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OPTIMAL DESIGN OF LONGITUDINAL REINFORCEMENT OF CONCRETE RECTANGULAR SECTIONS WHICH CARRY BIAXIAL BENDING

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The majority of reinforced concrete structures have sections subjected to biaxial bending. Daily we have examples in buildings, industries or bridges. Within their columns, bidirectional or twoway solid slabs subjected to longitudinal and transversal loads.

As concrete and bars have a non-lineal behaviour under high stress levels, the complexity of calculating sections in the ultimate limit state makes its manual calculation impractical. Existing software allows the calculation for rectangular sections but restricted to their distribution within the bar. However, it has not been specially considered how to distribute bars in order to minimize the amount of steel needed for any given load (N_d , M_{xd} , M_{yd}) and any section dimensions (b, h).

Before the bar's optimized study, a base design program should be used to calculate the strength developed by the section. Contrary to other methods based in numerical approximation and though it is not easy to do the accurate integral when the neuter fiber shows any other distribution, the expression for supported strengths have been determined with the maximum accuracy and calculus speed.

Once the first goal has been achieved the next step is to prove that the reinforcement can be better designed. Up to now this calculation has been done in sections subjected to biaxial bending and a correct distribution of reinforcement can save a large amount of steel, between 5 and 10% or even more depending on the situation. A new procedure for designing the optimal reinforcement of rectangular sections of concrete subjected to biaxial bending has been developed with the restriction of having the same bar in the four corners and symmetrical distribution in the sides.

Finally and after studying many examples we have found an expression which gives us the bar optimal distribution depending on the loads and geommetry of the section. This expression allows us, which was our main goal, to achieve an optimal section design subjected to this kind of strength.