2nd Annual Eastern Shore Crab Boat Engineering Challenge Rules

https://www.umes.edu/Tech/CrabBoat.html

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The University of Maryland Eastern Shore
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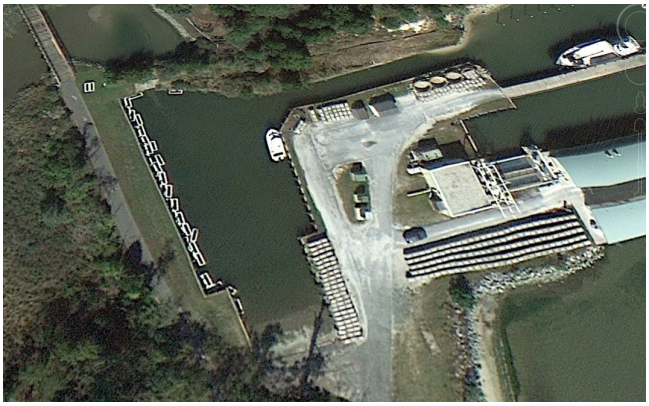
Grades:
9-12



Information/Rules Meeting:
October 12, 2016

Coaches Design/Build Workshop:
January 11, 2017

Registration Deadline with Names of All Team Members:
February 17, 2017

Written Report and Design Drawings Due:
April 21, 2017

Competition Date:
April 28, 2017 from 11am-2pm at the University of Maryland Center for Environmental Science in Cambridge, MD. Directions available here.

Team Size:
Minimum of 4 but no more than 10 students.

Challenge Scenario:
Design, develop, build, and demonstrate a radio-controlled scaled model of a Chesapeake Deadrise crab boat intended to economically carry (collect) crab baskets at a Chesapeake Bay location. The model will be required to travel empty (no ballast) to three crab basket collection locations, demonstrate its crab basket capacity and fully loaded performance by carrying scaled baskets through a course and return to the starting point.

Boat Specifications:

The model must be scaled 1"=1-'0" (1:12) and conform to the following specifications:

- Any Chesapeake Deadrise design is acceptable and the hull may be constructed of any rigid material.
- Boats may inadvertently contact (strike) each other, so ability to withstand minor collisions is a worthwhile (necessary) consideration – as is the watertight integrity and cushioning of the radio receiver/battery compartment.
- Propulsion will be provided by one or two specified electric motors (and battery) operating at no more than twelve volts.
- Boat hull maximum measurements must not exceed:
    - Length 40" including rudder and prop
    - Beam 12"
    - Maximum draft of the hull itself is not to exceed 2" when empty
- Boat Motor and Propeller specifications are:
    - Motor 9-12 VDC
    - 12,500 RPM
    - High Torque Kelvin # 850962
- Vessels must be painted or marked for identification with team name – and the quality of workmanship and finish will be a factor in judging. The model will be judged on how similar it looks to a real Chesapeake Deadrise crab boat. (Use images to help determine what a real Chesapeake Deadrise crab boat looks like.)
- The boats will be judged on their reliability to complete the competition while incurring as little damage as possible to the structure and function.
- Boats may lose points for purposefully striking other vessels.
- Failure to adhere to the above requirements will result in significant loss of points.
- It is recommended each team provide a floor stand for their boat model, high enough to permit working on their entry during the challenge.

Required Boat Elements:

- The boat must be marked with a maximum load line that is at least 2" below the gunwales edge measured mid-hull.
- The design does not have to include a full deck; crab baskets can (and for stability should) be stacked continuously up from the keel and may extend (4") above the gun wales (upper edges of the hull), provided they are at least 1 inch below the top of deck Cabin.
- The boat must have a cabin that occupies at least 10% of the hull overall length. This cabin must extend 5 inches above the deck and at least 1 inch above the top layer of the crab baskets. No cargo may be loaded in way of the cabin.
- At least 35% of the length of the hull must be free of crab baskets, pots and buoys. Room for workspace and crab bait must be provided. This space may be split between the cabin and the rest of deck to be used for machinery and/or electronics and battery access.
- The scaled crab basket containers which will be used are suet bird feed containers measuring 1-7/8" high x 5" wide x 5-1/4" long. They will be filled with 6 -8 large pebbles simulating crabs, rebar, and zinc anode; and when filled they must weigh approximately 16 ounces (450g) per basket. Containers should be provided by the teams for their own testing. UMES will have a limited number of containers should teams need replacements.

Performance Demonstration Expectations:
The boat must demonstrate its crab basket-moving efficiency by transporting as many (no less than 6) cages from each of the 3 designated crab collection locations out in the lagoon, back to the dock across a specified open water course of approximately 350'. Crab baskets must be off-loaded and the boat must return to the starting dock if multiple runs are planned.

Upon arrival at the competition site and after the judges' examination of their entry, each team must develop a load plan to carry as many crab baskets as possible without exceeding the load line, height above deck, allowable crab basket space, or stability limits. Once in the water, each crab boat will perform a run getting underway from a dock, to stop at designated crabbing stations and adding crab baskets to their boat, and maneuvering back to the launch ramp. The goal will be to have the minimum basket rate, which is determined by the following formula:

- Basket Rate = [(Fixed Costs) + (Operating Costs)]/(Baskets Carried x Distance Traveled)
  BR= (FC+OC)÷(BC x DT)
    - Fixed Costs (FC) = Length x Width x Draft Loaded x $10
    - Operating Costs (OC) = time to run course in seconds x $10 per second x number of propulsion motors
    - Baskets Carried (BC) = total number of full sized baskets
    - Distance Traveled (DT)

The boat must have adequate stability when fully loaded. This is important – test it before the challenge date! Stability is demonstrated by:

- Calculating metacentric height (GM) in excess of 7.5' (3/4") by placing a one lb. weight 4" on either side of the centerline and showing no more than 3 degrees of heel, OR
- Having a roll period (left – right – back again) of less than 2 seconds.

In evaluating the various trade-offs that must be made during the design phase, keep in mind that the course will be a few hundred feet long, and will be in the Chesapeake Bay, subject to whatever weather Mother Nature decides to deliver unlike a swimming pool or testing tank. Remember the objective is to model a boat that can reliably transport as many crab baskets within the course. Maneuverability is essential, but the key is to collect the greatest number of crab baskets from the designated stations.

Written Report and Drawings Criteria:

Evaluation Criteria:

Design/Written Report	20 points
Design and Construction	30 points
Oral Report (at event)	15 points
Performance Demonstration	35 points

*The format for the design and written reports as well as a judging rubric are provided on the website to help guide teams in developing these documents.

For More Information:
Please contact Dr. Tyler Love, Assistant Professor/Coordinator of Technology and Engineering Education at the University of Maryland Eastern Shore – tslove@umes.edu or (410) 621-3448

Good Luck To Your School!