

## TYPES OF HIGHWAY BRIDGES

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The problems of bridge engineering are gradually becoming recognized by those in authority as of sufficient importance, even in apparently simple cases, to warrant the retention of specialists in this work if the people's money is to be expended economically and effectively. Instances are only too numerous of insecure foundations and the gross and dangerous misuse of material in structures designed and built under the direction of those unacquainted with the distinctive problems of bridge construction. If immediate disaster does not attend misguided efforts of this kind, and the files of the technical press bear witness to the frequency with which it does, a very few years of service suffices to wear out the structure and render replacement necessary. The system of adopting a design from a number submitted by competing bridge companies without careful scrutiny by an experienced bridge engineer is scarcely less pernicious. Once freed of the restraint of a properly drawn and rigidly enforced specification, considerations of excellence in design and of graceful appearance are thrown to the winds in the efforts of competitors to underbid each other and secure the contract. An illustration of the evil effects of such a system is afforded by the absence of practically any improvement during the last fifteen years in the design or construction of Pony Warren Truss spans turned out by the average bridge company when not forced to conform closely to a good and complete specification and proper inspection in shop and field. The flimsy T-chord, rod laterals, excessively light sections in latticed hand-rails, corroded material, a large percentage of defective field rivets and poor materials and workmanship in painting are some of the consequences of entrusting the work entirely to the contracting bridge company without the check of adequate supervision by an engineer of experience in bridge design and construction. Fortunately this is being remedied by the growing disposition of municipalities to employ competent bridge engineers to prepare the designs and specifications, require proper inspection in shop and field, and give personal supervision to the work throughout its progress.

## STEEL HIGHWAY BRIDGES.

THE UNIFORM EXCELLENCE of structural steel with the increasing price and poor quality of timber has resulted in the practical abandonment of the latter as a material for bridge construction except in parts of the country where timber is cheap and plentiful. In the more populous districts it is now no longer used for floors, steel stringers and reinforced concrete floor slabs having been found much more economical in the end on account of the frequent renewals necessitated by rapid wear and decay. Even in the sparsely settled regions of New Ontario, the use of timber floors in bridges built by the Provincial Government is regarded as a temporary expedient, provision being made in designing for the substitution of concrete floors when the traffic becomes heavy and timber becomes scarce and poor.

While great progress has been made toward permanent bridge construction by the extensive employment of steel, neither excellence of design nor the valuable properties of the material remove the necessity for care in fabrication and erection. Thorough inspection in shop and field by experienced inspectors is the only method of ensuring that the plans and specifications of the designing engineer are executed with absolute fidelity. Without it the temptation on the part of the contracting bridge company to unload corroded and pitted material upon the municipality is often too great, and steel which has suffered, through rusting in the stock piles, a loss greater than ten years of service would entail, frequently finds its way into the work. The laxity which makes this possible is likely to result in field painting of a character no better than that of the steel supplied. In all our work the necessity for rigid inspection is recognized, both during fabrication in the shops and erection at the bridge site.

As a result of inadequate inspection during construction and infrequent and careless painting while in service, it is difficult to predict the life of many steel bridges without careful examination by an expert. If properly designed, constructed and maintained, a steel bridge should last at least fifty years, but so little care has been exercised in connection with a great number of highway bridges that they cannot last half of that time. The careless or incompetent builder responsible for such structures will defend himself on the ground that fifteen or twenty years ago the art of bridge building was far less advanced than it is to-day. While this is true, it is no reason why bridges built at that time should not be in excellent condition now, for the famous Britannia and Conway tubular bridges, built sixty years ago, are in service to-day, and are carrying some of the heaviest railway traffic in the British Isles.

It is to be regretted that so little attention has been given in the past to the appearance of steel highway bridges in Canada. Frequently careful re-designing will greatly improve a structure from the aesthetic point of view at no increase in cost, and in very many cases the expenditure of a small additional amount in order to employ a curved top chord or to substitute a latticed hand-rail for one of gas pipe will result in a most gratifying improvement.

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