QUICK-INSTALLATION EXPANSION JOINT SOLUTIONS FOR FASTER BRIDGE CONSTRUCTION AND MORE EFFICIENT MAINTENANCE

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INTRODUCTION

Expansion joints that can be quickly installed on a bridge offer a potentially very significant advantage over other types – especially where an existing structure's joints need to be replaced with minimum disruption to traffic, but also where every step in the construction of a new bridge – or parking deck, airport ramp, etc. – must be accelerated to avoid any delays to completion. A number of expansion joint solutions that facilitate relatively quick installation are presented below, with reference to a range of expansion joint types. Thanks to the implementation of solutions like these, the time required for bridge construction and maintenance work may be minimized – at least insofar as it relates to a structure's expansion joints.

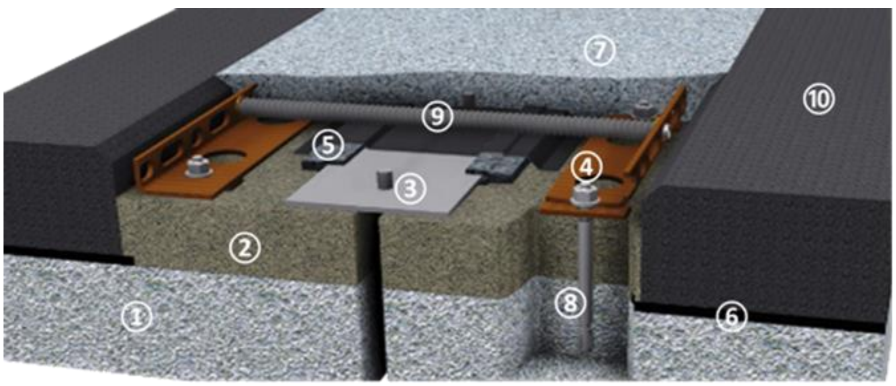
THE SINGLE GAP JOINT WITH POLYMER CONCRETE ANCHORAGE

Where the movements to be facilitated by an expansion joint are small (typically 80 mm or less, or somewhat more if equipped with noise-reducing surfacing), single gap joints often present an optimal solution, being very strong and durable, absolutely watertight and exceptionally accommodating of multi-axial deck movements and rotations. One type of single gap joint, shown in Figure 1, is ideally suited to use in bridge refurbishment projects, minimising the amount of break-out required when installed to replace an old joint. The edge profiles of the joint are anchored in high-strength polymer concrete, which is strong enough to secure them to a suitable substructure without reinforcement. This enables their dimensions, and in particular their depth, to be greatly reduced – so much so, in fact, that this type of joint can typically be installed within the depth of a bridge's asphalt surfacing. This means that much less of the existing structure must be broken out (Figure 1), resulting in less construction effort, less use of materials and less noise and dust nuisance. Indeed, breaking out of more than the surfacing may be highly undesirable or impossible in certain cases, e.g. where a girder is in the way or where concrete reinforcement bars would need to be cut, weakening the structure. Whatever the existing joint type, it is only necessary to remove the joint to a depth of approximately 60 - 80mm (likely to involve no breaking out of concrete or placing of reinforcement) and ensure a suitable subsurface to which the polymer concrete can bond. As well as being much stronger than regular concrete, the polymer concrete used also cures very quickly, gaining the strength needed to support traffic loading within a matter of hours (typically four to six, depending on temperature and humidity) – further reducing the impact on traffic. And the joint can be equipped, if desired, with noise-reducing surface plates. Such joints can thus play an important role in the rehabilitation of many of the countless bridges around the world that require renewal of small movement joints. Further details of this type of joint, its installation and its benefits are provided by Spuler and Moor (1).

Figure 1. A Tensa-Crete single gap joint with anchorage in high-strength polymer concrete (left) can be installed to replace an existing joint of any type and similar movement capacity, often requiring only removal of the old joint and asphalt surfacing and thereby avoiding the need to break out and reinstate concrete etc.

THE POLYURETHANE (PU) FLEXIBLE PLUG EXPANSION JOINT

Flexible plug expansion joints, which create a completely closed, absolutely flat driving surface across a structure's movement gap, offer various benefits over other small-movement expansion joint types. The continuous, flexible surface results in high driver comfort and very low noise under traffic, while also eliminating discomfort and safety risks for pedestrians and cyclists. Furthermore, the way the joints are constructed, by pouring freshly mixed material in situ, facilitates transport and handling and makes expansion joints installable in sections, lane by lane, with any desired shape or longitudinal profile (e.g. with intersections or upstands). However, flexible plug expansion joints made from traditional asphaltic materials have long been plagued by durability problems, especially at low or high temperatures. Inconsistent quality due to improper mixing and incorrect temperature during installation (high temperatures required) also frequently cause problems. To overcome such shortcomings while retaining the aforementioned benefits, modern flexible plug expansion joints such as that shown in Figures 2 and 3 have been developed. This type has a polyurethane surface, which offers a number of substantial advantages over the traditional bituminous type. It offers greatly improved strength, elasticity and durability, resulting in much less maintenance and far more reliable watertightness. Installation is far easier and less prone to error, with the two-component compound being mixed at ambient temperatures. Of course, avoiding the need to break out and replace superstructure concrete or steel in most cases (since the depth of the expansion joint is typically less than that of any bituminous surfacing) makes installation to replace an existing expansion joint much quicker and easier. For these reasons and others, this type of joint should be considered for use in bridge construction where low-movement expansion joints are needed, and, in particular, in bridge maintenance. Further details are provided by Moor et al (2).



1 Main structure
2 Polymer concrete base
3 Bridge plate across gap
4 Perforated steel angle
5 Sponge rubber
6 Bridge waterproofing
7 Special PU material
8 Anchoring
9 Stabilizing bar if needed
10 Road surfacing

Figure 2. Illustration showing the main elements of the described Polyflex-Advanced PU flexible plug expansion joint

Figure 3: Installation to replace an existing joint of any type is simplified by the fact that the new joint can typically be placed within the depth of a bridge's surfacing, avoiding the need to break out (and replace) concrete or steel (left), and the PU material used offers exceptional geometrical flexibility (right)

QUICK-EXCHANGE DESIGN OF MODULAR EXPANSION JOINTS

The modular expansion joint, which divides a superstructure's movement gap into a number of smaller individual gaps (each typically accommodating movements of up to about 80 mm), is often an ideal expansion joint solution where medium or large movements must be accommodated. However, installation of a new joint on an existing structure traditionally required an entire existing expansion joint to be removed, with breaking out of deck material (concrete etc.) and subsequent reconstruction of the connecting superstructure complete with waterproofing membrane. A way of reducing effort, time and disruption to traffic, by retaining the permanently anchored (e.g. concreted-in) parts of the existing joint (the so-called "box-in-box" method) is described by Spuler et al (3). But if the existing expansion joint has been designed to facilitate easy renewal (the so-called "Quick-Ex" (quick exchange) approach), the time and effort required when the time comes to renew the joint will be very much reduced. The design of a "Quick-Ex" modular joint will enable, when required, the main mechanical structure, consisting primarily of the centerbeams that form the driving surface and the support bars beneath, to be easily replaced without any need for cutting or welding on the joint or any impact on the main structure. It will not be necessary to break out concrete, or damage asphalt or deck waterproofing, and therefore will also not require placing of these materials to reconstruct the deck. The moving parts of the joint are simply unscrewed, lifted out and replaced (Figure 4) – far more quickly than would otherwise be possible, with an absolute minimum of impact on traffic. Further details are provided by Adam et al (4).

Figure 4. The "Quick-Ex" design of the Tensa-Modular joint enables the joint's main mechanical structure, consisting of its centerbeams and the support bars beneath, to be easily replaced, with the steel plates along both sides of the joint simply unscrewed to make this possible

CONCLUSIONS

Expansion joint solutions such as those presented, which facilitate expedited installation, can support faster bridge construction and more efficient maintenance. Of course, non-standard solutions can also be developed to meet the specific needs of any particular project, if discussed in good time with a capable supplier. Therefore, where time is of the essence in bridge construction or maintenance projects, cleverly developed and carefully selected expansion joint solutions can support that objective where appropriate.

REFERENCES

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