Timber-Strong Design Build Competition

Astro Jacks Engineering <u>CENE 476 12/6</u>/2024

SIMPSON

Strong-Tie

STROJACK

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Project Introduction

Purpose:

- Design-Build Competition
 - Design
 - Plan
 - Construct
- Two Story Wood Light Framed Structure
 - Sustainable
 - aesthetically pleasing
 - structurally durable

Client:

- \circ Mark Lamer
- Simpson StrongTie



Figure 1: Past Team Competition Build Day [1]

Project Introduction

Background:

- ASCE Intermountain
 Southwest Student
 Symposium
 - April 10-12, 2025

Location:

- \circ Tucson, Arizona
 - The University of Arizona



Task 1: Background Research

- 1.1: Competition rules
- 1.2: Material Research
- 1.3: National Design Specification (NDS) and NDS Supplement for Wood Construction
- 1.4: Special Design Provisions for Wind and Seismic (SDPWS)
- 1.5: Mathcad

Task 2: Preliminary Design

- 2.1: Timber selection
- 2.2: Initial design decisions and Design Matrix

Task 3: Load Determination

- 3.1: Determination of gravity loads
- 3.2: Determination of lateral loads

Task 4: Roof Design

- 4.1: Roof Gravity Strength Design
- 4.2: Diaphragm Design
 - 4.2.1: Seismic Load and Internal Shear
 - 4.2.2: Design for Strength
 - 4.2.3: Design for Serviceability
- 4.3: Chord Design
 - 4.3.1: Seismic Load and Internal Compression
 - 4.3.2: Design Strength
 - 4.3.3: Design for Serviceability
- 4.4: Collector Design
 - 4.4.1: Seismic Loading and Internal Shear
 - 4.4.2: Design for Strength
- 4.5: Rafter Tie Down Design
 - 4.5.1: Wind Uplift Load
 - 4.5.2: Design for Strength

Task 5: Wall Design

- 5.1: Wall Gravity Strength Design
- 5.2: Wall Lateral Design
 - 5.2.1: Shear Wall Design
 - 5.2.2: Seismic Load and Internal Shear
 - 5.2.3: Wall Design for Strength
 - 5.2.4: Wall Design for Serviceability
- 5.3: Hold Down and Anchor Bolt Design
 - 5.3.1: Overturning Force
 - 5.3.2: Design for Strength
- 5.4: Floor Design
 - 5.4.1: Floor Gravity Strength Design
 - 5.4.2: Cantilever Deflection
 - 5.4.3: Floor Lateral Design
- 5.5: Design Optimization

Task 6: Modeling

- 6.1: 2D Structural Modeling
- 6.2: 3D Building Information Modeling (BIM)

Task 7: Construction

- 7.1: Material Acquirement and Prefabrication
- 7.2: Construction Practices

Task 8: Deconstruction Plan

- 8.1: Disassembly
- 8.2: Plan for Repurpose

Task 9: Investigate Project Impacts

Task 10: Project Deliverables

- 10.1: Capstone Deliverables
 - 10.1.1:30%
 - 10.1.2:60%
 - 10.1.3:90%
 - 10.1.4: Final Presentation
 - 10.1.5: Final Report and Website
- Task 10.2: Competition Deliverables
 - 10.2.1: Registration and Compliance
 - 10.2.2: Final Project
 - 10.2.3: Structural Drawings and 3D Modeling
 - 10.2.4: Presentation
 - 10.2.5: Final RFI and Change Order
 - 10.2.6: Visual Aid

Task 11: Project Management

- 11.1: Resource Management
- 11.2: Schedule Management
- 11.3: Meetings
 - 11.3.1: Team Meeting
 - 11.3.2: Captain's Meeting
 - 11.3.3: Mentee Meetings
 - 11.3.4: Client Meetings
 - 11.3.5: Technical Advisors Meeting
 - 11.3.6: Grading Instructor Meeting

Exclusions

- Not designing for lateral wind loads
- Not designing for rain and snow loads
- Not designing for construction live loading
- Not anchoring structure during competition



Project Roles

SENG: Senior Engineer

- Licensed Civil Engineer (PE & SE)
- Timber design expertise
- Proficient in BIM and collaboration for effective teamwork.

STENG: Structural Engineer

- Bachelors in Civil/Structural Engineering (FE)
- Skilled in timber design
- Focused on load calculations and construction practices

Project Roles

SUPR: Superintendent

- Construction management background with site and safety expertise
- Strong leadership for safety enforcement and project execution

SAFT: Safety Officer

- Expert in construction safety regulations, training, and risk assessment
- Effective communicator for safety guidance

INT: Engineering Intern

- Civil Engineering student with design software knowledge
- Team-oriented and eager to learn

Project Staffing

Position	SENG	STENG	SUPR	SAFT	INT	Proposed
Task 1 Background Research	12	25	5	5	2	49
Task 2 Preliminary Design	30	55	14	15	2	116
Task 3 Design and Analysis	15	20	0	2	4	41
Task 4 Roof Design	15	55	5	5	4	84
Task 5 Wall Design	20	40	5	5	4	74
Task 6 Modeling	10	20	4	0	2	36
Task 7 Construction	15	30	60	50	20	175
Task 8 Deconstruction Plan	2	2	1	1	4	10
Task 9 Investigate Project Impacts	4	6	1	2	2	15
Task 10 Project Deliverables	20	40	10	10	1	81
Task 11 Project Management	10	20	10	5	0	45
Proposed	153	313	115	100	45	726

Proposed Cost of Engineering Services

Description	Quantity	Unit of Measure	Rate \$	Cost
Personnel				
Senior Engineer	153	Hr	\$260.00	\$39,780.00
Structural Engineer	313	Hr	\$200.00	\$62,600.00
Superintendent	115	Hr	\$220.00	\$25,300.00
Safety Officer	100	Hr	\$75.00	\$7,500.00
Engineering Intern	45	Hr	\$20.00	\$900.00
	\$135,180.00			
Travel				
Rental Van	5	Days	\$73.54	\$367.70
Driving Mileage	500	Miles	\$0.41	\$205.00
Per Diem	4	People (\$60 per day for 5 days)	\$300.00	\$1,200.00
Hotel Room	4	Nights (4 rooms)	\$1,200.00	\$4,800.00
			Subtotal Travel	\$6,572.70
Lab Use				
Field Station "Farm"	7	Days	\$100.00	\$700.00
	\$700.00			
Materials				
2x4x8 Hem Fir	70	EA	\$5.78	\$404.60
2x4x20 Hem Fir	4	EA	\$7.33	\$29.32
OSB Sheet (4x8)	18	EA	\$23.36	\$420.48
Fasteners	5	EA	\$40.53	\$202.65
Connectors / Hardware	1	LS	\$1.00	\$500.00
Paint	10	Gal	\$10.00	\$100.00
Primer	10	Gal	\$20.00	\$200.00
			Subtotal Material Cost	\$1,657.05
	\$144,110			

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Citations

- [1] Figure 1: <u>Home (nau.edu)</u>
- [2] Figure 2:

https://www.ceias.nau.edu/capstone/projects/CENE/2024/Timbe rStrong/Design.html

- [3] ASCE Timber-Strong Design Build Rules <u>2024 Timber Strong</u> Design Build Competition Rules (asce.org)
- [4] NAU Travel Prices <u>https://nau.edu/university-policy-library/travel-policies/</u>
- [5] Wood Costs https://www.myhomco.com/

QUESTIONS?



Scan for Project Website