the Carter-Halls-Aldinger Co., and the Northern Construction Co., built the easterly 47.4 miles of the work, and in association with the Canada Lock Joint Pipe Co., this same firm built 9.3 miles of 66-in. by 8-in. reinforced concrete pressure pipe east of the Red River.

Wm. Smaill was superintendent for the company, and J. C. Mitchell was the indefatigable officer in charge for the Canada Lock Joint Pipe Co., which company also manufactured 2.3 miles of 48-in. by 6½-in. reinforced concrete pipe which was laid west of the Red River.

Thos. Kelly & Sons built 17.8 miles of the main aqueduct, constructed the Red River tunnel crossing with its appurtenant surge tank, and laid the pressure pipe west of the Red River.

J. H. Tremblay Co., in association with the J. McDiarmid Co., built 19.7 miles of the aqueduct just east of the future reservoir site.

All portland cement used in the work was manufactured by the Canada Cement Company at their 4,000 barrel mill in South Winnipeg. The reinforcing steel was manufactured by the Algoma Steel Co., and the Steel Co. of Canada. With the exception of cast-iron specials, which were manufactured locally, the special 60-in. cast-iron pipe for the lining of the Red River tunnel crossing was manufactured by the Warren Foundry and Machinery Co., of Phillipsburg, N.J. Valves were supplied by the Chapman Valve Mfg. Co., of Indian Orchard, Mass., and several other American manufacturers.

James H. Fuertes, of New York City, was consulting engineer for the district. M. V. Sauer was chief of design but resigned about eleven months ago to become designing engineer of the hydraulic department, Hydro-Electric Power Commission of Ontario, and was succeeded by James Hyslop. Division engineers, in sections of the aqueduct corresponding to contracts let, were A. C. D. Blanchard, D. K. McLean, Wm. R. Davis, G. F. Richan, John Armstrong, C. J. Bruce and W. D. Mackenzie. There was, throughout the work, the heartiest spirit of co-operation between the contractors, the engineers and the district forces which operated the necessary railway and gravel pits, with the aim of providing a stable, water-tight and efficient conduit, and of completing the work on scheduled time.

WHY BUILDING MATERIALS SHOULD BE TESTED

By Emmanuel Mavaut
Milton Hersey Co., Ltd., Montreal

ONE often wonders why it is that so many engineers and architects seem averse to having their building and structural materials inspected and tested before accepting them for use in their work. Too often this is omitted during the construction of high-priced dams, bridges, breakwaters, office buildings, theatres, etc., where the professional reputation of the engineer or architect, the capital of the investor, and quite frequently the lives of many people, are at stake.

Is it through ignorance? Is it through jealousy and selfishness, not wanting any other engineer or chemist to share the credit for the appearance or assured safety of the structure? Or is it through a mistakenly economical point of view?

To review these points one by one: Is it through ignorance? I may answer that in quite a few cases it is. Engineers of high standing have deliberately claimed to me that it was not necessary to test anything, using as an argument that cement is standard, that any experienced man can tell good sand at sight, and that so far as stone is concerned, limestone is limestone and that is all there is to it.

These men start work without knowing the quality of the materials they are using; and, too frequently, their structures fail. If it is concrete, the mass crumbles, disintegrates, cracks or otherwise goes to pieces, and the average person who sees it concludes that after all concrete is a poor investment.

Review of Opposing Arguments

Let us review the arguments of these engineers. They claim that cement is standard. I say it is not; though I know that the cement manufacturers, especially the larger ones, do all in their power to have the cement not only up to specifications but as near perfect as practically possible. But the chemist and superintendent can not be all over the works at once; and for that reason there is always a possibility, though it may be remote, of the cement coming out too fresh, too high in sulphuric anhydride or in magnesia, or too low in specific gravity.

These defects, which can not be found without having the cement tested, will cause many different troubles in concrete work. For instance, one defect will cause the cement to set too quickly; that is, it will take its initial and sometimes its full set before being placed on the job, or in other words, while the men are mixing it. In this case, there will be no cementitious qualities between the different lumps of concrete as it breaks up when being deposited, and so many stones covered with mud might just as well be thrown into the forms.

On the other hand, another defect might cause the concrete to set too slowly. This naturally retards the work, because the forms can not be taken off as quickly as planned. If the risk is taken and the forms removed, there is a great possibility of the structure failing. If slow setting cement is used in winter and freezes before it sets, the concrete will soon disintegrate. Even if it should not totally collapse, it will be a constant cause of expense for repairs and an ever-present eye-sore.

Not Always Manufacturer's Fault

I had occasion some time ago to condemn 18 cars, containing over 16,000 bags of cement and amounting to over $11,000 in value. These 18 cars, which had been purchased by two of our largest Canadian manufacturing firms, were condemned for the reason that the setting took place in from 8 to 20 minutes. It should take at least one hour as determined by the Gilmore needle. Had not that cement been tested, it would naturally have been used and without a doubt the work would have failed because of the concrete setting before being placed.

Outside of this particular case, I have had occasion to condemn cement quite a few times in different parts of the country. In the majority of cases, the cement manufacturer was not to blame for these failures in cement, but either the railway company or the contractor was responsible. Cement is often stored in unsuitable sheds, where dampness and rain injure it. How many of us have not seen bags that were set as hard as rock taken out of temporary storage sheds? In such an instance, while only certain bags may be unusable, many others, and frequently a very large quantity, have been affected to such an extent that they should not be used.

Another instance came to my personal attention last summer. An electric power development company situated in the province of Quebec was about to raise its dam. The cement was purchased and stored beside the falls in an enclosure with no front. After this was filled with cement, a few boards were put up to protect the cement from the spray of the falls; but cracks ranging from one to ten inches were in evidence. The result was that the spray reached many of these bags of cement, making some of them so hard they had to be broken up with shovels before being used. I drew the attention of the superintendent to this fact, but his answer was that the cement was first-class.

It stands to reason that had this cement been tested before being used, it would certainly have been condemned, as chemical action had already taken place, rendering it of little value. This is but one of the many cases where the cement company was not to blame, and similar instances occur almost daily; but, whether the manufacturer or the