REINFORCED CONCRETE DESIGN.

The subject of reinforced concrete design and the question of economy in same is well treated by Mr. J. A. Davenport in a paper given before the Concrete Institute of London, England. The following abstract from the above paper gives the conclusions arrived at from the working out of tables presented to the institute by Mr. Davenport:—

Economy in reinforced concrete design might be discussed with regard to: (1) The engineering structure, (2) the architectural structure, and the two sets of conclusions might or might not coincide. The completed engineering structure was a skeleton frame, without any architectural finishes, embellishments, fittings, etc.; while the completed architectural structure was the engineering structure made ready for use and presentable to the eye by the addition of finishes, fittings, embellishments, etc. There were, of course, certain structures such as retaining walls, bunkers, harbor works, etc., which are engineering structures purely and simply, and could not well be considered from an architectural point of view. But it was the object of the paper to deal chiefly with the structures composed of beams, columns, slabs, and walls, which came under the head of architectural structures. The most economical reinforced concrete engineering structure would have a certain arrangement of slabs, beams, columns, etc., with definite percentages of reinforcements, such arrangement and percentages having been determined, with due regard to the loading, with a view of producing the cheapest possible skeleton structure. This result would probably be attained by keeping the slab thicknesses small by the introduction of beams, by keeping beams deep and narrow, and by having the size of columns (probably all different) just sufficient to carry the loads. The adoption of such a scheme would result, as already stated, in the most economical engineering structure; but if they considered the salient engineering points from an architectural point of view, they might find the nett results economical in some cases and very uneconomical in others. Generally speaking, it was economical to reduce the thickness of the slabs by introducing beams and keeping the spans small. Now, it often happens that beams running across ceilings required special finishes, cornices, etc., and the amount saved on the engineering structure might be much less than the extra cost of architectural finishing. The adoption of uniform column sizes might be more economical ultimately, for the same reason. Again, deep and narrow beams were, generally speaking, most economical from an engineering point of view; but they did not conduce to efficient lighting and ventilating, and it might cost more to get these necessary properties than the amount saved on the skeleton structure.

In order to design economical reinforced concrete structures many factors had to be considered, some of which varied in all cases, but there were three fundamental points which influenced all structures in the same way, and these were: (1) The effect of beam section on economy; (2) the effect of percentage steel on economy; (3) the effect of layout or arrangement of beams, columns, etc., on economy.

In dealing with the first factor, the relative economies of singly reinforced T-beams and singly and doubly reinforced plain beams, as regarded the ratio of breadth to depth, were discussed. The meaning of the second and third factors being self-explanatory were not further explained.

The total cost of any reinforced concrete structure, whether a single slab, column, a whole floor, or a complete frame, would be the sum of the total costs of the three items —concrete, steel, and centering—and these, in their turn, would depend upon the unit costs. Now, these unit costs would vary for different parts of the one complex structure, but not for any single member; so that while a mathematical expression for a single member was possible, it would be impossible, owing to the very large number of variable quantities involved, to deduce a mathematical general expression for all classes of structure, simple and complex. Any attempt to deal with the subject of economy mathematically could only lead to ambiguity and vexation. It was, however, possible to deal with the subject by taking different arrangements, percentages, etc., and by calculating the cost of the various items, the required totals could be obtained by summation. That method appeared at first sight to be rather formidable, but by a suitable arrangement of the work it would be found that the difficulty is more apparent than real.

The conclusions might be summarized as follows:—

1. As regards beam section—

(a) Reinforced concrete T-beams, correctly designed, with the total depth three times the breadth of web, are more economical than any other section for all values of unit cost and loading.

(b) For plain beams, reinforced in any way whatever, the most economical ratio of depth to breadth is 3 for all values of unit cost and loading.

(c) For singly reinforced plain beams, the most economical reinforcement percentage runs from 1 to 1.2 for all values of unit cost and loading.

(d) For doubly reinforced plain beams the most economical reinforcement percentage is 1, with equal tension and compression steel, for all values of unit cost and loading.

(e) Plain beams doubly reinforced may be more economical than similar beams singly reinforced, the relative economies depending upon the values of unit cost and ratio of depth to breadth of section, but not to any appreciable extent upon the loading.

The foregoing conclusions were quite independent of any economies effected by adopting uniform sections throughout a design.

(2) As regards percentage of steel—

(f) For ordinary values of unit cost square columns, helically reinforced, are most economical of cost when the diameter of lateral is small, the pitch of lateral is 0.2 the breadth of core, and the percentage longitudinal steel is high.

(g) Increased economy of cost will result from the use of longitudinal reinforcement having a lower yield point than ordinary mild steel, provided such material be cheaper than mild steel.

(h) The greatest economy of space is obtained by using large diameter laterals, pitched at 0.2 the breadth of core, and a high percentage of longitudinal reinforcement.

Summarizing conclusions drawn from layout, etc., he states:—

(i) A rational arrangement of slabs and beams supported by columns is more economical than slabs supported by beams only.

(j) A low-percentage slab reinforcement is more economical than a high percentage.

(k) A thin slab is more economical than a thick slab.

The British Columbia Electric Railway Company will spend nearly $200,000 in New Westminster this year. The new freight yards between Fourteenth and Sixteenth Streets, which will have a storage capacity for four hundred and fifty freight cars, will take $100,000, while $50,000 have been appropriated to new car barns. These barns, it is believed, will be the largest in Canada and will be capable of housing nearly fifty interurban cars. The clearing of the site is nearly completed and building will start shortly.