

Hydrodynamic Nest Box Construction

In June 2015, our research group, led by Dr. Kathleen Trauth, conceived and designed a hydrodynamic nest box to offset habitat loss in Ozark and North Carolina (Appalachian) streams. Existing nest boxes were rectangular in shape and tend to move during high-flow storm events. Mr. Mohammed Mohammed developed a set of CAD drawings, based on streamlined water flow principles to prototype a nesting box that would stay in place during high flow events.

https://www.researchgate.net/publication/317690978_Theory_and_Practice_of_the_Hydrodynamic_Redesign_of_Artificial_Hellbender_Habitat)

Construction of the boxes was conducted in my garage and driveway, using basic wood working tools, to create a concrete form. However, you should note that access to a CNC cutting machine is the way to go, as far as cutting materials.

Material List

Form Construction

1. 2 3/4" sheets of plywood
2. 1 1/4" general purpose screws
3. 3 1/2" general purpose screws
4. Wood glue

Nest Box

1. 1 70lb bag of concrete
2. 1 roll of 24" hardware cloth (wire mesh)
3. 1 4" PVC cleanout (screw cap)
4. Two galvanized steel handles
5. 1 3" piece of PVC (tail pipe for salamander access)

We actually created two designs, the first prototype, and then the refined final unit. We completed both units. From the drawings, which were labeled with metric, dimensions, we converted the measurements to inches, and scaled up the drawings directly on a sheet of 16 X 32" plywood to use as a master pattern. The pattern was then cut using a jig saw—this is where a computer driven CNC would be extremely useful to attain uniformity of cut, and a much better fit than we ended up having. We also constructed a frame box to provide a structure in which to secure the form during the concrete pour, set, cure process. Of particular interest, there is some variation in the CAD design versus the as-built. The changes made were based on rounding the interior corners of the nest box. The reasoning was to aide in removing the concrete box from

the mold, and secondarily to provide rounded corners that would not injure the residents. Also, rounded corners tend to be less vulnerable to cracking.



Figure 1. The original design for the Hellbender nest box, fresh from the mold, was created using a multipiece wooden mold. The lid is molded separately, and fits into the top of the nestbox.



Figure 2. The more refined second prototype nest box features a much-improved lid design complete with more substantial handles and integrated viewing port. The mold creation process was nearly identical. However, lessons learned from the first prototype in the mold creation process, and particularly in the preparation for pouring the concrete and working with the reinforcement materials.

Preliminary material preparation

We cut one sheet of plywood into 9, 16 X 32” panels for the original prototype, and 9, 16” X 36” panels for the final prototype.

Outer Securing Form

We used one 16 X 32” panel to form the securing form for the shaping forms. Each end was closed with a 16” by 7½” board, and secured on the sides with two 6” X 7½” boards around each end (four total), using glue and 1½” screws. The 6” linear dimension on the sides was arbitrary and could be longer if desired, but you do want some open space on the securing form because it gives you an opening to pry out the shaping form after the concrete has cured. The securing form is also used as a construction jig during the inner shaping form assembly. (Figure 3)



Figure 3. The outer securing form is shown with the inner shaping forms stacked inside.

Shaping form (inner and outer)

We manually transferred dimensions to one of the panels, and jigsaw-cut the pattern. (Figure 4) The result is a master pattern, which can then be copied onto the remaining seven panels. Each panel was then cut as the first. This is where a CNC would have been very helpful, more consistent and faster. Three pieces result: the outer shaping form, the C-shaped portion where concrete will be poured, and the inner shaping form (Figure 5). All pieces were labelled with a number, so that all pieces of the same panel were readily identifiable for fitting purposes.

One of the shaping form panels was placed in the outer securing form, and the C-shape portion was glued and secured to the outer form. This was done to lock all of the pieces in place during final preparation to pour concrete. Holes were also drilled through the bottom of the securing form to prevent a vacuum forming when removing the completed concrete nest box. (Figure 6)

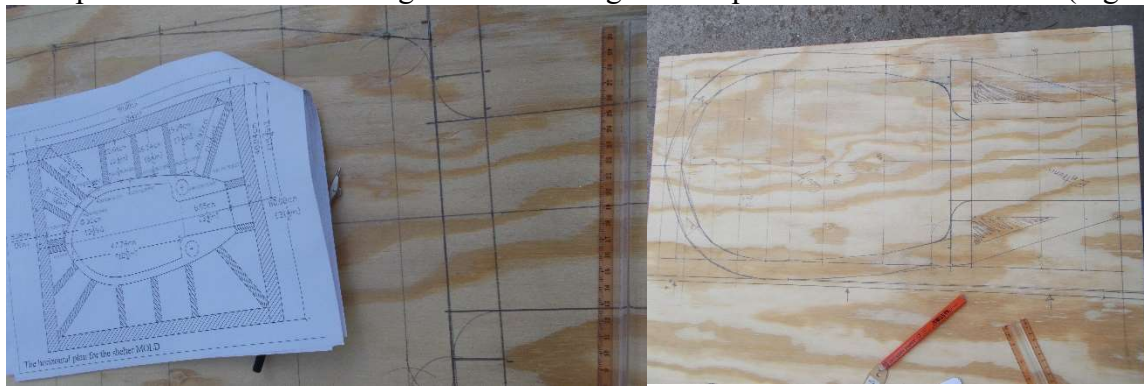


Figure 4. the nest box shape is transferred manually to a master pattern, once completed the shape will be cut with a jigsaw. A CNC machine will do a much better job—more consistent and faster.



Figure 5. Cutting along the lines yields three pieces: the inner shaping mold, the outer shaping mold and the blank area in between where the concrete will cure.



Figure 5. The completed outer securing form forms an open sided box with holes drilled into the bottom to prevent a vacuum from forming, aiding the form-removal process. The raised form on the floor of the box will form the top of the box. The innerform pieces will sit in the central area, and are secured in place by the raised area. The actual nest box is poured upside down.