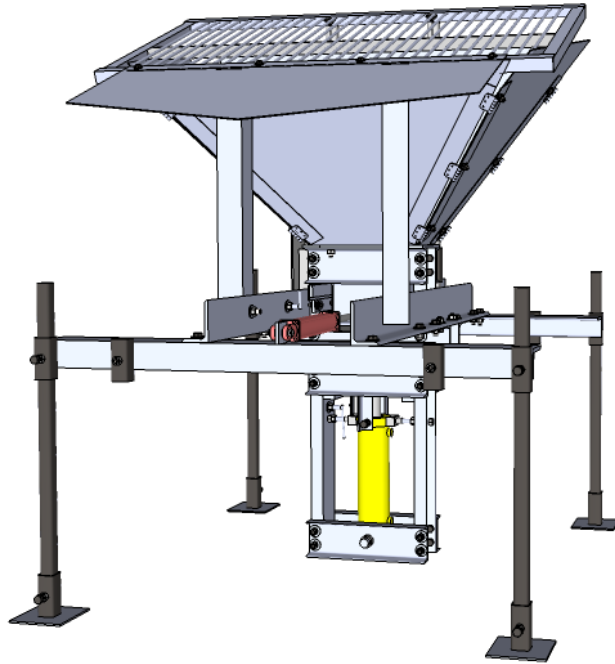


CEB



Complete Fabrication Instructions, 2011

Open Source Ecology

Compiled by Brianna Kufa

CEB Introduction

The purpose of this guide is to provide all information to make the 2011 version CEB Press from stock steel and parts. More information, and a constantly updated procedure can be found on the OSE wiki [CEB Manufacturing page](#).

This guide is broken into 3 main fabrication steps: Mechanical Fabrication, Electronic Components, and Machine Integration. The steps in Mechanical Fabrication and Electronic Components are independent of each other, but within each category, the suggested order should be followed. Once both are finished, you the machine's mechanical and electronic components can be integrated. At that point, your machine can be used.

Mechanical Fabrication begins with the cutting of all stock steel. After that, it is broken into two sections: Parts Fabrication, and Parts Assembly. Parts fabrication focuses on cutting, drilling, punching, bolting and welding the steel into individual parts, and is organized by machine systems. Parts assembly joins all of the sub-parts into the whole machine. To complete mechanical fabrication, the machine must be painted.

[This video](#) offers good insight on how to do many of the steps in assembly. Some steps will vary though. The written instructions are correct.

The Electronic Components section covers preparing all of the components which automate the machine. It requires the preparation of the machine sensors, and all of the components which reside in the controller box.

Machine Integration links the hydraulic, mechanical, and electrical components into a functioning CEB.

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CEB Bill of Materials

Steel

Type	Size	Total (inches)	Total (feet)
Angle	.25x2x2	291	24.25
Angle	.5x4x4	105	8.75
Angle	.5x4x6	288	24
Angle	.5x4x7	12	1
C-Channel	3	3	0.25
C-Channel	6 heavy	274	22.83333333
DOM Round	1.5	14.5	1.208333333
Dom tubing	1.5 ID 2.0OD	3	0.25
Flat	.25x1	14	1.166666667
Flat	.25x2	71.5	5.958333333
Flat	.1875x2.5	72	6
Flat	.25x3	6	0.5
Flat	.25x6	27	2.25
Flat	.25x7	27	2.25
Flat	.25x8	44.5	3.708333333
Flat	.375x 3	51	4.25
Flat	.5x2	72	6
Flat	.5x3	93.5	7.791666667
Flat	.5x6	12	1
Flat	1/8x3	288	24
Flat	1x1	5	0.416666667
Flat	1x2	11	0.916666667
Flat	1x4	10	0.833333333
Flat	1x6	12	1
Flat	1x7	12	1
Pipe	.75ID 1OD	2	0.166666667
Rebar	0.375	9	0.75
Rebar	0.5	1122	93.5
Rebar	1	14	1.166666667
Round	1	7.25	0.604166667
Threaded Rod	0.75	40.75	3.395833333
Tubing	.1875x2.5x2.5	84	7
Tubing	.25x2x2	288	24
Tubing	.5x6x6	12	1
Sheet	1/8"x5'x10'	1 full sheet	
	1/8"x5'x23.5"	Part of a sheet.	

Fasteners

Description	Quantity
Bolt, HHCS, 0.313"-18x0.625"x0.625"	8
Bolt, HHCS, 0.375"-16x2"x2"	4
Bolt, HHCS, 0.5"-13x1"x1"	16
Bolt, HHCS, 0.5"-13x2"x1.25"	5
Bolt, HHCS, 0.5"-13x4"x4"	2
Bolt, HHCS, 0.75"-10x1.5"x1.5"	9
Bolt, HHCS, 0.75"-10x2"x2"	34
Bolt, HHCS, 0.75"-10x2"x2"	19
Bolt, HHCS, 0.75"-10x2.5"x2.5"	6
Bolt, HHCS, 0.75"-10x3"x3"	6
M12 Bolt, Modified- 55mm	4
Bolt, HHCS, 0.25"x2"	1
B18.2.4.1M - Hex nut, Style 1, M12 x 1.75-D-C	4
Nut, Hex, 0.375"-16	4
Nut, Hex, 0.5"-13	24
Nut, Hex, 0.75"-10	77
Nut, Hex, Steel, 0.75"x10	12
Nut, Hex, .25"-16, Lock	1
Washer, Plain, Narrow, B18.22.M, 12mm	4
Washer, Wide, 0.375"	8
Washer, Wide, 0.5"	28
Washer, Wide, 0.75"	74
Washer, Lock, 0.25"	1

Hydraulics

Type	Item	Qty.	Source
Cylinder	5x12x2.5		https://www.surpluscenter.com/item.asp?item=9-1143-12&catname=hydraulic
	Crosstube	1	
	2.5x14x1.125		https://www.surpluscenter.com/item.asp?catname=hydraulic&qty=1&item=9-7619-14
Motor	Clevis	1	
	Dynamic Hydraulic Motor	1	https://www.surpluscenter.com/item.asp?item=9-7077-50&catname=hydraulic
Hoses	1/4"x12" NPTM	1	https://www.surpluscenter.com/item.asp?item=916-1412&catname=hydraulic
	1/2"x36" NPTM	3	https://www.surpluscenter.com/item.asp?item=905-1236&catname=hydraulic
	1/2"x56" NPTM	2	https://www.surpluscenter.com/item.asp?item=905-1260&catname=hydraulic

Type	Item	Qty.	Source
Valves	1/2" NPT Needle Valve	1	http://www.surpluscenter.com/item.asp?item=9-7960-8&catname=hydraulic
	1/2" Flow Control and Relief Valve	1	https://www.surpluscenter.com/item.asp?item=9-064-50&catname=hydraulic
	1/2" NPTF Check Valve	1	https://www.surpluscenter.com/item.asp?item=9-7933-8-5&catname=hydraulic
Fittings	SAE 4M to 1/4" NPTF Swivel	1	https://www.surpluscenter.com/item.asp?item=9-6900-4-4-S&catname=hydraulic
	SAE 6M to 1/2" Swivel	6	https://www.surpluscenter.com/item.asp?item=9-6900-6-8&catname=hydraulic
	SAE 12M to 3/4" Swivel	2	https://www.surpluscenter.com/item.asp?catname=&qty=1&item=9-6900-12-12
	3/8" NPT Hex Nipple	2	http://www.surpluscenter.com/item.asp?item=9-7184&catname=hydraulic
	1/2" NPT Hex Nipple	6	https://www.surpluscenter.com/item.asp?item=9-5404-8-8&catname=hydraulic
	1/2" NPTM to 1/4" NPTF bushing	1	https://www.surpluscenter.com/item.asp?item=9-5406-8-4&catname=hydraulic
	1/2" NPT to 3/8" NPT bushing	2	http://www.surpluscenter.com/item.asp?item=9-5406-8-6&catname=hydraulic
	3/4" to 1/2" NPT Bushing	2	https://www.surpluscenter.com/item.asp?item=9-5406-12-8&catname=hydraulic
	1/2" NPTM to 1/2" NPTF 90 Elbow	3	https://www.surpluscenter.com/item.asp?item=9-5502-8-8&catname=hydraulic
	1/2" NPTM Elbow	2	https://www.surpluscenter.com/item.asp?item=9-5500-8-8&catname=hydraulic
	1/2" NPTF Tee	2	https://www.surpluscenter.com/item.asp?item=9-5605-8-8-8&catname=hydraulic
	1/2" Quick Coupler Pair	5	https://www.surpluscenter.com/item.asp?item=928&catname=hydraulic
Solenoid	3/4" Quick Coupler pair	1	https://www.surpluscenter.com/item.asp?item=928-C&catname=hydraulic
	Daman Manifold AD05S033S or Dalton part# 240-712	1	Call Dalton to order http://stores.daltonhydraulic.com/StoreFront.bok

Solenoid Valve for motor Type H, Dalton Part #: 240-241	1	http://stores.daltonhydraulic.com/-strse-675/Solenoid-Directional-Control-Valve%2C/Detail.bok?category=Control+Valves+-+Solenoid%3AD05+40GPM+Directional+Valves+-+DC
Solenoid Valve for rams Type C, Dalton Part #: 240-244	2	http://stores.daltonhydraulic.com/-strse-674/Solenoid-Directional-Control-Valve%2C/Detail.bok?category=Control+Valves+-+Solenoid%3AD05+40GPM+Directional+Valves+-+DC

Other

Description	Quantity	Source
Generic Door Hinge	12	Home depot
1" Keyed Coupler	1	https://www.surpluscenter.com/item.asp?item=1-1563-E&catname=powerTrans
12mm x 3mm N42 Epoxy Coated Disc Magnet	6	http://www.gaussboys.com/ndfeb-magnets/D1203E-N42.html
Pillow Block Bearing - 1"	2	https://www.surpluscenter.com/item.asp?item=1-205-16-P-C&catname=powerTrans
V-Groove Bearing	4	http://www.vxb.com/page/bearings/PROD/Kit8406
Power Clamps, AKA Hose Clamps- 1" Max OD	4	Automotive Store, see http://opensourceecology.org/wiki/File:Hose_Clamps.jpg

Electronics

Item	Qty.	Source	Notes
50ft 16AWG Extension Cord	1	Electronics Store	http://opensourceecology.org/wiki/File:50ft3Wire16AWGExtensionCord.jpg
Pair of Large Alligator Clips (Black and Red)	1	Electronics Store	http://opensourceecology.org/wiki/File:AlligatorClips.jpg
Female Insulated Connector 16-22AWG	1	Electronics Store	http://opensourceecology.org/wiki/File:FemaleInsulated16to22AWGConnector.jpg
Outdoor Main Lug Box	1	Hardware Store	http://opensourceecology.org/wiki/File:LugBox.png
Wire Clamps	2	Hardware Store	http://opensourceecology.org/wiki/File:WireClamps.jpg
Toggle Switch	1	Hardware Store	http://opensourceecology.org/wiki/File:ToggleSwitch.jpg
Washer 1.25" OD .5" ID	2	Hardware Store	http://opensourceecology.org/wiki/File:Washer1-25OD0-5ID.jpg

Fuse Holder	1	Electronics Store	http://opensourceecology.org/wiki/File:FuseHolder.jpg
Male Insulated Connector 10-12AWG	1	Electronics Store	
Ring Insulated Connector Small Hole 10-12AWG	2	Electronics Store	
Buss Fuse 10Amp	1	Electronics Store	http://opensourceecology.org/wiki/File:10ABussFuse.jpg
Ring Insulated Connector 10-12AWG 12cm by 7.5cm by 0.4cm	20	Electronics Store	
HDPE Plate (4.75"x3"x5/32")	2	Hardware Store	
M3 20mm Machine Screws	4	Hardware Store	
M3 Nylon-threaded Locknuts	4	Hardware Store	
8-32 machine screws of 3/8 inch length	7	Hardware Store	
8-32 machine screws of 3/4 inch length	4	Hardware Store	
Arduino Uno Microcontroller	1	Digikey	http://www.digikey.com/1/parts/2412553-arduino-uno-board-a000046.html
Underground Telephone Wire (4-wire) 3m length	1		
Shrink Tubing 16-22AWG 18cm length	1	Electronics Store	
Hall Effect Sensor	2	Digikey	http://www.sparkfun.com/products/9312
PVC Pipe with 1" Outer Diameter, 9/16" Inner Diameter, 3.5" Length	2	Hardware Store	
Silicone 250ml	1	Hardware Store	Transparent Silicone Caulking
Ring Insulated Connector 14-16AWG	20		
Red Wire 18AWG 25ft	1	Electronics Store	
Black Wire 18AWG 25ft	1	Electronics Store	

Solenoid Driver –

Note: this is included separately from electronics in case you choose to make a different driver board.

Description	Qty.	Source
Power N MOSFET	5	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=RFD16N05LSM9ACT-ND
Green LED	7	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=160-1169-1-ND
Diode	5	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=641-1331-1-ND
499 Resistor	5	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=311-499FRCT-ND
49.9k Resistor	5	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=311-49.9KFRCT-ND
10k Resistor	2	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=311-10.0KFRCT-ND
2 Pos Terminal	9	http://search.digikey.com/scripts/DkSearch/dksus.dll?vendor=0&keywords=ED1514-ND
reset switch	1	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=SW262CT-ND
6 Pos Header	2	http://search.digikey.com/scripts/DkSearch/dksus.dll?vendor=0&keywords=a1913-nd
8 Pos Header	2	http://search.digikey.com/scripts/dksearch/dksus.dll?pname&site=us&lang=en&WT.z_cat_cid=Dxn_US_US2011_Catlink&name=A1914-ND
PCB	1	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=473-1002-ND
100 Resistor	2	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=311-100FRCT-ND

CEB Cut List

Cut the steel into the following lengths. Label and separate cuts by "Step" number so you can easily find cuts for each step during the fabrication stage. The step number for each sub-guide is listed in parenthesis in the upper left corner in the header.

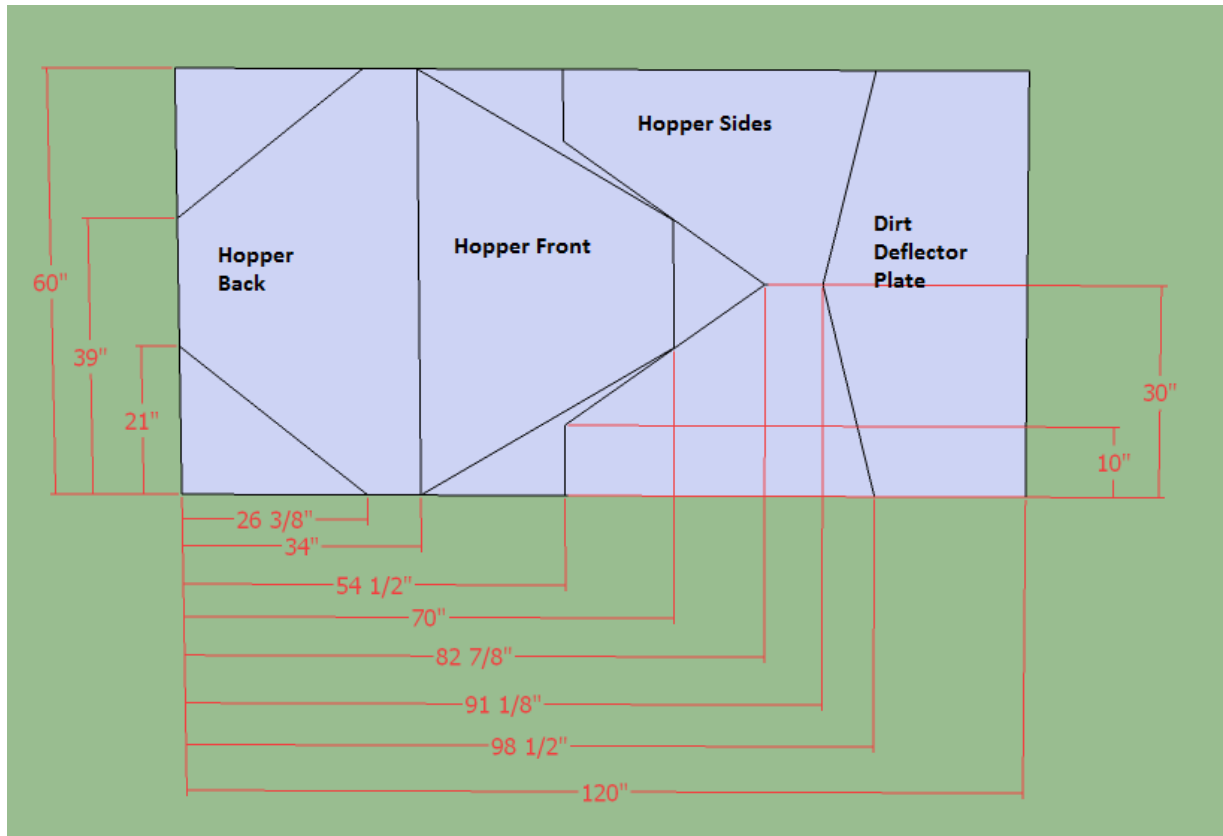
Type	Size (")	Length (")	Qty	Primary Part Name	Secondary Part Name	Step #
Angle	.25x2x2	6	2	Main Frame	Dirt Blockers	17
		6	2	Wide cylinder support		12
		10	2	Soil Shaker	Side of guard	3
		16	2	Soil Shaker	top and bottom of guard	3
		35.5	2	Soil Grate		9
		72	2	Soil Grate		9
Angle	.5x4x4	8	1	Soil Shaker		3
		21	1	Soil Shaker		3
		38	2	Grate supports		6
Angle	.5x4x6	72	2	Secondary Arms		2
		72	2	Primary Arms		2
Angle	.5x4x7	12	1	Soil Loading Drawer	Back	10
C-Channel	3	1.5	2	Main Frame Small Components	Thin Cylinder support	13
C-Channel	6 heavy	13	2	Main Frame	Spacers	17
		21	4	Main Frame	Horizontal Members	14
		29	2	Wide cylinder support		12
		53	2	Main Frame	Vertical Members	14
DOM Round	1.5	3.5	1	Main Cylinder	Fill in rod tubing	16
		11	1	Main Frame	Cylinder Pin	18
Dom tubing	1.5 ID 2.0OD	1.5	2	Main Frame	Horizontal Members, cylinder mounting	18
Flat	.1875x2.5	36	2	Soil Loading Drawer	Outer Rails	10
Flat	.25x1	14	1	Main Frame Small Components	Magnet Holder	13
Flat	.25x2	12	1	Controller Mount		1
		71.5	1	Soil Grate	Cross piece	9
Flat	.25x3	6	1	Controller Mount	Bottom piece	1
Flat	.25x6	12	1	Valve Mount		1
		15	1	Controller Mount		1
Flat	.25x7	13.5	2	Soil Loading Drawer	Sides	10
Flat	.25x8	8	4	Feet		2
Flat	.25x8	12.5	1	Soil Loading Drawer	Roof	10
Flat	.375x 3	24	2	Main Frame	Horizontal Members Reinforcement	17

		3	1	Roller Guides	Spacer Plate	11
Flat	.5x2	36	2	Soil Loading Drawer	Inner Rails	10
Flat	.5x3	3	1	Secondary arms	Eye for 2nd cyl	a5
		3	1	Soil Loading Drawer	Tongue	10
		11.25	2	Hopper Mounting Plate		8
		15	2	Hopper Mounting Plate		8
		16	2	Roller Guides	Main Plate	11
Flat	.5x6	12	1	Soil Loading Drawer	Vertical Supports	10
Flat	1/8x3	36	8	Hopper Sheet Metal	Hinge Plates	7
Flat	1x1	2.5	2	Preparing the Main Cylinder	Press foot supports	16
Flat	1x2	5	1	Soil Shaker	Hammer	4
		6	1	Soil Shaker	Hammer	4
Flat	1x4	10	1	Preparing the Main Cylinder	Lower Press Foot	15
Flat	1x6	12	1	Preparing the Main Cylinder	Upper Press foot	15
Flat	1x7	12	1	Soil Loading Drawer	Press Plate	10
Pipe	.75ID 10D	1	2	Main Frame Small Components	Thin Cylinder support	13
Rebar	0.375	3	1	Main Frame Small Components	Sensor Holder	13
		6	1	Main Frame Small Components	Sensor Holder	13
Rebar	0.5	34	33	Soil Grate		9
Rebar	1	7	2	Soil Shaker		3
Round	1	7.25	1	Soil Shaker		4
Threaded Rod	0.75	1.25	1	Main Frame Small Components	Magnet Holder	13
		3.5	1	Main Frame Small Components	Sensor Holder	13
		3.5	1	Main Frame Small Components	Sensor Holder	13
		6.25	2	Main Frame Small Components	Thin Cylinder support	13
		3.75	4	Main Frame	Drawer member drawer adjuster bolts	14
		2.5	2	Main Cylinder	Upper Press foot	15
Tubing	.1875x2.5x 2.5	6	14	Leg Holders		2
Tubing	.25x2x2	48	4	Legs		2
			2	Hopper Supports		6
Tubing	.5x6x6	12	1	Soil Loading Drawer	Spacer	10
	6x12	50	1	Optional Jig for Main Frame Assembly		17

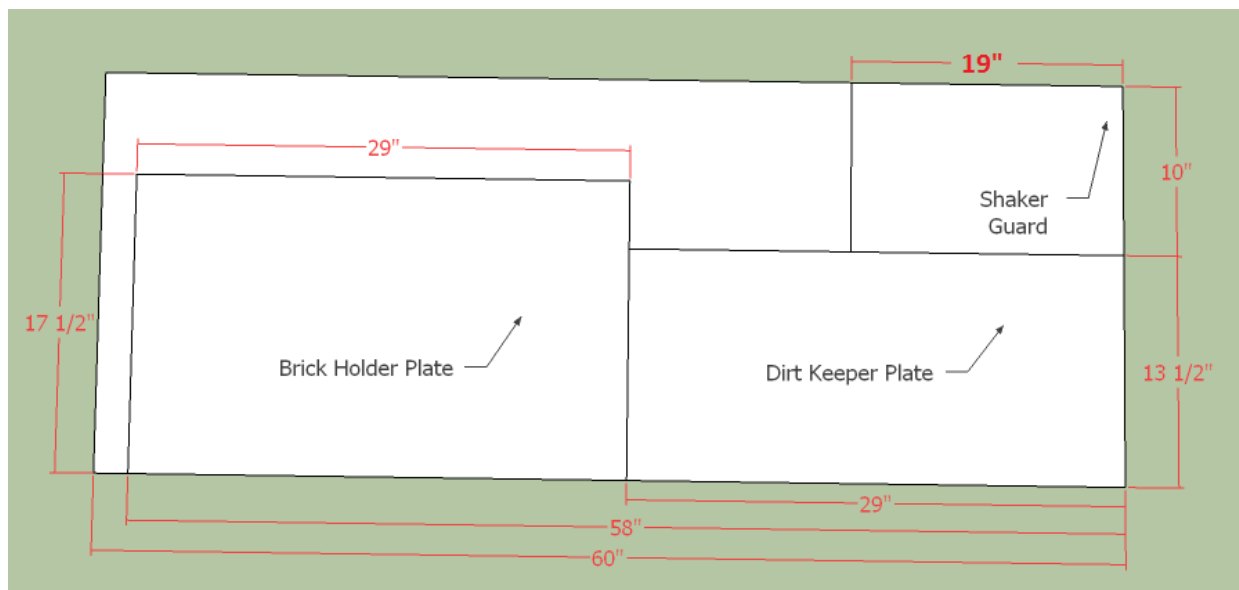
1/8" sheets, to be torched:

- After torching, grind the edges smooth.

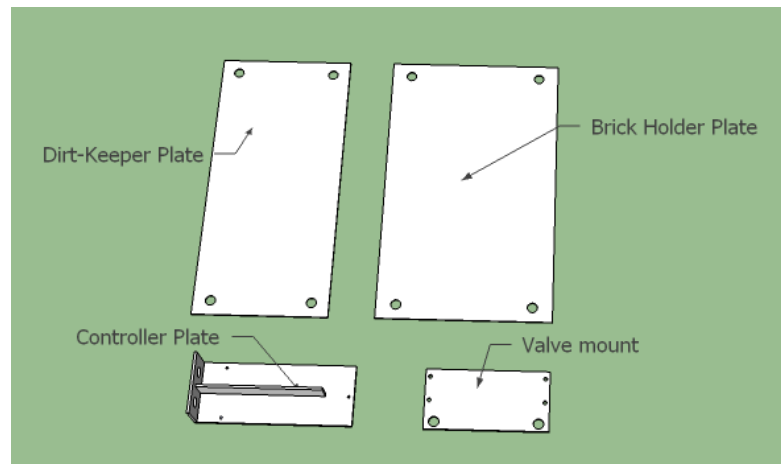
Full sheet:



Partial Sheet:



CEB Simple Plates



See the [Sketchup Model](#).

Tools Needed:

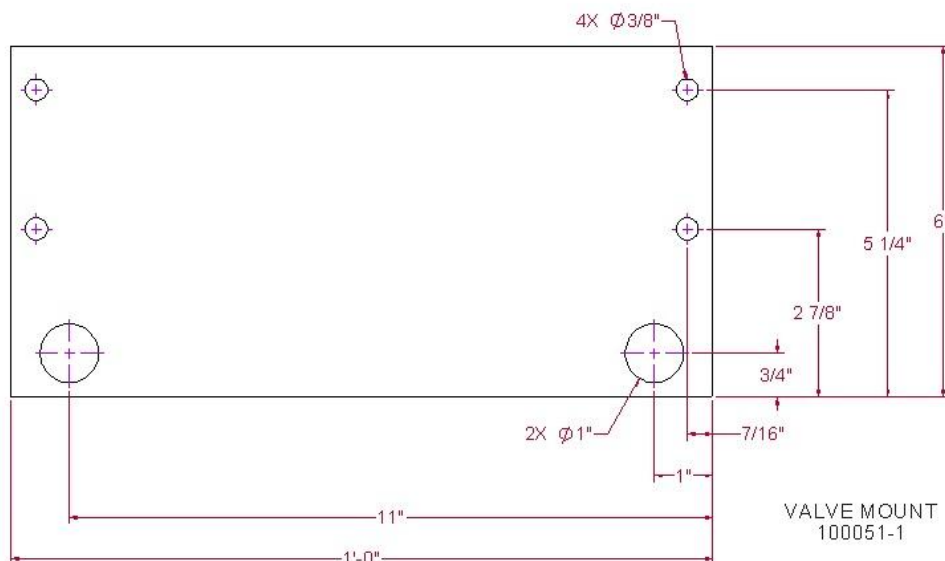
- Hole Puncher
- Drill Press
- Center Punch
- Hammer
- Welder

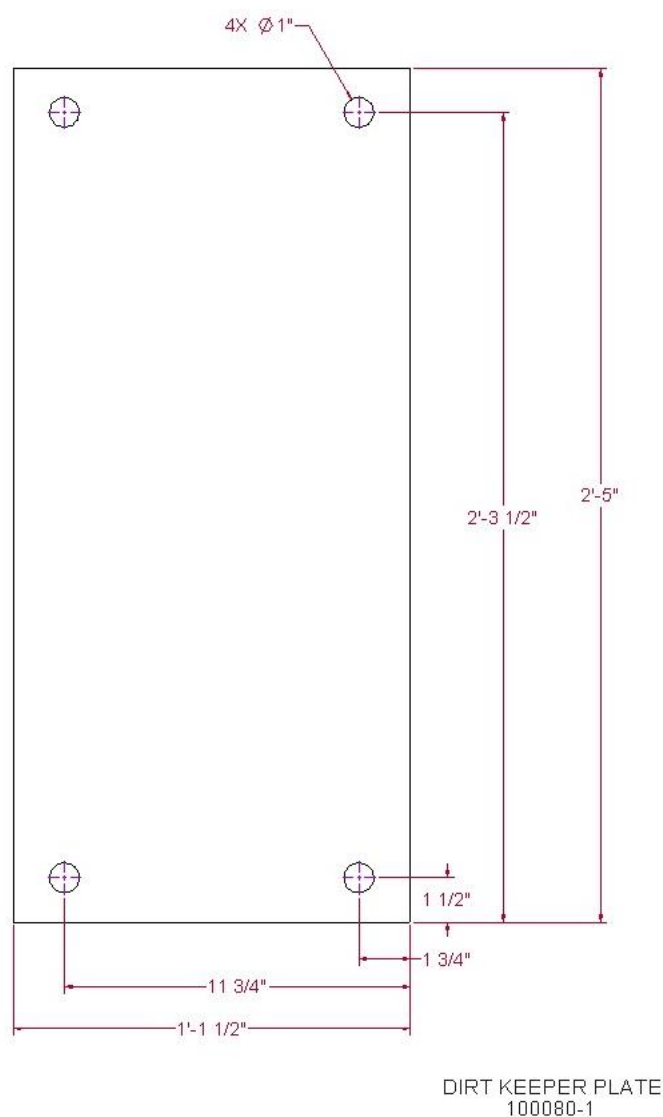
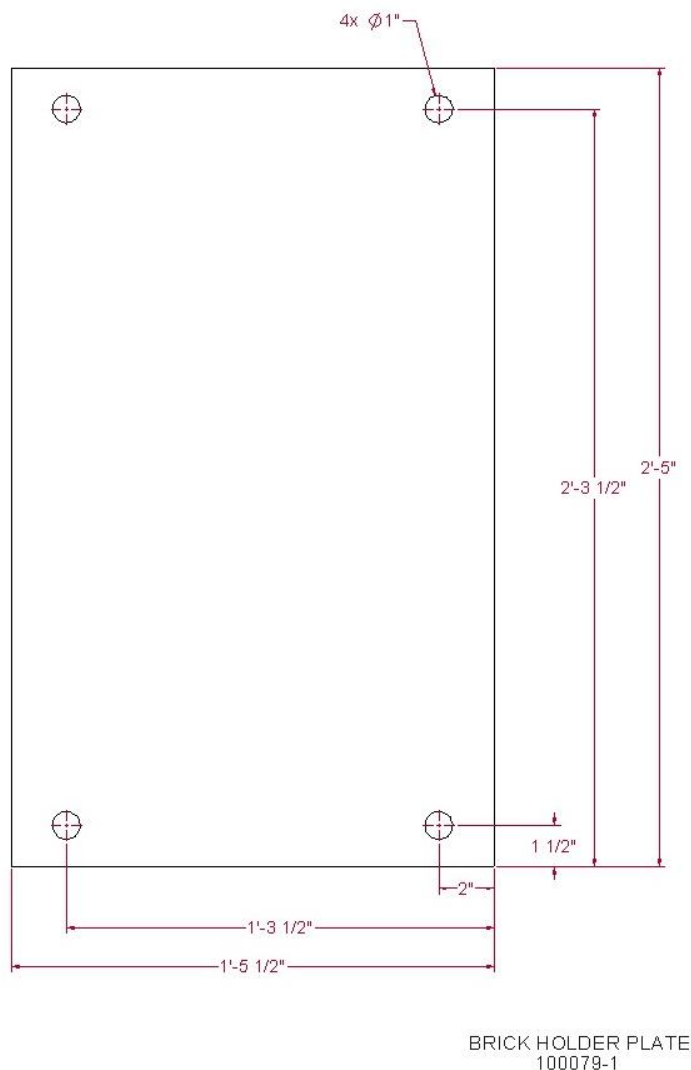
Materials Needed:

- 1/8" Sheet- 17.5"x29" Brickholder Plate
- 1/8" Sheet- 13.5"x29" Dirt-Keeper Plate
- 1/4"x6" Flat- 12" Valve Mount
- 1/4"x6" Flat- 15" Controller Mount
- 1/4"x3" Flat- 6" Controller Mount
- 1/4"x2" Flat- 12" Controller Mount

Brick holder Plate, Dirt Keeper Plate, Valve Mount

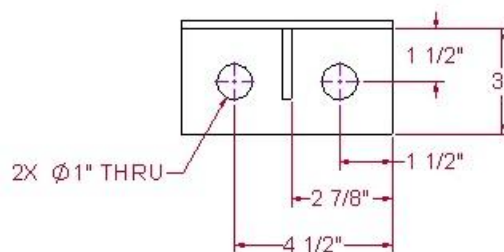
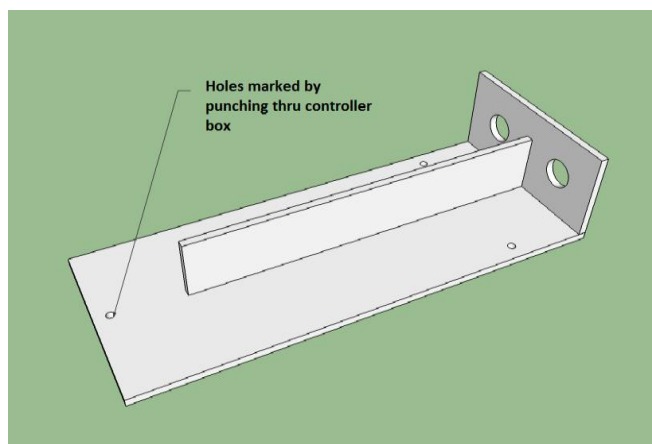
Punch or drill the holes as shown.





Controller Plate

1. Find your controller box (also called outdoor main lug box) and locate its mounting holes on the back.
2. Place it on top of the 6x15 plate so it is square and the top hole is about 1/2" away from the top. Transfer punch the holes on the controller box to the plate.
3. Drill those as 1/4" holes.
4. Punch the holes in the bottom piece.
5. Weld the bottom piece to the large plate. Make sure it is square.
6. Weld the 1/4"x2 to the back as well.



CEB Frame Structural Support Components

This section covers:

- Leg Holders-[Model](#)
- Feet- [Model](#)
- Legs- [Model](#)
- Secondary Arms- [Model](#)
- Primary Arms- [Left Primary Arm Model](#),
 - [Right Primary Arm Model](#)

Tools Needed:

- Angle grinder
- Speed Square
- Welder
- Hole Puncher
- Torch

Leg Holders

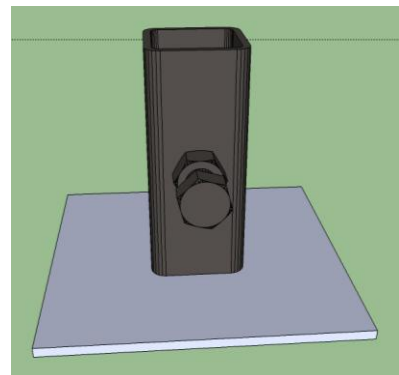
- You will need 14 Leg Holders for the CEB. 12 will be used in this section. Save the remaining ones for later. Make all leg holders at once to save time.
- These require:
 - 3/16"x2.5"x2.5" square tubing- 6" (14)
 - 3/4" Steel Nuts (14)
 - 3/4"x1.5" Bolts (14)



1. Torch a 3/4" hole in the center of one of the faces of the tubing; make sure it's large enough for a 3/4" bolt.
 - It's not crucial that the hole be centered. It just needs to be somewhere close to the center.
2. Weld the nut over the hole, ensuring the nut is level, and the hole is clear.
3. Make sure no spatter goes into the threads by covering the top of the nut.
4. Thread the bolt onto the nut.

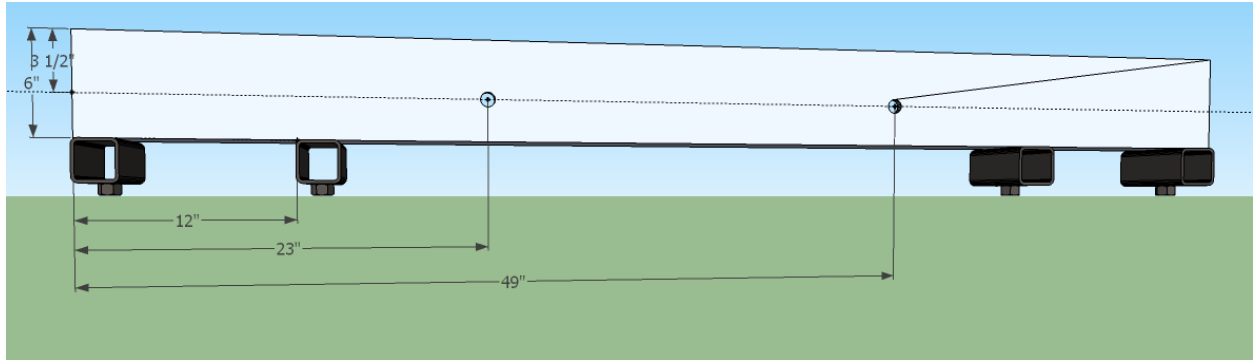
Feet

- You need to make 4 of these.
 - These require:
 - Leg Holders (4)
 - 1/4"x 8" Plate- 8" (4)
1. Center a leg holder on the 1/4"x8"x8" plate, insuring it is square in all directions.
 2. Weld it 100% to the plate.



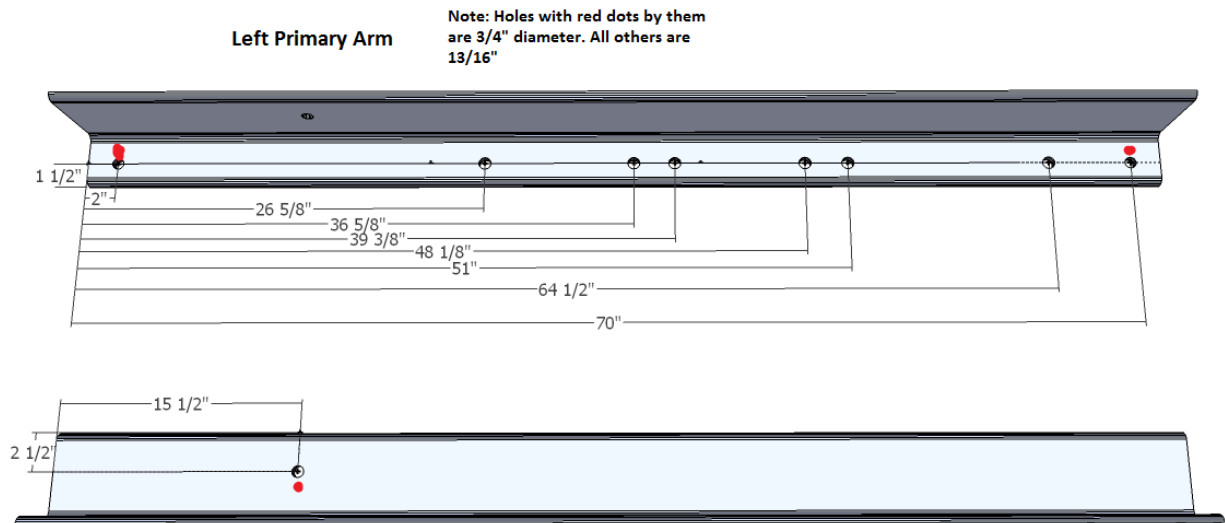
Secondary Arms

- These require:
 - Leg Holders (4)
 - $\frac{1}{2}$ "x4"x6" Angle- 72" (2)
- 1. Punch the $\frac{3}{4}$ " holes
- 2. Place the leg holders in their proper locations.
 - Make sure they are square with the angle iron and centered vertically.
- 3. Weld them to the angle.

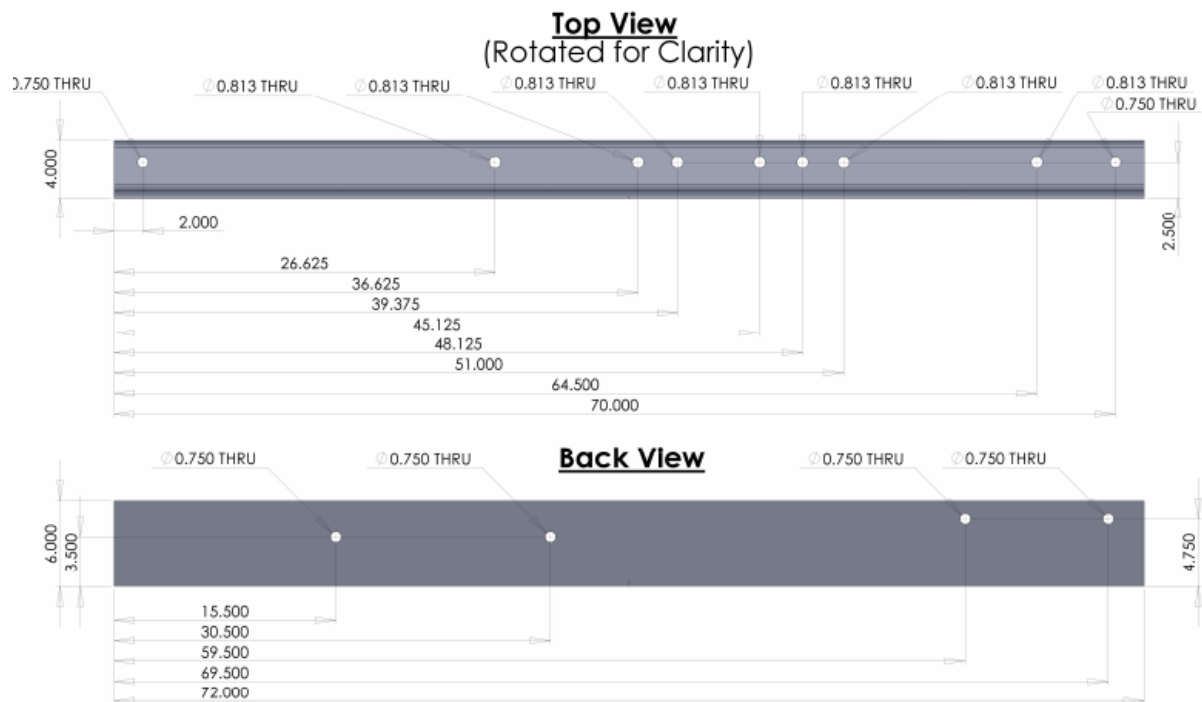


Primary Arms

- These require:
 - $\frac{1}{2}$ "x4"x6" Angle- 72" (2)
- 1. Punch all holes.
- 2. Label each arm with either "right" or "left."

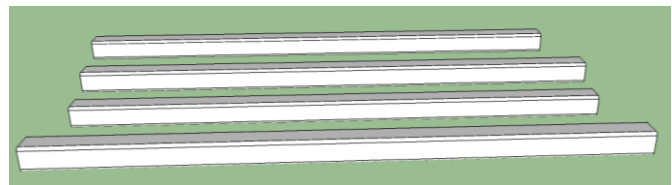


Right Primary Arm

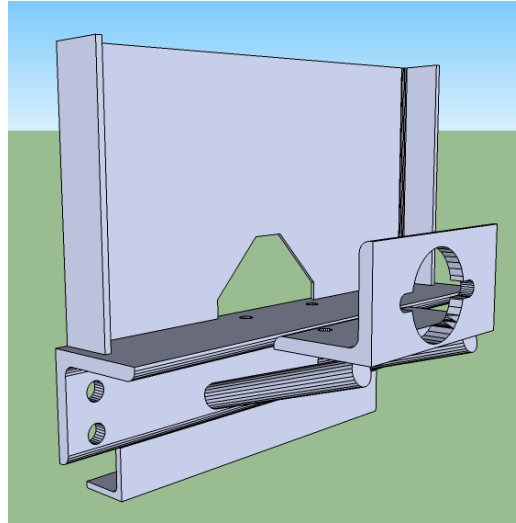


Legs

- These require:
 - ¼"x2"x2" Square tubing- 48" (4)
- There are no steps for these, just cut them.



CEB Shaker – Mount



Sketchup Model

Tools Needed:

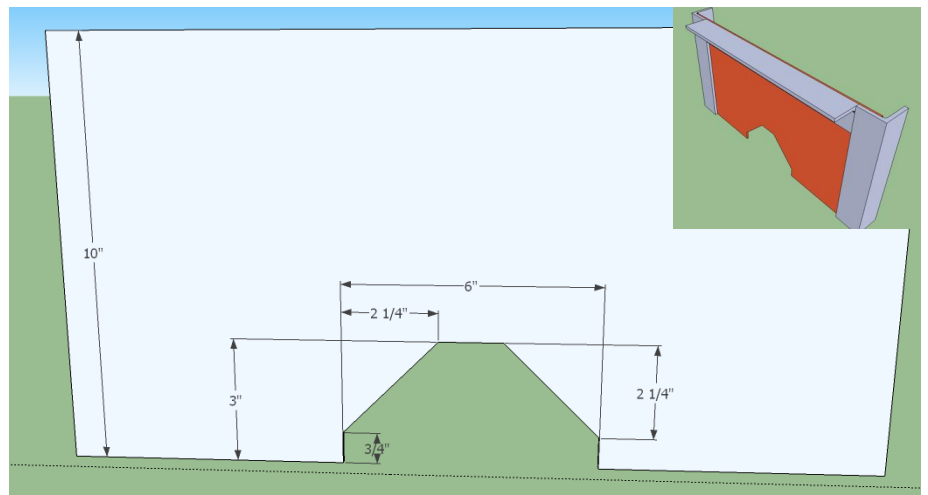
- Angle Grinder
- Welder
- Hole Puncher
- Torch

Materials Required:

- $\frac{1}{4}$ "x2"x2" Angle- 10" (2) Sides of Guard
- $\frac{1}{4}$ "x2"x2" Angle- 16" (2) Top and Bottom of Guard
- 1/8"x10"x16" Sheet- (1) Guard
- $\frac{1}{2}$ "x4"x4" Angle-(1) 8"
- $\frac{1}{2}$ "x4"x4" Angle- (1) 21"
- 1" Rebar- 7" (2) Braces

The Guard

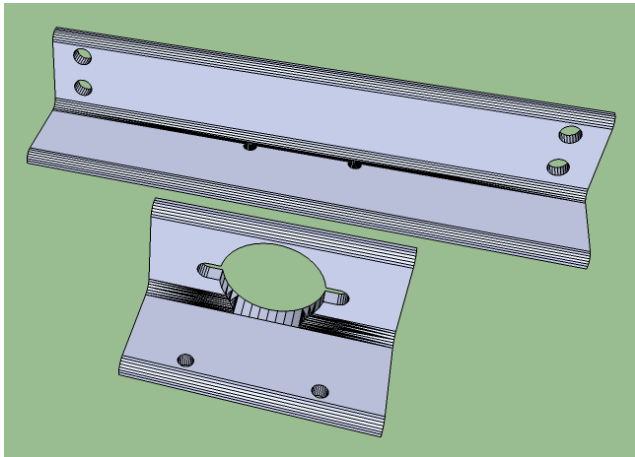
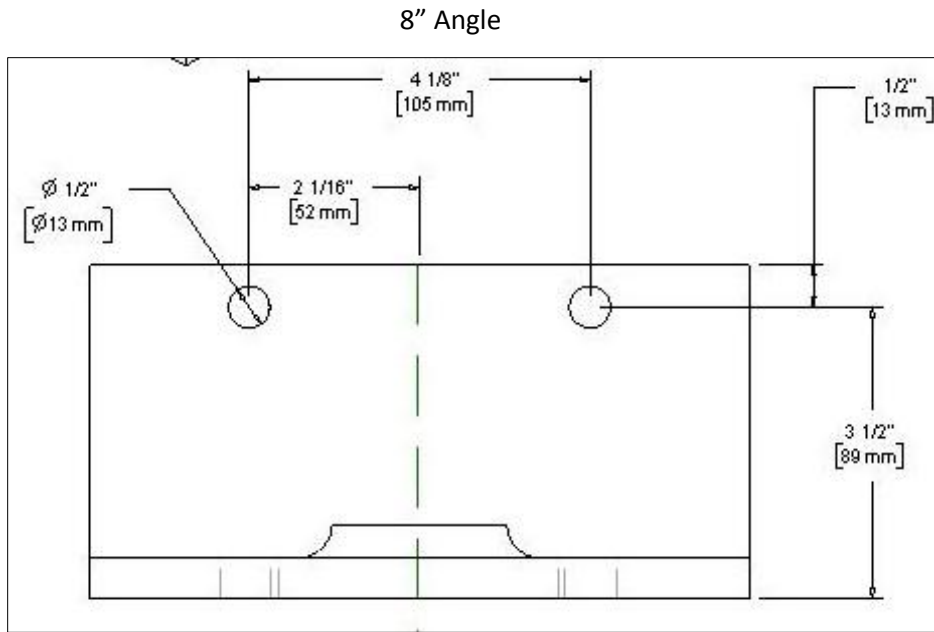
1. Torch the guard sheet metal as in the image.
 - Note: the shape shown is centered.
2. Weld the top and side 2x2 angle pieces to it as shown.



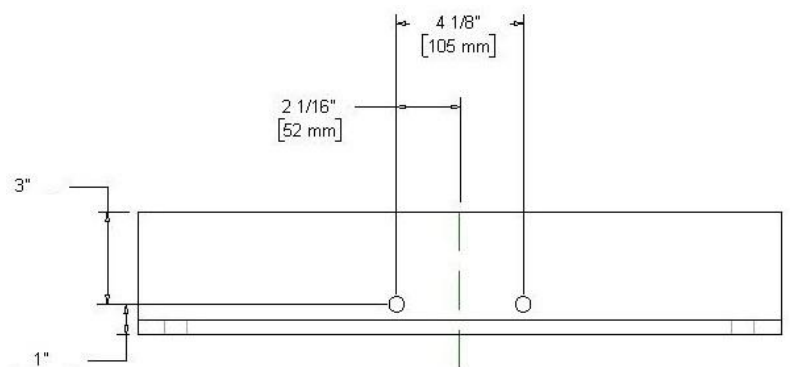
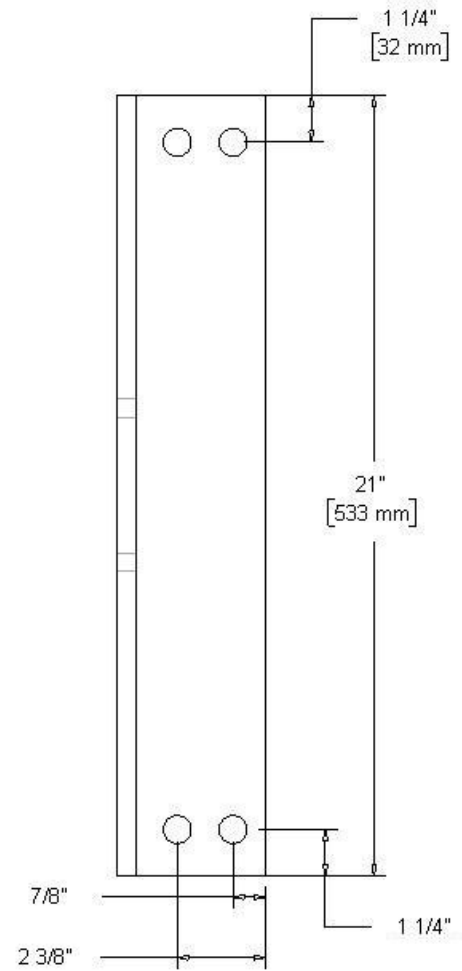
Mount Base

1. Punch the holes in the 4x4 angle.

- Not all holes will be accessible with a punch. Torch the rest.

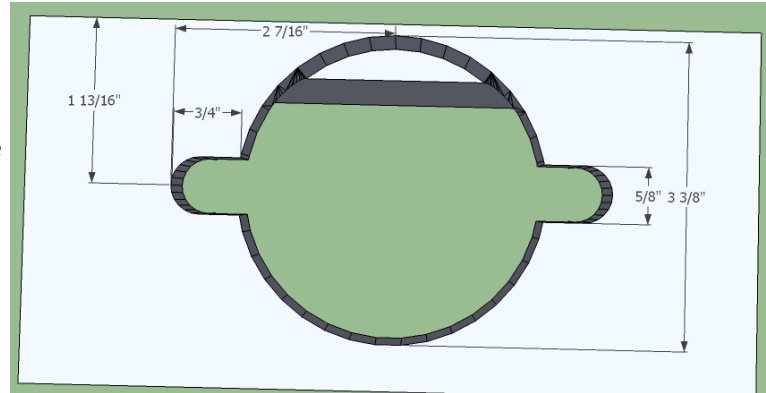


21" Angle



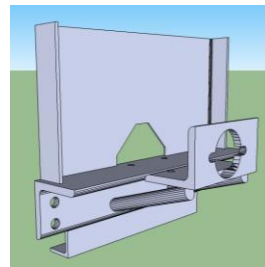
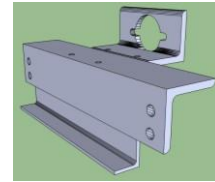
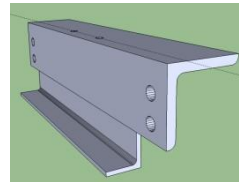
2. Torch the hole for mounting the motor in the 8" piece of 4x4 angle. Grind off the slag.

- Double check that the hole is large enough by putting on the motor and making sure the raised portion in the center goes all the way thru.
- You can torch separate holes for the bolts, or do one large, odd shaped one like is pictured.

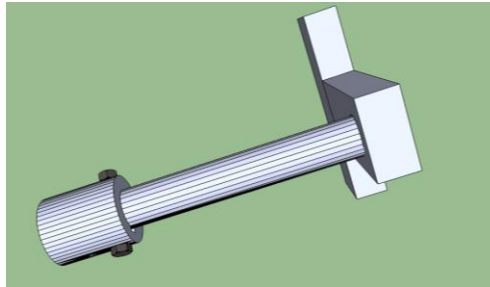


3. Weld it together

- Weld the bottom 2x2 to the 21" 4x4.
- Weld the two 4x4 angle pieces together as pictured, insuring they are perfectly flush and square.
 - Skip around while welding so it doesn't warp one way or another.
- Grind off the top weld linking the 4x4's so the bearing will be able to sit flush on it
- Also grind off near the bolt holes on the bottom.
- Weld the guard and braces to the mount.



CEB Shaker - Hammer and Shaft



[Sketchup Model](#)

Tools Needed:

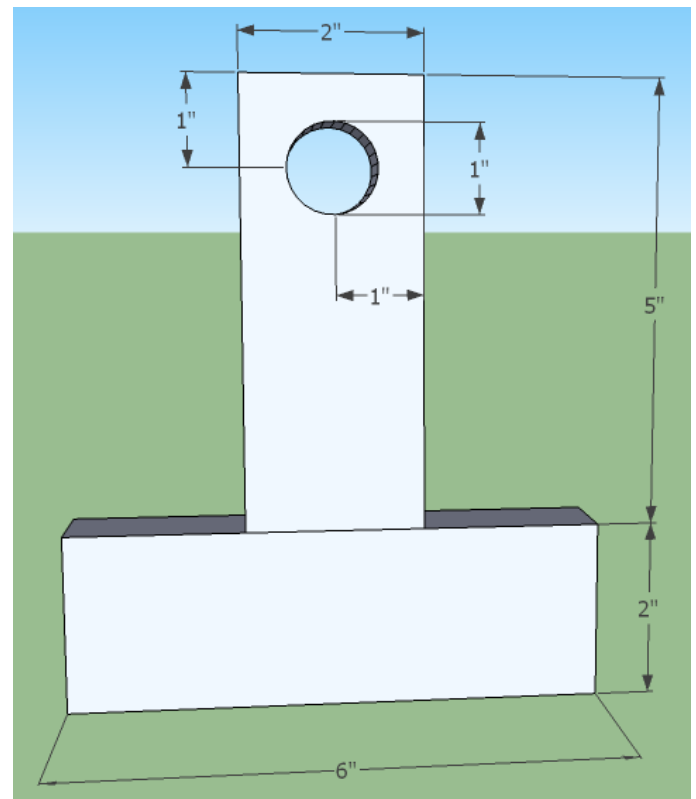
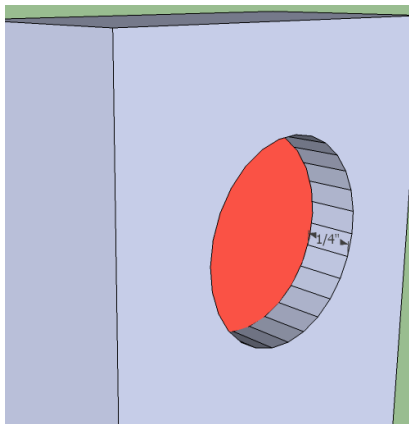
- Welder
- Something to mark steel with
- Drill Press
- Hole puncher

Materials Required:

- 1"x2" Flat- 6" (1) Hammer
- 1"x2" Flat-5" (1) Hammer
- 1" Round- 7.25" (1) Shaft
- 1" Keyed Coupler (1)
- ¼"x2" Bolt (1)
- Shaker Motor
- Shaker Mount

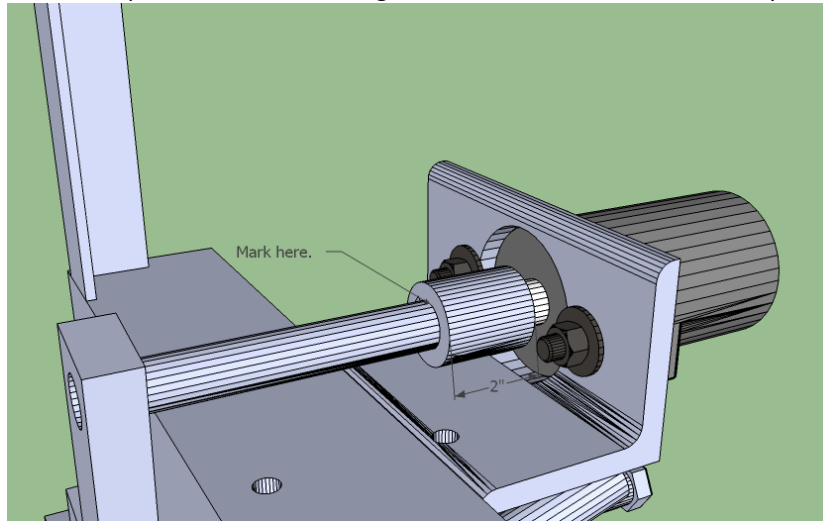
1. Prepare the hammer

1. Drill or punch the hole in the flatbar.
2. Weld the two pieces of flatbar together
 - This needs to be a really strong weld! The hammer will be under a lot of stress, and if it's not a solid weld, it could fly off! (This is why the guard is there).
3. Tack the shaft into the hole so there's about a 1/4" distance between the end of the shaft and the opposite side of the hammer.

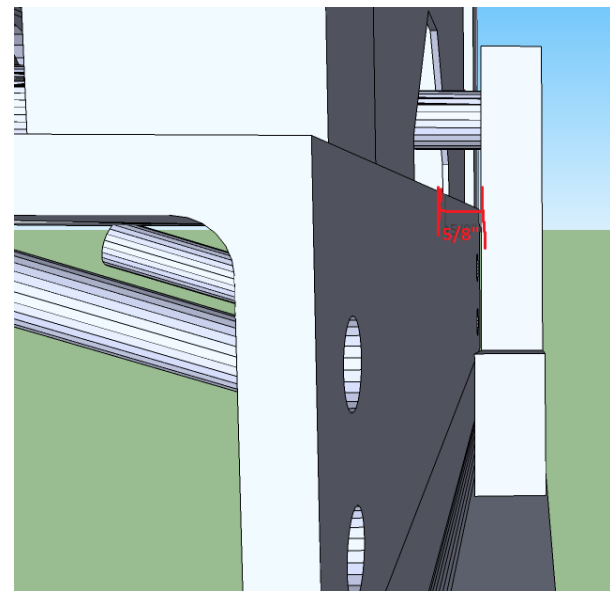


2. Couple the shaft

1. Cut the coupler down so it's 2" long. It doesn't matter from which side you cut it.

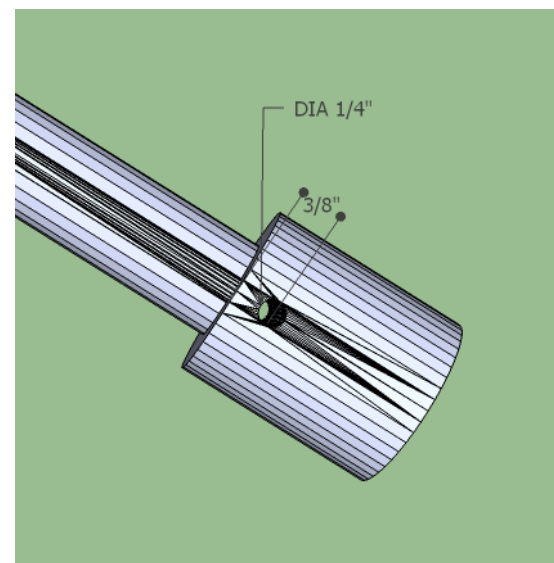


2. Get the shaker motor, the mount you made, the shaft/hammer, and the coupler.
3. Put the shaker motor onto the mount and couple the shaft to it. Mark where the shaft enters the coupler.
 - Make sure the coupler won't be rubbing on mount while it spins.
4. Make sure the hammer has about 5/8" clearance from the mount.
 - If not, you can pull it out of the coupler a little, but make sure the bolt won't be too close to the edge.
 - Otherwise, you can grind away the tacks on the hammer and tack it properly.



3. Drill Hole for bolt in coupler

1. Remove the motor and shaft from the mount
2. Put the coupler back onto the shaft.
3. Drill the 1/4" hole thru the coupler and rod, using the mark you made to make sure the rod is inside the coupler the proper amount.
 - The hole should be 3/8" away from the edge of the coupler.
 - Drill thru both at the same time. You will need some sort of vice to hold it down while you drill.
4. Double check that your bolt will fit thru. If not, either re-drill it.



CEB Shaker – Hydraulics Assembly

Tools Needed:

- Vise
- Various Wrenches

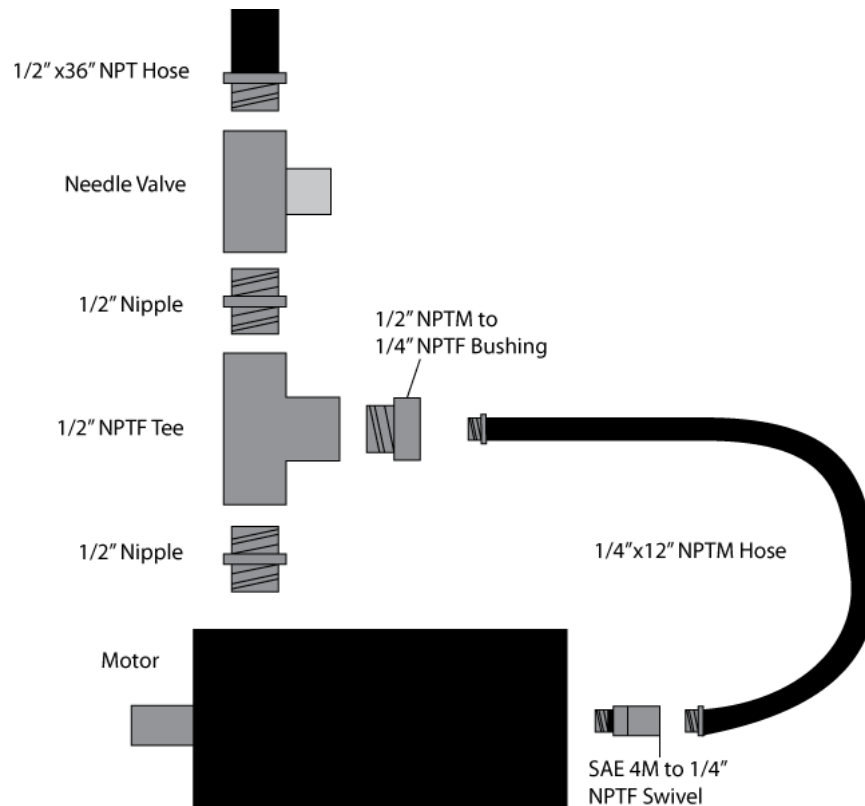
Materials Required:

- Thread tape
- Shaker motor [Buy](#)
- 1/2" NPT Needle Valve (1) [Buy](#)
- 1/4"x12" NPTM Hydraulic hose (1) [Buy](#)
- 1/2"x36" NPTM Hydraulic hoses (2)
- SAE 4M to 1/4" NPTF Swivel (1) [Buy](#)
- 1/2" NPT Hex Nipple (2) [Buy](#)
- 1/2" NPTF Tee (1) [Buy](#)
- 1/2" NPTM to 1/4" NPTF bushing [Buy](#)

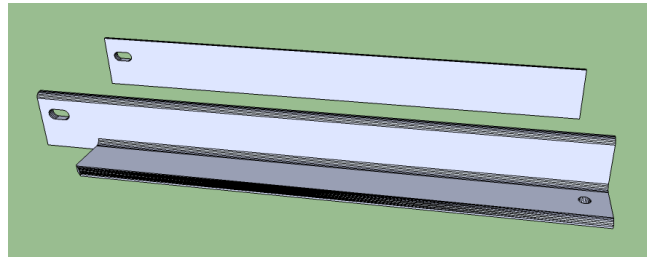
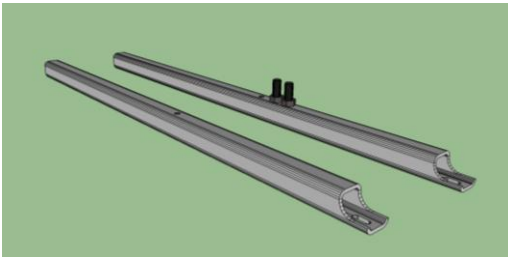
Things to know about working with hydraulics:

- Thread tape is necessary between each connection unless otherwise stated.
- Always wrap thread tape clockwise when facing the threaded portion.
- Always keep the end caps on hoses and fittings until you need to take them off. They need to stay protected inside.

1. Attach all of the fittings and the 2 hoses to the Tee, except the small swivel.
2. Tighten the tee assembly into the correct port (see the photo)
3. Install the swivel and tighten the small hose to it.
 - The swivel doesn't need thread tape.
4. Put the other 36" hose into the remaining port on the motor.



CEB Hopper and Grate Supports



- [Hopper Support Model](#)
- [Grate Support Model](#)

Tools Needed:

- Angle Grinder
- Welder
- Hole Puncher
- Torch

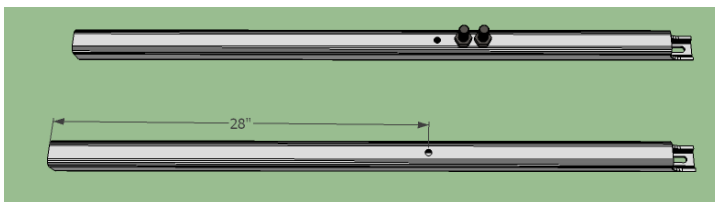
Materials Required:

- $\frac{1}{4}$ "x2"x2" Tubing- 48" (2) Hopper supports
- $\frac{1}{2}$ "x4"x4" Angle- 38" (2) Grate Supports
- Shaker mount
- $\frac{3}{4}$ "x1.5" Bolts (2)
- $\frac{3}{4}$ " Nuts (2)

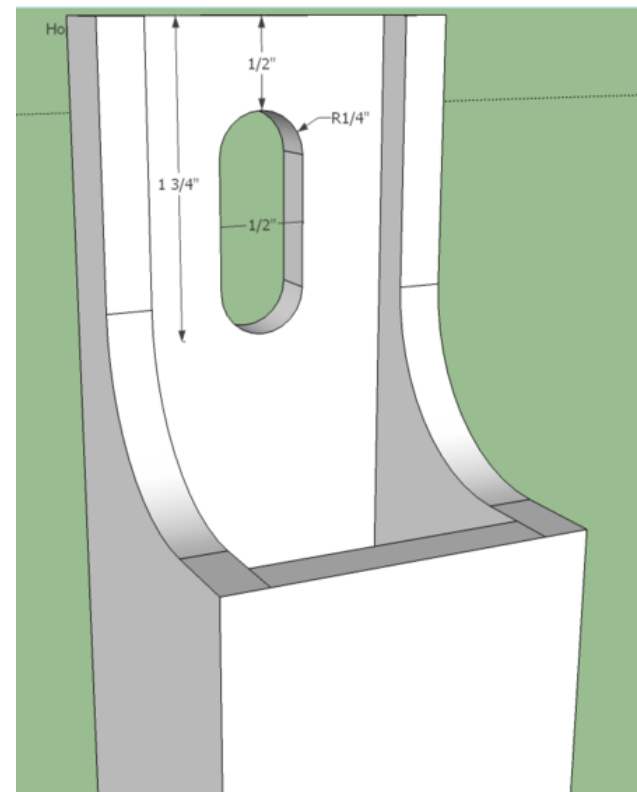
Hopper Supports

1. **Torch away the necessary areas.** See diagrams.

- The holes for the hopper mounting need to be 28" away from the bottom side. Mark 28" on the opposite tubing walls and torch 1/2" holes. Insure a 1/2" bolt goes all the way thru.
- Torch the cutaway at the top and the slot.

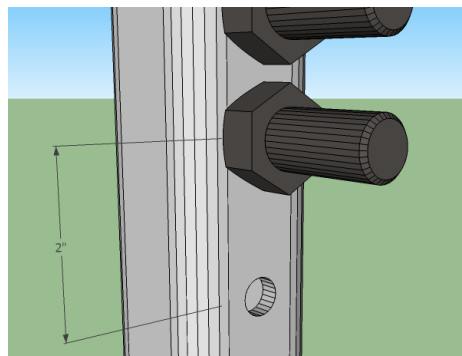
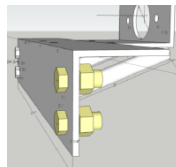


2. **Grind away any slag.**

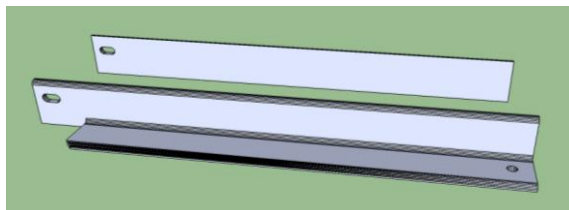


3. Weld the shaker mount bolts to it

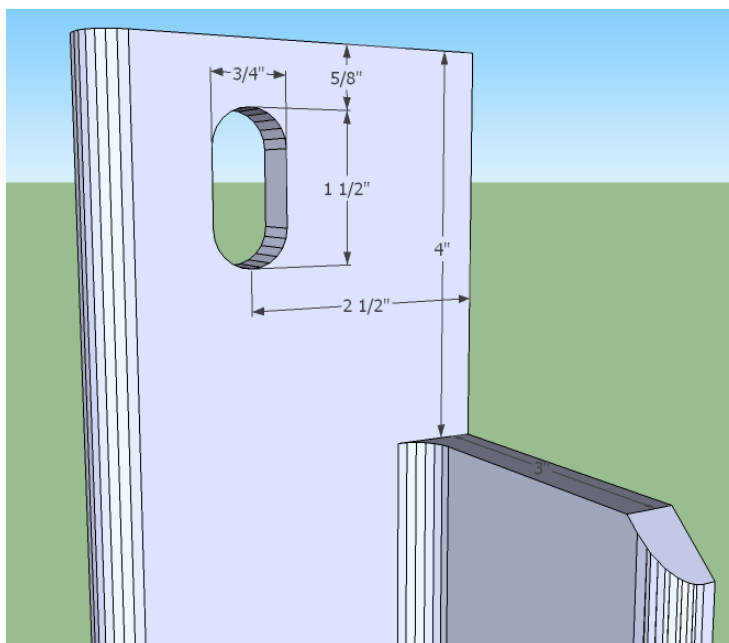
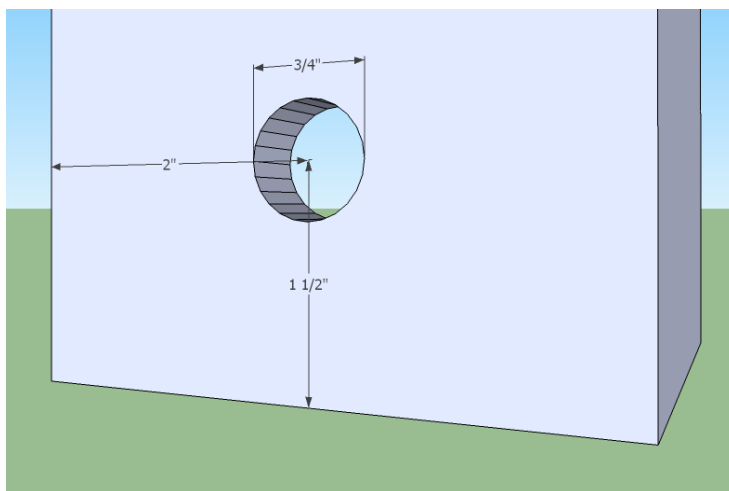
- Lay one support on the table, with the grate mount slot touching the table.
- Get the Shaker Mount and tighten 3/4" bolts with nuts to the Soil Shaker as shown.
- Prop this up on the hopper support, so the first bolt is about 2" above the 28" hole and both bolts are touching the support.
- Mark on the mount which side of the shaker you are welding the bolts for.
- Tack the bolts in place, remove the nuts and dismount the shaker.
- Protect the threads, and finish welding the bolts to the support.
 - You are only doing this on one of the supports. The other side, you will do in place, so the spacing is correct.



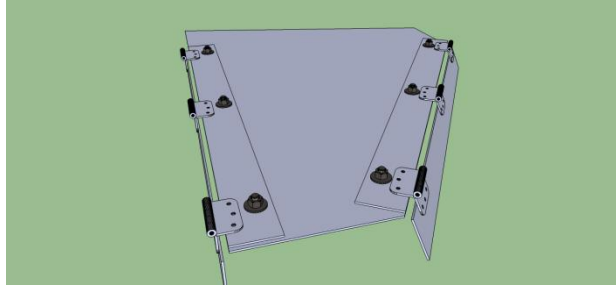
Grate Supports



1. Torch away a 4" section on the top of each grate to make it like the model shown.
 - Remember that the two are mirrored.
2. Cut away the corner so the hopper won't hit it, about a 1" 45 degree triangle.
3. Torch a slot for a 3/4" bolt at the top of the mount, as shown.
4. Grind away all the slag.



CEB Hopper Sheet metal



[Sketchup Model](#)

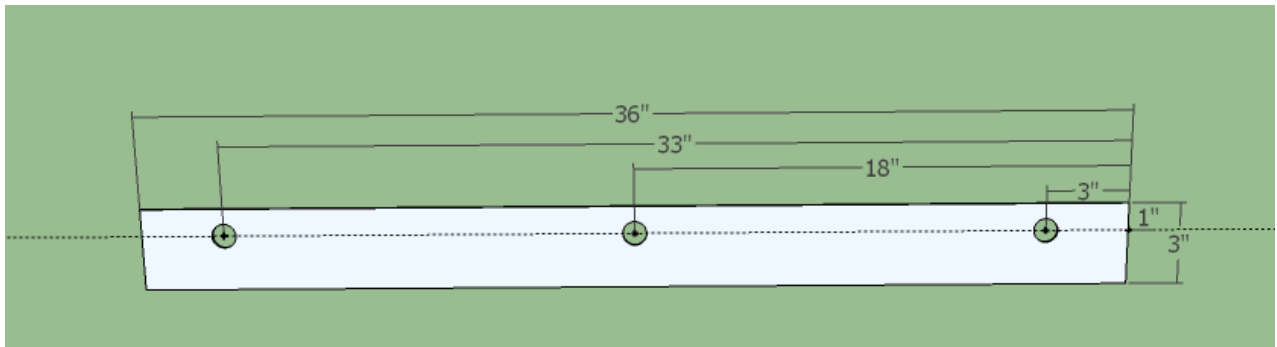
Tools Needed:

- Angle Grinder
- Welder
- Hole Puncher
- Torch
- Wrenches or Sockets

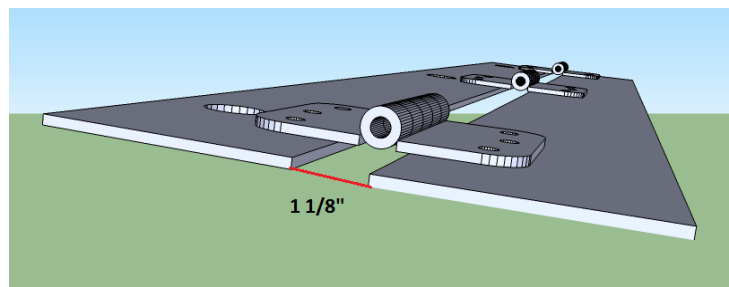
Materials Needed:

- Torched Hopper Sheet Metal (see cut list)
- 1/8"x3" Flat- 24" (12) Hinge plates
- Hinges (12)
- 1/2"x1" Bolts (12)
- 1/2" Nuts (12)
- 1/2" Washers (12)

1. Prepare the Hinge plates

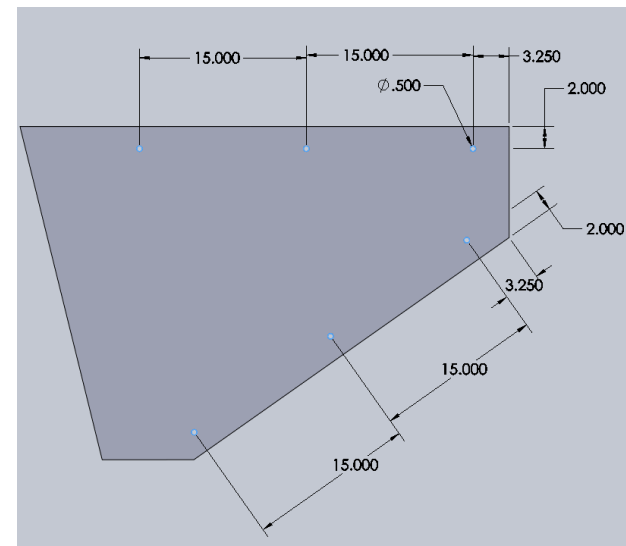
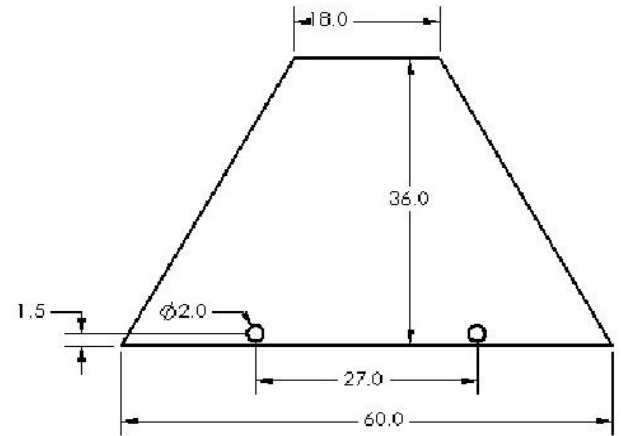
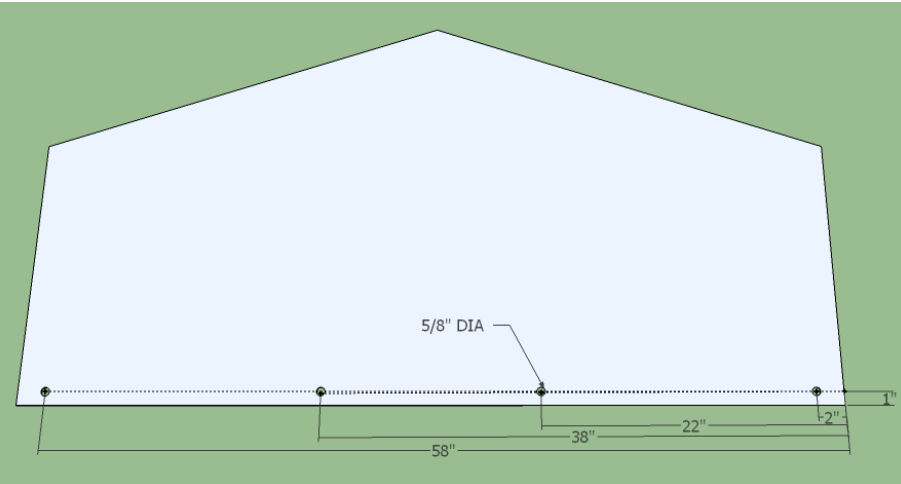


- Punch holes in 4 of the hinge plates as shown
- Weld one plate with holes, one without holes, and 3 hinges together as shown.
 - Make sure the side of the hinge that sticks out most is on the top; this way it won't interfere with the hopper metal below when installing the hopper. (See photo)
- Make 3 more of these. (4 Total)



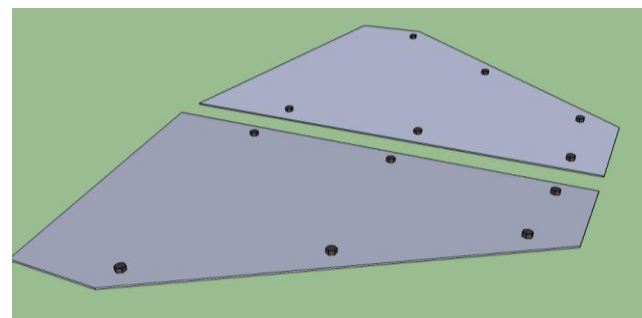
2. Hopper Sheet Metal

- Torch the holes shown in the front piece.
- Punch all of the holes shown in the side pieces and dirt deflector.



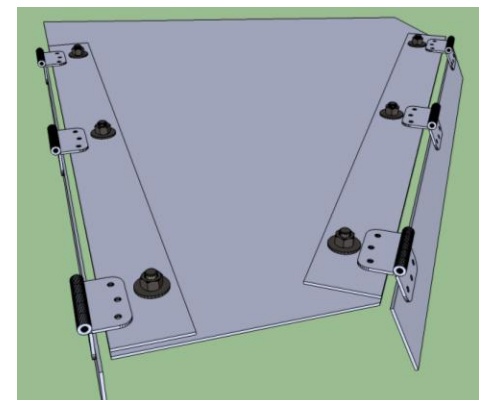
3. Weld the bolts

- Place 1/2" bolts thru the side pieces and weld them.
 - Make sure you are making them mirror images of each other.

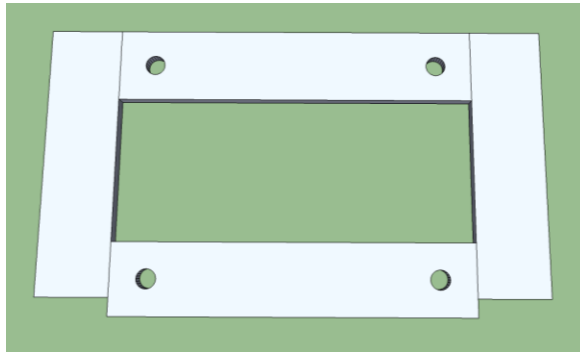


4. Assemble

- Bolt the hinge plate assemblies to the side pieces using a washer, lock washer, and nut on each bolt



CEB Hopper Mounting Plate



[Sketchup model](#)

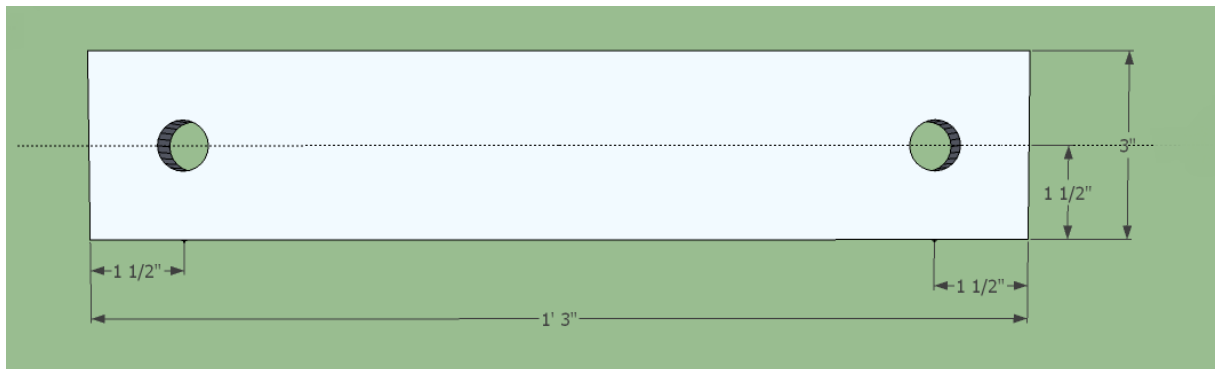
Tools Needed:

- Angle Grinder
- Welder
- Hole Puncher

Materials Needed:

- $\frac{1}{2}$ "x3" Flat- 15" (2)
- $\frac{1}{2}$ "x3" Flat-11.25" (2)

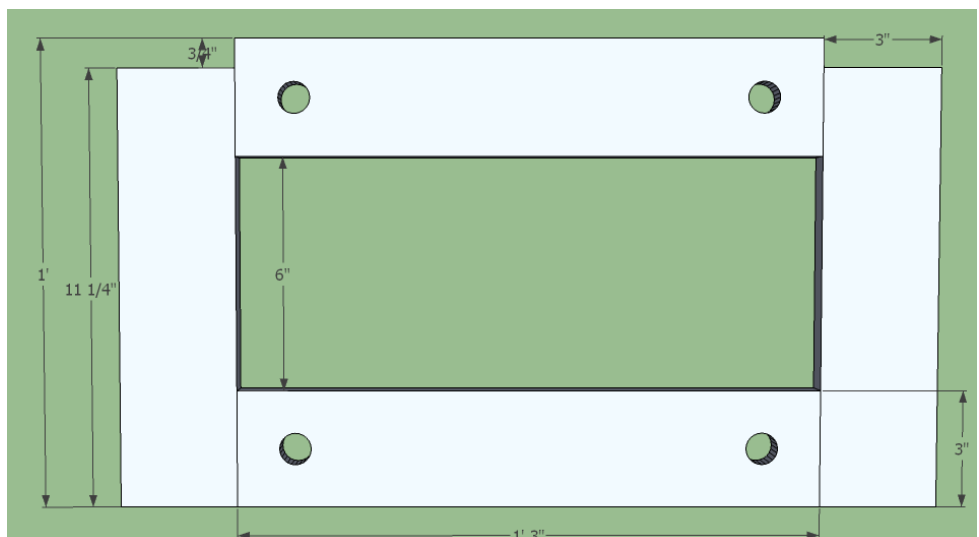
1. Punch the holes in the 15" pieces. They are both the same.



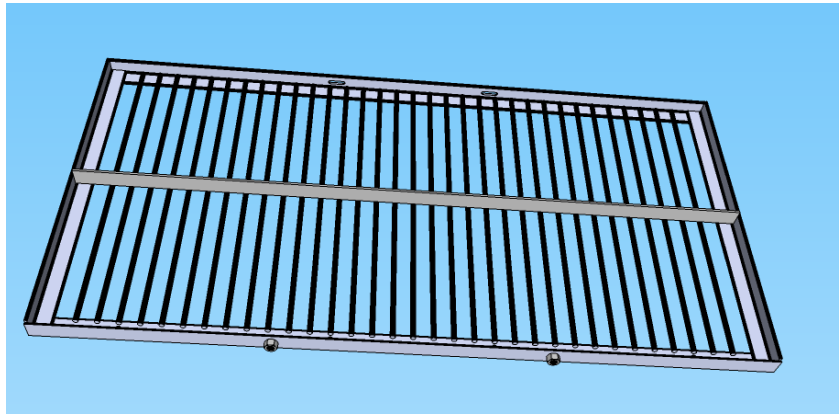
2. Weld the pieces together, insuring everything is square.

- There should be a 6" space between the 15" pieces.
- Skip around so the plate doesn't warp.
- Weld both sides on all seams

3. Grind away the welds on one side of the plate.



CEB Grate



[Sketchup Model](#)

Tools Needed:

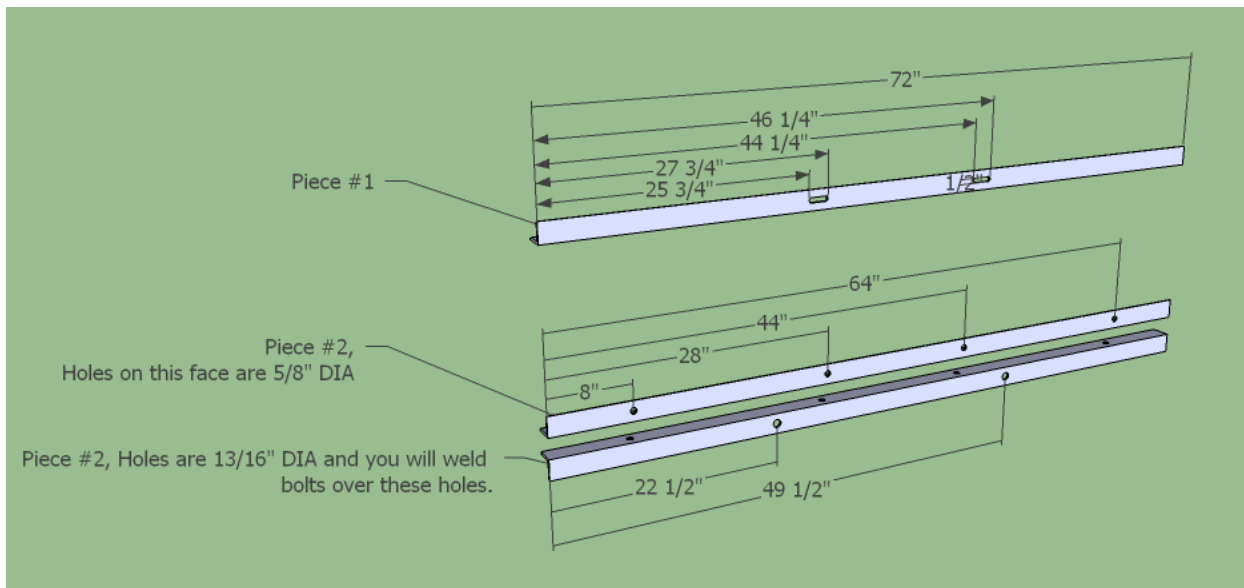
- Angle Grinder
- Welder
- Torch

Materials Needed:

- $\frac{1}{2}$ "x2"x2" Angle- 72" (2)
- $\frac{1}{2}$ "x2"x2" Angle- 35.5" (2)
- $\frac{1}{2}$ "x2 Flat- 71.5" (1) Cross Piece
- $\frac{1}{2}$ " Rebar- 34" (33)
- $\frac{3}{4}$ " Steel Nuts (2)

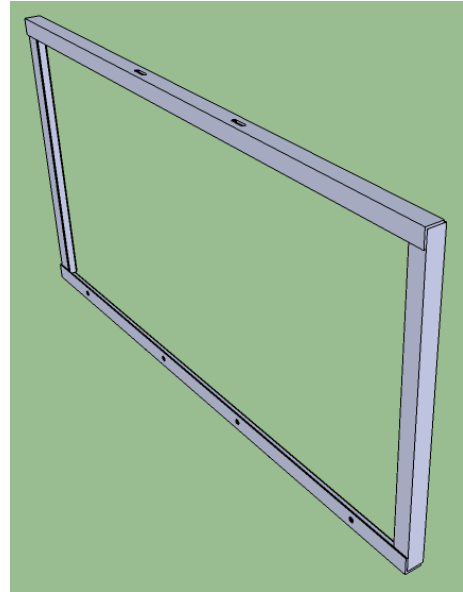
1. Prepare the frame

1. Torch all holes and slots in the 72" 2x2's as shown. Note that the slots are $\frac{1}{2}$ " tall.

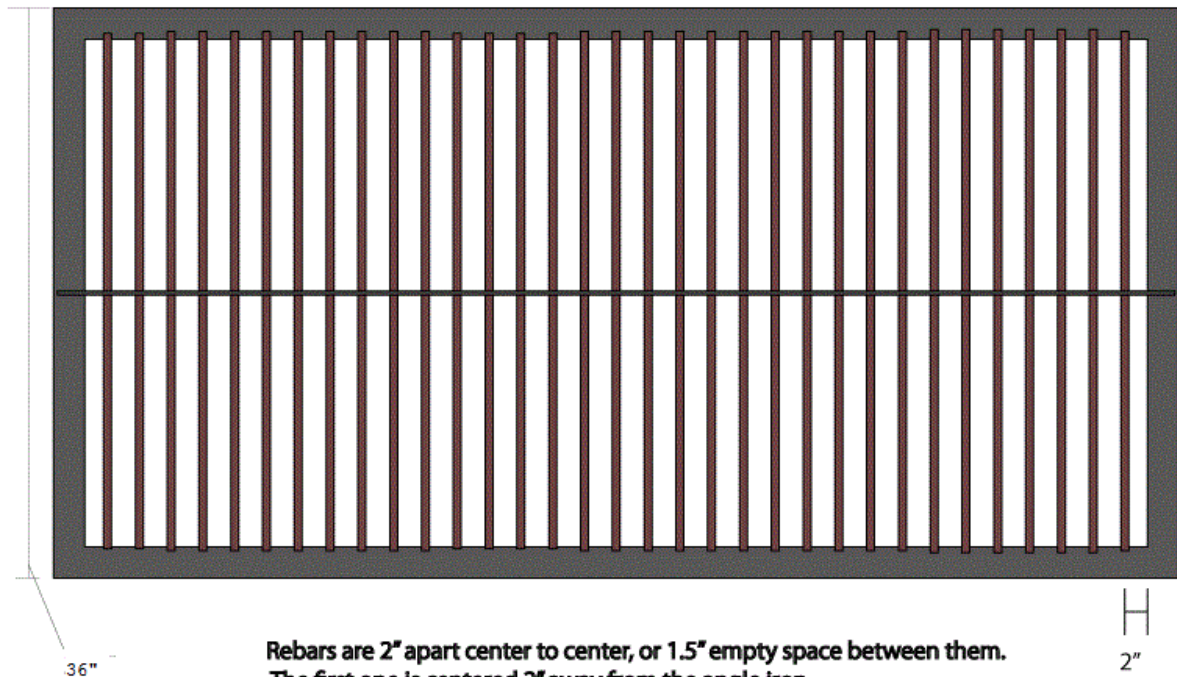


- Make sure you can fit the proper size bolt through each hole.
2. Grind away any slag
 3. Weld the nuts to the proper 2x2.
 - Protect the threads while you weld.

2. **Weld the angle together to make the frame.** The short pieces are sandwiched between the long pieces. See the diagram.



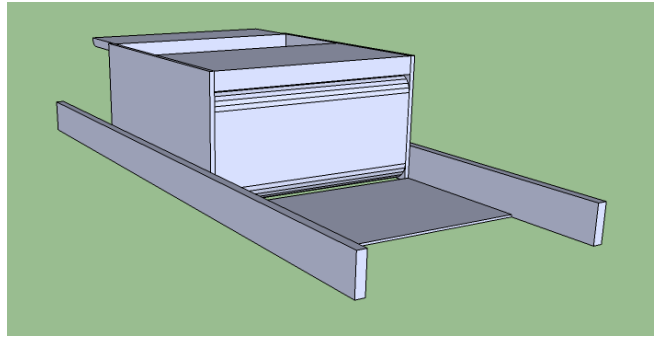
3. **Weld all of the rebar inside of the frame.**
 - It would help to find some 1.5" spacers laying around the shop so you can place them between the rebars quickly and be sure they are square. Nuts and hydraulic fittings might be the right size.



The rebar is welded into the frame first, and then the cross support.

4. **Weld the cross support** (the 1/4 x 2 flatbar) in centered and perpendicular to the plane of the frame

CEB Soil Loading Drawer



[Sketchup model](#)

Tools Needed:

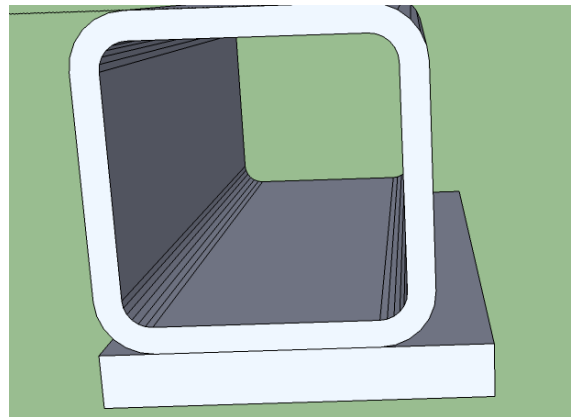
- Angle Grinder
- Welder
- Squares

Materials Needed:

StockSize	Size (Inches)	Length (Inches)	QTY.	Primary Part Name
Angle	.5x4x7	12	1	Back
Flat	.1875x2.5	36	2	Outer Rails
Flat	.25x7	13.5	2	Sides
Flat	.25x8	12.5	1	Roof
Flat	.5x2	36	2	Inner Rails
Flat	.5x3	3	1	Tongue
Flat	.5x6	12	1	Vertical Supports
Flat	1x7	12	1	Press Plate
Tubing	.5x6x6	12	1	Spacer

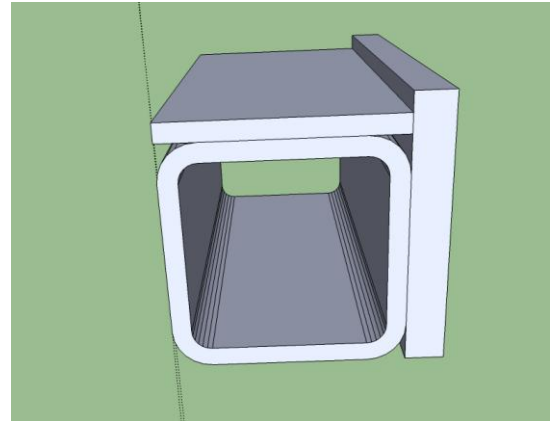
Step 1 — Weld Press Plate to Spacer

1. Lay the spacer tube on top of the press plate, align the sides and make the back edge flush.
 - Insure all edges are tight and squared; this piece is critical, it must be a uniform height throughout the entire item. Grind off any imperfections.
2. Tack weld the two together in many places (at least 3 on each seam).
 - Double check everything for squareness!!
3. Weld the two together on all edges where they touch
 - It is a good idea to weld in 1" or 2" increments, skipping around to different places to prevent warpage. You will need to weld multiple layers where the tubing is rounded.

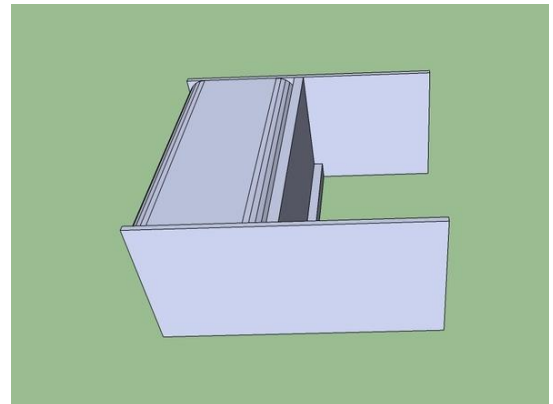


Step 2 — Weld the vertical support

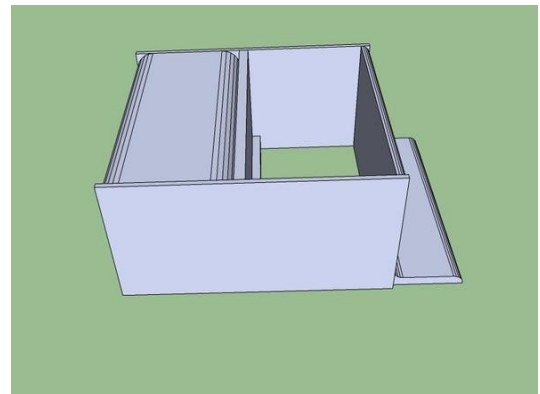
1. Place the vertical support and tack it in multiple places
2. Weld the vertical support to the press plate and spacer tube assembly.
3. Grind down the welds on the open end of the tube so they are flush with the rest of the tube.

**Step 3 — Tack Sides**

1. Lay the spacer/press plate assembly down so the press plate is touching the table.
2. Align side pieces with spacer and press plate assembly.
3. Insure the two are square vertically and horizontally with the spacer, that they are parallel, and that everything is touching the table.
 - It helps to use angle iron tacked to your table and the sides, so it insures they are vertically square. This also makes it a bit easier to align everything else. [Video Help](#)
 - Also, it may help to use paper shims (see between the sides and the tube to properly space them. [Video Help](#)
4. Tack the sides to the tube on all sides in multiple places except where it is touching the table. Add a few 1" seams to prohibit them from moving.
 - Do a few light tacks first, and double check it's still square. If not, grind off the tacks and start over.

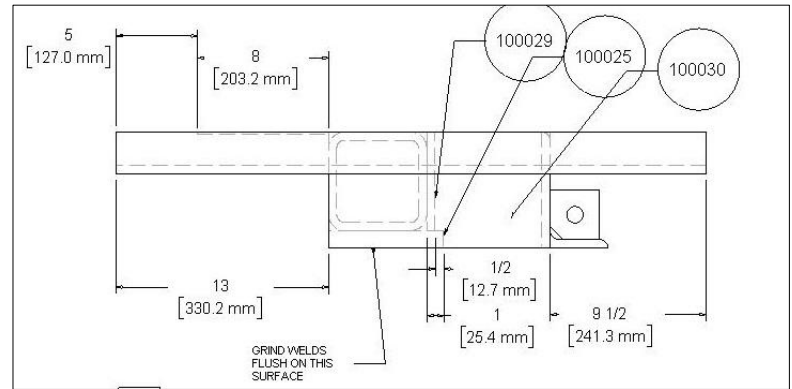
**Step 4 — Tack the back**

1. Tack the back piece in a few spots, with a 1" seam on each side.

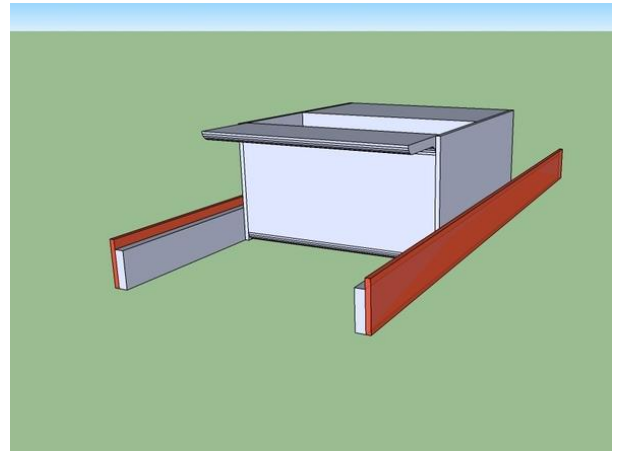


Step 5 — Tack Roof, Inner Rails

1. Grind off the welds for the back and side pieces so that the entire drawer is flush.
2. Flip the drawer over and tack the sides from the top.
3. Place the roof and inner rails in their respective places. See Diagram.
4. Insure inner rails are perfectly parallel (varying no more than a 16th of an inch) and square throughout the entire length.
5. Tack them in multiple places except where they are touching the table.

**Step 6 — Tack Outer Rails**

- Insure they are perfectly parallel; otherwise they will leave the roller guides. Insure they vary no more than 1/16" over the entire length.
- Hint: Use paper shims for this.

**Step 7 — Weld Entire Drawer**

- All the seams should be completely welded except the difficult to reach places between the inner and outer rails, those can be welded about 50%.
- Weld short lengths at a time and jump around a lot to minimize warping.
- You may want to grind off the welds in between passes around the drawer to allow it to cool.

Step 8 — Grind the entire drawer flush

- There cannot be any outstanding bumps or welds anywhere; the drawer will be sliding in and out of a tight spot and bumps will catch on the frame crossmembers.
- Make sure there's no welding spatter where the rollers will be rolling. Grind any off with a small grinder.

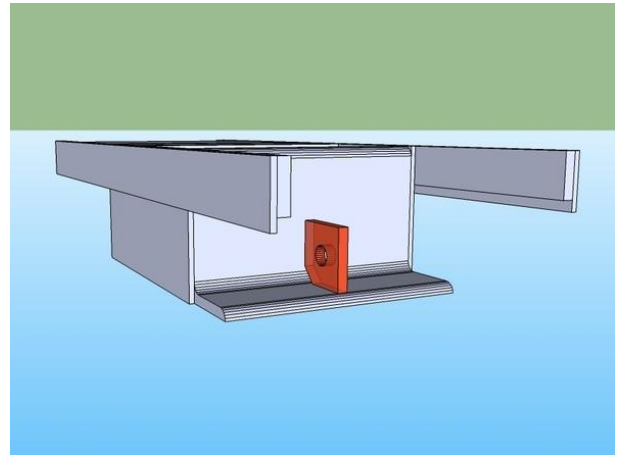


Step 9 — Check the Rails

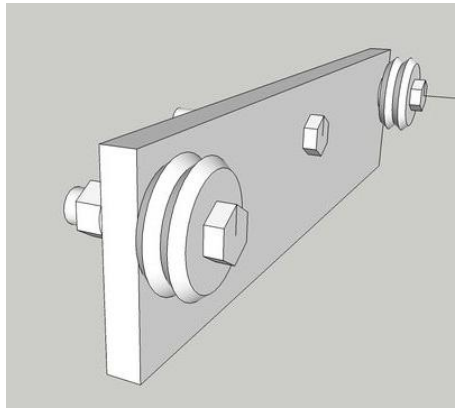
- The rails likely got warped outwards on the side with the back while you were welding.
- If they are not still parallel, you will need to pinch them inwards so that they are. You can do so using two C-Clamps as shown.

**Step 10 — Weld Tongue In place**

- Prepare as shown in the diagram
- Weld it to the back of the drawer, insuring it is square and centered.



CEB Roller Guides



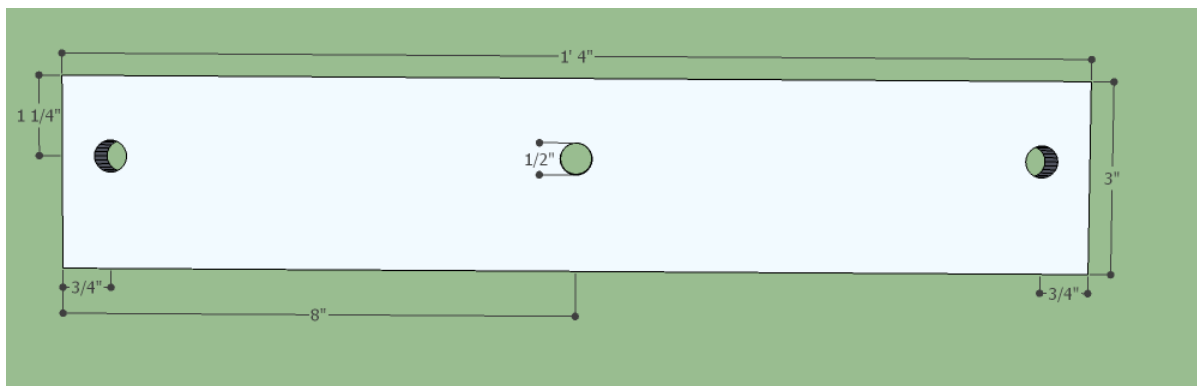
[Sketchup Model](#)

Tools Needed:

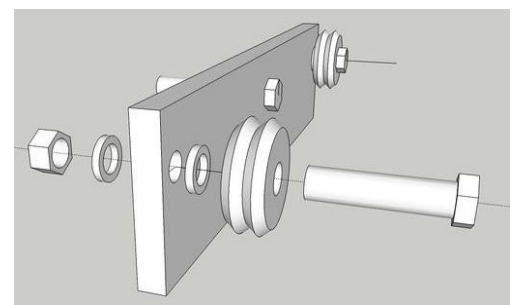
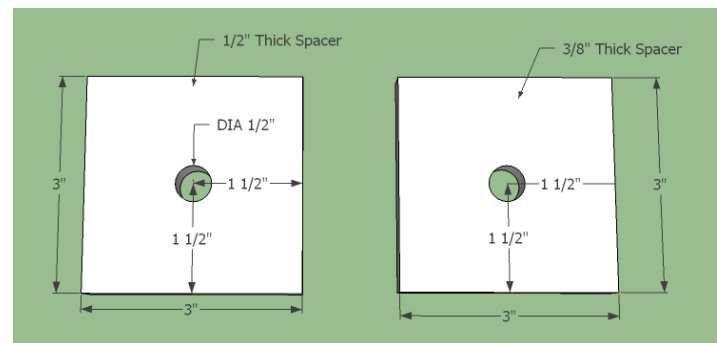
- Angle Grinder
- Welder
- Hole Puncher
- Wrench

Materials Needed:

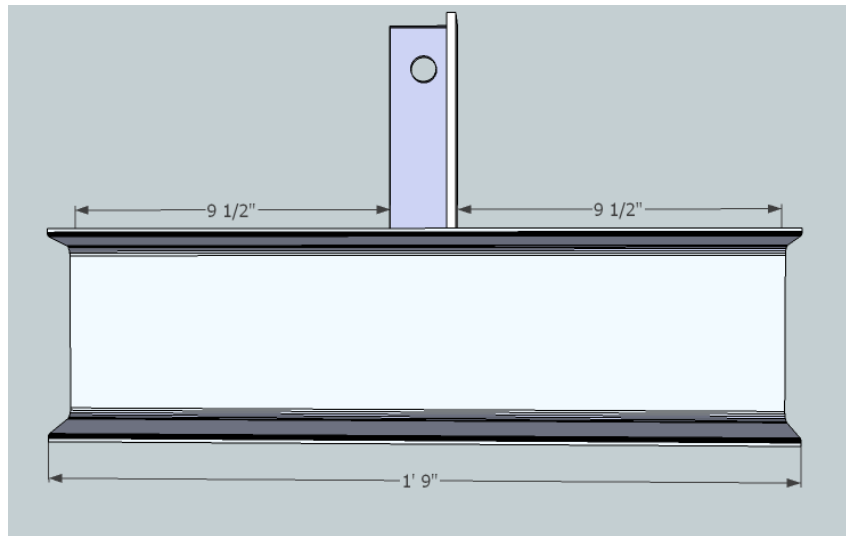
- $\frac{1}{2}$ "x3" Flat- 16" (2)
- V-Groove Bearings (4)
- $\frac{1}{2}$ "x 2.5" Bolts (2)
- M12x55mm Bolts (4)
- M12 Nuts (4)
- Washer, Lock 12mm (8)



1. Punch the holes in the main plates and the spacer plates.
2. Weld the $\frac{1}{2}$ " bolts in the center hole, from the bolt head side.
3. Grind off the top of the 12mm bolts so that the head is $\frac{1}{4}$ " thick or less.
 - This is so that the bolts will not be touching the drawer as it slides in and out.
4. Assemble the bearings to the plate as shown, with lock washers on each side of the main plate.



CEB Wide Cylinder Supports



[Sketchup Model](#)

Tools Needed:

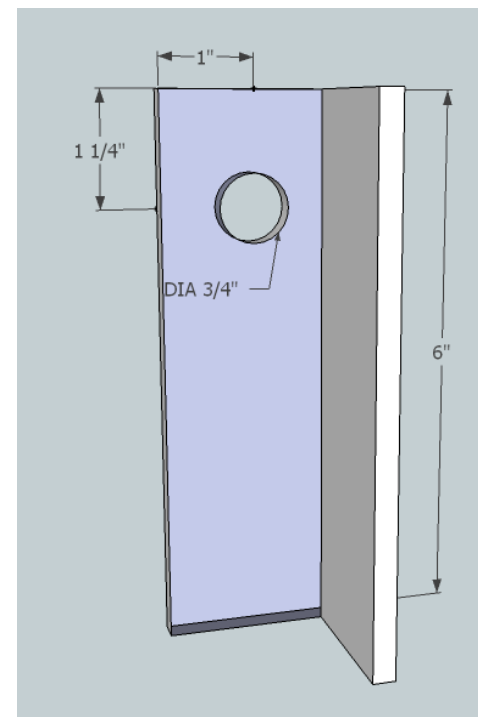
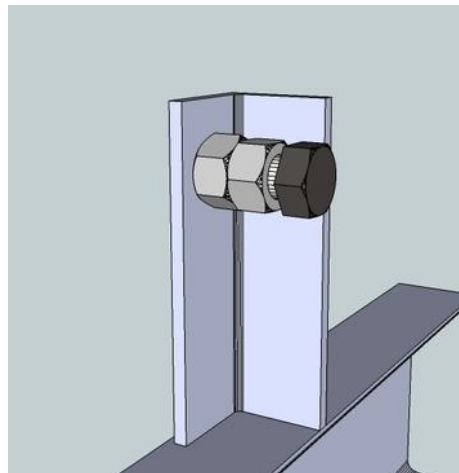
- Angle Grinder
- Welder
- Square

Materials Needed:

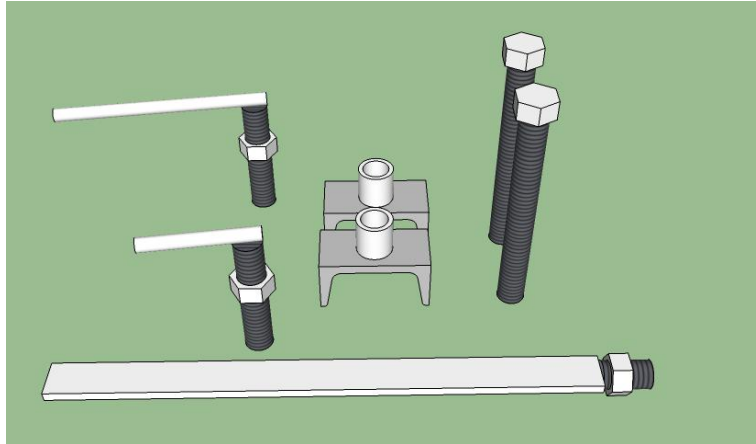
- 6" Heavy U-channel - 21" (2)
- 1/4"x2"x2" Angle - 6" (2)
- 3/4" Steel Nuts (2)
- 3/4" Galvanized nuts (2)
- 3/4"x2" Bolts (2)

You need to make two of these. They can be exactly the same.

1. Torch the hole in the 2x2 angle as shown.
2. Weld the angle centered on the U-channel. (see image above)
3. Weld a 3/4" bolt over the hole.
 - Protect the threads
4. Put a galvanized nut on a 3/4"x2" bolt and thread through the welded nut on each side.



CEB Main Frame Small Components



[Sketchup Model](#)

Tools Needed:

- Welder

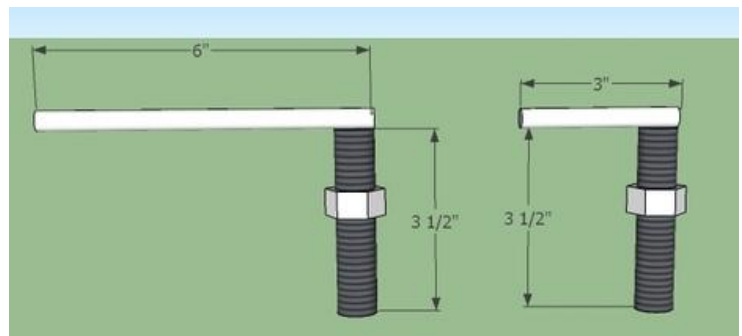
Materials Needed:

- $\frac{3}{4}$ " Steel Nuts (2)
- $\frac{3}{4}$ " Galvanized Nuts (3)

StockSize	Size (Inches)	Length (Inches)	QTY.	Primary Part Name
C-Channel	3	1.5	2	Thin Cylinder support
Flat	.25x1	14	1	Magnet Holder
Pipe	.75ID 10D	1	2	Thin Cylinder support
Rebar	0.375	3	1	Sensor Holder
Rebar	0.375	6	1	Sensor Holder
Threaded Rod	0.75	1.25	1	Magnet Holder
Threaded Rod	0.75	3.5	1	Sensor Holder
Threaded Rod	0.75	3.5	1	Sensor Holder
Threaded Rod	0.75	6.25	2	Thin Cylinder support

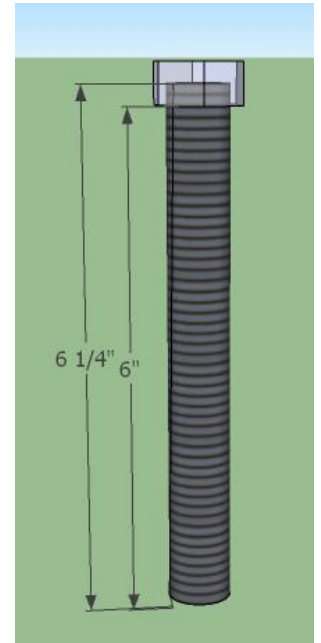
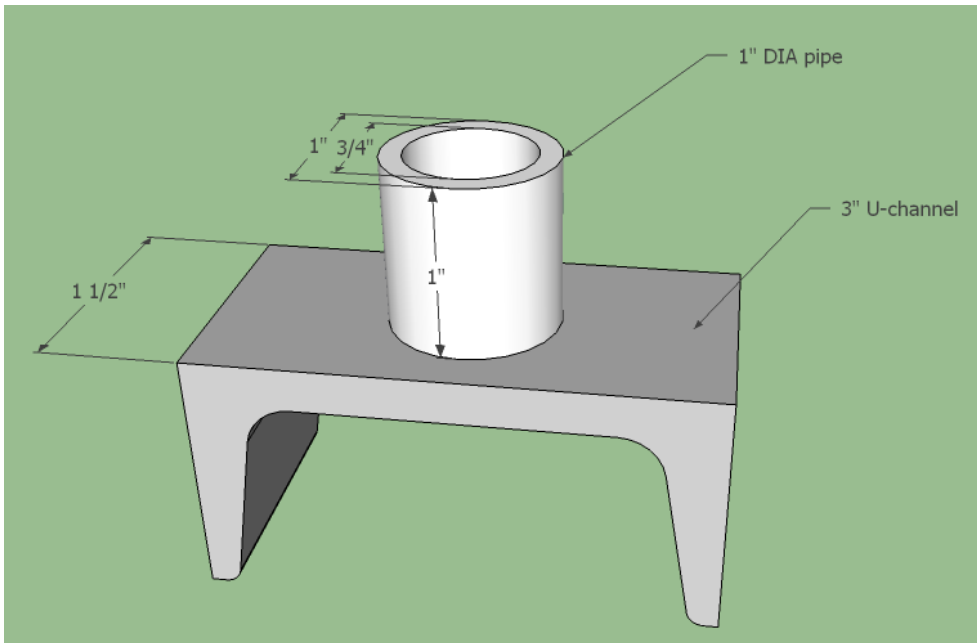
Sensor Holders

- One is for the main frame, and one goes in the primary arms.
 1. Weld the rebar to the threaded rod at a right angle.
 - Protect the threads on the threaded rod by welding. (A small pipe works well)
 2. Thread a nut onto it.

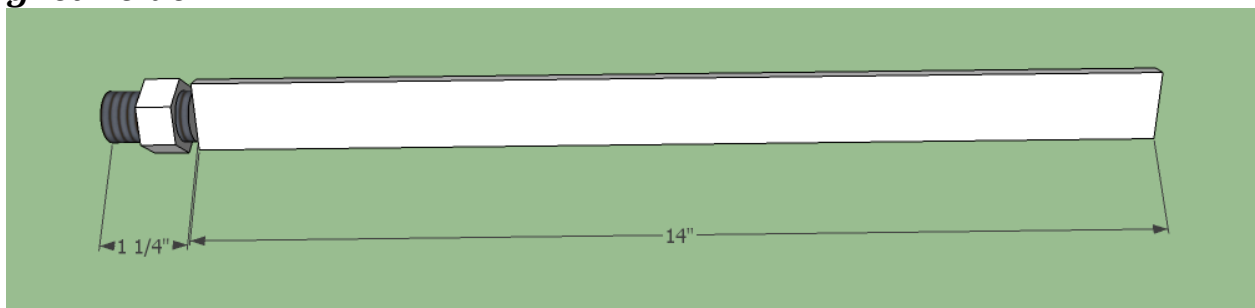


Thin Cylinder Supports

- Weld the 1" pipe to the 3" U-channel, in the center. 4-8 good tacks is sufficient.
- Make (2) 6" long 3/4" bolts, by using a nut and 6.25" of threaded rod. See [Making Bolts](#).

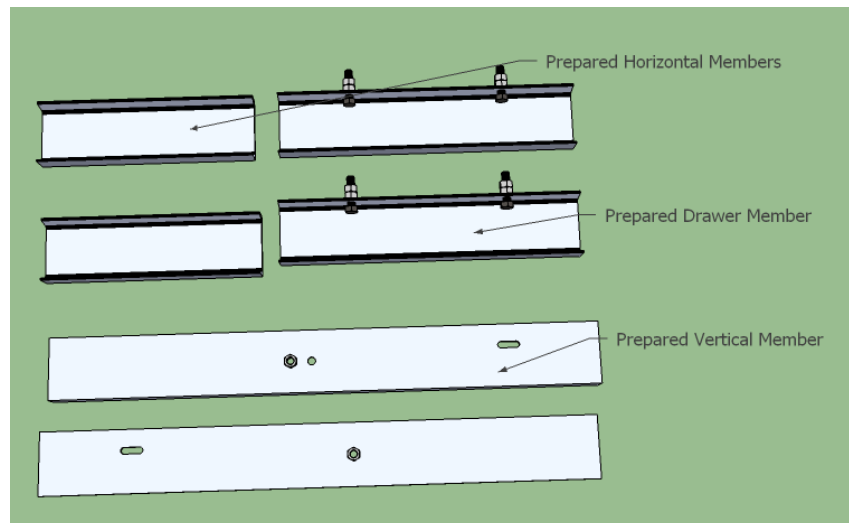


Magnet Holder



1. Weld the flatbar to the 1.25" piece of threaded rod.
 - Protect the threads.
 - Make sure they are perfectly parallel!
2. Thread a nut onto the threaded rod.

CEB Main Frame U-Channel Prep



[Sketchup Model](#)

Tools Needed:

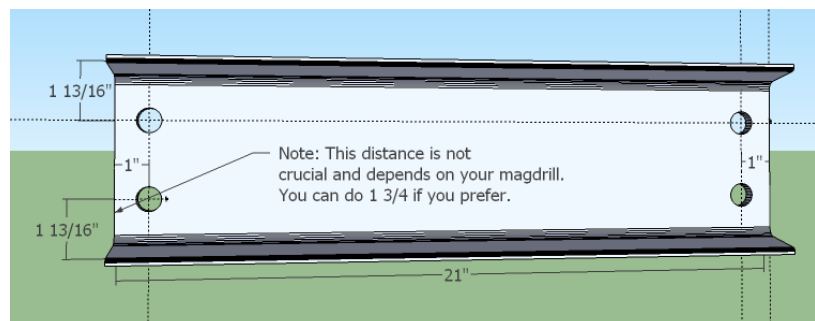
- Angle Grinder
- Welder
- Hole Puncher
- Torch

Materials Needed:

- 6" Heavy U-Channel- 21" (2) Horizontal Members
- 6" Heavy U-Channel- 53" (2) Vertical Members
- 6" Heavy U-Channel- 29" (2) Drawer Members
- $\frac{3}{4}$ " Steel Nuts (10)
- $\frac{3}{4}$ " Galvanized Nuts (4)
- $\frac{3}{4}$ " Threaded Rod- 3.75" (4) Drawer Adjustor bolts

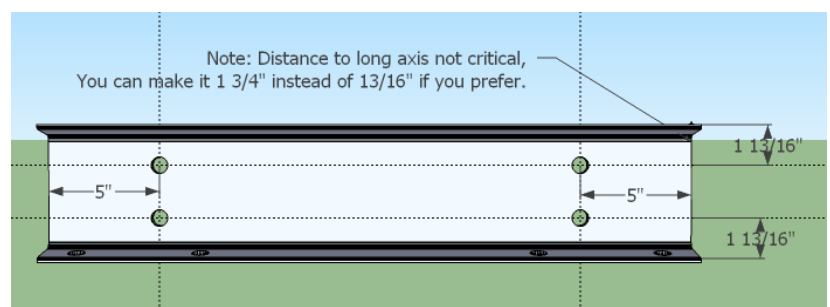
Prepare the Horizontal Members

- Mark the holes in the horizontal members as shown in the diagram. Center punch them.
- DON'T PUNCH THEM! They will be mag-drilled in a later guide.

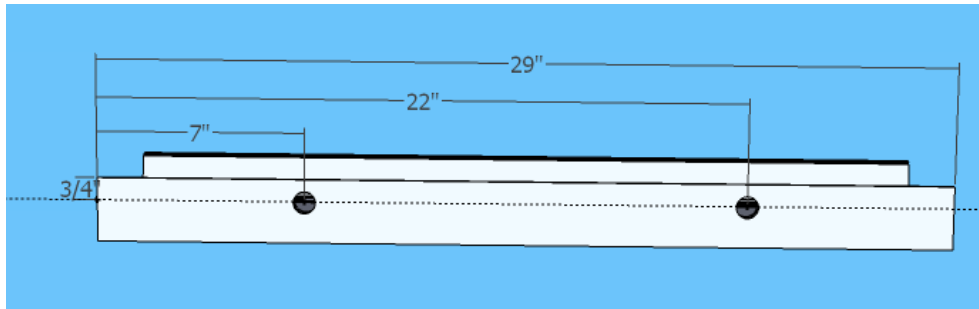


Prepare the Drawer Members

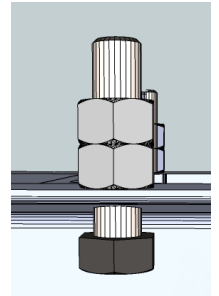
1. Mark and center punch the 4 holes on the face of the U-channel.
 - DON'T PUNCH THEM! They will be mag-drilled later.



2. Torch holes for 3/4" drawer adjustment bolts as shown in the diagram.

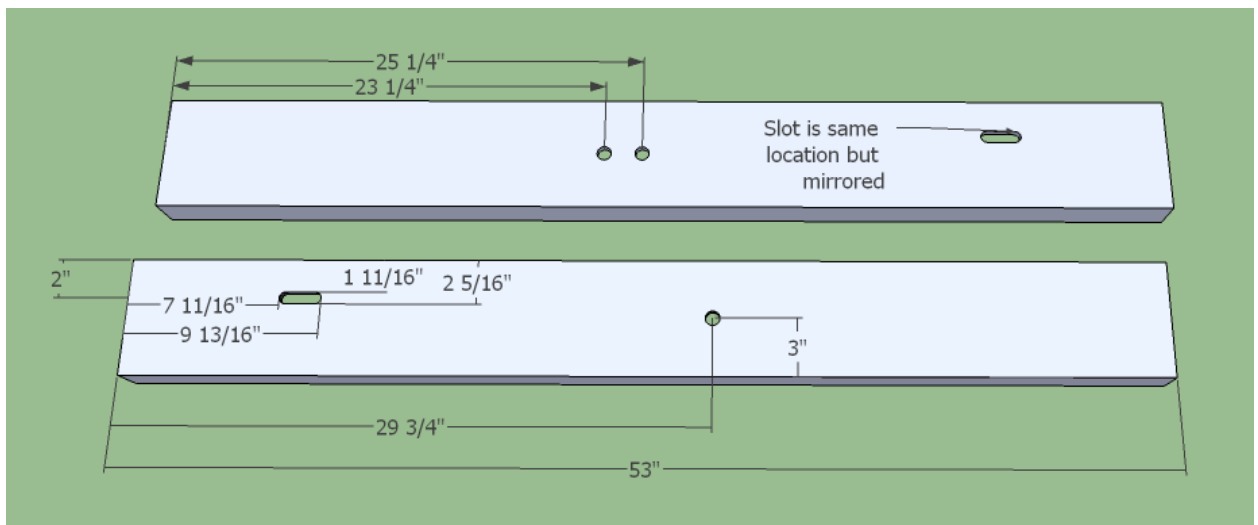


3. Grind away the slag.
4. Weld 3/4" nuts to the outside of the U channel where the holes are torched.
 - Weld it with a bolt coming thru the other side so it protects the threads and so you know the nut won't get off center.
5. Grind away any spatter between the bolts.
6. Make (4) 3/4" x 3.5" bolts using 3.75" threaded rod and steel nuts. See [Making Bolts](#).
7. Thread the bolts through the nuts and thread another nut on top as shown.

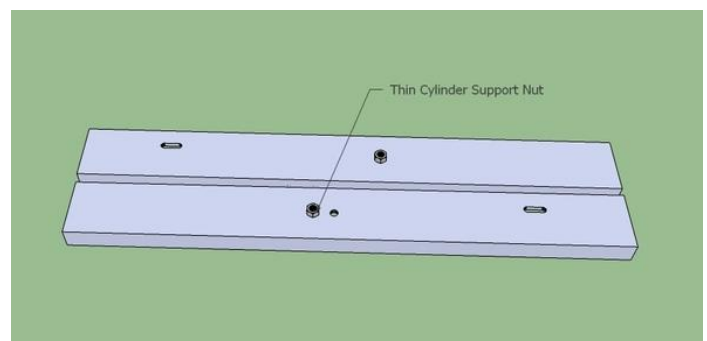


Prepare the Vertical Members

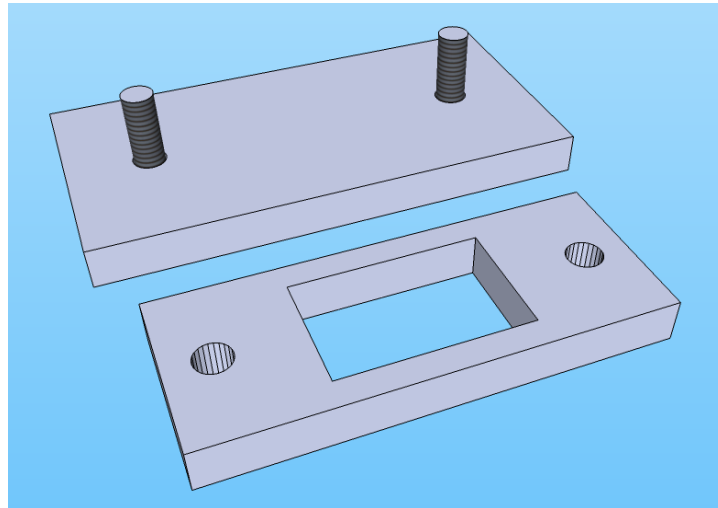
1. Punch the holes as shown.
2. Torch the roller slots as shown.



3. Grind away the slag.
4. Weld the thin cylinder support nuts, taking care to protect the threads.



CEB Prepare the Press Feet



[Sketchup Model](#)

Tools Needed:

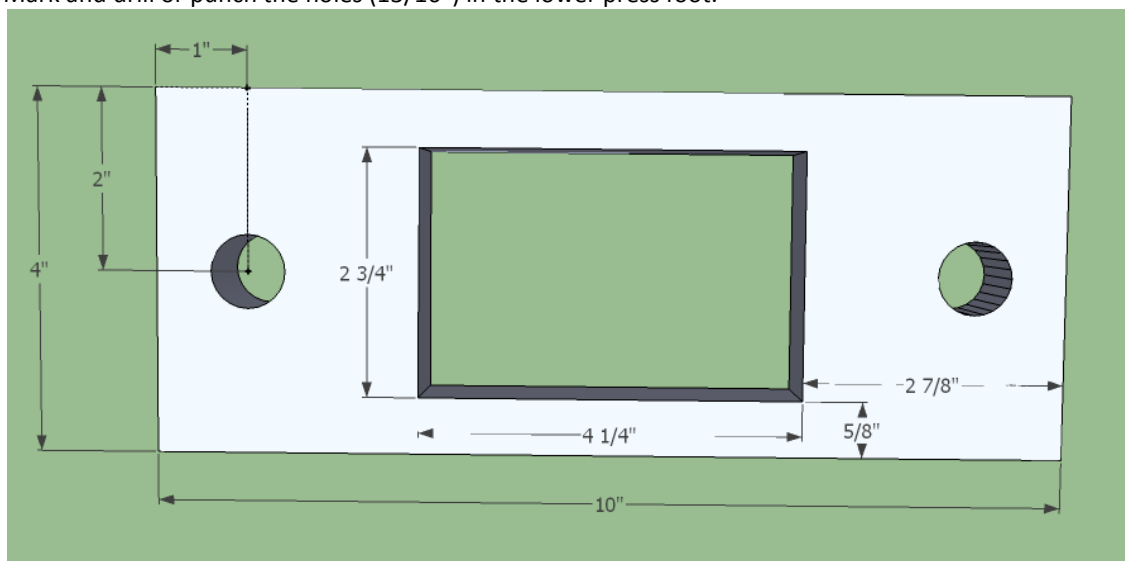
- Angle Grinder
- Welder
- Hole Puncher
- Drill Press or Mag Drill with 13/16" Bit

Materials Needed:

- 1"x4" Flat- 10" (1) Lower Press Foot
- 1"x6" Flat- 12" (1) Upper Press Foot
- 3/4" Threaded Rod- 2.5" (2) Upper Press Foot

Lower Press Foot

1. Mark and drill or punch the holes (13/16") in the lower press foot.

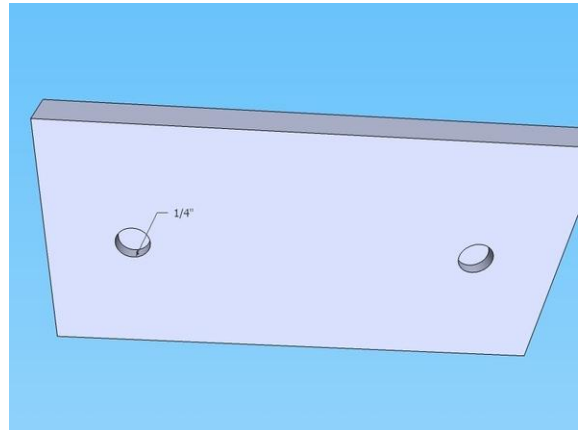


2. Place this centered on the upper press plate and transfer punch the hole locations.
3. Mag-drill these holes.

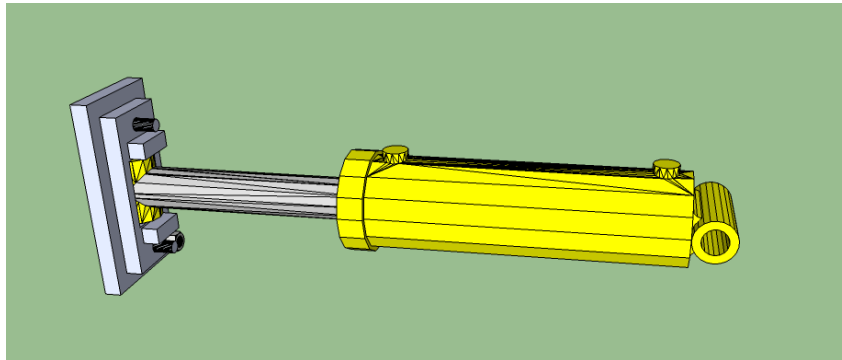
4. Torch out the hole in the center of the lower press plate.
5. Grind it smooth.

Upper Press Foot

1. Plug weld the threaded rod into the upper press plate, so that the threaded rod is about 1/4" deep in the plate.
2. Fill the hole with weld, then grind it flush.
 - The upper press foot NEEDS to be 12" exactly across at the top of it (the side without the bolts sticking up) or there will be "fuzzy edges" on your bricks. See the [video](#) for more info.



CEB Prepare the Main Cylinder



[Sketchup Model](#)

Tools Needed:

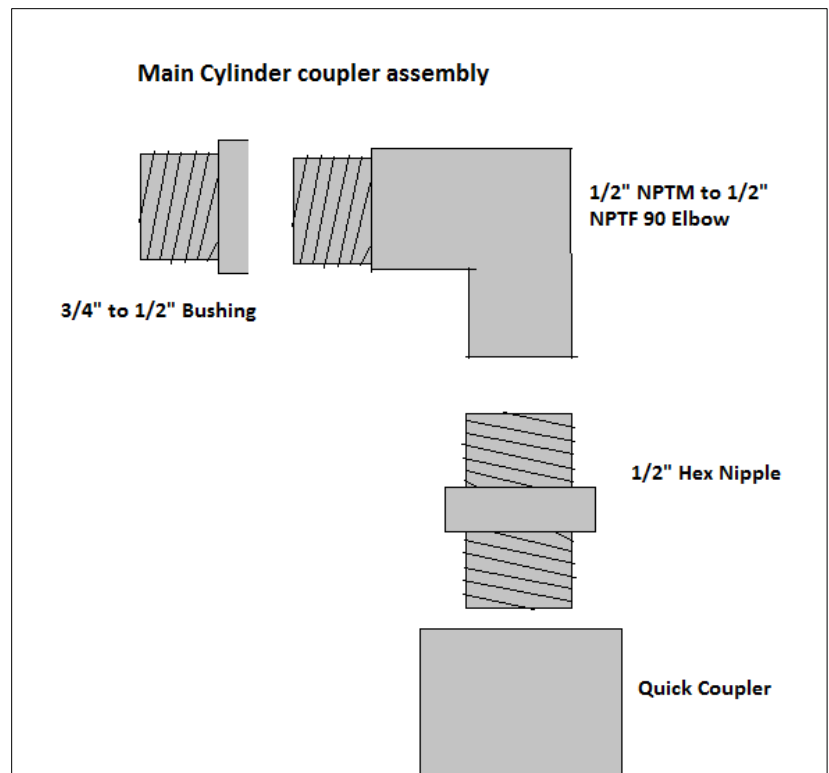
- 3/8" Allen Wrench
- Bucket and Water for cooling cylinder
- Hydraulic Pump
- Large Square
- Speed Square
- Thread Tape
- Vise
- Welder
- Various wrenches

Materials Needed:

- The Press Feet
- The Main Cylinder
- 1/4" to 1/2" Bushing (2)
- 1/2" NPTM to 1/2" NPTF Elbow (2)
- 1/2" Hex Nipple (2)
- 1/2" Quick Coupler Set (1)
- 3/4" Galvanized Nuts (2)
- 3/4" Steel Nuts (1)

Step 1-- Prepare the Hydraulic Couplers

- Thread tape is necessary between each connection. Always wrap thread tape clockwise when facing the threaded portion.
- You will need to make 2 of these, one with male quick couplers and one with a female.
 1. Put the hex nipple in the vise and tighten the quick coupler onto it. Put the elbow in the vise, male side up, and tighten the bushing onto it.
 2. Rotate the elbow in the vise and tighten the quick coupler/ nipple onto it.



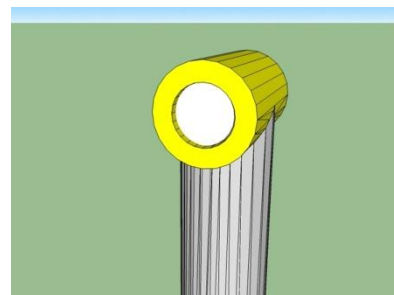
Step 2 — Install the Couplers

1. Remove the plugs on the cylinder.
 - The Prince brand cylinder uses a really large allen wrench for their plugs. If you can't find one, you can make one like we did.
 - Make sure the ports are facing up as there might be fluid in the cylinder and you don't want it to leak.
2. Tighten the coupler assembly into the holes, so that when the cylinder is lying on its side, neither one will hit the table.



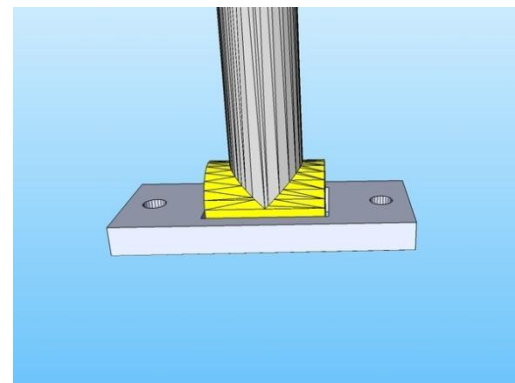
Step 3 – Weld the Filler Rod

1. Expand the cylinder so the shaft is fully extended, using a hydraulic pump.
2. Weld a 3.5" piece of 1.5" DOM roundstock inside of the tubing at the end of the shaft
 - Take care that the top of the shaft doesn't get hot; there is a rubber seal between that and the cylinder that will melt and cause leaking if you're not careful. If it starts getting warm, dunk the shaft in water to cool it down.



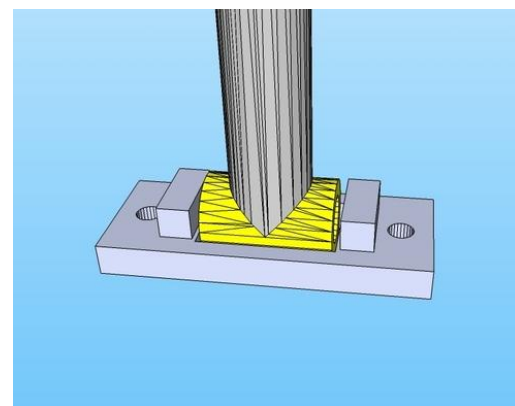
Step 4 — Tack the Lower Press Foot to the Cylinder

1. Stand the cylinder up vertically and prop it up using some sort stand so it is as close to square vertically as possible. Another option is to support it using some sort of rope.
2. Place the tubing at the end of the shaft inside of the hole in the lower press foot.
3. Insure the cylinder is square to the plate in all directions. [See video.](#)
 - Since there is a lip on the cylinder, its hard to tell if it's square unless you use two squares, one on the lip and against the other one which rests on the table.
4. Tack the lower press foot from all accessible dimensions.
5. Insure the cylinder is still square with it, if not, remove the tacks and fix it.



Step 5 – Weld the top

1. Weld the two together on the top. There will need to be at least 2 layers of weld.
 - **Warning:** Dunk this frequently, even if the shaft is not getting hot! The plate will warp upwards and cause you lots of woe if you do not.
2. Weld the press foot support pieces as close as you can to the tubing and the press plate.



Step 6 – Weld the Bottom

1. Lower the cylinder and flip it upside down.
2. Fill in the bottom side of it with welds.
 - This will require many layers of welds and many dunks to cool it.
3. Grind it flush with the rest of the plate.
 - A few spots where the welds are below the surface is OK, but the majority of the surface should be level.



Step 7 — Install the Upper Press Plate

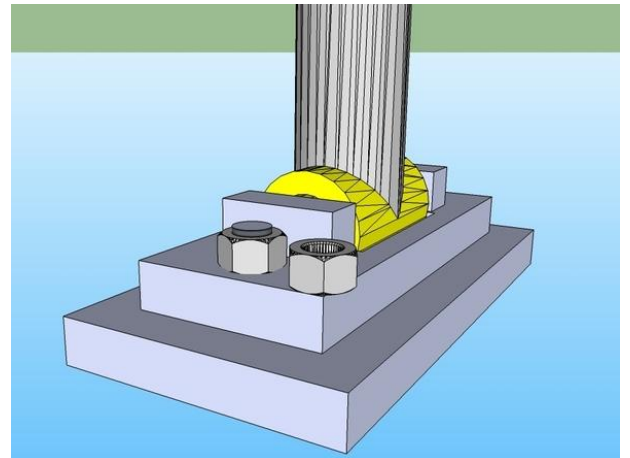
1. Put the upper press foot into the lower one and tighten nuts onto the threaded rod.
2. Stand the cylinder up again and insure the press plate is still square with the cylinder. [See video.](#)
 - If it's not, you'll need to add shims between the two press plates until they are square with the cylinder.



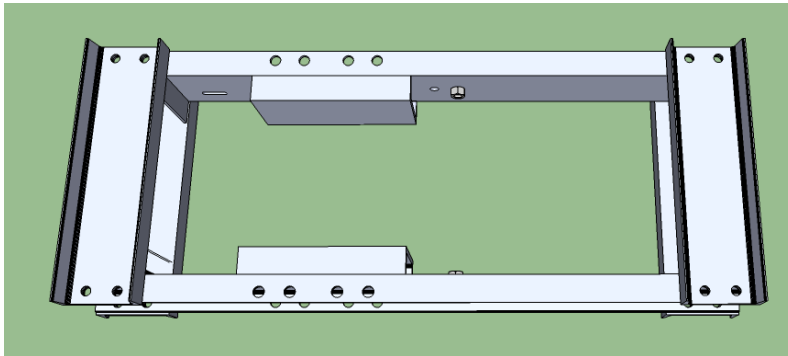
Step 8 — Weld the magnet holder nut

Weld the nut in the corner of the lower press plate, as shown.

- This should be on the opposite side of the ports of the cylinder, flush with the press foot, and as near to the corner as you can get it. It can even hang off a bit.
- Make sure you protect the threads.



CEB Frame U-Channel Assembly



[Sketchup Model](#)

Tools Needed:

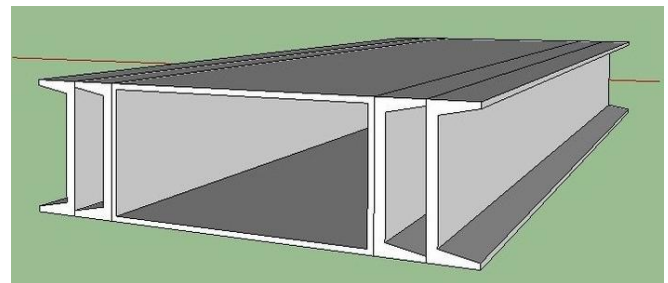
- Large Square
- Mag-Drill
- Vise Grips
- Welder
- c clamps

Materials Needed:

- The Prepared U-Channel
- Wide Cylinder Supports
- 1/4"x2"x2" Angle- 6" (2) Dirt Blockers
- 3/8"x3" Flat- 24" (2) Drawer Member Reinforcements
- 6" Heavy U-Channel- 13" (2) Spacers
- 3/4"x2" Bolts (16)
- 3/4" Galvanized Nuts (16)
- 3/4" Washers (16)
- 6"x12" Tubing – 52" Optional Jig

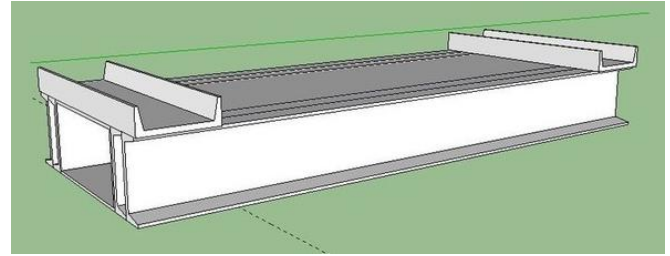
Step 1 — Clamp the Vertical Pieces

1. Gather materials for the "Jig"; this means 6"x12" tubing (52") and any extra heavy U Channel. If you don't have any laying around, you can use one drawer member, and one spacer on each side.
2. Clamp the vertical pieces to the "Jig" on each end, with extra U channel in between the tubing and the vertical pieces.
 - Make sure they are both orientated properly, that is that both roller slots are at the same end of the jig.
 - Insure the two verticals are flush at the top end.



Step 2 — Clamp the Horizontals.

1. Clamp one horizontal member at each end of the jig.
 - Make sure they are flush with the ends of the verticals and centered on them.
 - Insure they are square with the jig by using a large square.
2. Clamp using 1 or 2 vise grips on either side.
 - If you didn't need to use the drawer members for the jig, you can drill those and the wide cylinder support holes now too so you won't have to handle the material twice. See [below](#) for how to do it.
- It really helps to label each member, so that if you end up unbolting the piece later, you'll know exactly where it goes and in what orientation. Mark which side will be the top of the machine (could be either end at this time), and which member goes where.



Step 3 — Mag-Drill the holes and bolt to frame

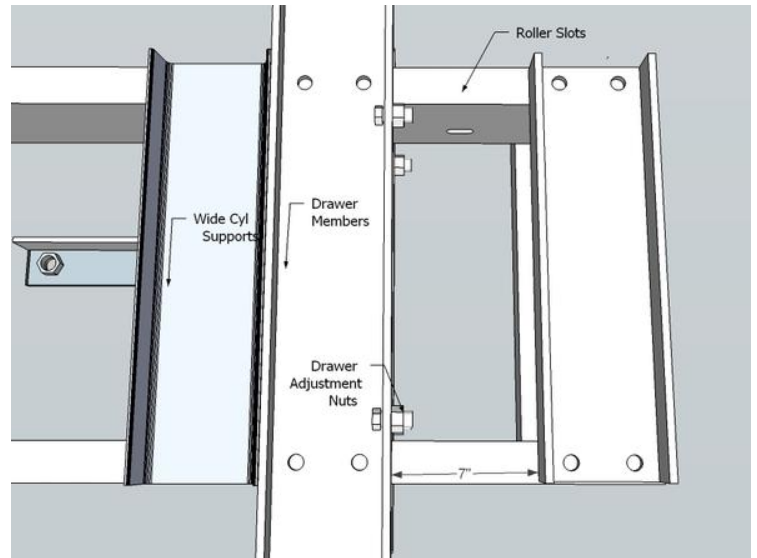
1. Use a Mag-Drill to drill the 3/4" holes each place where the horizontal members overlap the vertical members.
2. Bolt the horizontal members tightly to the vertical members.
3. Flip the jig over so you have access to drill the other holes. See [video](#) for help.
4. Clamp the other 2 horizontal members in place.
5. Align the other horizontal members with the ones below the jig, so that they are both at the same location relative to the vertical members.
 - This is crucial so that the machine will stand up straight and there won't be any gap between the drawer and the top horizontal members.
6. Insure once more that the horizontal members are square with the vertical members.
7. Mag Drill them.



8. Remove the clamps and the jig from the frame.
9. Bolt the horizontals tightly to the frame.
10. Double check to make sure everything is still square.
 - If not, loosen the bolts and square it up on what you labeled top first and tighten those bolts. Then square out the other side and torch out any spots prohibiting the bolts from going thru.
 - Bolt it back when you're done.

Step 6 — Mag-Drill the holes for the wide cylinder supports and drawer members

1. Clamp the drawer member centered, 7" from the upper cross member.
 - The drawer slots should be on this side, not opposite.
 - Make sure the adjustment nuts are facing where the drawer was, look at the picture.
2. Clamp the wide cylinder support adjacent to it.
3. Make sure you label each component for re-assembly later.
4. Mag-Drill 1" holes at these centers.
5. Don't bolt these yet, you'll do that later.



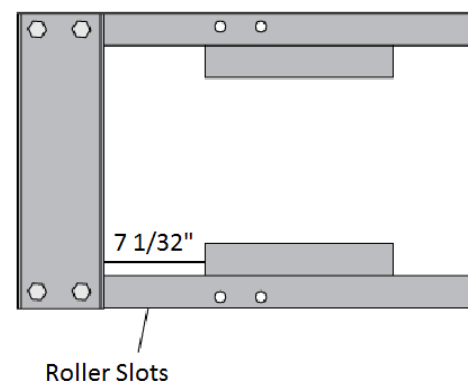
Step 7 — Re-inforce the drawer members

- Place the 1/2"x3"x24" flats on the drawer members centered as shown.
- Weld them in place, using about a 50% weld.



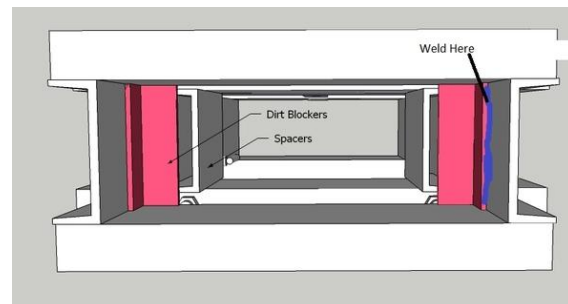
Step 8 — Tack the Spacers

- Note: You not welding them because when you stretch the frame, it may "move" their location.
 1. With the frame laid down, and one of the drawer members under it to support the spacers, place the spacers on each side.
 - The end of them is to be $7 \frac{1}{32}$ " away from the upper cross member. Look at the diagram.
 2. Insure they are parallel and flush with the U-channel and C-clamp in two places for each.
 3. Tack them on this side in 3 spots.
 - You may need to grind this off later, so make sure the tacks aren't longer than 1/4" or so.
 4. Flip over the frame and tack the other side.

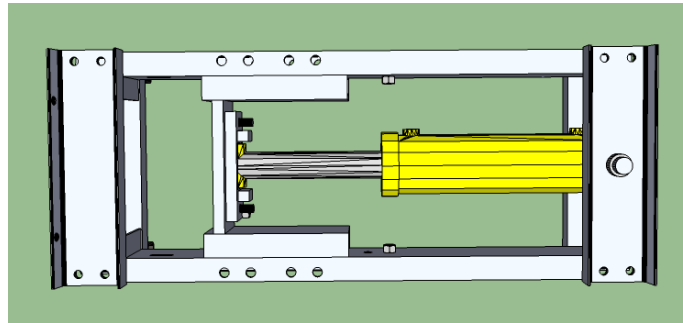


Step 9 — Weld the Dirt Blockers

1. Put the dirt blockers in place, between the vertical members, so the bottom side of them is about 1/8" above the bottom of the upper crossmembers.
2. Weld the portion inside of the vertical members, taking care to not weld them to the crossmembers.



CEB Fit the Main Cylinder



[Sketchup Model](#)

You need to fit the cylinder into the frame so that when it is fully extended, the press foot is in the correct spot to eject the brick. You will need to torch holes in the horizontals for the pin which goes thru the cylinder, and weld DOM tubing to hold the pin. We recommend you watch the [instructional video](#).

Tools Needed:

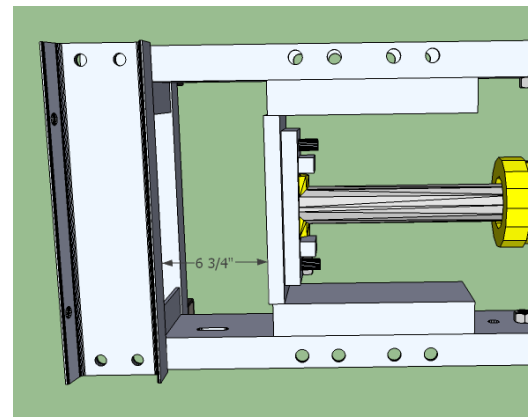
- Angle Grinder
- Welder
- 1/8" thick washer
- MIG welder
- Speed Square
- Spray paint
- Torch

Materials Needed:

- Prepared main cylinder
- Pin-1 1/2" DOM Roundstock, 11"
- Pin Receptors: 1.5" inner diameter, 2" outer diameter
- DOM tubing: 1.5" (2)

Step 1 — Position the Cylinder

1. Lay the frame down, with all of the crossmembers and drawer members in place except the upper crossmember and drawer member which are facing up.
2. Place the assembled cylinder lying down so that the press feet are between the spacers. You need to insure that the vertical height is correct, and that the cylinder is centered.
 - Insure the magnet holder nut (welded to the press feet) is on the same side as the sensor holder hole (hole in one vertical).
 - The top of the upper press foot should be 6 3/4" for monster away from the bottom of the upper crossmembers.



Step 2 — Squaring the cylinder

- Add a 1/8" spacer (big washers work great) under the cylinder, where it contacts the lower crossmember. This insures the cylinder is centered vertically. Where to put it is circled in the first image.
- Make sure the cylinder is centered, using a speed square pressed against the side of the cylinder, and a tape measure to the the vertical members as shown.
- Make sure the tubing for the pin is square with the lower crossmember using a speed square.



Step 3 — Marking hole locations

1. Mark the location for the hole for the pin on the bottom horizontal member using spray paint.
2. Put the top horizontal member on, and put in at least 3 bolts.
3. Spray mark this location as well, from the other side.
4. Remove the horizontal members from the frame.
 - This is possible to do without removing the cylinder, just prop it up on something to remove the lower member.
5. Place one of the DOM tubing pieces in the center of each of the sprayed marks and spray paint around this to mark where you will torch.



Step 4 — Torching

1. Torch out the hole, and grind away the slag.
 - Insure the tubing will go thru each hole. If not, retorch it. Grind off the slag.
2. Lay the cylinder back down, with the 1/8" spacer in, and replace the crossmembers, with their bolts. Place the tubing in the torched holes.
3. Insure the pin will go thru the tubing and the cylinder. If not, retorch the holes so that it will.



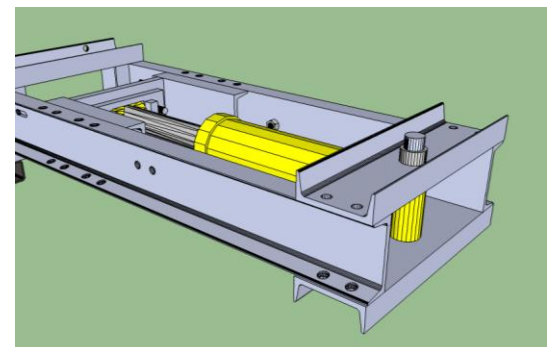
Step 5 — Welding

1. With the pin held in, tack the tubing on the top in place.
 - Make sure the tubing is pressed up against the cylinder, that is that it's as far into the hole as possible.
 - You'll want to tack it in many places before welding around it, at least 8 on each side.
2. Tack it as best you can on the bottom by hanging the frame off of the table and overhead welding. Again, insure the tubing is pressed up against the cylinder.
3. Remove cylinder and pin, as well as the two crossmembers.
4. Fully weld the tubing on both sides. Jump around a lot to minimize any warping on the tubing.
 - Block the insides of the tubing so no spatter goes inside. Big washers work well for this.



Step 6 — Re-Assembly

1. Replace the crossmembers and the cylinder.
2. Insure the pin still fits and hammer it thru.
 - If the pin doesn't fit, you will need to make it fit.
 - Tighten the bolts on only the bottom crossmember. Put the pin thru the crossmembers and the tube.
 - Mark where the bolt holes need to be torched away for the bolts to fit through. Torch it and you're done.



CEB Stretching the Frame

Tools Needed:

- Hydraulic Pump

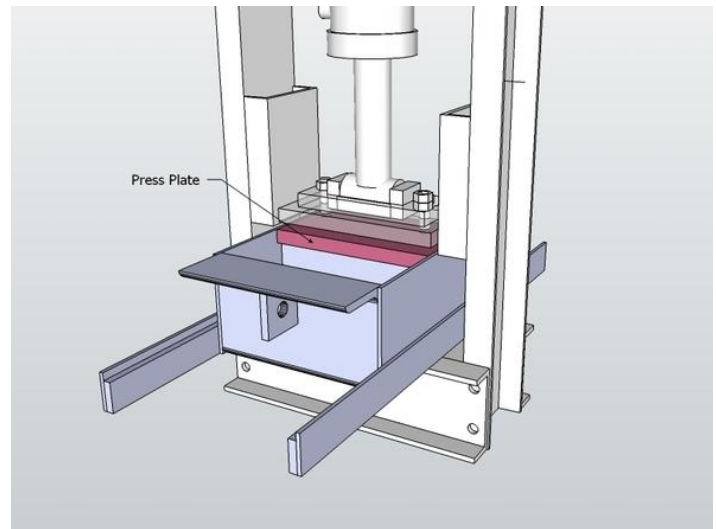
Materials Needed:

- Main Frame
- Wide Cylinder Supports
- Soil Loading Drawer
- $\frac{3}{4}$ "x2" Bolts (8)
- $\frac{3}{4}$ " Nuts (8)

See the [Video](#).

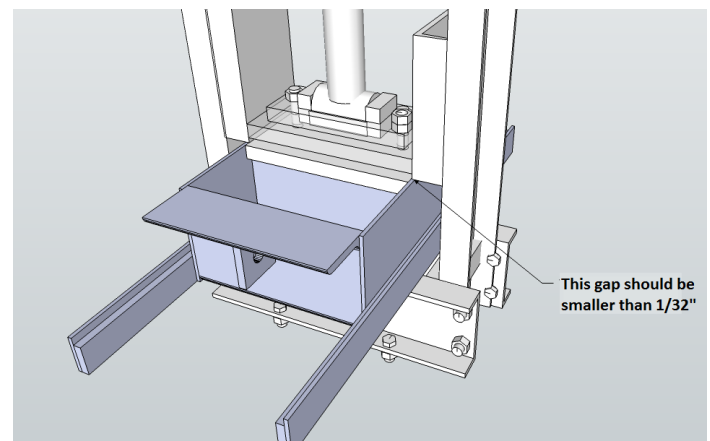
Step 1-- Stretch the frame

1. Attach the cylinder to a hydraulic pump or power cube and contract the cylinder at least 1".
2. Stand up the frame so the press feet are facing down.
3. Insert the Soil loading drawer on top of the horizontal members so that the press plate is facing the press feet.
 - If the drawer doesn't fit because of the spacers, you welded them too close. Grind off the tacks and tack them a little higher.
4. Position the drawer so that the press plate will be fully contacted by the press feet.
5. Bolt the drawer members on finger tight.
6. Use the pump to expand the cylinder as much as possible. The pump will likely stall out.
 - If the pump stalls, turn it back on and expand it fully once more.
7. Expand at least 3 times.
8. Contract it, so you can weld the spacers in. Then detach from the pump.



Step 2 — Observations

1. Remove the drawer members.
2. Look where the spacers are near the drawer.
 - The spacers should be very close to the drawer (less than 1/32")
See [quality control video](#) if you wonder why.
 - If they are too far, grind off the welds and re-tack them so they are lightly contacting the drawer. Yet again, make sure they are perfectly square with the verticals.



CEB Welding the Spacers

Tools Needed:

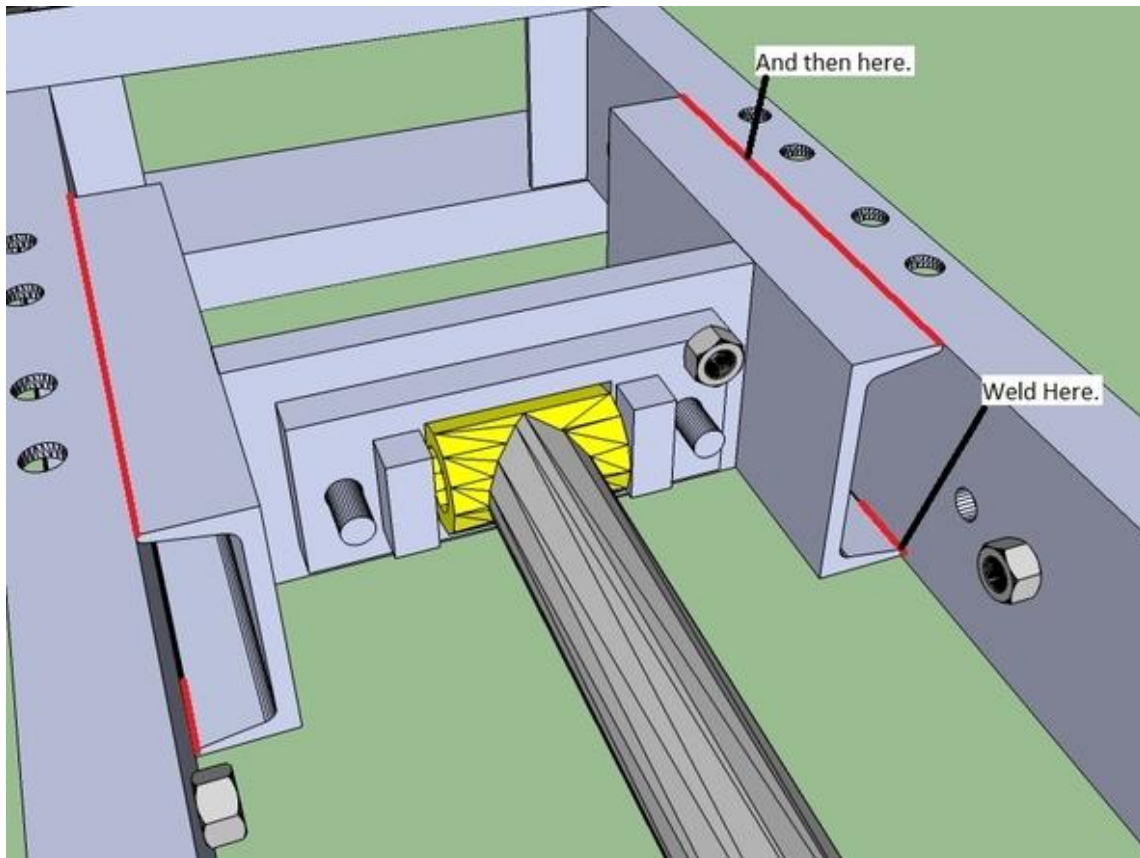
- Angle Grinder
- Welder

Materials Needed:

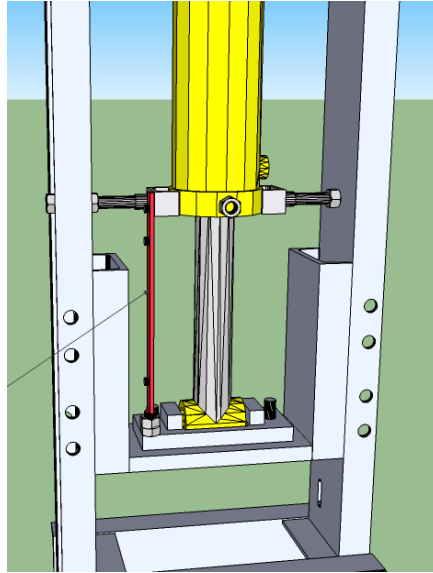
- Main Frame

Weld The Spacers

1. Lay the frame on its side.
2. Protect the cylinder and press feet so that when you weld, spatter won't stick. You could use some piece of metal or a nonflammable cloth.
3. On the inside, bottom edge, weld the interior of the spacer inwards as far as you can. This should be an inch or more. Do this in all 4 corners accessible from this side of the frame. See the photo.
4. Weld the top 100%, and grind it flush.
5. Flip over the frame.
6. Weld this side as you did the other side, also welding inside the spacers.



CEB Frame- Installing the Small Components



[Sketchup Model](#)

Tools Needed:

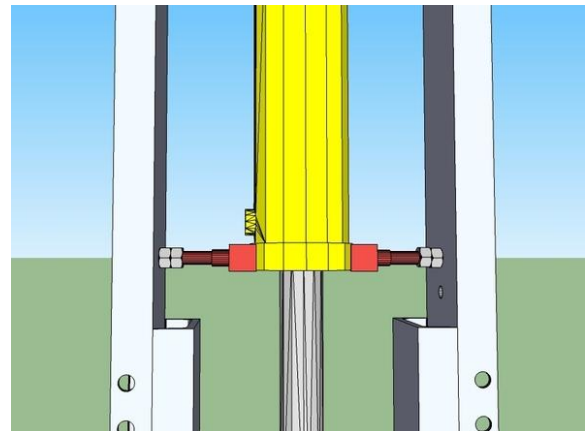
- Wrenches
- Welder

Materials Needed:

- Main Frame
- Sensor Holder
- Thin Cylinder Supports
- Magnet Holder
- Leg Holders (2)
- $\frac{3}{4}$ " Nuts (3)

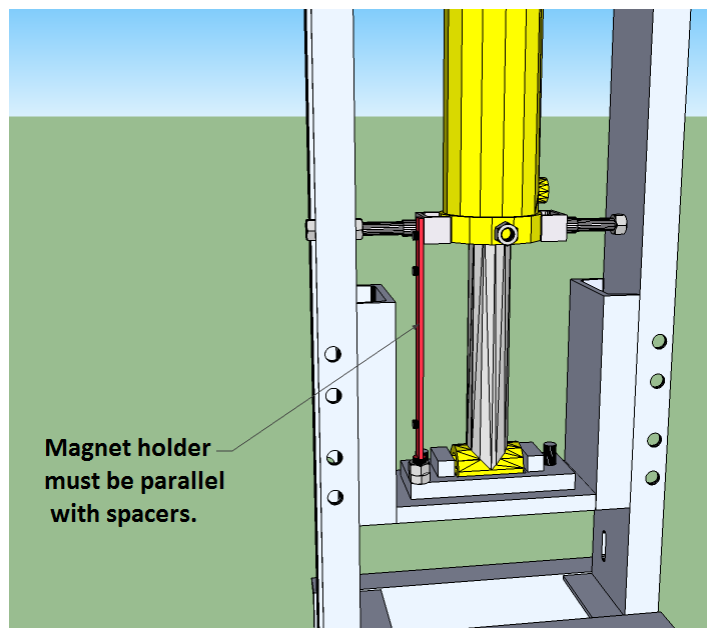
Step 1 — Install the thin Cylinder Supports

1. Install the thin cylinder supports by screwing the bolt in with an extra nut on it as shown, and placing the u-channel against the cylinder.
2. Get both of them snug so the cylinder is centered with pressure on each side.
3. Tighten down the nut to lock it.

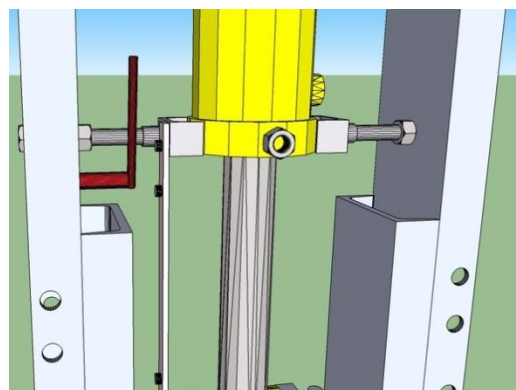


Step 2 — Install the magnet holder

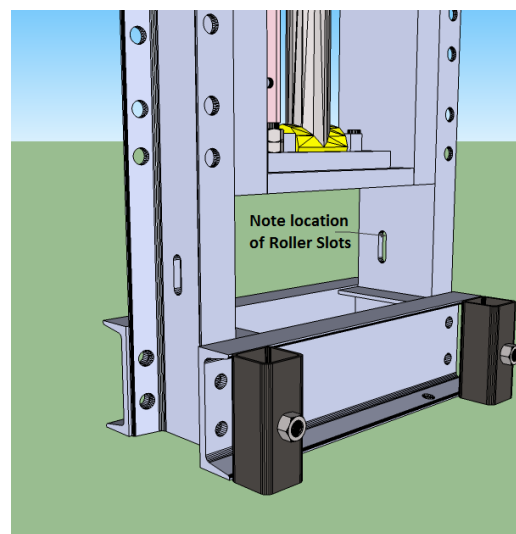
1. Install the magnet holder onto the press foot.
 - The flatbar needs to be parallel with the verticals. If not, bend it so it is.
2. Lock it down with the nut.

***Step 3 — Install the Sensor Holder***

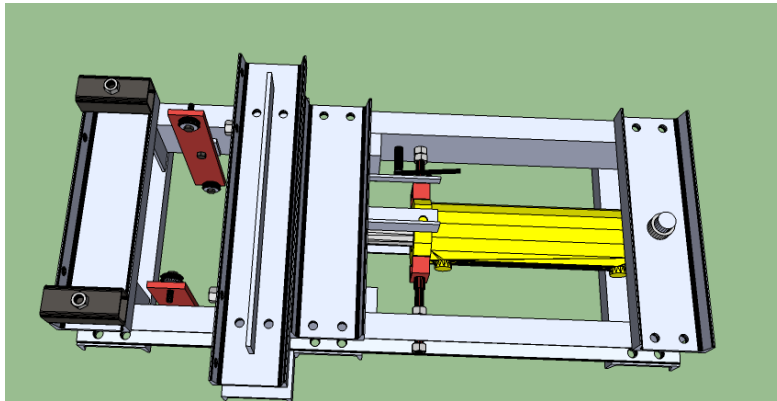
- Install the 6" sensor holder so the end of it is overlapping the path of the magnet holder as shown. The other sensor holder will be installed later.

***Step 4 — Weld the Leg Holders***

1. Position them on the upper horizontal members as shown.
 - Use the location of the roller guides to insure you attach them to the right side.
 - Insure they are square in all directions
2. Weld them to the horizontal members fully.



CEB Fit the Drawer Members



[Sketchup Model](#)

Tools Needed:

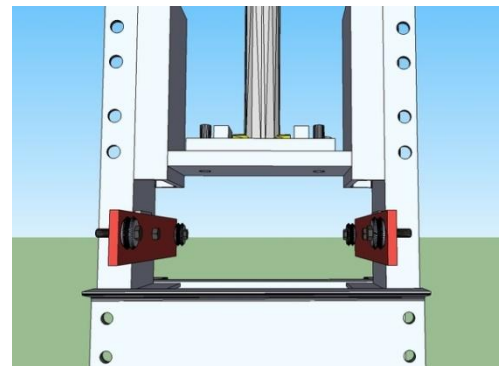
- Various Wrenches

Materials Needed:

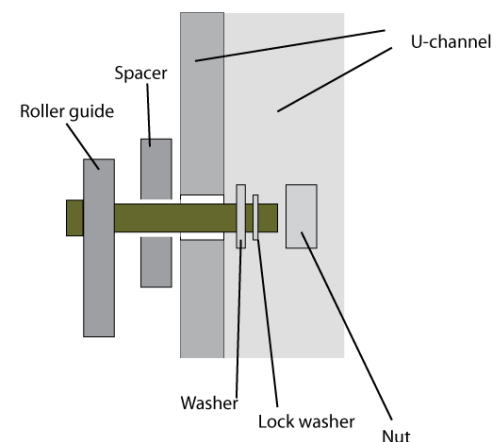
- Roller Guides
- Soil Loading Drawer
- Wide Cylinder Supports
- Drawer Members
- 3/4"x2" Bolts (16)
- 3/4" Nuts (16)
- 3/4" Washers (16)
- 1/2" Washer (2)
- 1/2" Lock Washer (2)
- 1/2" Nut (2)

Step 1 — Install the Roller Guides

1. Position frame so it is standing upside down as in picture on right.
2. Install the Roller guides as shown in the illustration. One side should have a 1/2" spacer, and the other should have a 3/8" spacer plate.
3. Tighten the bolts snug, but so that they can still move up and down.

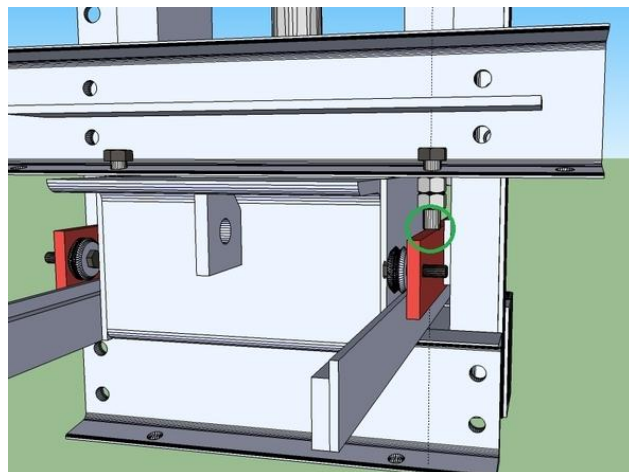


Roller guide placement



Step 2 – Bolt in Drawer Members

1. Replace the drawer as if you're going to stretch the cylinder again.
 - The roller bearings should be on top of the rails on the drawer, and be putting no pressure on the drawer.
2. Loosely bolt on the drawer members.
3. Adjust them horizontally so that the adjustment bolts are centered on the roller guides. See image.
4. Finger tighten the bolts on the drawer members, as they are sitting on top of the drawer.



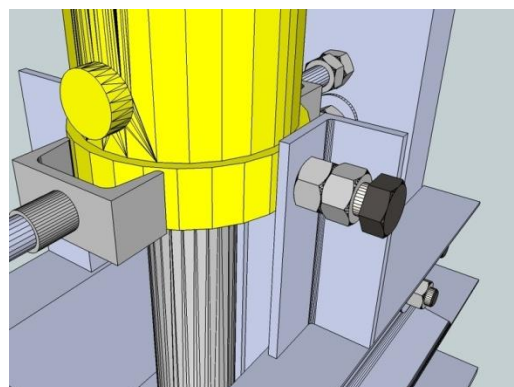
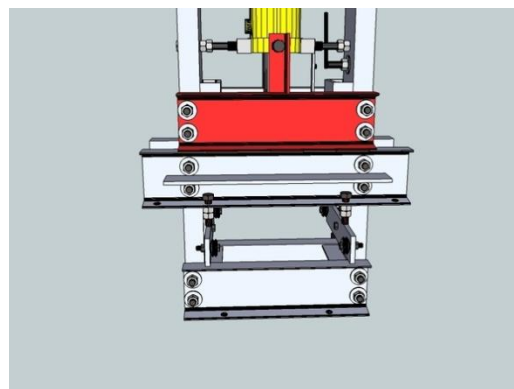
Step 3—Adjust Drawer Members

1. Try to slide the drawer in and out. If the drawer gets stuck somewhere, investigate and find where it's hitting. (It almost certainly will).
 - You'll probably need to loosen one, or both of the drawer members and move it up a bit.
 - This can be done uniformly using cardboard shims. See photo. Place the shim between the drawer and the crossmember. Tighten the bolts again. Remove the shims by "jiggling" the drawer.
 - If it's hitting a spacer, grind down the spacer.
 - If the drawer itself is prohibitive in some spots, it wasn't grinded evenly. Grind down the high spots.



Step 4- Tighten all Bolts

1. Once the drawer is properly adjusted, tighten these bolts all the way.
 - Make sure the drawer adjustment nuts are still centered on the roller guides.
2. Tightly bolt the wide cylinder supports to the frame, leaving no gap between them and the drawer members.
3. Tighten the bolts at the top of the wide cylinder supports so they are touching the cylinder on each side. Tighten the lock nut.
4. Go back through the entire frame and make sure every bolt is tight.



CEB Secondary Cylinder Hydraulics Prep

Tools Needed:

- Various wrenches
- Vice



Materials Needed:

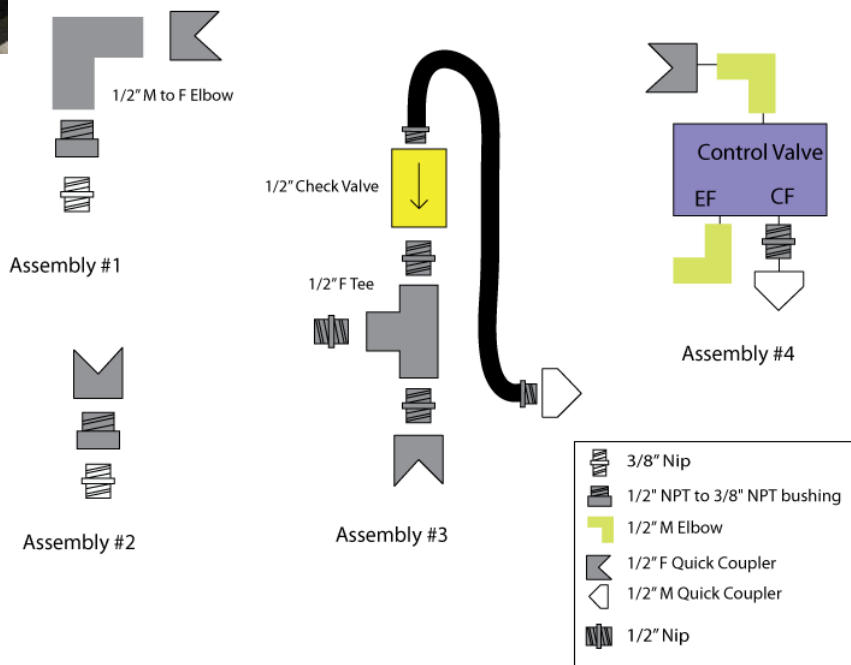
- Thread tape
- 3/8" NPT Hex nipple (2) [Buy](#)
- 1/2" NPT to 3/8" NPT bushing (2) [Buy](#)
- 1/2" NPTF to 1/2" NPTM 90 Elbow (1) [Buy](#)
- 1/2" M Elbow (2) [Buy](#)
- 1/2" Flow Control and Relief Valve [Buy](#)
- 1/2"x36" NPTM Hydraulic hose (1)
- 1/2"x96" Hose (2)
- 1/2" Quick Coupler Set (5) [Buy](#)
- 1/2" Check Valve (1) [Buy](#)
- 1/2" F Tee [Buy](#)
- 1/2" Hex Nipple (4) [Buy](#)

Procedure

- Thread Tape is needed between each connection.
- Always wrap thread tape clockwise when facing the threaded portion.
- Always keep the end caps on hoses and fittings until you need to take them off. They need to stay protected inside.

1. Assemble the individual assemblies as shown, and prepare the two 96" hoses by putting a male quick coupler onto one end of each.
2. Install Assembly #1 into the rod end of the cylinder (image above). Insure the quick coupler will be facing towards the ground when the cylinder is installed.
 - When you remove the plug on the cylinder, fluid may spill out, so keep some rags or a jar handy.

You will install the remaining components later upon installing the secondary cylinder.



CEB Assembly- Structural Components

Tools Needed:

- Angle Grinder
- Welder
- C-Clamps
- Vise Clamps
- Wrenches
- Torch

Materials Needed:

- Prepared Structural Components
- Main Frame
- $\frac{3}{4}$ "x2.5" Bolts (4)
- $\frac{3}{4}$ "x2" Bolts (12)
- $\frac{3}{4}$ " Nuts (17)

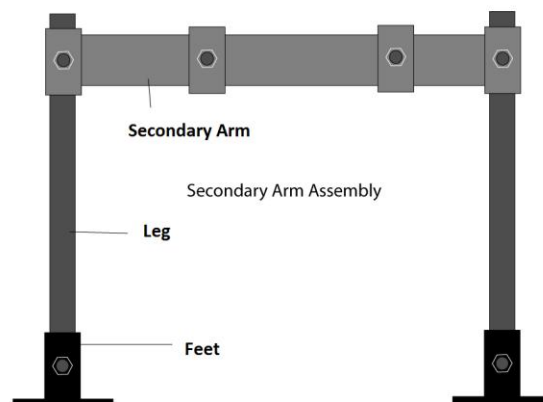
Step 1 — Position the main frame

- Set the main frame somewhere on level ground where you have access to a welder and torch and where you have at least an 8' radius of empty space. The CEB takes up a lot of room!
- Set it so the cylinder pin is near the ground.



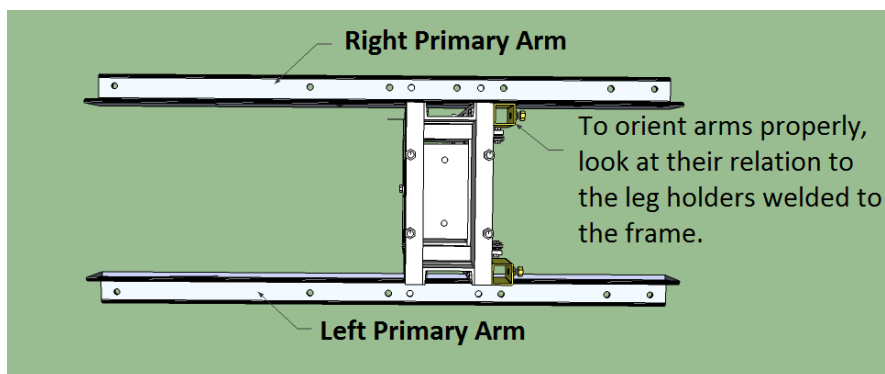
Step 2 — Assemble the Secondary Arms

1. Gather the secondary arms, the legs and the feet.
2. Onto the end of each leg, tighten a foot to one of its ends. Get the bolt tight enough so it won't fall off.
3. Insert one leg/foot into each of the outside leg holders on the secondary arms.
4. Adjust the height so that the top of the secondary arms will be very close to the height at the bottom of the primary arms.
5. Tighten the bolts in the leg holders so they are snug, but not too tight.



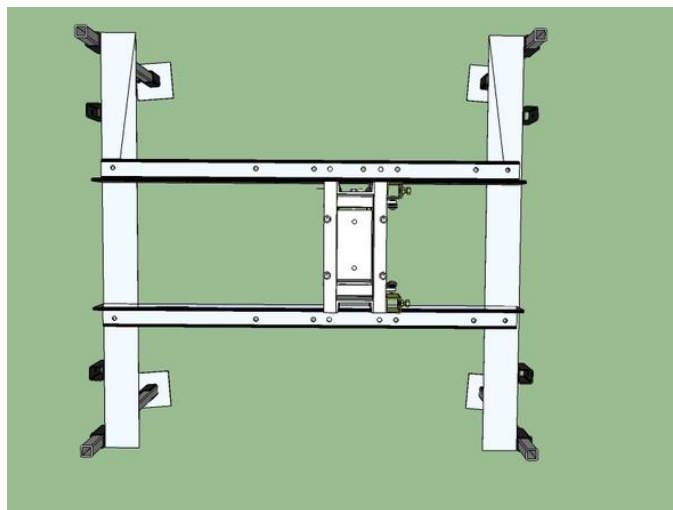
Step 3 — Place the Primary Arms

- Clamp them on the drawer members on the frame so that they are in the proper orientation. See image.
 - If the machine is going to tip over, have a friend move the assembled secondary arms to support it so it doesn't tip.



Step 4 — Attach the secondary arms to the primary arms

1. Loosely bolt the 2 sets of arms together.
 - You may need to loosen the clamps on the primary arms. This is OK.
2. Make sure the arms are all square to each other.
3. Tighten all bolts.
4. Loosen the clamps attaching primary arms to the frame.
5. Square the arms to the frame.



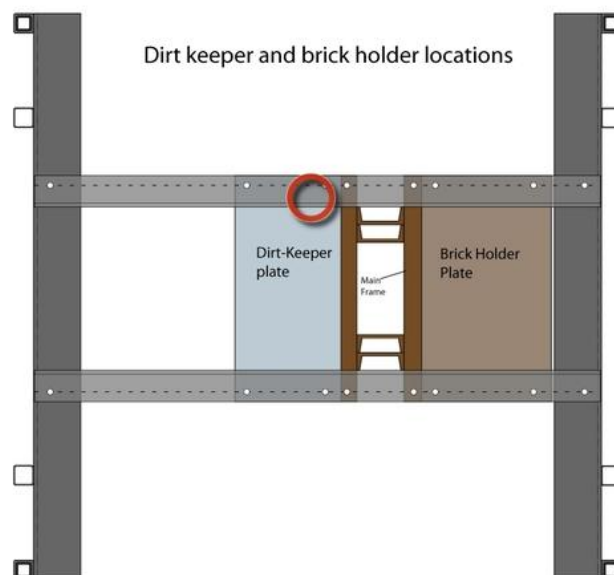
Step 5 — Attach the primary arms to the frame

1. Torch the holes in the frame through the holes in the primary arms.
 - Make sure bolts go through all holes.
2. Remove the clamps and grind away any slag
3. Bolt the primary arms to the frame.

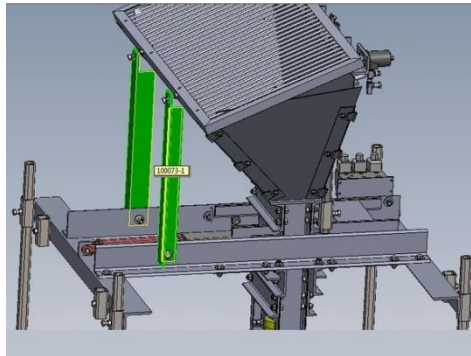


Step 6 — Install Brick Holder plate, Dirt keeper plate, and sensor holder

- The plates go on the bottom side of the primary arms.
 - If not all the bolts go through, torch away whatever is preventing it.
- Bolt them down so the bolt head is on the top. Tighten the nuts snug.
- Install the sensor on the right primary arm. Its location is circled in the diagram.



CEB Assembly- Soil Loading System



Tools Needed:

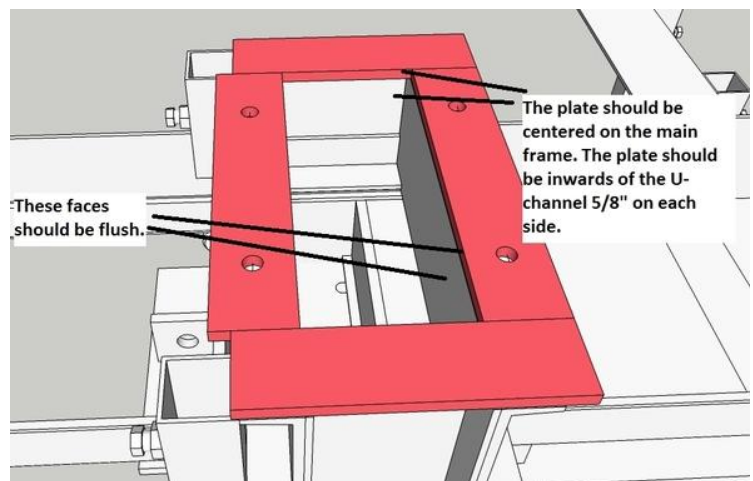
- Angle grinder
- Spray paint
- Vise clamps
- Welder
- C- clamps
- Torch
- Various wrenches

Materials Needed:

- All Components of Soil Loading System
- Assembled Main frame
- $\frac{3}{4}$ " Galvanized Nuts (10)
- $\frac{1}{2}$ " lock nuts (2)
- $\frac{1}{2}$ " nuts (2)
- $\frac{3}{4}$ "x1.5" bolts (8)
- $\frac{3}{4}$ "x2.5" bolts (2)
- $\frac{1}{2}$ "x2.5" bolts (2)
- $\frac{1}{2}$ "x3" bolt (2)
- $\frac{1}{2}$ " washers (8)
- $\frac{3}{4}$ " washers (6)
- $\frac{1}{2}$ "x1" Bolts (4)

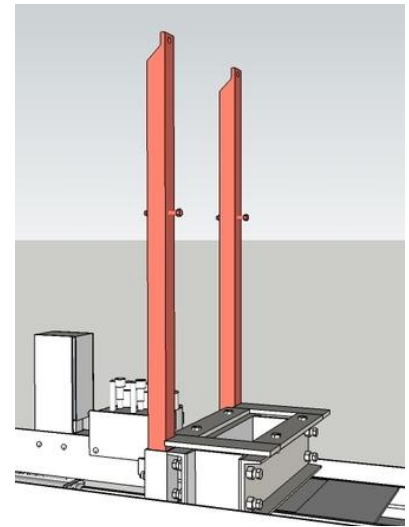
Step 1 — Torch the holes for the hopper mounting plate

1. Clamp the hopper mounting plate to the top of the main frame, positioned as shown, with the cutaways positioned by the leg holders.
 - Clamp it so that the side you grinded down the welds on is touching the main frame.
2. Torch the holes thru to the main frame.
 - Check that the fit is good by putting bolts in all the holes.
3. Grind away all the slag.
4. Bolt the mount to the frame.



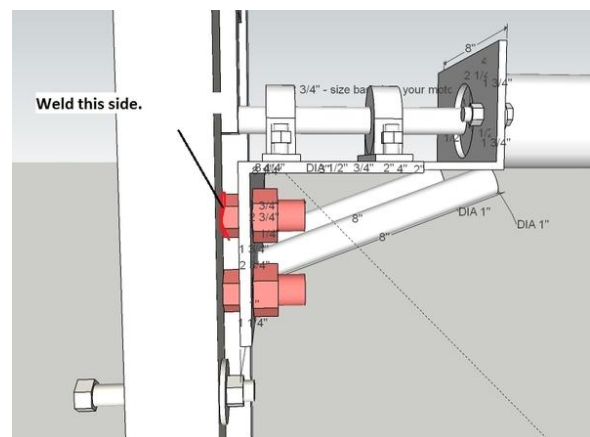
Step 2 — Install hopper supports and prepare shaker mount.

1. Install the hopper supports into the leg holders.
 - Make sure you put the support with bolts on it on the correct side (refer to your shaker motor and look where you marked it.)
 - Their bottom side should be flush with the bottom of the leg holders on the frame.
 - Make sure they are orientated correctly. See photo.
2. On the side of the shaker motor that you didn't weld bolts for, put a bolt (3/4"x1.5") thru both holes and tighten nuts onto them.



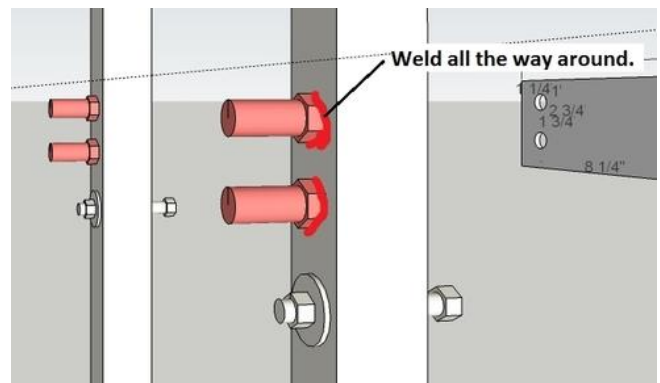
Step 3 — Tack shaker bolts to hopper support

1. Place the shaker onto the bolts already welded to the hopper supports.
2. Clamp the other side to the hopper support.
 - Use a square to make sure the shaker mount is square with the hopper supports.
3. Tighten nuts onto the side with the welded bolts.
4. Tack the bolts to the hopper support.
 - Make sure you tack them to the hopper support, NOT the shaker mount.
 - Tack as much as you can from this position.



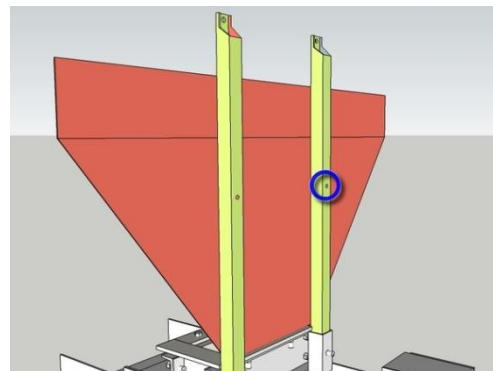
Step 4 — Weld shaker bolts.

1. Loosen all the nuts and remove the shaker.
2. Protect the threads on the bolts.
3. Weld all the way around the bolt to the hopper supports.
 - Don't remount the shaker yet.



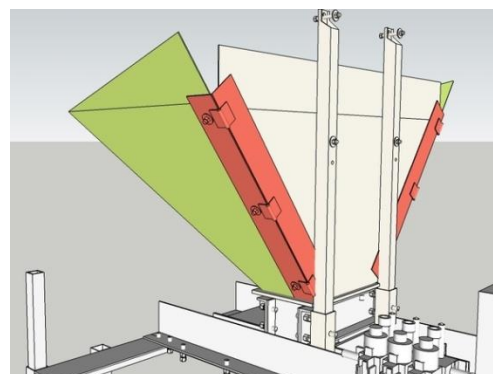
Step 5 — Clamp the hopper back to supports and torch holes

1. Clamp the hopper back to the hopper supports.
 - It should be centered horizontally between them, and touching the supports all the way down to the hopper mounting plate.
2. Torch through the holes circled in the diagram, so you torch through the hopper sheet metal.
 - Torch through it on each side, just enough so you have 2 small holes.
3. Un-clamp the sheet metal and torch 1/2" holes for the bolt.
4. Grind off the slag from torching.



Step 6 — Remount the first plate, and prepare to weld

1. Mount the first plate back to the hopper supports.
 - Use a 1/2"x3" bolt and a nut with washers on each side.
2. Lift the side pieces and clamp them to the first plate via the hinge plates.
 - Minimize the gap between them as much as you can by pushing them together tightly.



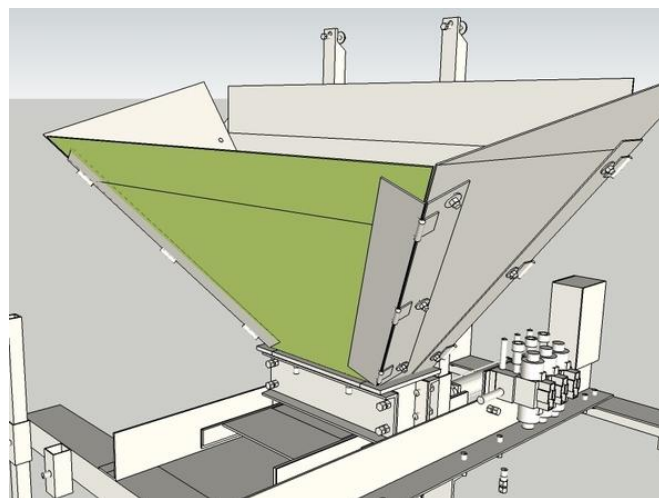
Step 7 — Weld the hinge plates to the back piece

- Weld it about 50%, as no more is necessary.
 - Weld in 3-4 inch sections.



Step 8 — Clamp and weld the front piece

1. Clamp the final piece in place to the other side of the side pieces.
 - Yet again, minimize the gap between the two.
 - You may need somebody to get inside of the hopper and push out so you can clamp it well.
2. Weld the last piece like you welded the first one.



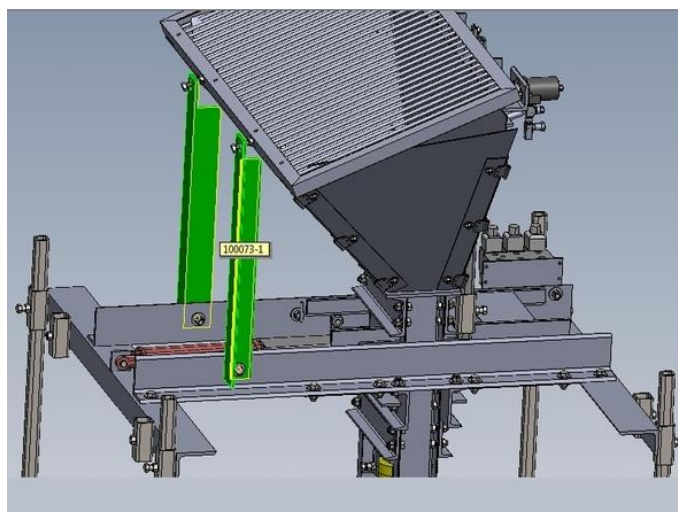
Step 9 — Place the grate and bolt it to the hopper supports

1. Get a friend or two and lift the grate on top of the hopper.
 - The front end (with the slots) should be as shown, and the grate should be inside of the hopper on the other side (the side with the nuts).
 - Have your friend hold the grate in place for the next step, or use C-Clamps to clamp the grate to the supports.
2. Bolt the grate to the hopper supports (1/2"x 2.5" bolt and lock nut). Bolt both loosely, and then tighten them.
 - You'll need 2 washers on each side, as the holes are slots and a 1/2" washer will be too small to prevent the washer from warping. Use a 3/4" washer as the other one.
 - You may want to use a large nut in place of a washer on the hopper support side. (see photo)



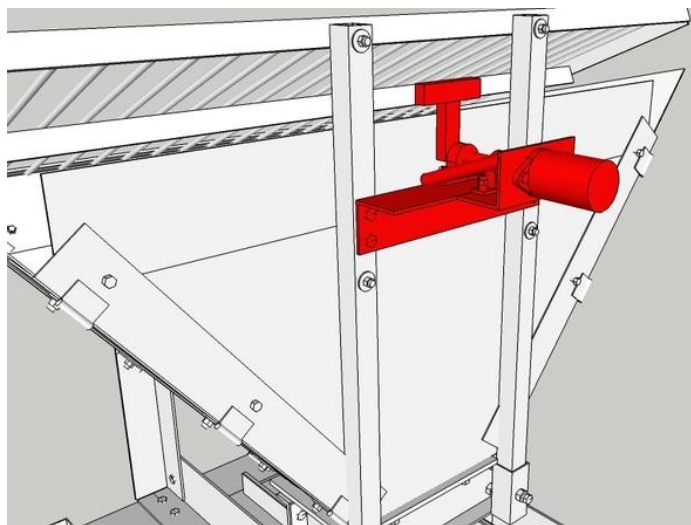
Step 10 — Install the grate supports

1. Loosely bolt the grate supports to the primary arms
2. Bolt (3/4"x2.5" bolt) The grate mounts through the hopper to the grate.
 - Use a 3/4" washer where the bolt goes thru the grate support.
3. Tighten all bolts



Step 11 — Re-install the shaker

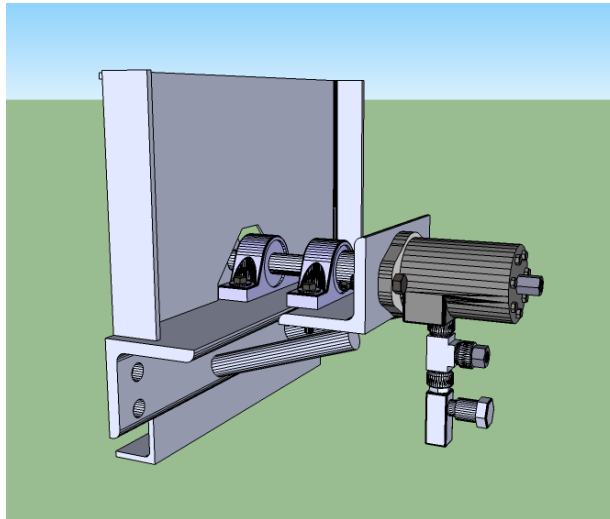
1. Install the motor (next section) on the shaker motor mount if you haven't already.
2. Place it on the bolts on the hopper supports.
 - If for some reason it doesn't fit, torch away whatever metal is preventing it.
3. Tighten nuts onto it.



Step 12 — Install the Dirt Deflector Plate

- Bolt it to the grate.

CEB Shaker Assembly



[Sketchup Model](#)

Tools Needed:

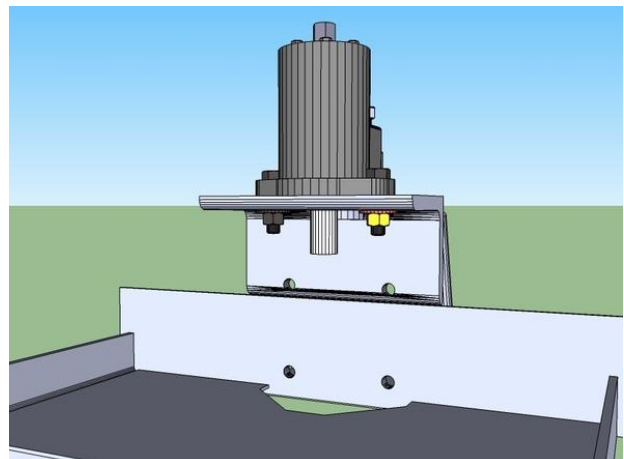
- Allen Wrench
- Various Wrenches

Materials Needed:

- Shaker Mount
- Shaker Motor
- Shaker Hammer and coupler
- 1" Pillow Block Bearings(2)
- 1/4"x2" Bolt (1)
- 3/8"x2" Bolts (4)
- 1/2"x2" Bolts (2)
- 3/8" Lock Nuts (4)
- 1/2" Lock Nuts (2)
- 3/8" Washers (8)
- 3/8" Lock Washers (4)
- 1/2" Washers (4)
- 1/2" Lock Washers (4)

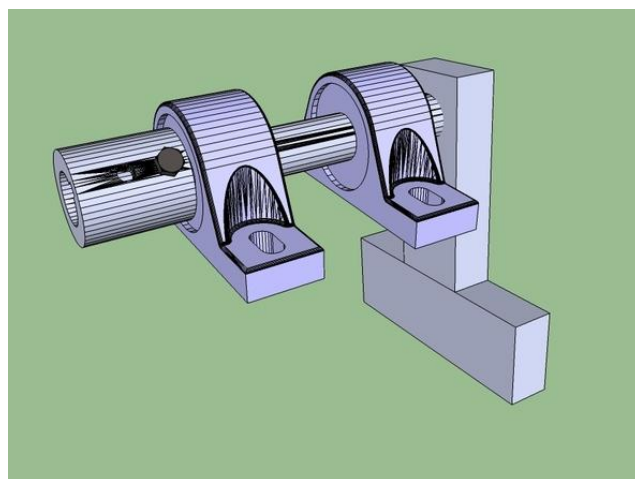
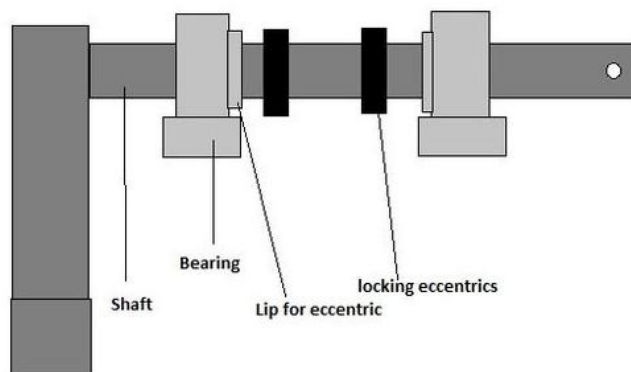
Step 1 — Mount Motor

- Loosely bolt the assembled motor to the mount, as shown, using washers on both sides, and a lock washer touching the nut.



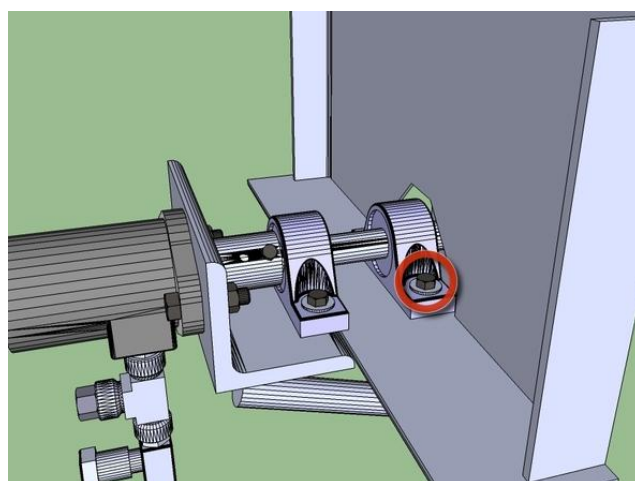
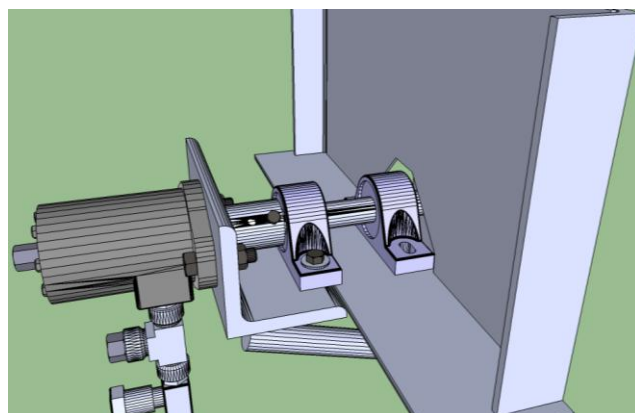
Step 2—Prepare Hammer and Shaft

1. Put the bearings onto the shaft, insuring the eccentric side is facing inwards.
 - Remember to put the eccentrics in between the two bearings.
 - The eccentrics are little collars with lopsided circles inside of them. This makes it so it can lock into the bearings.
 - Insure both collars are facing the right direction (So it will lock onto the lip) and so are the bearings.
 - Put the coupler onto the shaft.
 - Make sure you can see thru the holes, (it could be off 180 degrees and a little crooked) then put on the bolt, lock washer, and lock nut. Tighten
2. Couple it to the motor, tightening down the set screw.



Step 3 – Attach bearings

1. Tighten the motor mount bolts.
2. Bolt the bearing closest to the motor to the mount with a washers, a lock washer, and a lock nut. Tighten these down.
3. Insure the hammer rotates freely still.
 - It may require some force, but shouldnt need much.
 - If the hammer won't rotate, loosen the motor mount bolts, retighten them, and recheck it.
4. Position the other bearing and tighten it down, still insuring it will rotate without much force.
5. Lock the eccentrics by pushing them towards the lip on the bearing and twisting it.
6. Tighten the set screw on the eccentrics.



CEB Assembly- Adjusting The Drawer

See Videos:

- [Adjusting the drawer](#)
- [Properly adjusted drawers](#)

Tools Needed:

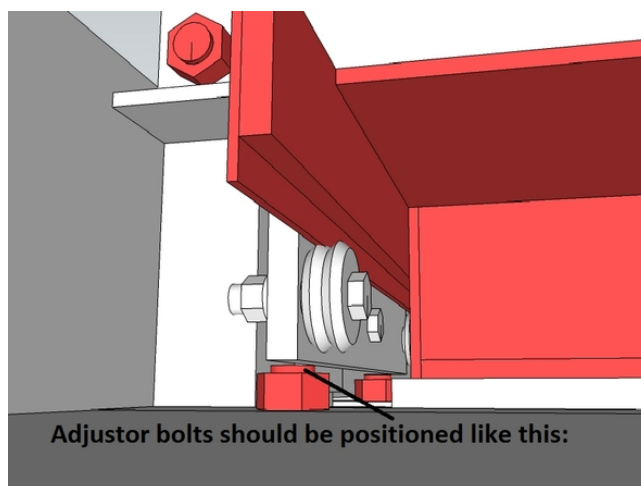
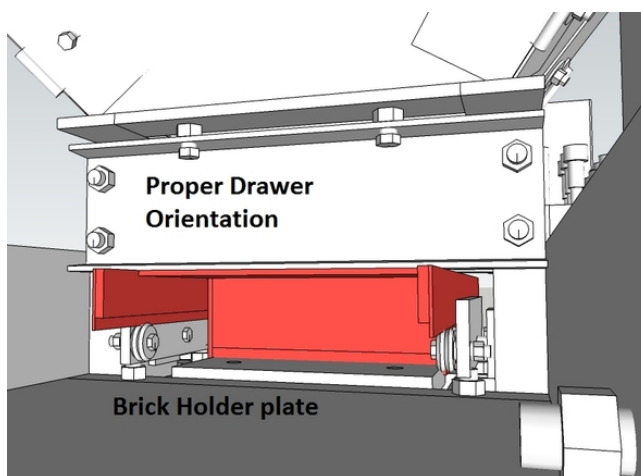
- Mallet
- Various Wrenches

Materials Needed:

- Assembled CEB
- Soil Loading Drawer

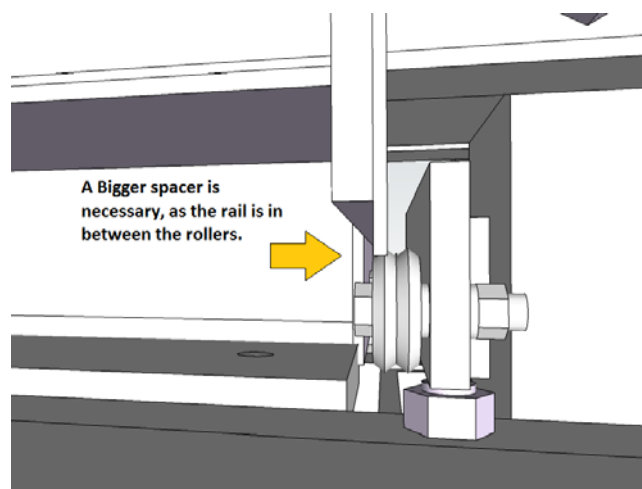
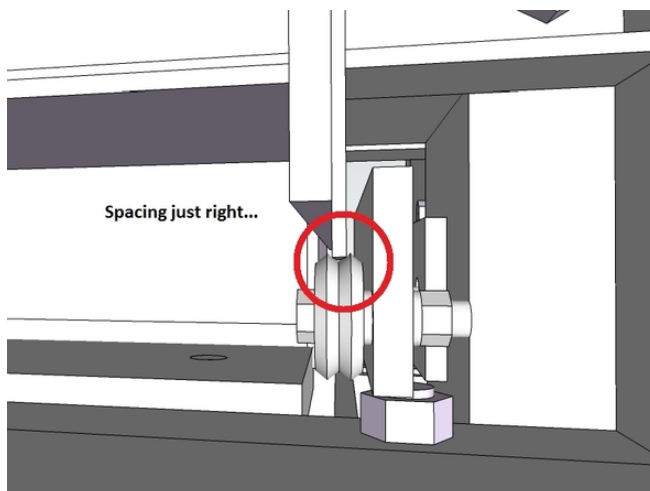
Step 1 — Put the drawer in

- Insert the drawer into the chamber as shown, in the fully retracted position. Its important that it be in the right orientation.
- The adjustment bolts should be lowered so that the roller guides are below the rails.



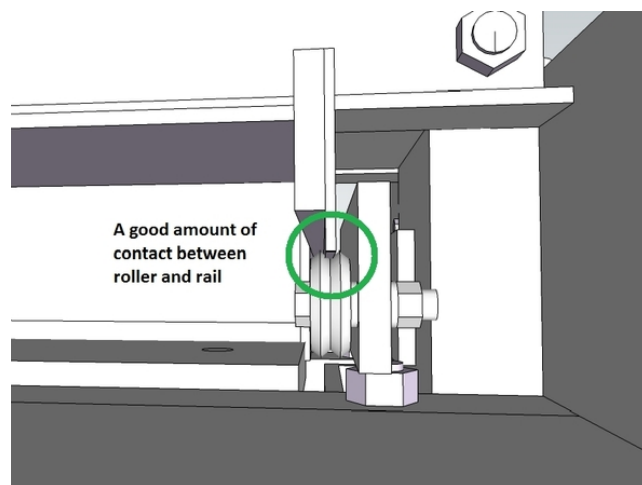
Step 2 — Align the rails with the center of the v's in the rollers.

- If for some reason the rails and the rollers aren't spaced properly (the guides need to be closer or further apart) remove one of the guides and switch out the spacer on it to one that will space them properly.
- If only one roller of the four is off, the guide is not parallel with the drawer.
 - Try tightening the nut that attaches the rollers to the frame.
 - If that doesn't work, you might have welding spatter or something between the guide and the frame. Remove it and check.
- If none of the above steps make all the rollers align, your drawer is likely flawed.
 - The rails are probably not parallel. Take the drawer out and double check by measuring the separation of the rails. If they aren't parallel, see [this page](#).



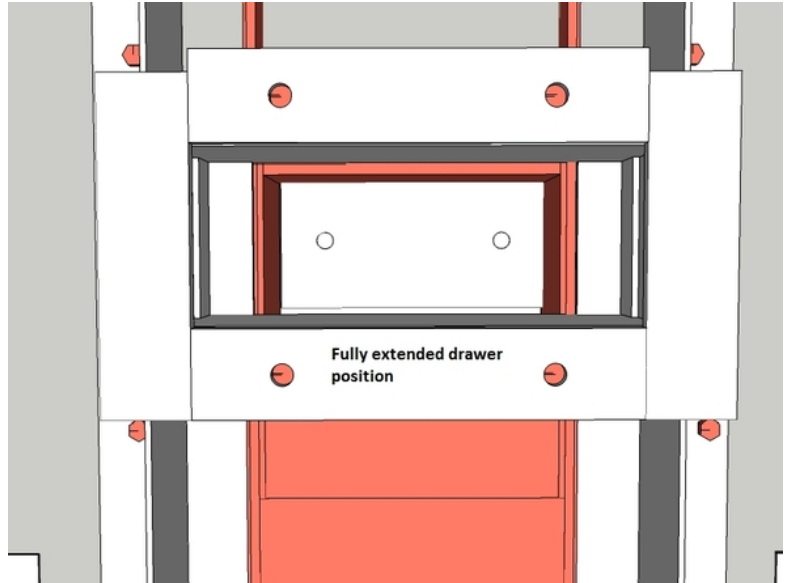
Step 3 — Tighten the rollers against the rails

- Tighten the adjustment bolts so they push the rollers up to the rail, so all of the rollers are contacting the rails.
 - The two should be touching snugly, but not forcefully.



Step 4 — Move the drawer and re-adjust bolts

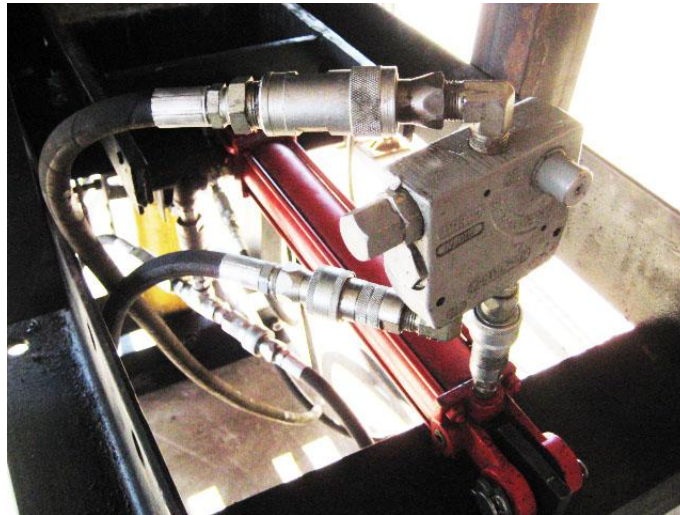
- Move the drawer to the fully extended position.
 - The drawer will likely get stuck along some points of its travel. Its OK to hit it with a hammer. Remember the secondary cylinder will be applying tons of force to move it.
 - If you need to hammer it REALLY hard, either your drawer is hitting something, or the rollers are too tight on the rails. Investigate the cause.
- When the drawer is in position, check the rollers again. They should all still be touching the rails.
 - If one is below the rail, tighten the bolt so the rail and roller are touching.



Step 5 — Slide the drawer in and out

- You will likely need to try sliding it in and out a few times before you can find the perfect amount of adjustment.
- Keep checking the contact as you slide it out.
- Your work is done when you can slide the drawer in and out and the rails stay on the roller the whole time.
 - Using a hammer is OK, but if you have to use too much force something is wrong.

CEB Assembly – Installing the Secondary Cylinder



Tools Needed:

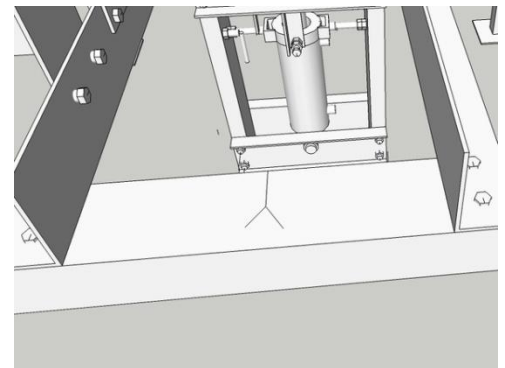
- Various Wrenches
- Welder
- Hole Puncher

Materials Needed:

- Assembled CEB
- Secondary Cylinder
- Prepared secondary cylinder hydraulics
- ½"x3" Flat – 3"(1)

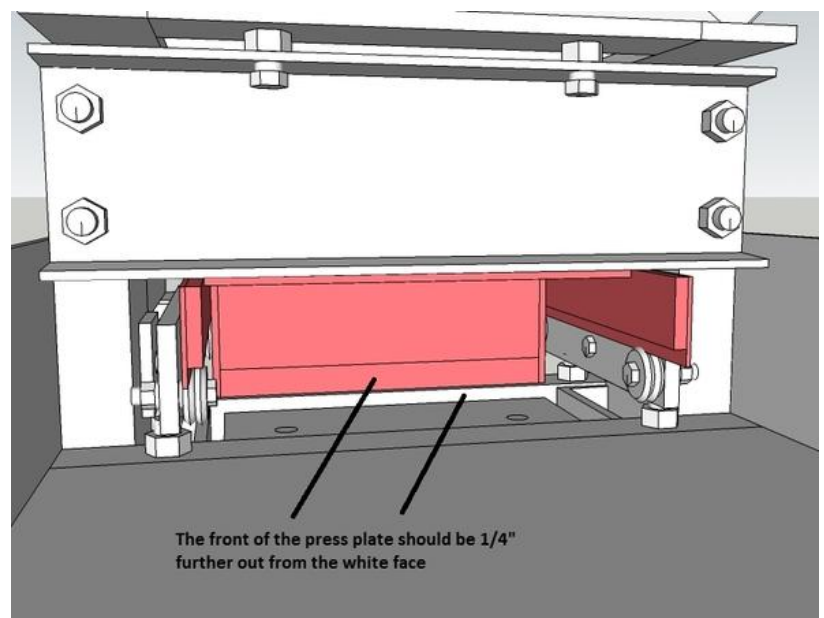
Step 1 — Mark the center between the primary arms on the secondary arm.

- This is on the opposite side of the CEB of the brickholder plate.



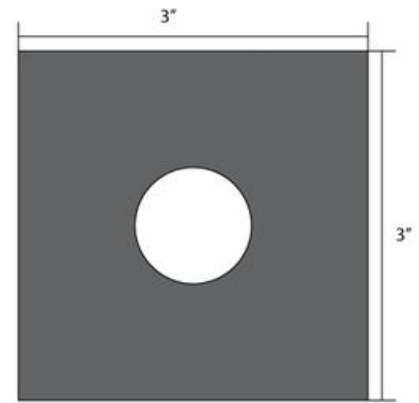
Step 2 — Position the drawer

- The drawer needs to be in the fully retracted position.
 - This is when the drawer is about to eject the brick, the press plate will be back 1/4" from the inside of the compression chamber.

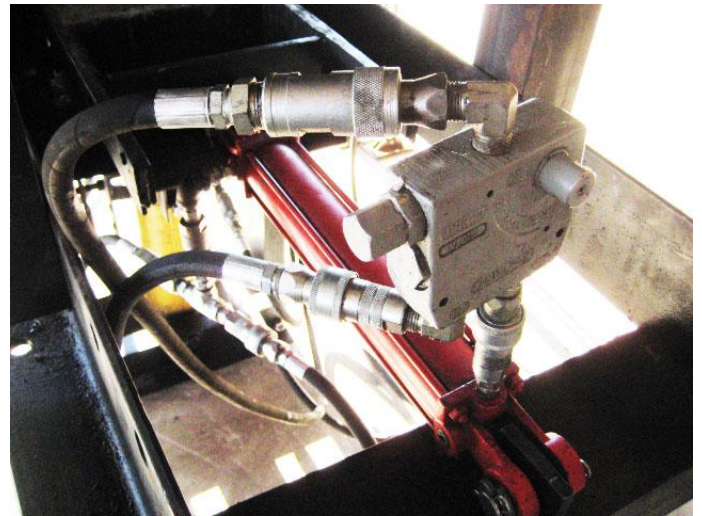


Step 3 — Prepare the cylinder mount.

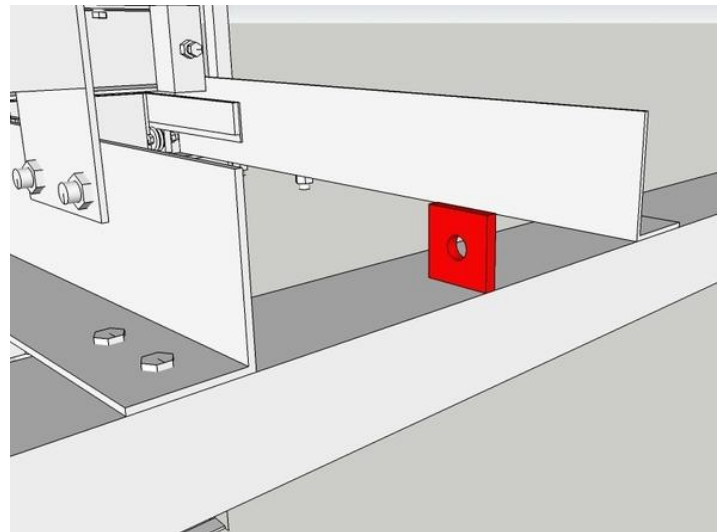
- Punch a 1" hole in the center of a 3"x3" piece of 1/2" thick steel.

***Step 4 — Place the cylinder***

- The base of the cylinder attaches to the secondary cylinder. The side of the cylinder with the rod attaches to the drawer.
- On the side which attaches to the secondary arm, put the pin through the mount, a 1" washer, and the cylinder.
 - Both sides will need a 1" washer to act as a spacer so the cylinder can't slide back and forth.
- When the cylinder is attached to the drawer, place the mount on your center mark.
- Square the mount in all directions.

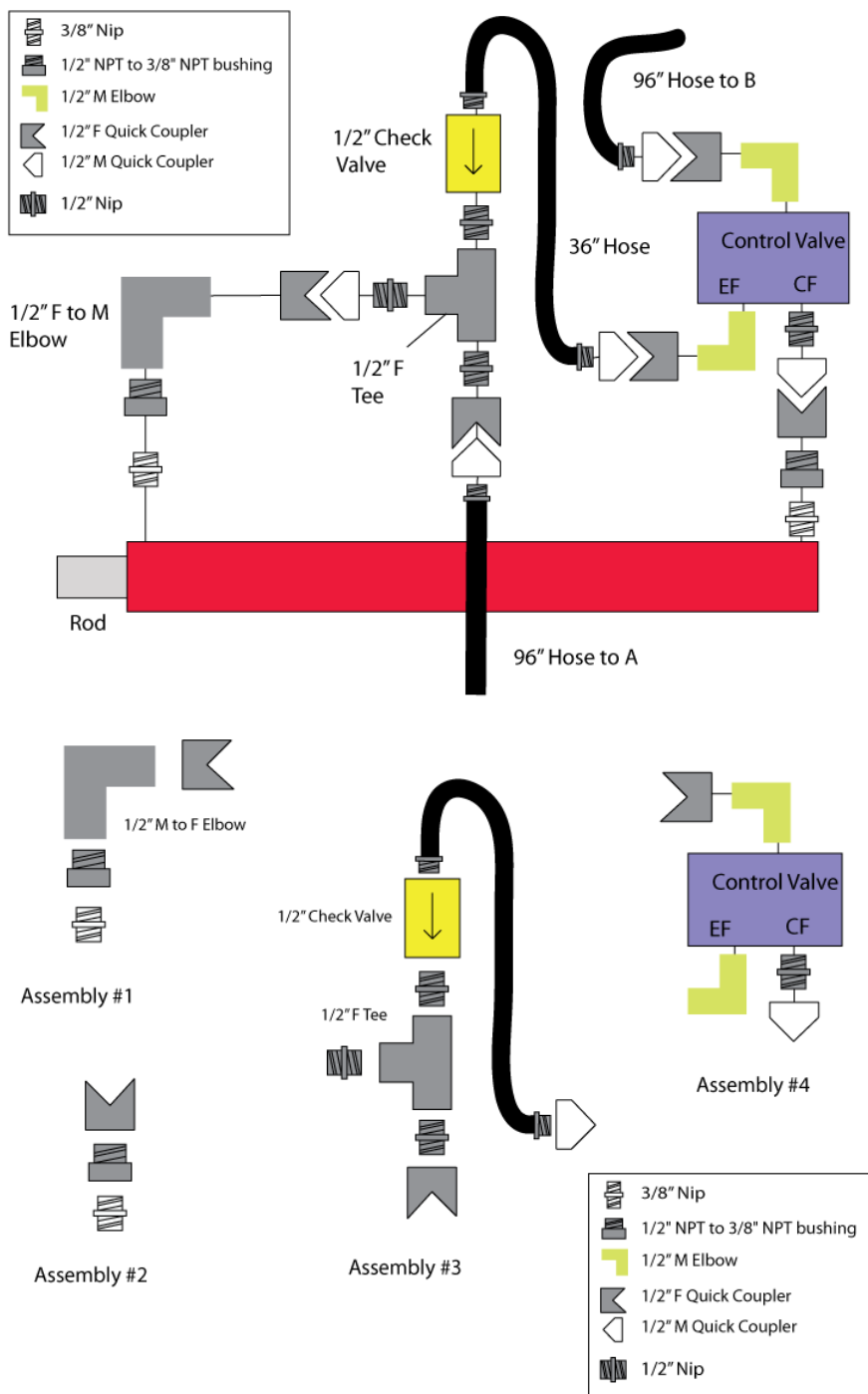
***Step 5 — Weld the mount in place***

1. Tack the mount in a few places.
2. Remove the pin and move the cylinder out of the way of the mount.
 - You can slide the drawer away so you don't need to remove that side.
3. Weld the mount solid, all the way around. Make sure it stays square.



Step 6 — Install hoses

1. Return the secondary cylinder and re-mount it. Don't forget the washer.
2. Remove the plug from the port on top of the cylinder. The cylinder may have fluid in it, so keep a jar handy to catch any that spills.
3. Install Assembly #2 into this port.
4. Couple the remaining assemblies and hoses in place.



CEB Hardlining the Main Cylinder

Tools Needed:

- Various Wrenches
- Thread tape

Materials Needed:

- ½"x56" Hydraulic Hose (2)

Procedure

1. Remove the couplers and hex nipples at the elbow using a wrench.
2. Tighten the hoses (with thread tape) into the elbows.

CEB Painting the Machine

Procedure

1. Cover the hydraulics and any other place that should not be painted.
2. Check all external surfaces for sharp edges and smooth with angle grinder.
3. Remove any surface rust with wire brush and / or sandpaper.
4. Apply a thorough coating of paint to all steel surfaces.
5. Allow 24 hours to dry before handling.

CEB Electronics – Linked Extension Cord

See [video](#) first.

Tools Needed:

- Straight Pattern Tin Snips
- Wire Strippers Compatible with 16 Gauge
- Crimpers Compatible with 16 to 22 Gauge Connectors
- Measuring Tape
- Handiworks
- Compatible Set of a Soldering Iron and Solder
- Soldering Stand
- Wet Sponge or Wet Paper Towel

Materials Needed:

- Extension Cord of 50 feet (about 15 meters) having 16 Gauge Wires
- Female Insulated Electrical Connector for 16 to 22 Gauge
- Battery Alligator Clips (2)

Procedure

1. Using the tin snips, cut the extension cord such that the male cord is 6 feet in length. The cutting tolerance is 8".
2. Using the tin snips, strip the loose sleeves of the male and female cords such that 12" of insulated wires are unsleeved. The stripping tolerance is 2".
3. Using the tin snips, cut the green wire of the male and female cords such that none or little of the green wire is visible. The cutting tolerance is 1.25".
4. Using the wire strippers, strip the white and black wires of the male and female cords by 0.75". The stripping tolerance is 0.25".
5. Using the crimpers, crimp the female connector onto the white wire of the male cord. Insure that no exposed wire lies between the wire insulation and the connector insulation.
6. Insert 1 alligator clip insulation into each of the white and black wires of the female cord.
7. Using the soldering set, solder the white and black wires of the female cord to the alligator clips.
8. Slide the inserted insulation pieces over the alligator clip handles.
9. Link the male and female cords together by their plugs.

CEB Electronics – Sensor Unit

See [video](#) first.

Tools Needed:

- Compatible Set of Soldering Iron and Solder
- Soldering Stand
- Wet Sponge or Wet Paper Towel
- Straight Pattern Tin Snips
- Wire Strippers Compatible With 22 Gauge Wire
- Heat Gun
- Pliers
- Helping Hand
- Measuring Tape
- Wire Strippers Compatible With 8 Gauge Wire

Materials Needed:

- Hall Effect Sensor
- 1.5m of 4 Wire Underground Telephone Cable
- Silicone
- [3] 3cm lengths of Shrink Tubing
- PVC Pipe with 2.5cm Outer Diameter, 1.5cm Inner Diameter, 9cm Length

Procedure

1. Using the tin snips, cut the sleeve of the telephone wire by 5cm and 20cm at both ends. The cutting tolerance is 2cm.
2. Using the tin snips, cut the orange-white wire at both ends of the telephone wire.
3. Using the wire strippers, strip the bluewhite, blue, and orange wires of the telephone wire by 2cm at the 5cm end and by 1cm at the 20cm end. The stripping tolerance is 0.5cm.
4. Insert 3cm shrinktubing into the 5cm blue, blue-white, and orange wires.
5. Bend the sensor prongs and the exposed metal of the 5cm wires into hooks such that the 3 prong hooks can latch onto the 3 wire hooks to facilitate soldering. Use pliers to pinch the hook connections during the soldering process.
6. Using the soldering set and the helping hand, solder the hall-effect sensor prongs to the 5cm wires. The orientation of the soldering connections is such that, when you can see the sensor text and its prongs pointing downward, from left to right the colour of the wires to be soldered are: bluewhite (for 5V+), blue (for GND), and orange (for Signal).
7. Using the heat gun, cover the soldered prong-to-wire connections with the shrinktubing then apply heat to the now-covered connections. The shrinktubing should shrink, forming a tight insulating seal for each of the prong-to-wire connections.
8. Pour the silicone into the tube such that the tube is completely filled in.
9. Insert the wired hall-effect sensor into the PVC tube leaving 2cm of space at the non-insertion end of the tube.
10. Gently set the sensor unit on a flat surface and wait 24 hours for the silicone to cure.

CEB Solenoid Driver

This is a complicated step. See the [wiki](#) for troubleshooting and additional techniques or upgrades.

Tools Needed:

- Oxide Remover Solution - Ex. Isopropyl
- Masking Tape
- Etching Solution - Ex. Ferric Chloride
- Toner Removal Solution - Ex. Acetone
- Glass Bowl that fits 3" x 4.5" area dimensions with at least 1" depth
- Paper towel
- Compatible Set of Computer and Laser Printer with Glossy Paper
- Laundry Iron
- Drill Press with Number 58 Twist Drill Bit
- Compatible Set of Soldering Iron, Low-diameter Solder, Flux and Brush, Soldering Stand, and Wet Sponge or Wet Paper Towel

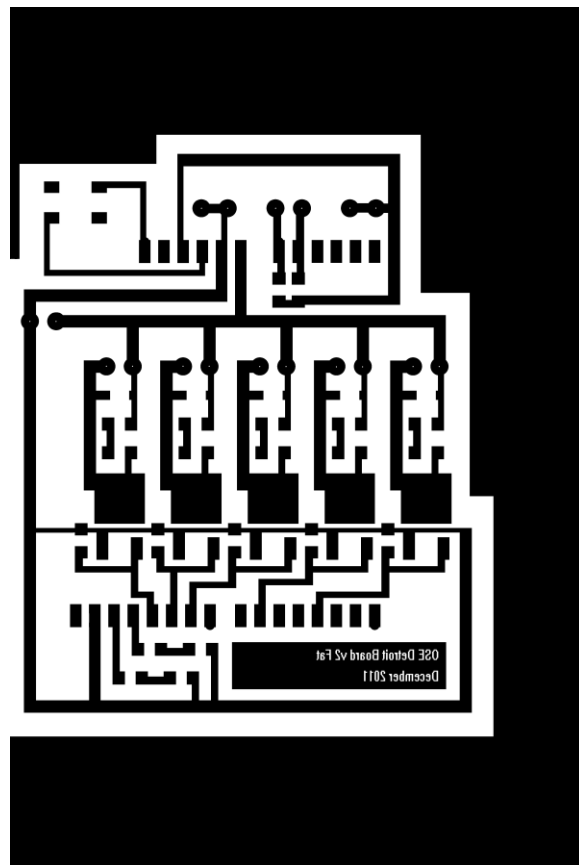
Materials Needed:

Description	Qty.
Power N MOSFET	5
Green LED	7
Diode	5
499 Resistor	5
49.9k Resistor	5
10k Resistor	2
2 Pos Terminal	9
reset switch	1
6 Pos Header	2
8 Pos Header	2
PCB	1
100 Resistor	2

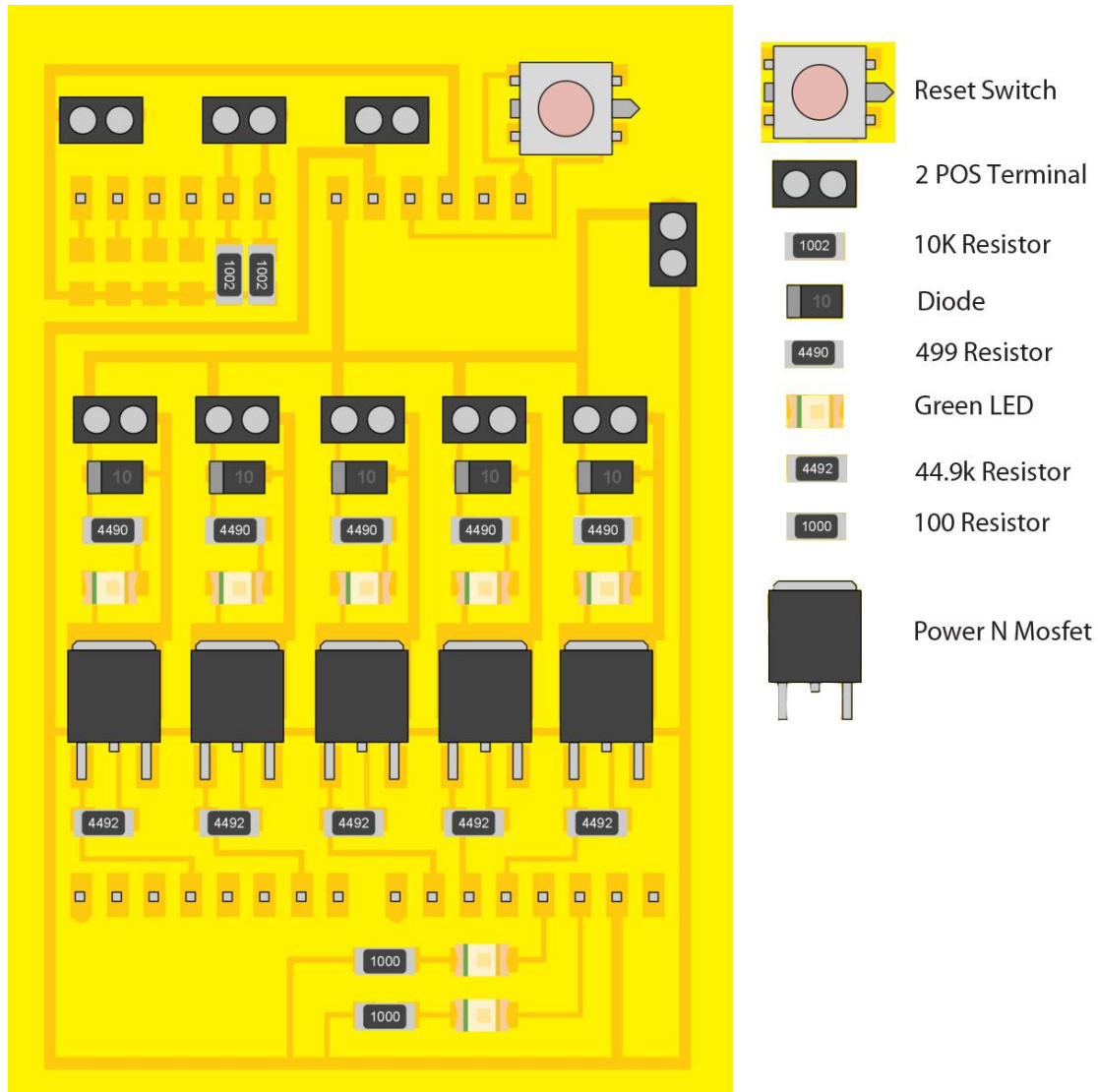
Procedure

1. Either mill your board using [this model](#), OR complete the remainder of this step.

- 1) Print the image on the right on laser photo paper, with dimensions of 3"x4.5."
- 2) Tape the paper onto the copper board.
- 3) Using a laundry iron, heat the paper until discolored.
- 4) Soak in water and peel the paper away.
- 5) Agitate in pcb etchant solution for 20-30 min until copper is gone.
- 6) Apply acetone to a cloth and wipe away toner.
- 7) Check and fix errors.
 - Places where not enough was etched away or where too much was. Can fix by soldering or sanding.



2. **Drill** the etched board at the two rows of small grey squares where the pins would be (28 holes) and all grey circles of where the screw terminals would be (18 holes) as shown in the following diagram.



3. **Surface-mount solder** the etched and drilled copper clad board with the complete board diagram above. The 6 POS Headers go in the top drilled holes, and the 8 POS Headers go in the bottom holes.

CEB Electronics – Case

See [video](#) first.

Tools Needed:

- Screwdriver with the following bits: Quarter Inch Flathead, Half Inch Flathead, Number 1 Phillips, and Number 2 Phillips
- Hammer
- Centre Punch
- Crimper
- Cordless Drill with the following twist drill bits: 9 by 64 inch, 1 by 8 inch, 3 by 16 inch
- Needlenose Pliers
- Electrical Tape
- Tap Wrench with 8-32 Tap

Materials Needed:

- Outdoor Main Lug Box
- [2] Wire Clamps
- Toggle Switch
- [2] 3.2cm OD, 1.27cm ID Washers (1/2" Washer)
- Fuse Holder
- Male Insulated Connector for 10-12 Gauge Wire
- Ring Insulated Connector with Small Hole for 10-12 Gauge Wire
- 10 Amp Buss Fuse
- Ring Insulated Connector for 10-12 Gauge Wire
- [2] 12cm by 7.5cm by 0.4cm high density polyethylene plate
- [4] M3 machine screws of 20mm length
- [4] M3 nylon-threaded lock nuts
- [4] 8-32 machine screws of 3/4 inch length
- [7] 8-32 machine screws of 3/8 inch length
- Arduino Uno Microcontroller
- [Arduino Uno Serial Issue Solution, Replies 2 and 4](#) Note: for Arduino Uno Version R2, the contact point for entering DFU mode is the top-left male pin instead of the top-left pad. You'll need to perform this solution method if initial serial communication tests prove buggy. You cannot perform this after mounting the microcontroller inside the case.
- Linked Extension Cord (from prior guide)

Procedure

1. Open the lug box
2. Using the screwdriver and the half inch flathead bit, unscrew and remove the terminal components inside the lug box
3. Using the safety glasses, hammer and the centre punch, remove the inner lids at the bottom-left, bottom-middle, bottom-right, and right-bottom of the lug box
4. Mount the two wire clamps onto the bottom-left and right-bottom holes of the lug box
5. Mount the toggle switch onto the bottom-right hole of the lug box; in the process, put the 3.2cm OD washers on both sides of the lug wall.
6. Using the crimper, crimp the small ring connector and the male connector onto the two ends of the fuse holder; then insert the buss fuse.
7. Using the crimper, crimp the ring connector to the black wire of the male end of the linked extension cord.

8. Using the safety glasses, cordless drill and the 9 by 64 inch drill bit, drill holes on the first plastic plate such that 5 terminal holes are approximately evenly spaced along an axis near the top edge, and such that 2 terminal holes are located near the bottom corners.
9. Using the safety glasses, cordless drill and the 1 by 8 inch drill bit, position the Arduino microcontroller board on a second plastic plate then drill through the board mounting holes through the plastic such that the holes of the board and those of the plastic align. Use M3 Machine Screws to help align the drilled holes during the process. Be careful not to excessively ream the Arduino board.
10. Using the safety glasses, cordless drill, and the 3 by 16 inch drill bit, drill 2 mounting holes near the far edges of the first and second plastic plates.
11. Using the safety glasses, cordless drill, and the 9 by 64 inch drill bit, drill holes on the back of the lug box such that they align with the mounting holes of the first and second plastic platforms. The Arduino platform should be positioned closer to the top than the terminal platform. Leave enough room surrounding the edges of the platforms to facilitate assembly, disassembly, and wiring.
12. Using the metal file, deburr the lug box's platform mounting holes.
13. Using the tap wrench and the 8-32 tap, tap the 7 terminal holes of the terminal platform and the 4 platform mounting holes of the lug box.
14. Using the screwdriver with the number 1 phillips bit and pliers, mount the Arduino microcontroller board onto the Arduino platform through the 4 mounting holes with the 20mm M3 machine screws and the 4 M3 nylon-threaded lock nuts.
15. Using the screwdriver with the number 2 phillips bit, mount the Arduino platform and the terminal platform onto the back of the lug box by screwing the 3 by 4 inch length 8-32 machine screws through the 4 mounting holes. Use 1/2-13 nuts to act as spacers between the platforms and the back of the lug box. The arduino platform should be mounted closer to the top of the lug box than the terminal platform.
16. Insert the non-clip end of the linked extension cord into the lug box through the bottom-left hole, then connect the black wire's female connector to the fuse holder's male connector. Wrap electrical tape around the exposed male-female connection and put a small fold at the end of the tape piece for ease of disassembly.
17. Using the screwdriver with the number 2 phillips bit, connect the fuse holder's ring connector to one terminal of the toggle switch. Then connect the linked extension cord's black wire ring connector to the bottom-right screw terminal on the terminal platform.
18. Using the screwdriver with the number 2 phillips bit, tighten the screws of the wire clamp at the bottom-left of the lug box.

CEB Electronics- Controller Box

See [Video](#)

Tools Needed:

- Straight Pattern Tin Snips
- Wire Strippers Compatible with 18 and 22 Gauge
- Crimpers
- 2.3mm Flathead Screwdriver
- Screwdriver with Number 2 Philips Bit
- Needlenose Pliers
- Measuring Tape

Materials Needed:

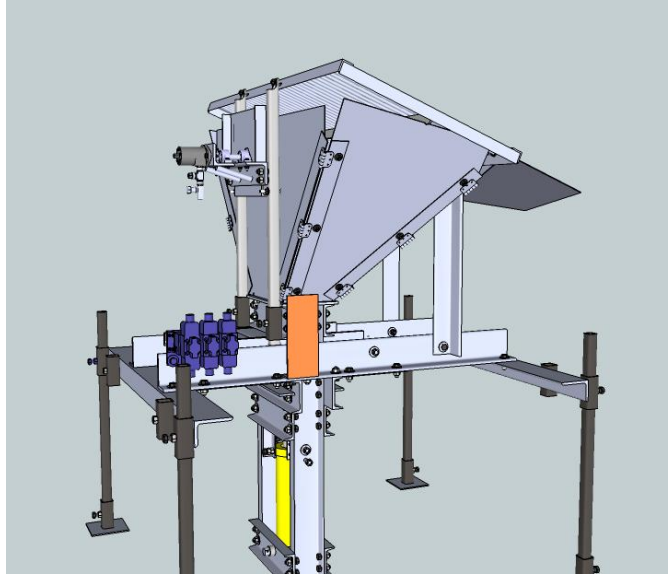
- Case
- [2] Sensor Units
- Solenoid Driver v2
- 18 Gauge Red Wire
- 18 Gauge Black Wire
- Ring Insulated Connector with Small Hole for 10-12 Gauge
- [14] Ring Insulated Connectors for 10-12 Gauge
- [6] Ring Insulated Connectors for 14-16 Gauge

Procedure

1. Mount the solenoid driver on top of the Arduino microcontroller.
2. Using the tin snips, cut 6 pieces of 20cm black wire, 2 pieces of 20cm red wire, 5 pieces of 1.5m black wire, and 1 piece of 1.5m red wire.
3. Using the wire strippers at 22 gauge, strip half a centimetre at one end of the 6 pieces of 20cm black wire and 1 piece of 20cm red wire.
4. Using the wire strippers at 18 gauge, strip a centimetre at the other ends of the 6 pieces of 20cm black wire and the 1 piece of 20cm red wire, as well as both ends of the other 1 piece of 20cm red wire, the 5 pieces of 1.5m black wire, and the 1 piece of 1.5m red wire.
5. Using the crimper, crimp the 10 to 12 gauge ring insulated connector at one of the 1 centimetre stripped ends of the 6 pieces of 20cm black wire, the 2 pieces of 20cm red wire, the 5 pieces of 1.5m black wire, and the 1 piece of 1.5m red wire.
6. Also crimp the 10 to 12 gauge small hole ring insulated connector at the remaining 1cm end of the 20cm red wire and crimp the 14 to 16 gauge ring connector to the remaining 1cm ends of the 5 pieces of 1.5m black wire and 1 piece of 1.5m red wire.
7. Using the screwdriver with the number 2 philips bit, connect the small ring end of the 20cm red wire to the remaining power switch terminal.
8. Insert the large ring end of the 6 1.5m wires through the bottom-middle hole of the lug box.
9. Using the screwdriver with the number 2 philips bit, connect the large ring end of the 1.5m red wire, the remaining ring end of the switch-connected 20cm red wire, and the ring end of the other 20cm red wire to the bottom-left screw of the terminal platform.
10. Connect the large ring end of the 5 1.5m black wires and the ring end of 5 20cm black wires to the top 5 screws of the terminal platform. Then connect the ring end of the remaining 20cm black wire to the bottom-right screw of the terminal platform.
11. Using the flathead screwdriver, connect the half centimetre ends of the 6 pieces of 20cm black wire to the lower terminal of the 5 mosfet terminal blocks, and the left terminal of the power terminal block. Note that the mosfet connections from left to right on the terminal platform should go from bottom to top on the solenoid driver. Also connect the half centimetre end of the 1 piece of 20cm red wire to the right terminal of the power terminal block.

12. Insert the 2 sensor units by their wire end into the right-bottom hole of the lug box.
13. Using the flathead screwdriver, connect the bluewhite wires, orange wires, and blue wires into the top, middle, and bottom terminal blocks, respectively, on the right side of the solenoid driver.
14. Using the screwdriver with the number 2 philips bit, screw-tighten the wire clamp at the right-bottom hole of the lug box.

CEB Mount Solenoid Valve Set and Controller Box



The [CEB Assembly video](#) also shows how to do this step. Note that the video is different than the written instructions in that they use quick couplers whereas the written instructions do not.

Tools Needed:

- Various Wrenches

Materials Needed:

- 3/4" Quick Coupler Set (1)
- SAE 12M to 3/4" Swivel (2)
- SAE 6M to 1/2" Swivel (6)
- Bolts and nuts for mounting on valve mount and controller
- 3/4"x1.5" Bolts (4)
- 3/4" Nuts (4)
- Power Clamps (4)
- Rare Earth Magnets (6)
- Prepared Controller Box
- Prepared Controller Mount

Install Controller

1. Bolt Controller Box to Controller Mount
2. Bolt controller mount to CEB.
3. Power clamp the sensor that has its orange (signal) wire in Arduino pin A0 (aka pin 14) next to the primary cylinder bar.
 - Attach 3 magnets to the primary cylinder bar such that they are vertically aligned and their terminals are reversing ex. NSN or SNS.
 - Space the magnets approximately 5cm apart. Change the magnet positions during testing to achieve the



desired soil loading position, maximum compression position, and press foot ejection position.

4. Power clamp the sensor that has its orange (signal) wire in Arduino pin A1 (aka pin 15) next to the secondary cylinder and soil loading drawer.
 - Attach 3 magnets to the soil loading drawer such that they are vertically aligned and their terminals are reversing ex. NSN or SNS.
 - Space the magnets approximately 5cm apart. Change the magnet positions during testing to achieve the desired soil loading position, compression position, and maximum ejection position.

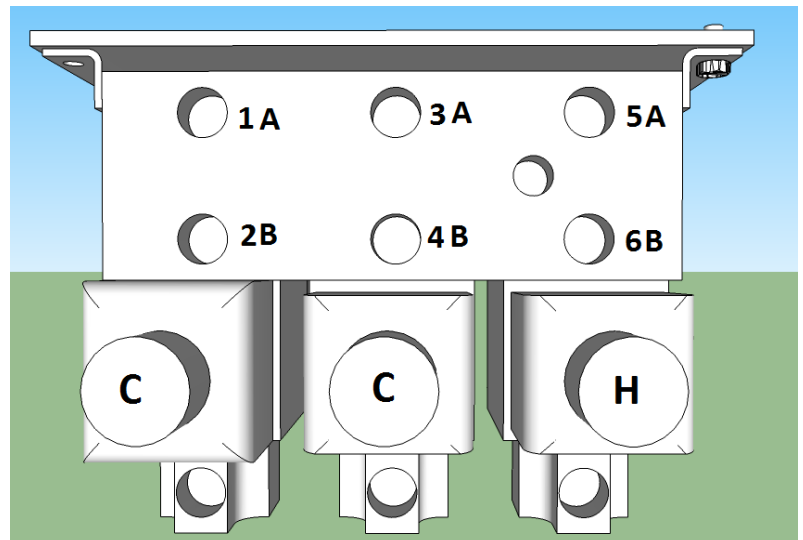


Prepare Solenoid

1. Install the solenoid valves on the manifold in the order C-C-H, going from left to right, with the ports at the top.
2. Install the quick connect inlet and outlet in the side ports on the manifold. DON'T use thread tape for any connections to the manifold.
3. Onto the top of the manifold, install the 6 swivel fittings into the ports.

Install Solenoid on Machine

1. Bolt the solenoid to the valve mount.
2. Bolt the solenoid and valve mount to the primary arms on the assembled CEB.
3. Attach hoses from cylinders and shaker to manifold. See illustration for number locations.
 - 1=Main Cylinder Top
 - 2=Main Cylinder Bottom
 - 3=Secondary Cylinder Tee
 - 4=Secondary Cylinder Control Valve
 - 5=Shaker Non Return Line
 - 6=Shaker Return Line (Side with Needle Valve and Tee)



CEB Electrohydraulic Integration

See [video](#) first. Note that this process should occur only if the solenoid valve set and controller box are already mounted on the CEB press. The process is shown separately from the CEB press for clarity.

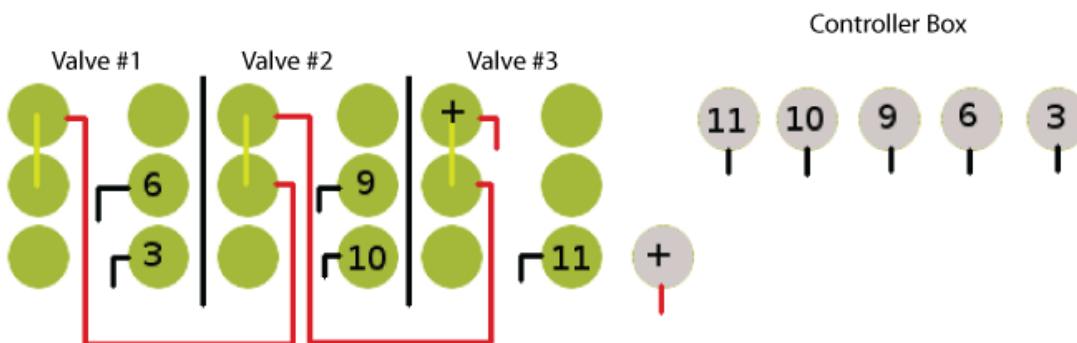
Tools Needed:

- Screwdriver with Number 2 Philips Bit
- Straight Pattern Tin Snips
- Wire Strippers compatible with 18 gauge
- Crimper
- 10mm Hex Key
- Measuring Tape

Materials Needed:

- Controller Box
 - Ensure that the connections between the top 5 terminals of the terminal platform and the left 5 (MOSFET) terminals of the solenoid driver are such that left to right (terminal platform) corresponds with bottom to top (solenoid driver), respectively. In this case, from left to right the top terminals of the terminal platform are indirectly connected to Arduino pins 11, 10, 9, 6, and 3, respectively.
- Solenoid Valve Set
 - Ensure that the solenoid valves are mounted to the subplate such that, when the work ports open away from you, from left to right the solenoid valve types are C, C, and H, respectively.
- 18 Gauge Red Wire
- [4] Ring Insulated 14-16 Gauge Connectors

Wiring Diagram



Procedure

1. Using the tin snips, cut 2 pieces of 30cm red wire.
2. Using the wire strippers, strip 1cm at all ends of the 2 pieces of red wire.
3. Using the crimpers, crimp the ring connectors at all ends of the 2 pieces of red wire.

4. Orient the solenoid valve set such that its work ports open away from you.
5. Using the hex key, unscrew the 3 hex caps closer to you.
6. Using the screwdriver with the number 2 philips bit, unscrew and remove the lids of the solenoid valve electronics.
7. Ensure and relocate if necessary the solenoid valve jumpers such that each solenoid valve has its left-middle and left-top terminals linked.
8. Screw the small ring end of the long red 1.5m wire to the left-top terminal of the rightmost solenoid valve.
9. Screw the small ring ends of the 30cm red wire to the left-middle terminal of the rightmost solenoid valve and the left-top terminal of the middle solenoid valve.
10. Screw the small ring ends of the other 30cm red wire to the left-middle terminal of the middle solenoid valve and the left-top terminal of the leftmost solenoid valve.
11. Screw the small ring end of the long black wire of pin 11 to the right-bottom terminal of the rightmost solenoid valve, pin 10 to the right-bottom terminal of the middle solenoid valve, pin 9 to the right-middle terminal of the middle solenoid valve, pin 6 to the right-middle terminal of the leftmost solenoid valve, and pin 3 to the right-bottom terminal of the leftmost solenoid valve.
12. Screw on the lids of the solenoid valve electronics.

CEB Code Upload

Tools Needed:

- Computer
- USB Cable
- CEB Press
- Arduino Integrated Development Environment Software

<http://www.arduino.cc/en/Main/software>

- [CEB Control Code V5 Annotated](#)

Procedure

Note that you may have to rotate the sensors about their position for the CEB Press to function properly. The hall effect sensors within the sensor units must have the correct orientation with respect to the magnets. Use the CEB Testing Code, python GUI, and Arduino serial monitor to ensure that the sensor is picking up the magnetic field from movement of the magnets.

1. Using the computer, open the Arduino Integrated Development Environment.
2. Within the Arduino IDE, click File > Open (a search box should pop up).
3. Within the Arduino IDE Search Box, navigate to and click on the .ino file in which the desired CEB code exists, then click Open.
4. Within the Arduino IDE, click Compile (if compiling failed, fix the code).
5. Connect the computer to the Arduino microcontroller via the USB cable.
6. Within the Arduino IDE, click Tools then check Serial Port for a connection and check Board for the correct microcontroller type selection.
7. Within the Arduino IDE, click Upload and wait for upload completion.
8. Disconnect the USB cable from the Arduino microcontroller.