Making a Lever Compression Molding Machine for Shape&Roll Prosthetic Foot Cores

Andrew Hansen, PhD
Craig Heckathorne, MS
Kerice Tucker
Steve Steer, MS

Northwestern University Rehabilitation Engineering Research Program and Prosthetics Research Laboratory

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This manual provides instructions on building the lever compression molding device shown above. The parts of the molding device are identified on pages 2-7. These pages will serve as useful reminders during the construction of the molding device.
This picture shows the **pivot end** of the molding device.
This picture shows the **latch end** of the molding device.
This picture shows the **compression area** of the molding device.
This picture shows the molding device in its closed position.
In this manual, we define the surfaces of the boards as shown above.
To make the molding device, narrow (top) and wide (bottom) boards are used. The minimum end dimensions of these boards are shown above.
Materials List

2 – wide boards of length 1.83 m
2 – wide boards of length 2.44 m
4 – narrow boards of length 1.83 m
1 – 25 mm diameter wooden dowel rod of length 0.91 m
1 – box of 65 mm long wood screws (see page 14)
1 – 25 mm square aluminum bar or tube of length 1.83 m
3 – sheets of 5 mm thick plastic (dimensions 190mm x 240mm)
2 – 10 mm diameter steel dowel pins of length 40 mm

The following items are not used in this manual, but their dimensions are needed to determine the diameter of two holes in the upper arm board (see page 22).

1 – threaded rod of length 0.91 m with a minimum diameter of 13 mm
1 – metal pipe that is a close slide fit with the threaded rod (length 0.91 m). See page 12.
Cut three 25 mm diameter dowels to the following length L:

\[ L = 115 \text{ mm } + (6 \times \text{ thickness of a narrow board}) \]

These three dowels are the pivot dowel, the latch dowel, and the upper arm support strut dowel.
Before beginning construction, find a combination of threaded rod and metal pipe that form a close sliding fit as shown above. The threaded rod should be at least 13 mm in diameter.
Construction of the Lever Molding Device
Pre-drill all holes for screws to avoid damaging the wood. We used screws that were 65 mm long (see below).
Set two 1.83 m long wide boards on their edges. These are the **lower arm boards** of the lever.
Space the **lower arm boards** a distance of 115 mm apart. Cut a board to fit on top as shown. This board is one of the **pivot arm spacers**.
After placing one screw through the **pivot arm spacer** and into one of the **lower arm boards**, square up the ends and put in the remaining screws.
The **pivot end** should look similar to the picture.
Next, repeat pages 16-17 on the **latch end** of the **lower arm boards**. The board added to the **latch end** is a **latch arm spacer**. The assembly should look as shown above.
Flip the assembly over and attach the other latch arm spacer and pivot arm spacer. With all spacers attached, the assembly should look as shown above.
Center a 400 mm narrow board on top of the **pivot arm spacer** and screw into place. The screw locations should be shifted toward the center to avoid hitting the screws in the **pivot arm spacer** beneath. This piece is a **foot board**. Repeat on the **latch end** of the assembly and flip it over. The assembly should look as shown in the lower image.
Stack and clamp two wide boards together and mark the centers of the holes to be drilled (see dimensions below). All distances (except A) are to the centers of holes H1 through H4. These are the **upper arm boards** of the device.

\[ A = 2.44 \text{ m} \]
\[ B = 1.14 \text{ m} \]
\[ C = 864 \text{ mm} \]
\[ D = 533 \text{ mm} \]
\[ E = 44 \text{ mm} \]
\[ F = 44 \text{ mm} \]
\[ G = 70 \text{ mm} \]

H1 and H4 diameter = 25 mm (or slide fit for chosen wooden dowel)

H2 and H3 diameter = 13 mm (or slide fit for chosen threaded rod mentioned on page 12)
Setup for drilling holes. The end opposite the drill press is supported such that the top face of the boards is level. Keep boards clamped until all holes (H1 through H4) are drilled.
Drill hole H4 through both boards. The diameter of the hole should be a slide fit for the pivot dowel. (Note: We used a 25 mm wooden dowel.)
Drill hole H1 through both boards. This hole will house the upper arm support strut dowel.
While the boards are still clamped, change drill bits and drill holes H2 and H3. These holes are called the cement mold support holes.
Measure the distance X on the lower arm assembly as shown above.
Cut two narrow boards that have a length equal to $X$ plus 165 mm. Line up these boards on a flat surface and mark for drilling. Center the mark between the edges of the board.

$$A = X + 165 \text{ mm}, \quad B = X + 89 \text{ mm}$$
Clamp the boards together and drill a hole that is a slide fit for the **pivot dowel**. These boards are the **pivot arms**.
Insert the **pivot dowel** through the **pivot arms** and the **upper arm boards** (hole H4) as shown. The ends of the **pivot arms** must sit on the **foot board**.

*These boards are temporary props and are used only for assembly*
Push the **pivot arms** toward the **lower arm boards**.
Clamp and screw the **pivot arms** to the **lower arm boards** as shown above.
The **pivot end** of the device should look like this picture.
Wedge a spacer tightly between the upper arm boards on the pivot end. Make sure the faces of the upper arm boards and the pivot arms are in contact as shown.
Place a similar width spacer (as in page 34) between the upper arm boards on the latch end of the device.
Clamp boards and spacer into place as shown.
With the device sitting on a level surface, stack boards and plastic pieces on the lower arm about 800 mm from the pivot end to level the upper arm boards.

Measure the distance Y from the top of the foot board to the top of the upper arm board. Cut two narrow boards that have a length equal to Y plus 50 mm.
Have one person stand on the foot board at the pivot end while another sits on the latch end of the upper arm boards.
Place one of two narrow boards (length = Y + 50 mm, see page 37) on top of the foot board on the latch end and against one side of the upper arm boards. This board is one of the latch arms.
Mark a line indicating the top of the **upper arm boards** on the **latch arm** board.
Mark a center point that is about 12.5 mm (half the diameter of the latch dowel) above the line.
Align the edges of the two latch arms and clamp them together. Drill a 25 mm diameter hole (the diameter of the latch dowel) through the center point. The edge of the hole should touch the line as shown above.
Cut a corner off of each latch arm from the end with the hole.
Sand the edges of this cut.
Assemble the **latch arms** on the **latch dowel** as shown.
This assembly should straddle the upper arm boards as shown. Without weight on the upper arm boards, there should be a small gap between the foot board and the latch arms.
Have one person first stand on the **pivot end** and then have a second person sit on the **latch end** of the **upper arm boards**.
Have a third person clamp and screw the **latch arms** to the **lower arm boards** as shown.
Remove the spacer that is wedged between the **upper arm boards** on the **pivot end**.
On the **pivot end**, clamp the **upper arm boards** to the **pivot arms**.
Measure the distance between the upper arm boards.
Cut a narrow board to fit tightly in this space.
Clamp and screw into place as shown. This board is an upper arm board spacer.
Still at the **pivot end**, measure the space between the lower edges of the **upper arm boards**.
Cut a narrow board to match the measured length and position the board in front of the pivot arms (as shown) to avoid interfering with the pivot dowel. Clamp and screw it into place. This board is also called an upper arm board spacer.
On the **latch end**, clamp the **upper arm boards** to the **latch arms** and then remove the spacer piece from between the **upper arm boards**.
Measure the distances between the upper arm boards at the top (as shown) and at the bottom.
Cut two narrow boards to fit the top and bottom distances. Clamp these boards into place as shown. These pieces are called upper arm board spacers.
Prop up the **upper arm** to clear the **latch arms** and screw both **upper arm board spacers** to the **upper arm boards** on both sides as shown.
At this point in the process, you now have a latching lever with strong upper and lower arms!
At a location that is approximately 360 mm from the pivot dowel, measure the distance between the lower arm boards. Cut a narrow board to match this measured distance.
The lever can be tilted up (as shown) to simplify the next set of steps. Place the board between the lower arm boards. This board is one of the cement tray support boards.
Clamp a scrap piece across the top of the lower arm boards and clamp the cement tray support board to this piece as shown. This clamping technique ensures that the face of the cement tray support board is in the same plane as the top edges of the lower arm boards.
Screw both ends of the cement tray support board to the lower arm boards. This board is the first of five.
Repeat this process with four more **cement tray support boards**. Each additional board is added in the direction of the **latch end**.
After all pieces are screwed into place, the **lower arm** should look like the above pictures.
Set the lower arm back onto the floor. Clamp four narrow boards together as shown. These boards should have a length equal to the distance between the outer faces of the lower arm boards. Position the boards on the lower arm leaving 366 mm of cement tray support boards (see inset). Drill and screw them to the lower arm boards. These four boards are called the mandrel support boards.
The assembly should look like this picture after the **mandrel support boards** have been screwed into place.
NOTE: If your boards are thicker than 38 mm, you may have to adjust their thickness for the next steps. Read pages 69-75 before proceeding.

Make the upper arm support strut next. Clamp two 90 mm narrow boards to the end of a 560 mm narrow board. Place one screw into the assembly as shown. Do not put screws within a 30 mm radius of the center of this board!
Turn the assembly over and place two screws into the other narrow board as shown.
Remove the clamp and put one screw toward the other end of the narrow board.
Turn the assembly over and place two screws near the end of the narrow board as shown.
In the center of the 90 mm narrow board, drill a 25 mm diameter hole through the boards. This piece is the upper arm support strut.
Using a 25 mm dowel rod (named the **upper arm support strut dowel**), connect the **upper arm support strut** between the **upper arm boards** (through hole H1).
The **upper arm support strut** holds the lever up when plastic is being placed into the mold and is pivoted out of the way (toward the latch end) during compression of the plastic.
Cut two 550 mm lengths of 25 mm square aluminum bar or tube.

If using a tube, you will need to fill the inside with wood (see next 2 pages).
If you are using aluminum tubing, cut a piece of wood that is at least 550 mm in length and that fits the inner dimensions of the square tubing (a press fit).
Using a hammer, drive the wood all the way into the aluminum tubing. Do this for both square tubes.
Cut the square tubes or bars such that one has a tapered section that is 114 mm long and the other has a tapered section that is 140 mm long. These pieces are called **mandrels**.
Sand the edges of the cut aluminum until smooth.
Clamp the two mandrels together as shown. Align the back ends of the mandrels.
Mark a drill center 32 mm from the end of the mandrels. Drill through the mandrels using a bit that gives a close slide fit for a 10 mm steel dowel pin.

**NOTE:** Test by drilling a scrap piece to verify that the hole will be a close slide fit for the dowel pin.
Drop a 10 mm bolt through the holes just drilled. Drill another hole through the two mandrels that has its center 191 mm from the center of the first hole.
At this point in the process, both **mandrels** are finished and have matching holes that fit 10 mm (diameter) steel dowel pins. The dowel pins should have a length of approximately 40 mm.
Cut three pieces of 5 mm thick plastic 190 mm wide and 240 mm in length. These pieces are the **mandrel support plastic pieces**. Stack them together and make the mark indicated in the photograph.
Select a drill bit that is slightly smaller than the 10 mm diameter of the steel dowel pin. Clamp the three pieces of plastic together and drill through the mark indicated on the previous page.
Hammer one of the 10 mm steel dowel pins through the three plastic layers as shown. The steel dowel pin must fit tightly into the **mandrel support plastic pieces**.
Place the mandrel over the steel dowel pin as shown. Center the mandrel on the plastic and draw reference marks on both sides.
Use your reference marks to center the **mandrel** on the **mandrel support plastic pieces**. Using the open hole in the **mandrel** as a guide, drill a second hole through the **mandrel support plastic pieces**.
After the second steel dowel pin has been hammered into the **mandrel support plastic pieces**, use the **mandrel** to help mark the areas of plastic that will be cut away. The **mandrel support plastic pieces** should look as shown in the inset after the cuts are made.
Place the **mandrel** on the dowel pins and set the entire assembly on top of the **mandrel support boards** such that the **mandrel** is centered between the two **upper arm boards**. The front of the **mandrel support plastic pieces** should be aligned as shown in the inset. When centered and aligned, clamp the **mandrel support plastic pieces** to the **lower arm boards**.
Screw the **mandrel support plastic pieces** to the **mandrel support boards** of the **lower arm**. Place the screws as shown in the inset.
Make the extraction board next. Cut a narrow board 230 mm in length. Create an opening through the center of the board that will allow the mandrel to pass through. We used a hole saw to cut a large hole.
The **locking pin** can be made in one of two ways:

(Option 1) Bend a piece of 10 mm diameter rod (threaded or not) leaving a 140mm straight section.

(Option 2) Create the pin shown in the right picture (see next page for instructions).

**Note**: we used option 2 for the device shown in this manual, but option 1 is simpler.
(A) Use a bolt that is 140 mm in length and approximately 10 mm in diameter, a matching nut, and a short piece of aluminum to create the **locking pin**. Drill a hole in the end of the aluminum that is a slide fit for the bolt. The second smaller hole has been drilled for a string attachment. (B) Bend the aluminum piece. The end with the larger hole is clamped in the vice. (C) Assemble the **locking pin**.
Cut two 229 mm long narrow boards. On each board, drill a centered hole 25 mm from the end. The holes should be a slide fit for the locking pin.
At the hole end of each board, cut one corner off as shown. These boards are called the *extraction hitch boards*.
Place the **extraction board** on top of the **upper arm**.

*(NOTE: Do **not** screw the **extraction board** to the **upper arm**.)*
Holding the **mandrel** as shown, insert a pen or bolt through the top hole and lower the **mandrel** through the hole in the **extraction board**.
The pen or bolt should rest on the extraction board.
Place the two extraction hitch boards between the lower arm boards and pass the locking pin through the bottom hole of the mandrel and both boards as shown.
Clamp the extraction hitch boards to the lower arm boards such that they butt up against the edge of the first cement tray support board and screw them into place. When finished and with the upper arm raised, the extraction hitch boards should look as shown in the inset.
Support the **upper arm** with the **upper arm support strut**. Drill a hole for the **locking pin** through one of the **upper arm boards** and into the side of the **upper arm support strut**.
When the locking pin is inserted into this hole, the upper arm support strut cannot be knocked out, providing a safety mechanism to the person using the device. The locking pin must be removed when the arm is to be lowered for molding.
Tie a string through the smaller hole of the locking pin and attach the string to the device as shown. This step will help to avoid losing the locking pin.
Congratulations! You have finished making a lever compression molding machine for Shape&Roll prosthetic feet! The machine should look as shown when the lever is closed and latched shut.
The machine should look as shown when the lever is open.
After making the lever compression molding machine, the next step is to fabricate the cement molds and the cement tray necessary for making Shape&Roll prosthetic foot cores.

See the following manuals describing cement mold and tray fabrication techniques:

Making a Cement Upper Molding Surface for Compression Molding of Shape&Roll Prosthetic Foot Cores

Making a Cement Tray for Compression Molding of Shape&Roll Prosthetic Foot Cores

Please let us know if this manual is not clear or if questions arise during the fabrication of the lever compression molding machine.

Email Andrew Hansen at a-hansen@northwestern.edu or call 312-238-6500.