

TRANSPORT SCOTLAND (Agency of the Scottish Executive)
TRUNK ROAD & BUS OPERATIONS (Bridges & Structures Team)
TS INTERIM AMENDMENT No 43 – STRATEGY FOR THE REPAIR/REPLACEMENT OF JOINTS

SUMMARY

This Transport Scotland Interim Amendment (TS IA) highlights the strategy for the repair/replacement of joints. 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 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 BACKGROUND

This interim amendment explains the strategy for the repair and replacement 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. Many of these joints have a single pair of rails, others have multiple sets. The current maintenance practice for these joints can lead to Operating and DBFO companies not being able to identify the signs of deterioration leading to abrupt failure of the joints. The supply of replacement parts for these joints can take some time as these are typically bespoke. The failure of such joints has the potential to cause considerable traffic disruption to the public and industry and significant cost to Transport Scotland. The manner of the failure of these joints also has the potential to create a considerable safety hazard to traffic with subsequent claims for damage.

1.1 Form of Construction

Multi-element expansion joints typically consist of steel beams arranged in the longitudinal direction of the joint with interposed steel strips (Figure 1). Depending on the width to accommodate the movement more than one centre beam 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 being restricted, several strip seals may be employed in series to accommodate the movement.

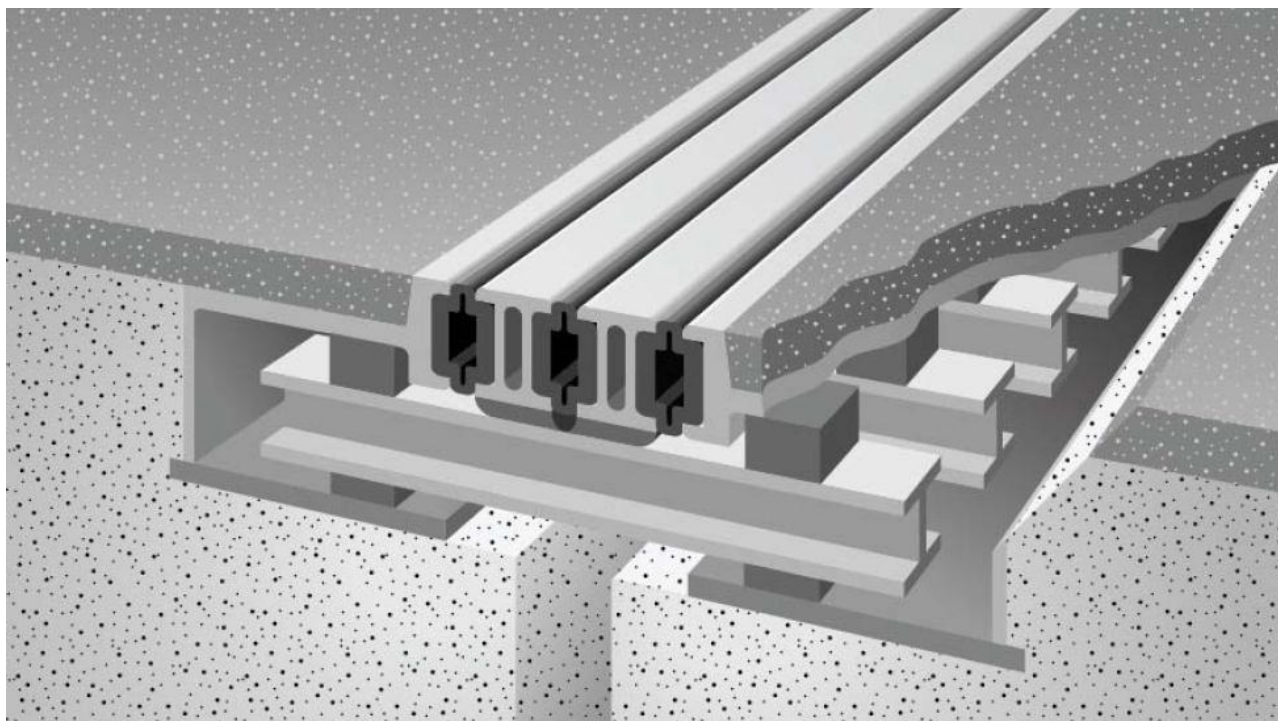


Figure 1 Multi element elastomeric joint with metal runners

[Typical arrangement, with the number of rails being adjusted to suit the design movement required. Individual manufacturer's have slightly different details.]

1.2 Examples of Defects

Unexpected failures may result in significant disruption as it can take weeks to procure some components particularly due to bespoke arrangements and joint types that are no longer manufactured.

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 on the joint manufacturer and maintenance requirements are retained to ensure that inspectors will be able to reference this when assessing joint condition and performance. It has been found that information in the Structures Management System (SMS) may not be current or complete which should be borne in mind during Cyclic Maintenance and structural inspections. Where new information comes to light records should be updated.

It is possible that timely inspection may not be carried out on elements which aren't readily accessible for example inaccessible or hidden components. However, on discovery of any visible signs of a potentially serious defect, (an example is shown in Figure 2) a thorough and complete inspection must be arranged in order to reveal full extent of the damage to the joints.

The photographs below show some defects discovered on bridges during inspections.



Figure 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.]



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



Figure 4 Cable Stayed Bridge (Composite steel-concrete deck) Built 1991
[Rust staining from expansion joints over pier (Seal replacement stopped water ingress.)]



Figure 5 Cable Stayed Bridge (Composite steel-concrete deck) Built 1991
[Corrosion to expansion joints sliding plates over pier.]



Figure 6 Cable Stayed Bridge (Composite steel-concrete deck) Built 1991
[Trimmer Beam Support Steelwork corroded.]



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



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



Figure 9 Viaduct (In-situ Prestressed Concrete) Built 1990
[Corrosion to rails and debris in seals.]

2. ACTION

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 Operating Companies and DBFO Companies 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 provided are accurate and available to the Operating Companies and DBFO Companies
- 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)

3. IMPLEMENTATION

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

4. FURTHER INFORMATION

If you have any questions regarding the use or content of this document, please contact the relevant Transport Scotland Unit Bridge Manager or Major Bridges Manager.