



# SR 520 Bridge Replacement and HOV Program



## AGENDA

### City of Medina, Committee of the Whole (COW)

Tuesday November 1, 2016, 1:00 – 3:00 p.m.

Council Chambers, Medina City Hall, 501 Evergreen Point Road, Medina 98039

	Topic Talking Points	Who
1:00 p.m.	<b>Welcome and Introductions</b>	All
1:05 p.m.	<b>Review of expansion joint measurements</b> <ul style="list-style-type: none"><li>• Measurement process</li><li>• Preliminary measurements</li><li>• Measurement data</li></ul>	Dave Becher Larry Kyle Lawrence Spurgeon
1:20 p.m.	<b>Replacing the expansion joint</b> <ul style="list-style-type: none"><li>• Testing prior to replacement<ul style="list-style-type: none"><li>○ Geometric modeling</li><li>○ Fatigue testing</li></ul></li><li>• Research study including all manufacturers</li></ul>	Dave Becher
1:40 p.m.	<b>Next steps</b> <ul style="list-style-type: none"><li>• Temporary tolling treadles</li></ul>	Dave Becher
2:00 p.m.	<b>Mageba proposal</b>	Dave Becher Larry Kyle Lawrence Spurgeon
2:30 p.m.	<b>Discussion and Questions</b>	All
3:00 p.m.	<b>Adjourn</b>	All

## Reference photo



Straight edge set across large joint at Pontoon A.

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## SR 520 BRIDGE REPLACEMENT AND HOV PROGRAM



# Expansion joint measurements on the new SR 520 floating bridge

The new SR 520 floating bridge has eight major expansion joints, four at each end of the bridge. Expansion joints are a critical part of a bridge's infrastructure. The joints allow the bridge to move and flex with changing traffic, weather, and lake conditions. Shortly after the new bridge opened, WSDOT heard from neighbors regarding new and different sounds coming from the bridge.

From Oct. 8 to 9, WSDOT inspected and documented the placements of the SR520 floating bridge expansion joints between Pier 36 (west end) and the east approach.

Measurements were taken across each expansion joint in each lane along each wheel track in the direction of travel to measure the distance between straightedge and beam, seal gap and slope. Measurements were taken during a full bridge closure using a straightedge, smart level, measuring tape, and taper gauge.

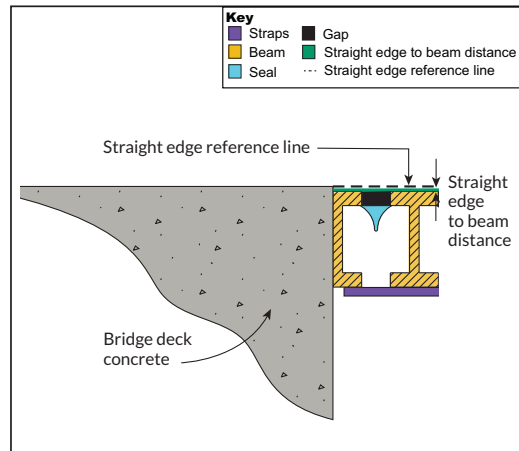
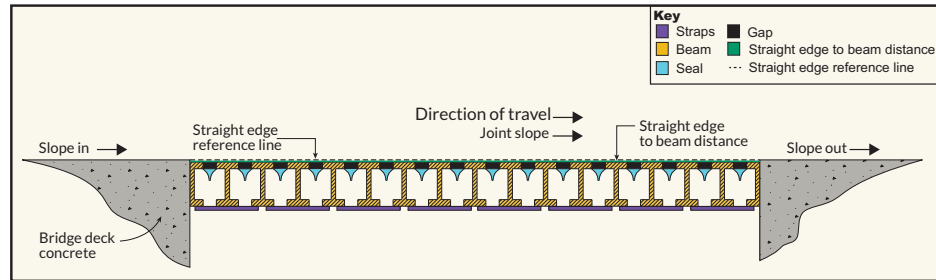
The following conditions were inspected and documented:

- Inspection date and lake elevation
- Location, direction, lane, and temperatures (air, deck, rail)
- Straightedge to beam distance
- Seal gap between beams
- Roadway slope in, roadway slope out, and joint slope



Picture indicates the largest expansion joints on the new SR 520 floating bridge.

## Expansion joint key



### Definitions

- **Beams:** Primary structure of the expansion joint.
- **Gap:** Space between each beam which allows the joint to expand and contract as needed.
- **Seal:** Material between beams that prevent debris from falling into the expansion joint.
- **Straps:** Allows the beam to move while preventing it from moving too far apart.
- **Straight edge reference line:** Represents the bottom of the straight edge which connected the two highest points of the expansion joint.
- **Straight edge to beam distance:** The space between the straight edge and expansion joint.

## Measurements

In October 2016, WSDOT inspectors collected extensive measurements of the expansion joints on the east and west ends of the new SR 520 floating bridge. These measurements should help determine if the installation of the expansion joints is contributing to the traffic sounds neighbors are hearing and inform potential adjustments to the existing joint. WSDOT inspectors took three different measurements:



1. **Expansion joint relative to pavement:** Whether or not the expansion joint is flush and aligned with the grade of the new roadway pavement.

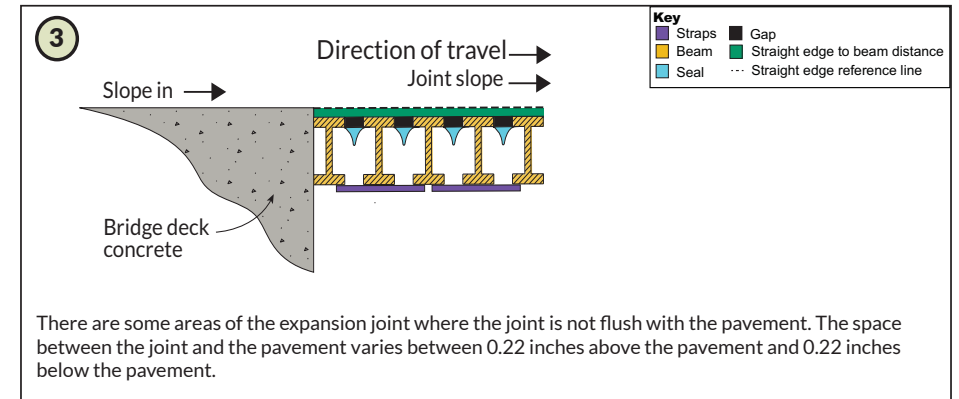
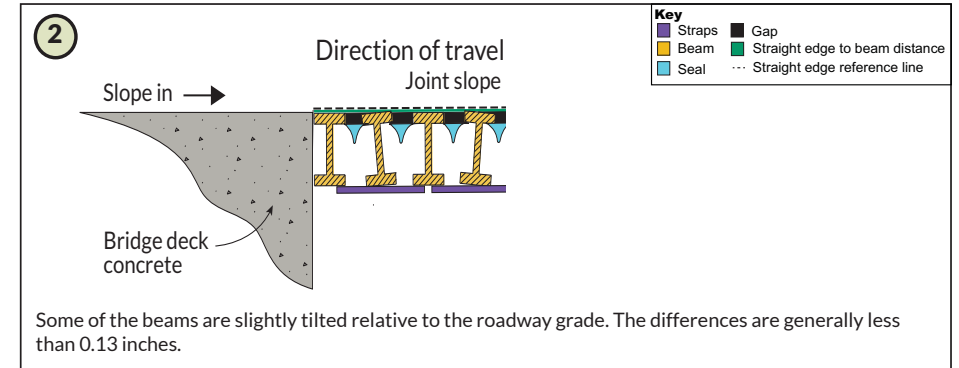
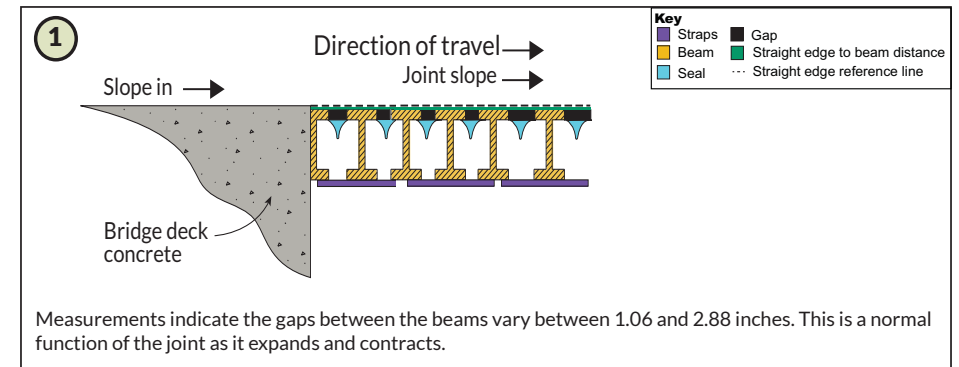


2. **Spacing between each beam:** Whether the gaps or spaces between each beam of the expansion joint are properly positioned.



3. **Orientation of the individual beams:** Whether the top of each beam is properly oriented in relation to adjacent beams and the overall roadway grade.

## Preliminary measurements on expansion joints





WSDOT – October 28th 2016

## Modular Expansion Joints at SR520

Evaluation of noise reducing possibilities  
following installation of the joints



Rodrigo Miranda

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**Introduction**

**2**

**Noise measurements**

**3**

**Noise reducing possibilities**

**4**

**Pilot project**

**5**

**Next steps**



## Brief summary of story to date

- In 2012, Mageba awarded the contract for the supply of modular joints for the floating bridge
- Soon after opening, residents start to complain about noise.
- Mageba assisted in looking at solutions and developing a proposal for noise measurements.
- Noise measurements carried out by WSDOT, report notes that:
  - All measurements were below FWA criteria for consideration of noise abatement
  - The noise from mageba joints is lower than from other comparable (older) joints
  - However, since the new bridge deck is also quieter than the old deck, and due to the different frequencies of the noise, the noise from the joints on this bridge may be more noticeable.
- Efforts to develop a solution ongoing

**Mageba continues to work with WSDOT towards a solution that will satisfy all concerned**

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Pilot project

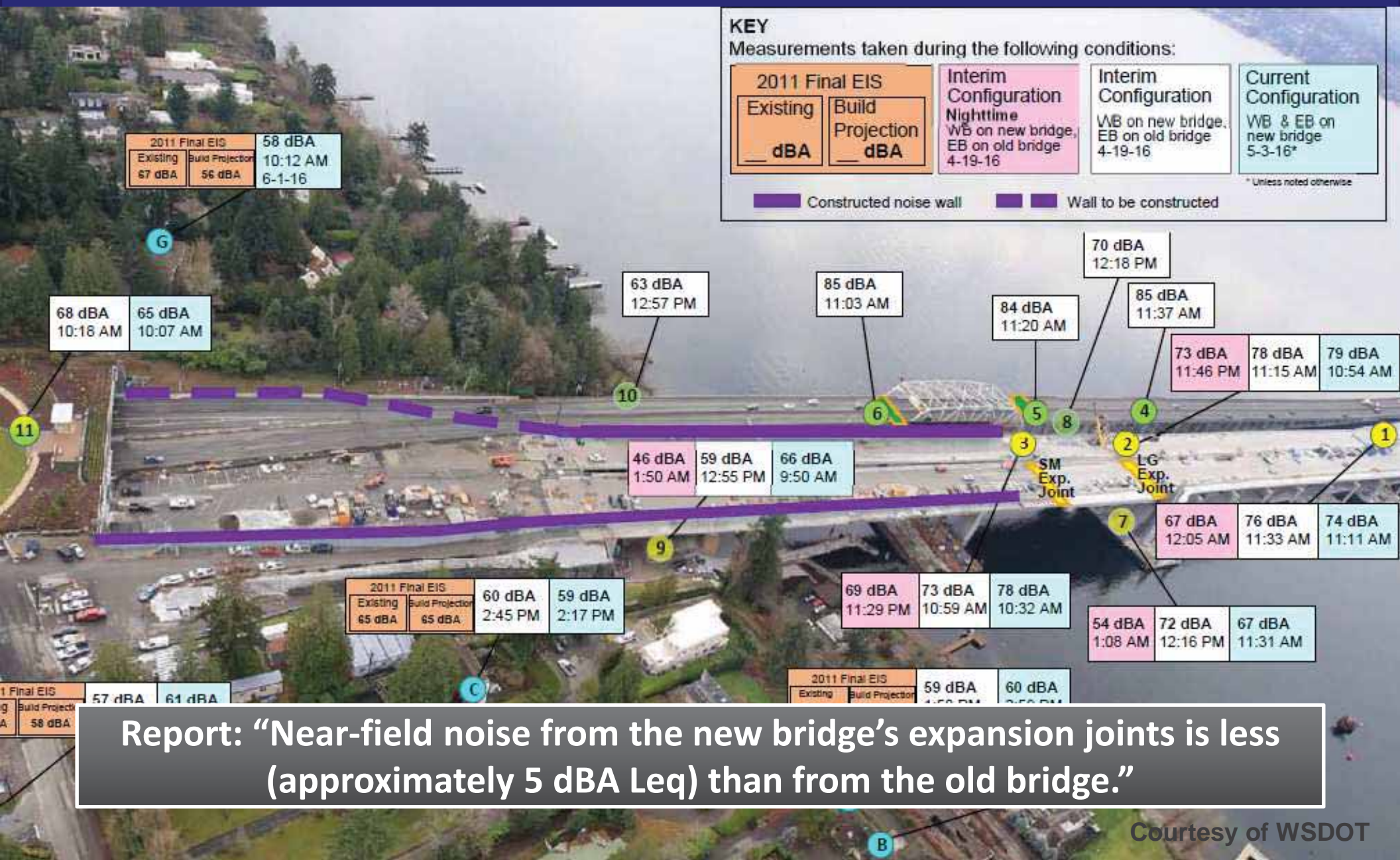
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Next steps



# Noise measurements carried out April – June 2016

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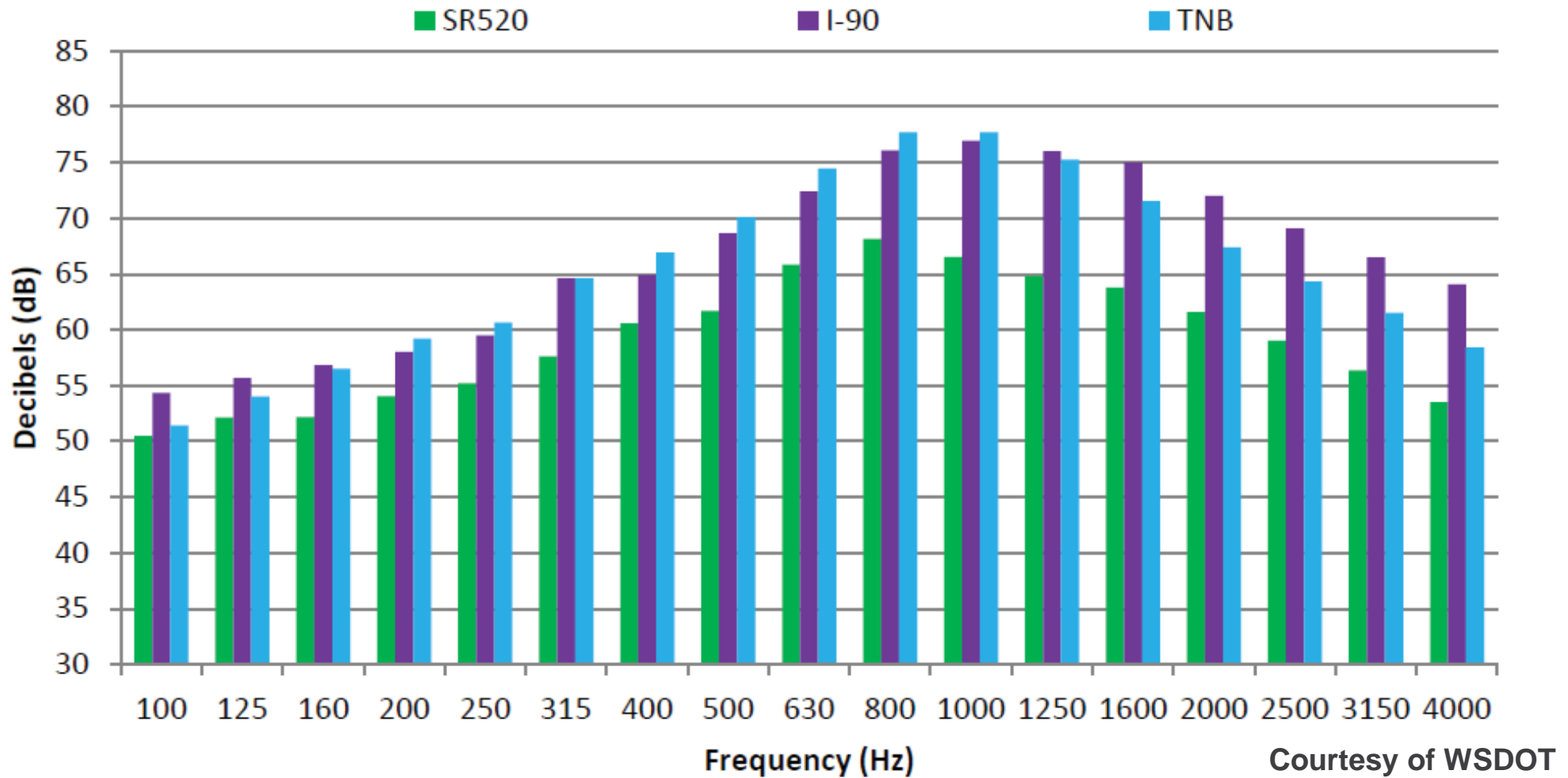
Courtesy of WSDOT



However, the joint noise is noticeable due to the very low “background noise” from the pavement of SR520

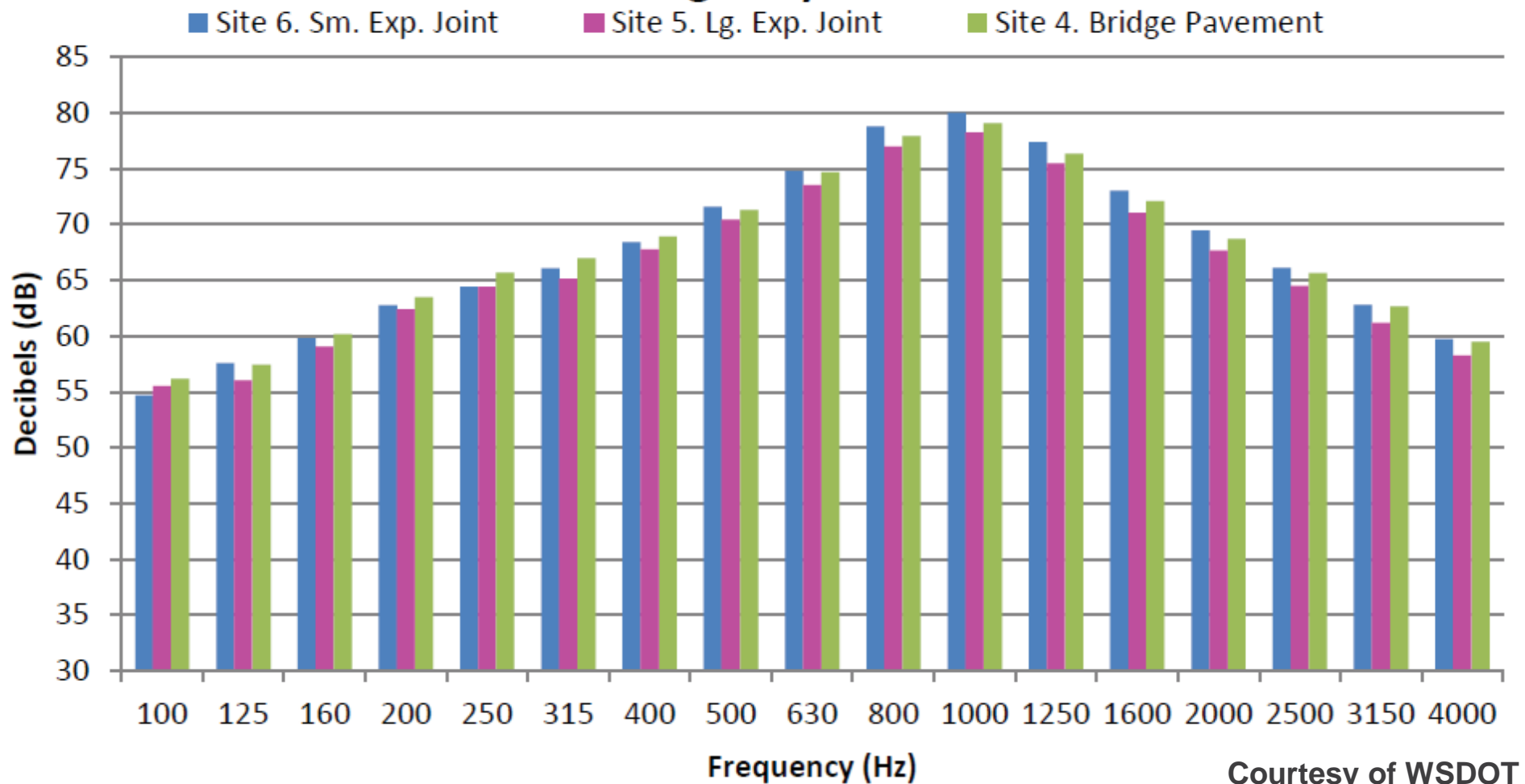
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Comparison of Pavement on Three Bridges



noise from the old joints blended in very well with the noise from the old pavement, making it well (Lg. joint noise from 55-78 dB)

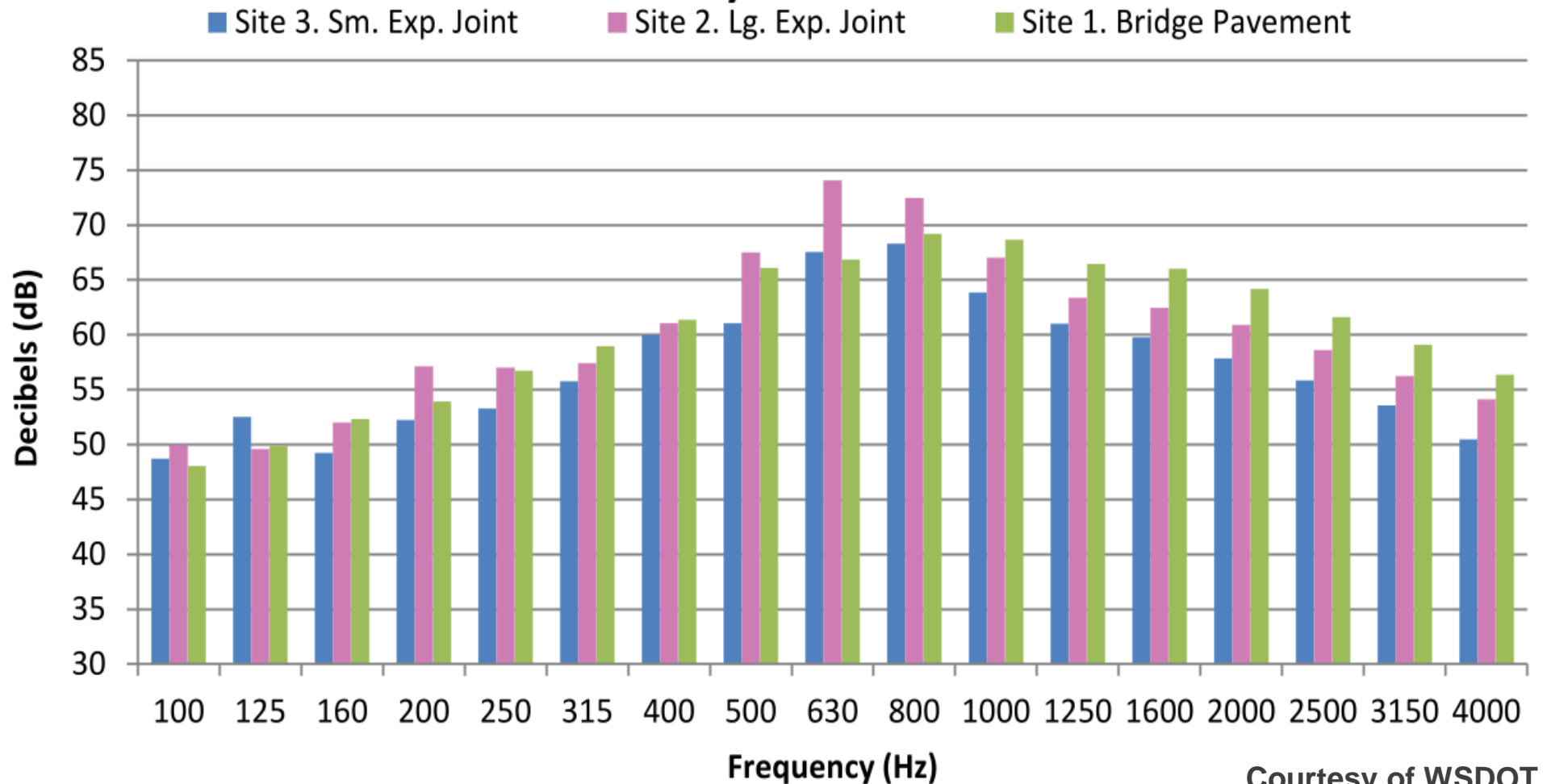
## Overall 1/3<sup>rd</sup> Octave Band Sound Levels for the Old SR 520 Bridge Daytime





New bridge shows lower noise levels for joints and pavement compared to the old bridge (Lg. joint noise from 50-74 dB)

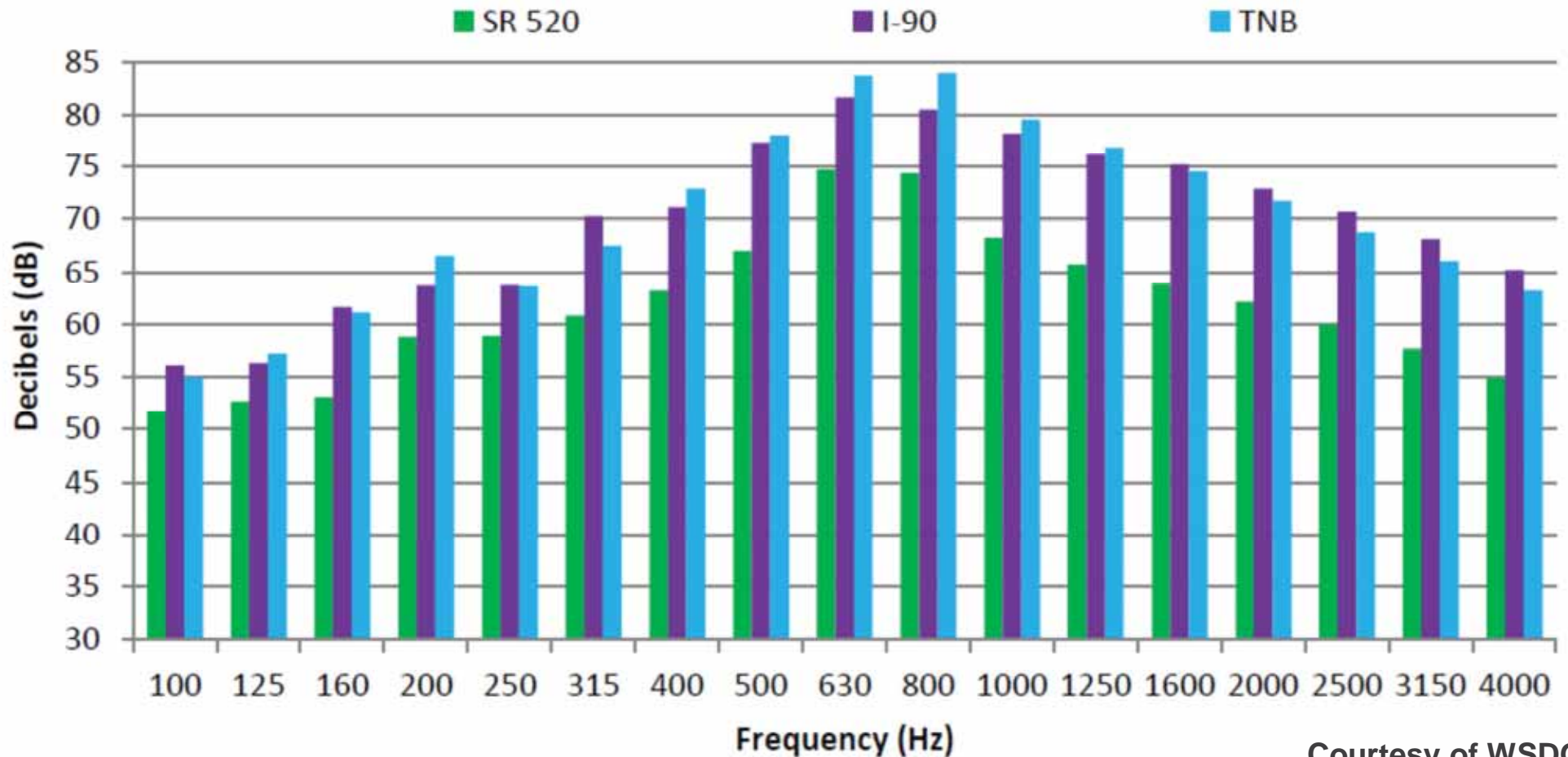
## 1/3<sup>rd</sup> Octave Band Sound Levels for the New SR 520 Bridge Daytime



The expansion joints are also significantly quieter than those on other bridges in the region

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Comparison of Large Expansion Joints on Three Bridges



Courtesy of WSDOT



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The most effective way to address the noise problem would be to equip the joints with noise-reducing sinus plates on the surface, but this would be a big job with a number of challenges, including:

- completion of geometric modeling
- traffic disruption (lane by lane)
- raising of driving surface level
- loss of toll revenue



The remaining options primarily include:

- Robo®Foam - rubber foam gap filler between the joint's surface beams
- Robo®Mute - a solution for enclosing the space beneath an expansion joint, trapping noise



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Noise reducing possibilities:  
**Robo®Foam**

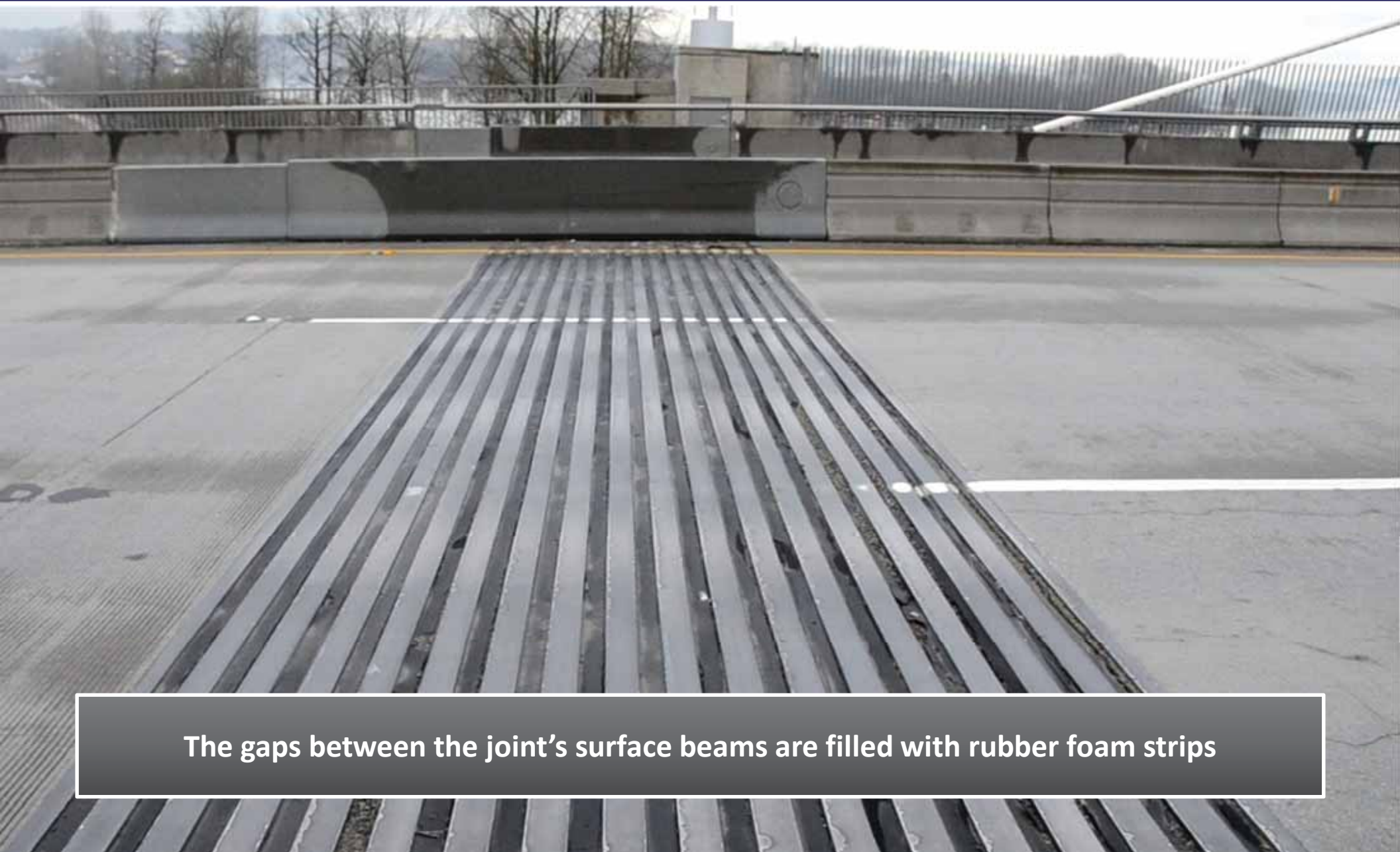
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**Robo®Foam is a solution for reducing impulse noise  
due to the compression of air as a wheel crosses a gap** **mageba** **USA**



The gaps between the joint's surface beams are filled with rubber foam strips

**The rubber foam strips are glued to the top flanges  
of the steel surface beams**

**mageba** USA



**(In this model, the rubber seal has a U shape rather than the standard V shape)**



This solution has been used at Golden Ears Bridge,  
just east of Vancouver

mageba **USA**

Following installation of large modular expansion joints (with up to 17 gaps), local residents complained of noise and the owner contacted Mageba to request support in developing a solution. In 2011 the owner wrote:

*We have introduced this noise reducing measure to the north side of the Golden Ears Bridge, and achieved an attenuation in the range of 8-10 dB in a certain frequency band.*

The rubber foam does not offer high durability / resistance to damage, but it is relatively inexpensive and easy to replace

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Noise reducing possibilities:  
**Robo®Mute**

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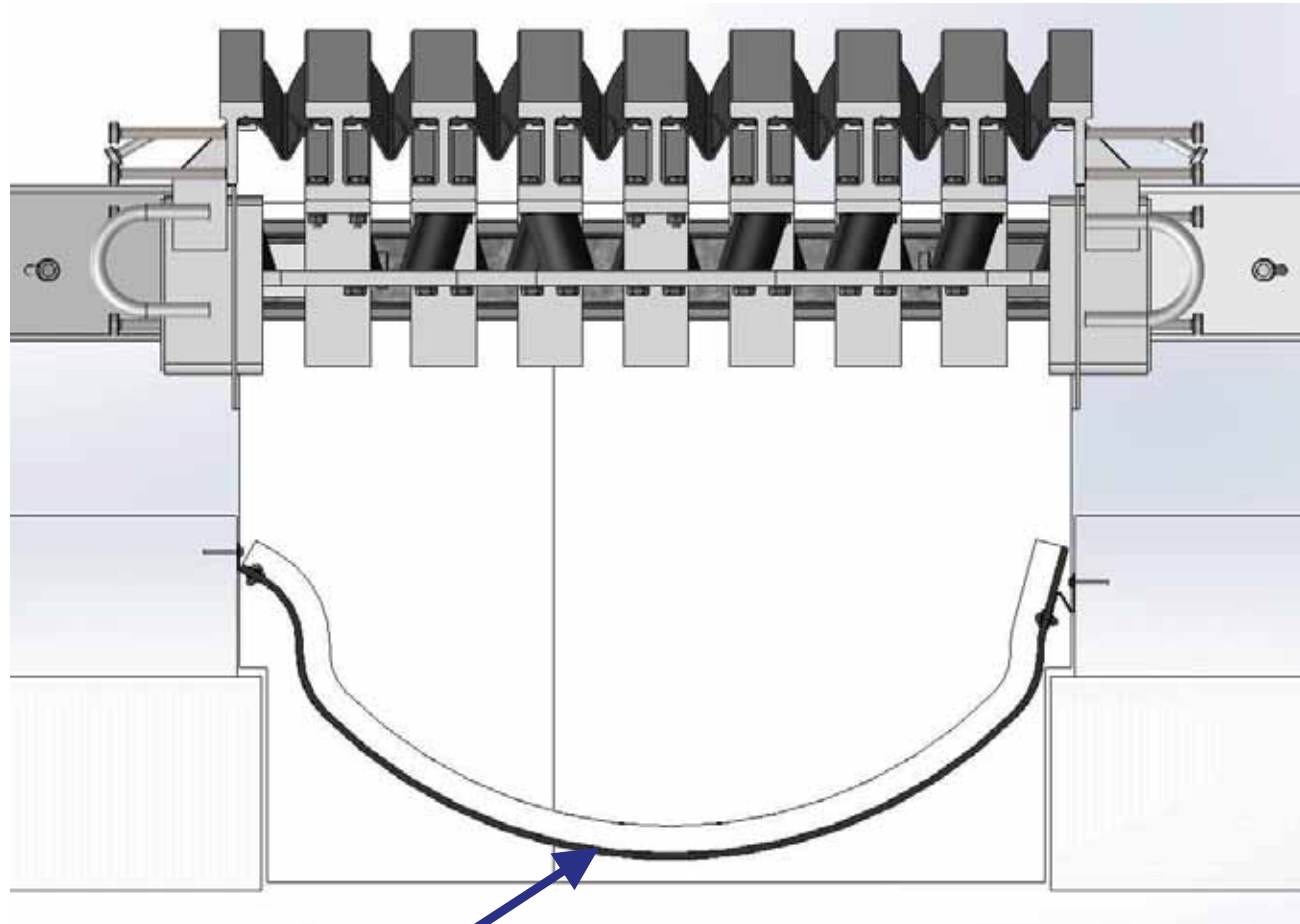
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**Robo®Mute is a system designed to enclose the space directly beneath an expansion joint, trapping noise**

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**Robo®Mute mat forming a channel beneath the joint, along its full length**



# Robo®Mute channel material

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Laid flat



Bent to form channel shape

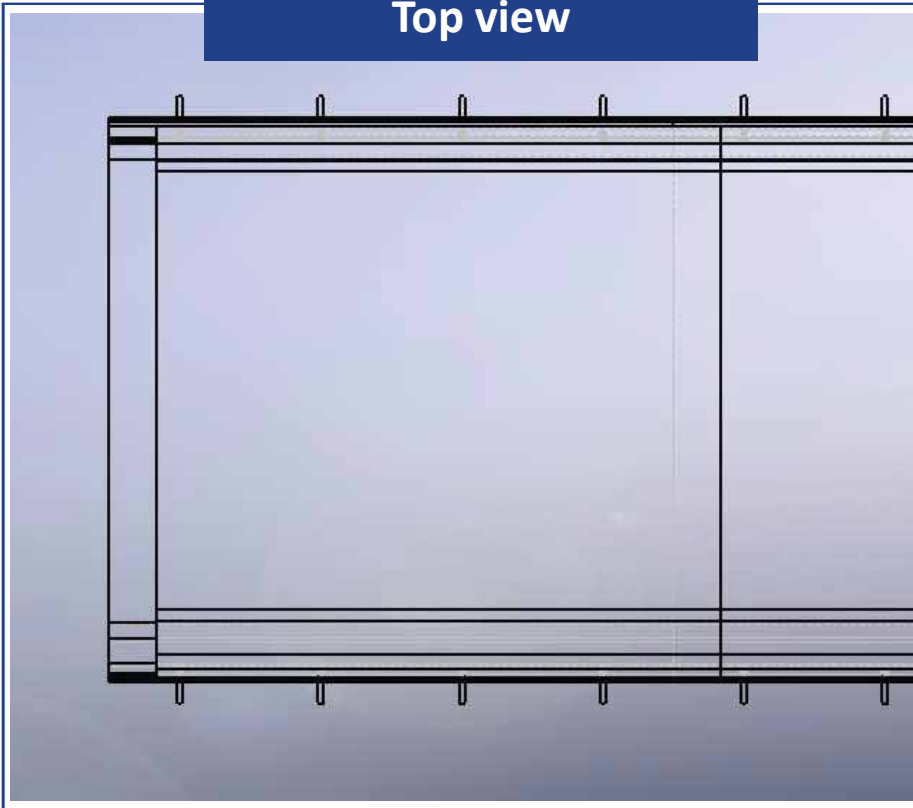


The channel material consists of sound absorbing PET foam, a sound encapsulating rubber sheet and galvanized steel connection angles with bolts/anchors

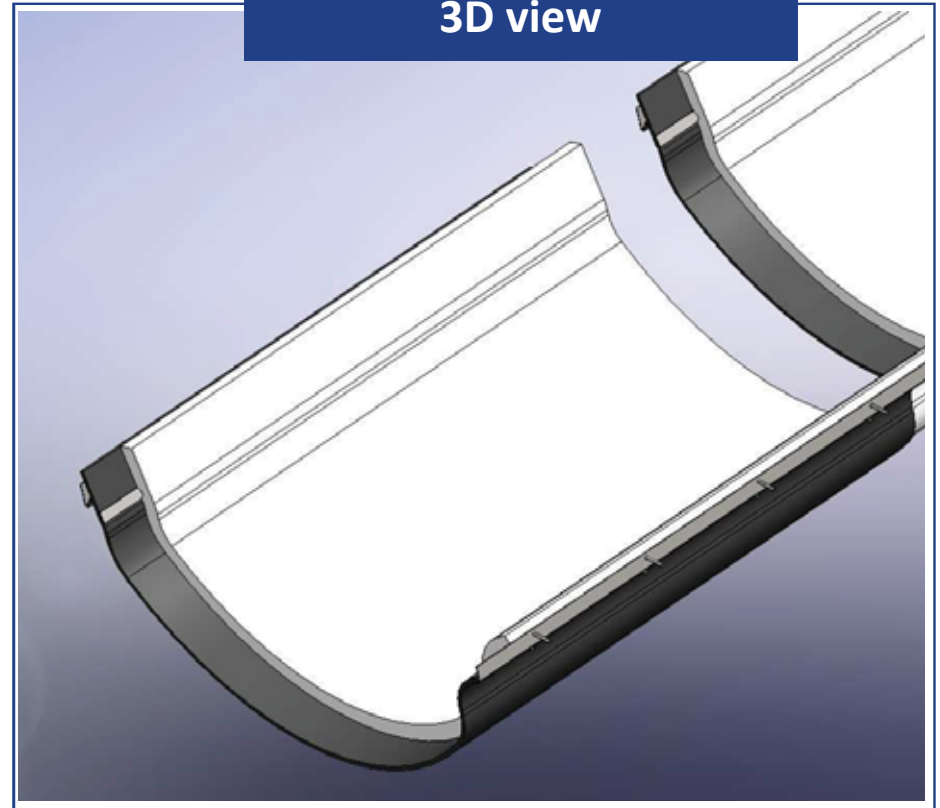
# Robo®Mute channel arrangement

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Top view



3D view



Overlapping of the Robo®Mute panels: 4" per unit

View from below of an installed Robo® Mute system

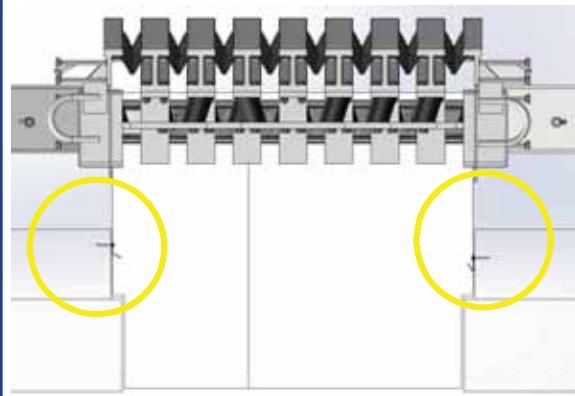
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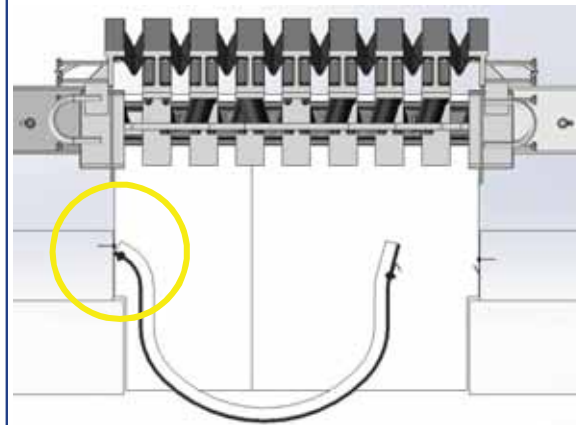


# Installation procedure – step by step

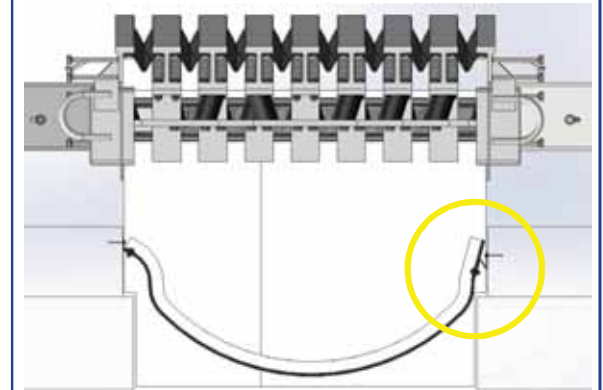
**Step 1:  
Fix profiles**



**Step 2:  
Bolt on Robo®Mute**



**Step 3:  
Snap profile in**

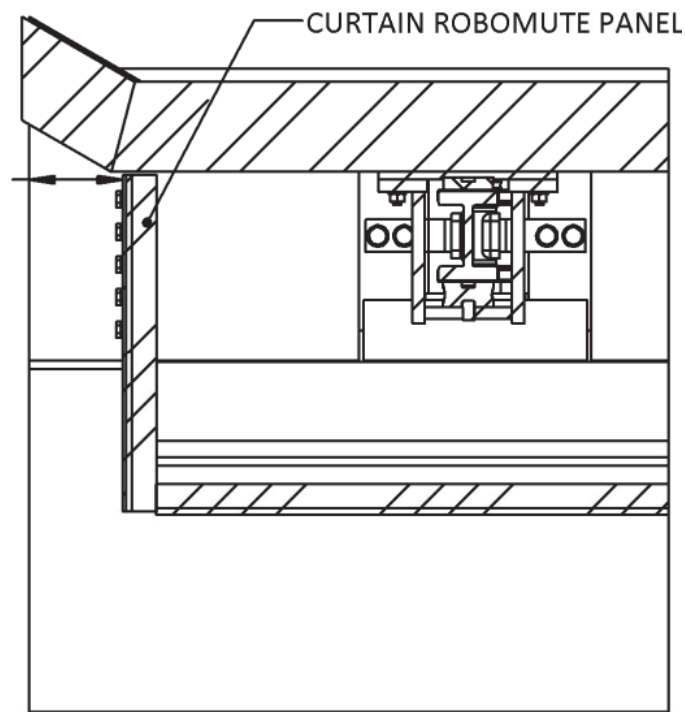


**This snap-in system simplifies installation and maintenance**

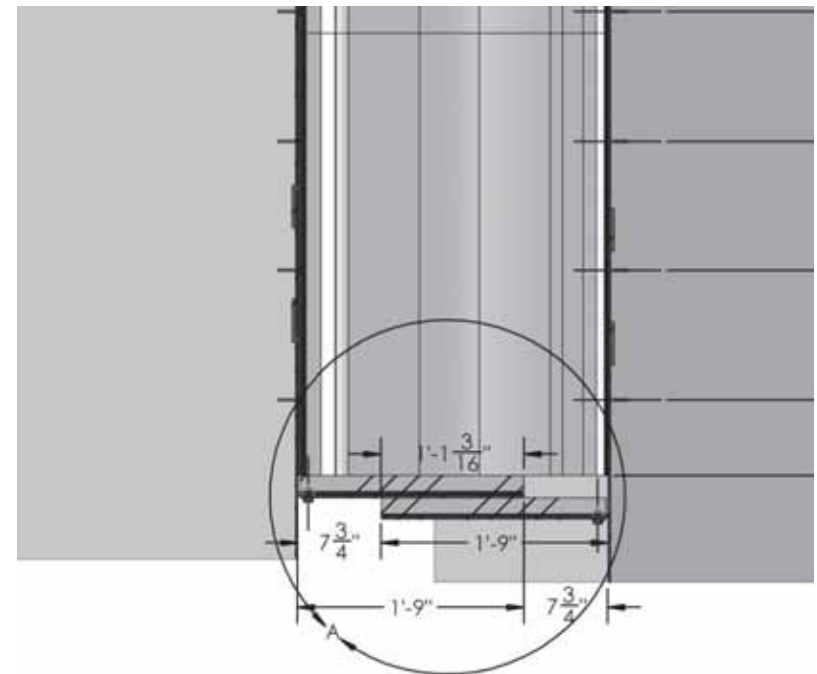
To complete enclosing the space beneath the joint, “curtain” sections are also required at the joint’s ends

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Side view



Top view



# Impression of a “curtain detail” on an executed project

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Possible “pilot project”

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# Possible “pilot project” approach to testing effectiveness of both Robo®Foam and Robo®Mute

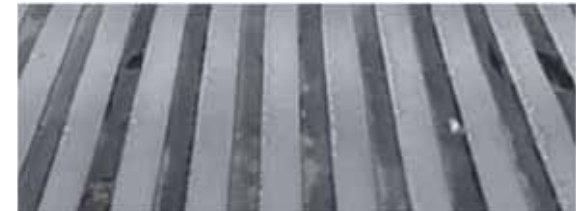


In order to assess the effectiveness and general suitability of the previously mentioned two noise reduction possibilities for the SR520 situation, both Robo®Foam and Robo®Mute could be installed on a single, relatively small expansion joint, as follows:

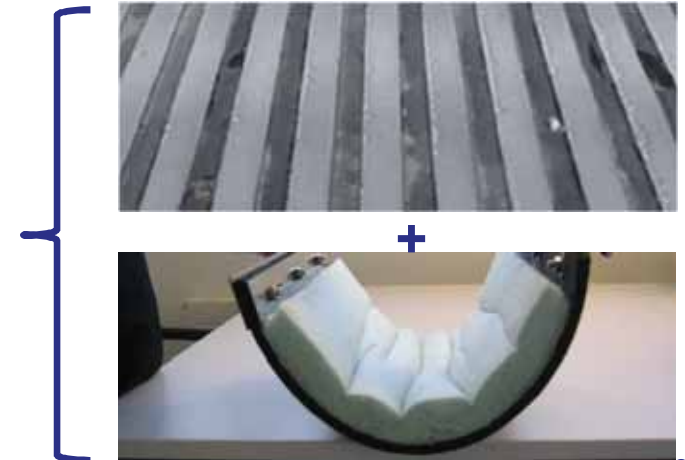
**Step 1: Robo®Mute alone**



**Step 2: Robo®Foam alone  
(after disconnecting Robo®Mute)**



**Step 3: Robo®Foam and Robo®Mute together  
(after reconnecting Robo®Mute)**





With noise measurements taken at all 3 stages, the optimal solution can then be selected.

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Noise measurements – on top



Noise measurements – from below





# Other issues: Non-uniform gap widths, and apparent tilting / unevenness of centerbeam

The following two issues have been observed:

## 1) Uneven gap widths

- Not an issue as the joint has an elastic steering system
- Over time the gap width balances out (vibrations, etc.)
- One gap being larger than another one has no effect on durability
- Gap-limiting straps connecting the centerbeams underneath ensure that no gap becomes too large.



## 2) Tilting / unevenness of centerbeams

- This seems to be acceptable in general.
- mageba recommends however that an inspection be carried out by a mageba specialist, while also checking the overall installation and current condition and assessing pilot project proposals.



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Thank You.