



Timber-Strong Design BuildSM Competition

This document, which is available at <https://pswc2019.weebly.com/>, describes the Student Timber-Strong Design BuildSM Competition and states the 2019 rules for the conference. Clarifications, which include any revisions to the rules, are published at that web site and do not appear in this document although they are formal addenda to the rules. The web site includes the form for requesting clarifications and other information. Information at the web site takes priority over any other source except as herein noted.

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WELCOME

American Wood Council, Simpson Strong-Tie, APA – The Engineered Wood Association and the American Society of Civil Engineers support and encourage the equitable opportunity for participation in the Student Timber-Strong Design BuildSM (TSDBSM) Competition by all interested and eligible individuals without regard to race, ethnicity, religion, age, gender, sexual orientation, nationality, or physical challenges. Participation should be inclusive, open, and fair to all interested and eligible students.

Welcome!

Last Year's Competition



Timber-Strong Design BuildSM

Competition

Pacific Southwest Conference 2019

1.0 Event Description

The American Wood Council (AWC), Simpson Strong-Tie Company Inc. (SST) and APA – The Engineered Wood Association (APA) are interested in developing a concept for a new subdivision of sustainable, light-framed wood student houses within the city of San Luis Obispo, California. The city continues to witness population growth which increases demand for housing. While other natural resources are rapidly depleting due to this demand, wood is the only building material that grows naturally, is 100% renewable, and outperforms other building materials in overall carbon footprint reduction. As a result, AWC, SST and APA are seeking proposals and prototypes for a student house that is sustainable, structurally durable, and efficient.

2.0 Objective

The 2019 Timber-Strong Design BuildSM (TSDBSM) 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, which must be unique and not a replication of a previous year's design. 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 structural engineers involved in sustainable design and construction.

3.0 Participant Rules

- Maximum of 20 teams may participate.
- Each University may enter only one team per department (max. two teams per University)

- In the interest of collaboration, universities with American Society of Civil Engineers (ASCE) Student Chapters are encouraged to combine into one team
- ASCE Architectural Engineering Institute (ASCE/AEI) Student Chapters are encouraged to participate.
- All team members must be a registered participant of PSWC 2019
- Teams shall consist of a minimum of 4 engineering students.
- 4-6 members shall be designated as “builders”.
- The members designated as “builders” may not change once the team is on the jobsite.
- One builder of the team must be identified as the Team Captain.
- The team must have at least one underclassman.
- The team must have at least one male and one female.
- The team members shall not vary throughout the competition. In other words, the team members that start the competition will be the same team members that complete all portions of the competition.
- The team must have a least one faculty advisor.

4.0 Safety

Safety is the highest priority; activities that risk personal injury will not be tolerated. PSWC Safety Officials may use their own discretion on determining a hazardous condition and provide suggestions for correcting the issue. If a team member cannot compete safely, they will be disqualified. The remaining team members may continue with the competition if the number of team members does not drop below 4 builders. PSWC Safety Officials may take action which results in withdrawal of a building from competition for safety violations if they are not corrected once brought to the attention of the team. Judges are empowered to halt and prohibit any activity that PSWC Safety Officials deem hazardous. If the structure being built is deemed by PSWC Safety Officials to be unsafe to participants, judges or spectators, it must be withdrawn from competition.

Students shall practice safe fabrication procedures and seek appropriate instruction and supervision (see Section 9.0). General construction safety standards for activities during this competition shall follow the standards set forth in OSHA Regulation Standards Number 1926. The following are the URL addresses to the OSHA Standards 1926:

<https://www.osha.gov/laws-regs/regulations/standardnumber/1926>

and CAL/OSHA Title 8 of the California Code of Regulations (T8 CCR)

<https://www.dir.ca.gov/samples/search/query.htm>

related to construction industry (Pocket Guide For the Construction Industry may be found at https://www.dir.ca.gov/dosh/dosh_publications/constguideonline.pdf).

Student teams are solely responsible to follow the safety standards.

5.0 Project Scope and Milestones

Scope:

Each of the Universities within the Pacific Southwest Region are invited to structurally design and construct a light-framed wood structure. Throughout the design process, teams are required to create a preliminary design and a final bid report.

Each team is required to construct the wood structure which was designed in the team report at the “construction site”. Each team will conclude with a display board presentation (see Section 8.0).

The PSWC 2019 hosts will provide each team captain with a link to a Google Drive Folder where the report, pictures and videos of the team’s design and building process, and the team presentation must be uploaded. To gain access to this folder, each team Captain must send an email to pswc2019@gmail.com with [Timber-Strong Design BuildSM Folder request] in the email title. The folder may include practices, meetings, etc. as well as photos and/or videos of the competition itself. All teams must have photos and/or videos in the folder before 4:30 pm pacific time on April 6, 2019 (the day of the Timber-Strong Design BuildSM competition) or the team will be disqualified.

Milestones:

- March 15, 2019 - Report
- March 15, 2019 - Requests for SST connectors and fasteners
- March 15, 2019 - Requests for stipends
- April 5, 2019, 7:00pm pacific time - Captain’s meeting:
- April 6, 2019 - Display Board & Presentation after each build session
- April 6, 2019 - Construction of Structure:
- April 6, 2019, 4:30 pm pacific time - Google Folder with at least 1 photo and video of presentation:

6.0 Structural Design

Each team will design the structure for both lateral and vertical loads as follows.

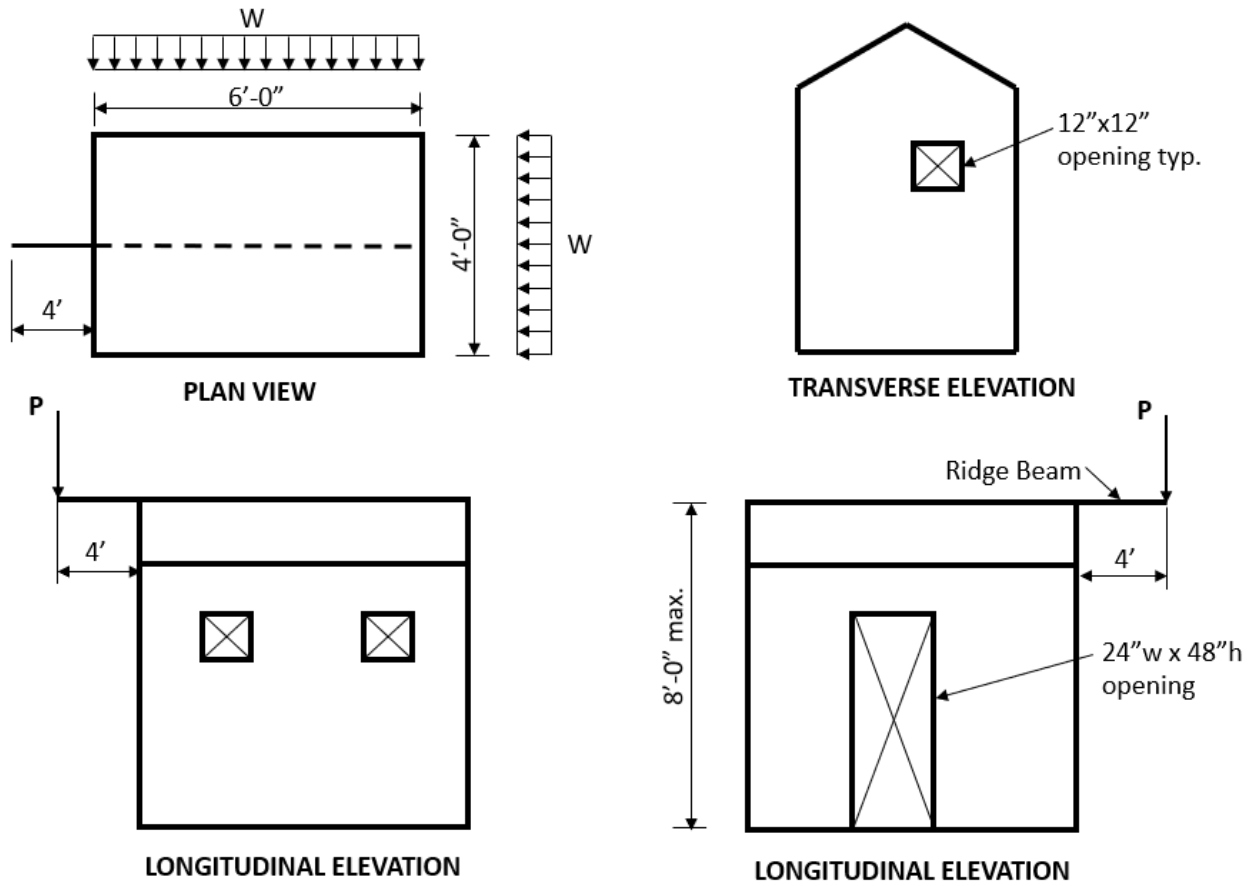
6.1 Structural Durability-Lateral Load:

- a. The structure shall be designed and analyzed to resist an applied lateral seismic load of $W = 350$ 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 standard. Link: <http://awc.org/codes-standards/publications/sdpws-2015>
- c. Assume that the structure will be connected to a foundation with typical anchor bolts and SST hold-downs.

6.2 Structural Durability-Vertical Load

- d. A vertical point load of 135 pounds will be applied at the end of the cantilever roof beam after the construction phase via steel chain and iron weights to perform the beam deflection test. Deflection will be measured at the loading point.
- e. In the design report, teams shall calculate the predicted 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.
- f. Beam deflection, once loaded, must at least .5" and not great than 1".

The demand (load) on the structural shall not exceed the capacity (resistance) of the structure.



No Scale

Figure 1.

7.0 Report and Display Board

7.1 Report

Each team's report must include:

1. Table of Contents
2. All team member names and email address. Additionally, identify the 4-6 members who are designated at the "builders".
3. Carbon Footprint calculations
 - a. Analyze the carbon footprint for 10x the building's structural framing volume to simulate an actual full-size building. Determine the amount of carbon stored in the single-story structure using the WoodWorks Carbon Calculator tool found at <http://www.woodworks.org/carbon-calculator-download-form/>
 - b. All input and output shall be provided.
4. Itemized list of materials including costs and scanned receipts
5. Calculations of the entire weight of the structure
6. Legible structural HAND calculations (non-computer analyzed). Must include the following:
 - a. Lateral Design
 - i. Roof diaphragm design (in-plane shear only)
 - ii. Shear wall design (in-plane shear only)
 - iii. Anchorage to the foundation that includes anchor bolt and SST hold-downs to resist in-plane shear and overturning. NOTE: structures are not allowed to be anchored to the job site area and it is the team's responsibility to provide adequate measures to resist overturning loads as a result of, the applied cantilever loading.
 - iv. Factor of safety for the diaphragm and shear walls (ratios 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 0.50 inch deflection constraint
7. A statement that all team members have read and understand the rules including section 4.0 Safety in addition to the referenced OSHA and CAL/OSHA documents.

8. Statement of how the team will remove the structure from the site and 2-3 methods of recycling or donating the structure after the competition (see Section **9.0 Construction**).

7.2 Display Board

Each team's display board must be 30" tall x 40" wide with a foam-core base.

On the board:

1. Drawings, graphics, text, photos, etc. that summarize and illustrate the significant aspects of the project. Minimally, the board must contain:
 - a. University and team member names.
 - b. Graphics and/or photos of the structure
 - c. Ratio of the Factor of Safety for the diaphragm and the shear walls to the calculated weight of the entire structure.
 - d. Design features
 - e. Total material cost of the structure
 - f. Total calculated weight of the structure
2. The board shall be displayed on an easel near the completed structure at the building construction site or designated area.
3. Each team will give a display board presentation (10 minutes max.) about their project upon completion of the construction of their structure. A video recording of the presentation shall be uploaded into the team folder.

8.0 Materials

All framing shall be of sawn lumber or engineered wood products. Wood structural panels are permitted to be used for the diaphragm and shear walls (structural insulated panels (SIPS) are not permitted). Connections shall be made with nails, screws, and steel connectors.

Each team is responsible for bringing their own tools and safety gear (minimum requirements include construction hard hat, safety glasses, gloves, closed toed shoes) for use at the construction site. NOTE: Nail guns and power saws are not permitted to be used at the competition.

All supplies (materials, connectors, tools, etc.) to construct the structure shall be provided by each team. NOTE: Simpson Strong-Tie will donate connectors and fasteners (see section **10.0 Budget**).

9.0 Construction

Each team will construct their proposed single-family house per the design shown in their submitted report and display board. A hard copy of the report and 24" x 36" structural drawings must be on the job site. Teams that do not construct the structures to the specifications outlined within the report and display board will be subject to a scoring penalization (see section **11.0 Scoring**). All individual structural framing members are allowed to be pre-cut prior to the competition date. The wall framing assemblies (excluding wall wood structural panel) is the only structural component of the building that may be pre-fabricated prior to the competition date. No prefabrication may be done at the building site prior to the start of the competition. The remainder of the structure, including the roof and all roof and wall sheathing, must be installed at the construction site during the competition (see section **8.0 Materials**). Construction on-site during the competition will be judged based on the time of construction, materials cost and accuracy of construction according to the team report. Material costs will be graded with respect to the provided receipts (see section **10.0 Budget**). Without proof of receipts the calculated cost will not be accepted. Please refer to section **11.0 Scoring** for any other scoring concerns.

Each team is responsible for removal of all material used for the project after the competition. Each team will coordinate with the PSWC organizers prior to the competition and define in writing their plans for removal of all material. Potential reuse or recycling of the project materials should be determined prior to the competition and included on the display board. Possible solutions include donating salvageable materials to Habitat for Humanity or other charitable organizations or researching other options at: <http://reusewood.org/>.

9.1 Site Constraints

All teams will be provided with a 15' x 15' area known as the "construction site" as defined by clearly marked lines on the floor (or ground) to construct their structure. The construction site limits will be measured from the inside of the boundary marker. All construction materials (including framing members, fasteners, connectors, tools, etc.) must remain in the construction site during the entire construction process. Point reductions shall apply for violations. (see section **11.0 Scoring**). All sites will be located on level surfaces.

9.2 Time Constraints

The construction process will be timed for each team. A maximum of **1.5 hours** will be allotted for each team's construction period.

1. All teams shall have their materials set up within the construction site prior to the start time.
2. No construction shall start within the construction site prior to the start time.
3. No additional materials may be added to the construction site after the start time.
4. Upon completion of the assembly of a team's structure, all team builders must exit the construction site before the timer is officially stopped.
5. Team builders will receive a penalty for exiting the construction site prior to completion of the structure (see section **11.0 Scoring**).

9.3 Design Constraints

All proposed and constructed structures shall have a footprint dimension of 4'x6', which is measured to the outside face of wood stud wall. Wall sheathing, roof sheathing, roof eaves, and the cantilever ridge beam may extend outside the footprint dimension. The structure shall comply with the following rules:

1. Design and build a structurally efficient building system of wood light-framed construction.
2. The single-story structure shall include all the elements that are included in the team's structural design, including but not limited to:
 - a. Roof system: A ridge board/beam that cantilevers 4' outside of the footprint to support the applied point load. The slope of the roof shall be determined by the team. The overall height of the structure shall not exceed 8 feet, measured from the highest point of the roof (ex. ridge beam) to the bottom of the structure (see figure 1).
 - 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).
 - c. Shear walls and diaphragms specified in the structural calculations and drawings.

10.0 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 \$300.00).

Additionally, to encourage participation, AWC and APA is offering a stipend to qualifying teams of \$300.00 max. per team, to offset the materials and t-shirts for the first 20 teams to request the stipend.

Teams will need to request the stipend and/or the SST connectors/fasteners by completing and submitting the request forms which will be posted on the PSWC 2019 website.

11.0 Scoring

Scoring will be based on the team's report and construction of their building. There is a total of 125 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.

11.1 Strength and Durability Analysis in Report: 55 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 entire structure.

Diaphragm

- 7.5 points for the lowest ratio of factor of safety to entire weight of structure
- 5 points for the second lowest ratio of factor of safety to entire weight of structure
- 2.5 points for the third lowest ratio of factor of safety to entire weight of structure

Shear Walls

- 7.5 points for the lowest ratio of factor of safety to entire weight of structure

- 5 points for the second lowest ratio of factor of safety to entire weight of structure
- 2.5 points for the third lowest ratio of factor of safety to entire weight of structure
- 5 points will be deducted for incorrect analysis

Completeness and Accuracy of the structural calculations 15 points

Points will be awarded based on the structural analysis completeness and correctness.

- 15 points for most complete and correct report
- 10 points for the second most complete and correct report
- 5 points for the third most complete and correct report

Structural Drawings: 10 points

Points will be awarded based on the accuracy of the drawings

- 10 points for most complete and correct report
- 6 points for the second most complete and correct report
- 3 points for the third most complete and correct report

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

11.2 Sustainability: 15 points

Points will be awarded for the most sustainable structure based on the submitted Life Cycle Assessment (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.

11.3 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.

NOTE: The team is not allowed to start constructing their project on the construction site until the time starts recording.

- 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

11.4 Presentation and 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 presentation time limit

11.5 Creativity/Aesthetics: 10 points

Points will be awarded by the judges for the most creative and aesthetically pleasing structure.

- 10 points for first place
- 6 points for second place
- 3 points for third place

11.6 Additional Possible Points Deducted and Disqualification:

- Up to 10 points will be deducted if the structure is not constructed to the specifications and drawings in the report. Each team must have a hard copy of the report and 24" x 36" structural drawings must be on the job site.
- 5 points will be deducted for each instance that materials, tools or builders are out of bounds
- 5 points will be deducted for structures, excluding the cantilever, that are larger than 4' w x 6' w x 8' h dimensions.
- 5 points will be deducted if the measured beam deflection is less than 0.5 inches or greater than 1.0 inch.
- Teams will be disqualified from the competition if the folder does not contain the report and pictures/videos (see section 5.0)
- Structure failure results in a disqualification.
- If there are any safety violations as identified by PSWC Safety Officials, the team must correct the issue(s) or they will be disqualified.

12.0 Additional Information

- Teams may submit questions as explained through the “FAQ” page of the www.pswc2019.com website.
- There will be a team captain’s meeting the evening before the competition where they can also ask questions. All judges should be present at this meeting.
- Each team is responsible for video recording their presentation and taking pictures of the completed structure which shall be uploaded into the team’s Google drive folder immediately after the TSDBSM Competition.
- All electronic entries/pictures and videos entries shall become the sole property of the sponsors: American Wood Council, Simpson Strong-Tie and APA-The Engineered Wood Association. Sponsors reserve the right to use or publish all entry material in publications, social media, etc. By entering, the Entrants grant a royalty-free license to American Wood Council, Simpson Strong-Tie, and APA-The Engineered Wood Association to use any material submitted. Such right includes publication of photographs and names of award recipients without compensation to Entrants.
- Final judging shall be completed on the day of the competition.