11.4 Common requirements

11.4.1 General

Delete the fourth paragraph and replace with:

All exposed and embedded steel components of joints and bearings shall be protected against corrosion. The corrosion protection system shall either be:

- hot-dip galvanizing in accordance with ASTM A123/A123M, or,
- metalizing to AWS C2.23M/C2.23 with a minimum zinc coating thickness of 0.2 mm, or
- a coating system which is selected from the Ministry's Recognized Product List.

The choice of corrosion system shall be subject to the Consent of the Ministry.

The steel/concrete interface for both joints and bearings shall be detailed such that no rust staining of the concrete occurs.

Add the following to the list in the fifth paragraph:

k) Traffic noise caused by the deck joint system.
l) Ride-ability for all bridge users including motorcycles, bicycles and pedestrians.

Commentary: *Ministry experience has shown that bridge maintenance and rehabilitation is most commonly associated with deck joints and bearings. Designers should consider structural forms, such as integral and semi-integral abutments, continuous girders, and fixed pier joints, which either eliminate or minimize the use of deck joints and bearings.*

Where bearing assemblies are required to support structural steel girders fabricated from atmospheric corrosion resisting steel, the use of similar material for bearing plates may be considered.

11.5 Deck joints

11.5.1 General requirements

11.5.1.1 Functional requirements

Add the following:

All deck joints, except finger plate joints, shall be sealed. All deck joints shall have armour.

Unless otherwise Consented to by the Ministry, expansion joints shall be designed as finger plate deck joints when the total movement exceeds 100 mm. When the total movement becomes too large for finger plate joints to meet the functional requirements of the joint, then modular deck joints shall be used when Consented to by the Ministry.

In regions of high seismicity where large relative displacements may occur at deck joints, the joints chosen shall be suitable for the performance requirements.

Commentary: *The Ontario requirements for modular deck joints systems can provide guidance to designers. The Ministry has had past performance issues with modular joints, including fatigue and*

premature deterioration of springs and sliders. Additional considerations are necessary for contract specifications for modular joints. Designers are cautioned that large movement finger joints require special consideration for safe passage of motorcyclists, cyclists and pedestrians. The limit of 100 mm has been developed based upon the Ministry experience with the performance of strip and compression seals.

Add to the fourth paragraph:

Deck joints with a left hand forward skew angles between 32 and 38 degrees shall be avoided by designers. For right hand forward skew angles between 32 and 38 degrees, the designer shall confirm the maintenance practices at the bridge site.

Commentary: *On bridges with large skews there is the possibility that the skew angle could match the angle used on snowplow blades (which is generally about 35 degrees) and this could result in a blade dropping into a deck joint and damaging it.*

In general, the use of deck joints should preferably be limited to skew angles of 30 degrees or less. The joint type should be carefully selected and detailed to accommodate the transverse displacements that are commonly experienced in skewed deck joint applications.

Add to the end of the sixth paragraph:

Cover plates over joints on bicycle paths or pedestrian walkways which are greater than 100 mm in width shall be surfaced with a non-skid protective coating acceptable to the Ministry.

Add the following:

Proprietary joint products shall be Consented to by the Ministry prior to use on a Project.

Gaps between the superstructure end-diaphragm and the substructure directly exposed to backfill shall be waterproofed with a glued EPDM membrane to prevent ingress of moisture from the backfill.

Commentary: *Ministry experience is that peel and stick type membranes have not performed well and should not be used. Properly installed EPDM membrane provides greater longevity than modified bitumen or SBS type membrane. Designers must carefully consider structure articulation and seam locations when detailing waterproofing. For structures with tall abutments and return walls, drainboard and supplementary drains may improve the longevity of the installed EPDM membrane Similar waterproofing details are provided on the standard reference details for box girder bridges.*

11.5.2 Selection

11.5.2.1 Number of joints

Commentary: *The main weakness in the various forms of deck joints has been the lack of durability and associated maintenance problems. Minimizing or eliminating deck joints should improve overall lifecycle performance. Where feasible, semi-integral or integral abutments should be considered in consultation with the Ministry.*

Damage to deck joints can be attributed to the increase in traffic volumes, especially heavier vehicles. Impact forces caused by vehicles passing over expansion joints combined with poor detailing has resulted in the leakage of surface run-off and de-icing salts onto the substructure and bearings.

11.5.2.3 Types of deck joints

Add the following:

Joints at piers shall only be used when Consented to by the Ministry.

Commentary: *Ministry experience has shown that a significant proportion of bridge maintenance and rehabilitation is attributable to poorly performing deck joints. Designers should select joint types with a reliable track record, and which ensures that wearable components are accessible and maintainable with minimal disruption to traffic. Good design and correct installation are key to good performance. Where feasible, expansion joints should be located at the abutments for accessibility.*

11.5.3 Design

11.5.3.1 Bridge deck movements

11.5.3.1.2 Open deck joints

Delete paragraph and replace with the following:

Only properly detailed finger plate joints, including appropriate drainage details below the joint to accommodate debris and run-off water, Consented to by the Ministry, shall be use as an open deck joint. Openings in finger joints shall not exceed 60 mm in the least direction at SLS. Control of deck drainage is mandatory and shall be detailed in accordance with Clause 11.5.8.

Commentary: *Ministry experience has shown that well designed cantilever finger joints require minimal maintenance. Sliding finger joints are susceptible to debris accumulation and wear of the sliding surface. Consideration should be given to designing the joint system so that it can be removed and replaced in sections.*

Some finger joint configurations can present a problem for bicycles. Designers should consider options to meet the functional requirements.

11.5.3.2 Components

Commentary: *Anchors should penetrate the reinforcing cage to achieve the required joint anchorage., The designer should consider compatibility of the anchor spacing and details with the embedded reinforcement to ensure correct fit-up of the joint assembly.*

11.5.3.2.4 Bolts

Delete and replace with the following:

All anchor bolts for bridging plates, joint seals, and joint anchors shall be high-strength bolts fully tensioned as specified. Cast-in-place anchors shall be used for all new construction unless otherwise

consented to by the Ministry. Expansion anchors shall not be used for any joint connection. Drilled-in epoxy anchors may be used when Consented to by the Ministry. Tapered-head countersunk anchor bolts shall only be used when Consented to by the Ministry.

11.5.6 Joint seals

Add the following:

Only deck joint seals made of natural rubber or virgin neoprene shall be used. The use of silicone requires Ministry Consent.

Commentary: *Deck joint seals made of tyfoprene and santoprene have been observed to perform poorly and are not allowed. Silicone can have a significant cost premium.*

11.5.8 Open joint drainage

Delete and replace with the following:

"Finger" plate deck expansion joints shall have a drainage trough installed beneath. The drainage trough design shall use of a corrosion-resistant material such as high-density polyethylene (HDPE) or stainless steel. The trough shall be robust enough to prevent deflection when fully loaded with wet sand. All steelwork supporting the trough shall be galvanized or metallized after fabrication.

Where HDPE material is used for joint drainage, the material shall be UV-resistant. The design shall accommodate the coefficient of thermal expansion of HDPE which is an order of magnitude greater than steel.

Slopes for drainage troughs shall be maximized and where possible, the drainage trough should be sloped at a minimum of 10%. A 50 mm hose bib connection shall be provided to deck level, at the top end of the trough, to allow easy access and attachment for flushing and cleaning of the drainage trough during maintenance. Adequate space shall be provided to the drain trough and other drainage hardware for inspection and maintenance.

Commentary: *Deflection plates may be required between the underside of the finger joint and the top of the drainage trough to guide water into the trough.*

11.6 Bridge bearings

11.6.1 General

11.6.1.1 Design considerations

Add the following to the first paragraph:

Elastomeric bearings shall be used whenever possible.

Add the following to the end of the seventh paragraph:

Bearing replacement shall be considered in the design. Jacking points and design jacking loads shall be shown on the Plans.

Sufficient horizontal and vertical space shall be provided between the superstructure and substructure to accommodate the required jacks for replacing the bearings.

Commentary: *A minimum of 150 mm is suggested for typical bridges up to 35 m in span, larger spans may require specific assessment. Ensure that the end diaphragm is detailed for jacking if this is part of the design intent (e.g. that web stiffeners or additional reinforcing are included).*

Connections between girders and sole plates and the bearings and sole plates etc., must use bolts or cap screws on at least one interface to facilitate maintenance and replacement.

Commentary: *Elastomeric bearings accommodate the bi-axial rotational and displacements that are typically required for most bridge bearing applications. By accommodating superstructure displacements with shear strains, elastomeric bearings reduce maintenance requirements. Ministry experience is that correctly designed elastomeric bearings have performed well and are a cost-effective solution.*

The inaccessibility of bearings creates a major problem for their inspection and maintenance. In the past little consideration has been paid to bearing accessibility. A suitable gap should always be provided between the top of the bearing seat and the soffit of the diaphragm, and as many sides of the bearing should be accessible as possible.

The use of concrete shear keys with appropriate rebar detailing may be considered for lateral seismic load restraint. Shear keys can be used in addition to the anchor bolt details. Shear keys are considered to be more cost-effective and require less maintenance than guided bearings. Shorter shear keys or the use of curved faces can mitigate the potential for jamming.

The designer shall ensure compatibility between the various structural elements (shear keys and their allowable gaps, joints, and bearings).

Where practicable, a single line of bearings in lieu of a double row of bearings over the piers may result in a reduction in construction costs.

For seismic load applications the use of a base isolation system in accordance with Section 4 can be considered.

11.6.3 Sliding surfaces

11.6.3.2 Sliding Surface

11.6.3.2.1 PTFE Layer

Replace the last sentence of paragraph 3 with the following:

The lubricant shall be silicone grease, effective to -40°C and comply with U.S. Department of Defense MIL-S-8660C or the Society of Automotive Engineers specification SAE AS8660

11.6.3.4 Attachment

11.6.3.4.1 PTFE layer

Commentary: *Sheet polytetrafluorethylene (PTFE) should preferably be confined.*

Delete the third sentence and replace with the following:

Sheet PTFE which is not confined must be bonded to a rigid metal surface by a method acceptable to the Ministry.

11.6.4 Spherical bearings

11.6.4.1 General

Add the following:

Spherical bearings shall preferably be installed concave part down to prevent accumulation of water and dirt. When installed concave down, additional forces can be developed at the bearing level, which need to be accommodated by the bearing and adequately transferred to the substructure.

11.6.6.2 Geometric requirements

Delete the second row and replace with:

$L \geq 4h_e$ and $R \geq 2h_e$, with 15 mm < h_e < 25 mm

Add the following:

Bearing pressure requirements for continuous strips may be waived where the bearing is used only as a temporary bearing pad.

Commentary: *Problems with plain bearings that are too thin or too thick have been observed. Therefore, the allowable thickness has been amended here.*

11.6.6.5 Fabrication

11.6.6.5.2 Laminated bearings

Add after first sentence the following:

Steel reinforced elastomeric bearings shall have at least two steel reinforcing plates, and the minimum cover of elastomer for the top and bottom steel reinforcing plates shall be 5 mm. Allowable tolerance on the top and bottom cover shall be 2 mm.

11.6.6.6 Positive attachment

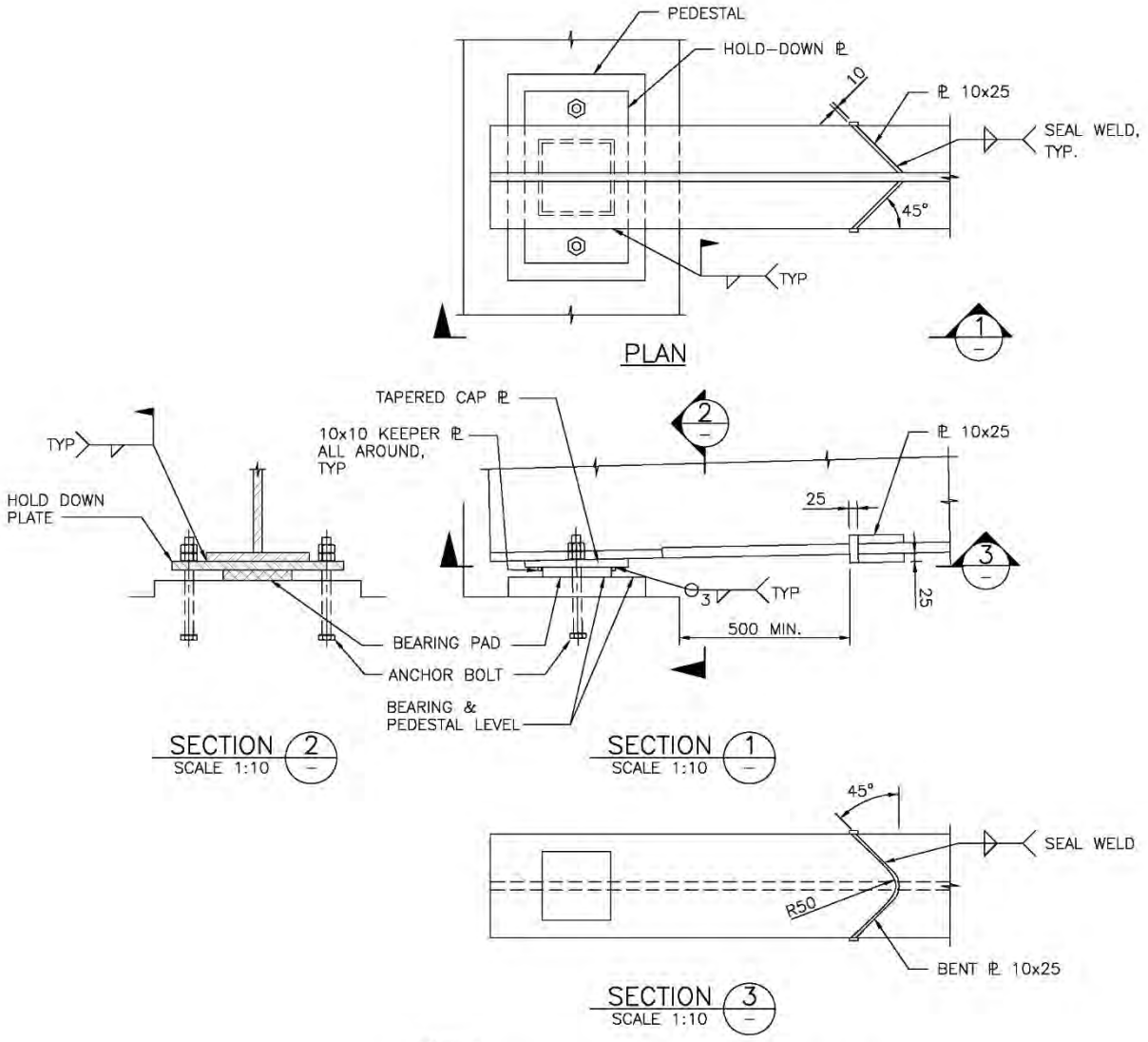
Add the following:

The recommended attachment details for elastomeric bearings under non-seismic loadings shall be as shown in Figures 11.6.6.6 (a) and 11.6.6.6 (b) below.

The holes for anchor bolts in hold-down plates shall be slotted at expansion ends.

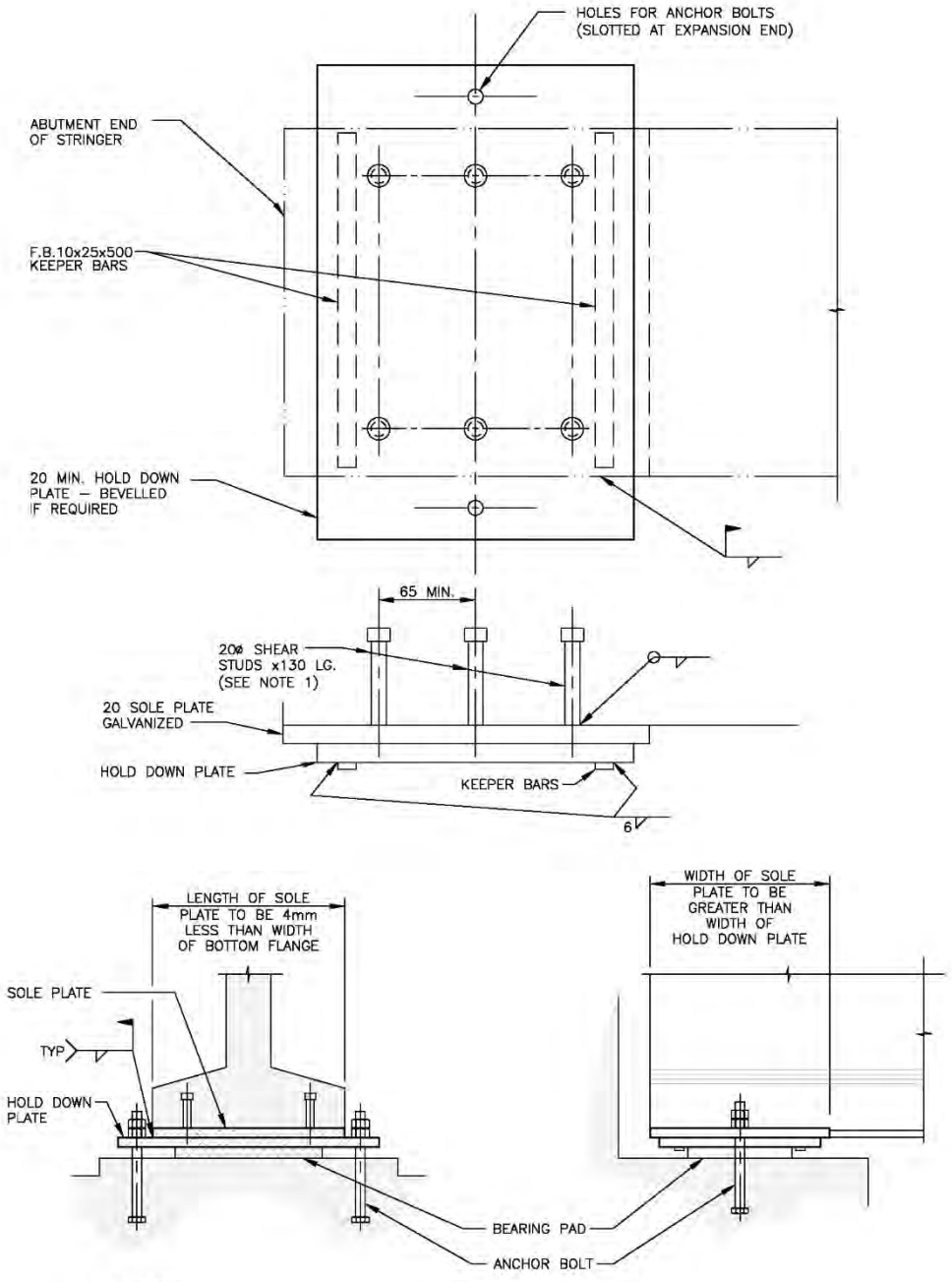
Figure 11.6.6.6 (a)

Bearing hold down details for steel girders



11.6.6.6.(b)

Bearing hold down details for concrete girders



NOTES:

1. LENGTH OF STUDS TO BE ADJUSTED SUCH THAT THE STUD HEAD LIES BETWEEN LAYERS OF STRANDS.
2. GRIND OFF GALVANIZING ON EDGES OF SOLE PLATE AND TOP OF HOLD DOWN PLATE TO ACCOMMODATE WELDING. PAINT WELDS AND EXPOSED STEEL WITH AN APPROVED GALVANIZING AGENT AFTER ERECTION.

11.6.9 Load plates and attachment for bearings

11.6.9.2 Tapered plates

Add the following:

Unless otherwise Consented to by the Ministry, bearings shall be installed level using tapered sole plates to account for differential slopes between the girders and the bearing seat.