Renewal of modular expansion joints - an innovative approach that minimises impacts on traffic and on the main bridge structure

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Summary

An innovative method for the replacement of an old modular expansion joint in a concrete structure is presented: the "box-in-box" method. It requires only the replacement of dynamically loaded parts of the joint, and thus offers several advantages over traditional full-replacement techniques. In particular, it saves the need to break out concreted-in parts of the joint and to place new reinforcement and concrete. Costs are therefore reduced, disruption to traffic is minimised, and structural impacts on what might otherwise be a perfectly sound structure are avoided.

Keywords: Modular expansion joint, renewal, replacement, minimum time, impact on structure

1. Introduction

Expansion joint renewal is a source of considerable expense to bridge owners and can cause enormous disruption to traffic – both impacts which should be minimised during the life of any structure. Where significant movements must be accommodated, even the most perfectly designed and fabricated joint is likely to require replacement several times during the life of the main structure. When the time comes to replace such an expansion joint, a full new joint must generally be supplied and installed - after complete removal of the existing joint and any parts of the bridge deck to which it was connected. In the case of a modular joint in a concrete bridge deck, this traditionally required breaking out of significant quantities of concrete at each side of the bridge gap, and placing of new reinforcement and concrete around the new joint. But a method has recently been optimised which saves this effort, bringing a number of benefits.

2. The modular expansion joint

Modular expansion joints have a great deal to offer to bridge designers and constructors, thanks to their ability to facilitate very large longitudinal movements and the great flexibility they can offer - no other type of joint can accommodate longitudinal movements of two metres or more while also facilitating transverse and vertical movements, and rotations about all axes.

A modular expansion joint contains on its surface a number of lamella beams which divide the movement

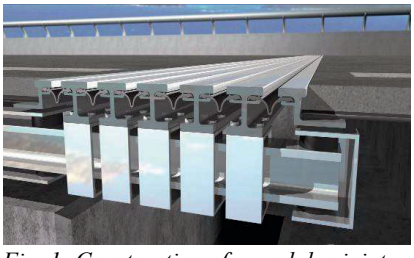

Fig. 1: Construction of a modular joint

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gap at the end of a bridge deck into smaller individual gaps. The lamella beams are connected by elastomeric sealing profiles, and supported by perpendicularly orientated beams underneath, typically spaced approximately 1.6 metres apart, along which the lamella beams slide. These beams, known as support bars or cross-beams, span between steel boxes in the deck at each side of the bridge's movement gap (as shown in Figure 1).

3. The "box-in-box" method for modular joint replacement

Recognising that the parts of a modular joint which are concreted in are not subjected to dynamic loading, it may be concluded that it will not be necessary to replace those parts in most cases – saving the effort of breaking out the concreted-in parts and the traffic disruption caused while the structure is partially demolished and reconstructed. As an added benefit, this approach also avoids weakening what might otherwise be a perfectly sound structure.

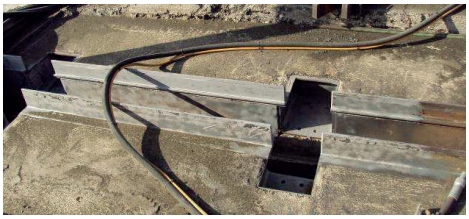

Fig. 2: View of the retained substructure following completion of cutting and removal

The procedure may be summarised as follows:

Step 1: Removal of asphalt at each side of joint
Step 2: Removal of the old joint (less substructure)
Step 3: Cleaning of retained steel and application of corrosion protection
Step 4: Inserting of new joint with support bar boxes located inside cut-open boxes of old joint
Step 5: Welding in place and filling of voids between old and new boxes
Step 6: Formation of steel edge profiles
Step 7: Completion of corrosion protection
Step 8: Insertion of sealing profiles
Step 9: Reinstatement of carriageway

4. Conclusions

Adoption of the "box-in-box" method for modular joint replacement offers many benefits, and requires only that the new joint which is to be installed can be designed to suit the retained parts of the old one. This is particularly important in relation to the locations of the support bars of the new joint, which must be designed to fit (complete with new boxes) into the boxes of the old joint. Implementation of the method saves a great deal of effort – in particular, in the breaking out of concreted-in parts of the joint and the placing of new reinforcement and concrete. It also greatly reduces the disruption to traffic that is caused by these works. The impact on what might otherwise be a perfectly sound structure is also minimised, with unnecessary damage to deck concrete and reinforcement avoided. And the approach is environmentally friendly, minimising not only the use of new materials and the construction effort required, but also the various impacts of traffic congestion during the works. It is thus clear that this innovative approach to expansion joint renewal should be seriously considered whenever modular joints are to be replaced on existing structures.

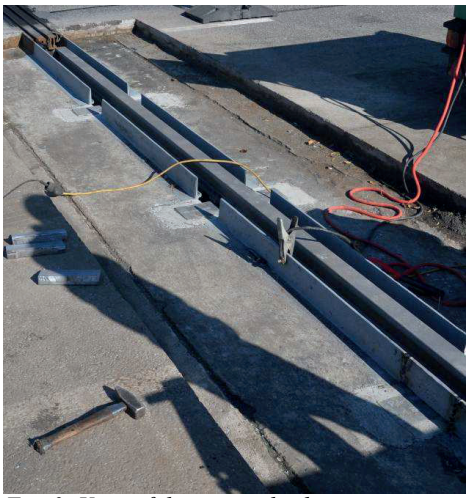

Fig. 3: View of the retained substructure following completion of cutting and removal