



A New Angle



Tutorial for "Structure" Team Managers



A New Angle: Session Overview

- Summary of Challenge
 - Two part wood structure
 - one on top of another
 - Testing description
 - Presentation element
 - merged Art Form



- Introduction to teaching basic structure techniques

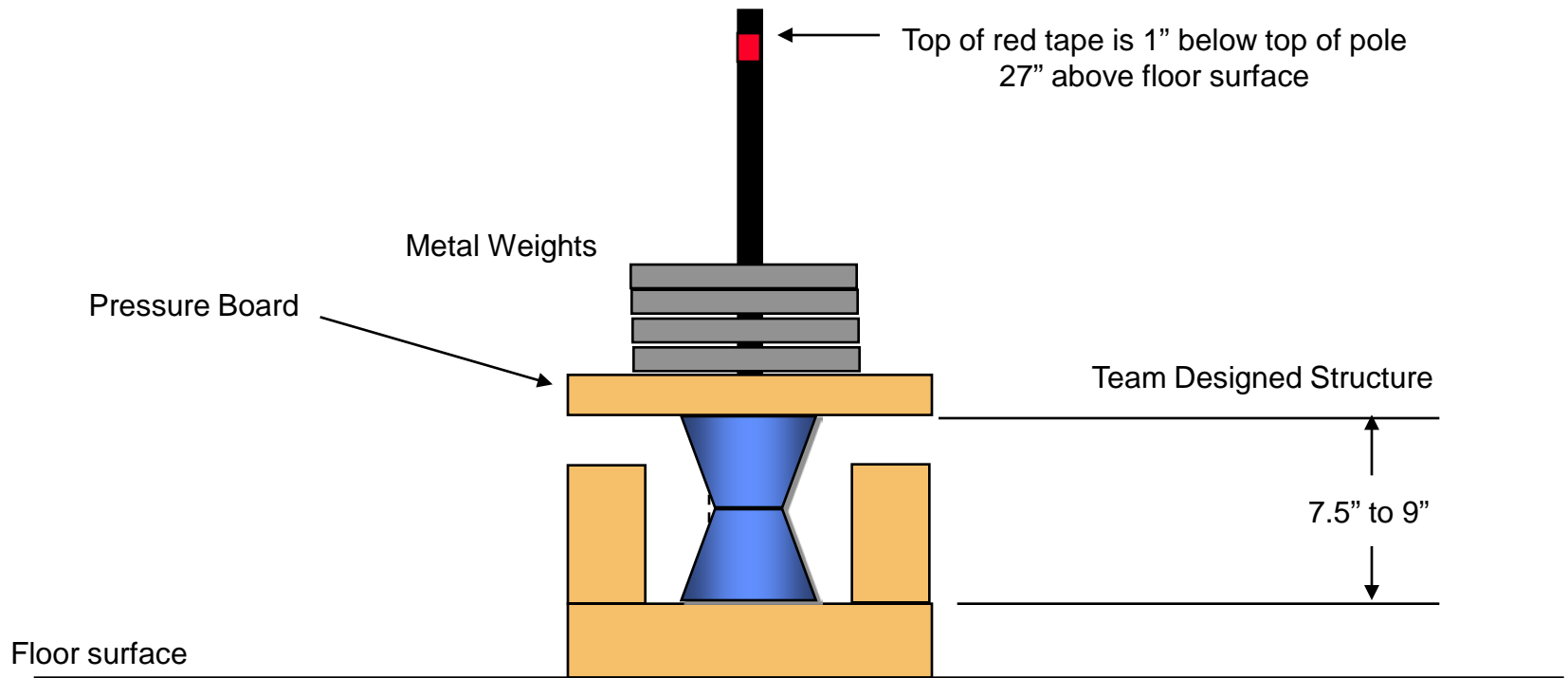


Challenge - Structure

- Read Challenge, Clarifications, Rules of the Road, Team Manager Guide
 - Structure Specification Details (relevant to two orientations)
 - Two-part structure made out of natural wood and glue
 - **7.5"** ≤ combined height above tester surface ≤ **9"**
 - **3.75"** ≤ each individual structure height
 - Small end of each structure must fit inside a 3" circle
 - Large end of each structure must fit over a 4"x4"x0.75" block w/o touching
 - Total structure wt. ≤ **30.0** grams (25 grams at States)
 - Combined structure fits over **2"** cylinder
 - Any wood allowed as long as it is just natural wood (no plywood, laminates, composites, coatings)
 - Glue may only be used as an adhesive (no exterior coating)



Tester setup



Traditional Tester

Combined Structure Tested



Challenge - Presentation Theme: New Art Form

- Story
 - Creativity of the **way in which 2 Art forms merge** to create a new Art form in story
 - Creativity of the **merged Art form** that is created
 - Integration of **Structure Testing** (placing of weights on structure) into story
 - **Overall effect** of the Story
 - Two Side Trips



Simultaneous Testing & Performance

- Setup, performance and weight testing all within 8 minutes
 - Team decides how performance and testing is staged



PERFORMANCE



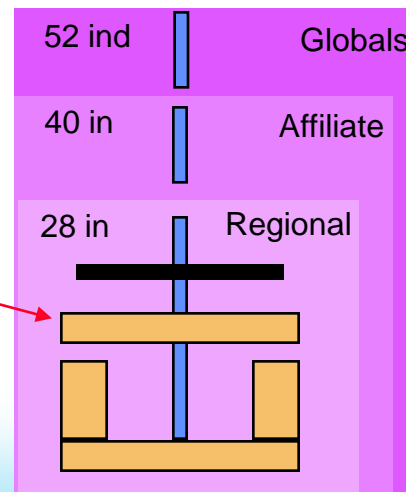
Structure Testing

■ Weight placement rules

- Adult assistant can help: $\geq 25\text{lbs}$ (Elementary & Middle Level)
(however, must be directed by team member and must share load)
 - Presser board initially must not touch pole
 - Weight placement ends if presser board touches any of 4 support posts, weights reach 1" below top of pole (effective 27" pole)
- 8 minute period ends, team elects to stop

Typical size weights:
5, 10, 25, 35, 45 lbs

Presser Board ~ 10 lbs
Pole - 28" floor to top of pole



Don't underestimate the kids!
(this stack over 500 lbs)



Closeup of a Tester

- Base alone
- Loaded with structure, presser board & weights



Presser Board supported ~1" above corner posts by structure



Structure Scoring

- Official Weight Held Ratio
 - Weight Held (in lbs) divided by Weight of Structure (in grams)
- Workmanship of structures



Overall Scoring

- Official weight held 38%
- Workmanship of structures 7%
- Story 15%
- Two Side Trips 15%
- Instant Challenge 25%



Tournament Day

- Bringing in Props, fixing everything
- Check-in (Structure checked in & weighed)
- 8 minute Presentation
- Instant Challenge
- Closing ceremonies





General Hints & Comments

- Insure that team correctly interprets requirements stated in Challenge
- Try to get a parent or teacher to build a tester, or see if you can do a test somewhere else (contact Regional Challenge Master). (guide for building structure tester available at www.dini.org, see resource links) (or check out www.madikids.org/tournament.cfm)
- The cost of materials used solely for testing & experimentation (i.e., test structures) is NOT included in your Challenge budget for tournament



Intro to teaching basic structure

- Wood
- Glue
- Tools
- Construction Area
- Forces
- Designing
- Jigs
- Summary



Helping teams learn about wood characteristics

■ Wood

- Wood comes in a variety of dimensions (sticks and planks).
- Hobby stores carry balsa and basswood (basswood generally denser and heavier)
- USA Balsa and SIG has a large assortment of wood (www.sigmfg.com)
- Factors to consider
 - Weight
 - Strength
 - Ease of use



Strength of Balsa Compared to other woods

	<i>Weight Lbs /Cu. Ft.</i>	<i>Stiffness Strength</i>	<i>Bending Strength</i>	<i>Compression Strength</i>
Balsa	8	72	70	75
Balsa	10	100	100	100
Balsa	14	156	161	149
Spruce	28	230	260	289
Yellow Pine	28	222	277	288
Douglas Fir	30	241	291	341
Hickory	50	379	638	514
Oak	48	295	430	366
Basswood	26	261	288	288
Black Walnut	37	301	506	512



Helping teams learn about glue characteristics

■ Glue

- Expose team to many different types of glue, read directions
 - Hot glue (fast prototyping method)
 - Super glue (CA glue)
 - Wood glue (Gorilla glue)
 - Epoxy
 - Carpenter's wood glue (Elmer's)
- Factors to consider
 - Strength
 - Drying time
 - Weight
 - Ease of use

Provide Adequate Ventilation !



Tools & Safety

- Tools such as saws, X-acto knives, and razors can be used to cut wood. When any sharp tool is used, sharp edges should always be directed away from flesh.
- Let team members experiment with cutting, sawing, and sanding wood with various tools. Encourage them to explore any tool they think will allow them to build better/easier.



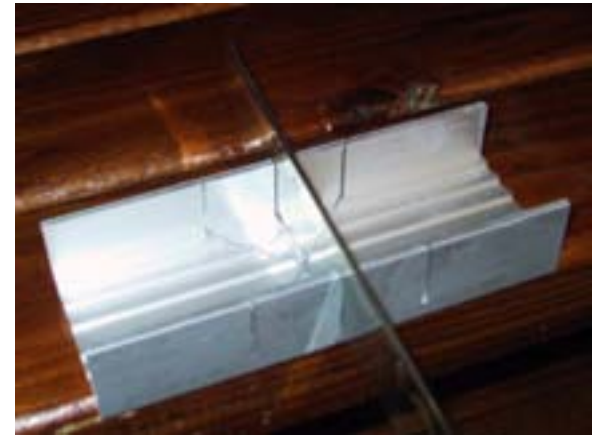
Useful tools



- X-acto fine tooth razor saw
- Plastic holder holding a single edge razor blade

Other useful building items:

- Flat tile or mirror
- Building square
- Emery boards, sand paper



- small aluminum mitre box for razor saw

***All tools should be readily available to consumers
and of the team's own choosing***



Other Useful Things to Have

- Gram scale accurate to 0.1 grams
 - Permits weighing wood and completed structures
 - Ohaus has a low-cost one (<\$90) but you can probably borrow or get access to one (school lab, workplace, post office, police station (ask for confiscated scales)).
- Hair Dryer
 - Speeds up glue drying
 - Removes excess moisture from wood (weight)



More Useful Things to Have

- **Structure Tester**

- TM or other parents are allowed to construct a tester for the team
- Instructions are available (www.madikids.org/tournament.cfm)
- Try borrowing a tester

- **Weights**

- Olympic style flat metal weights (2" hole)



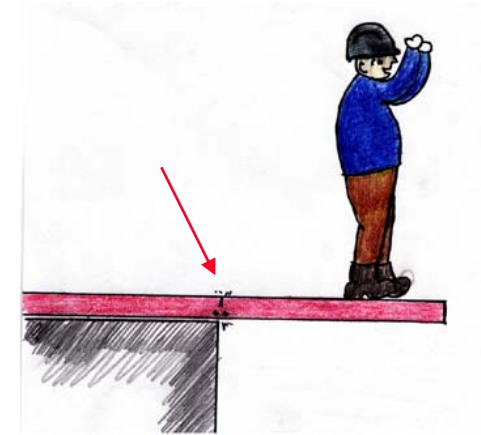
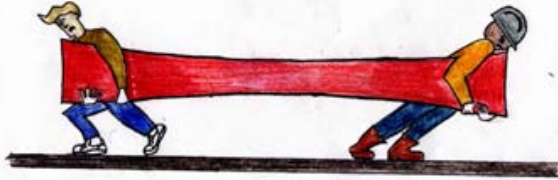
Construction Area

- A large open table, where team can place building jigs, weigh wood, saw and cut materials, assemble, & finish structures
- Cover the table top (sheet of thick plastic or masonite) (unless you like scratch marks to give it that antique look).
- Make sure that work areas are kept well ventilated, especially when teams are using glues with harmful vapors.

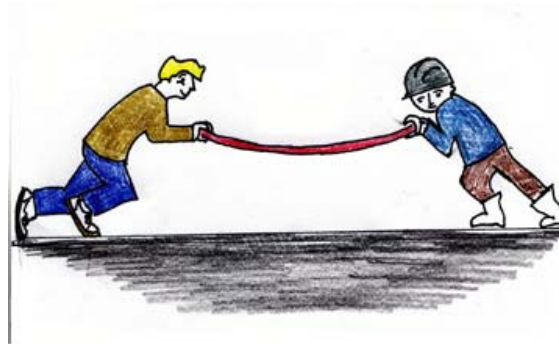


Forces at Work

- Compression



- Tension



- Shear



Qualities of good structures

- **Strength**
 - Buckling is a failure mechanism where long thin members loaded in compression end up “bowing” (& eventually breaking) near the middle (Depends on length, cross-section and material)
- **Stability**
 - Many structures “fail” because they start to lean -- and the leaning loads one side of the structure more than the other.



Basic structure design

- Sources for basic design ideas
 - Any books with pictures of structures (water towers, antennas, watch towers, cell telephone towers, power line towers, etc.). Take them on field trips.
 - Introductory structure books (see list later in presentation)
- Small scale experiments for basic single structure
 - Give teams short-term challenges such as structures out of soda straws and tape to hold up books
 - For those adept with balsa wood, construct structures out of balsa
 - Focus on BASIC principles, such as which structural members hold up weight, and which pieces provide stability



Building to a plan

■ Plans

- Can be drawn on graph paper or more consistently using a computer
- Plans take design ideas and provide a blueprint for building
- Allows them to keep records of designs and performance
- Team manager should encourage team to brainstorm alternate assembly orders/processes. However team decides which they like best.



Using Jigs

- It would be Interference for a Team Manager to insist the team use a jig, but it is OK to expose them to the concept of jigs.
- “construction jigs” to hold pieces in place for gluing,
 - Simple foam squares (thick pink insulation) (with aluminum square or other straight edges)
 - pin drawings to foam (Dress T-pins are easy to use)
 - pin wood to drawing and against square forms
 - Metal background and magnets to hold pieces
 - Custom wooden frame jigs
- Teams must build the jigs that they use





Experiment

- Let team build and test structures
- Help them learn what broke
- Remind them to keep a log
- Let them figure out how to improve design
- Keep experimenting



Thoughts on Structure Teamwork

- Try and involve all team members early on
 - Everybody can contribute design ideas
 - Have team explore their skills and competencies in all areas related to the challenge
- As season progresses, insure that everyone is involved with some aspects of solution



Final Thoughts

- **Keep it simple, straight, level, and well-glued**
- The goal of ALL DI problems is to encourage the kids to learn, stretch themselves and have fun. Kids that really enjoy the structure problem will begin to see the structure in everything around them. They will question WHY things they see were designed the way they were. This awareness, appreciation and curiosity is perhaps the greatest benefit this problem has to offer.



Good Texts to Teach Kids Structure

- Messing Around with Drinking Straw Construction, Bernie Zubrowski, Little, Brown & Co, Ltd, 1981, ISBN 0-316-98875-8, 164 pgs, Grades 3-Adult
- Building Toothpick Bridges, Jeanne Pollard, Dale Seymour Publications, Palo Alto, CA, 1985, ISBN 0-86651-266-7, 32 pgs, Grades 5-Adult
- Structures, Bernie Zubrowski, Cuisenaire Company of America, White Plains, NY, 1993, ISBN 0-938587-35-8, 96 pgs, Grades 5-Adult (Excellent)
- The Art of Construction, Mario Salvadori, Chicago Review Press, Chicago, IL, 1990, ISBN 1-55652-080-8, 200+ pgs, Grades 6-Adult (Excellent)

These can be hard to find in bookstores or libraries. However, they all can be ordered on the web from www.amazon.com

Check out our MADI sales table for books on structures and building



Useful Websites for Information

<http://structure.texasdi.org>

great tutorial site for new structure teams (Diary of a Balsa Goddess)

http://www.farnorthdi.org/ResourcePages/Structure/Structure_Team_Resources.htm

lots of great tips and resources for structure teams

<http://www.pbs.org/wgbh/buildingbig/lab/index.html>

Great interactive tools for kids to learn about structure and forces

<http://www.madikids.org>

Resource links for this presentation, Intro presentation and How-to guide for building your very own tester



Useful Websites for Buying Balsa and other hobby woods

<http://www.sigmfg.com>

Very high quality balsa, spruce, basswood. CA glue (tips) and tools. Tell them the balsa is for Destination Imagination and they may give you a discount on the balsa portion of order. Shipping is free for some minimum size order (ask).

<http://www.zimsweb.com/balsa/>

Great links for balsa structure information. This site sells balsa at specific weights. You pay more for the pre-sorting. They are very responsive and let you know right away what they have.