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Time dependent analysis of structural concrete continuous bridges produced using balanced cantilever method

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The cantilever concept is used for the construction of balance cantilever bridges. The first segment on the pier is kept under fixed condition and the rest of the segments are attached to the first segment successively by post tensioning. In this type of bridge, time dependant analysis is important at the fabrication and all construction stages. An analysis procedure exhumed from literature, for time dependant analysis which is most comprehensive, systematic and succinct is followed in this study. The method recognises all the materials in a bridge section such as different concrete parts and different steel parts encountered during the entire life of the bridge in a unified manner. This approach is ideal for computer coding and adopts the matrix notation and algebra. The method is based on basic structural mechanics where flexural theory is extended to cover composite sections in which centroid is a variable due to time-dependant nature of the material properties (the modular ratios change with time). Hence the standard bending formula is not applicable. For the Principle of Superposition to be valid throughout the analysis, the concept of an arbitrarily defined reference point is introduced. This may be selected to suit the preference and convenience of the user. The resulting equations follow a matrix procedure. The overall analysis is based on matrix displacement technique using axial strain at the reference point and curvature of the section as the basic unknowns. The subsequent changes arising from time dependant effects in the two unknowns are calculated in a similar manner. This rigorous procedure can handle any changes to statical conditions, material and geometrical properties. The analysis accounts for Creep, Shrinkage and Relaxation which are usually ignored by some designers. A companion computer programme developed in this study is adopted successfully for the design as there is a large number of analyses to perform in the design process. This tool can be conveniently used in continuous bridge designs to predict time-dependant stresses and deformations at the service stage.

A design example involving a bridge produced using the balanced cantilever construction technique is discussed. The results show that design checks are important to ascertain whether concrete cracks should be eliminated or controlled. The computer procedure developed and implemented is very powerful and fills several voids that existed in the serviceability design stage.

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