New Town

Cardboard Boat Regatta

Boat Building Manual

Benefiting the American Cancer Society

Boat Building Basics

Developing a concept:

- Sketch yourcreative ideas on paper
  - Calculate length, width, height, draft, balance
  - Consider size and weight of crew
- Build a scale model

Preparing for construction:

- Secure adequate work and storage space
- Gather supplies

Suggested supplies:

- Corrugated cardboard - three layers for floor, two layers for walls
- Acrylic latex caulk
- String line of straight edge; right angle or squaring tool
- Wood glue, liquid nail panel adhesive, or DAP contact cement
- Water sealer; polyurethane
- Foam brush
- Paint brush or roler; paints, including latex house paint
- Paper tape, masking tape - NO DUCT TAPE
- Creasing tool (scissors work well)
- Clamps (spring & quick)
- Measuring tape

Construction steps:

- Transfer model concept to cardboard
- Mark lines
- Cut cardboard
- Brace
- Glue
- Tape
- Seal
- Waterproof

Being creative:

- Develop a theme

Paddling:

- Types of paddles - canoe or kayak oars only
- Consider whether you'll be rowing alone or with others

Testing:

- Test prior to the event or take your chances on race day!

Remember this is a fun event!

Sinkings are just as much fun for spectators as award-winning times are for participants!

Rules & Regulations

Construction rules & supplies:

- Any thickness of corrugated cardboard is permitted, but waxed cardboard
- Tape may only be used on seams, joints, or patches.
  - *DO NOT WRAP IN PLASTIC, SHRINK WRAP, OR ANY OTHER MATERIAL*
- Caulking may be used, but only on seams and edges.
- A one-part enamel or lacquer paint and/or polyurethane varnish or water seal is permitted.
  - *DO NOT USE TAR-BASED SUBSTANCES, FIBERGLASS RESIN, OR ANY TWO-PART SUBSTANCES INCLUDING TWO-PART VARNISHES/PAINT*
- Applied paint must be allowed to dry for at least 24 hours prior to launching
- Styrofoam or other flotation-type foam is a major no-no. Violators will be branded pirates.
- There is no restriction on decorative materials, as long as they do not aid in the flotation or propulsion of the boat and do not create a fire or safety hazard.
- All boats must display the assigned entry number on a vertical surface of the boat. The number must be at least 6” tall.

Safety Rules:

- All boat occupants must wear appropriately-sized, properly fastened U.S. Coast Guard-approved life jackets.
  - *LIMITED SUPPLY AVAILABLE ON RACE DAY. IT IS BEST TO BRING YOUR OWN*
- The passenger area of the boat much not be permantently enclosed above the shoulders of the occupants. Each occupant must be visible while the boat is in the water.
- Boats must be free of sharp edges or anything that could pose a danger.
- ALL PARTICIPANTS MUST BE ABLE TO SWIM.

Race Rules:

- Each boat must have a designated captain. The captain must check in at the registration area on the day of the race during the designated time.
- To qualify as a finalist, particpants must correctly navigate the race course around the buoys and all crew members must be in the boat as it crosses the finish line.
- Boats with the fastest times in the time trials will advance to the semifinals, and/or finals.
- Filming of a perceived violation will not be viewed or considered. The offical spotters have the final say.
- ANY BOAT NOT READY TO RACE AT THE DESIGNATED TIME WILL BE DISQUALIFIED.

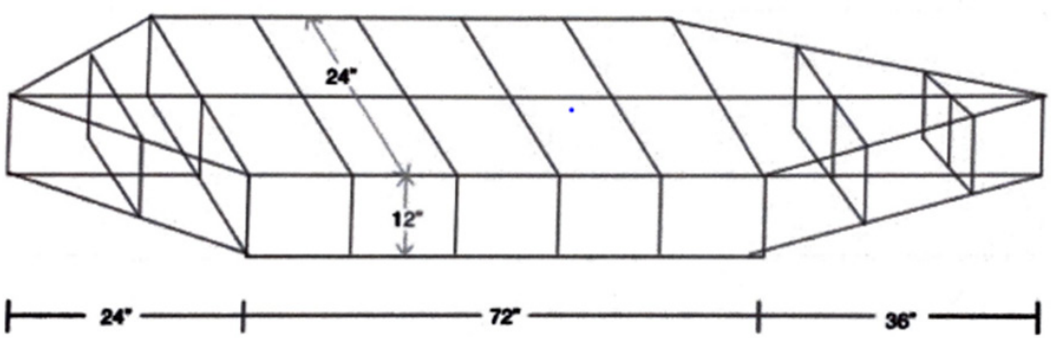
Boat Design Fundamentals

Before you develop a concept, consider these fundamentals of boat design.

A boat floats in the water and displaces a quantity of water equal to the weight of the boat and the crew. If the weight you put into a boat is greater than the weight of the water the boat displaces, the boat sinks.

Water weighs approximately 60 pounds per one cubic foot (12” x 12” x 12” cube).

For illustration, let’s look at the smallest size boat, a guppy with a single crew member. Once you understand this example, it’ll be easy to calculate for a larger boat.



The above boat sketch is 24” wide, 12” high, and 72” long with an additional 24” tail and 36” nose, which makes the overall length 132” or 11 ft. The inside volume of the boat is 17 cubic ft. (L x W x H - 6’ x 2’ x 1’ = 12’, plus 2’ for the tail and 3’ for the nose). As we stated earlier, water is 60 pounds per cubic foot; therefore, this boat’s total displacement weight is 1,020 pounds (17’ x 60 lbs.).

The side of the boat is 12” high; therefore, it takes 85 pounds to push the boat down into the water 1” (1,020 lbs. divided by 12 = 85 lbs.). If a single crew member weighs 170 pounds, the boat will be pushed down into the water 2” (a 2” draft or waterline). The weight of the boat was not included in these calculations, so the actual draft would be slightly higher. a 2” draft gives the boat approximately 10” before water enters the boat from a wave.

That’s the basis of floating (designing) a boat with one crew member. If you put two crew members in this boat (add 175 lbs.), the draft would be 4” and would leave only 8” to the top of the boat - maybe okay for smooth water, but a little wave action might sink the boat.

Therfore, more crew members require a larger boat to displace more water and still keep the draft small relative to the side of the boat to protect from wave action and sinking.

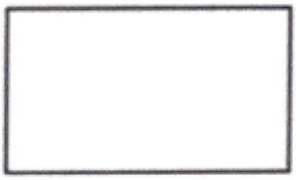
Now, let’s look at other aspects that influence the final design of the boat, such as:

- Hull and Prow Types
- Stability
- Balance

Types of Hulls

Hulls with flat surfaces are easier to build but not as stable in the water as others.

A



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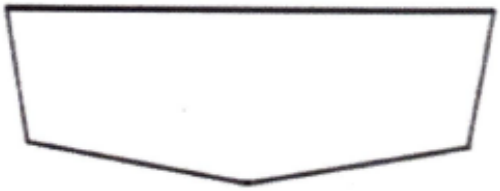
C

D



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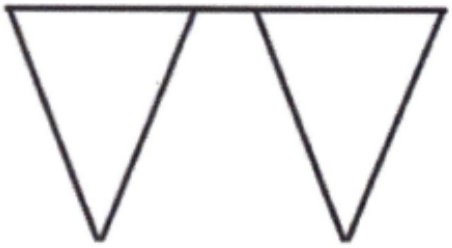
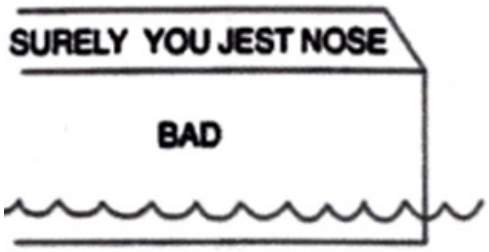
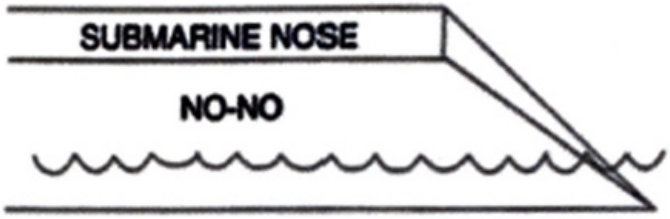


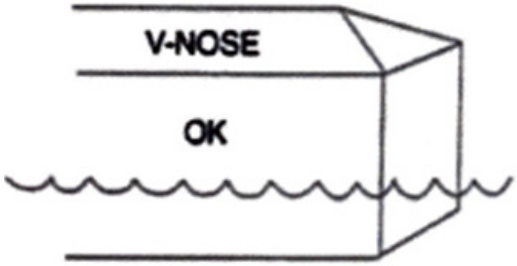
F

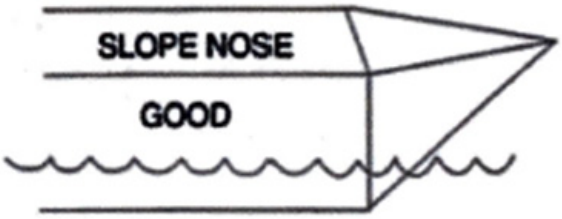
Types of Prows

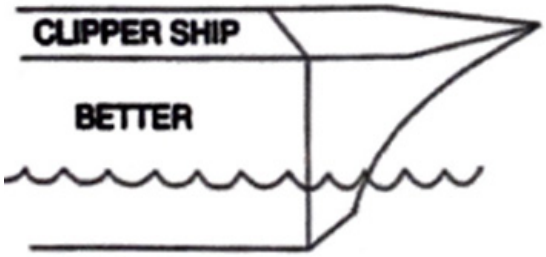
Some prow types deflect water better in wave action than others. Keep in mind that you'll need to blend your prow shape with your hull bottom shape or "footprint". Consider where the waterline will be when your boat is loaded.

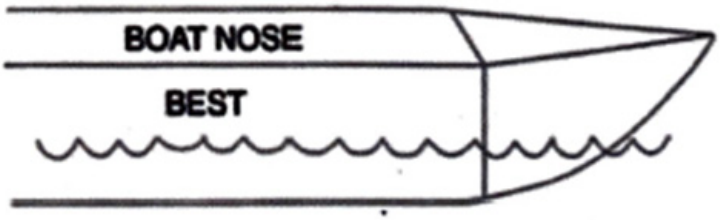








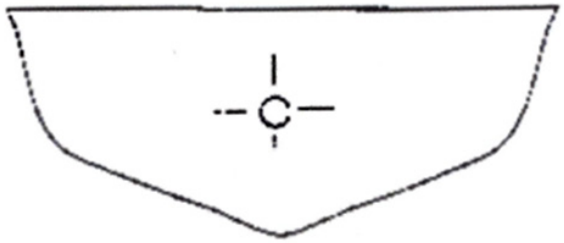




Boat Stablity & Design Creativity

Center of Gravity:

The next area to consider is boat stability. The sketch below shows a cross section of a hull and the center of gravity (cg). As crew members position themselves in a boat, some of their body obviously sticks out of the boat. the lower the crew sits in the boat, the lower the cg. Your goal is to make the cg at or below the waterline or draft. This makes the boat more stable and more difficult to tip over.



Balance:

The balance of the boat forward and aft is also very important for proper performance. The center of the boat forward and aft is approximately in the middle of the boat. When positioning the crew, keep the most weight to the rear of the boat. By doing this, the prow will tend to stay up in rough water, keeping water from entering the boat from the front.

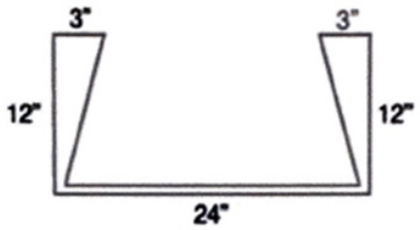
Design Creativity:

So far, we've only discussed the technical issues of the boat design. The more creative part of your boat building project is the boat's theme and decoration for both the boat and crew. The sky's the limit as long as you follow basic construction and safety rules, which are listed in the back on this packet.

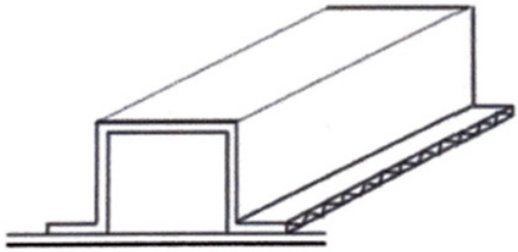
Your boat could look like a Viking ship, a row boat, a battleship, or a tug boat. It could be built like a banana, a tube of toothpaste, or a school bus! Let your imagination be your guide!

Construction Techniques

Cross section of boat using a large piece of cardboard

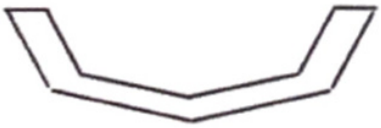


Stiffeners glued to the inside bottom and side of the boat add strength

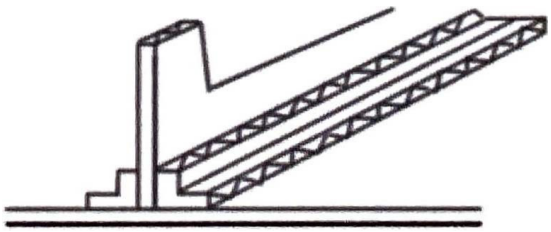


Stiffeners run the length of the boat

Attaching bulkheads to adjacent cardboard (outer boat skin)



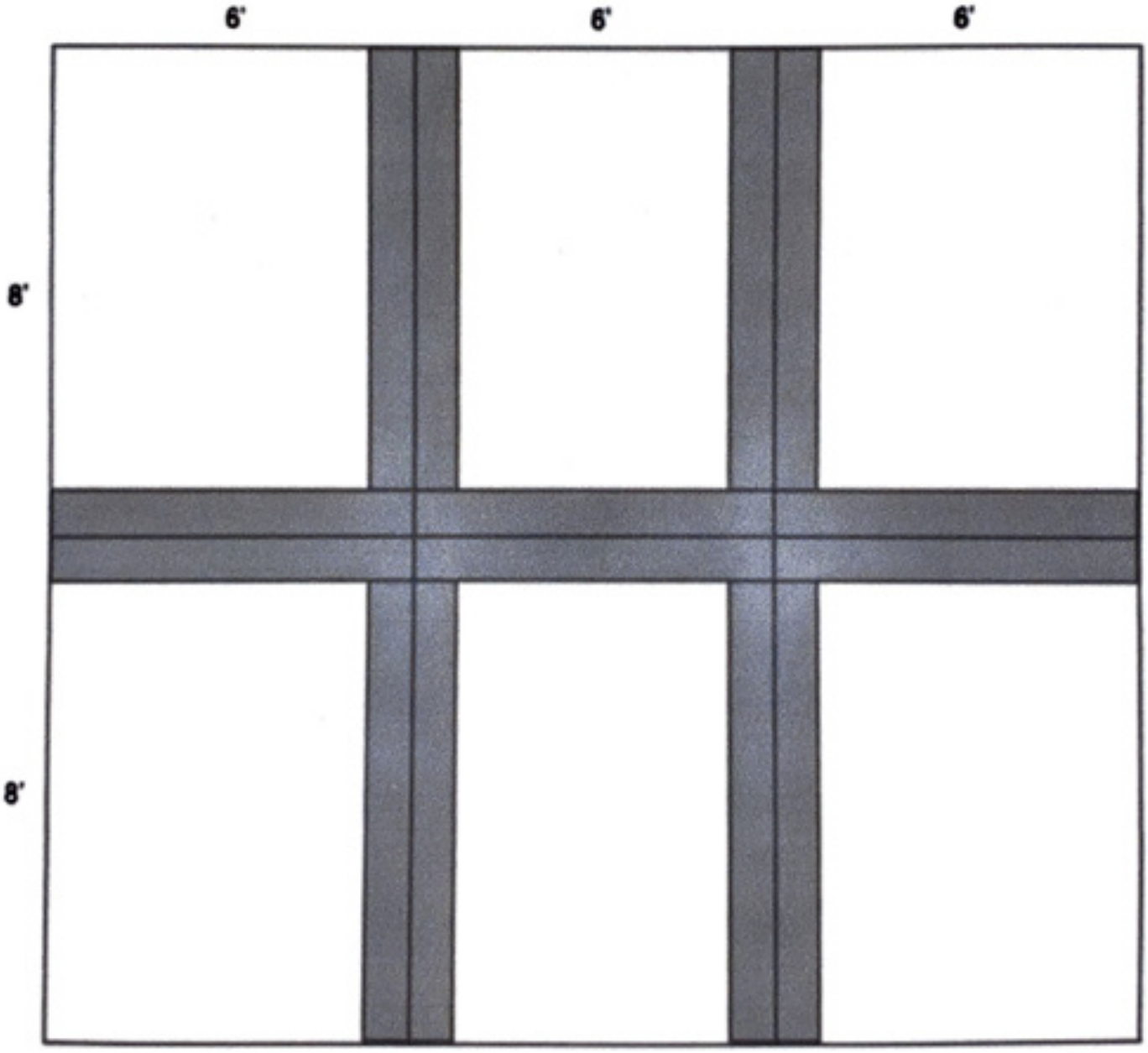
Bulkhead side view

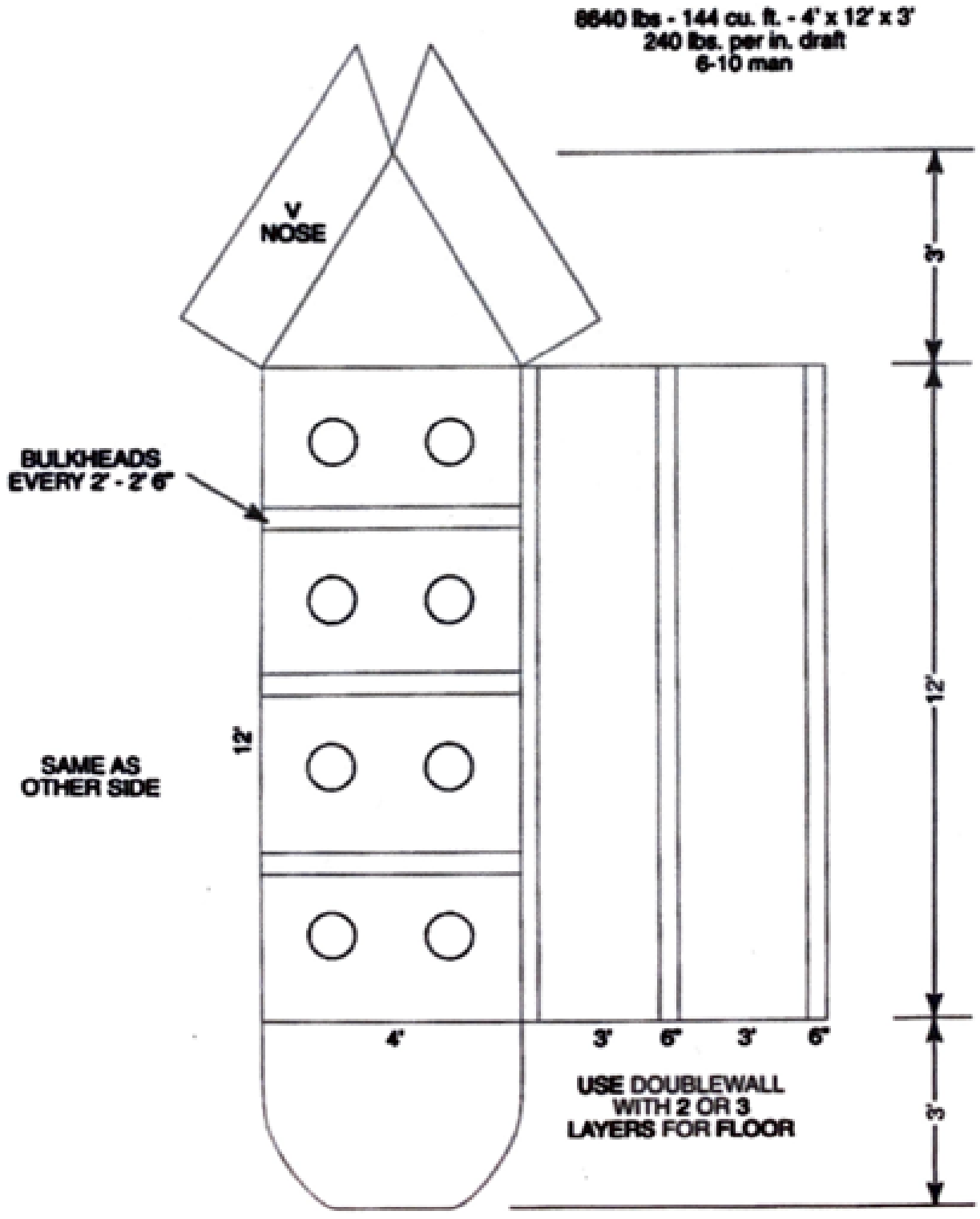


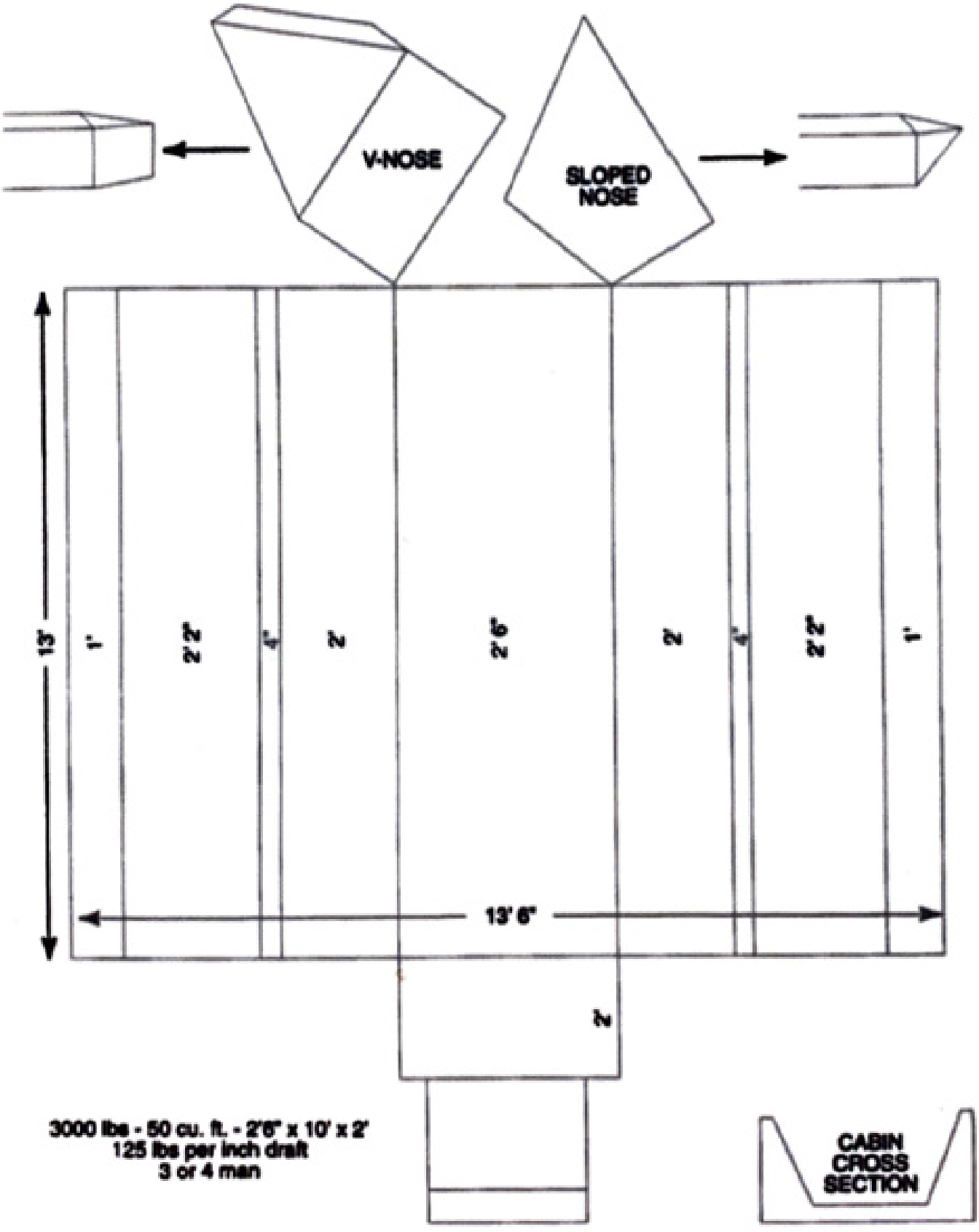
How to attach bulkheads

Construction Concepts

If possible, cut your boat from one sheet of cardboard. Several sheets of cardboard can be spliced together to make a big sheet. Splicing 6 x 8' pieces creates one 18 x 16 piece.




6640 lbs - 144 cu. ft. - 4' x 12' x 3'
240 lbs. per in. draft
6-10 man
V
NOSE
3'
12'
3'
BULKHEADS
EVERY 2' - 2' 6"
SAME AS
OTHER SIDE
12'
4'
3'
6"
3'
6"
USE DOUBLEWALL
WITH 2 OR 3
LAYERS FOR FLOOR


V-NOSE
SLOPED NOSE
13'
1'
2' 2"
4"
2'
2' 6"
2'
4"
2' 2"
1'
13' 6"
2'
3000 lbs - 50 cu. ft. - 2'6" x 10' x 2'
125 lbs per inch draft
3 or 4 man
CABIN CROSS SECTION