Modelling of gradual construction of road bridge and its creep

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ABSTRACT

Fast construction of new highways in the Czech Republic makes demand on efficient technologies of highway bridges construction. The construction of bridges is one of the most expensive and the most complicated parts of the whole highway construction. Therefore, a lot of interest is devoted to the concrete bridges construction. Detailed analysis of the gradual bridge construction is not performed in practice because it is very time consuming and necessitates the use of specialised software.

This contribution deals with an analysis of gradual construction of a highway prestressed concrete bridge. Two technologies are studied and modelled. In the first case, the first span and approximately one fourth of the second span of the bridge is cast on prepared falsework. After curing the falsework is removed and the remaining part of the second span and one fourth of the third span is cast and so on. In the second case, the first span is cast on prepared falsework. After time for certain concrete hardening, falsework is moved and the second span is cast and so.

The whole bridge, as in the final stage of construction, is discretized by a finite element mesh. A virtual falsework occurring along the whole bridge is also discretized by a finite element mesh. The gradual construction is modelled with the help of time functions which are used for switching the nodes and finite elements on or off. The time functions of finite elements describing existing spans of the bridge and the actual position of the falsework are unity while the time functions of remaining elements are zero. It is assumed that the falsework supports newly cast span for some time and then the new span is connected with the preceding span and the falsework can be removed.

Applied loads play an important role in the analysis. First of all, dead load of the falsework and the bridge is taken into account. Beside the dead load, longitudinal and transverse prestress is assumed as a load case. The loads are also managed by time functions which switch them on or off.

The loads are applied during the early stages of the hardening of concrete and therefore creep effects have to be considered. The analyses are based on the modified B3 creep models for concrete developed

by Bažant in reference [1]. A new variant of the creep model using retardation spectra (see reference [2]) is used for its significantly shorter time requirements.

The behaviour of two different technologies of gradual construction together with the behaviour of the whole bridge were investigated and compared. It is clear that the behaviour of the whole bridge differs significantly from the behaviours describing the gradual construction. Vertical displacements of selected points are summarised in tables and depicted in figures. This study was motivated by a civil engineering company which needs a detailed analysis of gradual construction of bridges with the help of a new type of falsework. Our results will be used for comparison with their own analysis and later with measurements on new constructed bridges.

References

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