MANUAL FOR CONSTRUCTING

THE

LO-PRO & OYSTER REEF BALL (TM)

Written by
Marsha Pardee and Kathy Fitzpatrick, PE
Edited by
Todd Barber, President, RBDG

Constructing the Lo-Pro Reef Ball ™ is a relatively simple process and can be accomplished single-handedly or with a small group of people participating in various steps of the operation. An overview of the general procedure is summarized in the following paragraphs, followed by a step-by-step outline to facilitate efficiency and ease of the operation. A checklist has been added that details the necessary mold parts, materials, and tools needed for construction. Diagrams are included to ensure understanding of references to various parts and placement of pieces. Suggestions for fabrication with group participation are also included.

Once all parts, tools, and materials are gathered, begin by assembling the mold. Follow the steps outlined in Section A, securing the pins just enough to be able to move the mold about.

Section B details how to attach the mold to a plywood base, prior to firmly securing all pins and hold-down plates.

Section C details the steps for mixing the concrete. The amounts given have been adjusted for mixing within a 5-gallon bucket so that a 5-gallon paint mixer may be used (attached to a 1/2"drill) to facilitate mixing. If mixing by hand, use of a larger, more shallow container is suggested along with a board or paddle shaped stick for stirring. You will need approximately five 5-gallon batches to fill the LoPro mold or one 3.5 cubic cement mixer load for mold, varying with the number of portal forms that are added and thickness of the Reef Ball ™. One 3.5 cubic meter cement mixer load should fill 3 Oyster Ball molds. An optional additive of air entrainment can be used if a rougher (actually micro-pitted) surface is desired and to make casting a bit easier. Wear gloves to prevent skin irritation.

Filling the mold is detailed in Section D. Prior to pouring the concrete mixture, the mold is "customized" by the addition of portal forms. These forms are used to create holes that provide habitat and protection to marine organisms that will inhabit the Reef Ball ™. The portals also increase water circulation throughout the structure. The portal forms can consist of inflatable toys, heavyweight balloons, wads of newspaper, or any other imaginative article that can withstand the weight of the concrete and be easily removed. If bottom portals are desired, put a layer of sand in the bottom of the mold, mounding it in a couple of places along the sides. Portal forms may also be nestled into the base. Next, insert the deflated Polyform buoy (center bladder) with the hold-down bar resting across the top of the mold and begin to inflate it. As it expands, place other portal forms so that they are wedged between the Polyform buoy (center bladder) and the sides of the mold. This will help to ensure that all objects remain in place as the concrete is poured.

Be sure to leave enough openings for the concrete to flow through. Pour the mixture slowly and tamp it with a stick as settles into the mold to avoid the formation of air pockets. It is also helpful to vibrate the mold by banging on the sides (a rubber mallet is suggested) and jumping on the plywood base. *Do not tamp the Oyster mold unless you are holding it down from the top of the Polyform ball. As the mold is filled, remember to allow enough space for the deflated Polyform buoy (center bladder) to be removed through the opening at the top, so do not overfill. Immediate wash down of all utensils and the mold's exterior is advised. A message or label may be etched into the exposed concrete top while the mixture is still slightly soft.

The next section (Section E) emphasizes the importance of releasing the pressure off the center bladder to prevent cracking the Reef Ball ™. After about 2-6 hr., dependent upon ambient conditions, the mold will start to get hot as the concrete sets. Check the mold by touching the sides, and if warm, let a 1-2 second blast of air out of the Polyform buoy (center bladder). This process will relieve the pressure in the bladder that is caused by air getting hot and trying to expand. This step may not be necessary if working in cooler climes or pouring just before nightfall, but is critical on a hot day or in direct sun.

Section F explains how to remove the mold. Reef Ball ™ requires a minimum of 12 hours to set. Up to 48 hours is needed to ensure maximum integrity of the concrete, dependent upon the temperature and humidity of the area. Once set, the first step is to deflate the center bladder. This step is extremely important, as the Reef Ball (™) will explode or crack if the bladder is left inflated when you remove the mold. Next, remove all pins, plates and the Polyform buoy (center bladder), and then gently pull on the fiberglass shells to release them. If this is difficult, place a large flathead screwdriver between the seams of the shells and gently tap with a hammer. Finally, remove the portal forms by gently pulling them out or lightly chiseling around them if necessary. If desired, additional sculpting may be accomplished by gently tapping areas with a hammer, but be careful not to crack the Reef Ball (™). Do not forget to clean and spray all metal parts with a light oil such as WD-40™.

The final section (Section G) describes steps for curing the Reef Ball ™. Over time, concrete strengthens as long as it does not dry out. To aid strengthening, place a plastic tarp around your Reef Ball ™ and rinse it with a hose every two days. Wait at least three days if possible before handling the ball to avoid breakage. At this point, you can immerse it in water to continue the curing process.

Suggestions for the organization of a group of participants include the delegation of procedure sections to different members or teams, so that each has a specific task. As the mixing part is somewhat labor intensive by hand, several people may be involved, either taking turns or by having several containers being mixed simultaneously, to reduce time constraints. Depending on the number of participants, each member could be asked to provide a portal form or other idea for customizing the Reef Ball ™. Dependent upon the level of organization, a 2-hour production time is suggested to complete the tasks. Group organizers may wish to complete a practice run before incorporating student participation. From filling the mold to earliest deployment, it is advisable to allow the Reef Ball ™ to set and cure for a week before deployment.

CHECKLIST OF INGREDIENTS

PARTS LIST (Lo-Pro)
Fiberglass panels (3)
3" side pins (6)
Wedges (6)
6" bottom pins (3)
(2.5"x 6") hold-down plates (3)
Polyform buoy (center bladder)

ADDITIONAL MATERIALS
3/4" marine plywood (4'x 4' square)
Sugar
Spray bottle
75 Ibs Type II Portland cement (masonry concrete)
75 Ibs bag Sand
75 lbs pea gravel or other small aggregate
15 Tablespoons Non-toxic super plasticizer (Daracem 19)
5 Ibs Force 10,000 Microsilica (condensed silica fumes)
Mixing bucket(s) -- 5 gallon or larger
Portal forms; toy inflatables, heavy duty balloons, newspaper...

Optional
5 gallon paint mixer attachment for a half inch drill OR concrete mixer
Non-toxic air-entrainment (1 tsp.) or plain dishwashing detergent such as Ivory ™(1/4 tsp.)

TOOLS LIST
Heavy duty drill
5/8" drill bit
Hammer
Rubber mallet
Mixing paddles or sticks
Access to fresh water

STEP - BY - STEP OUTLINE
*Please pay special attention to the steps in bold print and refer to the written portion of the manual for further explanation.

A. ASSEMBLING THE MOLD
1) Arrange fiberglass sections to form mold, with side flange holes aligned.
2) Place side pins with washers through side flange holes and add the second washer. Align pin slots vertically.
3) Insert wedges into slots on side pins and tap lightly to secure.

B. ATTACH MOLD TO BASE
1) Set mold in the center of the 3/4" plywood square and outline mold base.

2) Mark the center of the bottom flange for each section
3) Drill one 5/8" hole in plywood 1 1/2" out from center marks.
4): Set mold aside.
5) Place washers on bottom pins and insert through each drilled hole from the bottom of the plywood.
6) Replace mold to original position on plywood.

NOTE: **Steps 1-6 are only performed the first time you set up your mold system. If your bases are complete with bottom pins, then put mold pieces on base and arrange as in Section A (1-3)**

7) Slip the holddown plates over the bottom pins and position so that the plates overlap the bottom flange of each mold section.
8) Insert wedges into slots on bottom pins and tap lightly to secure.
9) To firmly secure mold, hammer ALL wedges into place working from top to bottom.

B. MIXING THE CONCRETE

***Note: Steps 1-6 are amounts given are for approximately 5-gallon batches of mixture. Steps 7-13 are for using a 3.5 Cubic meter concrete mixer.**

1) In 5-gallon mixing container, add 3 quarts water.
2) Put in 1 pound of Microsilica (Force 10,000). Mix well, no lumps.
3) Add 15 pounds of sand and 15lbs of gravel and continue mixing until a wet black sand mix is produced.
4) Put in 10 pounds of masonry concrete (Type ll Portland) and mix to a thick paste. Adjust water or dry mix as necessary to achieve desired consistency
5) Optional -- Add teaspoon of non-toxic air entrainment and mix for a minimum of 5 minutes.
6) Add 3 tablespoons of super-plasticizer and mix. This will change the consistency of your mixture so that it pours easily into the mold (7-9" slump).
7) For 1 barrel of concrete mixer, add two 5 gallons of sand
8) Add two 5 gallons of gravel
9) Add 3 gallons of portland cement
10) Add .5 gallons microsilica
11) One handful fibermesh
12) Let rotate until thoroughly mixed
13) Add 2.5 gallons water. Should be a cake mix like consistency.

C. FILLING THE MOLD

1) Prior to filling, spray the inside of the mold with sugar water (1-cup sugar/1 gallon water) and allow to dry. **This is an important step as the sugar water serves as a mold release agent and allows the molds to be removed easily**
2) put sand in bottom of mold and fill along sides. Optional -- To create bottom holes, mound the sand in a couple of spots—these make good small lobster holes.
3) Insert deflated Polyform buoy (center bladder).
4) As the bladder is inflated, add portal forms to create portals. This will allow all objects to be wedged into position between the bladder and mold sides**. **On Oyster Ball molds, add a coral transplant plug between the smaller of the two "chickens" (fiberglass inserts)**. **On the Lo-Pro molds, where tetherballs are used as**

bottom portals, be sure that the tetherball tie-downs are facing outward and downward towards the joining edge of the base and mold for ease in release. Put the holddown bar through the holes provided on the mold and polyball (no holddown bar for Oyster Balls) **Check that the polyform ball and portals are centered so that all sides are equally distributed in terms of spacing.**

5) Pour concrete mixture slowly into mold, dispersing around the edges equally. (Thin the consistency of the mixture with the addition of more super plasticizer if necessary).

6) While pouring, eliminate air pockets by vibrating the mold and using a stick to tamp the concrete into place**. **Do not vibrate Oyster Ball molds unless holding down the top of the Polyball.**

7) Fill the mold and allow to set. **Don't over fill it -- make sure that the polyball plug is accessible!**

8) Immediately rinse the outside of the mold and all utensils before the concrete hardens.

9) As concrete starts to set, it is possible to etch a message or label into the exposed concrete. You can also add coral transplant plugs to the top of the concrete mold.

D. BLEEDING THE BLADDER

1) After 2-6 hr. (when concrete is warm to the touch), **release the pressure from the Polyform buoy (center bladder)** by opening the valve for a 1-2 second blast of air.

E. REMOVAL OF THE MOLD

1) A minimum of twelve hours is needed for the concrete to set, and up to 48 hours.

2) **Deflate the center bladder** and remove as soon as the concrete is set.

3) Remove the holddown plates and side pins.

4) Pull fiberglass shells gently apart to remove from concrete

5) Remove the forms used to create portals.

6) If desired, additional sculpting may be done by gently tapping hole edges with hammer.

7) Spray down the concrete ball to expose the gravel surface. A light scrubbing with a brush or gloved hand may also be helpful to expose more gravel and roughen the texture of the concrete. Increased and roughened surface area means increased area available for attachment by marine organisms.

8) Clean all metal parts and coat with WD40.

G. CURING

1) Wait at least three days before further handling of the ReefBall ™ if at all possible. Otherwise, wait as long as possible and handle gently.

2) Concrete should be kept damp for aid in strengthening. This can be accomplished by either covering with plastic tarp and rinsing with water every couple of days or immerse in water.
