Timber Strong Design Build

PSWC18

Timber Strong Design-Build Competition

Pacific Southwest Conference 2018

1.0 Event Description

The American Wood Council, Simpson Strong-Tie Company Inc. and Binational Softwood Lumber Council are interested in creating a new subdivision of sustainable, wood framed buildings within the city of Tempe, Arizona. The city continues to witness a growth in population size which increases the demand for housing and non-residential buildings. While other natural resources are rapidly depleting due to this demand, wood is the only building material that grows naturally and is 100% renewable and outperforms other building materials in overall carbon footprint reduction As a result, the American Wood Council, Simpson Strong-Tie Company Inc. and Binational Softwood Lumber Board are seeking proposals and prototypes for a building design that is sustainable, structurally durable, and efficient.

2.0 Objective

The Timber Strong Design-Build Competition enables students to gain experience in performing crucial aspects of common Civil Engineering design and practice. Participating students will learn about the processes involved in professionally designing and proposing a project bid. Students will also gain exposure to the management and building practices used in construction environments. Through preparation of a project bid, the performance of analysis, and management of the construction process, each team is expected to act as a design construction firm while competing in a friendly environment. It is the goal of this competition to provide unique insight and hands-on experience for the next generation of sustainable design and construction engineers.

3.0 Participant Rules

- Each University may enter only one team.
    - In the interest of collaboration, Universities with NCSEA and ASCE Chapters are encouraged to combine into one team
- Teams may consist of 4-6 members. One of the members must be known as the Team Captain.
- Everyone on the team must be a registered participant of PSWC 2018.
- The team must have at least one underclassman.
- The team must have at least one female.

4.0 Project Scope and Milestones

Scope:
Each of the Universities within the Pacific Southwest Region will be prompted to develop a wood framed structure scaled within a 4’ x 6’ x 6’ box (W x L x H). Throughout the design process, the teams will be required to create a preliminary design and final bid report. Additionally, each team will be required to discuss the integration of sustainable systems within the design of their model structure, such as rainwater capture systems or solar paneling on the rooftops, which must be discussed in the sustainability section of their report.

Each team will be required to erect and construct the structural wood frame and walls on site at conference. Each team will conclude with a display board presentation lasting 10 minutes. The PSWC 2018 hosts will provide you with a link to a Google Drive Folder where you must submit pictures and/or videos of your design and building process. This may include practices, meetings, as well as event photos and videos of the competition itself. If your folder does not have any pictures and/or videos by 11:59 pm on April 13, 2018 (the day of the Timber Strong Design-Build competition) you will be disqualified from the competition.

Milestones:

- Report: March 15
- Display Board (at competition): April 13
- Google Folder with at least 1 photo or video: April 13, 11:59 pm

5.0 Construction

Each team will construct their proposed single family house or non-residential building as per the design shown on their submitted plan set. Teams that do not construct the structures to the specifications outlined within their submitted plan sets and reports will be subject to a scoring penalization, please see section 7.0 Scoring for more information. All structural members, wall, and roof elements are allowed to be fabricated prior to the competition date, however the structure is to be constructed onsite during the competition, please see section 8.0 Materials for more information. This aspect of the competition will be judged based on the time of the construction build and materials cost. Material costs will be graded with respect to the provided receipts as discussed within the Budgets Section. Without proof of receipts the cost calculated will not be accepted. Please refer to the Scoring Section for any other scoring concerns.

Each team is responsible for removal of all material used for the project after the competition. Potential reuse or recycling of the project materials should be determined prior to the competition and included on the display board. One possible solution is to donate salvageable

materials to Habitat for Humanity or another charitable organization. Other options for wood products are available at: http://reusewood.org/.

5.1 Site Constraints

All teams will be provided with a 15’ x 15’ area to construct their structure as defined by clearly placed lines on the floor. The site limits will be measured from the inside of the boundary marker. Neither materials nor participants may exceed the boundaries of the area during the construction process. All sites will be located on level concrete or another hard surface.

5.2 Time Constraints

The construction process will be timed for each team. A maximum of **two hours** will be allotted for each team’s construction period. Upon completion of the assembly of a team’s structure, all team members must exit the site before the timer is officially stopped. Team members will receive a penalty for exiting the site prior to completion of the structure, see section 7 Scoring for more details.

5.3 Design Constraints

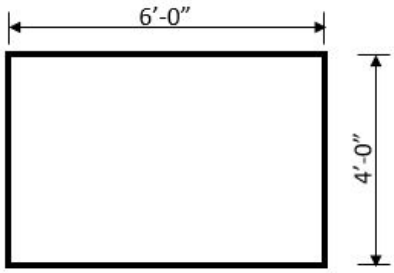
All constructed and proposed structures are not to surpass the 4’ x 6’ x 6’ dimensions. Teams may pre-mark, pre-assemble, pre-cut, and tamper with all exterior members, sustainable systems, façades, etc. Each team’s building must comply with the following rules:

1. Design and build a structurally efficient building system using **only** wood products except for fasteners/connectors.
2. One-story structure needs to include:
    a. Roof system: ridge board/beam that spans the 6’ length of the building and cantilevers 4ft. The slope of the roof shall be determined by the team. However, the overall height may not exceed the 6’-0” max.
    b. Framed openings: **three** 12” x 12” windows and **one** 24” (width) x 48” (height) door. The windows may be located anywhere, but the door must be on one of the longitudinal elevations. (See diagram).
3. Structural Durability-Lateral Load:
    a. The structure shall be designed and analyzed in the report to resist an applied lateral wind load of 350 pounds per linear foot (plf) at the roof in both directions (not simultaneously).
    b. Using the wind Allowable Stress Design (ASD) capacities, the diaphragm and shear walls shall be based on the 2015 Special Design Provisions for

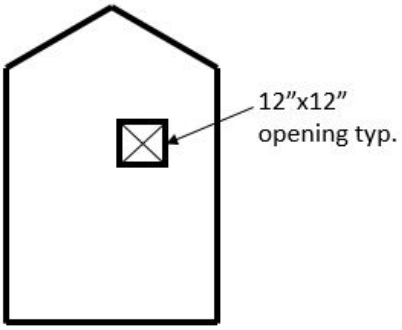
Wind and Seismic standards. Link:
http://awc.org/codes-standards/publications/sdpws-2015

c. It is assumed that the structure will be connected to a foundation with typical anchor bolts and SST holdowns.

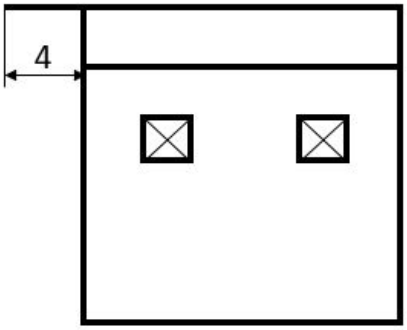
4. Structural Durability-Vertical Load
    a. A vertical point load of 135 pounds will be applied at the end of the cantilever roof beam at the competition via buckets filled with sand.
    b. In the design report, the teams will calculate the deflection assuming all applicable adjustment factors are equal to 1.0. This predicted deflection from the report will be compared to the actual deflection measured at the competition.
    c. Beam deflection, once loaded, must be less than 0.50”.
    d. The building will be disqualified if the deflection is greater than 1” or if the structure fails.



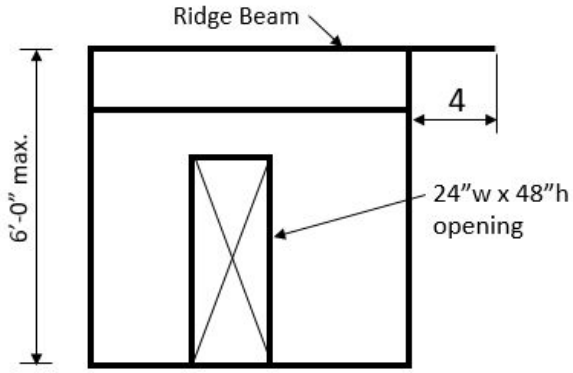
Plan View



Transverse Elevation



Longitudinal Elevation



Longitudinal Elevation

No Scale

6.0 Report and Display Board

Each team's report must include:

1. Table of Contents
2. Carbon Footprint calculations
    a. Determine the amount of carbon stored in the one-story structure using the WoodWorks Carbon Calculator tool. Link: http://www.woodworks.org/carbon-calculator-download-form/
3. Itemized list of cost of materials and scanned receipts
    a. If materials were donated, obtain an estimated cost from the donor
4. Calculations of the entire weight of the structure
5. Structural hand calculations. Must include the following:
    a. Lateral Design
        i. Roof diaphragm design (in-plane shear only)
        ii. Shear wall design (in-plane shear only)
        iii. Factor of safety for the diaphragm and shear walls (rations of allowable/actual)
    b. Vertical Design
        i. Design of ridge beam
        ii. Deflection of cantilever
        iii. Max load the roof should be able to hold/support within the 0.5 inch constraint

Each team's display board must follow these criteria:

1. Foam-core base
2. 30" tall x 40" wide

On the board:

1. Drawings, graphics, text, photographs, etc that summarize and illustrate the significant aspects of the project

7.0 Scoring

Scoring will be based on the team's report and construction of their building. There is total of 100 points possible. In the instance of a tie, the teams involved will receive the same place and score. For example, if two teams tie for second place in build time, both will receive 20 points.

Strength and Durability Analysis in Paper: 30 points
Points will be awarded for the most durable structure based on the performance to withstand the wind lateral and vertical loads, as well as the structural efficiency of the overall structure.
Factor of Safety 15 points
Points will be rewarded based on the ratio of the factor of safety of the lateral design in the report over the calculated weight of the structure.

- 15 points for the lowest ratio of factor of safety to weight
- 10 points for the second lowest lowest ratio of factor of safety to weight
- 5 points for the third lowest ratio of factor of safety to weight

Deflection 15 points
Points will be awarded based on ratio of predicted deflection from the report to actual deflection measured in competition.

- 15 points for the ratio of the predicted deflection to actual deflection closest to 1.0
- 10 points for the ratio of the predicted deflection to actual deflection second closest to 1.0
- 5 points for the ratio of the predicted deflection to actual deflection third closest to 1.0

Sustainability: 15 points
Points will be awarded for the most sustainable structure based on the submitted LCA and carbon sequestration reports.

- 15 points for the lowest carbon footprint as determined by the WoodWorks Carbon Calculator tool.
- 10 points for the second lowest carbon footprint as determined by the WoodWorks Carbon Calculator tool.
- 5 points for the third lowest carbon footprint as determined by the WoodWorks Carbon Calculator tool.

Construction: 30 points
Points will be awarded based on the time of the construction build and materials cost.

Time: 15 points
Time will begin being recorded after the builders have laid out their materials, hold their hands above their heads and the captain states that they are ready to begin.

- 15 points for the fastest recorded build time
- 10 points for the second fastest recorded build time
- 5 points for the third fastest recorded build time

Materials Cost: 15 points
Material costs will be graded with respect to the provided receipts as discussed within the Budgets Section. Without proof of receipts the cost calculated will not be accepted.

- 15 points for the lowest cost of materials
- 10 points for the second lowest cost of materials
- 5 points for the third lowest cost of materials

Display Board: 15 points
Points will be awarded for the content and presentation of the display board

- 5 points for all required elements present on the display board and meeting the size criteria
- 5 points for a board that is well-organized and clearly communicates the design and sustainability considerations
- 5 points for a presentation that is complete and thorough
    - 2 points will be deducted for exceeding the 10 minute time limit

Creativity/Aesthetics: 10 points
Points will be awarded for the most creative and aesthetically pleasing structure. Both judges and PSWC 2018 attendees will cast votes.

- 10 points for first place with the highest number of votes
- 5 points for second place with the second highest number of votes

Building Process and Deflection

- 5 points will be deducted for each instance that tools or builders are out of bounds
- 5 points will be deducted if the beam deflection is greater than 0.5 inches but less than 1.0 inches.

8.0 Materials

Each team may use structural wood and connectors, of any type, to design and build their scaled structure.

All supplies to construct the structure shall be provided by each university team.
NOTE: Simpson Strong-Tie will donate connectors and fasteners, see section 9.0 Budget for more information.

9.0 Budget

Each team will provide a budget based on the receipts for the materials used to design their structure. This should be an itemized list of the cost of materials. If materials were donated, obtain an estimated cost from the donor. Each participating university has the option to use an allotment of Simpson Strong-Tie products (total maximum retail value of $200.00) that they may order using the provided spreadsheet to be posted on the PSWC 2018 website.

Additionally, the Binational Softwood Lumber Council is offering a stipend of up to $200.00 to offset the costs of travel and materials per school to encourage participation. In order to request the stipend complete the provided form to be posted on the PSWC 2018 website.

10.0 Additional Information

- Teams may submit questions as explained through the “FAQ” page of the www.pswc2018.com website.
- Team captains’ will meet the evening before the competition where they can also ask questions.
- All electronic entries/pictures and videos entries shall become the sole property of the sponsors: Simpson Strong-Tie, Binational Softwood Lumber Council, American Wood Council and reThink Wood reserve the right to use or publish some or the entire entry material in publications. By entering, the Entrant grants a royalty-free license to Simpson Strong-Tie, Binational Softwood Lumber Board, American Wood Council and reThink Wood to use any material submitted. Such right includes publication of photographs and names of award recipients without compensation to Entrants.