Construction Sequencing and Gap Tolerances For Standard Finger Plate and Cover Plated V-Seal Deck Joints

This Design Bulletin is to inform Engineering Consultants of changes to the design and construction of plated deck joint assemblies.

Background

Bridges with large thermal demand and/or high skew typically require the use of the Department's standard cover plated v-seal or finger plate deck joints. These joints are able to accommodate higher movement and skew angle but require significantly more fabrication and construction effort in order to meet the specified plate gaps and associated tolerances. The service life and performance of these deck joints is directly related to the magnitude of plate gaps. Consultants specifying these joints should recognize the limitations in performance of these joints and ensure that the joints can accommodate the corresponding movements and rotations associated with longer span bridges. Contractors installing these joints should be made aware of the special care required when manufacturing and installing these joints, that the specified plate gaps and associated tolerances are met.

Finger plate and cover plated v-seal deck joints will provide the longest service life and best performance when the gap between the cover/finger plate and the base plate is zero. The deck joint standard drawings outline the plate gap tolerance values that are to be met at both the fabrication and construction stages. As plate gaps increase, the performance of these joints is reduced from both a fatigue and operational perspective. Fatigue failure of finger/cover plates and cover plate bolts can occur resulting in premature maintenance and rehabilitation costs with significant disruption and potential hazards to the travelling public.

It has been found over time that larger plate gaps result in earlier deterioration of the joint itself as well as the concrete anchorages. Contractors have expressed concern with meeting the specified plate gap tolerance requirements. As a result, the Department recently completed a detailed engineering study to further assess the impact that various plate gaps have on design service life. This study reconfirmed that substantial reductions in deck joint design service life occur with small increases in plate gap size.

The Department recognizes the level of effort and technical challenges associated with the installation of finger plate and cover plated v-seal deck joints and is issuing this Design Bulletin to provide information on potential alternate construction sequencing and corresponding modified plate gap tolerance requirements.

Construction Sequencing

The overall general construction sequence of bridge structures is determined by the Contractor unless specific sequencing is required by the Consultant. The most common approach typically used for Alberta Transportation bridges has been to install deck joints after construction of the deck, curbs/barriers, roof slabs and prior to installation of waterproofing, asphalt concrete pavement (ACP), medians, bridgerails, etc. With this construction sequence.
superimposed dead loads (waterproofing, ACP, medians, bridgerrails, etc.) result in girder rotations that affect deck joint plate gaps. The plate gap tolerances specified on the standard drawings and the timing of their measurement contribute towards minimizing the gaps in service and preventing significant reduction in the service life. The plate gaps are likely to increase in service and the tolerances have been implemented to ensure that these increases in plate gaps remain within acceptable limits which are known to reduce the effects of fatigue failure.

If alternate construction sequencing is implemented, such that all superimposed dead loads are placed before deck joint installation, a relaxation of modified deck joint plate gap tolerances will be provided.

Alternate construction sequencing is expected to also improve the schedule for construction projects as waterproofing and ACP can occur earlier in the project, typically in warmer weather. It will also allow for more flexibility in the installation schedule for the deck joint, which may result in the ability to schedule this work during periods of favorable temperature conditions.

A construction sequence that considers placement of all superimposed dead loads before deck joint installation that could result in application of modified plate gap tolerances is as follows (refer to attached sketches for further details):

- Deck construction - blockouts for deck joints are formed and maintained;
- Barrier/curb construction - blockouts for deck joints are formed and maintained. The dimensions of barrier/curb blockouts would typically be equivalent to the deck and backwall/roof slab blockout dimensions;
- Infill of deck joint blockouts - temporary supports are designed and installed by the Contractor to support blockout infill material comprised of Des 2 Class 25 crushed aggregate material compacted to 100% maximum dry density. The methods used to form and support the blockout infill material would need to accommodate the anticipated movement of the structure and retain the blockout material until the deck joint installation occurs. The Des 2 Class 25 infill material would be placed to the elevation of the deck side and abutment side concrete adjacent to the blockout. If any traffic is to be accommodated on the bridge prior to waterproofing and asphalt concrete pavement placement, the infill Des 2 Class 25 material should be capped with 50 mm of cold mix or hot mix ACP placed to the elevation of the deck side and abutment side concrete adjacent to the blockout. The edges of the blockout should be marked such that the markings are visible after paving and the joint location can be accurately identified;
- Waterproofing placement;
- Median placement (if applicable);
- Bridgerrail placement;
- ACP placement - ACP placement operation should be continuous including deck, roof and approach slabs. Transverse joints in the asphalt pavement will not be considered. Crack inducers (sawcuts) should be placed within the ACP as soon as is practical after paving operations to eliminate potential damage to the ACP from thermal movements.
- Blockout infill material removal - within 10 days of asphalt being placed the ACP should be saw cut full depth to the limits of the blockout. The ACP from the blockout areas should be removed and temporary wood angles with a minimum thickness of 19 mm placed to protect the saw cut ACP edges for the full depth of the ACP. All infill and supporting materials within the blockout should be removed. Care should be taken to
eliminate damage to the waterproofing membrane.

- **Blockout surface preparation** - all ACP residue, debris and foreign material cleaned from concrete and reinforcing steel surfaces. Before placing the steel reinforcement, the blockout concrete faces abrasive blasted and cleaned to expose fine aggregate;
- **Deck joint assembly and reinforcing steel installation** – Install in accordance with the applicable Standard Drawings and the project specific Drawings. In situations where a conventional abutment with a roof slab is being constructed the threaded rod embedded into the backwall may be omitted and a threaded rod elevation/grade assembly similar to the deck side may be considered.
- **Deck joint blockout concrete placement and curing**
- **Waterproofing surface preparation and tie ins**
- **Hot applied ACP rubberized crack sealant** – to ACP construction joint tie ins with concrete paving lips.

### Modified Plate Gap Tolerances Based on Construction Sequence

If the deck joints are installed using a revised installation sequence that includes placement of all superimposed dead loads prior to deck joint installation and that has been reviewed and accepted by the Consultant and Department (Bridge Engineering Section of Technical Services Branch) the plate gap tolerance values will be as follows:

For finger plate deck joints the plate gap tolerances measured at the tips of the deck fingers are as follows:
- 100% of finger tips: gap ≤ 0.4 mm at hold point 1;
- 100% of finger tips: gap ≤ 1.0 mm at hold points 2, 3, and 4.

For finger plate deck joints the plate gap tolerances measured at the heels of the deck fingers are as follows:
- 100% of finger heels: gap ≤ 1.0 mm at hold point 1;
- 100% of finger heels: gap ≤ 2.0 mm at hold points 2, 3, and 4.

For cover plated v-seal deck joints all plate gap tolerances measured between cover plates and base plate (along the full length of the sinusoidal shaped joint gap) are as follows:
- 100% of length: gap ≤ 0.4 mm at hold point 1;
- 100% of length: gap ≤ 1.0 mm at hold points 2, 3, and 4.

All other tolerance requirements from the standard drawings apply unless modified herein. Other installation sequences that do not include all superimposed dead loads on the bridge prior to installation of the deck joint will not be eligible for the use of the modified plate gap tolerances.

### Implementation & Roles and Responsibilities

For tendered projects and projects under construction the Contractor may propose a construction sequence that includes placement of all superimposed dead loads prior to deck joint installation to the Consultant and the Department (Bridge Engineering Section of Technical Services Branch) for review and acceptance. If reviewed and accepted the modified plate gap tolerances may be used in replacement of the Contract tolerances. There will be no additional engineering and construction costs by the Consultant or Contractor considered by
the Department for this work.

For projects where detailed design has not yet occurred or currently underway, the Consultant shall include details of the proposed deck joint blockouts on the site specific drawings. Details on the Drawings or development of special provisions specific to construction sequencing and the deck joint installation should be developed for inclusion into the tender package.

Timeline

The Department has issued a number of documents and bulletins related to the standard finger plates and cover plated v-seal joints which are summarized below:

<table>
<thead>
<tr>
<th>Document Issued</th>
<th>Date</th>
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<tbody>
<tr>
<td>Revised deck joint tolerances added to Standard Drawings S-1638 &amp; S1802</td>
<td>January 2012</td>
</tr>
<tr>
<td>Construction Bulletin #26 issued to clarify deck joint tolerance inspection</td>
<td>January 2016</td>
</tr>
<tr>
<td>Standard Drawings and Standard Specifications for Bridge Construction Section updated</td>
<td>May 2017</td>
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Currently the Department is undertaking an additional investigation into the performance and detailing of these joints in an effort to improve fabrication, constructability, and the life span of these joints. It is anticipated that as additional knowledge is gained by the Department through this process it will be made available to industry as follows:

<table>
<thead>
<tr>
<th>Document to Be Issued</th>
<th>Anticipated Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updated deck joint standard drawings to incorporate results of Department study of deck joints</td>
<td>2018</td>
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Effective Date: August 31, 2017. Questions on this bulletin may be directed to Mike Tokar at (780) 415-1020.

Recommended by: 

[Signature]
John Alexander
Director
Bridge Engineering

Approved by: 

[Signature]
Des Williamson
Executive Director
Technical Services Branch
STAGE 1 - CAST DECK AND ABUTMENT WITH DECK JOINT BLOCKOUTS

NOTE: REINFORCEMENT PROTECTING FROM DECK AND ROOF SLAB NOT SHOWN FOR CLARITY
TEMPORARY CorR or OTHER TEMPORARY SUPPORT MAY BE REQUIRED TO SUPPORT ROOF SLAB [WHEN APPLICABLE] DESIGN BY CONTRACTOR

STAGE 2 - INSTALL TEMPORARY SUPPORTS TO SUPPORT GRANULAR FILL AND PAVING LOADS

NOTES
- VIEWS ARE PROVIDED WITH THE IDEA OF ILLUSTRATING THE GENERAL STAGING AND CONCEPT OF THE ALTERNATIVE DECK JOINT CONSTRUCTION SEQUENCE
- ALL PROGRAMS ARE SPECIFIC STAGING DETAILS MUST BE REVIEWED AND ACCEPTED BY THE CONSULTANT
- LIMITS OF BLOCKOUTS TO BE DETERMINED BY CONTRACTOR AND REVIEWED AND ACCEPTED BY THE CONSULTANT AND THE DEPARTMENT

STAGE 3 - PAVE ON BRIDGE DECK AND ABUTMENT CONTINUING DIRECTLY OVER THE GRANULAR FILLED BLOCKOUT

ALTERNATE CONSTRUCTION SEQUENCE FOR FINGER PLATE AND COVER PLATED DECK JOINT INSTALLATION
STAGE 4 - REMOVE ACP, GRANULAR FILL AND TEMPORARY SUPPORTS AND INSTALL PLYWOOD ANGLES

STAGE 5 - INSTALL DECK JOINT, POUR BLOCKOUT CONCRETE CONCRETE AND PLACE ACP CRACK SEALANT

NOTES
- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING THE GENERAL STAGES AND CONCEPTS OF THE ALTERNATE DECK JOINT CONSTRUCTION SEQUENCE
- ALL PROPOSED SITE SPECIFIC DETAILS MUST BE REVIEWED AND ACCEPTED BY THE CONSULTANT

Alberta Transportation

ALTERNATE CONSTRUCTION SEQUENCE FOR FINGER PLATE AND COVER PLATED DECK JOINT INSTALLATION

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SKETCH 2