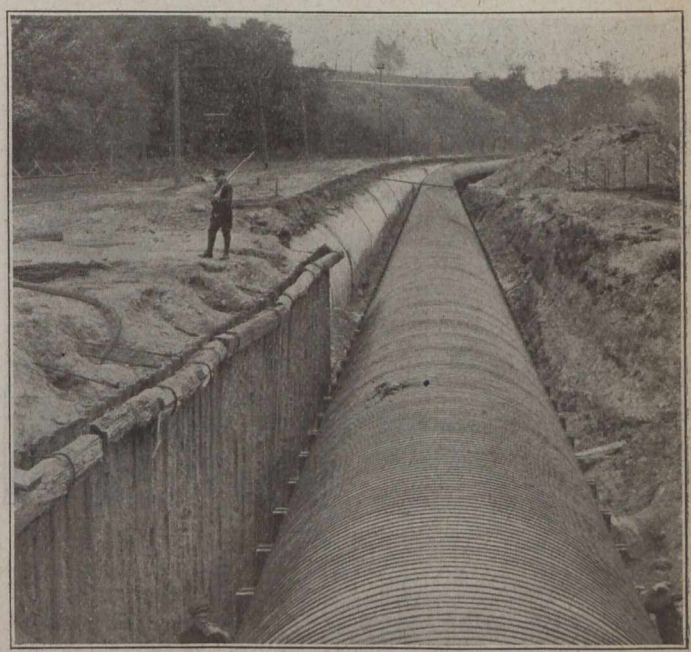
The gate house as constructed provided a twenty-foot diameter steel thimble projecting about three feet. Connection of the 13.5 foot diameter wood stave pipe to this steel thimble is made by a taper section 25 feet in length, built of reinforced concrete surrounding the steel thimble previously placed and ending in another steel thimble 13.5 feet in diameter, 6 feet long. The staves are lapped 18 inches over this plate, which projects about two feet from the concrete envelope, and the connection is made when the ⅞-inch bands are tightened on the staves.

The difficulties of excavation along the pipe line were varied and in some places severe. At the gate house, and for



ERECTION OF WOOD STAVE PIPE, USING SADDLES AS FORMS

1,200 feet below, the excavation is in rock. The pipe is laid parallel to No. 2 conduit and at its widest point with only 40 foot centres. The utmost care was therefore necessary in shooting and taking out the rock. The side next to No. 2 conduit was channelled, and when centres between the pipes decreased to 24 feet, both sides were channelled. A great deal of water was encountered in the first 800 feet to the crossing of the Dufferin Island Channel. This was successfully handled with an 18-inch suction centrifugal pump driven by a 50 h.p. motor. The material was handled from the cut by shovels, derricks and locomotive cranes; a portion of the excavated material was deposited along the sides of the cut for back-fill, while the remainder was placed on dumps located at convenient points. The construction of the pipe itself presented no particularly difficult problems, and was erected under the supervision of a representative of the Pacific Coast Pipe Co.



NO. 3 CONDUIT COMPLETED, SHOWING METHOD OF BRACING LACKAWANNA STEEL SHEET PILING BETWEEN CONDUITS NOS. 2 AND 3

The saddles used to support the pipe, view of which is shown on this page, are built-up timber sections so constructed as to make a continuous form for the lower half of the pipe. The outward thrust along the horizontal diameter of the pipe, caused by the tendency of the pipe to flatten when filled with water under a low head, is taken care of by two ¾ inch diameter round rods. These rods pass around the lower half of the pipe, and the end reactions of the rods are carried to both sides of the saddle by means of cast iron washers. These saddles were spaced at 4.5 feet intervals, except in certain locations where the pipe is concreted in place.

Through the earth cut, mud sills were used under the saddles to distribute the load and thus prevent as far as possible any settlement of the pipe. Through the rock cut the mud sills were left out and the lower timber of the saddle was placed directly on the rock, which was evened up to grade after excavating the trench.

During the construction of the pipe these saddles served as a form for laying up the lower half of the pipe, due to the fact that they supported the entire lower portion of the same and were set at close centres.

Ample Drainage Provided

It was necessary to provide ample drainage for the pipe trench on account of the bottom of the trench being below the water level in the Niagara River for a large portion of its length. As shown on this page, vitrified tile drains laid with open joints in crushed stone are provided, one on either side of the pipe. These two drains run from Sta. 9+00 on the conduit to the steel distributor, where they are connected to the penstock drains which carry the drainage water down through the power house to the lower river. The first 350 feet of the drain is of 6-inch diameter and remainder of 8-inch diameter. The two drains are connected together at intervals of 200 feet by 6-inch laterals which pass under the pipe.

For 1,000 feet at the upper end, and 825 feet at the lower end, the pipe is concreted in place. This is necessary by