INTERIM ADVICE NOTE 168/12

Strategy for the repair / replacement of Joints

Summary
Some expansion joints have complex components comprising of multiple parts. These need to be inspected and maintained to ensure functionality and durability. Replacement of these joints need to be planned as it has been reported that some components may need to be specially fabricated so it is recommended that this is considered in the management plan

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1. Introduction

There have recently been a number of failures of modular expansion joints. (multi-element elastomeric in metal rails). These types of joints are mostly used on long-span structures, on strategic parts of the network. The Highways Agency's Structures Management information System (SMIS) has records of almost 300 multi-element elastomeric joints in metal runners. Many of these joints have a single pair of rails, others have multiple sets.

When investigating some of these failures, it was been found that the maintenance requirements for these joints was unclear and this has led to the maintenance contractors not being able to identify the signs of deterioration leading to abrupt failure of the joints.

It has been reported that on some structures, where failure occurred, the supply of replacement parts took some time as these were bespoke. The failures have caused considerable disruption to the public and significant direct cost to the Agency in the replacement of these components and indirect costs like traffic delay. The manner of the failure of these joints has the potential to cause considerable safety hazard to the traffic.

2. Form of Construction

Multi-element expansion joints typically consist of steel beams arranged in the longitudinal direction of the joint with interposed steel strips. Depending on the width to accommodate the movement more than one centre beams may be required between the edge beams supported on cross bars, which are aligned in the direction of the movement of the structure. Due to the individual gaps between the longitudinal steel beams restricted several strip seals may be employed in series to accommodate the movement.

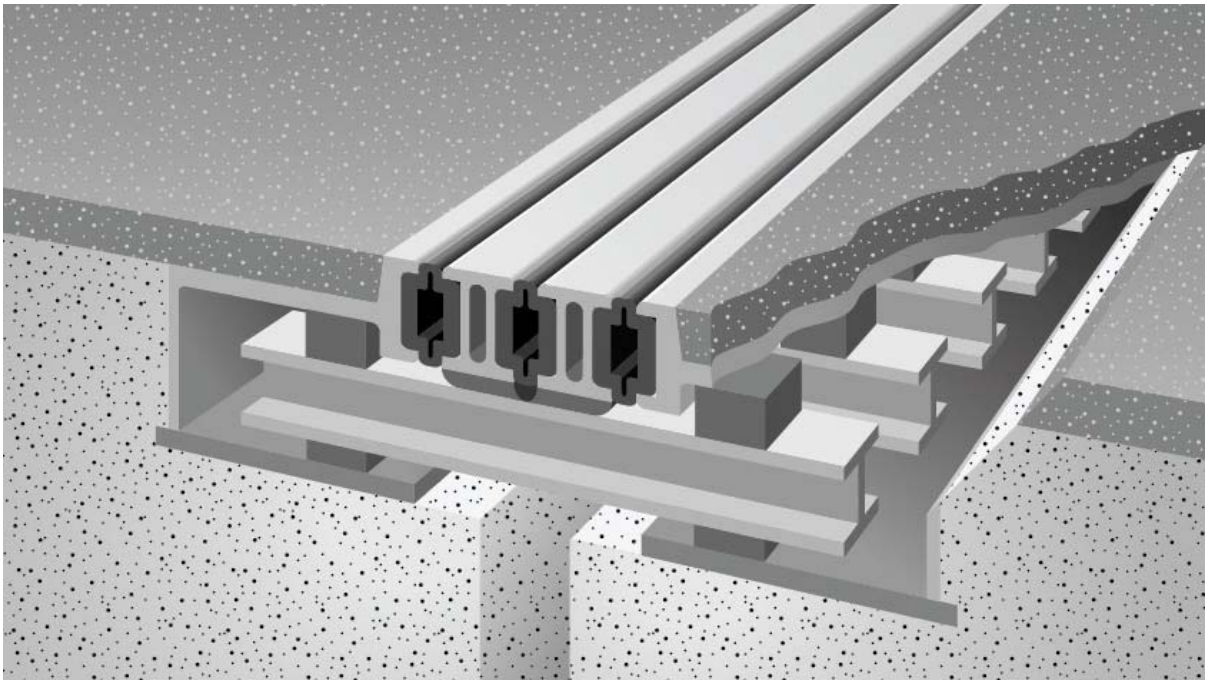

Fig 1: **Multi element elastomeric joint with metal runners**
[Typical arrangement, with the number of rails being adjusted to suit the design movement required. Individual manufacturer's have slightly different details.]

3. Examples of defects discovered

Unexpected failures may result in significant disruption as it can take weeks to procure some components. Especially with older joints that may not be manufactured now.

For example, on one viaduct, the failure of a joint resulted in a rail failing. (Fig 2) The failure occurred on both the Coast-bound and London-bound carriageways and lane 1 had to be closed on both the carriageways, which resulted in disruption to the traffic.

There was no record of any inspection being carried out internally to the abutment or the main span. This may be because the internal was classed as a confined space. On discovery of the failure, a temporary Modular Bridging System with speed restriction was put in place over the failed joint. A full internal inspection of the abutments was arranged, which revealed extensive damage to the joints with loss of components and failed bearings at the edge of the lane 2 and offside verge. It had been reported that there was excessive noise emanating all over the lane 2 of the joint, suggesting worn bearings in the joint. It is believed that the wear/collapse of these bearings is the root cause of the joist failure and subsequent rail/joint failure.

The photographs below are some defects discovered on these bridges during inspections.

The failure of components is generally a result of deterioration over time. In many cases, failure of the joint is preceded by indicators like an increase in noise levels, components becoming loose or vibrating.

Inspectors may be able to identify signals of deterioration without direct visual evidence. However it requires the inspectors to have some appreciation of the specifics of the joint type. These should be a trigger for further investigation and testing to quantify the scale and nature of the issues

It is important that information is recorded to provide information on manufacturer and maintenance to ensure that inspectors will be able to reference this when assessing performance. It has been reported that information on SMIS may not be current or complete.

Fig 2: **Viaduct (Precast Prestressed Concrete) built in 1993**
The damaged rail has been taken out of the joint and corrosion is visible on the rails

Fig. 3: **Cable Stayed Bridge (Composite steel-concrete deck) Built 1991**
Fracture in the support joist immediately below the welded connection to the rail

Fig 4: Cable Stayed Bridge (Composite steel-concrete deck) Built 1991
Rust staining from expansion joints over pier (Seal replacement stopped water ingress, circa 2007)

Fig 5: Cable Stayed Bridge (Composite steel-concrete deck) Built 1991
Corrosion to expansion joints sliding plates over pier, circa 2007

Fig 6 **Cable Stayed Bridge (Composite steel-concrete deck) Built 1991**
Trimmer Beam Support Steelwork corroded

Fig 7: Viaduct (Precast Prestressed Concrete) Built 1976
Failure of joint on footway. Seal failed between rails on carriageway

Fig 8: Viaduct (Insitu concrete deck) Built 1986
Damage to the West Deck Expansion Joint- Rail broken in the middle and level difference

Fig 9: Viaduct (In-situ Prestressed Concrete) Built 1990
Corrosion to rails and debris in seals

4. Recommendations

Expansion joints provide a means of allowing the bridge to move whilst limiting the visible gap on the surface and preventing the ingress of water and deleterious material. However, to ensure that this functionality is sustained it is important to inspect and maintain the joint. Where defects are discovered then steps should be taken to reduce the risks.

A management plan should be prepared by the maintaining agent to attempt to minimise the effect of the failure of these components. The management plan should include the following: (this list is not exhaustive but is indicative of what may be prudent to include)

a. Joint Type

- Identify type of joint – and ensure that the drawings are provided are accurate and available to the maintaining agent
- Instructions for inspection and maintenance are provided. (and are sufficiently detailed)
- Details of joint settings and special features are included. (for example is any specialist equipment required?)
- Details identifying the manufacturer and information such as availability and lead / delivery times for replacement parts are included.

b. Procedure

- Manufacturer's instructions – must set out any specific requirements for inspection or maintenance.

c. Inspections

- Recommended intervals for inspections must included as part of the management plan
- Manufacturer's manual may recommend specific areas to inspect or issues to look for, these should be incorporated into the plan.
- Levels of skill and experience of the inspector are important and should include awareness of the product.
- Is there access for inspection? – Specific guidance / arrangement may be necessary and must be included as part of the plan. It may be necessary to remove seals to view or arrange for specialist equipment.
- Plan may include specific instructions as to what to look for / record, eg the need to record specific issues like: Spot corrosion, unusual noises, loose components, etc

d. Maintenance

- In accordance with the manufacturer's instructions. As a minimum:
  - Clean and remove debris from the joint
  - Record any issues found if apparent.
  - Grease in accordance with the manufacturers instructions

e. Life expectancy

- Identify in the plan the recommended lifespan of components such as seals, and when the date when replacement of seals is anticipated
- Expected replacement dates of other components.

f. Repair strategy

- Be aware of replacement component lifespans and replacement schedules
- Consider if stocks of hard to obtain components or components with a long lead-time should be kept (for critical routes)

5. Implementation

Provisions for inspections and maintenance are incorporated within existing standards. This standard imposes no new requirements it just highlights the importance of these and recommends that confirmation is given that these are in place.

6. Contact Details

If you have specific queries regarding this IAN then contact; Jim Gallagher,
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