Dynamic analysis and fatigue verification of precast bridge decks for high speed railway lines

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A PhD work is currently in progress at FEUP, devoted to the study of precast bridge decks for high speed railway lines. This article presents one of the tasks of that work, comprising the analysis of a case study. The case study is a continuous bridge deck, constructed with precast prestressed "U" beams (two per span).
This study intends to clarify the relevance of the following effects:
- resonance phenomenon for fatigue verification;
- daily temperature variation for fatigue verification;
- fatigue behaviour of continuity connections in this kind of structures;
- non-linear behaviour of the connections.

Three routines (interacting with DIANA) were developed in the course of this task.
Routine 1 is a programme for pre and post-processing that interacts with DIANA, with the purpose of computing the dynamic structural response due to the passage of high-speed trains. This pre and post-processing programme was developed using Microsoft Visual Basic. The pre-processing programme executes a series of instructions leading DIANA to perform a transient analysis under the effect of a series of loads corresponding to the axles of the trains. Routine 1 automatically carries out the calculation for a series of trains and speeds. The post-processing programme is intended to gather the results, in a convenient format.
Routine 2 carries out the fatigue verification for a particular point in a structure, and for a predefined traffic scenario, based on linear damage accumulation. This routine interacts with Routine 1 and with DIANA. Routine 2 carries out the computation of stress histograms and accumulated fatigue damage, resulting from high-speed trains crossing the structure.
Routine 3 was prepared for automatization of parametric analyses. This routine interacts with DIANA, automatically running several calculations, considering for each calculation a different value (previously defined by the user) for each parameter. This routine also collects the results, making the parametric analysis more feasible.