Critical loading position for proof load testing of reinforced concrete slab bridges based on scripted FEM analysis

As the bridge stock in The Netherlands and Europe is ageing, various methods to analyse the capacity of existing bridges are being studied. Proof load testing is one of the method to test the capacity of bridges by applying loads on the existing concrete bridges with small spans. Because of the fact that neither the actual traffic load nor the design traffic load required by Eurocode can be directly applied on the target bridge in real-life proof load testing, an equivalent wheel load has to be applied instead. The magnitude and the location of the equivalent wheel load is determined in such a way that it generates the same magnitude of inner forces in the cross section. Such calculation is usually done by linear finite element analyses (FEA). Whereas, different bridges have different geometry such as length, width, thickness, angles, number of spans and lanes etc. For each configuration, FEA has to be done first to determine the loading position. The main aim of this paper is to study the relation between bridge geometry and unfavourable loading positions (ULP). Based on that, a guidance tool is developed for the determination of the critical proof load testing locations for the practice.

To achieve this goal, a Python script has been developed using Diana FEA. The script enables the automatic generation and analysis of a bridge model with different geometries and loading conditions. By applying the Eurocode Load Model 1 at variable locations, the most unfavourable loading positions for the proof load are obtained at the corresponding boundary conditions. The output of the study provides a convenient tool for future proof load testing.