within it. The maximum stress, on the other hand, will not be on the line of the maximum bending moment because the strength there (since it is within the head) is increased due to the greater depth of concrete. It is fair to assume, therefore, that the maximum stress is at the edge of the column head, and we may assume the "critical section" as on this line. The exact location of the line of maximum moment is indeterminate. Under ordinary conditions it appears fair to assume its location as within the column head, a distance equal to the thickness of the slab. Therefore, Mr is figured for a value of $r=r_0+t$. In figuring this moment, values of the constants C_s and Ce should be taken from the curves in Figs. 3 and 4. As in an ordinary fixed beam, this bending moment is negative, so that the upper side of the slab is in tension and the lower in compression. Having found the moment, the design of the reinforcement and the thickness of the slab may be worked out as for an ordinary beam.

The curves in Figs. 5 to 8 inclusive will be found of assistance in working out the design.

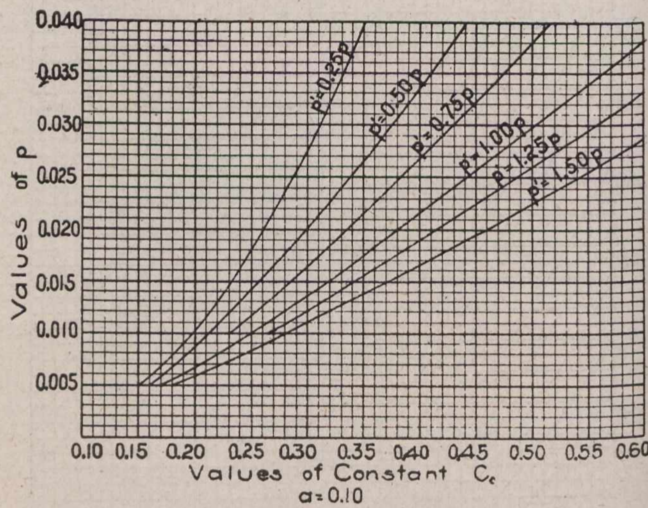
Steel in Column Head.*—The slab at the column head might be designed with the steel all in the top of the slab running in four directions provided the slab is thick enough so that the concrete will not be overstressed in compression. In order to reduce the thickness of the slab and therefore save the additional cost and weight of concrete over the entire floor, it is economical to place steel in the bottom of the slab as well as the top, and figure it as assisting the concrete to take compression. Since a portion of the bars need to extend only far enough beyond the column head to furnish suitable bond, the cost of this additional steel will be much less than the cost of an additional thickness of concrete over the entire slab.

To make it easy to place the concrete and also to bring the entire gravity of the steel as near to the surfaces of the slab as possible in order to give the longest moment arm, and thus a thinner slab, two layers of steel may be placed in the top of the slab and two layers in the bottom. The relation of the quantity in the top and bottom must be determined by the design. If a thin slab is desired, even more steel may be placed in the bottom than in the top. In the tables, three ratios of steel are given and the percentages selected are those that will give the required working stresses in the concrete and the steel.

The Minneapolis test already referred to shows that not only the steel directly over the column head, but the steel for a considerable distance each side, takes tension. In view of this test and of the tests made at the University of Illinois,† it is safe to assume that the steel may be spaced over a distance at least equal to the diameter of the column head plus three times the thickness of the slab.

The determination as to whether the diagonal or rectangular steel should be placed at the top is governed by the relative quantities of each. More steel is required for the diagonal direction through the slab, hence the layers which are largest in section may be run diagonally.

Agreement with Minneapolis Tests.—By our theory it is possible to compute the stresses not only next to the column head but at any point in the slab. In several cases, knowing the exact location of the points where the deformations were measured in the Minneapolis tests, we have computed the stresses at these points. Using 5.6 in. as the moment arm, and including the radial bars as assisting to take tension, we figure the maximum stress in the steel over the edge of the column as 25,000 lb. per sq. in. under the normal load of 225 lb. per sq. ft. as compared with 20,700 lb. per sq. in. given by Mr. Lord as the actual maximum stress in the floor. This is no greater difference than there ought to be between design and test and shows our method to be slightly more conservative than the actual test.



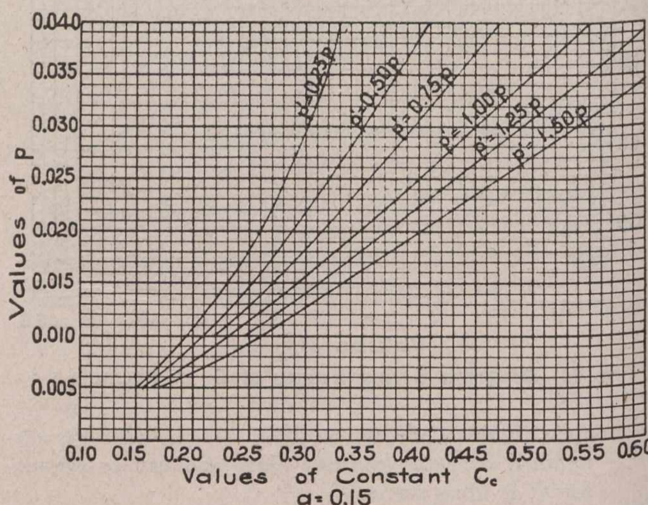


Fig. 5.—Diagram Giving Values of Constants in Formula.

$$fc = \frac{M}{Ccbd^2} \text{ for } \alpha=0.10 \text{ and } \alpha=0.15$$

$$\alpha = \frac{\text{Depth of Steel in Compression.}}{\text{Depth of Steel in Tension.}}$$

$$p = \frac{\text{Area of Steel in Tension.}}{\text{Area of Concrete above Steel.}}$$

The compression in the concrete is more difficult to check since the exact locations of the test points are not given. Computations, however, show unquestionably that our methods are conservative enough to allow for the irregularities in concrete mixtures, and the danger of not having perfect concrete at the critical section.

(To be continued.)

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* Certain features of flat slab reinforcement are covered by letters patent No. 1,003,384 of C. A. P. Turner.

† See paper on "A Test of a Flat Slab in a Reinforced Concrete Building," by Arthur R. Lord, Proceedings National Association of Cement Users, Vol. VII., page 182.

Calgary street railway receipts for the month of February show an increase of almost 100 per cent. over the receipts for the same period last year. Last year's earnings amounted to $19,383.21. The figure this year reaches a total of $37,545.45.