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COST EFFECTIVE DESIGN OF REINFORCED CONCRETE MEMBERS

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Reinforced concrete is the most widely used material of construction in Sri Lanka. At present the normal practice is to design these concrete structures following the guidelines presented in the relevant British Standards, viz. BS 8110:1985. The approach adopted by these standards does not specifically take into account the cost aspects of the resulting structures. However, in the context of the present highly competitive market conditions, it is of extreme importance for the design engineers to pay attention to the overall cost of the structures that they design. Normally it is expected that the experience of senior design engineers would enable them to achieve cost effective structures. At least in the case of less experienced designers there is a need for some specific guide lines to achieve the same. This study presents a methodology that can be used to develop such guidelines.

The basic problem is one of optimizing the cost of a reinforced concrete member subject to the applicable constraints such as strength, durability, and serviceability conditions. It is also important to present the results in a manner that is easy for the designers to use in their day to day work. The most significant parameters involved are the dimensions of the concrete member, amount of reinforcement, and the strengths of the materials used. Generally, the amount of reinforcement can be reduced by increasing the amount of concrete and *vice versa*. Therefore it is reasonable to expect that there will be a set of optimum values for these parameters which will yield a least cost design. This is critically dependent on the ratio of the cost of reinforcing steel to that of concrete and is referred to as the *cost ratio* in this study.

The study was limited to slabs and singly reinforced beams. After the formulation of the optimization problem numerical procedures were used to produce results corresponding to different cost ratios and characteristic strengths of materials. They were presented in easy to use graphical formats. In order to indicate the sensitivity of the optimum cost to variations of the dimensional parameters, the regions corresponding to 10% increases in the optimum cost also were identified.

The results indicate that:

- (a) In many cases straightforward application of the guidelines provided in the standards do not necessarily produce least cost designs.
- (b) It is possible to obtain cost effective designs within the present design procedures by the judicious use of design aids such as the graphical presentations produced in this study.
- (c) The least cost solutions are highly sensitive to the cost ratio, which is in turn dependant on the characteristic strengths of materials.