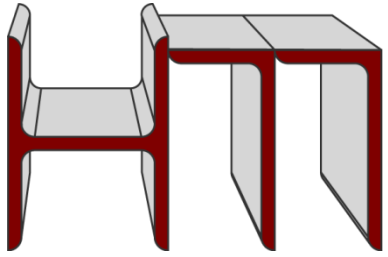


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NOT YOUR TYPICAL
STRUCTURAL ENGINEERING FIRM

What Engineering Rules to Follow When
the Rules Aren't Clear—Zip Line Design

Robert A. Hubbard, P.E., S.E. - David S. Merrell, P.E., M.L.S.E.



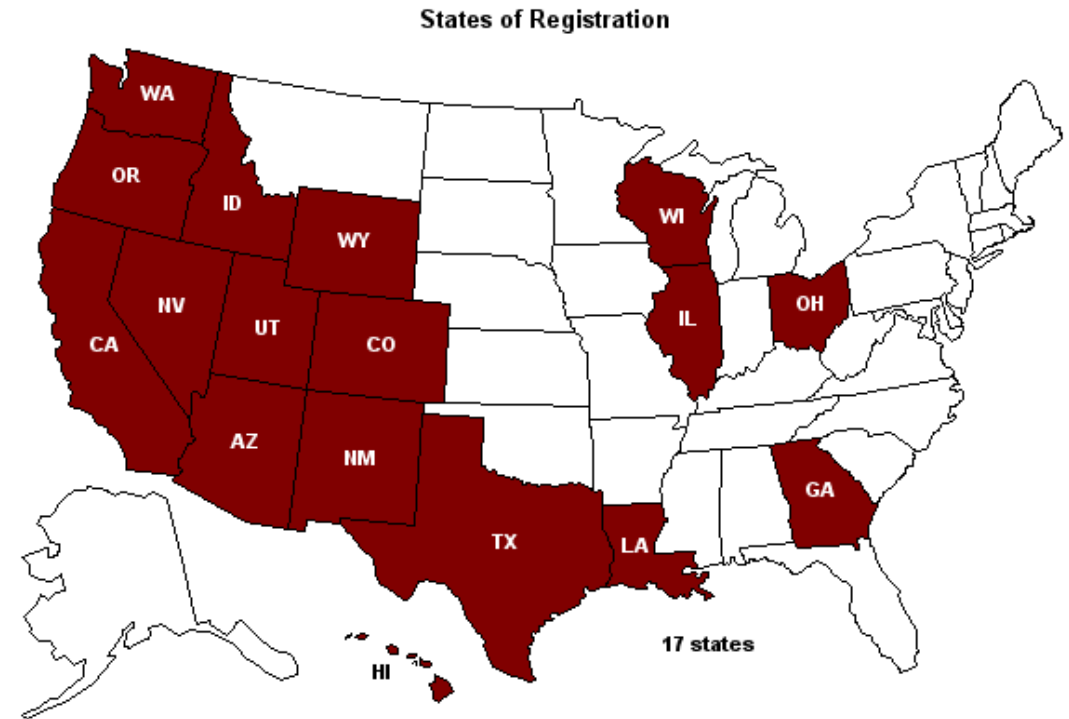
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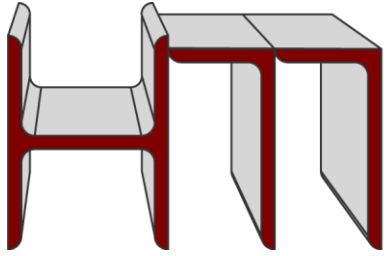
ABOUT HUBBARD MERRELL

- Founded in 2012 as a continuation of T.O.R. Engineering's Structural Department.
- Located in Flagstaff, AZ



- Licensed in 17 States primarily for Zip Line/Challenge Course work



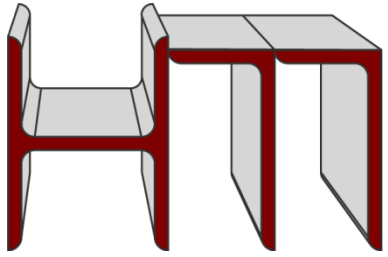


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HUBBARD MERRELL (CONT.)

- Currently employ 13 people including:
 - 5 P.E.'s
 - 2 Full Time Drafters
 - Expert in Challenge Course Operations and Inspections
- Began Challenge Course design in 2009.
 - NAU Challenge Course Relocation
 - Over 40 Challenge Course/Zip Line Projects Total

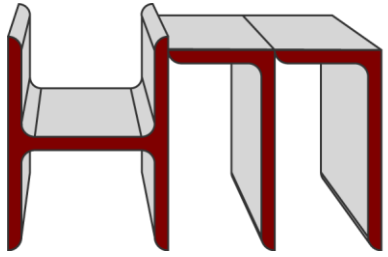




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NAU CHALLENGE COURSE

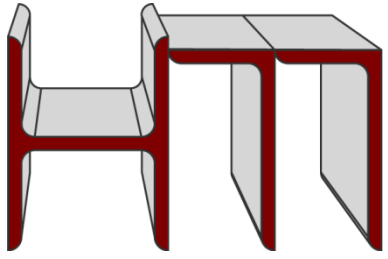




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NAU 'CHALLENGE' COURSE

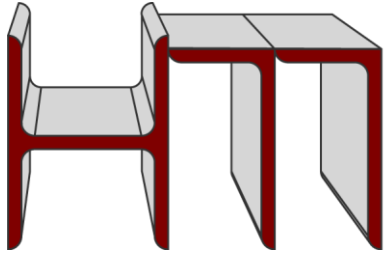
- Struggles:
 - “Standard” didn’t exactly cover structural parameters.
 - “Designer” had no input on connections or style.
 - Site had shallow rock – Standard utility pole installation did not work.
 - Our firm served as the Building Official for most university projects, so we had no forum for consideration.
 - Third party inspectors – Unqualified to inspect.
 - Knowledge of constructability limited.



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NAU 'CHALLENGE' SWING





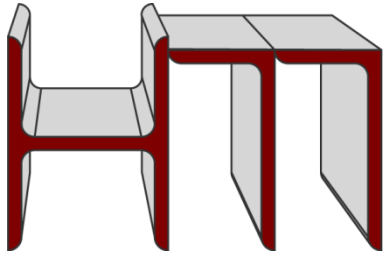
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CHALLENGES OF INNOVATION

- Standards
 - Quality
 - Alternate “similar” standards
- Jurisdictional Acceptance
 - Plan Reviewers
 - Inspectors
- Consequences on imperfection
- Unforeseen conditions
- Etc...

*When you innovate,
you've got to be prepared for
people telling you
that you are nuts.*

Larry Ellison - Co-founder, Oracle

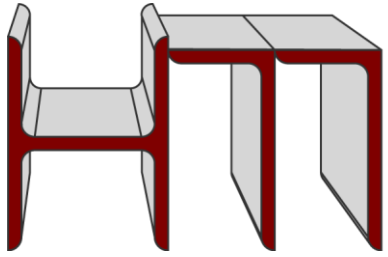


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TAKE THE 'CHALLENGE' OUT

- Be Proactive.
- Get Involved.
- Use sound engineering judgement.
- Let your client know what they are getting into.



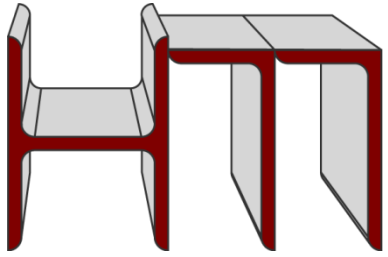


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BE PROACTIVE

- Know which standards may apply and which you'd like to live by
 - ADA
 - Building Codes
 - Jurisdictional Standards
 - Other Standards
- Contact the Building Official.
 - Determine the Standards they will hold you to.
 - Set a process for review and “determining conformance”

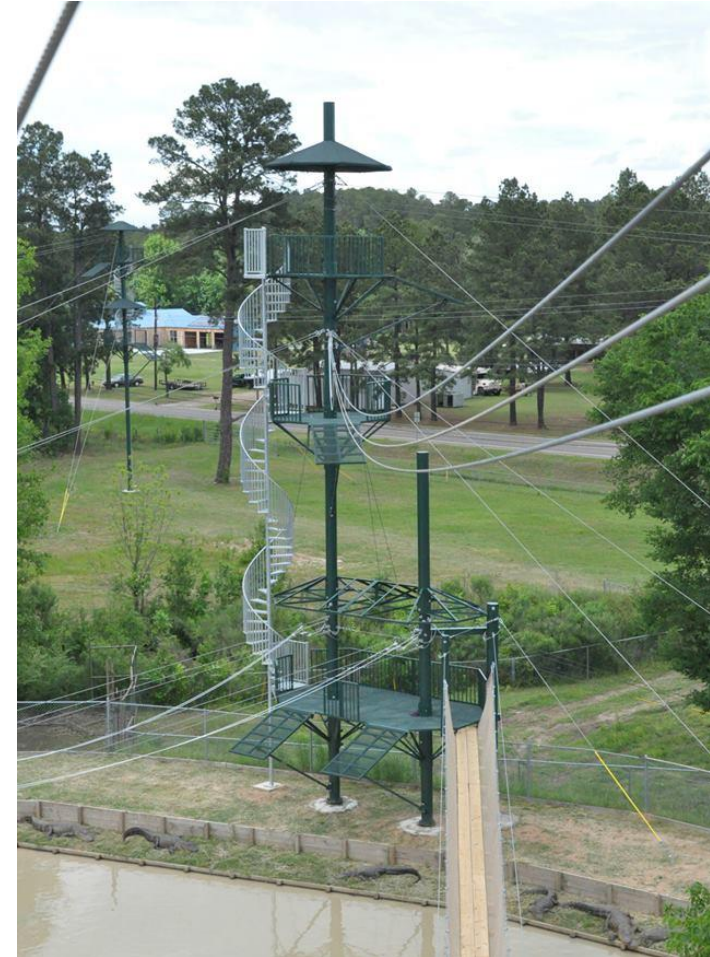


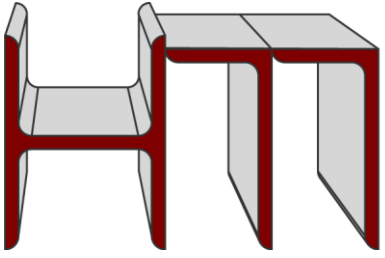


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GET INVOLVED

- Find Trade Associations and join them.
- Find an ANSI or ASTM standards writing group and discover their thoughts, plans and actions.
- Encourage jurisdictions to adopt “design friendly” standards.
- Get hands on with the final product.



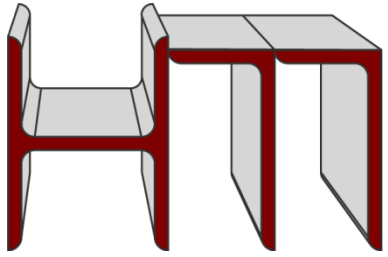


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USE SOUND ENGINEERING JUDGEMENT

- Don't use untested principles on untested projects.
- Have a peer double check your work.
- Break those old text books out.
- Find inexpensive places to be conservative.
- Ask others in similar situations what they are doing.



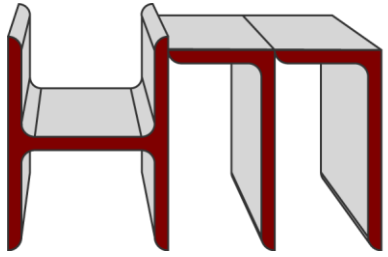


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LET YOUR CLIENT KNOW WHAT THEY ARE GETTING INTO

- “I don’t know” is a perfectly acceptable answer.
- Communicate, Communicate, Communicate.

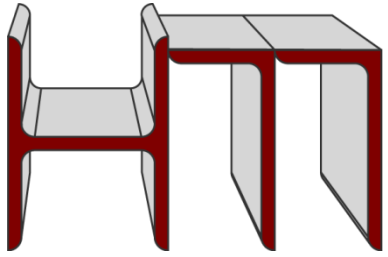




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LET'S GO FOR A RIDE





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ANY QUESTIONS?



ZipLines@HubbardMerrell.com