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Strength assessment of a concrete bridge: From 3D linear to 2D non-linear

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For the structural assessment of concrete bridges the typical approach is to adopt some simplifications regarding modelling the actual geometry. Common practice is to use a combination of beam, plate or shell elements to describe the structural behavior and only in rare cases solid elements are used. This modelling approach is established throughout the years due to the lack of computational power. Nowadays this problem has been tackled when it comes to linear-elastic analysis. The reason can more be found in the conventional methods for the capacity checks, which are based on internal forces of structural members rather than checking the capacity on element stress level.

In this project a prestressed girder viaduct with a compression layer cast on-site is analyzed with respect to bending moment capacity. An integral model with the bridge piers is used to adequately describe the rotational spring stiffness of the substructure. Geometry of the bridge is imported in DIANA IE. For the linear analysis a full 3D model with solid elements is adopted. From these internal forces the first capacity checks are performed. This indicated that redistribution of the bending moment between the mid-span and support was necessary to comply with the required load bearing capacity. The ability to do so is verified by a non-linear analysis. The practical approach that enabled reuse of the 3D results for the 2D physical non-linear analysis is discussed. Phased analysis combined with a so called double mesh model is adopted for the prefabricated girder and compression layer. The load bearing capacity is verified after several refinements by the GRF-safety format.