**2020 Steel Bridge Competition Simplified Rules**

https://www.aisc.org/globalassets/aisc/university-programs/ssbc/ssbc-2019-rules.pdf

**Overall Goal**

To design and fabricate a ~20 foot, tenth scale bridge out of smaller steel members, connected by nuts and bolts, that can support 2,500 lbs and be assembled quickly.

**Major Rule Changes**

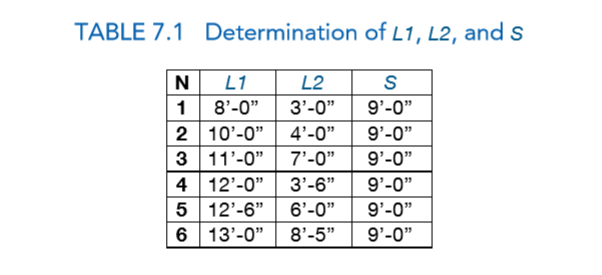
* Power tools are allowed
* Temporary piers are not allowed
* Deflection is emphasized more (see cost calculations below)
* Builders now cost $70,000 per builder
* Hidden Bolts are now an automatic Disqualification
* Weight Restrictions are more lenient

**Categories of Competition**

* Display
  + Appearance of the bridge, including balance, proportion, elegance, and finish. Quality of fabrication, including welding, shall not be considered because some bridges may be fabricated professionally rather than by students
  + A poster describing the design is also required. The poster shall present information specified in the official rules
  + Display is the tiebreaker for all categories of competition. Judges shall not declare ties in display.
* 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).
* Lightness
  + The bridge with the least total weight will win in the lightness category.
    - Total weight is measured weight plus weight penalties prescribed in 8.2, 9.3, 9.5, and 10.4.2. Measured weight is the weight of the bridge as determined by scales provided by the host student chapter. Decking, tools, lateral restraint devices, and posters are not included in measured or total weight.
* 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.
* Construction Economy
  + The bridge with the lowest construction cost Cc will win in the construction economy category. Construction cost is computed as
    - Cc = Construction time (minutes) x number of builders (persons) x 70,000 ($/person-minute) + (Total time - Construction time) x 240,000 ($/minute) + load test penalties ($).
* Structural Efficiency
  + The bridge with the lowest structural cost Cs will win in the structural efficiency category. Structural cost is computed as
  + If measured weight does not exceed 175 pounds,
    - Cs = (Total weight – measured weight) (pounds) x 5000 ($/pound) + Aggregate deflection (inches) x 3,150,000 ($/inch) + Load test penalties ($).
  + If measured weight exceeds 175 pounds but does not exceed 300 pounds,
    - Cs = (Measured weight – 175) (pounds) x 8,000 ($/pound) + (Total weight - Measured weight) (pounds) x 5,000 ($/pound) + Aggregate deflection (inches) x 3,150,000 ($/inch) + Load test penalties ($).
  + If measured weight exceeds 300 pounds,
    - Cs = (Total weight – 237.5) (pounds) x 16,000 ($/pound) + (Total weight - Measured weight) (pounds) x 5,000 ($/pound) + Aggregate deflection (inches) x 3,150,000 ($/inch) + Load test penalties ($).
  + “Measured weight” and “total weight” are defined in 6.2.3, and “aggregate deflection” is defined in 11.5.2, which also prescribes “load test penalties.”
* Overall Performance
  + The overall performance rating of a bridge is the sum of construction cost Cc and structural cost Cs. The bridge achieving the lowest value of this total wins the overall competition.

**Load Determination**

* Immediately before timed construction of the first bridge, the head judge rolls a die to determine the locations of decking units. These designations will guide load tests as described in 11.4.1, 11.5.1, and the Load Test Diagrams. For each possible result S of the roll, Table 7.1 gives the dimensions for positioning decking units.



* The same values of L1 and L2 will be used for all bridges in the same Regional Event. The east end is determined individually for each bridge after construction by a randomizing process (e.g., coin flip)

**Material and Component Specifications**

* Steel is defined as an iron alloy that is strongly attracted to the magnet provided by the host chapter. Some grades of steel are not magnetically attractive. All parts of the bridge must be made out of magnetic steel.
* A bridge shall be constructed only of members, loose bolts, and nuts. Solder, brazing, and adhesives are not permitted. Except for in the case of purely decorative items.
* Parts of a member are welded together. Bolts and nuts that are welded to a member are threaded parts that are considered part of that member and are not considered to be loose bolts and loose nuts.
* A member shall not exceed overall dimensions of 3’6” x 6” x 4”. That is, it shall fit into a right rectangular prism (i.e., box) of those dimensions.

**Structural Specifications**

* The bridge shall have exactly two straight stringers, each of which is contiguous over its full length so that decking could be placed on the tops of the stringers anywhere along the span.
  + The bridge shall provide access for safely placing 3’-6” wide decking and load along any point between the interior most footings of the bridge.
  + 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
  + Decking support surfaces shall be free of holes, splits, separations, protrusions, and abrupt changes in elevation or slope.
* The bridge shall not extend more than 5’0” above the ground or river.
* The bridge shall not be wider than 5’0” at any location along the span.
* The tops of the stringers shall be no more than 1’-11” and no less than 1’-7” above the surface of the river or ground at any location along the span.
* Each stringer shall be at least 20’ feet long, measured along the top.
* Each individual member shall be connected to each member that it touches by at least one loose bolt or externally threaded part of a member secured by a loose or welded nut so that those connected members cannot be separated without first unscrewing and removing the loose bolt or externally threaded member that connects them, or without first unscrewing and removing the 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.

**Construction Regulations**

* There shall be no more than six builders.
* Builders shall wear proper personal protective equipment at all times
* A tool or unassembled part of a tool must not weigh more than twenty pounds and shall fit within a right rectangular prism (i.e., box ) of dimensions of 3'-6” x 6” x 4”. Welding machines and tools requiring external power connections shall not be used during timed construction. Tools powered by batteries or other internal energy supplies are acceptable.
* Containers of lubricant shall not be in the construction site at any time.
* A builder shall not cross from the ground on one bank of the river to the ground on the other bank.
* Every member, loose nut, loose bolt, and tool must be in contact with the ground and must fit entirely within the assigned area of a staging yard as designated on the Staging Yard detail on the Site Diagram.

**Load Test Instructions**

* Judges shall continuously observe sway carefully during vertical load testing. If sway exceeds one inch, loading shall cease and load shall be removed carefully.
* Judges shall continuously observe deflections carefully. If any deflection exceeds three inches downward, loading shall cease and load shall be removed carefully.
* Lateral Load Test
  + A fifty-pound lateral load is applied and sway is measured on the right side of the bridge, centered on the decking unit positioned at S. Lateral load is applied at the level of the decking or top of the stringer, which is the bottom of the decking. The sway measurement is made as close as possible to the location of the lateral load.
* Vertical Load Test
  + The crew distributes 100 pounds of preload on the decking unit positioned at L1 and 100 pounds of preload on the decking unit positioned at L2. The preload is distributed uniformly, centered laterally on the decking unit, and positioned identically for each bridge.
  + The load test crew shall consist of no more than four students
  + Initialize the sway measurement device.
  + Initialize the two deflection measuring devices at D1 and D2, or record the initial readings.
  + The crew places 1400 pounds of additional load on the decking unit at L1.
  + The crew places 900 pounds of additional load on the decking unit at L2.
  + Record the final readings for D1 and D2.

