Single gap expansion joints – an optimal solution for small deck movements

Thomas SPULER
Civil Engineer
Mageba SA
Bulach, Switzerland
tspuler@mageba.ch

Thomas Spuler, born in 1956, received his civil engineering degree from the Polytechnic of Brugg, Switzerland and is today CEO and Chairman of mageba Group. He is a member of the European expert team for Road Bridge Expansion Joints (EOTA), and Vice-Chair of IABSE's *Working Group 5* on bridge bearings and expansion joints.

Gianni MOOR
Civil Engineer
Mageba USA
New York, USA
gmoor@magebausa.com

Gianni Moor, born in 1968, received his civil engineering degree from the Swiss Institute of Technology in Zurich, Switzerland (ETHZ), and was later awarded an MBA degree by the Business School IESE (Barcelona, Spain). Today he is COO of mageba Group, and CEO of the American subsidiary Mageba USA.

Colm O'SUILLEABHAIN
Civil Engineer
Mageba SA
Bulach, Switzerland
cosuilleabhain@mageba.ch

Colm O'Suilleabhain, born in 1971, received his civil engineering degree from the University of Dublin, Trinity College in 1993 and qualified as a Chartered Engineer with the Institution of Engineers of Ireland in 2001.

Summary

Small movement expansion joints are probably the most important type for most road and bridge authorities due to the dominance of short span bridges in their area of responsibility. Considering the key issues of durability and reliability, robust single gap joints have a great deal to offer and should always be considered for use. Variations on the standard, most commonly used version are available to satisfy specific demands – for example, to minimise installation time and disruption to traffic when installed as a replacement for an old joint. They can also be equipped with surface plates if desired to reduce noise and vibrations under traffic. The factors which should be considered in selecting such an expansion joint for use are presented, along with some well-proven solutions. Armed with this knowledge, bridge owners and engineers will be better able to make informed decisions when selecting and using small movement joints in their structures.

Keywords: Bridge, expansion joint, small movement, installation, replacement, durable, low noise

1. Introduction

Every public authority with responsibility for roads and bridges is likely to have a regular need for expansion joints for movements of 100 mm or less. This is due to the simple fact that the majority of bridges have short spans, and their decks therefore do not experience large changes in length due to temperature changes etc. Although small movement joints tend to be less complex than larger ones, their design and selection should not be taken lightly. It is important that the responsible engineers consider the impact of their selection of joint type, and are aware of the features and benefits offered by various types.

Fig. 1: Small movement expansion joint (single gap joint with noise-reducing surface plates)

2. Key issues to be considered when selecting joint type

The issues which should be considered when selecting an expansion joint depend on the bridge structure, its location and users, and its owner's practices and preferences in relation to installation, inspection and maintenance. These are discussed, and it is stressed that joint selection should not be based on initial direct financial costs alone, which tend, in fact, to be insignificant when all other issues are properly considered.

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3. An optimal solution for small movements: Single gap joints

For longitudinal deck movements of up to 80 mm (or 100 mm in some cases), the described demands can often be optimally achieved by the use of a single gap joint. Such a joint typically consists entirely of robust steel profiles, securely anchored to the bridge at each side of the movement gap, and an elastomeric sealing profile between them. Two types of single gap joint are presented. These joints maximise the use of pure steel for strength and durability, without any moving or sliding parts. The strip seal between the steel profiles is more prone to damage but its use is unavoidable, so its suitability must be carefully assessed and its reliability verified.

3.1 Single gap joints with standard loop anchorages in normal concrete

Where space in the bridge structure is not limited – for example, because the structure is being constructed new – standard anchorages and normal concrete can be readily used, and detailed for connection of deck waterproofing membrane if the deck has asphalt surfacing (see Figure 2).

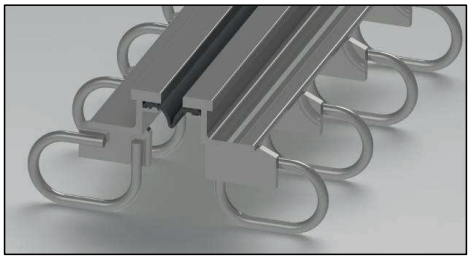

Fig. 2: Single gap joint with standard loop anchorage in normal concrete

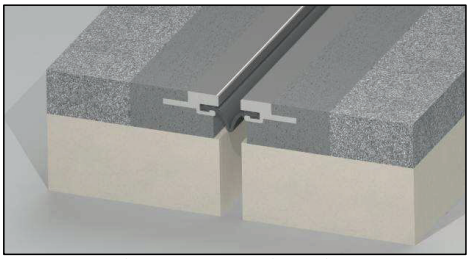

Fig. 3: Single gap joint with anchorage in high-strength polymer concrete

3.2 Single gap joints with reduced steel profiles anchored in polymer concrete

An alternative design of single gap joint, which minimises the amount of break-out required when it is installed as a replacement for an old joint, is illustrated in Figure 3. The edge profiles of the joint are anchored in polymer concrete which is strong enough to secure the profiles to a concrete substructure without reinforcement. This enables their dimensions 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, as shown in Figure 4. As a result, the use of this type of joint will minimise not only construction effort but also the impact on traffic while the works are carried out, while still ensuring a service life of several decades.

Fig. 4: The anchorage in polymer concrete minimises break-out – typically requiring only removal of the old joint and asphalt surfacing

3.3 Optional surface plates

Single gap joints of either type described above can be fitted with surface plates as shown in Figure 1. These create a continuous driving surface for a vehicle's wheels, preventing the impacts which would result from crossing a continuous gap and striking a straight edge. They thus greatly reduce noise from over-passing vehicles, improve driver comfort and practically eliminate vibrations.

4. Conclusions

Considering all factors which should be taken into account when selecting and detailing a small movement joint, it might be concluded that single gap joints, consisting of robust steel edge profiles and a durable elastomeric strip seal, often offer an optimal solution - for the owner, the environment, and the bridge users who would be inconvenienced by avoidable replacement works.