Summary

Over the past decades, an increasing number of integral bridges have been built. This type of bridge offers various advantages in comparison with standard bridges equipped with expansion joints and bearings. In particular, integral bridges require less maintenance since they have less mechanical elements. Therefore, cost of retrofitting and indirect costs such as time spent by users during the maintenance works is reduced. Moreover, the static efficiency is increased and the noise of circulation during its lifetime is reduced. However, for the design and analysis of this kind of structure, the soil-structure interaction needs to be investigated to take in account the monolithic behaviour of the bridge with the embankment near the abutment and the piers with the foundation. This interaction is complex and further research is needed.

The report begins by a general introduction of the topic. Thereafter a brief description of the state-of-the-art on integral bridges is presented, as well as the main difficulties faced during design and the main actions that need to be considered. Limit states and numerical analysis on integral abutments and pier on shallow foundations are discussed towards a better understanding of the structural behaviour in order to improve current detailing and design practice.

The study of integral abutments shows that soil-structure interaction should be considered at early stages of the design process. This allows introducing small geometric adaptations to improve detailing which in turn allows significantly increasing the long term performance of the integral abutment without a sensible increase of building costs. This set of new rules can further be applied to both new and existing bridges which require retrofitting of the expansion joints at the abutments.

The study of the cracking limit state of piers shows the strong influence of the geometry of the shallow foundations on the soil-structure interaction.

This two studies show that geometric adaptation in combination with accurate soil-structure modeling could lead to an increase of the current Swiss limit length for integral bridges which is now set at fixed to 60m.

Keywords: integral bridges, semi-integral bridges, end of bridge, integral abutment, semi-integral abutment, transition slab, bridge pier, shallow foundation, soil-structure interaction, durability, serviceability limit state, conceptual design