# Innovative roadway transition structure for a long integral abutment bridge in Austria

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## Summary

A new roadway transition structure for long integral abutment bridges has been invented at the Institute of Structural Engineering at Vienna University of Technology. It consists of prefabricated prismatic concrete elements which are positioned on a sliding plane and connected by flexible corrosion resistant tension members. At one end, these tension members are connected to the bridge structure and at the other end to an abutment block. The total horizontal displacement of the bridge is evenly distributed among small joints between the elements. As part of the extension of the A5 highway in Austria, a 112 meter long integral abutment bridge has been designed. It was decided to incorporate the new flexible expansion joint in this bridge project, in order to gain experience with the design, the installation and the durability of this new type of transition structure.

**Keywords:** integral abutment bridges, roadway transition structure, expansion joint, concrete, durability

## 1. Design principles of the new roadway transition structure

The transition structure exists of several concrete slab elements that are inter-connected by flexible, corrosion-resistant tension members. One end of the tension members is fixed to the bridge structure and the other end to an abutment block. The concrete elements are sliding on a sliding plane. The displacements at the bridge end are spread across a lot of small deformations at the joints between the elements. Thus, the maximum deformation between two elements at the joint is very small. The structural behaviour can be described by a cracked concrete tension bar, where the distance of the cracks is determined by the concrete elements. When the structure is extended, the elongation of all joints between the elements is approximately identical. The final joint opening is sufficiently small so that a specially designed bituminous pavement structure is able to absorb the deformations. This bituminous pavement structure consists of several layers. The first layer is the so called SAMI-layer (stress absorbing membrane interface). This layer is directly installed above the concrete elements. Above the SAMI layer a flexible bituminous road construction is built, which consists of a 110 mm binder and 30 mm wearing course. Between the SAMI and the binder course a stress distributing asphalt reinforcement grid is placed. This is to prevent the propagation of cracks between SAMI-layer and asphalt covering.

## 2. Pilot project

To test the properties of the new roadway transition structure a prototype was built. Based on the results of the prototype the pilot project was designed. The two directional lanes are designed as completely separate bridge structures. The bridge structure has a length of 112 meters from abutment to abutment. The structure consists of 3 inner fields with a span of 24 meters each and two fringe fields with a span of 20 Meters. The structure is built as a slab bridge with haunched slab connections to the piers and to the abutment walls. The thickness of the slab is 0,9 m and 1,4 m at the haunched parts respectively. To reduce the constraining forces the bored piles of the abutment

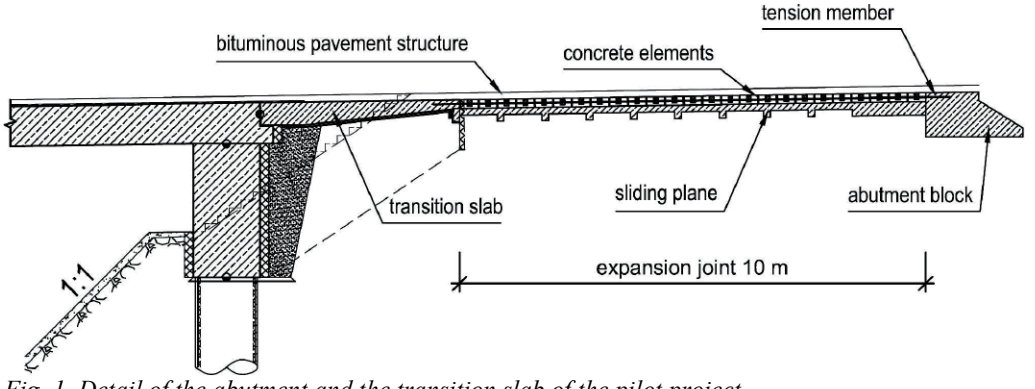


*Fig. 1. Detail of the abutment and the transition slab of the pilot project.*

wall are covered with a layer of expanded polystyrene over the first three meters. The abutment wall is disconnected from the embankment by an expanded polystyrene layer and thus, the earth pressure is be significantly reduced

The transition structure was designed in such a way that the entire system of slab and expansion joints interoperate seamlessly. The overhead transition slab exists to bridge the local settlements behind the abutment wall. Thus the horizontal deformations of the abutment are transferred to the end of the transition slab. The new durable roadway transition structure is situated directly behind the transition slab (see Fig. 1). Because of this arrangement, rotation of the abutment wall and differences in length is expected to be absorbed. It was decided that for the purposes of the pilot project, a variation of the design for the expansion joints should be carried out. To obtain more information about the durability of the specifically designed bituminous pavement structure and the sliding plane, each abutment will be equipped with a different combination of expansion joint and pavement structure. The different versions of the expansion joints will allow to compare a normal version and an economically optimized version of the new durable transition structure. In the normal version a conservative interpretation of the theoretical foundations is considered and in the economically optimized version the actually expected behavior of the design is considered. This variation will show whether there is a difference of the durability.

## 3. Conclusions

The implementation of the prototype test in the course of the development of a new transition structure has yield very satisfactory results. Based on the experiments it could be demonstrated that the production and the construction of the new durable roadway transition system are feasible with low effort due to the high degree of prefabrication. Summing up the construction without existing pavement structure reflects the expected linear elastic structural behaviour, as is shown by the calculations that match the measured results very well. The results of the prototype were implemented in the design of the pilot project. Different design variations of the new transition structure can be verified by means of monitoring.

## 4. Acknowledgements

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The bridge design and the new expansion joint could be optimally linked, due to good cooperation during the planning process. This was achieved by a good cooperation between the research team and FCP – Consulting Engineers which is gratefully acknowledged.