

manent. Both are designed to carry the heaviest engines in existence with a considerable margin of safety, and are epoch-making in the art of bridge engineering in as much as they have demonstrated that reinforced concrete can take the place of steel for a large number of permanent bridges.

"These two structures are so solid that when passing over them on a train one gets the impression that he is on a solid fill instead of on a bridge.

"The method employed in the erection of the reinforced concrete spans is a specially interesting feature of the structures. Each slab, as a unit, weighed 55 tons, which was the limit load that could be handled by the C.P.R. 100-ton standard wrecking cranes. The crane engaged handled no less than 110 slabs each 55 tons in weight, or in all something like 6,000 tons, and all this was done without a single mishap to either men or material. Another remarkable feature is that both structures were built without interruption from the beginning of June, 1917, to the beginning of July, 1918, which was a shorter period than would have been required to manufacture and erect similar structures in steel. Passenger and freight traffic on the C.P.R. main lines was continued without interruption during the progress of these interesting works."

WAR BURDENS OF WATERWORKS

RECORDS have been received from fifty typically important waterworks in the United States by a committee appointed by the American Water Works Association for the purpose of investigating the effect of the war upon the costs of construction and operation of waterworks systems. Leonard Metcalf is chairman of the committee, the other members being George W. Fuller and Major George A. Johnson. The committee reports that the records received indicate:

(a) That the advance in the cost of labor used by waterworks in construction work during the past three years was approximately 13 per cent. in 1916 and 27 per cent. in 1917, over the pre-war costs in the United States. These pre-war costs were fairly reflected by prices prevailing in the year 1915. Material decrease in efficiency of labor has also been observed in all parts of the country, the consensus of opinion indicating an approximate loss in efficiency of from 25 to 35 per cent.

(b) The important waterworks construction materials, pipe, valves, hydrants, etc., have more than doubled in cost. The more important operating materials, such as coal and fuel oil, have also more than doubled and chemicals for the treatment of the water have advanced from 50 to 100 per cent. and more.

(c) The normal annual increase in revenue of the waterworks has in general decreased, except where war activities have materially increased the local market for water.

(d) The operating and maintenance expenses have increased approximately one-third, the increase in gravity works being of less serious moment generally than in the pumping plants.

(e) The net revenues applicable to depreciation allowance, fixed charges, dividends, and surplus have, in general, remained about stationary, instead of increasing substantially from year to year, thus indicating that the new investment is not being taken care of, and that the divisible revenue is declining. The conditions vary markedly at individual plants and in groups, the eastern group

showing the most marked decline in net annual revenues. Unfortunately, the conditions are growing more and more serious.

The committee has summed up the results of its investigations in ten conclusions, which are as follows:—

First—That the waterworks of the United States have suffered, through war conditions, large increase in construction and operation costs.

Second—That marked decline in net revenue has resulted.

Third—These conditions did not begin to make themselves generally felt until late in 1916, and it was not until the latter part of the following year that they became serious. The desirability and continuity of employment tended to delay the advance in wages.

Fourth—The advance in cost of labor used in extension and minor construction work has gathered force in the last six months, and it is the general opinion of municipal and corporate managers that additional increases are certain to come during 1918 and thereafter, if labor is to be held.

Fifth—It is undesirable to replace old, well-trained forces, familiar with these waterworks properties, with other labor not having this familiarity, in the effort to hold the wages at a point below the general local standard for similar service. The character of the service would suffer and it would not be fair to labor.

Sixth—Serious and conscientious effort has been made by waterworks operators generally to reduce construction and operating forces to a minimum. These reductions have in many cases already gone beyond desirable limits, even to reducing the working efficiency of the properties. In other cases still greater economies are possible in better consumption of coal; waste reduction by increased use of controlling meters, pitometer surveys, and more frequent house-to-house inspection, and in quarterly instead of monthly meter readings of small meters.

Seventh—The general situation is a very serious one and has shown itself in increasing difficulty of attracting capital for necessary betterments. While extension of service is likely to be increasingly limited with the conditions of war, it would be unfortunate, if the activities of important industrial and commercial centres, particularly those concerned in governmental activities, should be thus circumscribed.

Eighth—The menace of the situation lies in the increasing difficulty under such conditions of maintaining constantly a water service safe from a sanitary standpoint, necessary for good fire protection service, and adequate for industrial, commercial and domestic needs.

Ninth—Public Service Commissions and other regulatory bodies have already recognized the danger of the present situation to the public as well as to the utilities, and are likely at least to afford such relief as may seem to them necessary to maintain credit, but it is imperative for waterworks operators to keep clear records, showing the actual change in conditions and prices of materials and labor, that these bodies may have uncontestable proof upon which to pass judgment as to the necessity for relief.

Tenth—It is imperative, in the interest of good service, that waterworks operators of municipally as well as corporately owned plants, should anticipate their construction and operation needs, as far as possible, and should be careful to obtain the necessary priority orders, that the quality of the water and the service rendered may not be seriously impaired in the future for want of construction and operation materials and supplies.