CONCRETE STRUCTURES FROM THE VIEWPOINT OF THE CONTRACTING SPECIALIST.*

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Work by Contract.

There have been much discussion and differences of opinion as to the manner of executing any construction work, but at this time we believe the majority of the architects and engineers and prospective builders will agree that the best results are secured by bona fide propositions from reliable contractors and the awarding of the contract to the lowest responsible bidder. Certainly it would seem that the best results should be obtained in this way, as the man who gives his life and his constant thought to the building trade, watching for every improvement in methods and materials and continuing constantly in touch with the labor and material market, is far better qualified to build economically and efficiently than is the owner who takes upon himself the doing of same. The owner can have but one object in mind in handling the work himself, and that is, to save the contractor's profits, and this purpose is nearly always defeated by the increased cost and errors in the work so done.

Granting then, that when work is to be done it is to be by contract, the next question is to determine the lowest responsible bidder. It would seem there is no line of work in the business world so easy to enter into as contracting. It appears to the observer that when some individual is looking for a new or change of occupation, who perhaps has gained some slight knowledge of construction work, sees contracts constantly being awarded to contractors who apparently are making money (it is always the successful contractors who are noticed and the unsuccessful ones who soon drop out of sight), he decides that here is a field for his efforts and one in which he can soon secure a competency. By his own effort, or possibly by hiring some young engineer, he calculates the quantities of work to be done and figures his bid, which, nine times out of ten, will either be an excessively high figure or an excessively low figure. Having no real experience of his own, he must depend for his unit prices upon the published prices paid for work previously let. Since the prospective contractor has little personal knowledge and since his hired estimator has no individual financial responsibility, errors in quantities and unit prices are liable to result. The writer has personal knowledge of a case where an error of this kind was made. A contract was awarded for a large amount of concrete work for $4.85 per cubic yard. The next day after a contractor of the above description bid exactly the same price for the construction of several reinforced concrete culverts, where the amount of concrete was practically nothing and the form work was the large item. He was bidding on the latter work on the basis of the work let the previous day and asking the same price for work that was worth twice as much on a cubic yard basis. Numerous cases of the same kind can be mentioned.

As this paper is intended to deal particularly with the modern use of concrete for construction, some of the statements as above may not be equally applicable to other lines, for the reason that the concrete industry is to a very large extent not yet thoroughly understood or organized. Along the lines of structural steel construction, cut stone, brick, timber, etc., we are dealing with industries of long standing, which are well organized and which can not be entered by the irresponsible individual, due to the fact that a considerable amount of money must be invested in the plant and working capital in order to qualify for the work. On the contrary, along the line of concrete, much stress has been laid upon the fact that anyone can mix concrete and that no capital or previous experience is required; therefore, we find men rushing into this work with the idea of mixing the concrete by hand, with no investment except for wheelbarrows and shovels. To illustrate a little further along this line, the manufacturers of concrete mixers and concrete block machinery have flooded the country with circulars demonstrating beyond the shadow of a doubt that with no capital and no experience the investor in their machinery can secure work at enormous profits. An understanding of this kind may be satisfactory and true so far as the placing of concrete foundations, pavements and perhaps for sidewalks, steps, cellar floors, etc., but when we broaden along this line and include structural concrete, properly reinforced, the experiment is a dangerous one.

For structural work of this kind the contractor should have a complete organization and plant and he also should have a knowledge of design in the material he is using. The contractors should be more timid about entering the field of concrete work unless thoroughly prepared than he would be to attempt the competing constructions in steel and timber.

Engineering Design.

The designing of work in concrete, so far as the details are concerned, will not be touched upon in this paper. Design in structural concrete has advanced to a point where there are numerous individuals and firms properly qualified to prepare an efficient and economical design. These parties have made a study of the subject and have informed themselves by reference to all existing data, and, in addition, are keeping pace with the advance in the construction with concrete by close observation and reading, and while all may not have exactly the same idea and may use slightly different forms of reinforcing material and may differ in their methods of work, still so far as the results are concerned the prospective builder should have no hesitancy or doubt in his mind in placing entire confidence in the plans prepared by such experts. The only thing occurring to the writer along the line of design as belonging particularly to this paper is to lay as much stress as possible on the economical design. Many engineers and architects prepare plans for structures which are absolutely safe beyond the shadow of a doubt, but which are extravagant in their excess use of concrete or steel, or both, and also are many times extravagant in the preparation of a design which is more expensive than necessary in the preparation of the forms and centers, which, even when economically designed, comprise very important items in the cost.

Effect of Plans and Specifications.

It is always presumed that the plans and specifications of the work go together and are explanatory, one of the other, and what is not clearly set forth in one is to be found in the other, etc., but in the practical work of construction, as the writer has experienced same, this is not always the case. The plans may be very carefully prepared and be efficient in strength according to the latest and best information, but the specifications may place such restrictions and be so exacting as to make the interpretation of the plans not only a serious question, but also to result in high prices and unnecessary expense. Many specifications are written by men, who, though perfectly familiar with the design, have no practical idea whatever of the actual construction, and the result is—a specification as to quality of material, amount of materials, manner in which they are to be handled, etc., which are very unreasonable. As an illustration, specifications may mention what kind of forms and centers are to be constructed and the length of time they are to remain upon the work, and same may be entirely out of reason. Each and every structure must be considered by itself on this question. Again, the manner of finishing or kind of finished surface of the concrete specified may be entirely unnecessary when the purpose for which the work is to be used is considered. Many times it is far better to have the concrete left rough than smooth. Too often specifications for one job are copied verbatim for a new job under different conditions. Another illustration is the specifying of the live load to be carried without the proper consideration to the fact that concrete construction when properly designed is far more rigid than either timber or steel. In other words, exactly the same loads are specified for concrete as for timber and steel in alternate design. This is not a fair comparison, as a floor

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