A method for the creep analysis of composite cable-stayed bridges

A Method For The Creep Analysis Of Composite Cable-Stayed Bridges

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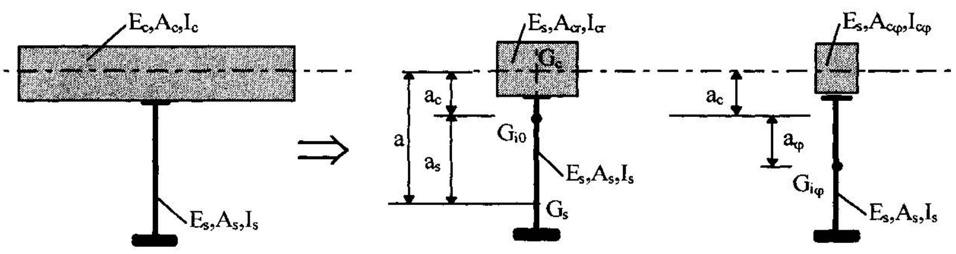
Abstract

In general, as an internally heterogenous structure with external elastic restraints the 'exact' creep analysis of composite cable-stayed bridges has to be performed by using numerical step-by-step techniques with more than 100 calculation steps. The so-called one-step method which is presently based on some solutions by using dischinger method (rate of creep method) or based on the age-adjusted effective modulus (AAEM), is apparently applicable for most practical designs. The solutions for composite cross sections obtained by using dischinger method or the usual AAEM method, however, inevitably have errors, which in some cases are negligible, but in other cases unnegligible. This paper proposes a one-step method for the creep analysis of complex composite structures including composite cable-stayed bridges which is based on a method newly developed for the creep analysis of composite sections. The creep analysis of composite sections by using the new method is mathematically exact on the usual hypotheses. Therefore, the accuracy of the results by using the new method is better than ones by using the AAEM method or the dischinger method.



a) b) c)

Fig. 1 a) Original cross section b) Fictitious cross section for elastic analysis c) Fictitious cross section for creep analysis

In order to perform the creep analysis of statically indeterminate composite structures, a fictitious transformed section for creep analysis which is similar to the transformed cross section for elastic analysis of composite structures is introduced (see Fig.1) and equivalent loading vectors for sustained loads are derived from the results of creep analysis of composite sections. The calculation of the properties of the fictitious transformed sections and equivalent loading vectors can be easily implemented in a usual finite element program for the elastic analysis of structures. The creep effects can be then evaluated by using the finite element program by means of the properties of the fictitious transformed sections. It should be noted that the structure for creep analysis has a system line which is different from that for elastic analysis(i.e. a remove of a_φ).

To show its application, redistribution of internal forces due to creep in a cable-stayed bridge with composite cross section shown in Fig. 2 is evaluated by using the presented method. The elastic internal forces $N(t_0)$, $M(t_0)$ and the change of internal forces N_φ, M_φ due to creep for sustained load g=300 kN/m are illustrated in Fig.3.

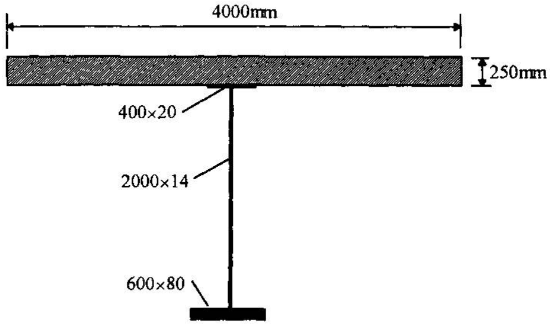


Fig. 2 Cross section

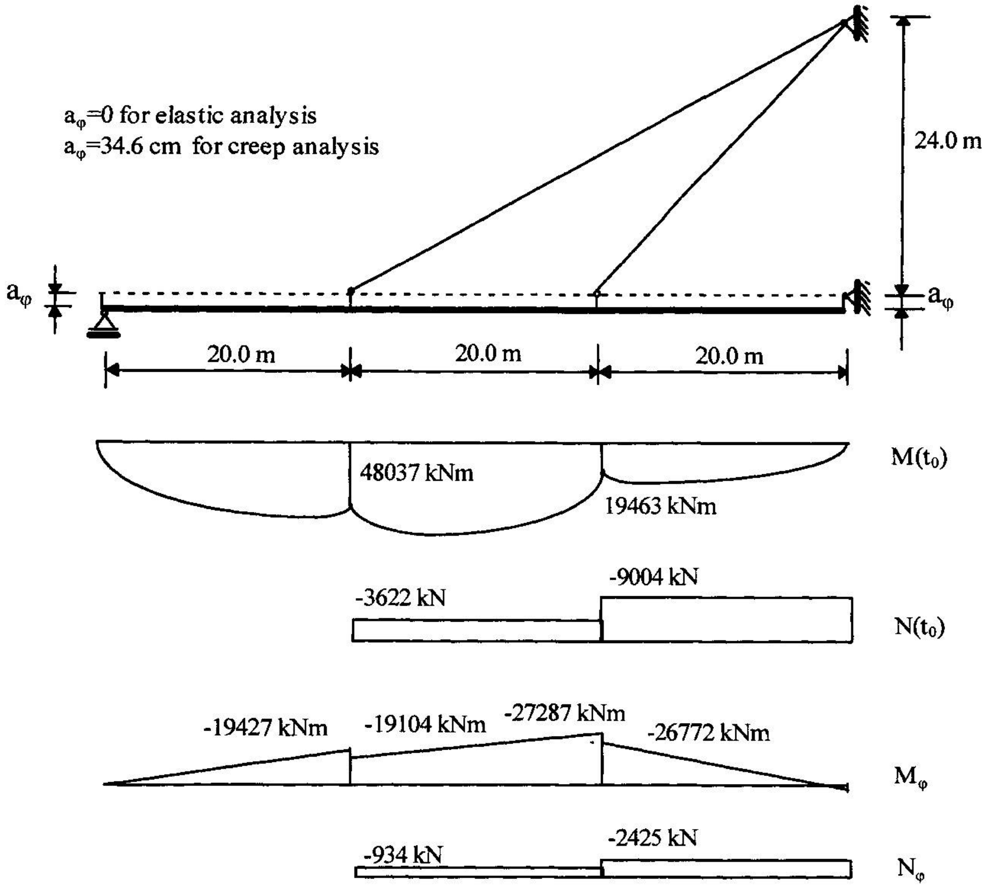


Fig. 3 Example