



CSCE-CISC CANADIAN NATIONAL STEEL BRIDGE COMPETITION

2017 RULES

This document describes the Canadian National Steel Bridge Competition (CNSBC) and states the 2017 rules of this competition. **Clarifications, which include any revisions to the rules, are published at that website and do not appear in this document although they are formal addenda to the rules.** The website includes other information and the contact for requesting clarifications. Information at this website takes priority over any other source except as noted herein.

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WELCOME AND DISCLAIMERS

The Canadian Society for Civil Engineering (CSCE) and the Canadian Institute of Steel Construction (CISC) support and encourage the equitable opportunity for participation in the Canadian National Steel Bridge Competition (CNSBC) by all interested and eligible individuals without regard to race, ethnicity, religion, age, gender, sexual orientation, nationality, or physical challenges. Bridge teams should be inclusive, open, and fair to all interested and eligible participants. The goal of this competition is to give to Canadian civil engineering students an opportunity to have a first hands-on experience during their curriculum.

CNSBC committee would like to thank the American Institute of Steel Construction (AISC) as well as the American Society of Civil Engineers (ASCE) for the use of the AISC/ASCE National Student Steel Bridge Competition (NSSBC) rules as a baseline for these rules. Please note that the Imperial system was used in this document to facilitate reading of teams participating to both American and Canadian competitions.

We will see you in May 2017 for the second edition at Laval University in Quebec City, Canada!

Section 1 – MISSION AND SUMMARY

Civil Engineering students are challenged to an intercollegiate competition that supplements their education with a comprehensive, student-driven project experience from conception and design through fabrication, erection, and testing, culminating in a steel structure that meets client specifications and optimizes performance and economy. The Canadian National Steel Bridge Competition increases awareness of real-world engineering issues such as spatial constraints, material properties, strength, serviceability, fabrication and erection processes, safety, aesthetics, project management, and costs. Success in competition requires the application of engineering principles and theory, and effective teamwork. Future engineers are stimulated to innovate, practise professionalism, and use structural steel efficiently.

Students design and erect a steel bridge by themselves but may consult with faculty and other advisors. Students gain maximum benefit if they fabricate the entire bridge themselves. However, because appropriate shop facilities and supervision are not available at all universities, students may use the services of a commercial fabricator if they develop the work orders and shop drawings, and observe the operations. Students are encouraged to maximize their involvement in fabrication.

Safety is paramount. CNSBC committee request that competitors, advisers, hosts, and judges take all necessary precautions to prevent injury to competitors, judges, host personnel, and spectators. Risky procedures are prohibited. Load testing is stopped if sway or deflection exceeds specified limits, or if collapse is imminent. Bridges that cannot be constructed and loaded safely are withdrawn from competition. In addition, the rules identify and penalize construction errors that represent accidents in full-scale construction.

The Canadian National Steel Bridge Competition provides design and management experience, opportunity to learn fabrication processes, and the excitement of networking with and competing against teams from other colleges and universities.

Section 2 – INTRODUCTION

The rules simulate a request for proposals that requires a scaled model to demonstrate the efficacy of competing designs. Section 3, “Problem Statement,” relates the rules to realistic challenges encountered in bridge design and construction.

Sections titled “Material and Component Specifications,” “Structural Specifications,” and “Construction Regulations” set standards for strength, durability, constructability, usability, functionality, and safety that reflect the volumes of requirements that govern the design and construction of full-scale bridges. Criteria for excellence in the award categories are architectural design, structural efficiency and constructability. Competition judges and the CNSBC committee take the role of the owner and have authority to accept and reject entries.

The rules accommodate a variety of designs and encourage innovation. Designers must consider the comparative advantages of various alternatives. For example, a through bridge may be stiffer than a deck bridge but slower to construct. Successful teams compare alternatives prior to fabrication using value analysis based on scoring criteria. The rules are changed every year to renew the challenge and ensure that competitors design and build new bridges. Teams must also keep in mind that the architectural design of the bridge will be evaluated.

The rules are intended to be prescriptive but may require some interpretation. The procedure for requesting clarification of the rules is described in section 13, “Interpretation of Rules.”

Section 3 – PROBLEM STATEMENT

Île à Boilard Lodge Estates
New homes starting at \$200,000

These signs will announce a new construction on the Île à Boilard on the Jacques-Cartier River. Few lots will be soon available, but first a bridge must be built to connect the island to the near road. Civil infrastructure such as water and sewer lines already run parallel to the river.

The Jacques-Carter River is scenic and environmentally sensitive. Damage to the banks will be minimized by location bridge foundations back from the river, by staging construction equipment and materials even farther back, and by limiting the weight of transported loads. Temporary piers are permitted. High water in spring requires clearance under the bridge, and cost is minimized by completing construction before that season. Deck, foundations and approaches will not be included in the bridge contract.

A site survey indicates that a simple span of approximately 200 feet would be feasible, but the foundation at one end would conflict with the existing water and sewer pipes. Therefore, the contract for this bridge design would include the cost of relocating these utilities. Alternatively, the foundation could be nearer the river, and the bridge would have a cantilever extension over the pipe location thus eliminating the relocation charge. Both alternatives, simple span and cantilever, have the same overall length.

Serviceability, construction cost and duration, material costs, and aesthetics are critical considerations. Steel is specified for ease of prefabrication, rapid erection, superior strength to weight ratio, and high levels of recycled content.

Each competing firm is requested to submit a 1:10 scale model to demonstrate its concept. Models will be erected under simulated field conditions and will be tested for stability, strength, and serviceability using standardized lateral and vertical loads. A panel of engineers will judge the models by multiple criteria including architecture, structural efficiency and constructability. The contract will be awarded to the company whose model satisfies specified requirements and best achieves project objectives.

Any attempt to gain advantage by circumventing the intent of the competition as expressed by the rules, including this problem statement, will be grounds for rejecting the model and terminating the company's eligibility.

Section 4 – ELIGIBILITY

Only one bridge per college or university may compete at the Canadian National Steel Bridge Competition.

A team shall consist only of undergraduate and graduate students. All team members are required to be **student members of the Canadian Society for Civil Engineering (CSCE)** and will be asked to provide a proof of membership at the official registration (e.g.: membership numbers).

Section 5 – SAFETY

Safety has the highest priority – risk of personal injury will not be tolerated. Subsections 9.2.6, 9.4, 10.2, 10.3, 11.1, 11.2, 11.4 and 11.5 of these rules identify hazardous conditions and actions that will result in withdrawing a bridge from competition if not corrected. Judges will document these safety violations by checking appropriate boxes on the data entry forms. Judges also must comply with and enforce safety regulations for load testing in subsection 11.2.

Judges are empowered to halt any activity that they deem to be hazardous. If a bridge cannot compete safely, it must be withdrawn from competition. If the problem is not anticipated by the subsections listed in the preceding paragraph, the judge should write a brief description of the problem on the data form.

Students are requested to practise safe fabrication procedures and seek appropriate instruction and supervision. The subsection 8.2 footnote warns of a welding hazard, and precautions listed in subsection 11.2 guide safe load testing prior to competition.

Section 6 – SCORING

6.1 RECORDING DATA, ANNOUNCING RESULTS, SUBMITTING SCORES

Scoring data shall be recorded for every team that competes, using judges' scoring forms. Data from those forms are then entered in the spreadsheet. After all scoring information has been collected for a team, the scoring official review data entry with the captain of that team. The captain is given adequate time to verify the data before signing the form. Then a paper or electronic copy of the team's "Computation" worksheet from the scoring spreadsheet may be given to the captain if requested.

The "Rankings" worksheet from the official scoring spreadsheet summarizes the performance of all teams and may be distributed at the awards ceremony, electronically or as paper copies.

6.2 CATEGORIES OF COMPETITION

Categories of competition are divided into three categories: 1) Design Aesthetics, 2) Structural Efficiency, and 3) Constructability. These three categories are divided into different subcategories. The overall winner team is the one with the highest overall score as described in Section 6.3.

6.2.1 Design Aesthetics

6.2.1.1 Architectural design

Bridges will be evaluated regarding the originality of the design compared to the other CNSBC bridges, which takes into account innovative ideas, originality and the difficulty level regarding the bridge structural design. Also, appearance of the bridge, including balance, proportion, elegance, and finish will be evaluated. The bridge must be presented exactly as it will be erected during timed construction. However, quality of fabrication, including welding, shall not be considered because some bridges may be fabricated professionally rather than by students.

Permanent identification consisting of the name of the college or university must be on the bridge. The name shall be formed from steel or applied to steel with paint or decals, and should be easily legible (lettering at least 1" high is recommended). A bridge that lacks appropriate identification will receive a very low architectural design rating.

6.2.1.2 Poster

The poster shall present the following information:

- Identification of the college or university, using the same name that appears on the bridge,
 - brief explanation of why the overall configuration of the bridge was selected,
 - scaled, dimensioned side view of the bridge,
 - free-body diagram of the bridge for one of the load cases specified in section 7,
 - shears and moment diagrams for the bridge considered as a single spanning beam. The diagrams shall correspond to the free-body diagram, and peak magnitudes shall be shown,
 - provisions for Accelerated Bridge Construction (ABC), such as design features, construction sequencing, and procedures intended to minimize construction time, and
 - acknowledgement of university technicians, faculty, and others who helped fabricate the bridge or provided advice.
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- The poster shall be flat with maximum dimensions of two by three feet,
 - present all information on one side,
 - not have attached pages that must be lifted or turned, and
 - be in English or French.

Additional information may be included. Names of financial sponsors may be shown on an optional second poster that could accommodate their logos.

Electronic displays, decorated supports, lights, and sound are not permitted and will result in the lowest possible rating for the poster. A zero score rating will be imposed if there is no poster or if it is grossly inadequate. The poster is not part of the bridge but must be in place whenever the bridge is on display.

6.2.1.3 Oral presentation

An oral presentation (maximum 5 minutes) is required for each participating university. All presentations shall be conducted in a professional manner (defined as a presentation that the engineers team would give to the client). Oral presentations shall be in English or French. Presentation order will be selected randomly before the competition begins.

The presentation will take place during the bridges exhibition. The teams will be asked to do the presentation next to their poster and bridge. Presenters may be any of the registered participants. A maximum of three (3) people shall speak during the live presentation.

The teams shall discuss the following but not limited to: ingenuity of the design and construction, added value of the selected design, risk mitigation analysis, estimated

construction time and budget. Teams are encouraged to refer to their poster during their presentation. Judges will be allowed time to ask questions after the presentation.

6.2.2 Structural efficiency

6.2.2.1 Lightness

The bridge with the least total weight will win in the lightness category. Total weight is the weight of the bridge (determined by scales provided by the host organization) plus weight penalties prescribed in 8.2, 9.3, and 9.5. Temporary piers, decking, tools, lateral restraint devices, and posters are not included in total weight.

6.2.2.2 Structural cost

The bridge with the lowest structural cost (C_s) will win in this category. Structural cost is computed as follows:

For a bridge that weighs 303 pounds or less,

$$C_s = \text{Total weight (pounds)} \times 10,000 (\$/\text{pound}) \\ + \text{Aggregate deflection (inches)} \times 1,000,000 (\$/\text{inch}) \\ + \text{Load test penalties } (\$)$$

For a bridge that weighs more than 303 pounds,

$$C_s = [\text{Total weight (pounds)}]^2 \times 33 (\$/\text{pound}^2) \\ + \text{Aggregate deflection (inches)} \times 1,000,000 (\$/\text{inch}) \\ + \text{Load test penalties } (\$)$$

“Total weight” is defined in 6.2.2.1, “aggregate deflection” is defined in 11.5, and “load test penalties” are prescribed in 11.5. **Teams will be asked to submit an estimation of the structural cost no later than 17h00 (EST), April 14, 2017.** A special award will be given to the team that has the smallest difference between estimated structural costs and real structural costs.

6.2.2.3 Stiffness

The bridge with the lowest aggregate deflection will win in the stiffness category. Aggregate deflection is determined from measurements as prescribed in 11.5.

6.2.3 Constructability

6.2.3.1 Construction Speed

The bridge with the lowest total time will win in the construction speed category. Total time is the time required for construction modified by construction penalties prescribed in 9.4, 10.4 and 10.8.1. There is an upper limit on construction time (see 10.8.2). **Teams are requested to submit an estimation of the construction time prior to the registration.**

6.2.3.2 Construction Economy

The bridge with the lowest construction cost (C_c) will win in the construction economy category. Construction cost is computed as

$$\begin{aligned} C_c &= \text{Total time (minutes)} \times \text{number of builders (persons)} \\ &\times 50,000 \text{ (\$/person-minute)} \\ &+ \$30,000 \text{ for each temporary pier that is staged for construction} \\ &+ \text{load test penalties (\$)} \\ &+ \$150,000 \text{ if A \& C footings are used.} \end{aligned}$$

“Total time” is defined in 6.2.3.1, “builder” is defined in 10.1.1, and “load test penalties” are prescribed in 11.5. A penalty increase to the number of builders is prescribed in 10.4.1.

6.3 OVERALL SCORING

The overall scoring is divided into two categories: design aesthetics (AD) and overall cost of the bridge (OC). The AD portion is worth one third of the overall scoring (33.3%). The OC of the bridge is worth two thirds of the overall scoring (66.6%) and is itself computed as the sum of the structural cost (Section 6.2.2.2) and the construction economy (Section 6.2.3.2).

The points for a given judge (i.e. raw score) will result in an independent ranking from 1st to nth place (with n being equal to the number of teams competing) for each category. The independent rankings of the judges will then be averaged to determine the overall score for the entry. Raw scores will be used in the event of a tiebreaker.

For example, assume a team receives scores of 90, 87, 94, 83, and 90 for the Poster which when compared to scores given to other teams by the same judge, results in independent rankings of 2nd, 3rd, 1st, 2nd, and 4th places, respectively. The average ranking will be 2.4. The average ranking of all teams shall then be compared to determine the overall ranking (OR) in a given category.

The points attributed for each category will be based upon the team’s overall ranking (OR) in a given category and the number of teams competing (n). The overall score (OS) is computed using equation (1) where OR_{AD} and OR_{OC} are respectively the overall ranking of both architectural design and overall cost of the bridge categories:

$$OS = \left(1 - \left(\frac{OR_{AD} - 1}{n}\right)\right) \times 33.3\% + \left(1 - \left(\frac{OR_{OC} - 1}{n}\right)\right) \times 66.6\% \quad (1)$$

All the teams will be finally ranked from 1st to nth where n is the number of teams based on the overall score (OS). The team with the highest overall score wins the competition. In the case of a tie, the bridge with the lowest overall cost of the bridge wins the tie breaker.

Section 7 – SCHEDULE OF COMPETITION

In the months before the competition, students design their bridges, fabricate members, test load, practice construction, and select the builders for timed construction.

7.1 ORDER OF COMPETITION

The following events occur during the competition:

- (1) The committee determines the order in which teams will compete.
- (2) Bridges are erected for public viewing and are judged for display. After the start of display judging, bridges shall not be altered, modified, or enhanced in any way except for corrections prescribed by subsection 9.4.
- (3) Bridges are disassembled.
- (4) In a meeting at which all team captains are present, the head judge or a committee member clarifies rules and conditions of the competition, and answer questions.

Immediately before timing construction of the first bridge, the head judge rolls a die to determine the magnitude and location of loads described in 11.5.1.1 and 11.5.2, and illustrated by the Vertical Loading Plans. For each possible result S of the roll, Table 7.1 gives the load distribution and dimension for positioning a decking unit. Team captains may observe the roll. The same locations will be used for all bridges.

TABLE 7.1 Determination of D

S	Wb (lb).	Wc (lb).	M
1	1500	500	5'-6"
2	1500	500	6'-6"
3	1500	500	8'-6"
4	1300	700	5'-6"
5	1300	700	6'-6"
6	1300	700	8'-6"

- (5) The die is rolled again. If S for this second roll is even, the left and right sides of the bridge are relative to travel from the A end to the C end. If S is odd, the left and right sides are relative to travel from C to A. The same designations will be used for all bridges in the same conference competition.
- (6) Bridge members, fasteners, temporary pier, and tools are staged for construction and inspected by the judges. See section 8, "Material and Component Specifications," and subsections 10.1, 10.2 and 10.6 for details.
- (7) Timed construction. See section 10, "Construction Regulations," for details.
- (8) Judges inspect assembled bridges. For details, see section 9, "Structural Specifications." Between corrections described in 9.4 and load testing, force

shall not be applied to the bridge except as necessary to move it. For example, leaning or sitting on the bridge is not allowed.

- (9) Bridges are weighed (if it is impractical to weigh the entire bridge, its parts may be weighed prior to construction). **All bridges shall be weighed, including those that are withdrawn from competition and not ranked for awards.**
- (10) Load testing. See section 11, "Load Test Instructions," for details.
- (11) After a team has completed all phases of the competition, data for the team is transcribed from the judges' scoring forms into the official scoring spreadsheet and checked by the team captain. After data entry has been completed, a copy of the team's "Computation" worksheet from the scoring spreadsheet may be given to the team captain electronically or on paper.
- (12) Scores and rankings are determined using the official scoring spreadsheet.

7.2 ALTERNATIVES

The order recommended above may be altered. However, it is essential that:

- (1) Bridges are not modified after selection of loads and sides locations.
- (2) Bridges are not modified between display judging and timed construction.
- (3) No components or tools are added to or removed from the construction site after staging for inspection.
- (4) Modification between timed construction and load testing are limited to connection corrections described in subsection 9.4.

Section 8 – MATERIAL AND COMPONENT SPECIFICATIONS

8.1 MATERIAL

For the purposes of this competition, steel is defined as an iron alloy that is strongly attracted to the magnet provided by the host organization. Some grades of steel are not magnetically attractive. If any member, nut or bolt is not magnetic steel or incorporates parts that are not magnetic steel, the bridge will not be approved for construction or load testing, and will not be eligible for awards in any category. See 8.2. for definition of “member”, “nut” and “bolt”.

8.2 COMPONENTS

Violation of the specifications in this subsection (8.2) will result in penalties being added to the weight of the bridge. The penalty is 25 pounds for every non-compliant loose bolt and loose nut, and 25 pounds for every non-compliant member plus the weight of that member. See 8.2.2, 8.2.3, and 8.2.4 for definitions of “member,” “loose,” “bolt”, and “nut”.

8.2.1 Bridge

A bridge shall be constructed only of members, loose bolts, and loose nuts. Solder, brazing, and adhesives are not permitted. Exceptions: Purely decorative items such as coatings and decals are permitted, and bridge parts may be labelled.

8.2.2 Members

8.2.2.1 A member is a rigid component comprised of parts welded¹ together. Bolts and nuts that are welded¹ to members are parts of members and are not considered to be loose. A member shall retain its shape, dimensions, and rigidity during timed construction and load testing. Members with moving and flexible parts are prohibited. Exception: Deformations caused by mechanical strains (e.g., bending, stretching) during construction and load testing are not violations.

¹ **Health advisory:** The bright silvery or colored coating on bolts, nuts, threaded rod, and other hardware contains zinc and cadmium. At welding temperature, both elements create hazardous fumes. Inhalation of zinc fumes causes symptoms resembling those of influenza. Cadmium gas can damage lungs and kidneys, and is a potential carcinogen. **Participants are advised to weld only plain (uncoated) hardware.**

8.2.2.2 A member shall not exceed overall dimensions of 3'-0" x 6" x 4". That is, it shall fit into a right rectangular prism (i.e., box) of those dimensions.

8.2.2.3 Threads shall be continuous around the full circumference of an externally threaded part of a member if that part is necessary for compliance with 9.4.1.

8.2.3 Loose Bolts

Loose bolts shall not have parts that flex, move, or are not steel. Nominal length shall not exceed 3" measured from the bottom of the head to the end. Loose bolts shall have external threads that extend around the full circumference shall be commercially available and shall not be mechanically altered or modified in any way but may be painted.

8.2.4 Loose and Welded Nuts

8.2.4.1 Nuts shall be hexagonal in shape and not have parts that flex, move, or are not steel. Nuts shall be commercially available and shall not be mechanically altered or modified in any way but may be painted.

8.2.4.2 Nuts shall have internal threads that extend for the full circumference and thickness.

8.2.5 Holes in Members

8.2.5.1 The hole in a member for a loose bolt or externally threaded part of another member shall be completely surrounded by the member. Furthermore, such holes in the outer plies of a connection shall be small enough that the nut or bolt head cannot pass through.

8.2.5.2 Holes for loose bolts or externally threaded parts of members shall not be threaded. Exception: A nut that is welded to a member and conforms to the specifications of subsection 8.2.4 is not a violation.

Section 9 – STRUCTURAL SPECIFICATIONS

9.1 MEASUREMENT

Conformance with the specifications in this section (9) will be checked with the bridge in its as-built condition after the termination of timed construction, before the bridge is moved from the construction site or load tested. The bridge shall not be modified or distorted from its as-built condition in order to conform to these specifications except as prescribed by subsection 9.4. Dimensions will be checked without decking or applied load.

9.2 FUNCTIONALITY AND SAFETY

If any specification in this subsection (9.2) is violated, the bridge will not be approved for load testing and will not be eligible for any awards in the structural efficiency and constructability categories.

9.2.1 The bridge shall have exactly two decking support surfaces, each of which is contiguous over the full length of the bridge so that decking could be placed to bear on them anywhere along the span. Decking support surfaces are upper surfaces of members. See Section 1 on the Bridge Diagrams.

9.2.2 The bridge shall provide access for safely placing 3'-6" wide decking and load.

9.2.3 The decking shall not be attached or anchored to the bridge. This prohibition includes but is not limited to protrusions, irregularities, and textures of the decking support surfaces that enhance strength or stability of the bridge.

9.2.4 Decking shall not distort the bridge from its as-built condition.

9.2.5 The bridge shall not be anchored or tied to the floor.

9.2.6 Teams shall construct and load the bridge safely using the site, equipment, and floor surfaces provided by the host student organization. **Bridges and participants shall accommodate local conditions.**

9.3 USABILITY

Specifications in this subsection (9.3) are illustrated by the Site and Bridge Diagram.

A weight penalty will be assessed for each specification in this subsection (9.3) that is violated, rather than for every violation of that specification. If there are multiple violations of the same specification, the penalty will be based on the largest violation.

The penalty for violation of each of the specifications in this subsection (9.3) will be an addition to the weight of the bridge determined as follows:

- (1) 20 pounds for a dimensional violation of 1/4" or less,
- (2) 100 pounds for a violation greater than 1/4" but not exceeding 1",
- (3) 200 pounds for a violation greater than 1" but not exceeding 2", and
- (4) if a violation exceeds 2", the bridge will not be approved for load testing and will not be eligible for any awards in the structural efficiency and constructability categories.

9.3.1 The bridge shall not touch the river or the ground outside the declared footings. Refer to 10.1.8 for definition of "declared footings".

9.3.2 The bridge shall not extend more than 5'-0" above the ground or river.

9.3.3 The bridge shall not be wider than 5'-0" at any location along the span.

9.3.4 The decking support surfaces shall be no more than 2'-7" above the surface of the river or ground at any location along the span.

9.3.5 Decking support surfaces shall be at least twenty feet long, regardless of whether footings A and B or footings A and C are declared.

9.3.6 At the ends of the bridge, parts of members, nuts and bolts shall not extend away from the river beyond the vertical planes that pass through the construction zone boundaries.

9.3.7 The bridge shall provide a straight vehicle passageway such that the template illustrated by the Vehicle Clearance Template detail on the Bridge Diagram drawing page will pass without obstruction along the decking support surfaces for the full length of the bridge. To verify compliance with 9.3.7 and 9.3.8, judges will slide the template along the decking support surfaces while holding it plumb and perpendicular to the span of the bridge.

9.3.8 Decking support surfaces shall contact the tops of the two notches in the template for the full length of the bridge during the verification procedure described in 9.3.7. Non-compliance with 9.3.8 will be penalized as a one-inch violation, and that weight penalty will be in addition to penalties for non-compliance with 9.3.7.

9.3.9 Decking support surfaces shall be free of holes, splits, separations, protrusions and abrupt changes in elevation or slope, except that between segments of decking support surfaces that are surfaces of adjacent members there may be a horizontal separation not exceeding 1/4" and a change in elevation not exceeding 1/8".

9.3.10 Vertical clearance shall be provided under the bridge at all points directly over the ground and river. The clearance shall be at least 1'-6" high, measured from the surface of the ground or river. No part of the bridge, including nuts and bolts, shall extend below this limit. Exception: No clearance is required over footings except as necessary to apply restraint during the lateral load test described in subsection 11.4.

9.4 CONNECTION SAFETY

After the termination of timed construction and inspection by the judge, the team is required to attempt to correct every connection that violates specification 9.4.1 or 9.4.2, and will be granted the option to correct connections that violate specifications 9.4.3. Only tools, temporary piers, loose nuts and loose bolts that were in the staging yard at the start of timed construction shall be used. Safe construction practices (10.2 and 10.3) are required, but accidents (10.4) will not be penalized. A team will be allowed five minutes to correct all connections. If any connection still violates specification 9.4.1 or 9.4.2 when that time limit is reached, the bridge will not be approved for load testing and is not eligible for any points and awards in the structural efficiency and constructability categories.

9.4.1 Every individual member shall be connected to each member that it touches by at least one loose bolt or externally threaded part of a member so that those connected members cannot be separated without first unscrewing and removing a loose bolt or externally threaded member that connects them, or without first unscrewing and removing a loose nut from that bolt or threaded member. The loose bolt or externally threaded part of a member shall pass through holes in all the members that it connects. A loose bolt or threaded part of a member may connect more than two members. Penalty is five minutes added to construction time for each individual violation.

9.4.2 Every individual nut shall fully engage the threads of the matching bolt or member. That is, the terminal threads of the bolt or member shall extend beyond or be flush with the outer face of the nut. The threads of the nut shall match the bolt or externally threaded member so that installation and removal require relative rotation. Penalty is five minutes added to construction time for each individual violation.

9.4.3 Every loose nut or loose bolt shall be tightened sufficiently so that the nut or bolt head contacts the outer surface of a member that it connects. Penalty is one minute added to construction time for each individual violation. However, if a fastening consists of a loose nut on a loose bolt, only one penalty will be applied for that fastening.

9.5 INSPECTABILITY

Each individual nut, head of a loose bolt and threaded end of a bolt or member shall be visible in the completed bridge so that compliance with specifications in subsection 9.4 can be verified. A penalty of 25 pounds will be added to the weight of the bridge for every individual threaded end, nut, and bolt head that cannot be inspected.

Section 10 – CONSTRUCTION REGULATIONS

10.1 DEFINITIONS

10.1.1 “Builders” are an undergraduate or graduate student members of a team construct the bridge. See section 4, “Eligibility.”

10.1.2 The team designates one builder to serve as “captain” for the entire competition. The captain signifies that the builders are ready to start timed construction, declares the finish, and signs scoring forms.

10.1.3 The “site boundary” encloses the “construction site”, which is comprised of “river”, “construction zones”, “transportation zones” and “staging yards”. All construction activities are conducted within the site boundary. The committee marks the site boundary as its enclosed features on the floor before the competition, as illustrated by the Construction Site drawing.

10.1.4 The “River” represents a natural feature that builders will not enter.

10.1.5 Builders on the ground in the “construction zones” put members together to create the bridge.

10.1.6 Builders carry objects across the “transportation zones”.

10.1.7 “Staging yards” are occupied by builders and objects at the start and finish of timed construction.

10.1.8 “Footings” are areas marked on the floor within the construction zones. “Declared footings” are the four footings chosen by a team on which the bridge will stand. The team may choose either the footings marked A and B, or the footings marked A and C. The two footings that are not chosen are not considered to be footings during construction. A cost is added to Construction Economy if the A and C footings are chosen.

10.1.9 “Ground” is the floor inside the site boundary, including footings, construction zones, transportation zones and staging yards, but excluding the river.

10.1.10 “Personal protective equipment” consists of a hard hat meeting ANSI standard Z89.1 and protective eyewear or safety goggles meeting ANSI standard Z87.1. A competing organization provides its own personal protective equipment.

10.1.11 A “pouch” is an optional article of clothing that is used to carry nuts, bolts, and tools. This definition encompasses tool belts, magnets, and other accessories worn by builders and having the same function.

10.1.12 A “tool” is a device that is used to construct the bridge but is not part of the completed bridge. A competing organization provides its own tools.

10.1.13 “Temporary piers” are optional devices that are used to support only constructed portions during timed construction. They have no other purpose are not tools, and are not part of the completed bridge. Temporary piers are provided by the team may be made of any material, and may bear on only the river or construction zones. Construction cost is increased for each temporary pier that is staged for construction.

10.1.14 “Member”, “loose bolt”, and “loose nut” are defined in subsection 8.2.

10.1.15 A “constructed portion” is comprised of members, loose nuts and loose bolts, and is created during timed construction by builders on the ground in the construction zones. There may be multiple constructed portions.

10.2 PRE-CONSTRUCTION CONDITIONS

Timed construction will not commence or will be stopped if any provision of this subsection (10.2) is violated.

10.2.1 Only builders and judges are permitted within the construction site boundary during timed construction. Team members who are not builders, coaches, faculty, advisers, other associates of the team, and spectators shall remain in designated areas at a distance from the construction site that assures they are not at risk and cannot interfere with the competition.

10.2.2 There shall be no more than six builders.

10.2.3 A tool shall not weigh more than fifteen pounds. Welding machines and tools requiring external power connections, batteries, or other internal energy supplies shall not be used during timed construction.

10.2.4 There shall be no more than two temporary piers. Each temporary pier shall retain its original dimensions, not weigh more than fifteen pounds, and not exceed 1’-6” in any horizontal dimension. Wheels and rollers are permitted if they rotate about concentric axes so that dimensions of the temporary piers are not changed.

10.2.5 Containers of lubricant shall not be in the construction site at any time.

10.3 SAFE CONSTRUCTION PRACTICES

If any rule in this subsection (10.3) is violated during timed construction, the judge will stop the clock and explain the violation. Before the clock is restarted, builders, temporary piers, tools, members, nuts and bolts will be returned to the positions they occupied before the violation. Then builders will be asked to resume construction using safe procedures. Builders will have the opportunity to construct their bridge safely. However, if they are not able to construct the bridge completely using safe procedures, construction will cease and the bridge will not be approved for load testing and will not be eligible for any awards in the structural efficiency and constructability categories.

10.3.1 Builders, judges, host personnel, and spectators shall not be exposed to risk of personal injury. Only builders and judges may be in the construction site.

10.3.2 At all times during times construction every builder shall wear personal protective equipment in the proper manner.

10.3.3 A pouch or other article of clothing shall not be removed from a builder's person or held in a builder's hand(s).

10.3.4 Nuts, bolts, and tools shall not be held in the mouths of builders.

10.3.5 Throwing anything is prohibited.

10.3.6 A builder shall not cross from the ground on one side of the river to the ground on the other side.

10.3.7 A builder who is outside a staging yard shall not simultaneously touch (or touch with tools) more than one member that is not in a constructed portion.

10.3.8 A builder who is outside a staging yard shall not simultaneously move a temporary pier and touch (or touch with tools) a constructed portion or a member.

10.3.9 A temporary pier shall not be moved while it is supporting a constructed portion.

10.3.10 A builder shall not use the bridge, a constructed portion of the bridge, a temporary pier, a member, or a tool to support the builder's body weight. However, a builder may be partially supported by the constructed portion if the builder is kneeling on the floor on both knees, kneeling on the floor on one knee with the other foot on the floor, or standing with the heels and toes of one or both feet on the floor.

10.3.11 Construction of each individual constructed portion shall commence by placing a member on the ground within a declared footing. That member or becomes a constructed portion. When a member, loose nut, or loose bolt is in contact with a

constructed portion it becomes part of the constructed portion and is not considered to be a member, loose nut or loose bolt while in contact with that constructed portion.

10.3.12 A builder who is outside a construction zone shall not touch (or touch with tools) a constructed portion and shall not install a member, nut or bolt on a constructed portion.

10.3.13 At no time shall a builder or builders support the entire weight of a constructed portion. However, a builder or builders may remove a single member from a footing or from a constructed portion.

10.4 ACCIDENTS

In general, the clock is not stopped when there is an “accident,” i.e., an infraction of one of the provisions of this subsection (10.4).

A penalty is assessed for every separate accident. If an accident is continuous (for example, a builder stands in the river, or a dropped item is not retrieved promptly) it will be counted as multiple occurrences until corrected. Builders involved in accidents may continue to build. Items involved in accidents shall be recovered promptly and may be used.

Construction cannot depend on deliberately committing an accident. Therefore, the clock will be stopped if any work is accomplished by committing an accident. Before timing construction is resumed, builders, temporary piers, tools, members, nuts, and bolts will be returned to the positions they occupied before the accident.

10.4.1 A builder or builder’s clothing/footwear touches the river or the floor outside the site boundary. For each occurrence, the number of builders is increased by one when the spreadsheet computes construction cost, C_c (the number of builders actually constructing the bridge does not change). Exception: There is no penalty for stepping out of bounds or entering the river to retrieve an object that has been dropped, such as a member, tool, nut, bolt, or personal protective equipment.

10.4.2 A member, constructed portion, tool, loose nut, loose bolt, or personal protective equipment touches the river, the ground outside the staging yard, or the floor outside the construction site. Penalty is 1/4 minute (15 seconds) for each item during each occurrence. Exception: There will not be a penalty for a member touching the ground within a declared footing. However, construction may proceed if it is no longer possible to hold the bearing surfaces of a construction portion within the declared footings. In this situation, the captain may request that the clock is stopped while the difficulty is demonstrated to the head judge. If the head judge is convinced, no additional accidents will be cited for a construction portion touching the ground outside the declared footings, the clock will be restarted, construction will resume and a 200-pound weight penalty will

be assessed, even if the bearing surfaces of the bridge are within the declared footings when it is completed.

10.4.3 A temporary pier touches the ground in a transportation zone or the floor outside the site boundary. Penalty is 1/4 minute (15 seconds) for every occurrence.

10.4.4 A member, tool, nut, bolt or temporary pier is placed on a temporary pier. Penalty is 1/4 minute (15 seconds) for every occurrence.

10.4.5 Outside the staging yards, a member that is not part of a constructed portion touches or is in contact with another member that is not part of a constructed portion. Penalty is 1/4 minute (15 seconds) for every occurrence.

10.4.6 A temporary pier falls over or collapses while supporting a constructed portion. Penalty is 1/2 minute (30 seconds) for every occurrence.

10.5 CONSTRUCTION SITE

See the Construction Site drawing for the layout of the construction site. The host committee lays out the site before the competition. The construction site shall be laid out so that tape that designates lines is wet or out of bounds. That is, the edges of tapes, not the centrelines, designate the lines shown on the drawing.

10.6 START

10.6.1 The captain informs the judge whether the finished bridge will stand on the four A and B footings, or on the four A and C footings.

10.6.2 Before construction begins, only the following are in the staging yard: all builders, members, loose nuts, loose bolts, temporary piers and tools. Every member, loose nut, loose bolt, tools and temporary pier must be in contact with the ground and must fit entirely within assigned areas of the staging yard as designated on the Staging Yard detail on the Construction Site drawing. Builders are wearing personal protective equipment as well as optional clothing such as pouches. Builders start without tools, nuts, and bolts, which may be passed from one builder to another after timing construction begins. Similarly, temporary piers may be passed from builder to builder. There shall be nothing within the construction site that is not in a staging yard.

10.6.3 Judges inspects members, loose nuts, loose bolts, temporary piers and tools as they are placed in the staging yard. Tools and temporary piers that do not conform to regulation 10.2.3 and 10.2.4 shall be removed from the staging yard and shall not be used. After inspection and throughout timed construction, additional members, temporary piers, tools, nuts, bolts, or other items shall not be brought into the

construction site nor shall anything be removed. Additional builders shall not enter the construction site after the beginning of timed construction.

10.6.4 Timing and construction begin when the captain signifies that the team is ready and the judge declares the start.

10.7 TIME

10.7.1 Time is kept from start to finish of construction. The clock will be stopped under the following conditions.

- (1) If a builder or judge sees a condition that could cause injury, or
- (2) when a safety regulation has been violated (see 10.2 and 10.3), or
- (3) when work has been accomplished by committing an “accident”. The clock is not stopped if the “accident” does not contribute to the construction process (see 10.4), or
- (4) if a builder or judge is injured.

10.7.2 Construction ceases while the clock is stopped. After the situation has been corrected, builders, temporary piers, tools, and bridge components are returned to the positions they occupied before the interruption, and the clock is restarted.

10.8 TIME LIMIT

10.8.1 If construction time not including penalties exceed 30 minutes, the scoring spreadsheet will count construction time as 180 minutes. “Accidents” (10.4) that occur after thirty minutes will not be penalized but safety rules (10.2 and 10.3) will still be enforced. Judges may inform the team when this time limit is approaching and shall inform them when it is reached.

10.8.2 If construction time not including penalties exceed 45 minutes, judges will halt construction. If local conditions allow and the head judge approves, the team may move its bridge offsite for continued, untimed construction if it can be done safely. The bridge will not be eligible for any awards in the structural efficiency and constructability categories, but, at the discretion of the head judge, it may be load tested after all eligible bridges.

10.9 FINISH

10.9.1 Construction ends and the clock is stopped when

- (1) the bridge has been completed by connecting all the members that were in the staging yard at the start of timed construction,
- (2) all builders are in the staging yard,

- (3) all tools and extra nuts and bolts are held in the hands of builders, or are in clothing worn by builders, or are on the ground in the staging yard,
- (4) all temporary piers are on the ground in a staging yard and,
- (5) the captain informs the judge that construction is complete.

10.9.2 Installation of decking is not included in timed construction.

10.9.3 After construction is finished the bridge shall not be modified except for repair of connections as prescribed in subsection 9.4.

Section 11 – LOAD TEST INSTRUCTIONS

11.1 DAMAGE

A bridge with damage that would reduce its strength or stability (such as a fractured weld, missing or broken member, broken bolt, or missing nut) will not be approved for load testing and is not eligible for any points and awards in the structural efficiency and constructability categories. Repair and modifications are not permitted after timing construction except as prescribed by subsection 9.4.

11.2 SAFETY PRECAUTIONS

It is the responsibility of judges, host personnel, and competitors to employ effectively all precautions, which are summarized in this subsection (11.2). Competitors should follow the same precautions when proof testing bridges in preparation for competition.

11.2.1 General Precautions

11.2.1.1 An activity shall be halted if the judge considers it to be hazardous. If competitors cannot load their bridge safely, loading will cease and the bridge will not be eligible for any awards in the structural efficiency and constructability categories.

11.2.1.2 Competitors who are not participating in loading, faculty, advisers, and other spectators shall observe from a safe area designated by the judges and host committee.

11.2.1.3 While participating in load testing, competitors shall wear hard hats meeting ANSI standard Z89.1, protective eyewear or safety goggles meeting ANSI standard Z87.1, work gloves, and leather construction boots. This safety equipment is provided by the competitors. Judges will not permit load testing by competitors who are not wearing the specified safety equipment or are wearing it improperly.

11.2.2 Lateral Load Test Precautions

11.2.2.1 Not more than three competitors shall participate in lateral load tests.

11.2.2.2 Bridges that sway in excess of 1/2" during lateral load testing shall not be loaded vertically and is not eligible for any points and awards in the structural efficiency and constructability categories.

11.2.3 Vertical Load Test Precautions

Bridges may collapse suddenly without warning, and a failure may involve only one side so that the load tips sideways. The intent of the provisions of this subsection (11.2.3) is to prevent personal injury if a bridge collapses.

11.2.3.1 The number of people near the bridge shall be minimized during vertical load tests. The loading crew is limited to three competitors, but substitutions may be made during the loading process.

11.2.3.2 Safety supports shall be provided by the host organization, and shall be of adequate strength, height, and numbers to arrest falling load if a bridge collapses.

11.2.3.3 Safety supports shall be in place under the decking units before load is placed on the bridge.

11.2.3.4 The number and location of safety supports under a decking unit shall be sufficient to arrest the load even if only one side or one end of the bridge collapses. Therefore, safety supports are needed under the sides and ends of the decking units, not just in the middle. Safety supports should be directly under decking units rather than under bridge trusses or cross braces, if possible.

11.2.3.5 Safety supports shall be adjusted individually for each bridge so that load cannot drop more than 5". If the height of the safety supports is not adjustable in appropriate increments, they shall be augmented with pieces of wood or other suitable material provided by the host student organization.

11.2.3.6 No one shall reach, crawl, or step under a bridge while any portion of the vertical load is in place. If safety supports must be adjusted during loading, the load shall first be removed without disturbing the bridge, adjustments made, and the load replaced as it was before being removed.

11.2.3.7 Bridges that inhibit safely placing vertical load shall not be tested and is not eligible for any points and awards in the structural efficiency and constructability categories.

11.2.3.8 Judges shall observe sway carefully during vertical load testing. If sway exceeds 1", loading shall cease and load shall be removed carefully.

11.2.3.9 Judges shall observe vertical deflections carefully. If deflection at any target exceeds 3", loading shall cease and load shall be removed carefully.

11.2.3.10 Judges shall observe the behaviour of the bridge. Loading shall cease and the load shall be removed carefully if, in the opinion of a judge, collapse is imminent.

11.3 PREPARATION

The captain shall observe the load tests and may handle load. A captain who does not handle load shall comply with 11.2.1.3 but does not count toward the three-person limit.

Temporary piers are not used during load tests. Teams shall accept imperfect field conditions such as bent decking, sloping floors, and unfavourable floor surfaces.

At their discretion, judges may impose a penalty for a bridge that incorporates parts having the primary function of interfering with the placement of decking, load, or measuring devices. If the bridge cannot be loaded safely, or sway or deflection cannot be measured in accordance with the provisions of this section (11), the bridge shall not be load tested and is not eligible for any points and awards in the structural efficiency and constructability categories.

“Sway” is a translation in any horizontal direction. Typically, sway is determined by using a plumb bob attached to the bridge at a specified target. A sway requirement is failed if any part of the bridge causes the displacement of the plumb bob at floor level to exceed the specified limit, even if the plumb bob is not attached to that part.

11.4 LATERAL LOAD TEST

The provisions of this subsection (11.4) are illustrated by the Lateral Load Test detail on the Loading Diagrams drawing.

11.4.1 General

Lateral load tests are conducted with one decking unit centred on a point 9'-0" from the end of the decking support surface at the A end of the bridge and approximately 75 pounds of weight on that decking near the right side of the bridge. This load is intended to restrain the bearing surfaces of the bridge from lifting off the floor when lateral load is applied. No additional uplift restraint will be used, even if bearing surfaces lift.

Bearing surfaces are prevented from sliding by lateral restraint applied by competitors. This lateral restraint shall not restrain rotation or uplift. The restraint is applied as close to the floor as possible, at the locations shown on the Lateral Loading Plans. Competitors may provide and use optional devices to prevent sliding. The lateral load test is failed if the bridge is restrained in other than the lateral direction, or if the restraint is not applied close to the ground, or if the restraint is not effective.

Lateral loads are applied at the level of the decking or decking support surface, which is the bottom of the decking. Each sway measurement is made as close as possible to the location of the corresponding lateral load.

If the bridge does not pass both lateral load tests, it is not approved for further testing and is not eligible for any points and awards in the structural efficiency and constructability categories. Do not conduct any other load test. Check the appropriate box on the judges' scoring form.

If the bridge passes both lateral load tests, proceed with vertical load tests.

11.4.2 First Lateral Load Test

A fifty-pound lateral pull is applied and sway is measured on the left side of the bridge, 9'-0" from the end of the decking support surface at the A end of the bridge. The test is failed if sway exceeds 1/2".

11.4.3 Second Lateral Load Test

A fifty-pound lateral pull is applied and sway is measured on the left side of the bridge. The pull is applied as close as possible to the end of the decking support surface at the C end of the bridge. If the measuring device cannot be placed at that point, it may be shifted laterally to a feasible location between the ends of the decking support surfaces. The test is failed if sway exceeds 1/2".

11.5 VERTICAL LOAD TESTS

The provisions of this section are illustrated by the Vertical Loading Plans.

11.5.1 Set Up

11.5.1.1 Decking units are 3'-0" long in the longitudinal (span) direction of the bridge so that the main bars of grating span laterally. Two decking units are used. Decking units are placed squarely with and centred on the decking support surfaces. Decking units shall not be attached to the bridge and shall not distort it (see 9.2.3 and 9.2.4).

A decking unit is placed at a distance M from the end of the decking support surfaces at the A end of the bridge to the near end of the decking unit. M is determined at the beginning of the competition as described by paragraph 7.1.

The other decking unit is placed flush with the end of the decking support surfaces at the C end of the bridge.

A decking unit that does not contact the decking support surface at location where deflection will be measured will be clamped to the decking support surface at or near that location. The clamp will be removed when load is sufficient to hold the decking unit in contact with the decking support surface.

11.5.1.2 Safety supports are placed under the decking so that no portion of the load will drop more than approximately 5” if the bridge collapses.

11.5.1.3 “Deflection” is vertical translation. Deflections are measured as close as possible to decking support surfaces, which are the same level as the bottom of the decking. Measurements are made at the following locations

- DbL centred on the left side of the decking unit closest to the A end of the bridge.
- DbR on the right side and the far end of the decking unit closest to the A end of the bridge.
- DcL on the left side and 1’-0” from the C end of the bridge.

Sway is observed on the left side of the bridge, 9’-0” from the end of the decking support surface at the A end of the bridge. Left and right are determined before construction as described by paragraph 7.1.

11.5.2 General Loading Procedure

Load is laterally centred on the decking unit and distributed over the length of the decking unit as uniformly as possible. Load is distributed and aligned identically for every bridge. Load shall be placed at a steady pace, without hesitation. Competitors shall stand outside the bridge while placing load.

As the load is being placed, observe the deflection and sway. Stop loading if :

- (a) Sway exceeds 1”, or
- (b) any measured deflection exceeds 3” downward, or
- (c) decking or any part of the bridge, other than the intended bearing surfaces, comes to bear on a safety support or the floor, or
- (d) a decking unit or some of the load falls off the bridge, or
- (e) the bridge collapses or a dangerous collapse is imminent, in the opinion of the judge.

If loading is stopped for any of the situations a, b, c, d, or e, the bridge is not approved for further load testing and is not eligible for any points and awards in the structural efficiency and constructability categories. Remove the load and **do not continue load testing**. Check the appropriate box on the judge’s scoring form.

Data collected after all of the first vertical load, Wb, is placed will be used by the scoring spreadsheet to compute absolute values of deflections at DbL and DbR.

Data collected after all of the second vertical load, Wc, is placed will be used by the scoring spreadsheet to compute absolute values of deflection at DcL.

Magnitude of W_b and W_c are determined at the beginning of the competition as described in paragraph 7.1.

The scoring spreadsheet computes aggregate deflection as the sum of DbL , DbR and DcL rounded to the nearest 0.01". If any measured deflection exceeds 2", the scoring spreadsheet will add penalties of \$4,000,000 to the Construction Economy score and \$10,000,000 to the Structural Efficiency score.

11.5.3 First Vertical Load Test

- (1) Initialize the sway measurement device.
- (2) Initialize the two deflections measuring devices at DbL and DbR , or record the initial readings. The initial readings must be recorded by both the team captain and a judge.
- (3) Competitors place the W_b load.
- (4) Record the final readings for DbL and DbR . The final readings must be recorded by both the team captain and a judge.

11.5.3 Second Vertical Load Test

- (1) Load W_b remains in place.
- (2) Do not initialize the sway measurement device or the two deflections measuring devices at DbL and DbR .
- (3) Initialize the deflection measuring device at DcL , or record the initial reading. The initial reading must be recorded by both the team captain and a judge.
- (4) Competitors place the W_c load.
- (5) Record the final readings for DcL . The final reading must be recorded by both the team captain and a judge.

If deflection data is lost or compromised, the judge will require the team to disassemble the bridge, repeat timed construction beginning with the initial conditions prescribed in 10.6 and redo lateral and vertical load tests. Compliance with specifications in section 8 and subsection 9.3 will not be checked again, but compliance with specifications in 9.4 and 9.5 will be verified. Scoring will be based on the run that results in the largest construction cost, C_c (not including load test penalties), but will not exceed 110% of C_c (not including load test penalties) for the initial run.

11.6 UNLOADING

Load W_c is removed before load W_b . If the bridge collapses during unloading (situation c, d, or e), it is not eligible for any points and awards in the structural efficiency and constructability categories.

Section 12 – EQUIPMENT PROVIDED BY HOST

Although the equipment described in this section (12) will be provided by the host committee, competitors should acquire similar equipment for load testing before the competition.

12.1 DECKING

Preferred decking is steel bar grating identified as W-19-4 (1" x $\frac{1}{8}$ "). The dimensions of a unit of grating are approximately 3'-6" x 3'-0" x 1" and the weight is approximately 50 pounds. However, the host may provide a different type of decking with approximately the same dimensions. Grating has significant bending strength only in the direction of the main bars, which are 3'-6" long. The grating will be installed with the main bars perpendicular to the length of the bridge, creating a roadway that is 3'-6" wide. Therefore, support for the grating is needed for the edges that are parallel to the length of the bridge but not for the edges that are perpendicular to the length.

12.2 SAFETY SUPPORTS

Safety supports must be used during load tests and are intended to limit the consequences of a bridge collapsing. Safety supports shall be of sufficient height, strength, number, and extent so that none of the load will fall more than approximately 5" if the bridge collapses. Safety supports may be steel, nested stacks of plastic buckets, timbers, sand bags, or masonry units.

12.3 LOAD

A total load of 2000 pounds should be supplied in uniform pieces of size and weight that can be handled safely. When in place, the load should not provide significant stiffness in the longitudinal direction of the bridge. The recommended load consists of 25-pound lengths of 5" x 5" x $\frac{5}{16}$ " steel angle placed perpendicularly to the length of the bridge. Sacks of material, containers of liquid, concrete blocks, or jacking systems could be used. Decking is not included as part of the 2000-pound load. If a jacking system is used, loading forces may be concentrated on the decking support surfaces nine inches in from each end of the decking locations.

12.4 TEMPLATE

A template as dimensioned in the Vehicle Clearance Template detail on Bridge Diagrams drawing. Plywood is recommended. Holes for handholds are helpful but optional.

Section 13 – INTERPRETATION OF RULES

Requests for Information (RFI) should be directed via e-mail to the Organizing Committee of the Canadian National Steel Bridge Competition at cnsbc.cncpa@gmail.com. Official responses will be posted to the CNSBC Facebook page. **The cut-off date for submitting a RFI is Friday, April 21, 2017.** Those received after this date will not be acknowledged or addressed. RFIs will be accumulated and published in RFI summaries by the CNSBC on or about December 1, 2016, and March 1, 2017. **Teams are strongly encouraged to contact the CNSBC to avoid misinterpretation of rules at the competition. All RFIs will be made public.**

The CNSBC has a Facebook Page (CNSBC-CNCPA) to post relevant information including RFI responses. Teams are also responsible for all information provided in the Rules, the general questions and answers posted to the Facebook Page, and information given at competitions from the date of the release of the information. This page is not intended for the submission of RFIs and any posted to the page will not be addressed by the CNSBC.

For the CNSBC to respond to the questions submitted via e-mail in a timely manner, indicate the section(s) being referenced in the “Subject” of the e-mail (for example, “Section 8.2.4 Loose and Welded Nuts”), provide the particular sentence or paragraph in question along with the question(s) being asked. Please be as specific as possible when providing the questions.

Section 14 – JUDGING

The CSCE Student Competition Committee will recruit judges. Judges are empowered to halt any activity that they deem to be hazardous. Judges have full authority over conduct of the competition and interpretation of the rules. Decisions, scoring, and ranking are the sole responsibility of the judges and will be final. The host student organization will assure that the judges are fully informed of the rules and procedures, and fully equipped for their tasks. More information for host organizations and judges will be available on a website, which will be available later this fall.

Section 15 – APPEALS

15.1 At the beginning of the competition each team will identify its captain. The committee will identify the head judge.

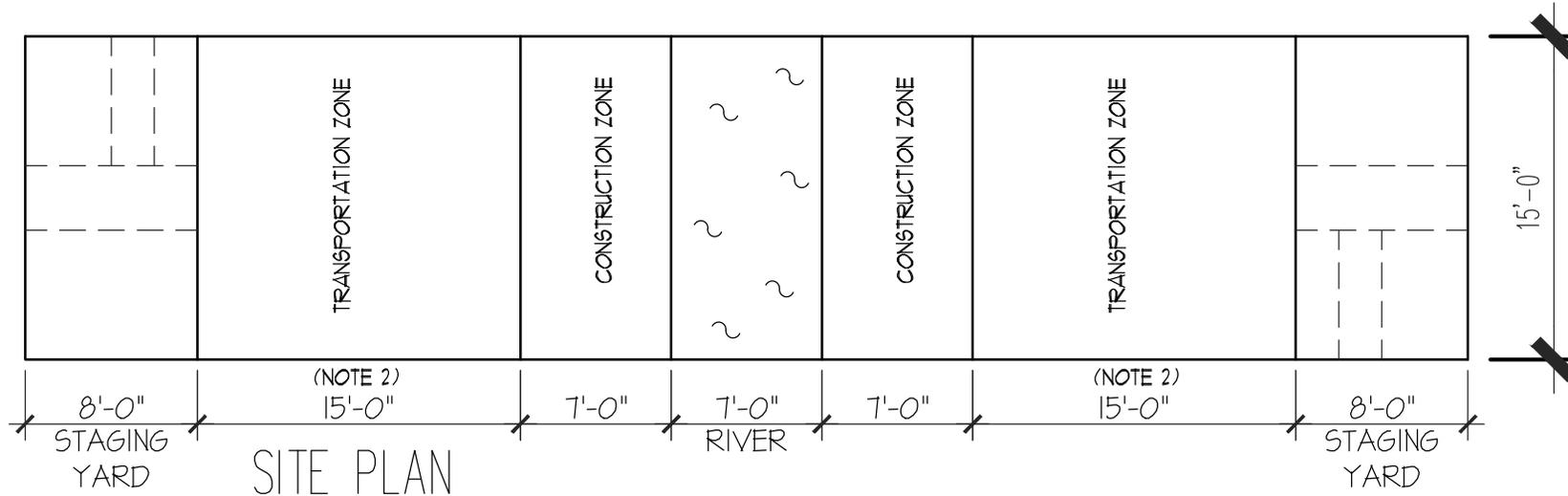
15.2 A penalty, decision, measurement, score, or condition of competition may be appealed only by a team captain and only to the head judge. The head judge will not hear the appeal if he or she is approached by students other than the team captain. The appeal must be made as soon as possible after the situation becomes apparent and before the conditions at issue are changed (e.g., by further construction, loading, or disassembly of the bridge). Judges will refuse to hear protests from a team concerning any bridge other than their own. The head judge will hear the appeal as soon as possible and will make a ruling. The conditions at the issue will not be changed during deliberation. Participants are reminded that civility and ethical behaviour are expected during the competition and particularly concerning appeals.

15.3 After hearing the head judge ruling, the team captain may request a five-minute recess to discuss the issue with the team. During the recess, the conditions at the issue will not be changed. Immediately after that recess, if the team has justification to contest the head judge ruling, the captain has the option to appeal that decision to the CNSBC rule's committee. The CNSBC rule's committee will hear the appeal as soon as possible and will make a ruling. The conditions at the issue will not be changed during deliberation.

15.5 The decision of the CNSBC rules committee is final; there are no further appeals. However, CNSBC rules committee welcome written suggestions for improving future competitions.

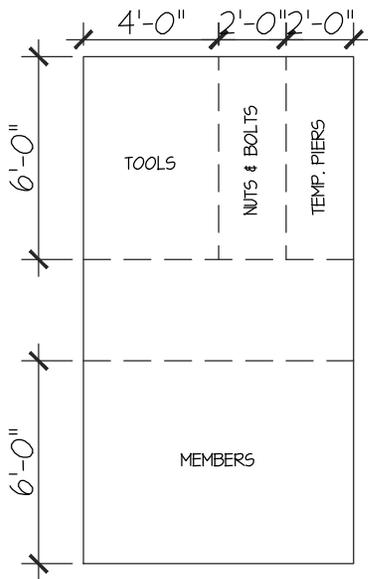
Section 16 – INDEX OF DEFINITIONS

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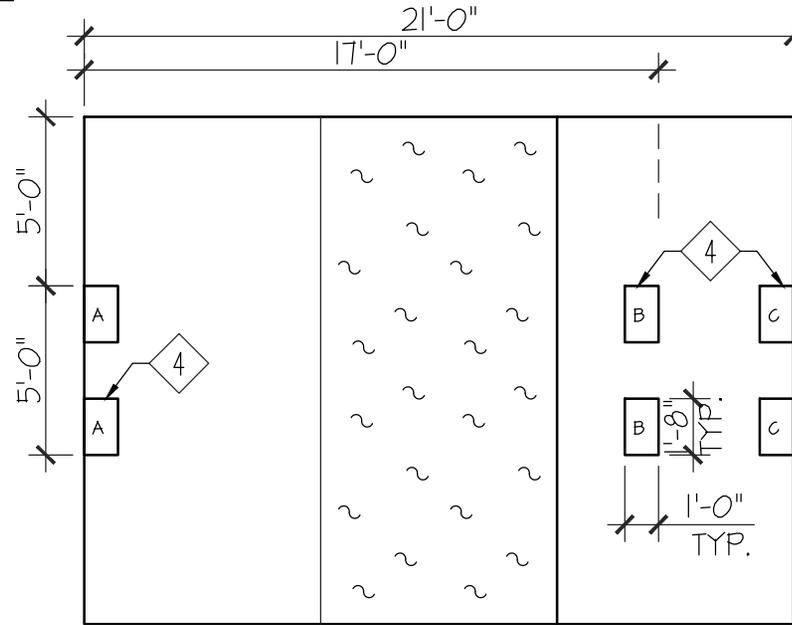
SITE PLAN

SCALE: _____ NTS



STAGING YARD DETAIL

SCALE: _____ NTS



CONSTRUCTION ZONE AND RIVER DETAIL

SCALE: _____ NTS

NOTES:

1. DRAWINGS ARE NOT TO SCALE.
2. DIMENSIONS THAT REFERENCE NOTE 2 MAY BE REDUCED TO FIT LOCAL CONDITIONS.
3. DIMENSIONS AND LAYOUT ARE IDENTICAL FOR STAGING YARDS AT BOTH ENDS.
4. DIMENSIONS AND SPACING ARE IDENTICAL FOR FOOTINGS A, B, AND C.

REV.	BY	DATE	APP.	REC. NO.	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY: F. HATFIELD
 DRAWN BY: D. SEPULVEDA
 CHECKED BY: RULES COMM.
 IN CHARGE: N. GAVLIN
 DATE: 08-10-2016

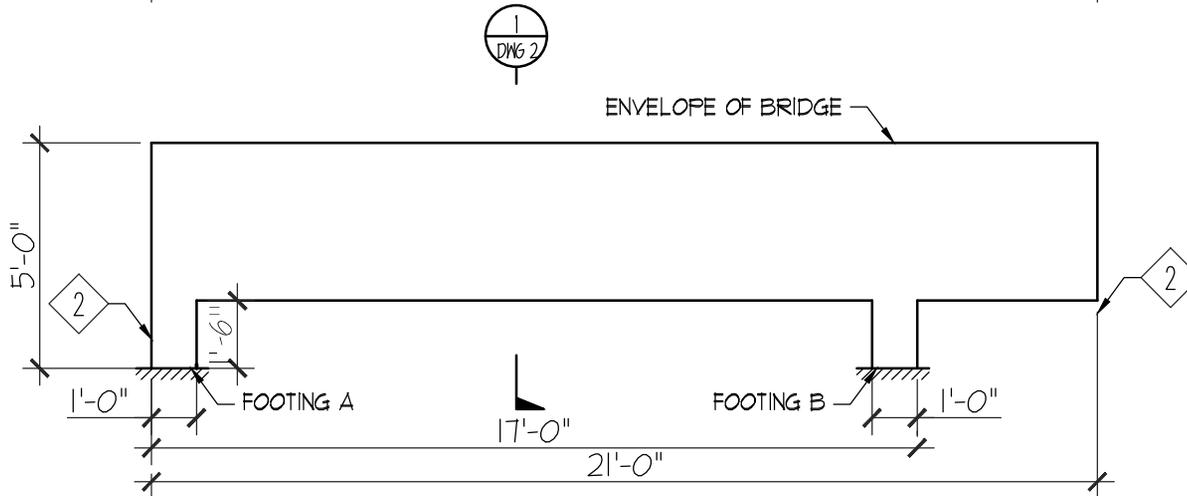
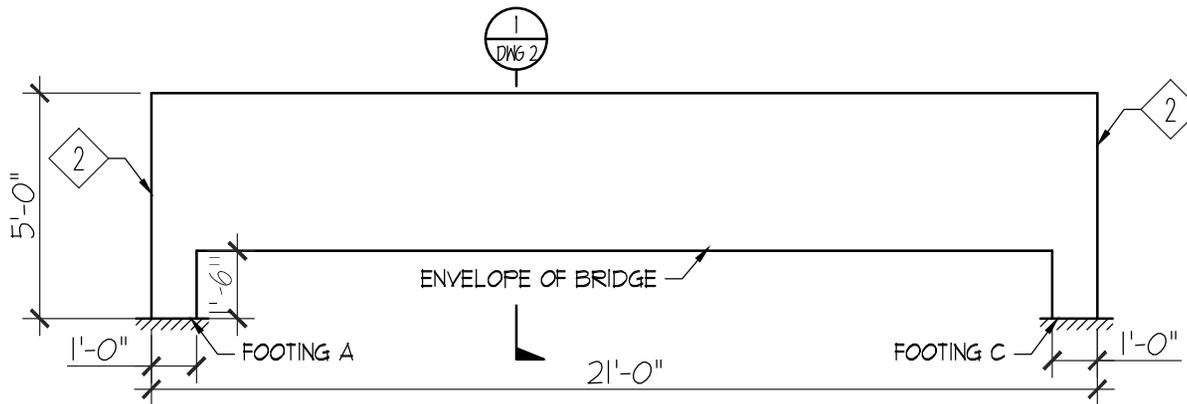


ASCE-AISC
 STUDENT STEEL BRIDGE CONTEST

SUBMITTED: _____
 APPROVED: _____

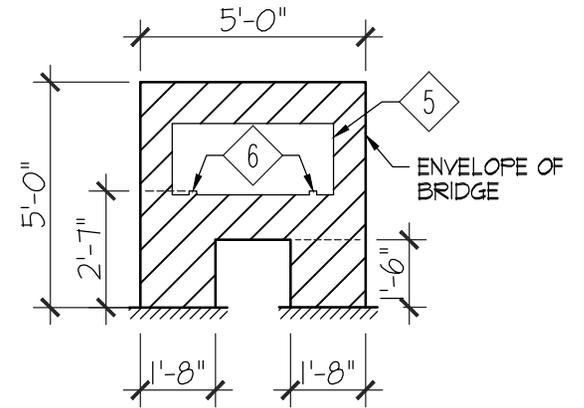
CONSTRUCTION SITE
 REFER TO SECTION 10

CONTACT NUMBER	
DRAWING NO.	DWG 1
SCALE	NTS
SHEET NO.	



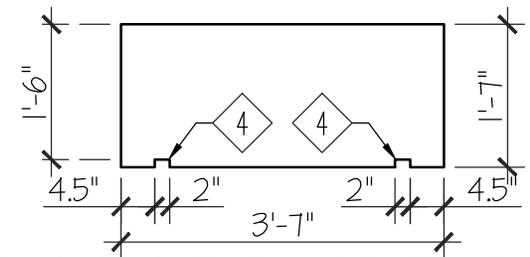
ALTERNATIVE PROFILES

SCALE: NTS



SECTION

SCALE: NTS



VEHICLE CLEARANCE TEMPLATE

SCALE: NTS

NOTES:

1. DRAWINGS ARE NOT TO SCALE.
2. NO PART OF THE BRIDGE SHALL EXTEND AWAY FROM THE RIVER BEYOND LIMITS OF CONSTRUCTION ZONES.
3. DECKING SUPPORT SURFACES SHALL BE AT LEAST 20 FT. LONG.
4. DECKING SUPPORT SURFACES SHALL CONTACT THE TOPS OF NOTCHES IN THE VEHICLE CLEARANCE TEMPLATE.
5. REFERENCE VEHICLE CLEARANCE TEMPLATE.
6. DECKING SUPPORT SURFACES.

REV.	BY	DATE	APP.	REC. NO.	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY
F. HATFIELD
DRAWN BY
D. SEPULVEDA
CHECKED BY
RULES COMM.
IN CHARGE
N. GAVLIN
DATE
08-10-2016

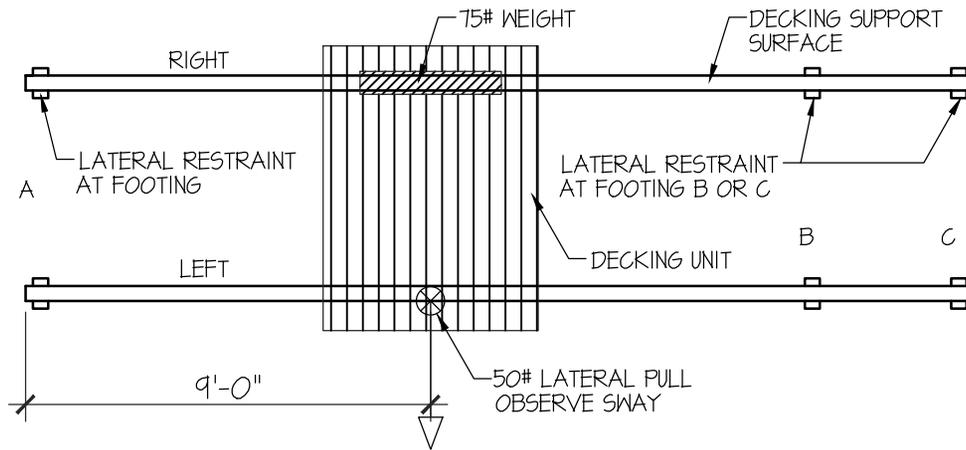


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APPROVED _____

BRIDGE DIAGRAMS
REFER TO SECTION 9

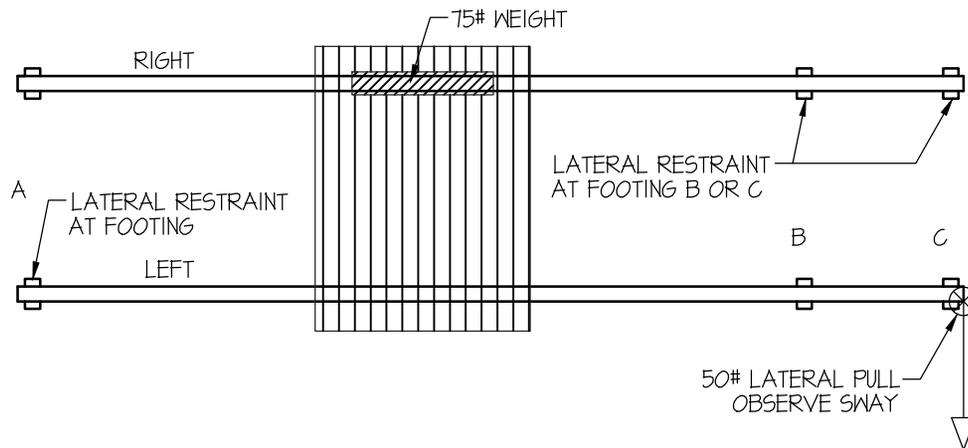
CONTACT NUMBER
DRAWING NO. DWG 2
SCALE NTS
SHEET NO.



FIRST LATERAL LOAD TEST

SCALE:

NTS



SECOND LATERAL LOAD TEST

SCALE:

NTS

LATERAL LOADING NOTES:

1. DRAWINGS ARE NOT TO SCALE.
2. A, B, AND C DESIGNATE FOOTINGS (10.1.8); A & C ALSO DESIGNATE ENDS OF THE BRIDGE.
3. "LEFT" AND "RIGHT" SIDES ARE DETERMINED RANDOMLY (7.1.(7)). EACH MEASUREMENT LOCATION, LATERAL RESTRAINT, LATERAL PULL, AND 75 LB. WEIGHT IS SPECIFIC TO A LEFT OR RIGHT SIDE.
4. LATERAL RESTRAINT IS PROVIDED BY TEAMS AND APPLIED CLOSE TO GROUND.
5. LATERAL RESTRAINT IS APPLIED AT BASE OF ABUTMENTS AT ONE EACH OF DECLARED FOOTINGS A AND B, OR AT ONE EACH OF DECLARED FOOTINGS A AND C.
6. IF THE PULL OR OBSERVATION POINT FOR THE SECOND LATERAL LOAD TEST CANNOT BE LOCATED AS SHOWN, IT MAY BE SHIFTED LATERALLY.

- ⊕ LOCATION OF DEFLECTION MEASUREMENT
 ⊗ LOCATION OF SWAY MEASUREMENT

REV.	BY	DATE	APP.	REC. NO.	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY F. HATFIELD
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 IN CHARGE N. GAVLIN
 DATE 08-10-2016

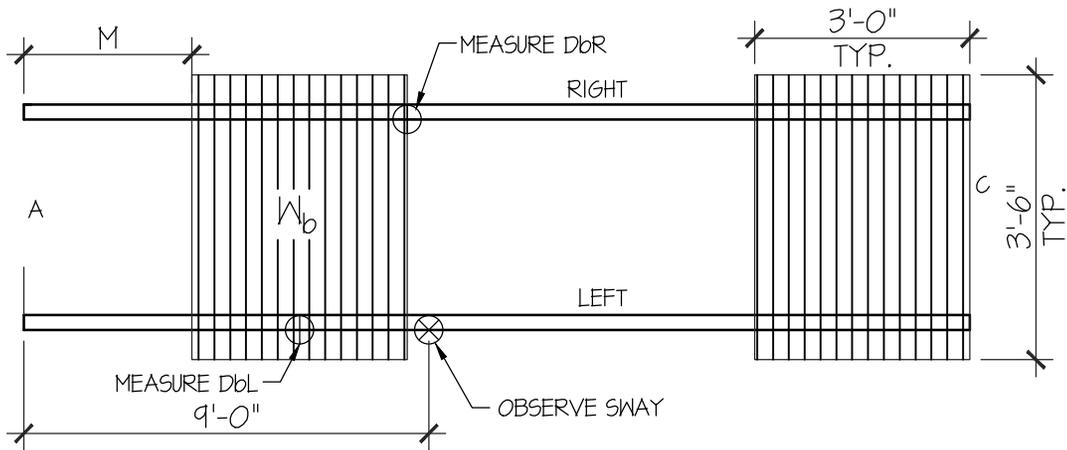


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 STUDENT STEEL BRIDGE CONTEST

SUBMITTED _____
 APPROVED _____

LATERAL LOADING PLANS
 REFER TO SECTION 11.4

CONTACT NUMBER _____
 DRAWING NO. DWG 3
 SCALE NTS
 SHEET NO. _____



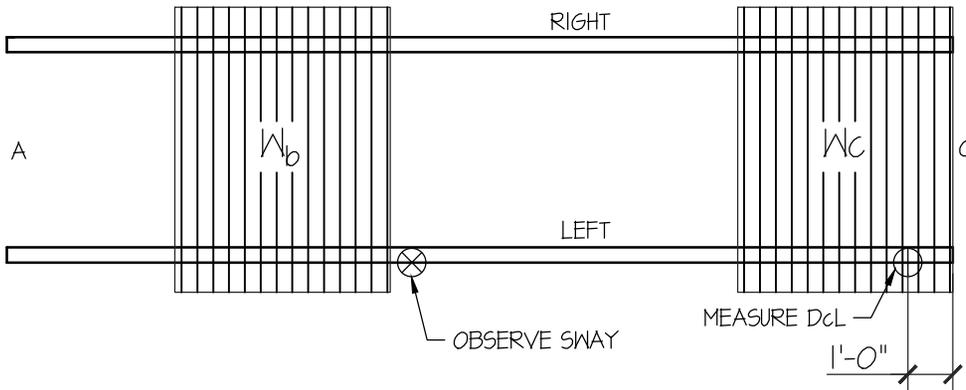
FIRST VERTICAL LOAD TEST

SCALE:

NTS

VERTICAL LOADING NOTES:

1. DRAWINGS ARE NOT TO SCALE.
2. A, B, AND C DESIGNATE FOOTINGS (10.1.8); A & C ALSO DESIGNATE ENDS OF THE BRIDGE.
3. "LEFT" AND "RIGHT" SIDES ARE DETERMINED RANDOMLY (7.1(7)). EACH MEASUREMENT LOCATION IS SPECIFIC TO A LEFT OR RIGHT SIDE.
4. SAFETY SUPPORTS ARE REQUIRED UNDER BOTH DECKING UNITS AT ALL TIMES DURING VERTICAL LOAD TEST.
5. LOADS W_b AND W_c , AND DIMENSION M ARE DETERMINED RANDOMLY (7.1(6)).
6. THE W_c LOAD IS NOT IN PLACE DURING THE FIRST VERTICAL LOAD TEST.
7. W_b REMAINS IN PLACE WHILE W_c IS BEING PLACED DURING THE SECOND VERTICAL LOAD TEST.
8. REFER TO SPECIFICATION 11.5.1.3 FOR LOCATIONS OF DEFLECTION MEASUREMENTS.



SECOND VERTICAL LOAD TEST

SCALE:

NTS

- ⊕ LOCATION OF DEFLECTION MEASUREMENT
- ⊗ LOCATION OF SWAY MEASUREMENT

REV.	BY	DATE	APP.	REC. NO.	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY F. HATFIELD
 DRAWN BY D. SEPULVEDA
 CHECKED BY RULES COMM.
 IN CHARGE N. GAVLIN
 DATE 08-10-2016



ASCE-AISC
 STUDENT STEEL BRIDGE CONTEST

SUBMITTED _____
 APPROVED _____

VERTICAL LOADING PLANS
 REFER TO SECTION 11.5

CONTACT NUMBER _____
 DRAWING NO. DWG 4
 SCALE NTS
 SHEET NO. _____