rests on the rock. The type of abutment decided upon was a gravity section resting upon 30-inch walls at 6-ft. 6-in. centres carried down to rock and having the main wall reinforced to carry over the sewer. Fig. 8 shows the elevation and a cross-section of the north abutment;

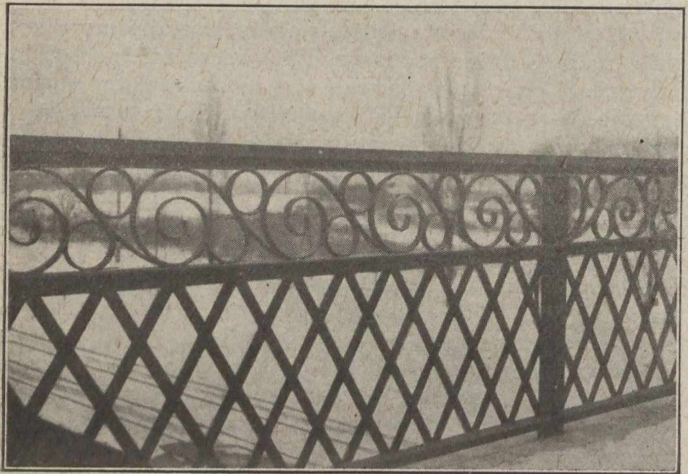

Fig. 9.—Ornamental Handrailing.

the south abutment being similar. The 2-inch space around the sewer was filled with well-packed sand. The reinforcing rods are 1⅛-inch square twisted steel. This type of abutment proved very economical.

The contract price for the concrete floor, waterproofing, abutments and about 400 lin. ft. of retaining walls for the north approach was $33,206.38, and for the steel

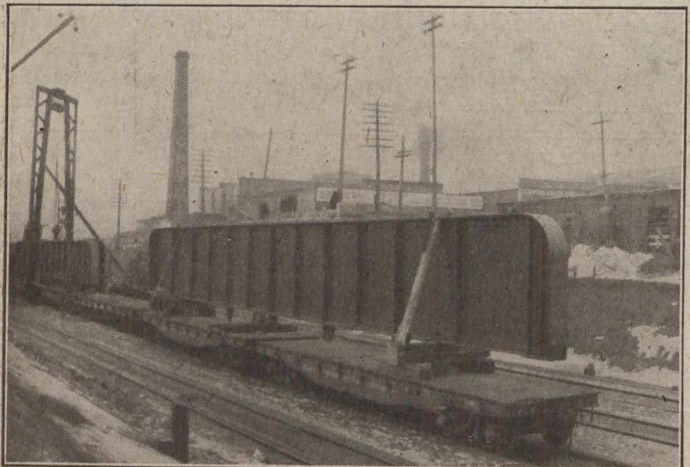

Fig. 10.—Girders as Delivered Just Before Erection.

work, $11,046.69, which makes a total cost of $44,253.07. These figures do not include cost of paving, lighting and filling of approaches.

The bridge was designed under the supervision of G. A. McCarthy, engineer of the railway and bridge section, Department of Works, City of Toronto. C. J. Townsend was contractor for the concrete work and the Dominion Bridge Company had the contract for the steel work.

An announcement made by W. Rathbone Smith, the general manager of the E.D. and B.C. Railway, states that the head of steel on the Grande Prairie branch railway is now at mile 40, or only 10 miles from Grande Prairie city, thus tapping the heart of the Peace River district.

REINFORCED CONCRETE IN SEWERS.*

About the year 1900 reinforced concrete had been taken up in many fields of construction and applied to long-span arches, and the advantages of its use in sewer construction were soon appreciated. During the next five years, many examples of concrete sewers are found, although with a few exceptions the reinforcement consisted of wire mesh or expanded metal and there was an evident tendency on the part of the majority of engineers to use rather heavy sections similar to the plain masonry types. A few examples are also found of extremely radical designs involving very light sections heavily reinforced. These two extremes suggest the difference between the sewer engineer adapting his designs to reinforced work and the concrete expert breaking into the sewer field. In the last 10 years, all of these ideas have been through the melting pot, and we are beginning to find certain standard types of reinforced concrete sewers used generally. These are the horseshoe type varying in proportions from the semi-circular to those of about equal height and width, and the elliptical, usually constructed as a five-centered arch. Of exceptional advantage under certain conditions the box or slab section is often employed, but under average conditions it is less economical than the other types. The circular sewer is difficult to construct in what is known as "monolithic" work, that is, if built in place, but the circular reinforced concrete pipe developed along other lines has become standard construction in size up to about 8 feet. It is unit work and may be considered as a factory product, and for that reason a much more satisfactory concrete can be secured through its use than is generally obtained in monolithic work.

In many cases, the shape of the sewer will be controlled by local conditions. In wet ground the invert must be kept as high as possible and a broad, shallow section results. For such cases the semi-circular shape is the most economical, and, in fact, is about the limit of distortion in that direction, as computations show that little further decrease in height can be obtained by adopting a wider, flat segmental arch. For such extremes where the semi-circular is not satisfactory, it is possible to design a box section, and if necessary, a multiple box, though this latter should always be compared with a similar multiplication of normal arches before being adopted.

Where the sewer is deep, and in particular, if in rock, there is usually economy in making the heights of the section greater than the widths, and if in deep rock cut, it is possible to use plain concrete sides and a flat arch abutting on the rock.

Under average conditions the most economical section is undoubtedly one approaching nearly to the circle; that is, having width and height about equal, but on account of the difficulty of securing satisfactory construction with a semi-circular invert, a segmental invert (usually a 45 to 60-degree segment) has been common.

For loads due entirely to earth pressure and for sewers through fully developed territory where the loading can be definitely determined, arch sections of the semi-elliptical or similar types can undoubtedly be used to advantage, as the concrete can be worked in direct compression for the normal load and reinforcing put in to allow for unusual conditions. But where the loads cannot be predicted with reasonable accuracy or where extreme loads of opposite character must be provided for, there will be little difference between the semi-elliptical

*Extracts from a paper read before the American Concrete Institute by W. W. Horner, Engineer Board of Public Service, St. Louis, Mo.