resulting from H is past the point of bending up the first pair of rods. The space to C is too great in the light of good practice, even though it may be very close to d. Point H^1 is therefore set, with $GH = GH^1$, and an extra stirrup placed. Between this stirrup and the support arbitrary stirrups are placed at approximately $\frac{3}{4}d$ apart, for the purpose of supporting the bent rods during construction.

The rods turned up are carried 50 in. beyond, to develop the required bond. In addition, they are hooked at the ends.

The chart in Fig. 5 shows the solution of eqs. (6) and (7) when j is variable and $f_s = 16{,}000$ lb/in.^{2} A set of similar charts may be made up, each with a different fiber stress. Such a set will apply to both rectangular and T-beams. Fig. 2 applies to nearly all forms of rectangular beams since j varies so slightly; but it is not applicable to T-beams except when j is $\frac{7}{8}$, as was the case in the preceding problem. For T-beams j varies from .82 to .97 and therefore requires a chart that takes this change into account.

LETTER TO THE EDITOR.

Stresses in Lattice Bars of Channel Columns.

Sir,—In response to your letter of March 11th, I would submit the following notes on the ingenious and interesting paper "Stresses in Lattice Bars," by Mr. Pearse, published in *The Canadian Engineer* of February 24th, 1916:

(1) If Sc is the stress at which the material will be crushed, which may be inferred from the three lines at top of page 274, S_1 will be larger than 16,000 lbs. per square inch, the base stress used in Equation 3. In Proceedings of the American Society of Civil Engineers of December, 1915, I find tests showing unit ultimate strength in columns running as high as 45,000 lbs. per square inch. It is presumed that the base stress in the columns should be assumed as the utmost which they can carry, say, from 30,000 to 50,000 lbs. per square inch, for it is at this time when we are interested in the behavior of the lattice.

(2) In the third paragraph, page 274, it would appear that the total stress in the more highly stressed column should be $K\frac{A}{2}$, and not $2K\frac{A}{2}$. Note that S_1 is the base stress, when the added stress due to bending is K and not $2K$. The stress K is added to the stress S_1 in one channel and subtracted from the stress S_1 in the other.

(3) In Equation 3 the quantity $\frac{1}{12{,}000}$ in the denominator seems to be somewhat arbitrarily selected. In Merriman's "Mechanics of Materials," dated 1905, I find, on page 202, for the Rankine formula $\frac{1}{25{,}000}$, $\frac{1.78}{25{,}000}$ and $\frac{4}{25{,}000}$ given as the constants which meet average results in fixed, fixed and round, and round end columns. Again, on page 212, I find for the Ritter formula, which reduces to the Rankine when one constant replaces a theoretical expression, the factors $\frac{1}{34{,}000}$, $\frac{1.78}{34{,}000}$ and $\frac{4}{34{,}000}$. The Dominion Government Specifications of 1908 use $\frac{1}{9{,}000}$, $\frac{1}{12{,}000}$ and $\frac{1}{16{,}000}$, which are, of course, supposed to be conservative.

(4) The table gives only one distance apart for each channel pair, and the r given is that for the strong way of the channel itself. A round end condition is one that one does not expect to find in practice; using sines of two or three times the size used in the table, as indicated at bottom of first column of page 274, would produce other results. As to the width of lattice bars chosen, one may find them a bit large for the smaller sizes of channels; the Dominion Government Specifications require a width of $1\frac{3}{4}$ inches for lattice on 6-inch channels, which exceeds ordinary practice in building work.

(5) Equation 7 predicates a column of, say, $200\frac{l}{r}$ and over; Johnson says the Euler formula applies from $150\frac{l}{r}$. The results are applied to columns of less than this length.

(6) Equation 18 does not follow from Equation 17.

In the Engineering News of October 3, 1907, will be found a solution of lattice bars by Mr. A. M. Meyers. In the same number is an article of interest by Mr. Pritchard, suggesting, *inter alia*, 3% of axial stress to be taken in lattice.

Mr. Modjeski states in Engineering Record 68, page 356, that in the new Quebec Bridge lattice take a shear of 2% of the axial stress.

In the Quebec Bridge Commission report are some very interesting calculations on lattice theory. If this report is not at hand, it may be found in part in the Engineering Record of April 18, 1908.

I regret that I do not have at hand Bulletin 44 of the University of Illinois. In the Engineering News of March 16, 1911, there is, however, a summary of this bulletin. Here I read that the stresses in lattice bars were very variable as between different bars; and the authors, Talbot and Moore, are quoted as concluding: "It seems futile to attempt to determine the stresses which may be expected in column lacing for central loading by analysis based on theoretical considerations, or on data now available."

Mr. Pearse's theoretical solution of this annoying problem is suggestive and very interesting. I fear, however, that the problem is one of which the complete solution is not in our possession. The same may be said of column formulæ. We can, of course, make satisfactory designs, but the perfect theory and the perfect practice seem still somewhat doubtful.

C. M. GOODRICH,
Designing Engineer, Canadian Bridge Co.

Walkerville, Ont., March 14, 1916.

[In our issue of February 24th we published an article by William Worth Pearse, city architect of Toronto, dealing with the derivation of theoretical formula for calculating stresses in lattice bars of columns. The article created a good deal of interest, and we are pleased to be able to publish the above letter containing some further notes on Mr. Pearse's paper, and trust that others of our readers will be disposed to give our readers the benefit of what information they have on this most interesting subject.—EDITOR.]

The Siamese Government, to which one would not generally look for engineering progress, use to a very great extent reinforced concrete poles, both for street and park lighting and for electric transmission lines. The concrete pole is not only more elastic than teakwood, but it is fireproof; it is easily made and fixed, and is, of course, impervious to the depredations of the white ant.