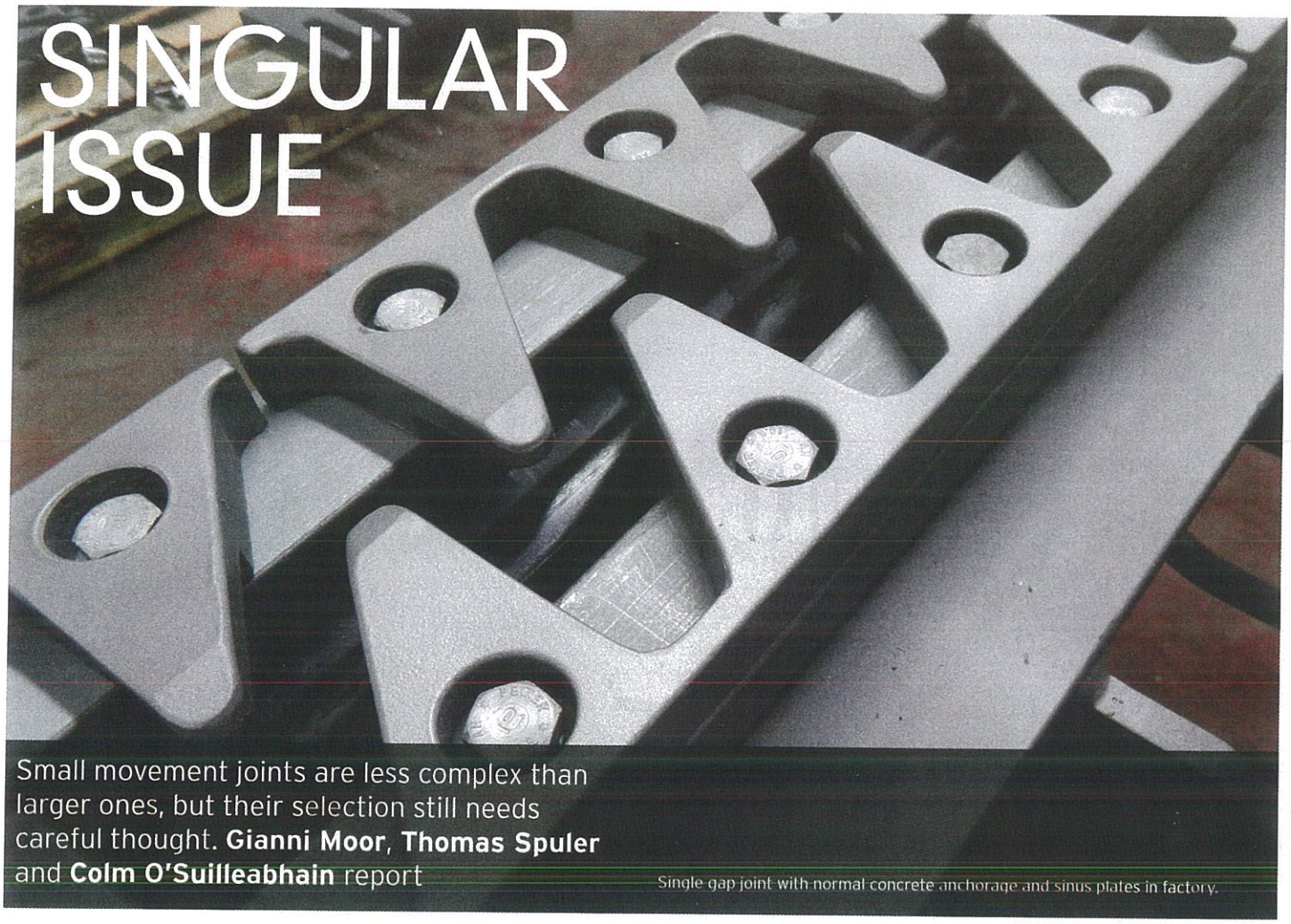
SINGULAR ISSUE



Small movement joints are less complex than larger ones, but their selection still needs careful thought. **Gianni Moor**, **Thomas Spuler** and **Colm O'Suilleabhain** report

Single gap joint with normal concrete anchorage and sinus plates in factory.

Every public authority with responsibility for bridges needs small movement expansion joints, since most bridges have short spans and the decks do not move much with temperature variations and other effects. But their design and selection should not be taken lightly.

The main considerations depend on the bridge structure, its location and users, its owner's preferences and practices in relation to installation, inspection and maintenance, and other factors such as whether the joint is for a new structure or as a replacement for an existing one. The most basic requirement is that it should enable all structural movements without allowing constraint forces to arise. Its ability to prevent leakage of surface water to the structure beneath is another critically-important factor, to avoid damage to the structural support system, and its design should maximise durability and reliability, minimising maintenance and repair effort and ensuring a long service life. In addition, joints should provide an acceptable riding surface and be reasonably quiet and vibration free. In the case of existing bridges, the impact the joint replacement has on traffic and the structure should be minimised.

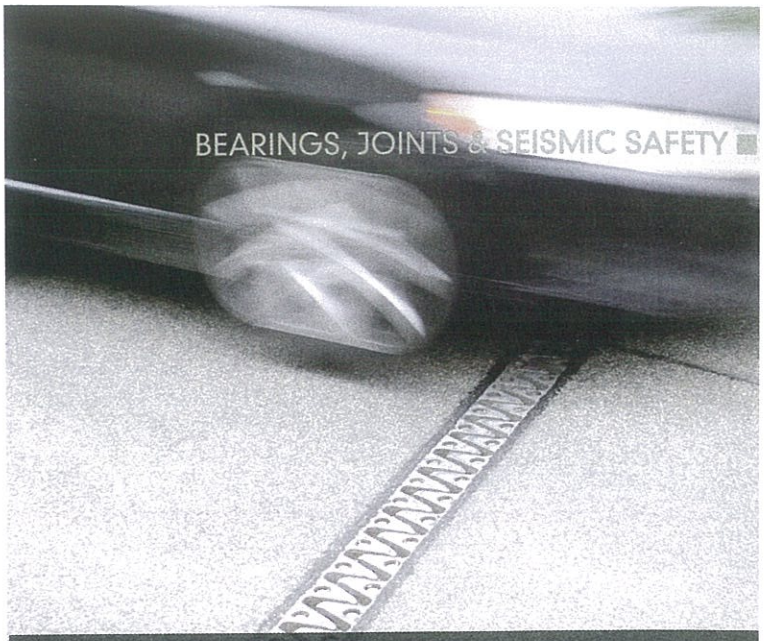
Naturally the cost to the owner is a high priority in the decision-making process, but care must be taken not to attribute too much weight to this factor and to ensure that all costs are considered, including initial and long-term, direct and indirect, financial and non-financial. Very often, only the cost of supply and installation are considered, but these are likely to be far less than future maintenance and replacement costs. Past research by the UK Transport Road & Research Laboratory concluded that initial costs are 'insignificant' when compared with the cost of maintenance, especially when user costs resulting from closure are included.

For longitudinal deck movements of up to 80mm – or more in some cases – the above demands can often be best achieved by the use of a single gap joint. This typically consists entirely of robust steel profiles anchored to the bridge at each side of the movement gap, and an elastomeric sealing profile between them.

Where space on the bridge structure is not limited, standard anchorages and normal concrete can be used. The steel edge profiles may feature horizontal flanges for the connection of bridge deck waterproofing membranes, as required, and this type of joint can facilitate significant transverse and vertical movements, especially when fitted with a special sealing profile. The uncomplicated design of this type of joint offers excellent strength, durability and watertightness.

If required, such joints can be supplied with profiled steel plates connected to the top surface. These offer a continuous driving surface, eliminating the impact which would result from vehicle wheels striking a straight edge. Such surface plates offer several advantages: noise from vehicles is greatly reduced, vibrations are eliminated, which protects the expansion joint and the main structure from fatigue loading and accelerated failure, and the creation of a continuous surface improves comfort for road users. In addition, since they offer a bridging effect across the gap, these plates allow the movement capacity of the joint to be increased to 100mm, potentially avoiding the need for a more expensive or less convenient alternative.

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, offers significant



A joint in place under traffic.

benefits in certain circumstances. The steel edge profiles of the joint are anchored in high-strength polymer concrete, which is strong enough to secure the edge profiles of the joint to a suitably prepared concrete substructure without reinforcement. This enables the dimensions of the joint – in particular its depth – to be reduced sufficiently that it can typically be installed within the depth of the asphalt surfacing. Much less of the existing structure has to be broken out, which reduces the construction effort required, with a corresponding reduction in noise and wasted materials. Whatever the existing joint type, it is only necessary to remove the joint to a depth of between 60mm – 80mm, which typically involves no breaking out of concrete or placing of reinforcement, and ensure a clean, solid subsurface to which the polymer concrete can bond. As well as being much stronger than regular concrete, the polymer concrete that is used cures very quickly, gaining sufficient strength to support traffic loading in just four to six hours.

This joint offers the same movement capabilities and other benefits as that with standard loop anchorages in normal concrete, and can also be equipped with surface plates if desired. But since it can be installed quickly it can play a particularly important role on bridges which require renewal of small movement expansion joints.

Single gap joints as previously described can be fitted with various types of elastomeric profile, depending on movement requirements and other demands. Standard v-shaped seals are typically used to accommodate longitudinal movements of up to 80mm, and depending on their design and connection details, may also be able to simultaneously accommodate significant transverse or vertical movements. A so-called 'hump seal' is the same in most respects, but features an additional hump which keeps the joint gap free of dirt and debris by pushing such material up and out each time the joint closes. In addition to providing this self-cleaning service, the hump increases the resistance of the joint to leaks by providing a second line of defence against piercing of the rubber. It also helps by filling out the gap, reducing traffic noise and any difficulties that pedestrians, for example in high heels, might experience as they cross the joint.

In a single gap joint, the elastomeric seal is the part which is most susceptible to damage or loss of performance, the remainder of the joint being made of solid steel. However its reliability and performance can be verified by laboratory testing, such as the seal push-out test in accordance with AASHTO LRFD Bridge Construction Specifications, and the test of watertightness prescribed by the German standard TL/TP FÜ. Such testing can prove the weakest link in any particular single gap joint to be anything but weak ■

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