AMERICAN SOCIETY OF CIVIL ENGINEERS

TIMBER-STRONG DESIGN BUILD[SM]

TIMBER-STRONG DESIGN BUILD℠
Previous Competition Winners

2020 PSWC

April 4th California State University, Fullerton
1st Place: California State University, Fullerton
2nd Place: University of California Los Angeles (UCLA)
3rd Place: California Polytechnic State University, San Luis Obispo (CPSLO)

2019 NCSEA SUMMIT

November 20th Disneyland Hotel, Anaheim, CA
1st Place: California Polytechnic State University, San Luis Obispo (ARCE CPSLO)
2nd Place: University of California Los Angeles (UCLA)
3rd Place: University of Kentucky (U of K)

2019 PSWC

April 6th California Polytechnic State University, San Luis Obispo, CA
1st Place: California Polytechnic State University, San Luis Obispo (CE CPSLO)
2nd Place: University of Arizona (UA)
3rd Place: University of California Los Angeles (UCLA)

2018 PSWC

April 13th Arizona State University, Tempe, AZ
1st Place: San Diego State University (SDSU)
2nd Place: Arizona State University (ASU)
3rd Place: University of California Irvine (UCI)
Honorable Mention: California State Los Angeles (CSLA)

This document, which is available at https://www.asce.org/student_conferences/ describes the Student Timber-Strong Design Build[SM] Competition and states the 2021 rules for the conference. **Clarifications, which include any revisions to the rules, are published on the ASCE website prior to the competition and do not appear in this document although they are formal addenda to the rules.**
See the Request for Information (RFI) Section below for details on how to submit questions.

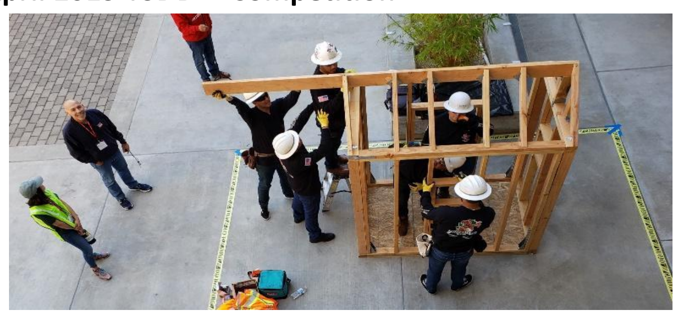
CONTENTS

WELCOME

The American Society of Civil Engineers (ASCE) and sponsors American Wood Council (AWC), Simpson Strong-Tie Company Inc. (SST), and APA – The Engineered Wood Association (APA) support and encourage the equitable opportunity for participation in the Student Timber-Strong Design Build℠ (TSDB℠) 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!

Examples

Examples of April 2019 TSDB℠ Competition



TIMBER-STRONG DESIGN BUILD℠ COMPETITION

1.0 EVENT DESCRIPTION

The American Society of Civil Engineers (ASCE) and the sponsors American Wood Council (AWC), Simpson Strong-Tie Company Inc. (SST), and APA – The Engineered Wood Association (APA) are developing a student competition based on creating a sustainable, 2-story wood light-framed building (a.k.a. project). While other natural resources are rapidly depleting, 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 student teams to design and build an artistically creative building that is sustainable, aesthetically pleasing and structurally durable. In light of the COVID-19 pandemic, the in-person build has been replaced with a virtual build, the creation of a building information model (BIM).

2.0 OBJECTIVE

The 2021 Timber-Strong Design Build℠ (TSDB) Competition enables students to gain experience in performing crucial aspects of common structural 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 (building information model), each team is expected to act as a design build construction firm while competing in a friendly environment. It is the goal of this competition to provide unique insights and hands-on experience for the next generation of structural engineers involved in sustainable design and construction.

3.0 AWARDS AND RECOGNITION

The winners of the Timber-Strong Design Build℠ Competition shall be determined by compiling a team's total number of points from the report, BIM model, presentation, and creativity portions of the competition. In addition to the top three teams receiving awards, the 1st place winning team will receive a travelling trophy which will reside at the winning team's college until the following year's competition where it will change hands to the next 1st place winning team.

4.0 GENERAL RULES AND ELIGIBILITY REQUIREMENTS

4.1 RULE CHANGES AND PRECEDENCE

The Rules and Regulations (Rules) of the Timber-Strong Design Build^{SM} Competition are updated each year. **Teams are strongly encouraged to read this document carefully and disregard previous editions from previous competitions.** Teams should not consider items such as rulings and interpretations made by judges in previous competitions and answers provided in previous *Interpretations of Rules*, as setting precedence of this year's competition.

4.2 GENERAL INFORMATION

To learn which Student Conferences are hosting this competition, visit the ASCE website (https://www.asce.org/student_conferences/). Visit the Student Conference hosts' websites (links are or will be on the ASCE student conferences webpage) for registration information.

Each competing student chapter is invited to structurally design and model a light-framed wood structure. Through the design process, teams are required to create a preliminary design and a final bid report.

Each team is required to model the wood structure which was designed in the team report. Each team will conclude with a presentation (see Section 6.0 PRESENTATION AND DISPLAY BOARD).

Host will provide each team captain with a link to cloud folders where all electronic files will be uploaded. Upon registration each team Captain will need to request access to the cloud folders by contacting the host.

Request for Information (RFI)
Requests for information (RFI) should be sent to student@asce.org with the subject line "**TSDB Competition RFI**". Clarifications will be posted on the Timber-Strong Design Build Competition Collaborate Site every other Friday starting January 1, 2021 until February 26, 2021. Each post will address the questions received from the previous two weeks through the Wednesday before 11:59 PM Eastern Time.

4.3 REGISTERED PARTICIPANTS

All team members and student chapters must be registered for the ASCE conference. There is no limit to the number of students who participate in the development of the report, building information model, and the visual aid, however, only 4-6 members should be designated as builders (see SECTION 4.3.1 ELIGIBILITY REQUIREMENTS).

4.3.1 ELIGIBILITY REQUIREMENTS

Registered participants shall meet all the following requirements:

a. Teams shall consist of undergraduate students enrolled during all or part of the current competition academic year. Each student must be a member of an ASCE Student Chapter in good standing and be a Society Student Member of ASCE.
b. 4-6 members shall be designated as "builders" and include at least one female and one male.
c. One builder of the team must be identified as the Team Captain.
d. The team must have at least one underclassman (freshman/sophomore).
e. The team must have at least one male and one female.
f. The team **MUST** have a least one faculty advisor.
g. Teams are encouraged (not required) to have a practicing structural engineer to mentor the team. Sponsors will help teams identify a mentor upon request.

4.4 ETHICS AND REQUIRED CONDUCT

This competition is to be conducted in the highest ethical standard. Students are referred to ASCE's Code of Ethics, which sets the standards of professional practice by all members of the Society.

All participants shall act professionally and respectfully at all times. Failure to act appropriately can result in sanctions, disqualifications, and loss of invitations to future competitions or Society-wide competitions. The inappropriate use of language, alcohol, or materials, uncooperativeness, or general unprofessional or unethical behavior will not be tolerated.

4.5 SAFETY

Safety is the highest priority; activities that risk personal injury will not be tolerated. As the coronavirus (COVID-19) pandemic continues, student teams shall comply with the guidance from the Centers for Disease Control and Prevention (CDC), university, and local health authorities.

4.6 SCHEDULE, DEADLINES, AND SUBMISSIONS

The following is a list of important dates related to the overall competition schedule, including deadlines for applicable submissions. Teams should consider this as only a partial list of dates (all dates are midnight (11:59 PM) in the time zone of the conference unless noted otherwise).

Mandatory Task	Due Date
All waiver form(s) (See APPENDIX B)	Prior to commencing any tasks
Electronic files Phase One upload to a cloud folder provided by Host (See SECTION 7.0)	1 month prior to the day of the competition
Electronic files Phase Two upload to a cloud folder provided by Host (See SECTION 7.0)	3 weeks prior to the competition

Team Captain's meeting	Day before the competition
Presentation & Visual Aid (See SECTION 6.0)	Day of the competition
Electronic file Phase Three upload to a cloud folder provided by Host (See SECTION 7.0)	Day of the competition (specific time TBD)

All Team Captains shall attend the Team Captain's meeting where they will receive an overview of the competition day and they will be able to ask any last-minute questions.

5.0 BUILDING PROJECT

5.1 GENERAL

All proposed and modeled BIM structures shall be a 2-story structure with a footprint dimension of 6'x6', which is measured to the outside face of wood stud wall. Wall sheathing, roof sheathing, roof eaves, and the cantilever floor beam may extend outside the footprint dimension (see **figure 1**). The structure shall contain the following:

1. Design and model a structurally efficient building system of wood light-framed construction.
2. The two-story structure shall include the following:
   a. Roof system: The slope of the roof shall be determined by the team. The overall height of the structure shall not exceed 12 feet, measured from the highest point of the roof (ex. ridge beam) to the bottom of the structure.
   b. 2nd floor system: A floor beam that cantilevers 4' outside of the footprint to support the applied point load.
   c. 2^{nd} floor framed opening: **one** opening in the floor.
   d. 2^{nd} floor walls framed openings: min. **three** windows. The windows may be located anywhere.
   e. 1^{st} floor walls framed openings: min. **three** windows and **one** door.

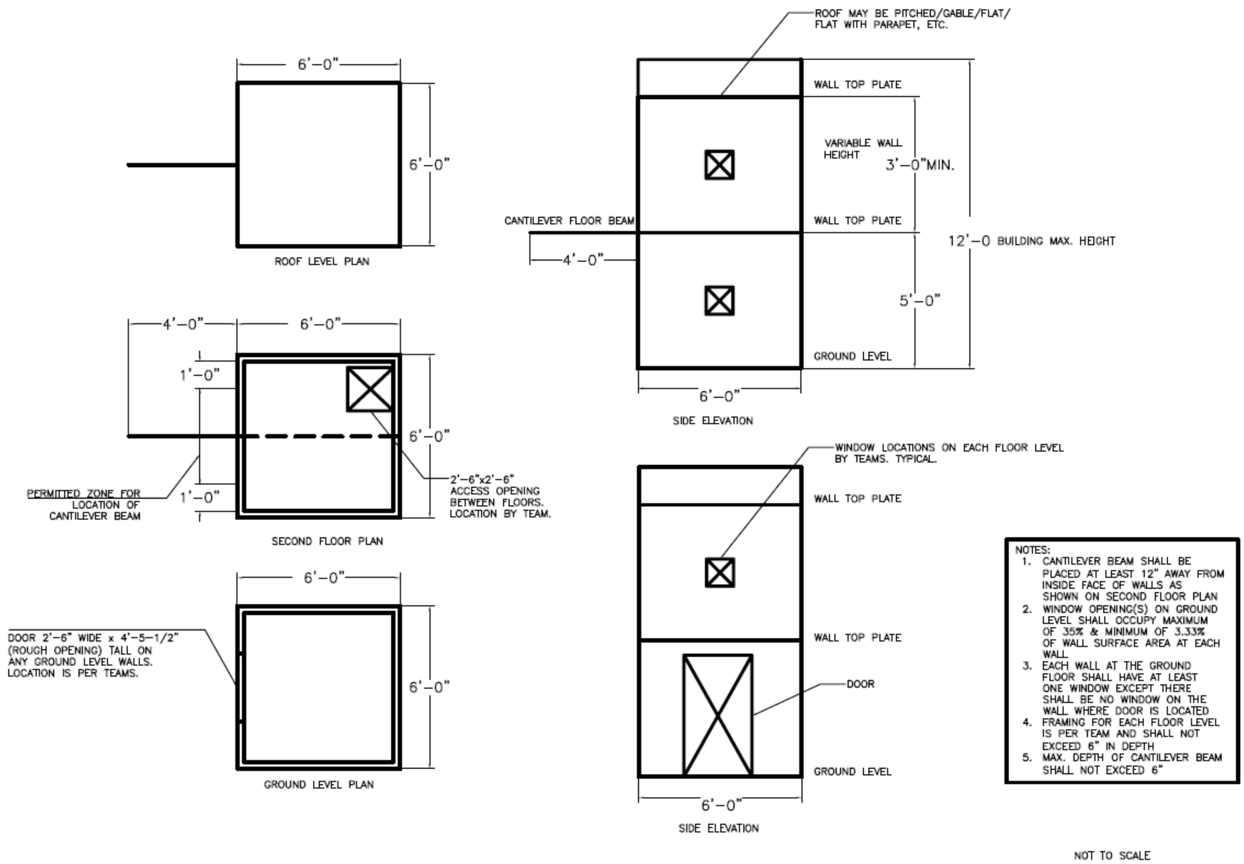


Figure 1.

5.2 STRUCTURAL DESIGN

Wood has been successfully used as a structural material for over 1300 years and the construction industry is on the verge of expanding the use of wood to high-rise under the 2021 International Building Code to up to 18 stories using mass timber construction. As a structural material that provides sustainability, strength, and resilience, each team will design the building per this section using wood products. The structural calculations shall be legible HAND calculations (non-computer analyzed) on the structure in **Figure 1**. All structural design will be done using the Allowable Stress Design (ASD) Method. It must include the following:

5.2.1 STRUCTURAL DURABILITY-GRAVITY DESIGN

1. Vertical design loads

   Roof Dead Load = calculated self-weight
   Roof Live Load = 20 psf
   Floor Dead Load = calculated self-weight
   Floor Live Load = 40 psf
   Point load at the end of the cantilever 150 lbs.

2. Design cantilever floor beam for shear and bending
3. Deflection of cantilever
   a. Calculate the predicted deflection assuming all applicable adjustment factors are equal to 1.0.
   b. Beam deflection, after the load is applied, must be at least .5" and not greater than 1" as tested (does not apply to 2021's virtual event).
   c. Calculate the entire weight of the structure.

5.2.2 STRUCTURAL DURABILITY-SEISMIC AND WIND DESIGN

1. Lateral Design Loads - the structure shall be designed and analyzed to resist seismic and wind loads as follows
   a. Lateral seismic ASD load of W = 250 plf at the roof diaphragm and 250 plf at the floor diaphragm in both directions (not simultaneously).
   b. Roof wind uplift pressure W=18 psf (no dead load is allowed to resist uplift pressures)
2. Lateral Design – the design shall include the following:
   a. Seismic:
      i. Roof diaphragm design (in-plane shear only) both directions including sheathing, chords, and collectors
      ii. Floor diaphragm design (in-plane shear only) both directions including sheathing, chords, and collectors
      iii. Shear wall design (in-plane shear and overturning)
      iv. Anchorage to the foundation that includes anchor bolt and SST hold-downs to resist in-plane shear and overturning.
      v. Factor of safety (F.S.) for the diaphragm and shear walls (ratios of ASD unit shear capacity/ASD demand). Teams shall provide calculations to the 1000th decimal place and include F.S. for each of the diaphragms and the shear walls and provide the average F.S. for the combined diaphragms and average F.S. for combined shear walls.
   b. Wind Design:
      i. Roof joist anchorage for the uplift wind load.
3. The ASD capacities for the diaphragm and shear walls shall be based on the 2015 Special Design Provisions for Wind and Seismic (SDPWS) standard.
4. Assume that the structure will be connected to a foundation with 1/2" diameter anchor bolts and SST hold-downs.

In all cases, the demand (load) on the structure shall not exceed the capacity (resistance) of the structure.

5.2.3 STRUCTURAL DRAWINGS

24" x 36" drawings accurately depicting the structure that is designed including roof and floor framing plans and shear wall details (see section 8.1 GENERAL) and include but not limited to:

- Framing members
- Diaphragm and shear wall sheathing type and fastening
- Connectors, blocking, and fasteners for continuous load path
- Plan views, elevations, and cross sectional details demonstrating continuous load path
- Anchorage to the foundation

5.3 SUSTAINABLE DESIGN

Wood is a superior sustainable building material.

Wood is renewable, like any crop. Engineered wood products can use smaller trees from well-managed forests, saving old growth for future generations to enjoy. Forest land comprises about 33 percent of the total U.S. land area. Demand for more wood products encourages forest landowners to maintain healthy forest regeneration, which in turn helps absorb more greenhouse gases.

Manufacturing wood uses less energy than producing steel or concrete, reducing greenhouse gas and other air-polluting emissions related to construction. Wood sequesters carbon. By trapping the carbon removed from the environment during the trees' growth, buildings made with wood can continue to have a net benefit on the environment when compared to their steel and concrete counterparts.

To show how much the structure is sequestering, provide carbon footprint calculations which include:

Analyze the carbon footprint for 100x the building's structural framing volume to simulate an actual full-size building. Determine the amount of carbon stored in the two-story structure and the total potential carbon benefit using the WoodWorks Carbon Calculator tool found at http://www.woodworks.org/carbon-calculator-download-form/

All input and output shall be provided in the report.

5.4 BUILDING MATERIALS

All materials specified in the BIM model of the structure shall be as follows. All framing shall be of sawn lumber (Douglas Fir (DF) or Spruce-Pine Fir (SPF)) 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.

5.5 BUDGET

A primary consideration with any project is the budget and making sure the costs are tracked. Each team will provide a budget which includes an itemized list of the cost of materials based on estimates for the materials used to design their structure and document how the costs were estimated. The budget shall be itemized and included in the report using a spreadsheet provided by the host. See APPENDIX A for example.

5.6 REPORT

5.6.1 REPORT CONTENTS

Each team's report must include:

a. Table of Contents
b. All team members' names, cell phone numbers and email address. Additionally, identify the 4-6 members who are designated as the "builders".
c. The name, telephone number, email address and title of the faculty advisor.
d. Structural design calculations (Section 5.2 STRUCTURAL DESIGN)
e. Sustainable design calculations (Section 5.3 SUSTAINABLE DESIGN)
f. The budget (Section 5.5 BUDGET) including references for the estimated material costs unit price.
g. Statement that all team members have read and understand the rules including section 4.5 SAFETY in addition to the referenced OSHA and CAL/OSHA documents.
h. Certificate of completion for the Ladder Safety Training (see section 4.5 SAFETY)
i. All the host and sponsor logos (ASCE, AWC, APA & SST)
j. The report shall be signed and dated by at least one (1) team captain and one (1) faculty advisor certifying that the information is valid. The phone number and e-mail address for both the team captain and the faculty advisor shall be provided.

6.0 PRESENTATION AND VISUAL AID

Each team's presentation visual aid must be created in PowerPoint and include the following items:

Visual aid:

1. Drawings, graphics, text, photos, etc. that summarize and illustrate the significant aspects of the project. The visual aid must at least contain:
   a. Student chapter and team member names
   b. Graphics and snapshots of the structure
   c. Factor of Safety for the diaphragm and the shear walls.
   d. Design features
   e. Total calculated carbon stored in structure and the total potential carbon benefit
   f. Total material cost of the structure

g. Total calculated weight of the structure
h. Logos of all the host and sponsors (ASCE, AWC, APA & SST)

2. The visual aid shall be shown during the team presentation.

Presentation:

1. Using the visual aid, each team will give a presentation about their project on the day of the competition.
2. All members of the builder team must participate in the presentation. The team members may be in different locations (e.g. home/dorm) or together (following CDC/state/local/university COVID-19 guidelines, may need to be x feet apart, wearing masks).
3. Each team will have 10 minutes maximum for the presentation.
4. Each team's presentation will be recorded for the TSDB^{SM} Competition.

7.0 ELECTRONIC FILES

Each team shall upload their electronic files into the cloud folder provided by the host. The team folder shall have **separate** folders for each submittal phase shown below. The files will be uploaded into three phases per SECTION 4.6 SCHEDULE, DEADLINES, AND SUBMISSIONS into the team folder as follows:

Phase One:

1. Project report (Submit in PDF form.)

Phase Two:

2. Structural drawings (Submit in PDF format on 22x34 sheet size. Drawings contained in one file. Separate sheets will not be accepted. AutoCAD files will not be accepted.)
3. BIM Model and associated 3D graphics as needed to appropriately convey complete load path.
4. Visual aid (PPT file)

Phase Three:

5. Video of the team presentation.

All teams must have all materials in the folder by the deadline or the team will have points deducted from their score.

8.0 Building Information Model (BIM)

The team members will model the entire building superstructure per the design shown in their submitted report, structural drawings and visual aid. Teams that do not model the structure to the specifications outlined within the report, structural drawings and visual aid will be subject to a scoring penalization (see section 9.0 SCORING). The structure shall be modeled using only wood members (see section 5.4 MATERIALS).

8.1 GENERAL

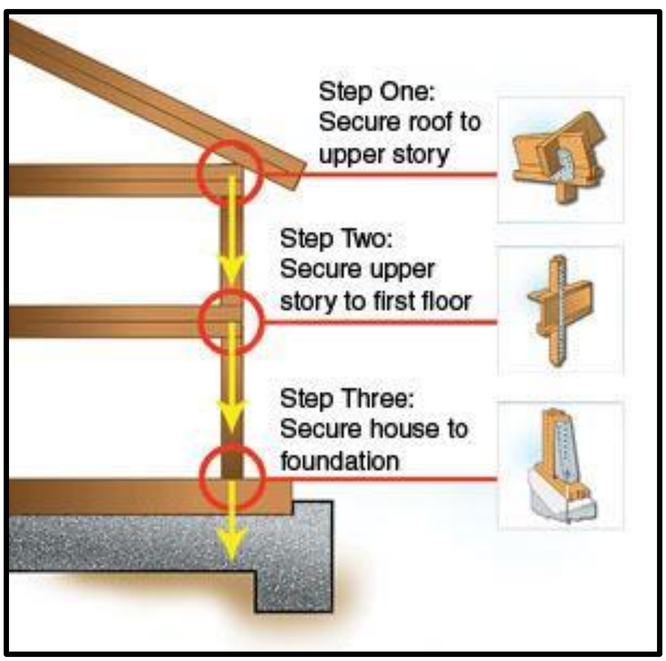
The completed model must provide a complete load path for gravity, wind, and seismic loads, and all loads shall be resolved into the foundation.

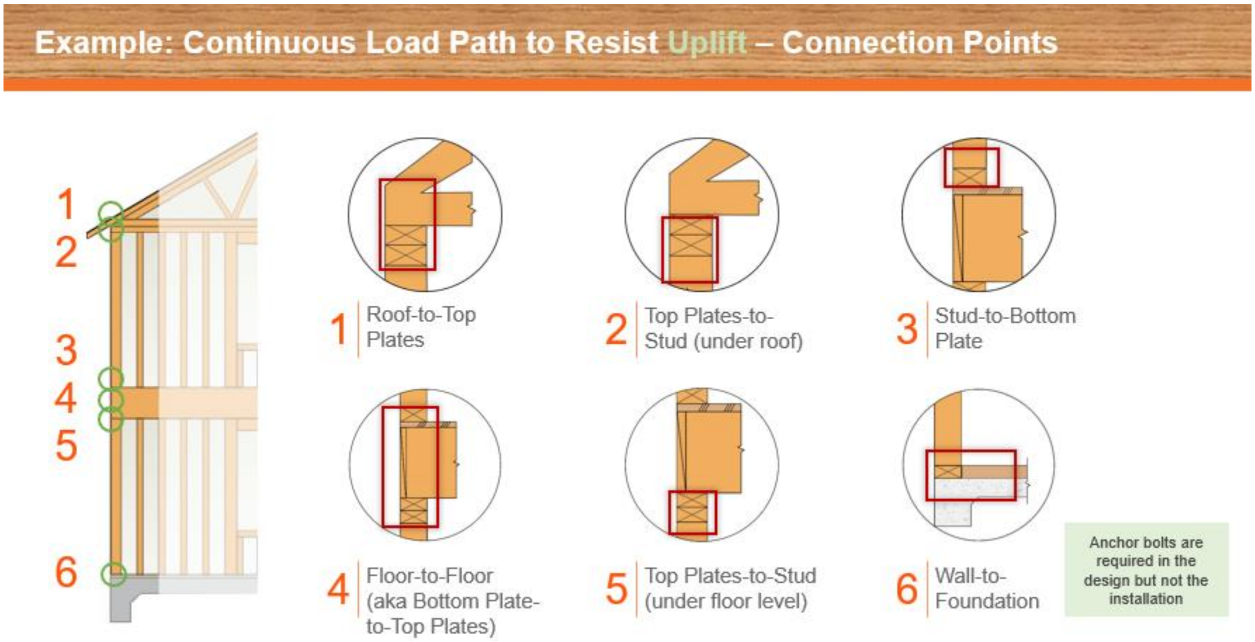
The BIM will be judged based on completeness of the model (including all structural framing materials and connectors), visually demonstrating the continuous load path, accurately calculating the materials cost, and accuracy of the model according to the team report. To be considered complete, all structural members must be modeled in three dimensions (see **9.4 BIM: 70 POINTS**).

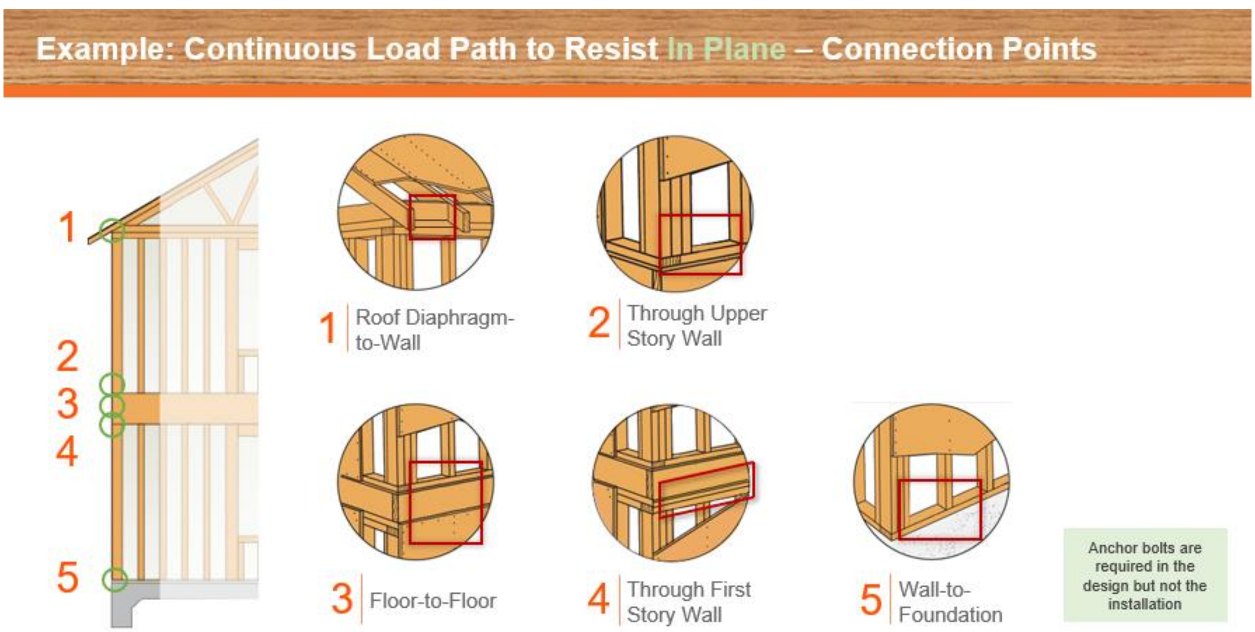
Please refer to section 9.0 SCORING for any other scoring concerns.

'Continuous Load Path' is another intended focus of this competition. How well a house or building can transfer energy from wind and seismic loading has much to do with 'Continuous Load Path'. A building absorbs seismic energy by connecting the horizontal roof and floor diaphragms to the walls. When ground motion produces inertial forces, these forces push on the roof (and floor) diaphragm in one direction and the walls hold back the roof in the opposite direction. This behavior is similar in a building absorbing wind energy. For the energy to be properly absorbed, the roof and floor diaphragms must be connected to the walls and the upper story walls are connected to the lower story walls. The lowest level walls are connected to the foundation. The roof connection to the walls must also account for the uplift forces due to wind. As an analogy, if the wind or seismic forces were electricity, it's the engineer's job to design a continuous path for that electricity to flow to the ground.

The following diagram illustrates the continuous load path through wood members, fasteners, and connectors:







Implementation of a continuous load path in the design and modeling of the structure in this competition will be a major focus. A Revit library of Simpson 2D & 3D connectors and fasteners will be available for use. The following link is for downloading the ‘Drawing Finder for Revit Plugin’ from the Simpson Strong-Tie website:
https://www.strongtie.com/drawing/drawing-finder-for-revit

This plugin allows the Revit user to insert Simpson products directly into the Revit model and drawings by pulling the most recent content from the Strongtie.com website. Note that there is also an installation instructions and best practices tutorial pdf file on the web page.

A wind unit uplift force will be given for calculation and teams will calculate the total uplift and appropriately connect the roof to the second level walls. Teams will be responsible to account for resisting that force to the foundation with fasteners, connectors, structure dead load, or a combination of the three. Holdowns are to be designed and installed to anchor the structure to the foundation.

9.0 OVERALL SCORING

Scoring will be based on the team's report, BIM, and presentation of their building. 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 Sustainability in Report, both will receive 18 points.

Scoring is as follows:

Section	**Maximum Points**
Strength and Durability Analysis in Report	130
Sustainability in Report	18
Costs	20
BIM	70
Creativity & Aesthetics	20
Presentation	11
Submission Requirements	19
Total Points Possible	**288 (+10 bonus points)**

9.1 STRENGTH AND DURABILITY ANALYSIS IN REPORT: 130 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.

Design Factor of Safety 6 points each, 12 points possible

Points will be rewarded based on the design factor of safety (F.S.) for the design of the diaphragms and the shear walls.

Points will be awarded to the teams that get closest to 1.500 as possible without being less than 1.500. If the F.S. is less than 1.500, zero points will be awarded.

Maximum scores are as follows:

- Roof and Floor Diaphragms 6 points
- Shear Walls 6 points

Completeness and Accuracy of the structural calculations 55 points

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

Structural Drawings: 48 points

Points will be awarded based on the completeness and accuracy of the drawings.

Deflection: 15 points

Points will be awarded based on ratio of calculated predicted deflection from the report to actual deflection measured in competition. In order to qualify for these points, the cantilever deflection must meet the requirements of SECTION 5.2.1 STRUCTURAL DURABILITY-GRAVITY DESIGN

9.2 SUSTAINABILITY: 18 POINTS

Points will be awarded for the most sustainable structure based on the calculated carbon sequestration and potential carbon benefit in the report.

Input Included	5
Carbon Footprint x100 correctly	5
Total Carbon Footprint (see below 8 pts. max)	8
8 pts. Total Carbon Footprint < 200 Metric Tons of CO2	
7 pts. 200 Metric Tons of CO2 < Total Carbon Footprint < 300 Metric Tons of CO2	
6 pts. 300 Metric Tons of CO2 < Total Carbon Footprint < 400 Metric Tons of CO2	
5 pts. 400 Metric Tons of CO2 < Total Carbon Footprint < 500 Metric Tons of CO2	
4 pts. Total Carbon Footprint > 500 Metric Tons of CO2	

9.3 COSTS: 20 POINTS POSSIBLE

Donor Documentation or estimate	5
Itemized Costs (quanity, unit costs)	5
Cost (see below 10 pts. Max.)	10
10 pts. Costs < $550	
8 pts. $550 < Costs < $650	
6 pts. $650 < Costs < $750	
4 pts. $750 < Costs < $850	
2 pts. Costs > $850	
If no receipts or other documentation are provided, the team get's zero points.	

9.4 BIM: 70 POINTS

Points will be awarded based on the BIM as follows:

Accuracy of model: 30 points

Load path: 20 points

Complete Structure: 20 points

Overall structure completion according to the drawings, connectors, anchors, hold-downs placement, cladding etc.

9.5 CREATIVITY/AESTHETICS: 20 POINTS

Points will be awarded by the judges for creativity and aesthetically pleasing structure. Judges will award 1-20 points.

Bonus points for top 3

- 5 points for first place
- 4 points for second place
- 3 points for third place

9.6 PRESENTATION: 11 POINTS

9.7 SUBMISSION REQUIREMENTS: 19 POINTS

Points will be awarded for:

Visual aid: 9 points
Report requirements: 10 points in total

9.8 ADDITIONAL POSSIBLE POINTS DEDUCTED AND/OR DISQUALIFICATION:

SECTION 5.1 GENERAL

SECTION 4.5 SAFETY

SECTION 4.6 SCHEDULE, DEADLINES, AND SUBMISSIONS AND SECTION 7.0 ELECTRONIC FILES

- Teams will have 10 points deducted if the team folder does not contain the required files for Phase One by the submission deadline.
- Teams will be disqualified if the team folder does not contain the required file for Phase One by Phase Two submission deadlines.
- Teams will have 8 points deducted if the folder does not contain the required electronic files for Phase Two.
- Teams will have 2 points deducted if the folder does not contain the required files for Phase Three.

10.0 ADDITIONAL INFORMATION

- Teams may submit questions as explained in the RFI Section above.
- All judges should be present at this Team Captain's meeting.
- All entries become the sole property of the host, American Society of Civil Engineers, and the sponsors: American Wood Council, Simpson Strong-Tie and APA-The Engineered Wood Association. Host and 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 the American Society of Civil Engineers, American Wood Council, Simpson Strong-Tie, and APA – The Engineered Wood Association to use any material submitted. This includes but is not limited to the right to publish or display submitted photographs, images, audio, and video and the names of the entrants or award recipients.
- Final judging shall be completed on the day of the competition.

APPENDIX A TEAM FORMS

MATERIALS REQUEST (FOR COST ESTIMATING PURPOSES)

Connectors/ Fasteners

Please return to: Angel Leon, ALeon@strongtie.com (951) 538-6529

www.strongtie.com

Quantity	SKU #	Description

BUDGET FORM (SAMPLE)

TIMBER-STRONG DESIGN BUILD

MATERIALS COST ESTIMATE

Description	Quantity	Unit	Amt	Unit Cost	Total
Wall Framing					
2x2 Wall Studs	40.5	LF			
2x4 Corner Posts	18	LF			
2x2 Top Plate	18	LF			
2x2 Bottom Plate	18	LF			
Total 2x4x8’			10	$ 3.25	$ 32.50
Roof Framing					
2x4 Roof System	16	LF			
2x6 Ridge Beam	12	LF			
4x8x7/16" Sheathing	25	SF			
Total 2x4x8'			2	$ 3.25	$ 6.50
Total 2x6x12'			1	$ 11.17	$ 11.17
Total 4x8x7/16" Sheathing			1	$ 17.45	$ 17.45
Wall Sheathing					
4x8x7/16" wsp	70	SF			
4x8x7/16" wsp	32	SF			
Total 4x8x7/16" Sheathing			2	$ 17.45	$ 34.90
	Lumber Subtotal:				**$ 102.52**
Fasteners					
10d Nails (5lb Box)			1	$ 13.57	$ 13.57
8d Nails (5lb Box)			1	$ 13.57	$ 13.57
SD8x1.25 Screws (100 Count Box)			1	$ 9.98	$ 9.98
	Fasteners Subtotal:				**$ 37.12**
Simpson Connectors					
A35 Framing Angles and Plates			6	$ 0.90	$ 5.40
RTC2Z Ridge Tie Connectors			6	$ 4.98	$ 29.88
RTB22 Ridge Tie Connectors			28	$ 1.30	$ 36.40
LSSJ26JZ/LSSJ26RZ Jack Hanger			4	$ 5.35	$ 21.40
A21 Angle			10	$ 0.36	$ 3.60

CS22-R (25' length)	1	$	21.97	$	21.97
	Connectors Subtotal:			**$**	**118.65**
	Total Materials Cost:			**$**	**258.29**

*It is the user's responsibility to verify the accuracy of the calculations.

APPENDIX B WAIVER FORMS

- Release of Liability
- Model Agreement