



Fox Valley United Way

# Boat Building Basics



## How To Build Your Cardboard Boat



# Construction Rules

- The ENTIRE boat must be built of cardboard, duct tape, and one-part polyurethane.
  - Only exceptions are the paddles & decorations
  - Use Cardboard boxes, “blocks”, carpet tubes
  - NO pre-treated cardboard allowed
    - No Sona-Tubes, waxed or ‘treated’ cardboard
  - NO wood, plastic or fiberglass
  - NO caulking compounds or two-part/mixed adhesives
  - NO wrapping in duct tape, plastic or fiberglass
    - Duct tape may be used to reinforce seams

# Construction Rules (continued)

- Waterproof the boat with Varnish, Paint or Polyurethane (one-part, paint-like substance)
- Decorations are encouraged - as long as they don't effect structural strength or buoyancy
- The crew compartment CANNOT be enclosed so as to interfere with escape
- Every crewmember must wear a personal floatation devise (PDF) and proper footwear





# Construction Materials

## Permissible Materials

- Corrugated Cardboard
  - Appliance or grocery stores
- Cardboard “blocks”
  - Furniture stores
- Cardboard Tubes
  - Carpet/linoleum stores
- Fastening material
  - Duct or masking tape
  - Liquid nails adhesive
  - Latex Paint, Varnish

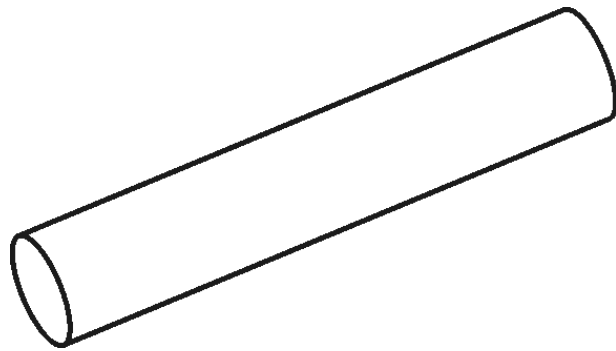
## Materials NOT Allowed

- Wood, Styrofoam
- Plastic sheathing
- Fiberglass
- Sona-Tubes, coated cardboard
- Silicon, Wax, Tar
- Caulking compounds
- Metal
- Staples, clamps, screws

**Judges decide on the  
Interpretation of the rules**

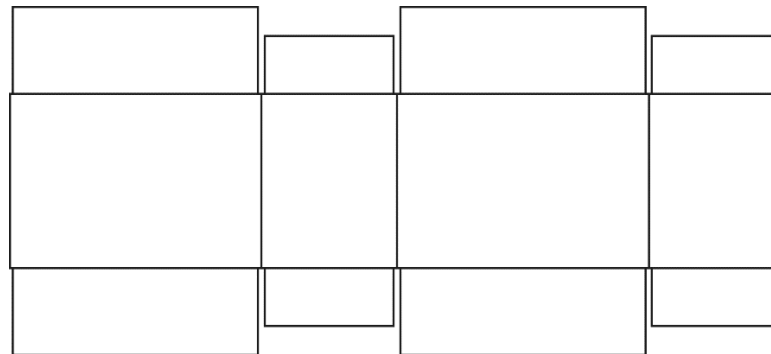
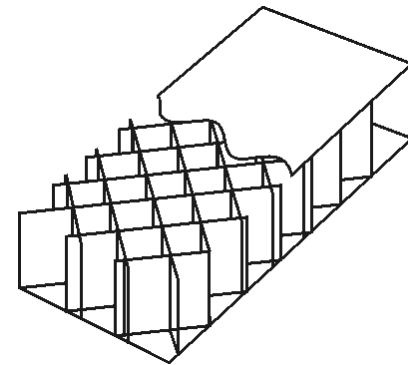
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# Construction Materials (examples)



Carpet Tube  
(about 4 1/2" dia.)

Cardboard  
Block  
(2-3" thick)



Cardboard Box - cut open

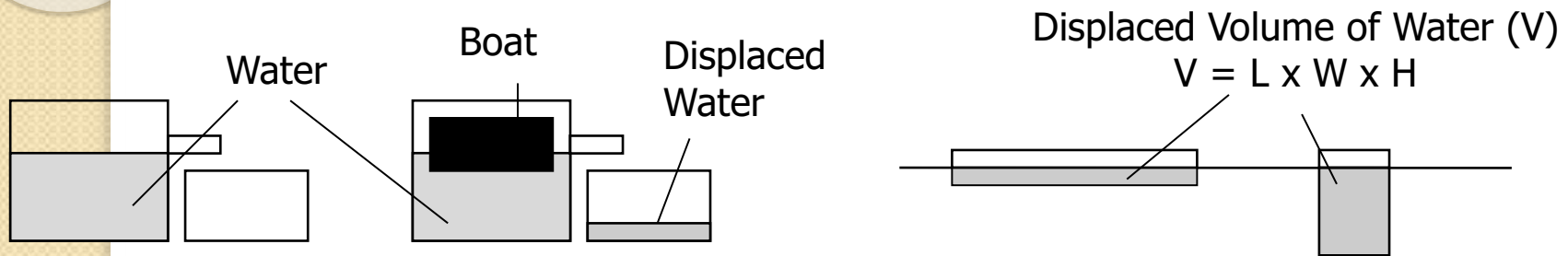


# Cardboard Boat Design

- Consider size - building & transporting
  - Big enough to hold crew, small enough to carry
  - Wider is better, but still be able to paddle
    - No surfboard style designs are allowed
    - Rafts are allowed
  - Consider total weight of all materials when wet
  - EVERYTHING must be removed from the lake
- Boat decorations and crew costumes are encouraged - use your imagination you will be awarded for your creativity!

# Cardboard Boat 'Physics'

- "How much will you sink?" - Displacement



Weight of Water =  
62.4 pounds/cubic-foot

$$\text{Water Displaced(ft}^3\text{)} = \frac{\text{Weight-of-boat-\&-people-lbs}}{62.4 \text{ lbs/ft}^3\text{-H}_2\text{O}}$$

Depth(ft) boat sinks \_\_\_\_\_

## Example:

Box boat, 3 ft X 6 ft, 1ft tall (high)

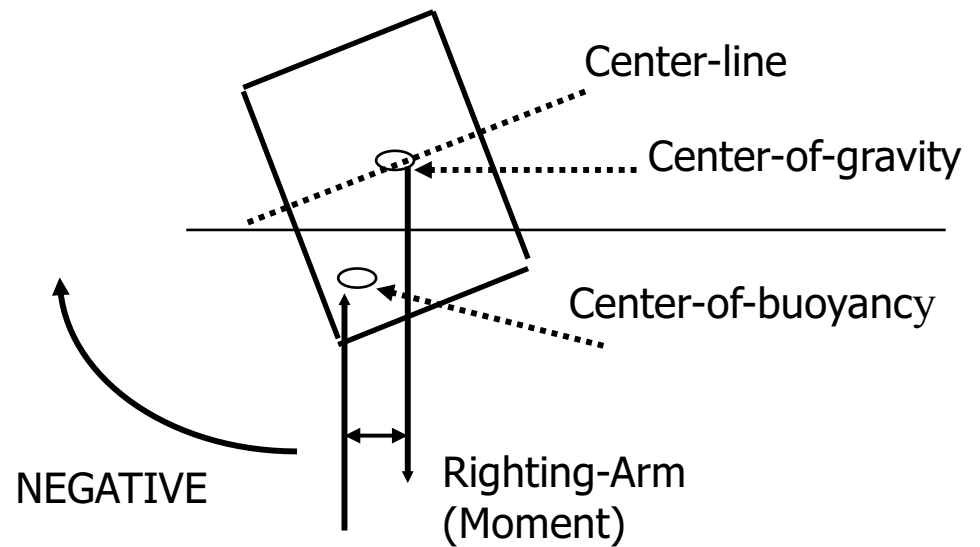
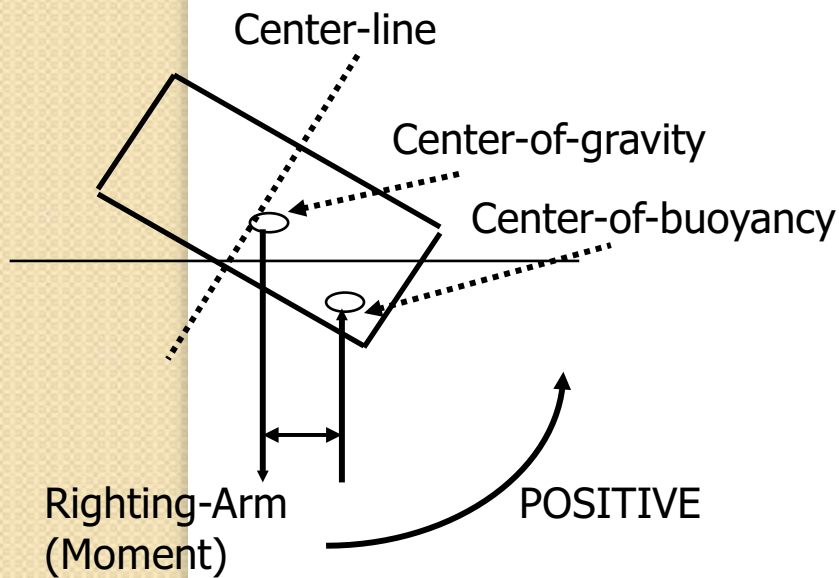
Boat volume = 3' X 6' X 1' = 18 ft<sup>3</sup>

Boat displacement = 18 ft<sup>3</sup> X 62.4 lbs/ft<sup>3</sup> = 1123.2 lbs

Which equates to 93.6 lbs per inch of boat height

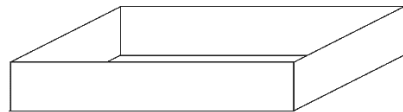
# More Cardboard Boat 'Physics'

- "Wider is Better" - Center of Buoyancy

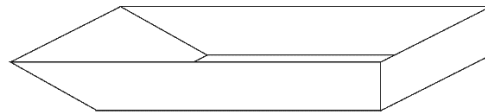


# Even More Cardboard Boat 'Physics'

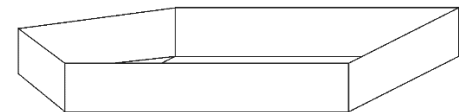
- Movement Through the Water



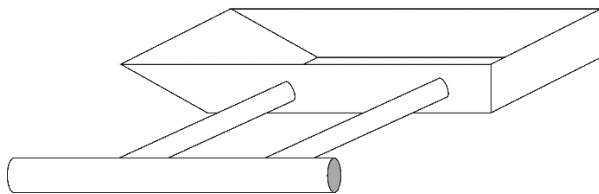
Simple  
Box



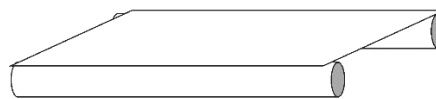
Slanted  
Box



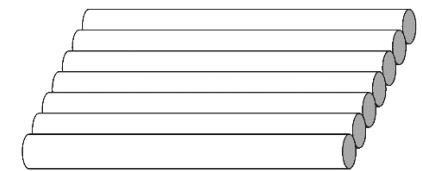
V-Shaped  
Bow



Outrigger  
Design



Pontoon  
Design



Raft  
Design



# Cardboard Boat Design Suggestions

- Set the Design Goal: Fun, Speed and Appearance
- Sketch out your design
  - build a scale model from manila paper:
    - estimate materials or plan how to use what you have
    - plan out what construction techniques will be used
- 1'x1'x3' box: will float 187 lbs.
  - if it'll hold you, it's big enough to float
- Flat bottom, sit-to-paddle & canoe styles - are the best/easiest
- Rudders help keep you straight but make turning difficult and adds complexity to your design.



# More Cardboard Boat Design Suggestions

- Long boats go fast - but are harder to turn
- Short boats (<8') - are difficult to keep straight
- Best Length: 8-12 feet
- Best Height: 18 inches
  - allows room to sit/kneel & still paddle over the edge
- Best Width:
  - 18"- 30"(max) for 1 person
  - 48" wide for 2 people side by side
- Kneeling is a "power" position but sitting is more comfortable



# Construction Tips & Techniques I

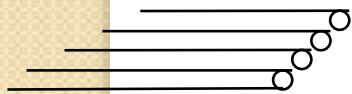
- Cover all edges of cardboard - acts like siphon
- Cardboard Tubes make great frames
  - Cut for joining & bending
  - Fasten tubes together
- Cardboard Hull
  - 1-2 layers, fasten & cover the seams
  - With 2 layers, overlap the seams & polyurethane in between
  - Decorate, paint & varnish
- Reinforce the area where you sit, kneel or stand



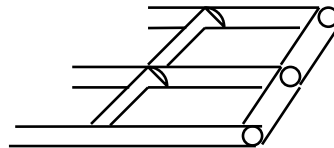
# Construction Tips & Techniques II

- Carpenter's glue and liquid nails work well
  - hot-melt glues will melt in the heat and sun
- Duct tape only non-painted surfaces (tubes or frame that will be covered)
  - Duct tape shrinks when painted
  - Duct tape should be covered with masking tape if you need to paint it
  - Clear tape melts when painted
  - Masking tape works well on glued edges & seams
  - Kraft paper with spray adhesive may also be used

# Construction Tips & Techniques III



Solid Tube  
Frame

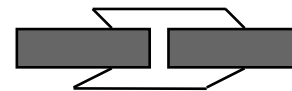


Center/Cross  
Beam  
Frame

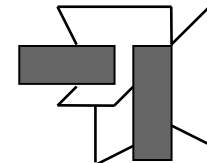
## FRAMES

## CONNECTING TUBES

Cardboard  
Wrapper for Tubes  
End-to-End

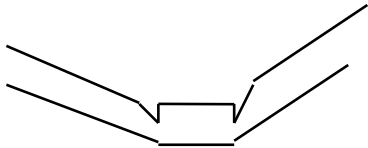


Cardboard  
Wrapper for Tubes  
At Right-Angles

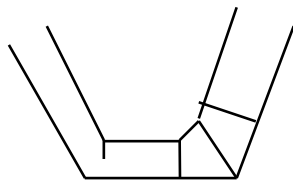


# Construction Tips & Techniques IV

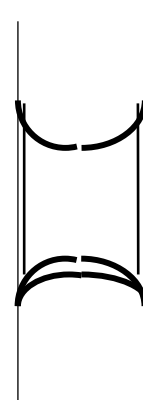
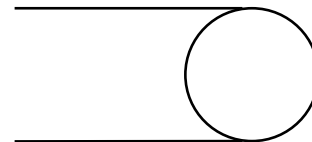
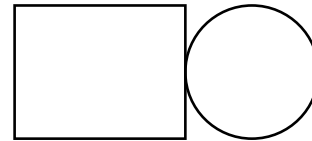
## FRAME ANGLES



V-Shaped Cuts

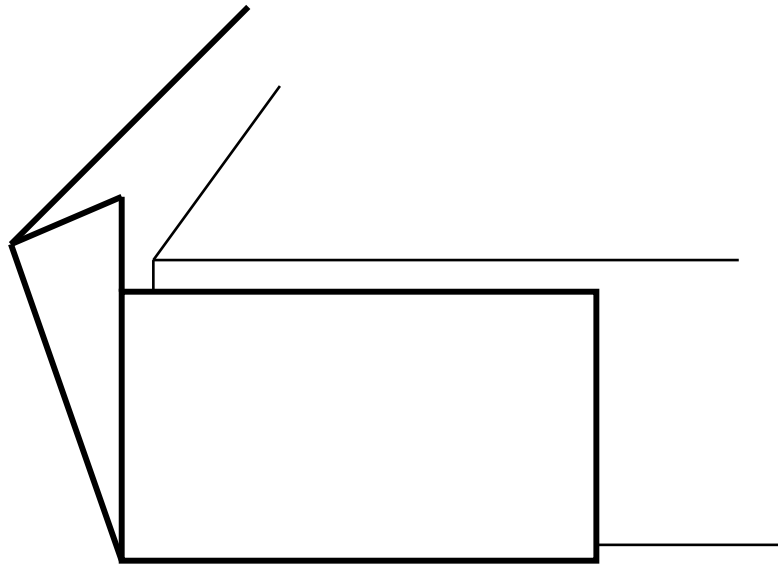


Multiple Cuts  
for Sharper Angles



## TUBE CUTTING TEMPLATE

# Construction Tips & Techniques V

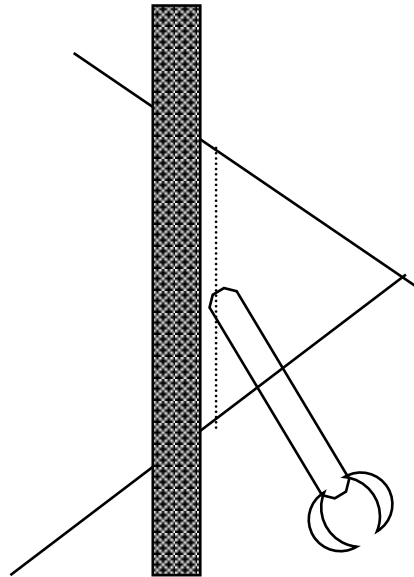


FOLD & OVERLAP  
CARDBOARD  
AROUND CORNERS

# Construction Tips & Techniques VI

Crease/Score a line  
for a nice

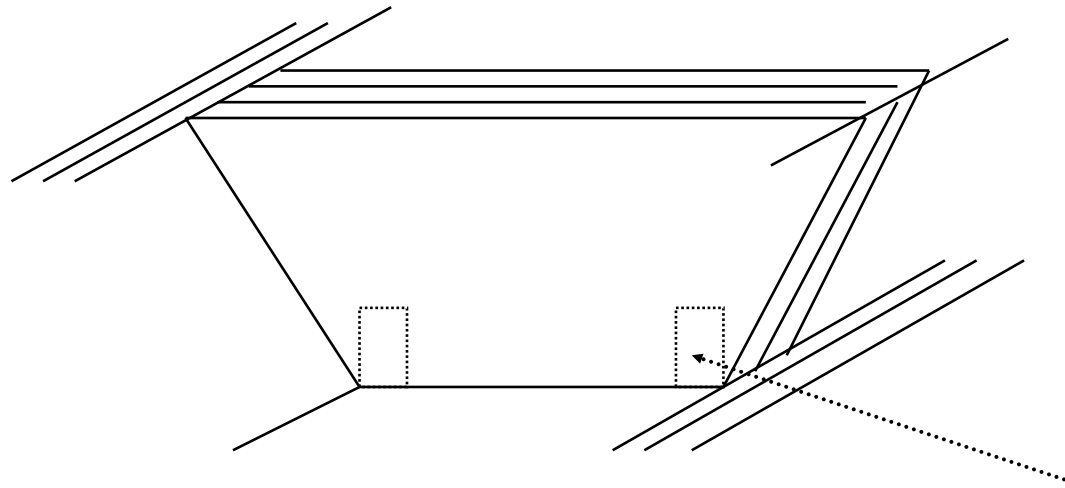
STRAIGHT  
FOLD



# Construction Tips & Techniques VII

Multiple cardboard layers  
"glued" together on the sides  
*strengthen the hull*

Multiple trapezoid-shaped pieces  
"glued" together to form a  
*"support block"*



A sheet of cardboard  
could be folded &  
"glued" together to  
form *tubes/beams*

