"The Quebec Bridge Disaster"

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In Which Some Points of Unwritten Law Are Cited for the Benefit of the Bridge Engineer—Attention Called to Important Points in the Ill-fated Structure That Were Either Overlooked or Neglected

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WHEN it is considered how much has been written on this, the greatest engineering calamity that has occurred for many years, it is not surprising that the wheat and the chaff are pretty well mixed up.

Fortunately the Royal Canadian Commissioners have the ability to get at the cause of the trouble and the courage to state their finding, so the whole continent is anxiously awaiting their report, and until that is received, engineers should be more or less circumspec in what they say on the subject.

In the meantime, it is the generally accepted opinion in New York:

1st. That the bottom chord section No. 9 west was the first to fail;

2nd. That the section of these chord members should never have been adopted, and showed, to say the least, want of judgment;

3rd. That there were many other serious and obvious defects in the design and construction;

4th. That there is no reason in the world why a perfectly safe cantilever can not be built for much greater spans than called for at Quebec.

One of the most prominent of the American engineering periodicals has taken the stand that, because the column which failed was so obviously of a poor design, engineers do not know how to design large columns and when a correctly designed column, drawn for a proposed 1,250 foot cantilever some twelve years ago, was published in their columns, they politely intimated that it was doubtful if the engineer could tell why he selected the correct lines, etc. But it is safe to say that no one ever built a bridge by guess and those who have tried have invariably come to grief.

THEORY VS. PRACTICE.

Our column formulas which have been used successfully for many years are not limited o size of the column, but like everything else they should be only used by those who understand them and who have the ability to create. Anyone with a certain knowledge of mathematics can calculate the strains in a structure and, perhaps, make an exact copy of some existing bridge or building, but to originate requires a natural instinct combined with knowledge of the theory and practical experience for that class of work just as much as talent is required for a great artist or musician.

As a matter of fact, we have frequently seen college graduates after years of practical experience turn out engineering structures which have been fully described by the term "fearfully and wonderfully made."

There are a few simple, written or unwritten, rules, which bridge builders follow often by instinct such as:

Making a column equally strong in any direction. (This was disregarded at Quebec.)

Placing the metal as far from the center as possible.

Seeing that every section of the column is strong enough to carry its share, on the principle that the strength of the chain is the strength of its weakest link (also disregarded in the Quebec Bridge).

That the length of the column (or section of a column) shall not exceed its least width, or its radius of gyration, by more than a certain number of times, the portions of the columns between lattice bars or angles being considered separately.

These are a few of a great many very simple but vitally important rules.

Many divide the weight of a bridge into two sections, calling the first the "efficient" weight and the second the "excess," the latter being all those parts which do not carry the direct strain but merely sustain the main members of the section. The "excess," of course, includes all such portions of a column as lattice bars or angles, rivets, connection plates, etc. The object is naturally to keep the proportion of excess as small as possible.

While some rely on "butt" joints in compression (as at Quebec) it is not good practice to do so, and while it is not always feasible to put in enough rivets to transfer the entire strain over the joint, it is always desirable to have a considerable portion of the strain so taken care of.

This question of "butt" joints is a very vital one in all steel skyscrapers and is very liable to be the cause of a very serious accident some day.

It is more apt to be dangerous in a building than in a bridge, for in the former the erector, who is always trying to plumb up his building, should be in constant fear of opening the "butt" joints thus putting all the strain on one edge of his column, which even the layman would know was not safe, if he stopped to consider the matter. This is a question that the engineering periodicals should keep pounding on.

UNWRITTEN LAW.

There is one point that should be, but is not, always understood, and that is, that it is not possible to control the design of a bridge by any specification that has ever been written or ever will be—and that the man who checks another man's plan is often obliged to pass work that he would never have turned out if he had made the original plan. For instance, many years ago, the plan of a bridge was submitted to me for my approval, and on reporting that the design was exceedingly poor, or even rank, the magnate asked me if the terms of the specifications had been complied with, and on receiving a confirmatory reply, he said: "Well, we will have to accept the contractor's plan then, for we have made a contract with him for a stated lump sum to build a bridge according to these specifications."

Some engineers have long taken the stand that in designing a bridge they did not even want to be bound by their own specifications, preferring to be free to use their own judgment for each case as it occurred.

Reference has been made here to the danger of marking plans for a bridge without knowing why. Some years ago a very able young railroad engineer was instructed to construct a 75 foot Howe truss bridge, and instead of frankly saying that he couldn't, he got a carpenter and together they measured up an existing very similar structure and with slight modifications their judgment suggested, proceeded to erect, and finally the young man sat down and wrote to his chief a very pathetic letter, as follows: "Dear Sir,—The bridge at (his) creek was swung at 2 p.m., and immediately failed." It ultimately transpired that they had put the detail of a top chord joint in the bottom chord, with the result that there were only two