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The Bridge Inspection and Maintenance System (BIM) Manual describes various bearing types but is not an exhaustive listing of all bearing types contained within the Provincial bridge inventory. Recent performance issues related to sliding steel plate bearings with self-lubricating bronze plates are noted within this BIM advisory bulletin as well as supplements to condition rating guidelines for bearing and concrete abutment and pier cap/seat/corbel condition sections of the BIM manual.

Sliding steel plate bearings with self-lubricating bronze plates were primarily utilized for PO type girders between the years of 1955 and 1965. The bearings consisted of details similar to Standard Drawing S-701. Variations to these details are found in some site specific designs and reference drawings should be reviewed when required.

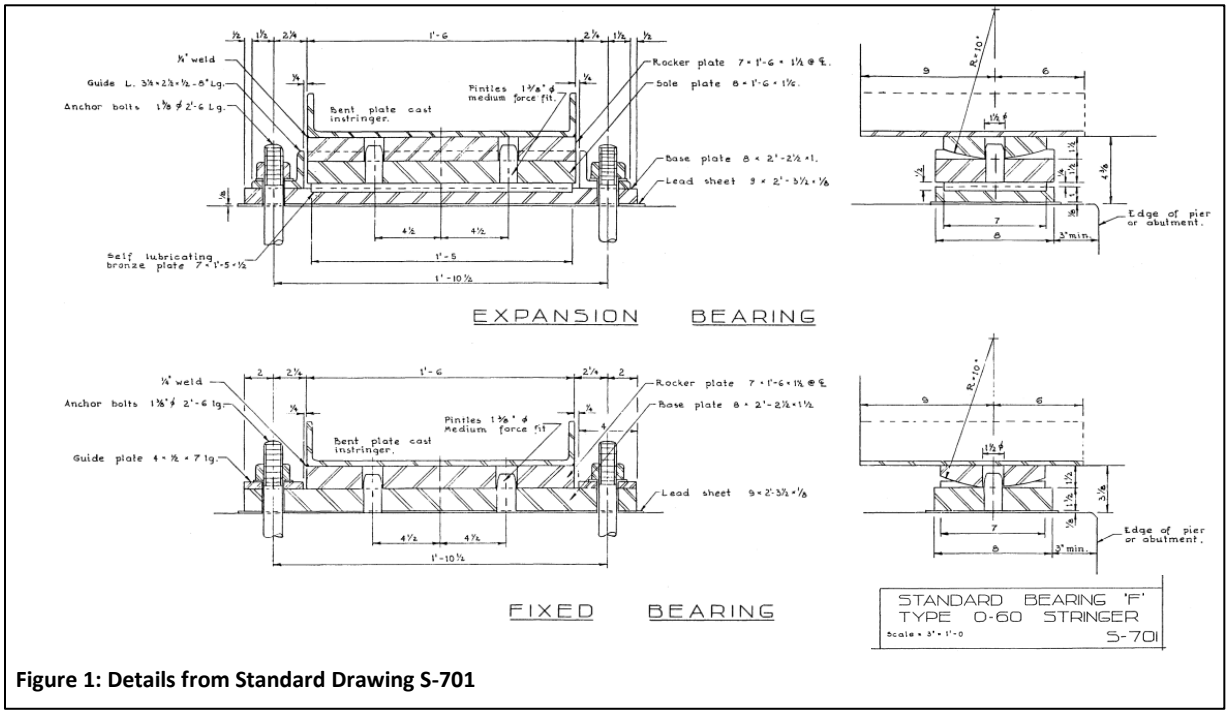

Figure 1: Details from Standard Drawing S-701

The self-lubricating bronze plates were intended to provide the sliding surface between the base/masonry and girder sole & rocker steel plates. Under actual field conditions the bearing system has not functioned as well as intended resulting in additional stresses being introduced to bearing components and substructure elements. These additional stresses combined with site specific abutment and pier seat/cap/corbel designs, as-constructed conditions, and deterioration over the past 60 years has resulted in failures.

Figure 2: Steel sliding plate expansion bearings with self-lubricating bronze plates

Figure 3: Concrete pier with shafts and arched cap.

Figure 4: Wide crack in concrete cap at expansion bearing with staining.

Figure 5: Concrete cap failure with girder drop in elevation.

The Department completed a review of other bridges of similar vintage and design details. During the review process, discrepancies in BIM element ratings were noted. Supplements to the BIM manual have been developed and are provided in this bulletin for use on all future inspections completed by certified inspectors and Consultants providing bridge inspection, maintenance and rehabilitation services.

Bridge Bearings

Bridge bearings are inspected and rated in accordance with section 7.20 of the BIM manual.

Excerpt from Section 7.20.1 of the BIM Manual:

- Bearings are designed to transmit loads to the substructure and permit rotational movement of the superstructure relative to the substructure. Certain types of bearings (expansion) must also permit longitudinal movement due to temperature changes and loading conditions. An effective expansion bearing allows movement with little frictional resistance. In many cases, metal expansion bearings freeze (lock-up) due to corrosion when salt, water, and debris are present. Once the bearing has frozen, high stresses may be induced in the girders, abutments, and piers. The result is generally cracks or spalls in the caps or seats, or tilting of the piers or abutments.

Supplement to 7.20.1 of the BIM Manual:

- Bearings are designed to transmit loads to the substructure and permit rotational movement of the superstructure relative to the substructure. Certain types of bearings (expansion) must also permit longitudinal movement due to temperature changes and loading conditions. An effective expansion bearing allows movement with little frictional resistance. In many cases, expansion bearings freeze (lock-up) due to corrosion when salt, water, and debris are present. *In some cases, expansion bearings may appear to be in adequate condition due to surface refurbishment, but are frozen due to previous exposure conditions such as leaky deck joints. In either case, o*nce *bearings have* frozen, high stresses may be induced in the girders, abutments, and piers. The result is generally cracks or spalls in the caps or seats, or tilting of the piers or abutments.

Excerpt from Section 7.20.3 of the BIM Manual:

- Check all steel components for rust, corrosion, sheared bolts, cracked welds, and evidence of frozen bearings or connections.
- Deterioration caused by leaking deck joints or cracks in the caps or seats caused by frozen bearings should be noted.

Supplement to 7.20.3 of the BIM Manual:

- *Deterioration caused by leaking deck joints should be noted.*
- *Cracks, delaminations, or spalls in concrete abutment and pier caps/seats/corbels emanating from bearing components should be noted and comments on suspected or confirmed reduced bearing functionality provided.*

Abutment and Pier Seat/Caps/Corbels

Concrete abutment and pier seats/caps/corbels are inspected and rated in accordance section 8.5 of the BIM manual.

Excerpt from Section 8.5.2 of the BIM Manual:

- Check concrete seats/caps for cracks, spalls, corrosion of reinforcement, and disintegration of the concrete.

Supplement to 8.5.2 of the BIM Manual:

- Check concrete seats/caps for cracks, *delaminations,* spalls, corrosion of reinforcement, and *other signs of concrete deterioration*.

Excerpt from Section 8.5.3 of the BIM Manual:

- Any deficiencies that would reduce the ability of these elements to transmit loads, rate 4 or less.

Supplement to 8.5.3 of the BIM Manual:

- Any deficiencies that would reduce the ability of these elements to transmit loads, rate 4 or less.
- *Bearing functionality should be considered in conjunction with the bearing seat/cap/corbel rating. If at bearing locations, concrete with visual signs of damage has not been sounded or wide cracks have not been marked for monitoring, rate 3 or less and recommend a more detailed inspection with appropriate access. Timelines for the detailed inspection and/or a reduced inspection cycle should be included. Recommendations may also include an engineering review of construction details and drawings to determine effects of existing conditions. Wide cracks that have been marked for monitoring and have not changed for a period of 5 years or more may have their rating increased by 1 rating point.*

Rating guidelines are provided throughout the BIM manual that requires certified inspectors and reviewers to use their extensive training, experience, and education to rate elements when conditions are such that a rating of 4 or less is to be assigned. Conditions that, in the inspector/reviewer's judgment, affect load carrying functions should also be rated in consideration of repair and maintenance priorities outlined in Section 11.2.1 of the BIM manual.

Examples are provided below:

Figure 5: Wide cracks and concrete delamination in concrete S3G6 – P3. Pier cap and expansion bearing rated 3.

Figure 6: Wide cracks and delamination in bearing area of concrete cap at S2G1 - P2. Pier cap and fixed bearing rated 3.

If you have any questions on this matter, please contact the undersigned.

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