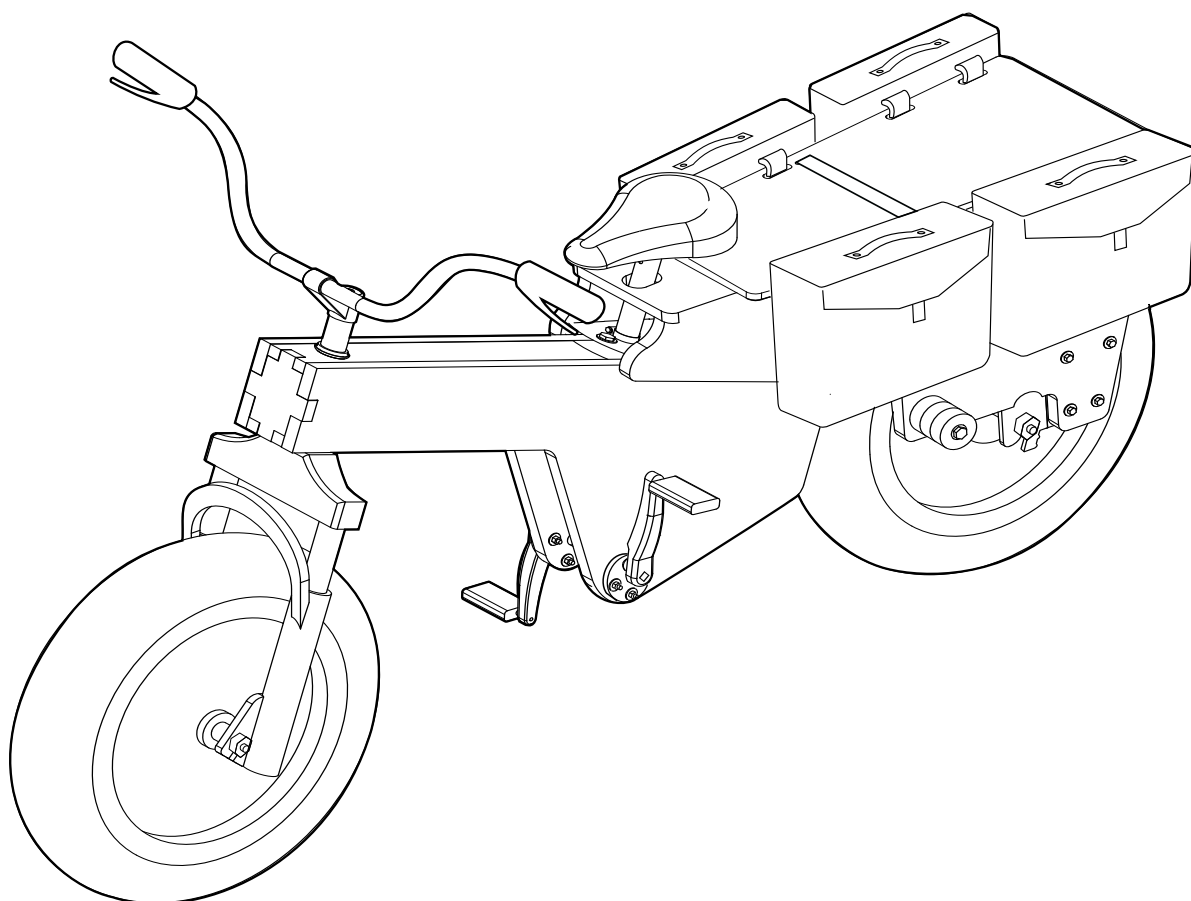


## 2uP Plywood E-Cargo Bike Construction Manual



# 2uP Plywood E-Cargo Bike Construction Manual

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# Introduction

This manual describes how to build your own open-source electric plywood 'long-tail' cargo bike. The project is based on the idea that sustainable transport should be accessible, affordable, and adaptable. By using widely available materials and openly shared knowledge, this design aims to empower individuals and communities to create a practical vehicle for everyday use while reducing environmental impact.

Wik-E-Cargo bikes are designed primarily from plywood and standard bicycle components. Plywood is a renewable, resource-efficient material with a significantly lower environmental footprint than steel or aluminum when sourced responsibly. It requires far less energy to produce, stores carbon during its lifetime, and can be worked with common woodworking tools, making it suitable for small-scale, local production and repair. Many parts of the bike can also be sourced from existing bicycles, encouraging reuse and extending the life of components.

The plywood frame components are cut from digital design files using a CNC router. Access to a CNC machine is therefore required to produce the main structural parts. Fortunately, CNC routers are increasingly available through maker spaces, fab labs, schools, and commercial workshops, making digital fabrication accessible to a growing number of people.

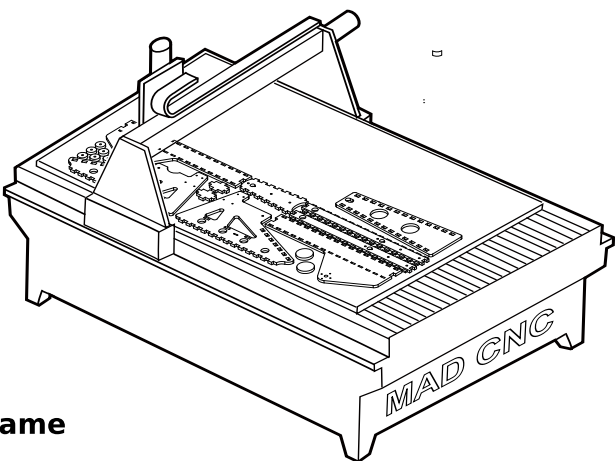
This manual deals specifically with the construction of the plywood frame. It focuses on the digital files, materials, machining, assembly, and finishing of the wooden structure. It does not cover in detail the installation or adjustment of bicycle systems such as brakes, gears, steering components, or electric motor systems, and readers should consult other resources for these aspects.

The construction of these bikes requires a combination of digital fabrication skills and relatively advanced woodworking techniques. However, no welding or metal machining is necessary. All structural elements are made from wood and commonly available hardware.

These designs are fully open source and free to download, modify, and share. All files are released under a GPL (General Public License). As with all GPL projects, there is no warranty: you build and use this cargo bike at your own risk. The authors and contributors cannot be held responsible for errors, omissions, or any damage or injury resulting from construction or use.

# Machining the Plywood

In the file system, find the dxf files called 18mmPlywoodNested.dxf, and 12mmPlywoodPartsNested.dxf and use your favourite G code software to generate the tool paths for your CNC router.



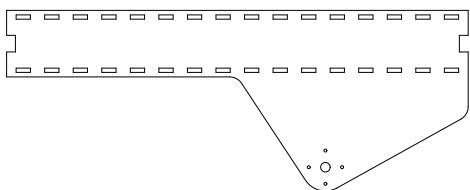
## Front Frame



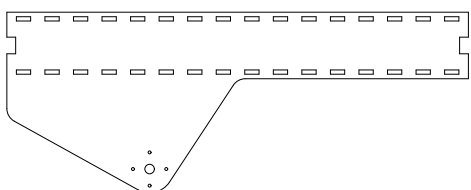
Top panel 18mm



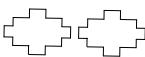
Bottom panel 18mm



Right side panel 18mm

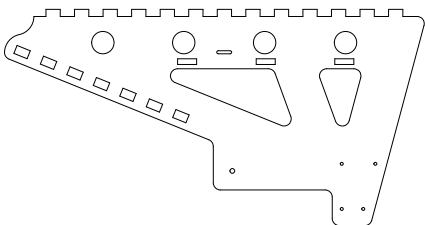


Left side panel 18mm

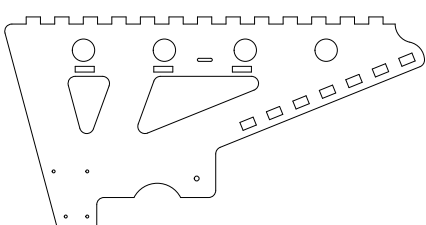


End Panels 18mm

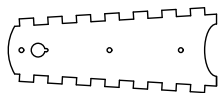
## Rear Frame



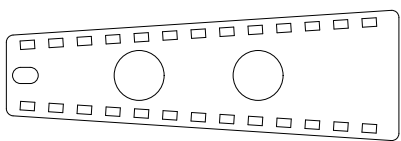
Right side panel 18mm



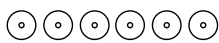
Left side panel 18mm



Bottom panel 18mm



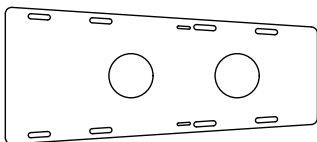
Top panel 18mm



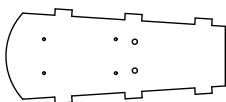
Passenger pedal discs 18mm



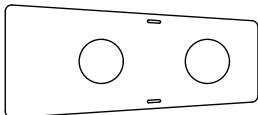
Seat and pannier discs 18mm



Pannier panel 12mm



Battery Panel 12mm

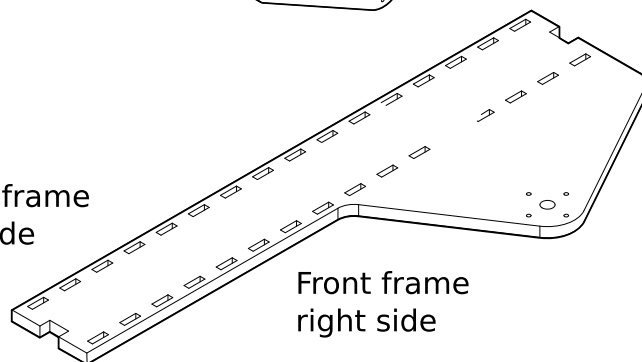
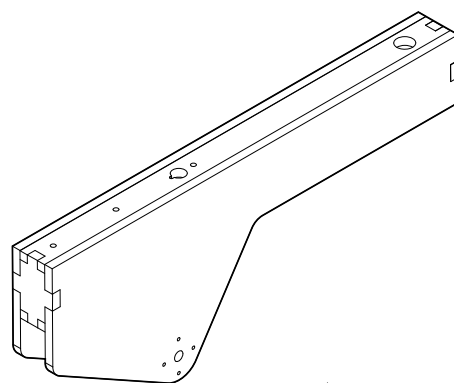
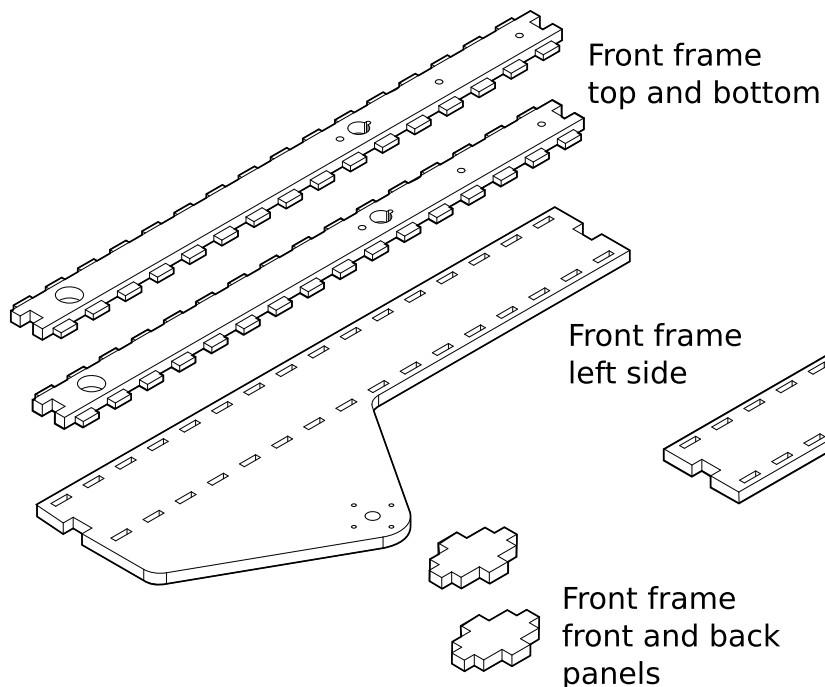


Seat panel 12mm

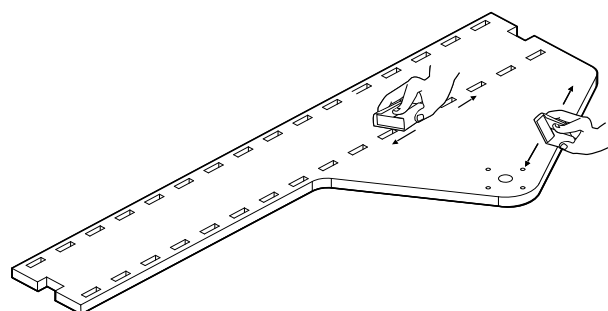
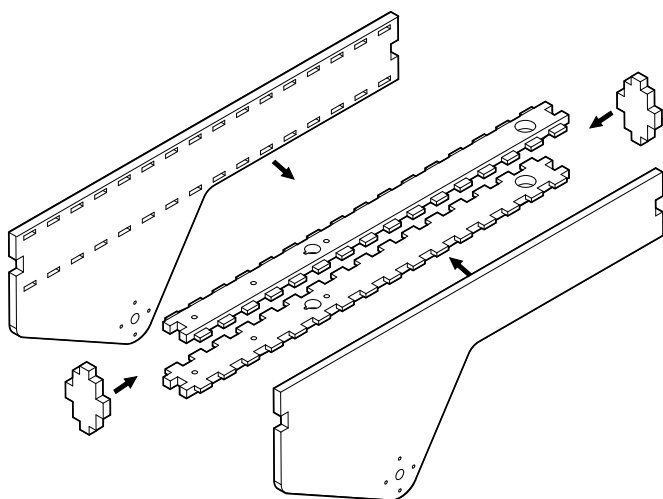


# Assembling the Front Frame

The rear frame is made up of four 18mm thick components.

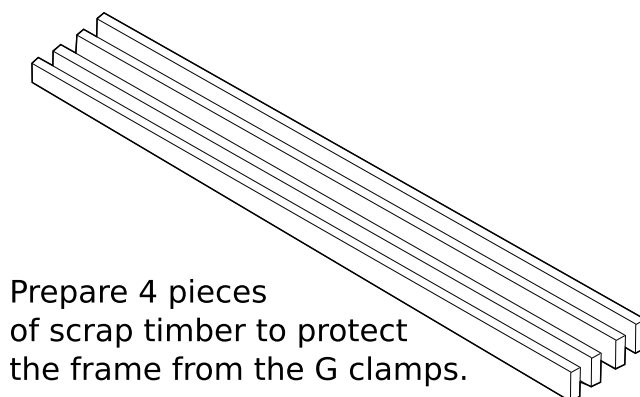


Sand all the faces and sides.

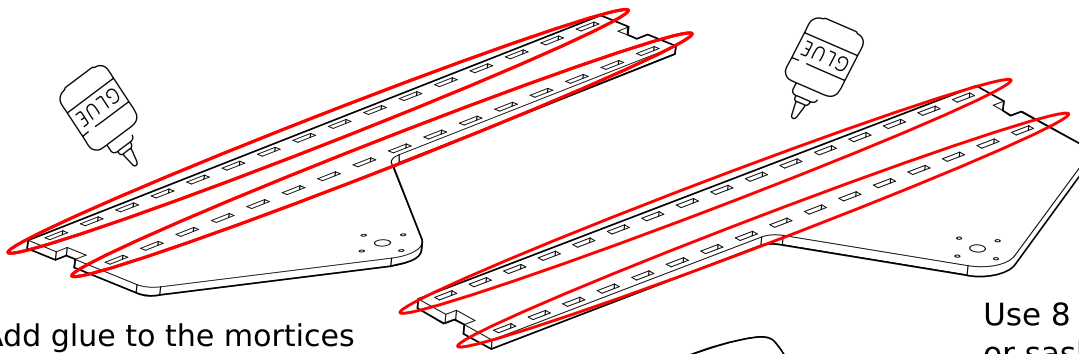


Round off all the arras edges that do not coincide with another part. This could be done with sandpaper or a router and a 4mm rounding over cutter.

Familiarise yourself with all the parts and how they fit together to form the structure, and to check all the joints fit together.

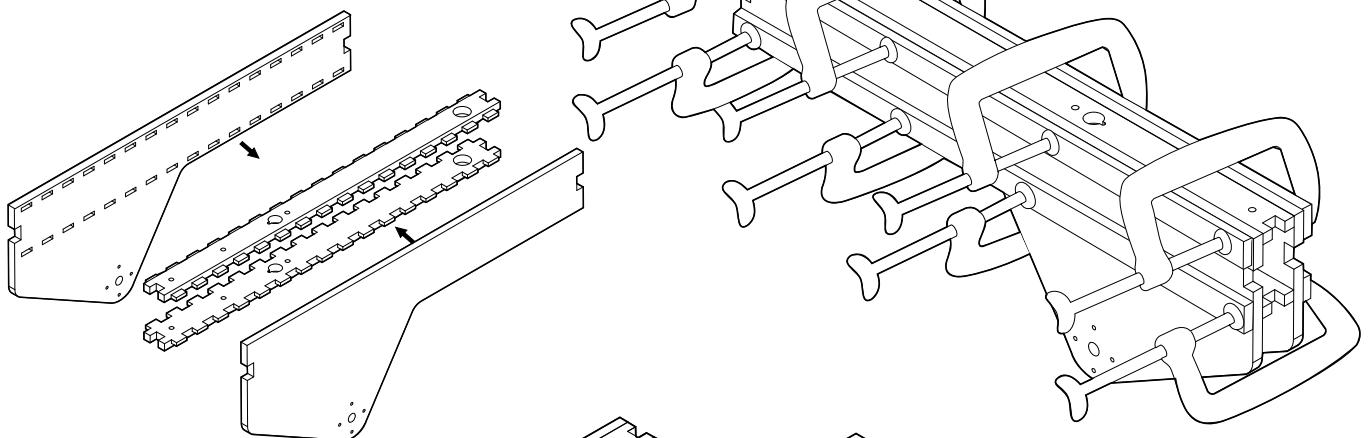


## Assembling the Front Frame (cont.)

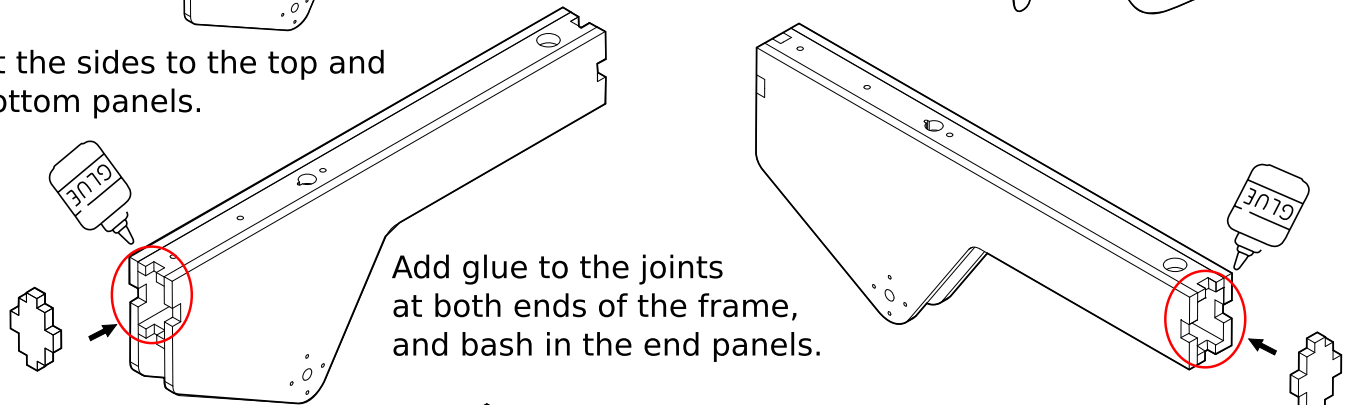


Add glue to the mortices of both of the sides. Do not add glue to the end joints.

Use 8 G cramps or sash cramps to glue the frame together.

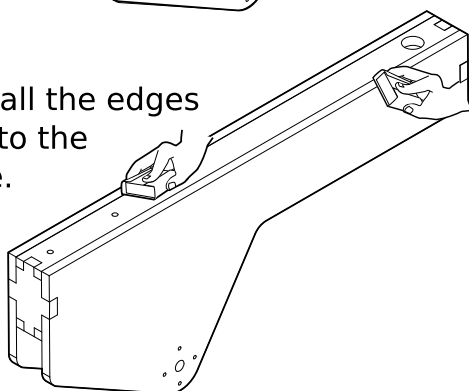


Fit the sides to the top and bottom panels.

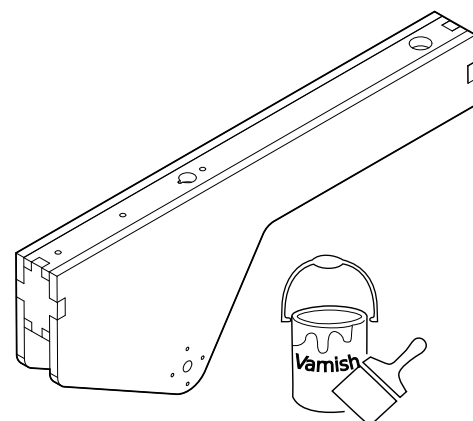


Add glue to the joints at both ends of the frame, and bash in the end panels.

Sand all the edges flush to the frame.



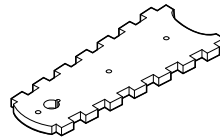
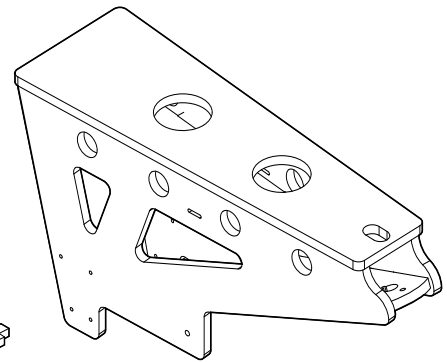
Round off all the arras edges. This could be done with sandpaper or a router and a 4mm rounding over cutter.



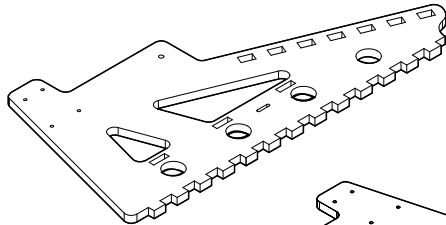
Add 3 or 4 coats of varnish.

# Assembling the Rear Frame

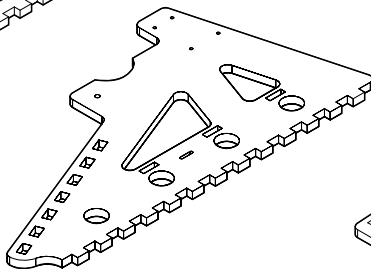
The rear Frame is made up of four, 18mm thick components and one, 12mm thick component. It is recommended to glue up the rear frame in two sessions, because it is difficult to varnish inside the battery compartment.



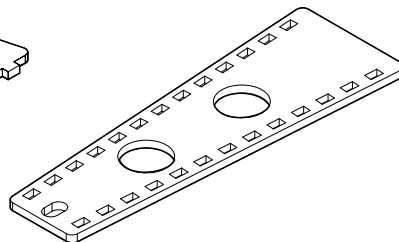
Rear Frame Bottom panel



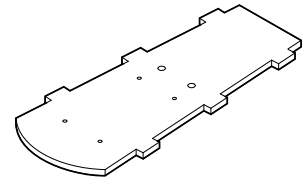
Rear Frame Right side



Rear Frame Left side



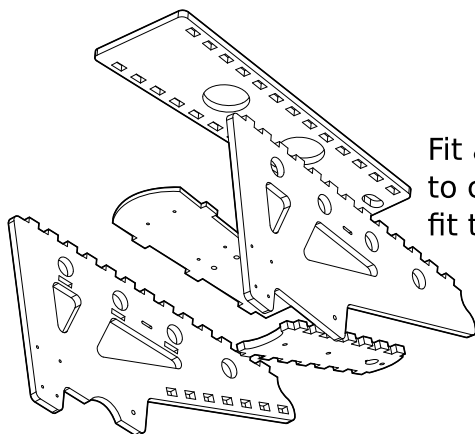
Rear Frame top panel



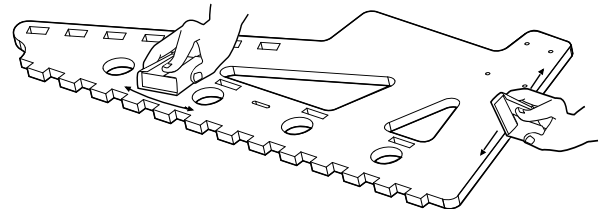
Rear Frame battery panel

Familiarise yourself with all the parts and how they fit together to form the structure.

Sand all the faces and sides.

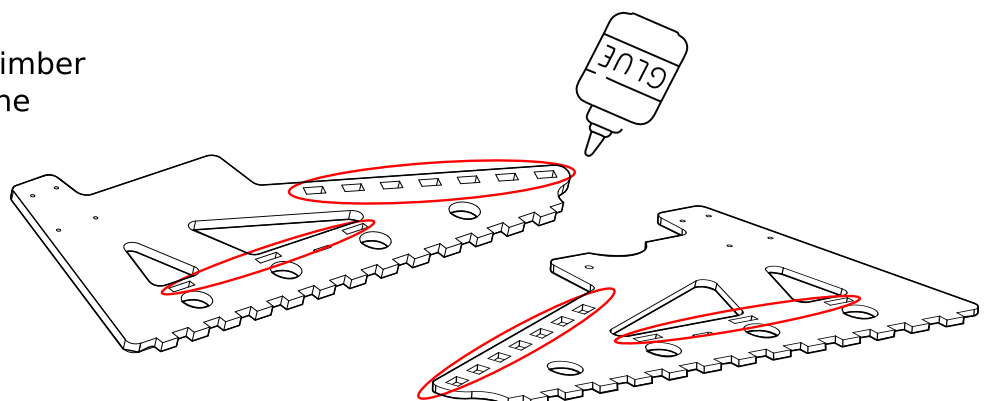
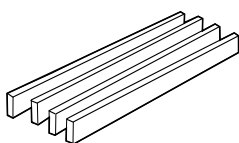


Fit all the joints to check they fit together.



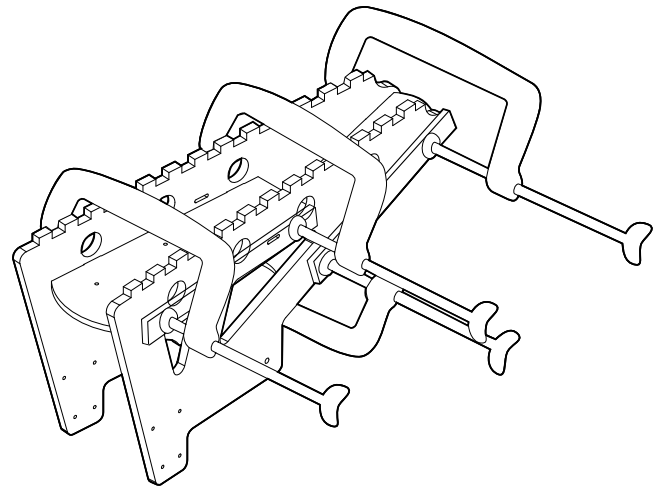
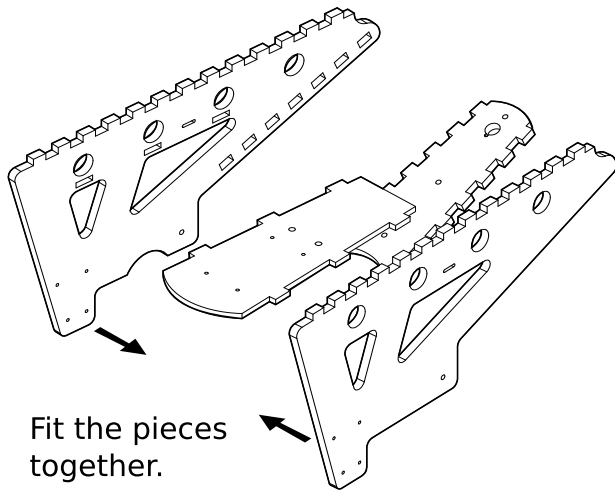
Round off all the arrases edges that do not coincide with another part. This could be done with sandpaper or a router and a 4mm rounding over cutter.

Prepare 4 pieces of scrap timber to protect the frame from the G clamps.



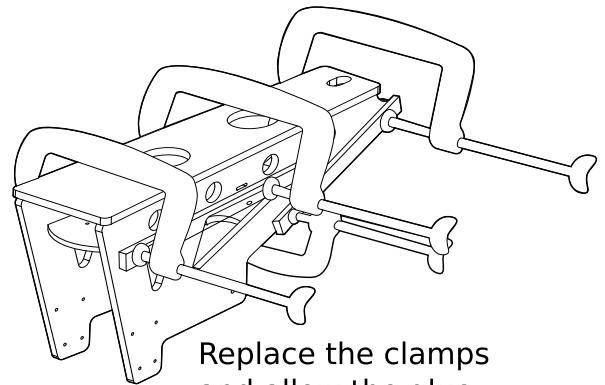
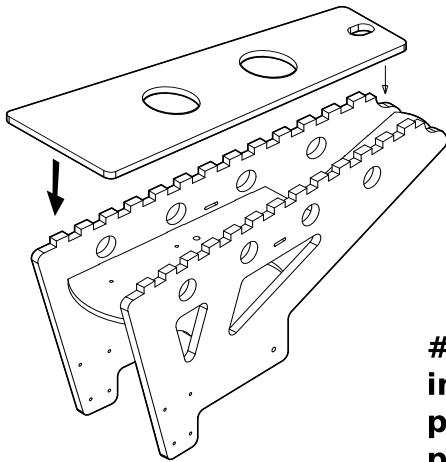
Add glue to the mortises for the bottom panel and the battery board. **Do not add glue to the top panel.**

## Assembling the Rear Frame (cont.)



Use extra large G cramps, or sash cramps to glue the frame together.

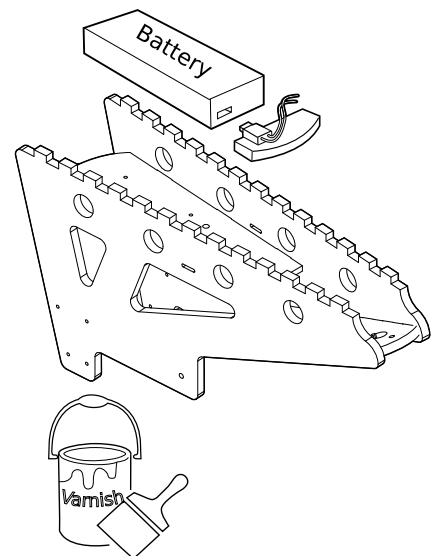
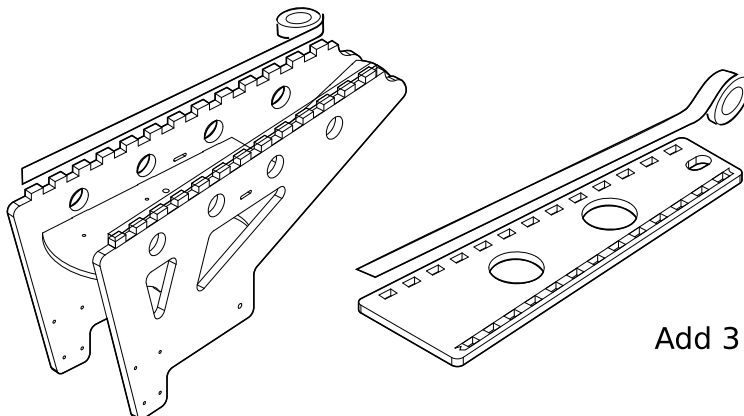
Remove the clamps and fit the top onto the frame, but do not glue it. This is so that the joints cure in the correct position.



Replace the clamps and allow the glue to dry

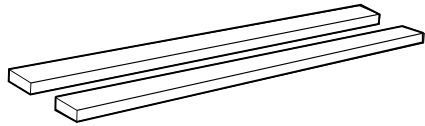
**#At this point it is very important to make provision for plugging the battery onto the socket.#**

Once the glue is dry, remove the top and use masking tape to mask off the joints at the top of the frame.

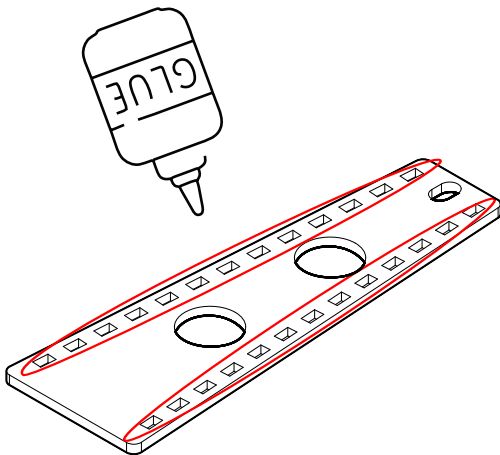
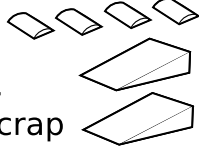


Add 3 or 4 coats of varnish.

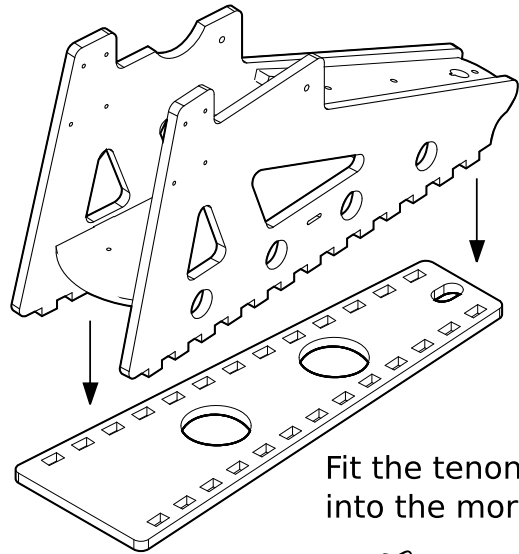
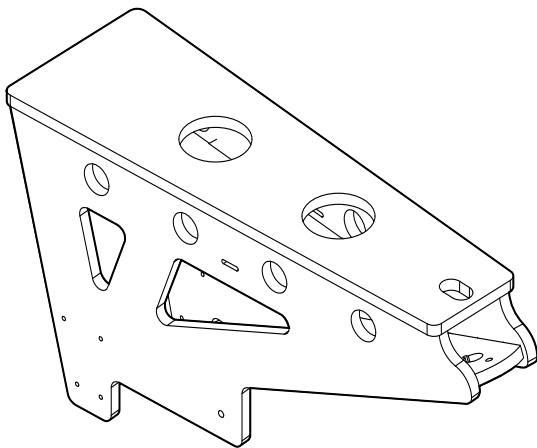
## Assembling the Rear Frame (cont.1)



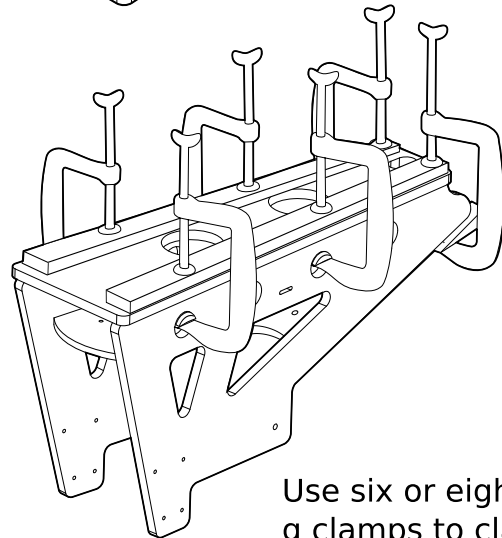
Make a couple of wedges, four small rounded pieces, and two long strips from scrap timber to protect the frame from the g clamps.



Remove the masking tape, and add glue to the mortices on the top panel.



Fit the tenons into the mortices.

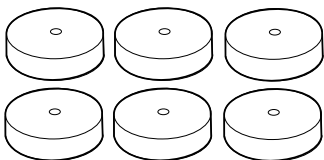


Use six or eight g clamps to clamp the top to the frame until the glue dries.



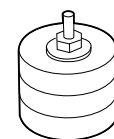
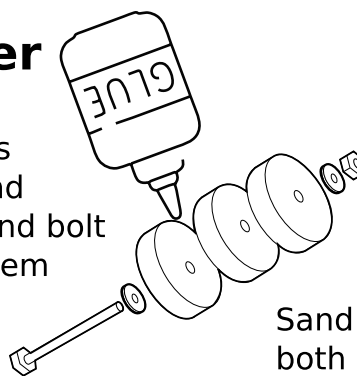
Add a final coat of varnish.

## Gluing up the passenger pedals

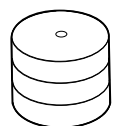


Take the 6 small discs.

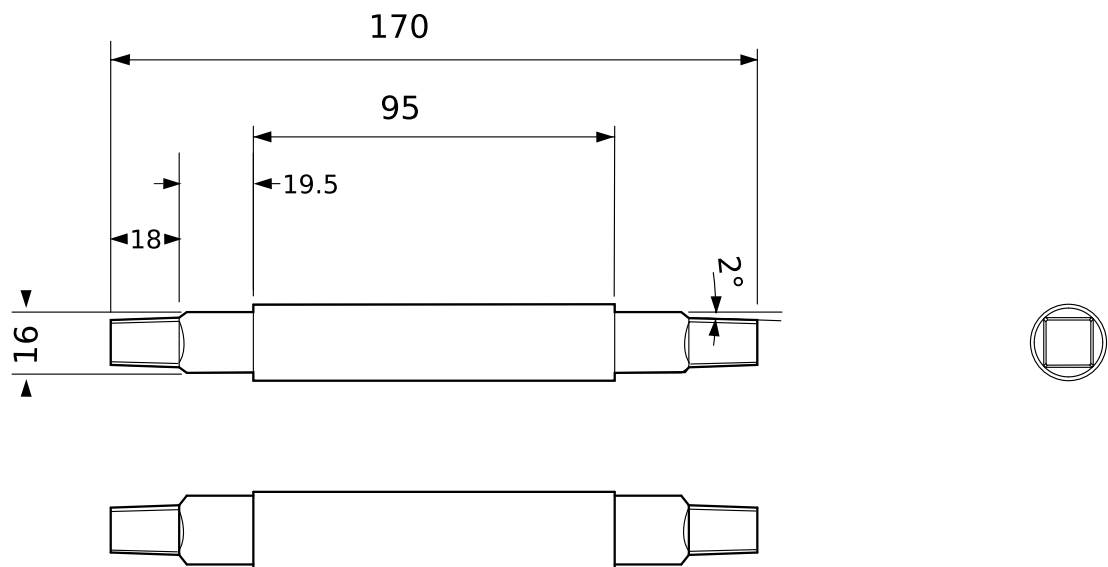
Glue 3 discs together and use a nut and bolt to clamp them together.



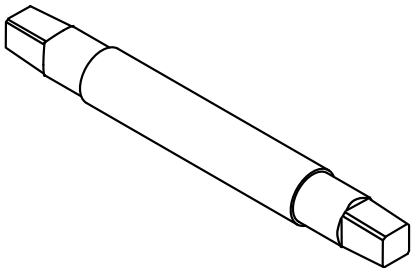
Sand and varnish both pedals.



# Bottom Bracket Spindle

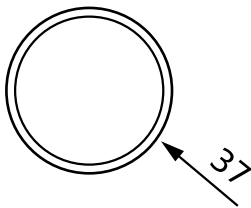
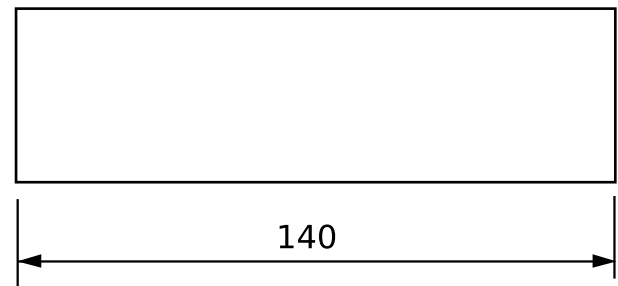


The bottom bracket can be bought as a threadless fat-bike bottom bracket and the spindle and bearings dismantled from the casing. Or, this component can be turned on a lathe and the tapered squares filed to the fit the holes in the cranks. Use 20mm dia. stainless steel, as mild steel is not strong enough.



# Steerer Bearing Tube

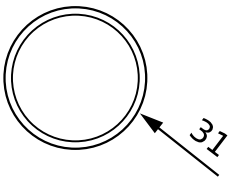
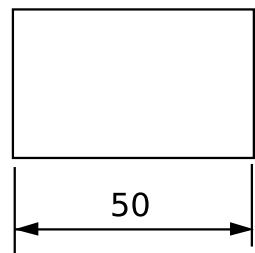
Mild steel bike tubing



This tube is embedded into the front frame

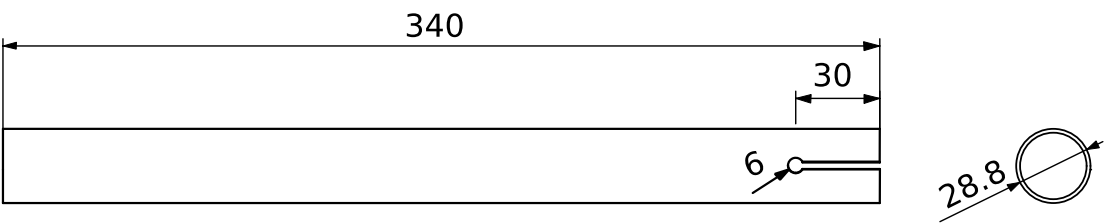
# Steerer Tube Sleeve

Stainless steel



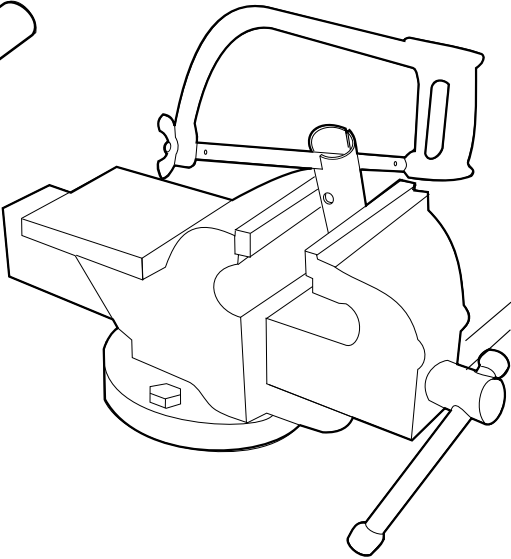
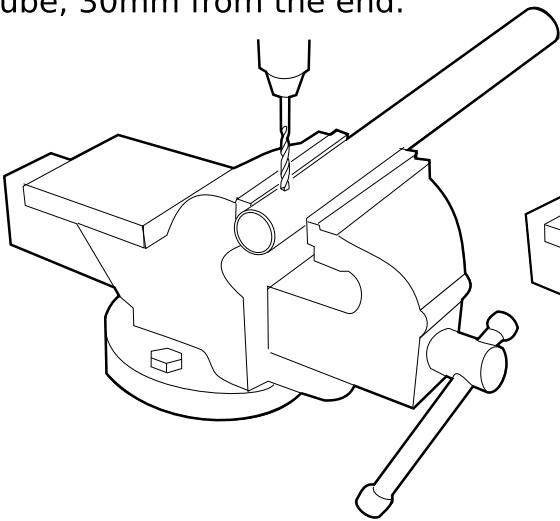
This tube slides over the steering tube of the front forks.

# Seat Stay



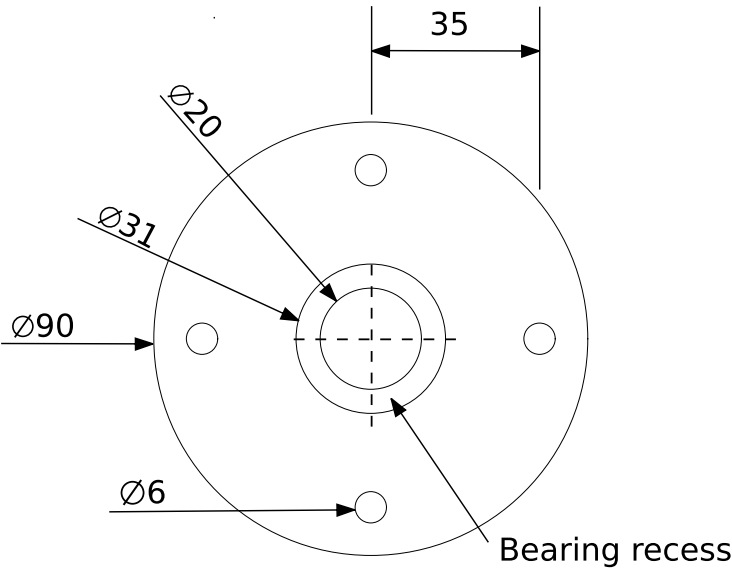
Made from a piece of stainless steel tube 28.8mm dia. 1.5mm thick

Drill a 6mm dia. hole right through the tube, 30mm from the end.



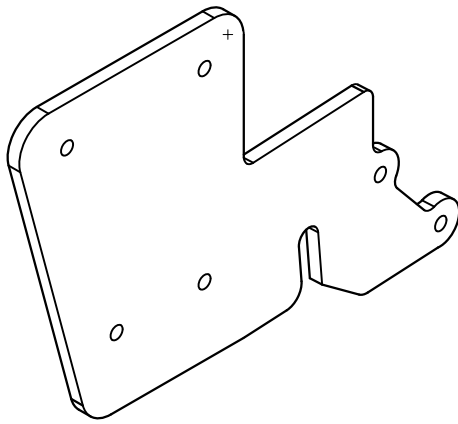
Cut a slot in the top of the tube to allow the seat post clamp to compress the tube.

# Bottom Bracket Plate

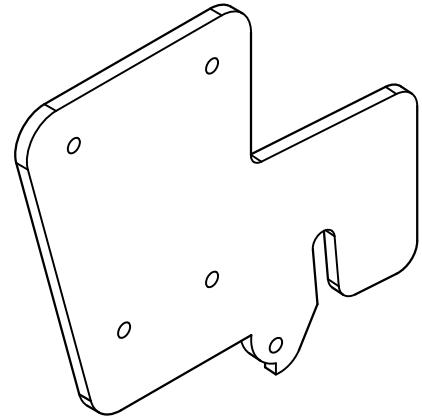


The bottom bracket plate is made from 12mm thick aluminium plate. It can be turned on a lathe or milled on a router. It is important that the bearing is a tight fit in the recess. To mill this part use file: BottomBracketPlateNested.dxf

# Rear Dropouts

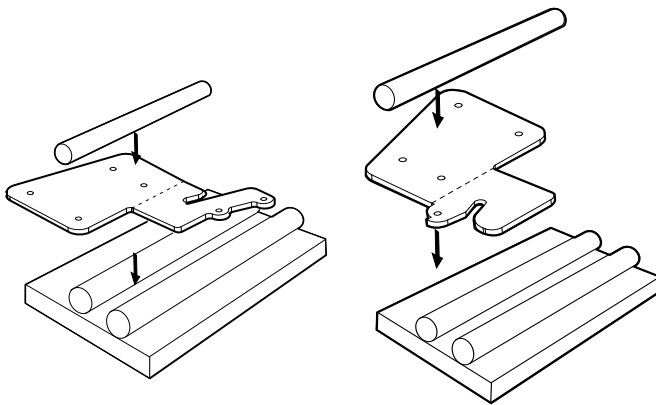


Brake side dropout

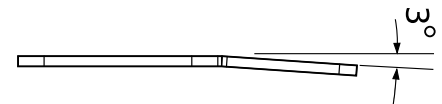
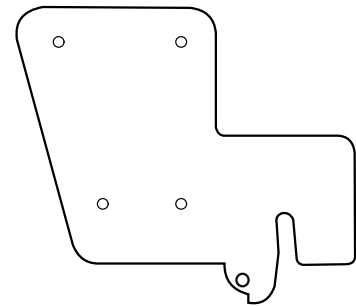


Gear side dropout

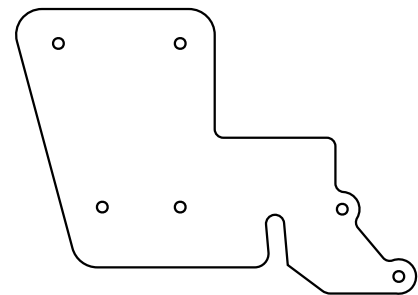
The rear dropouts are made from 6mm thick aluminium plate. Laser cut or milled from the file called DropoutsNested.dxf. They have to be bent to an angle 3 degrees in opposite directions.



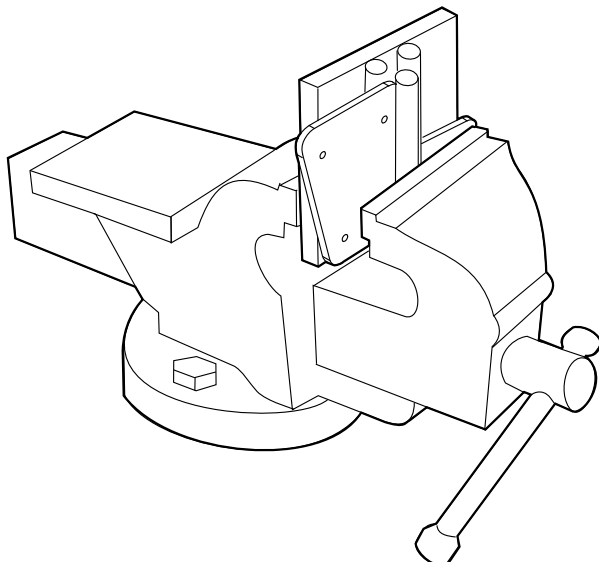
Some laser cutting companies will be able to bend these components. If you have to do this yourself make a jig from 3 pieces 12mm dia. steel rod, and a piece of steel plate. Place the jig and the dropout in a large metalwork vice and apply pressure.



Top view



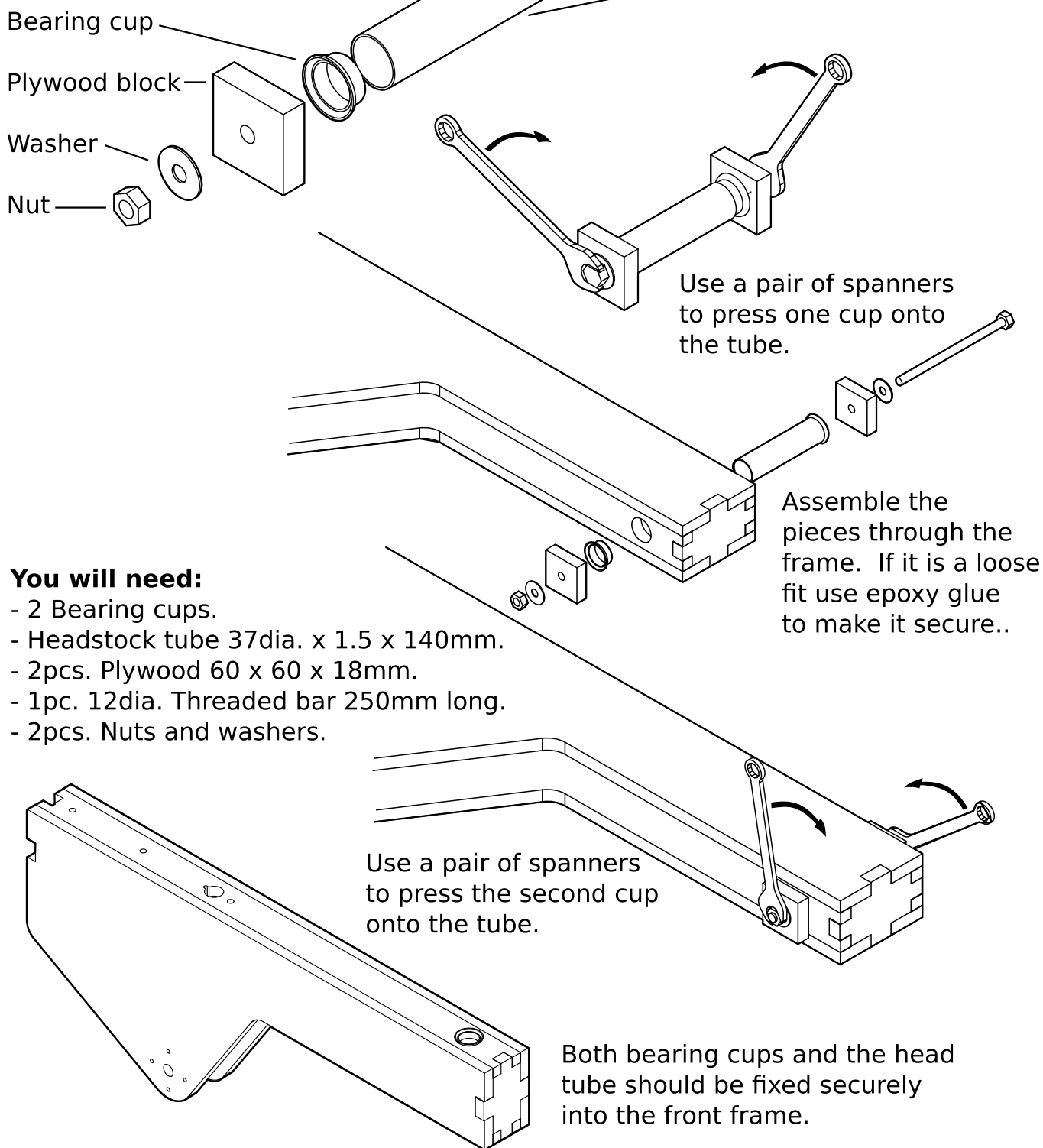
Top view





## Press fitting the bearing cups

Press fitting the bearing cups onto the headstock tube can be a bit tricky. It can be done with a pair of sash clamps, but it is probably better to make a special clamp from 2 pieces of plywood. A length of 12mm threaded rod and some nuts and washers.



### You will need:

- 2 Bearing cups.
- Headstock tube 37dia. x 1.5 x 140mm.
- 2pcs. Plywood 60 x 60 x 18mm.
- 1pc. 12dia. Threaded bar 250mm long.
- 2pcs. Nuts and washers.

# Bolting the Front and Rear Frames Together

## You will need:

- 3 pcs M10 x 180 stainless steel bolts.
- (You may need to cut these down by hand).
- 3pcs M10 stainless steel nuts.
- 6pcs. large stainless steel penny washers.

M10 nuts  
and penny washers

M10 penny washers

M10 bolts

## Bolting on the Drop-Outs

## You will need:

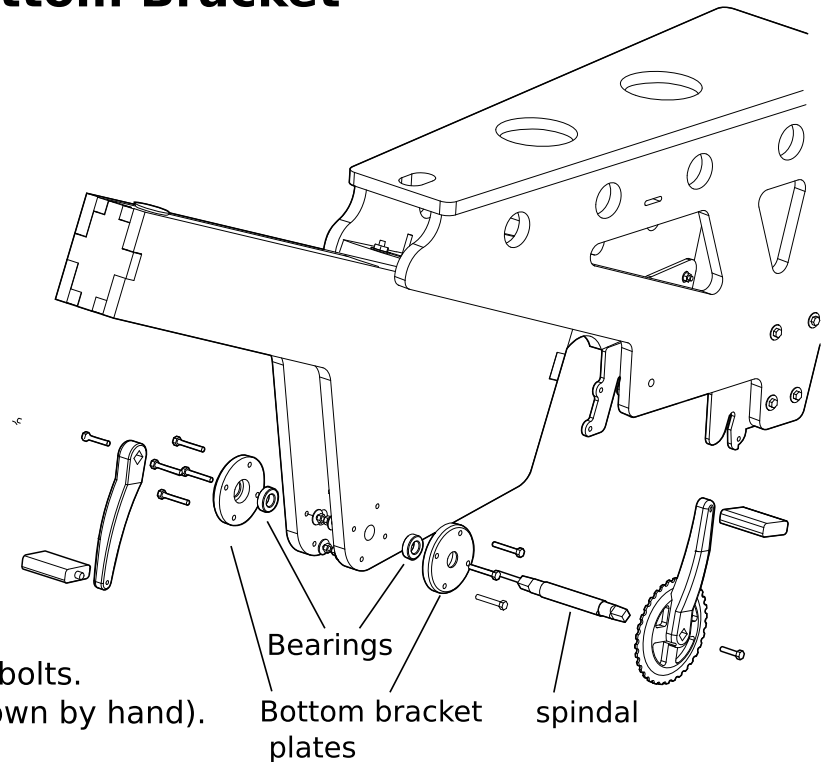
- 8 pcs, M6 x 35 stainless steel bolts  
(You will need to cut these down by hand).
- 8pcs M6 stainless steel nuts.
- 8pcs. large stainless steel penny washers  
(these go against the plywood frame).
- 8 pcs. stainless steel washers. (these go  
against the aluminium brackets).

Break side dropout

Gear side dropout

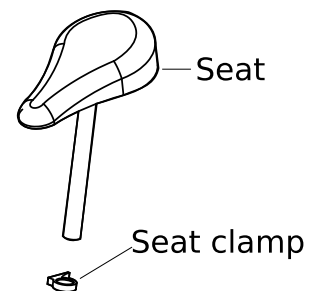
The dropouts are bolted to the inside of the frame.  
The brake side dropout goes on the right.  
The gear side dropout goes on the left.

## Assembling the Bottom Bracket



### You will need:

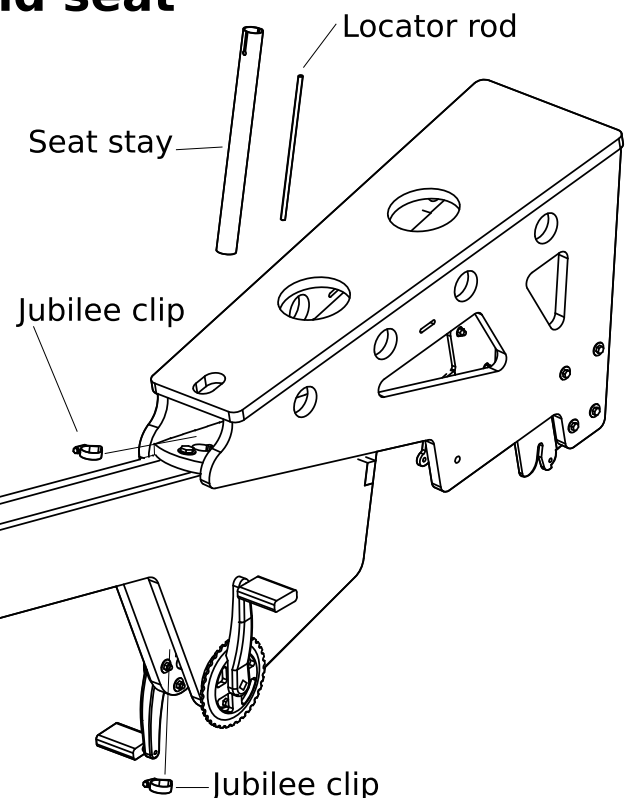
- 8 pcs. M6 x 45 stainless steel bolts.  
(You may need to cut these down by hand).
- 8pcs. M6 stainless steel nuts.
- 8pcs. large stainless steel penny washers.
- 1pc. crank set.
- Pair pedals
- 2pcs. 30 x 17 x 10 ball bearings.
- 2pcs. bearing plates.
- 1pc. Fat-bike bottom bracket spindle.



## Assembling the seat stay and seat

### You will need:

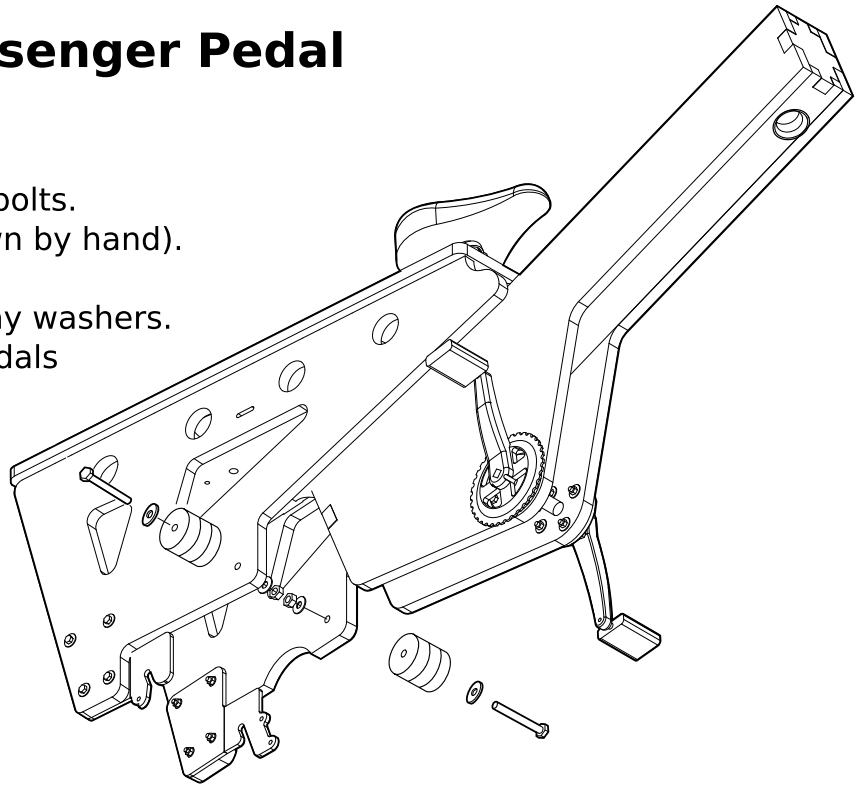
- 1 Seat and seat post.
- 1pc. seat clamp, 28.8mm diameter .
- 2 pcs. jubilee clip, 30mm diameter .  
(these hold the seat stay and locator rod in position).
- 1pc. locator rod.  
(6mm dia. x 220mm stainless steel rod.  
(This stops the seat stay rotating).
- 1pc. Seat stay.  
(28.8mm dia, x 1.5 stainless steel tube 340mm long).



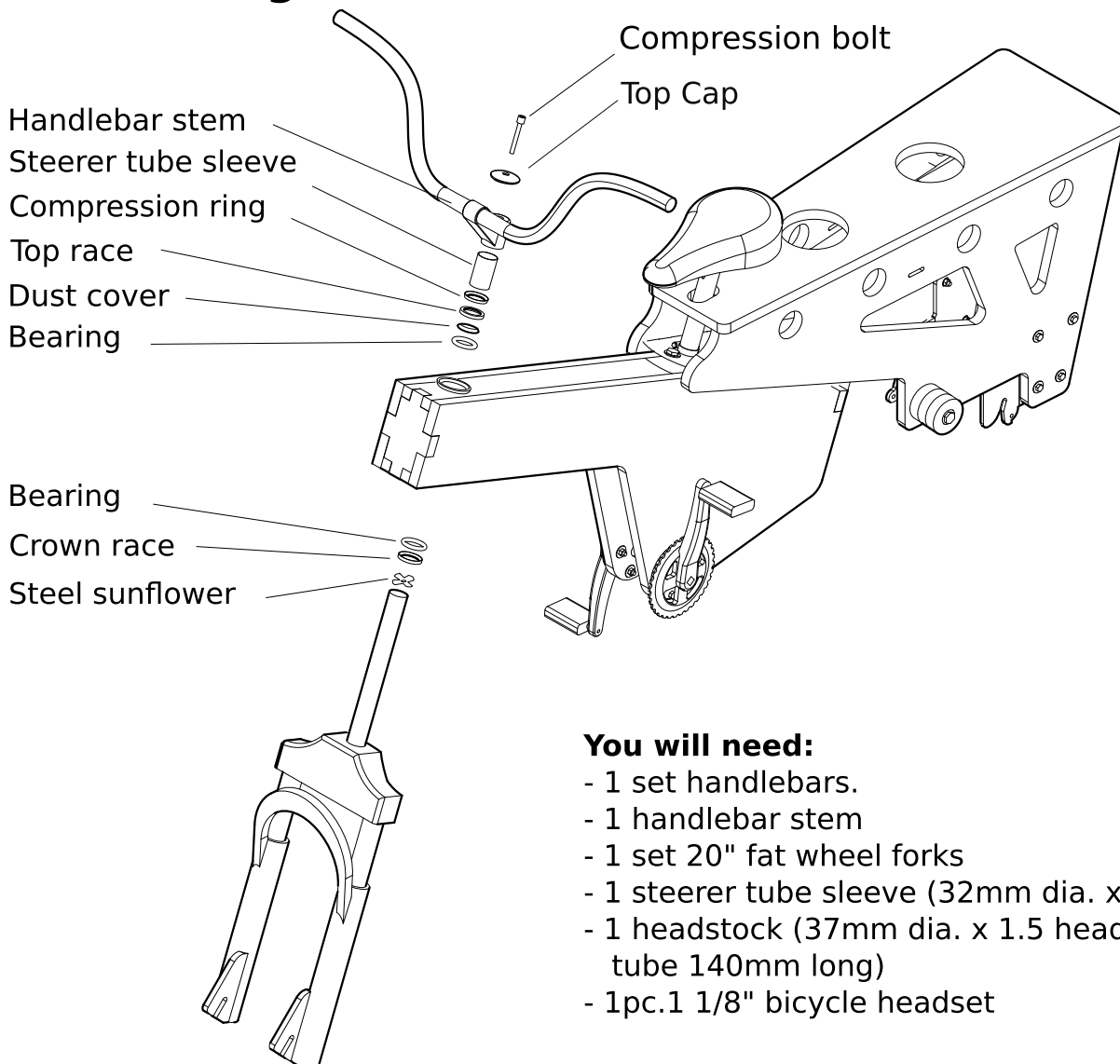
## Assembling the Passenger Pedal

### You will need:

- 2 pcs. M10 x 80 stainless steel bolts.  
(You may need to cut these down by hand).
- 2 pcs. M10 stainless steel nuts.
- 4 pcs. large stainless steel penny washers.
- 2 pcs. assembled passenger pedals



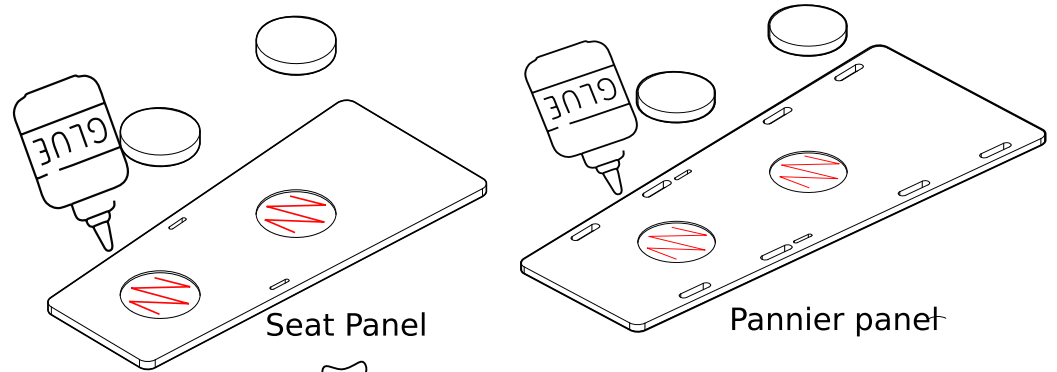
## Assembling the Front Forks



### You will need:

- 1 set handlebars.
- 1 handlebar stem
- 1 set 20" fat wheel forks
- 1 steerer tube sleeve (32mm dia. x 1.5)
- 1 headstock (37mm dia. x 1.5 headstock tube 140mm long)
- 1pc. 1 1/8" bicycle headset

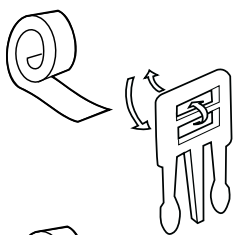
# Seat and Pannier Panels



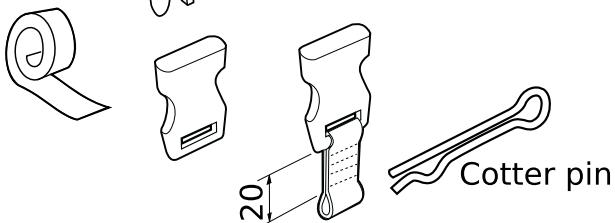
## You will need:

- Seat panel
- Pannier panel
- 4pcs. location disks
- 4pcs snap-lock plastic buckles
- 1M, 25mm wide black nylon webbing
- 2pcs large cotter pin

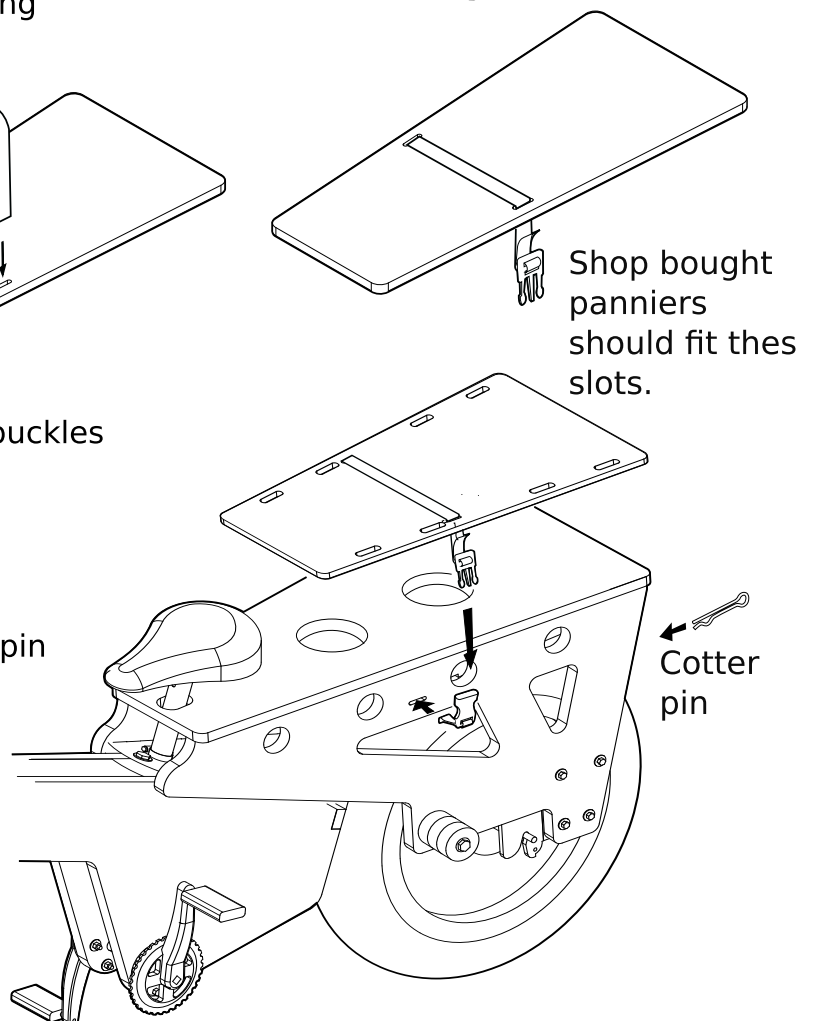
25mm Nylon webbing



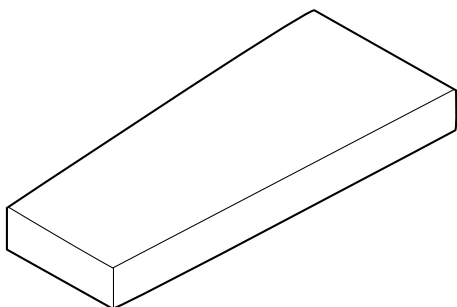
Snap-lock plastic buckles



Stitch 2 lengths of webbing so that they form 2 loops, 20mm apart, with one loop enclosing the bridge on the female buckle. Pass these through the small slots in the sides of the frame. These are then secured with the cotter pins from the inside of the frame.

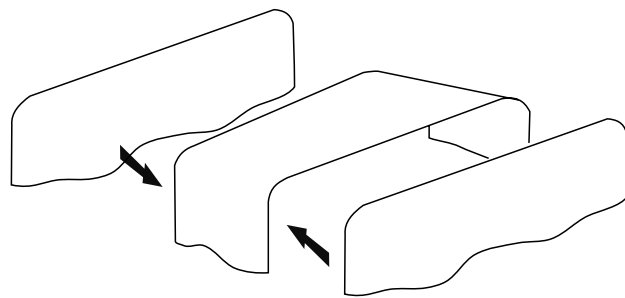


## Making The Rear Seat

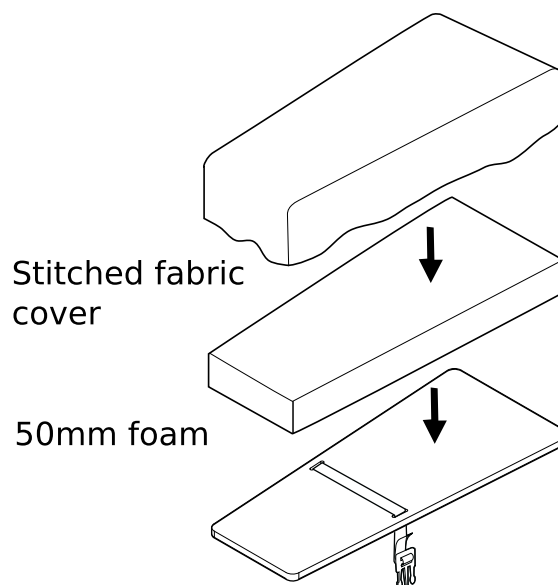


Cut a piece of 50mm thick foam to the same dimensions as the seat panel.

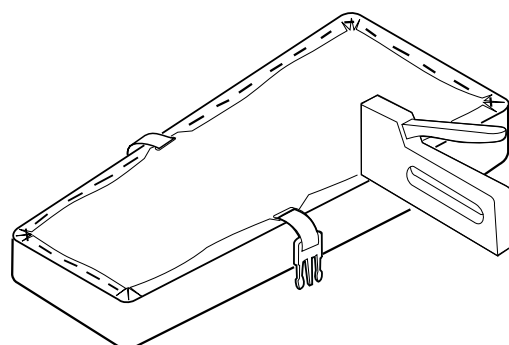
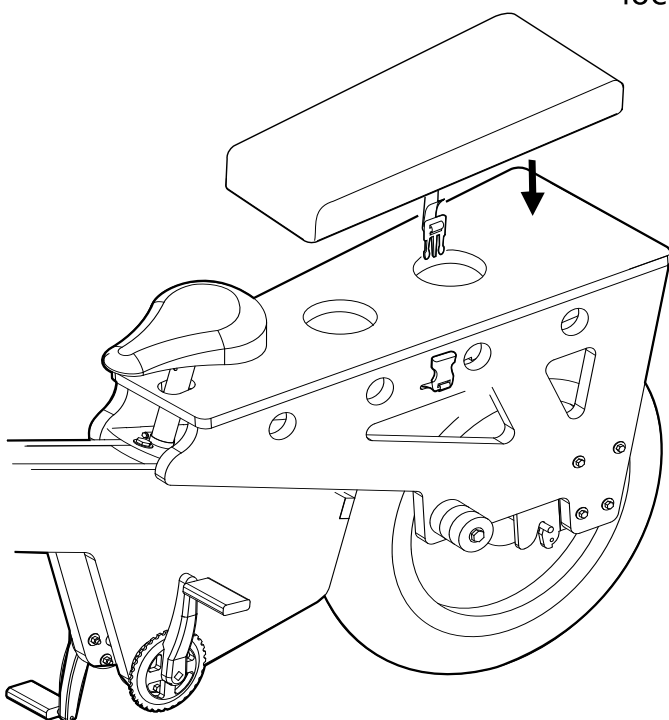
Stitch the three pieces together inside out. Turn it the right way round and assemble the fabric, the foam, and the seat panel, making sure the nylon webbing is in place.



Choose some water proof fabric and cut three pieces to fit around the foam and the seat panel.

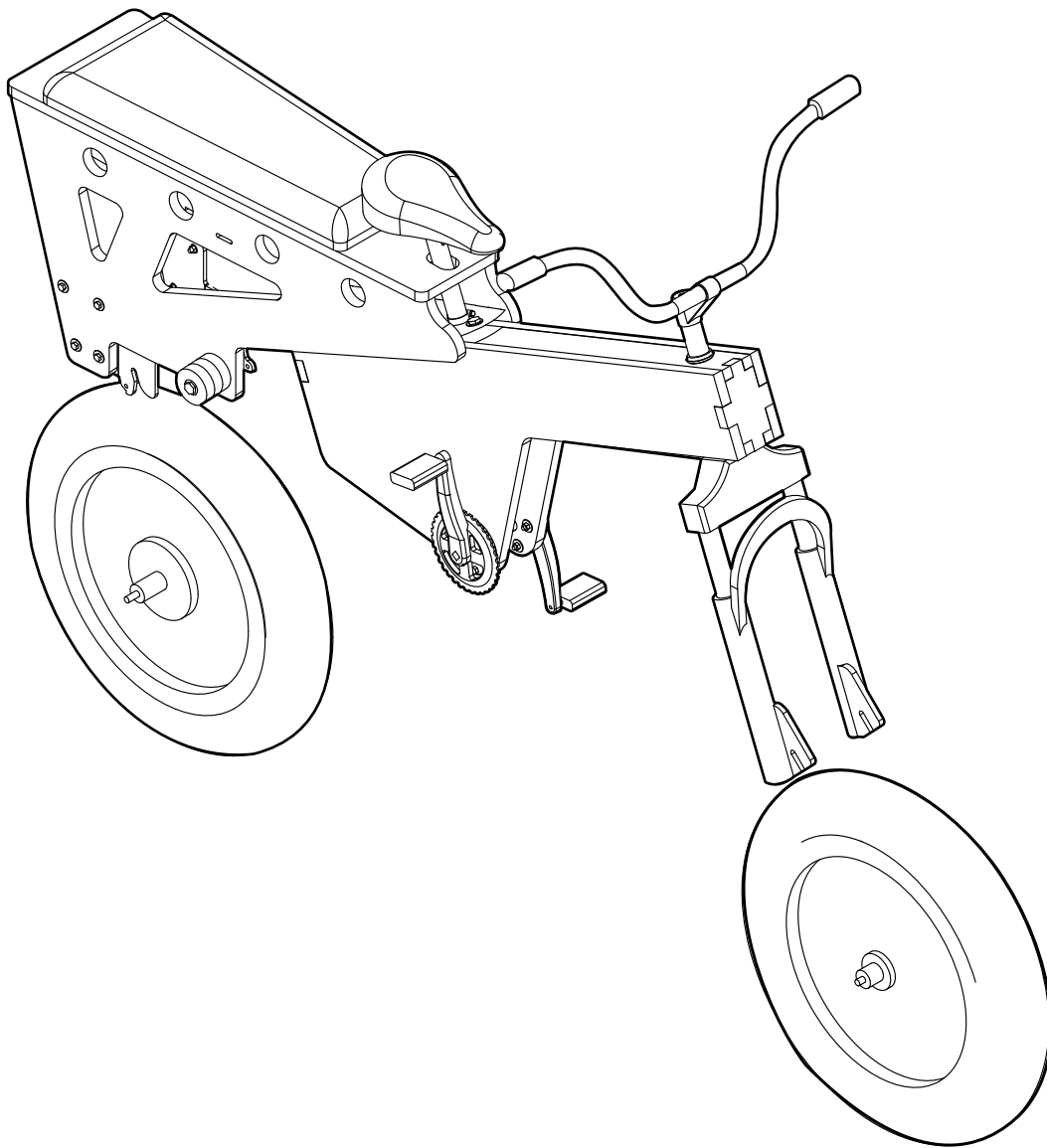


Seat panel with nylon webbing and snap lock plastic buckles.



Turn the assembly over, fold the fabric along the edge, and staple it to the bottom of the seat panel.

# Wheels, Brakes, Gears, Grips, and Electrics



Now it is time to add wheels, brakes, gears, grips, and electrics. However, these activities are beyond the scope of this manual. If you don't already know how to install these components, there are many books, YouTube videos, and forums that explain these processes far better than I can. But if you have made it this far, the rest is simple.

Finally, if you build one of these, please let me know—send me photos, comments, and ideas for improvements. Likewise, if you run into difficulties, please get in touch.

Aaron Moore

April 2026

[aaron@cnccraft.co.uk](mailto:aaron@cnccraft.co.uk)

***Let's make it local***

# Bill of Materials

**1 Sheet 18mm Marine plywood.** All parts are cut on a CNC Router. Use the file '18mmNested.dxf'.

- 1pc. Front frame top
- 1pc. Front frame bottom
- 1pc. Front frame left side
- 1pc. Front frame right side
- 1pc. Front frame front panel
- 1pc. Front frame back panel
- 1pc. Rear frame top
- 1pc. Rear frame bottom
- 1pc. Rear frame left side
- 1pc. Rear frame right side
- 4pcs. Seat and pannier panel disks

**1 Sheet 12mm Marine plywood.** All parts cut on a CNC Router. Use the file '12mmNested.dxf'.

- 1pc. Pannier panel
- 1pc. Seat panel
- 1pc. Battery panel

## **12mm Aluminium plate**

1pc. 100mm x 100mm - Bottom bracket plate, Milled or turned from the file 'BottomBracketPlate.dxf'.

## **6mm Aluminium plate**

1pc. 420mm x 220mm - Gear side dropout, Break side dropout. Laser cut or milled from the file 'DropoutsNested.dxf'

## **Stainless steel tube**

- 1pc. 28.8mm dia x 1.5mm wall x 340mm long - Seat stay
- 1pc. 31mm dia. x 1.5mm wall x 50mm long - Steerer tube sleeve.

**Mild steel bike tubing** (sourced from specialist bike frame building company)

1pc. 37mm dia. x 1.5mm wall x 140mm long - Head stock tube

## **Stainless steel rod**

1pc, 6mm dia. x 220mm - Locator rod



# Bill of Materials

**1 Sheet 18mm Marine plywood.** All parts are cut on a CNC Router. Use the file '18mmNested.dxf'.

- 1pc. Front frame top
- 1pc. Front frame bottom
- 1pc. Front frame left side
- 1pc. Front frame right side
- 1pc. Front frame front panel
- 1pc. Front frame back panel
- 1pc. Rear frame top
- 1pc. Rear frame bottom
- 1pc. Rear frame left side
- 1pc. Rear frame right side
- 4pcs. Seat and pannier panel disks

**1 Sheet 12mm Marine plywood.** All parts cut on a CNC Router. Use the file '12mmNested.dxf'.

- 1pc. Pannier panel
- 1pc. Seat panel
- 1pc. Battery panel

## **12mm Aluminium plate**

1pc. 100mm x 100mm - Bottom bracket plate, Milled or turned from the file 'BottomBracketPlate.dxf'.

## **6mm Aluminium plate**

1pc. 420mm x 220mm - Gear side dropout, Break side dropout. Laser cut or milled from the file 'DropoutsNested.dxf'

## **Stainless steel tube**

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## **Mild steel bike tubing** (sourced from specialist bike frame building company)

1pc. 37mm dia. x 1.5mm wall x 140mm long - Head stock tube

## **Stainless steel rod**

1pc, 6mm dia. x 220mm - Locator rod

## Bill of Materials (cont.)

### **Stainless Steel nuts, bolts and washers**

3pcs. M10 x 180 bolts and nuts + 6 penny washers - Front and rear frames  
2pcs. M10 x 80 nuts bolts + 4 penny washers - Passenger pedals  
8pcs. M6 x 35 nuts bolts + 8 penny washers - Rear dropouts  
8pcs. M6 x 45 nuts bolts + 8 penny washers - Bottom bracket plates  
2pcs. 30mm jubilee clips - Seat stay

### **Bicycle components**

Seat and seat post 24.6mm dia.  
Seat clamp 24.6mm dia.  
Threadless headset 1. 1/8" dia.  
Fat bike threadless bottom bracket, suggested product BUCKLOS Bike Crank -  
- Bottom Bracket BB120-174  
Fat bike front forks: suggested product BUCKLOS 20 x 4.0" MTB Air  
- Suspension Forks 140mm Travel  
Fat bike 20 x 4" front wheel, tyre, and inner tube  
Pedals  
Fat bike 20 x 4" rear wheel with 36 volt hub motor with compatible controller,  
- display, brake set with sensor, and speed sensor, suggested make  
36 volt battery, suggested product Comfto model no,R005  
Handle bars, suggested product BUCKLOS 720 x 120 MTB Riser Bars  
Handle bar stem  
Mechanical disk brakes and rotors  
7 Speed Derailier  
7 Speed cassette  
7 Speed shifter

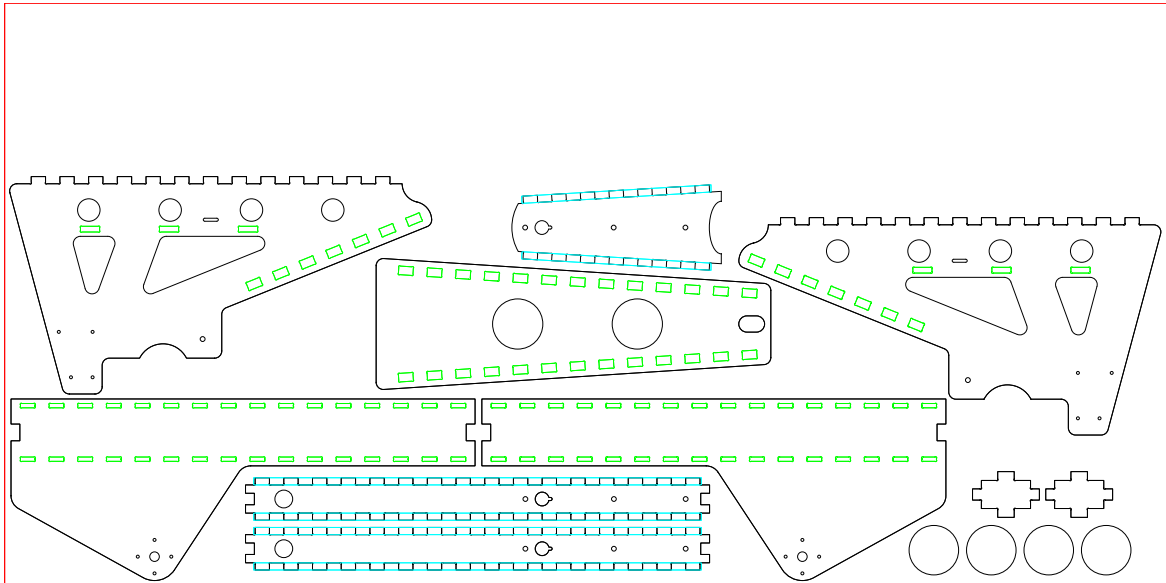
### **Miscelanious parts**

1pc. 1M x 25mm nylon webbing  
4pcs, snap lock plastic buckles  
2pcs. 50mm long cotter pins

### **Tools and equipment required**

Access to a large format CNC router  
Large metal work vice  
Metal work files  
Hack saw  
Drill press and assorted drills  
At least 6 large G clamps and or sash clamps  
Wood work jack plane or block plane  
Wood work chisels  
Orbital sander and sand paper

# Images of Cutting Files (not to scale)



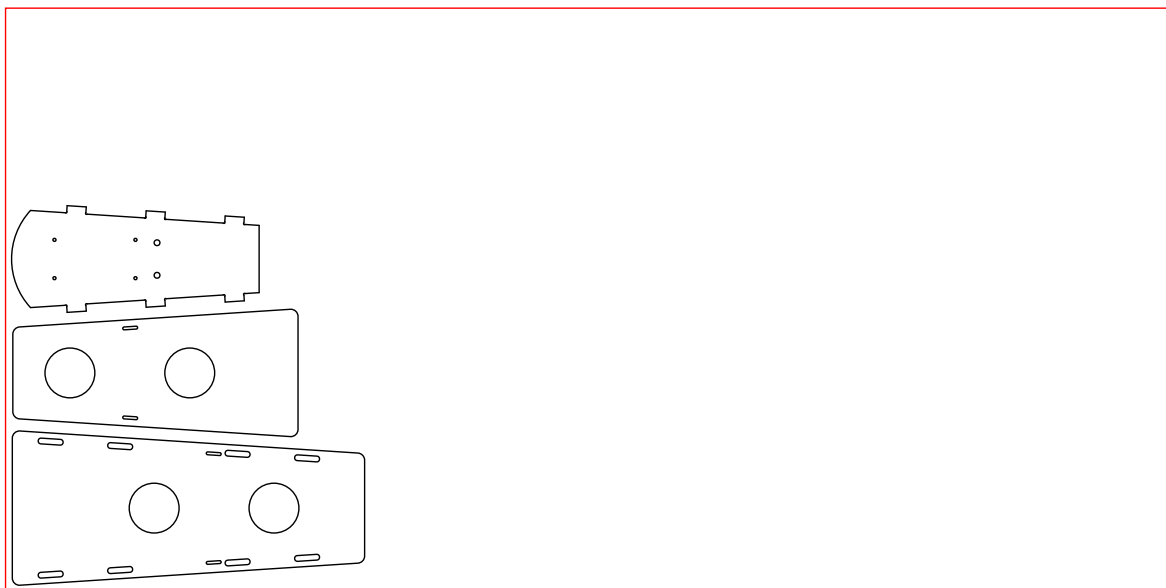
18mm marine plywood Components.

Use file '18mmNested.dxf'

Notes

- Use a 4mm x 18mm Router cutter
- Make sure the board is flat on the bed.
- Use tabs to protect the parts and the cutter

Black - cut through.  
Green - 15.5mm pocket  
Blue - 9mm pocket  
Red - plate



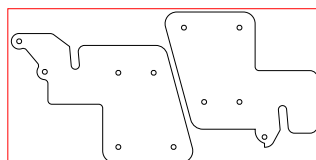
12mm marine plywood components.

Use file '12mmNested.dxf'

Notes

- Use a 4mm x 18mm Router cutter
- Use tabs to protect the parts and the cutter

Black - cut through.  
Red -plate

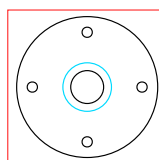


**Rear Dropout Plates**

Use file 'DropoutsNested.dxf'

Notes

- Use 6mm thick aluminium plate.
- Can be milled on CNC router or cut with a laser cutter.



**Bottom Bracket Plate**

Use file 'BottomBracketPlate.dxf'

Notes

- Use 12mm thick aluminium plate.
- Can be milled on CNC router or turned on a lathe.
- The central recess in blue is 10mm deep..

# Images



Battery compartment



Speed sensor



Rear dropouts



Pillion rider