Rail4Future

Projekttitel:	**Resilient Digital Railway Systems to enhance performance**
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Deliverable:	**D3.1.3 Report on Fatigue Modelling**

Fatigue modelling includes all individual steps to guarantee accurate design stress spectra at the relevant constructional details of the individual bridge members, for each train passage. Together with accurate load models and appropriate fatigue resistance models it forms the basis for an improved fatigue assessment, to estimate the remaining fatigue life of steel railway bridges.

In particular, fatigue modelling comprises the following procedures: i) accurate numerical model of the railway bridge for global analyses ("digital twin"), ii) in-situ measurements at the bridge and appropriate procedures to calibrate the numerical model, iii) comparison of measured stress spectra and numerical stress spectra, based on simulations for the train service.

All these individual procedures were worked out for two representative bridge structures, with consideration of monitoring data during regular train service for at least 4 weeks.

Bridge Eschenau represents a historical railway bridge – located along a branch line in Western Austria between Salzburg and Wörgl – with truss girders and riveted cross-sections and member joints. In this case, only a spatial truss-model was appropriate to represent the real behaviour of the structure. Based on in-situ measurements during individual train passages the connection stiffnesses and support conditions within the numerical model were calibrated.

Bridge Mürz-Kapfenberg represents a welded girder bridge without gravel ballast, situated on a main line of ÖBB in Eastern Austria between Graz and Vienna. A simple one-dimensional beam model was developed, capturing also the eccentricities of the neutral axis and the variable bending stiffness of the main girders. In this case the trains operate with significantly higher velocities up to 130 km/h. To study the dynamic effects due to train service, specific passages of individual locomotives took place (single and tandem locomotives), with different speed levels. In addition also the effect of the friction resistance at the moveable bearing on the stress spectra was studied in detail.

Different models for the global analyses of both bridges were analysed and studied, with the aim of ending with the simplest possible model for application in engineering practice.