



MINISTRY OF TRANSPORTATION

## Highway Design Office

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Technical Consultation Portal (MTO TCP)  
Comments and Responses

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## Minimum Bracing Requirements for NU Girders Installation SS107-9 TCP#000-0085

Comments (C)	Sent By	Responses (R)
<p><b>C1: ID-207</b> Gents,</p> <p>It is my professional opinion as the consultant engineer and also as the erector of the girders that the new bracing requirement is not suitable for the NU beams. It seems the idea is originated from the steel girders and now implemented for the NU girders.</p> <p>Please note the current bracing method used in vast Canadian HWY projects is safe and economically reasonable.</p> <p>The new bracing method is like permanent bracing not a temporarily bracing. Here are some cons and pros about the new bracing design:</p> <p>Pros:</p> <ul style="list-style-type: none"> <li>- It is more secure and provides stability against the construction loads (Wind + decking + formwork)</li> </ul> <p>Cons:</p> <ul style="list-style-type: none"> <li>- It will take double times for the installation of the girders.</li> <li>- For the HWYs, the 15 Minutes closure per girder will drag to 35 to 40 minutes closure.</li> <li>- one night job will becomes 2 night job.</li> <li>- As a result i.e. 50K erection will becomes 100K</li> <li>- To remove the bracing, it will cost more to remove and collect them.</li> <li>- It will cost the TAX payers double!</li> </ul> <p>The current bracing method being used for the past 25 years that i have been in</p>	<p>Allen Hejazi, P.Eng. AH Design Inc. KCC Construction.</p>	<p>R1:</p> <p>Thank you for providing your comments. The minimum bracing requirements presented in the SSD are not new; we only have improved the existing details and facilitated the installation and constructability on site. This update will enhance the purpose of maintaining safety and stability of NU girders after girder erection. The details shown on the SSD have been discussed in the series of meetings and reflects ORBA's input and feedback.</p> <p>MTO consider public safety as the matter of paramount importance and this standard is being implemented as per MTO's mandate.</p> <p>MTO has conducted a jurisdictional scan of US and Canadian DOTs and has reviewed literature surveys regarding cases of failure of concrete I-girders during construction. From information collected through the jurisdiction scan and literature review, it is evident that providing temporary bracings for NU girders during installation is</p>

<p>this industry and we had never had any failure.</p> <p>I am open to a teleconference meeting if you want more of my opinion.</p>		<p>a common practice to maintain stability of girders and for public safety.</p> <p>As compared to existing system the updated bracing system has substantially improved the girder stability during construction. The updated SSD meant to cover all types of bridge crossings of MTO's highway network. The associated cost to install this updated system is minimal compared to the public and construction safety it will provide during construction by avoiding potential issues causing delays to complete construction contracts. We believe the implementation of the updated SSD will enhance Ontario's status of maintaining one of the safest roads networks in North America.</p>
<p><b>C2: ID-208</b></p> <p>From the point of view of a Structural Engineer, I support this proposal because bracing is necessary to mitigate risks of something happening on site, it can ensure the stability of girders in case they are hit by a backhoe, gust wind, rotation during a deck pour, especially erection over traffic.</p>	<p>Individual Contributor</p>	<p>R2: Thank you for providing your comments.</p> <p>We agree and greatly appreciate your understanding.</p>
<p><b>C3: ID-209</b></p> <p>1. drawing show wind pressure designed for is 395pa, how about area that has higher pressure?</p>	<p>MTO Central Structural Section</p>	<p>R3: Thank you for providing your comments.</p> <p>1.The reference wind pressure in the design table was provided to cover</p>

<p>2. any reason there has to be end bracing and intermediate bracing? How much safety factor is provided?</p> <p>3. without bracing, how much is the safety factor? Is the bracing only designed for wind load?</p> <p>4. the parallel intermediate bracing does not provide proper stability, should it be crossed? if only needed.</p>		<p>majority of the sites in Ontario, in case if the site-specific wind pressure is higher than the reference wind pressure, the temporary bracing system can be designed to accommodate the higher wind pressure.</p> <p>2. As mentioned, above, using the literature review and findings from jurisdictional scan and after performing various 3D analyses, both end and intermediate bracings are optimized to minimize potential constructability issues. CHBDC does not cover all construction scenarios in design requirements of temporary bracings except providing static wind pressure for various site locations. In addition, many other factors (refer responses below) may impact the girder stability such as lateral torsional bucking and/or rollover phenomena if girder is not adequately braced after installation and prior to deck formwork is in place.</p> <p>3. Please see above response.</p> <p>4. The parallel intermediate bracing system would adequately work for erected girders up to 4.0 m spacing based on the analyses we</p>
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<p>5. pre-embedded holes will incur conflict with diaphragm holes at abutment, need to be carefully laid out.</p> <p>6. how the tension force is 0.5 of compression force? I check the compression member calcs, and it matches <math>KL/r = 80</math>. if thinner member is used, this is unsafe.</p>		<p>carried out with horizontal members for intermediate bracings. Parallel intermediate bracings with a combination of end bracings provide effective and efficient girder stability during girder erection. Cross bracings were not a preferable option based on ORBA's feedback.</p> <p>5. No conflict is anticipated between diaphragm holes and bracing holes at abutments because the holes for diaphragm are within abutment but holes for bracings are located 250 mm+/- away from the face of abutment.</p> <p>6. Intermediate bracing member design is theoretically governed by compressive forces due to windward directional forces acting on the girders. However, according to some literature surveys, a leeward directional wind pressure acting on the girders can be considered with 50% of windward directional wind pressure which can create the tension on the bracing system. With that reason, the Ministry believes tensile force considered with 50% of compressive force would be an adequate assumption for intermediate bracing member design. The question about the effective slenderness ratio</p>
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<p>7. the intermediate bracing is an addition to the existing standard drawing, any particular needs to add the intermediate bracing?</p>		<p>of any unbraced length for compression members (<math>kL/r = 80</math>) is not relevant here since the section size wasn't specified in SSD and will be designed by the Contractor. The bracing members shown on the drawing are schematic and specific member design will be covered by the shop drawings.</p> <p>7. There was a confusion regarding 5m bracing in the latest SSD. MTO has never considered to eliminate 5m bracing from SSD. 5m bracing was already existed with a rebar welded to the rebars projected from the girder top flanges and a timber block installed between girder top flanges. ORBA had previously concerned to improve the system. Ministry has just improved and updated the system to provide details with better constructability. The update is based on literature review and scan of other jurisdiction practices.</p>
<p><b>C4: ID-229</b> Please see ORBA feedback (comments, questions, and recommendations) in regard to MTO TCP Notice. No. 000-0085 on: Minimum Bracing Requirements for NU Girders Installation.</p> <p>Supporting attachments where applicable are provided for information and reference.</p>		<p>R4: <b>Thank you for providing your comments.</b></p>

<p>The revised drawing is much better than at the beginning. However, ORBA still believes that, Ministry needs to revisit and make changes to Construction Note #3, #5 and also keep the intermediate brace 5m from the bearings on skewed bridges.</p> <ul style="list-style-type: none"> <li>• Construction Note #3: There is absolutely no need to install intermediate braces immediately after adjacent girder is placed. This brace is arguably needed for 100km/h wind speeds, but we never work when the wind speed is more than 36km/h. The intermediate brace should and could be installed not on the crane time, but after the last girder is placed and the crane is off the clock.</li> <li>• Construction Note #5: Does MTO realize that we are not patching the girder, but just filling an embedded pipe with the grout?</li> <li>• Intermediate Brace: Keep the intermediate brace 5m from the bearings on skewed bridges. MTO is persistent to keep the brace 5m into the girder, why?</li> </ul>		<ul style="list-style-type: none"> <li>• As discussed, numerous times previously, the minimum bracing requirements are not only provided for wind load, but they also cover various additional effects (e.g. construction tolerances at various construction stages and their components, temperature impacts, bearing types, bridge geometric variations, etc.). It is also evident from jurisdictional scan and literature review that the use of temporary bracings can minimize potential situations which might occur during construction and could have unsafe and adverse effects on girder stability.</li> <li>• Holes are required to be filled with non-shrink grout as specified in the drawing for durability and aesthetic reasons.</li> <li>• Intermediate bracings are required for numerous reasons as explained above.</li> </ul>
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<p>In this case the 5m distance should follow the girder line not a skew.</p>		<p>Based on the structural analysis results of several cases of skewed bridges, MTO concluded that providing intermediate bracing located at 5m distance measured perpendicular from the CL of bearings is required to provide effectiveness of the intermediate bracing system. With consideration of ORBA's request, MTO has updated the SSD to install the intermediate bracings at 5m distance measured parallel to girder line for bridges with skew <math>20^{\circ}</math> or less. Rationale behind this provision is that majority of MTO bridges would fall into a category with skew angles less than 20 degrees.</p>
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