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Abstract :

The prices of the materials, that compose the reinforced concrete structures and the cost of their workmanship fluctuate according to the local conditions. In the time being the different design methods of R.C. sections subjected to simple bending are based on the balanced section concept. This work is a trial aiming for a practical design of such sections according to ultimate stress method based on economical concepts. An expression for determination of the neutral axis corresponding to the economic section is introduced. A family of curves for dimensioning the sections are also given. It has been proved that the proposed base for design gives a substantial decrease in the total cost of the element compared to that of the element designed according to the traditional basis. Some examples for design are illustrated.

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Introduction :

A reinforced concrete beam subjected to a gradually increased load leading to failure experiences three typical stages of stresses and deformations.

The first stage starts with the early stages of loading. within that range the stresses and deformations are comparatively low and almost elastic.

The second stage starts when the concrete in the tension zone cracks and releases gradually its share of stresses passing it on to the adjacent steel. As the loads are further applied the stresses and plastic deformations grow up. This stage lasts till the yield point of the steel is reached or till the max stress of the concrete is attained, whichever comes earlier.

The third stage is the period of failure. This period is very short and its acts happen almost instantaineously till the stresses reach their limit leading to complete collapse.

The compreseive stresses in the concrete due to pure bending is found to be related to the strains in some relation

similar to that due to pure compression. This is due to the fact that the distance of any pt. in the cross section from the N.A represents more or less to some scale a gradual linear change of strain. Therefore, at any stage of loading each pt. has got a certain value of strain proportional to its distance from the N.A, which corresponds by turn to a certain value of stress in some relationship similar to that deduced in the case of pure compression for the same kind of concrete used (Fig. 1-i). This means that the position of the N.A. has got a leading role in the behavior of R.C. beams subjected to pure bending. In the very begining of loading, the N.A. takes a preliminany position, then it moves along the cross section till it takes its ultimate position. Start of failure has three possibilities depending upon the ultimate position of the N.A. that depends by turn to the amount of reinforcement included.

First possibility - Failure starts with the yeild of tension steel. The strain in the reinforcement reaches the value corresponding to its yeild ε_y indicated in Fig.(1-ii), while the strain in the extreme fibres of the compression zone is lower than that corresponding to its failure. The