DTU

Animal Cart Programme

TECHNICAL
25
RELEASE

LIGHT STEEL AND WOOD DONKEY CART

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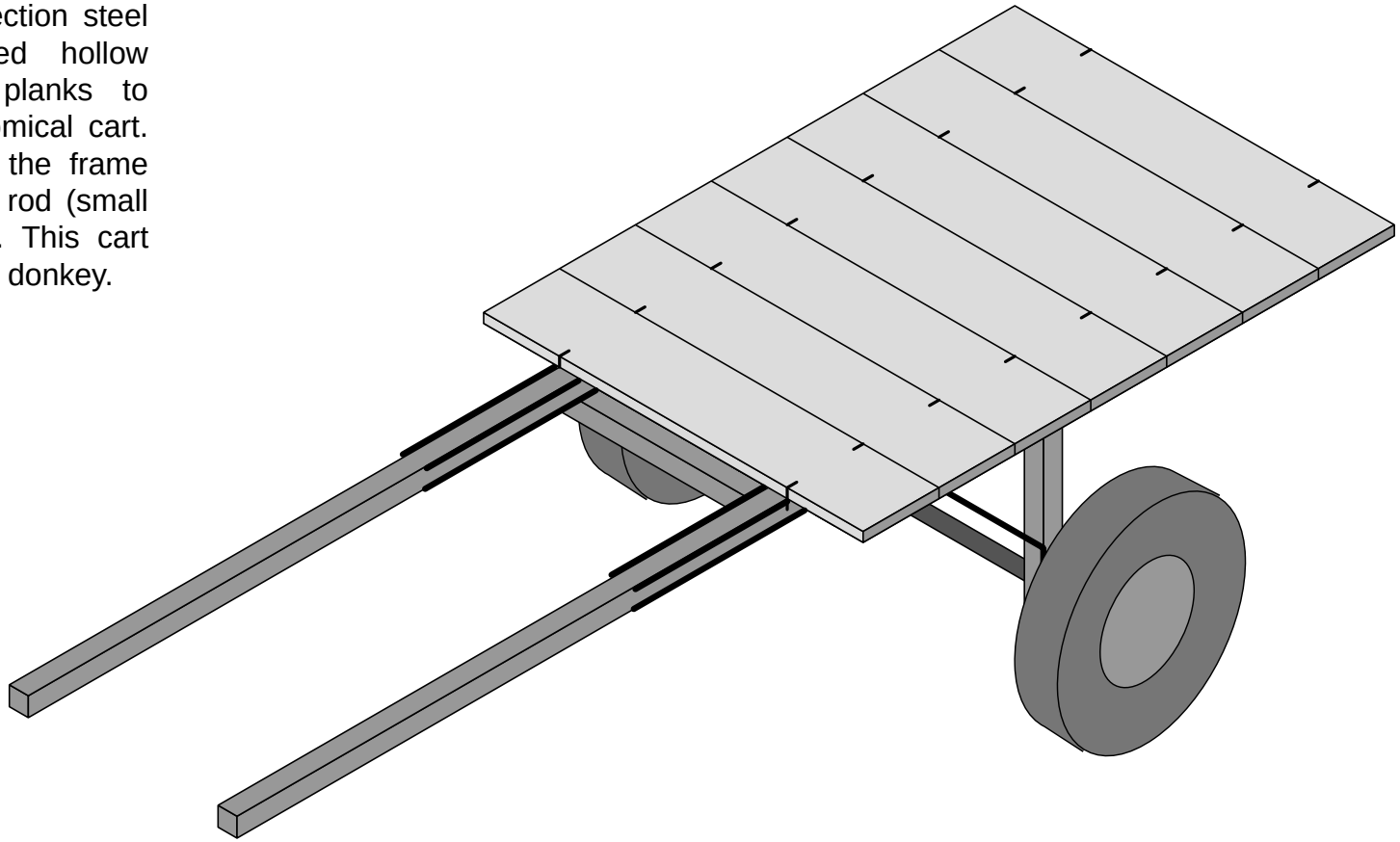
Figure 1: donkey cart made from square box tubing and wooden planking.

This cart uses square section steel box tubing (RHS rolled hollow section) plus wooden planks to make a quick and economical cart. The planks are fixed to the frame with 6mm diameter steel rod (small concrete reinforcing bar). This cart has two shafts for a single donkey.



TECHNICAL RELEASE 25

Lightweight Donkey Cart Body Made From Square Box Tubing and Timber Planks

Introduction

Not enough farmers in developing countries have animal carts. Those who have carts can take their produce to places where they can get good prices. They can also get into town and buy fertilizer and better seeds and move things around their farm easier. The trouble is that carts are too expensive for many farmers. What can be done?

Carts are made in many different places. Some carts are made in factories in industrial countries and some are made in African factories, but most are made by local blacksmiths or carpenters using scrap car and Land-Rover axles. These people cannot get enough axles to meet the demand, so the price is high. Even if they did have the axle, they still end up building heavy bodies that take ages to make. In another booklet in this series we have told you how you can make simple low-cost axles; in this booklet we tell you about a simple steel and timber body. You should be able to make the body for about $\$_{US}$ 30 depending on the cost of the materials and labour. Once you get organised, two men can probably make two bodies per day.

What you need is a cart body which carpenters and fabricators can make with their simple tools. These people will probably be in the small market towns used by the farmers and they will have an electric welder and some basic handtools like a hacksaw. Experts think that having the cart maker close to the farmer is a good thing because they can talk to each other easily and sort out any problems. Also if the cart is made locally, it can be repaired locally, so there should not be any problems with spare parts.

Idea Behind Design

The idea behind the design of donkey cart described in this technical release is to allow construction without lots of special tools and jigs, and without any hard-to-get materials. The only tools which you must have are a welder and a hacksaw. You might also find that a couple of 4" or a 5" G clamps (or something like it) are useful too. (The symbol " means inches here, so that 4" is about 100mm since there are about 25mm in an inch.) A wheelbrace or carpenters brace is also useful - you can make the drill bit yourself.

You will see that there are no mitres and unusual angles to cut in the square tubing so you save time when making the cart. Also the exact lengths of the components are not very fussy. But you will find that the carts look better if you take trouble to get things square and straight.

These carts have been tested in Nigeria, but we would like to

test them more. The only problems which we have found so far have been breaking of the animal shafts and we have fixed this by welding some strengtheners (bits of 8mm, 10mm or 12mm round bar or re-bar) to the top and bottom of the chassis. (Re-bar means concrete reinforcing bar). The construction tends to be a bit light in Nigeria, because they sell square tubing with very thin walls (much less than 1mm thickness). If you used tubing with a wall thickness of 2.5mm or more you probably would not need to put these strengtheners on. But really to get a cart at a reasonable cost you need to experiment a bit to see how the farmers treat their carts and what they expect them to stand. It's no good saying it must be strong enough so that they cannot ever break it - somebody will always break anything - and it will be very expensive to make it nearly unbreakable. At least with this design you can repair it easily and cheaply.

Cutting list and costs

Table 1 shows a cutting list for a complete cart. Recent prices of materials in Nigeria are shown converted to $\$_{US}$. The square box tube (sometimes called rolled hollow section or RHS) is about 2" or 50mm on one side. You can often buy it in a variety of wall thicknesses. It's best with a wall thickness of 2.5mm (12 gauge) or more, but we have used wall thicknesses down to 1.6mm (16 gauge) as we mentioned earlier.

Construction step by step

1) The first job, is to get all the material together and clear a space to work. Ideally you will be able to work on a flat area of concrete. Start by cutting the square box tube into the right lengths, as in the cutting list shown in Table 1. Then cut the various bits of re-bar or whatever you are going to use. You could cut the timber also at this stage, but it might be easiest to leave it till last.

TABLE 1: cutting list for light steel framed donkey cart.

component	material	# lengths & length reqd	total material in cart	materials cost in Nigeria
[#*mm]				
animal shafts	50×50 RHS	2×3150	6300	8.94
body cross pieces	50×50 RHS	3×700	2100	2.98
axle struts	50×50 RHS	2×600	2400	3.40
shaft strengtheners	8mm to 12mm round bar[1]	8×600	4800	1.02
axle strut braces	8mm to 12mm round bar	3×850	2550	0.54
axle fixing studs	M12 threaded rod or bolts	2×125	250	0.85
axle fixing loops	6mm dia re-bar or similar	2×330	660	0.07
plank fixing studs	6mm dia re-bar or similar	14×75	1050	0.11
tray planks	1"×12" or similar timber	6×1100	6600	3.90
TOTAL =				21.82

[1] The round bar can be anything actually - it doesn't even have to be round, so deformed or high-yield re-bar is fine. You could even use flat strip as long as its more than say 8mm thick.

2) Next weld the axle supports to the animal shafts. The method shown in Figure 2 is probably the easiest way to support the components during welding the first shaft and support. It's quick and if you do not tighten the clamps too

tight to start with, you can tap the parts with a hammer until everything is square and straight. Then tighten the clamps before you weld.

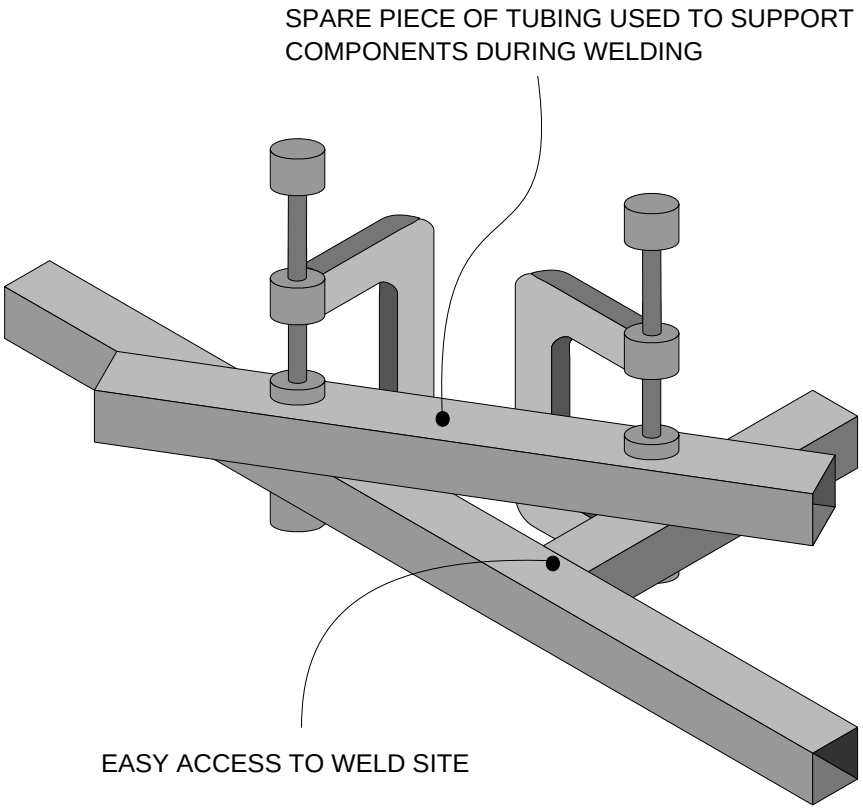


Figure 2: supporting components during welding.

Repeat the process using the first shaft and support as a pattern for the second as shown in Figure 3. Make sure you do not weld the two assemblies together!

3) It may be easiest to fix the axle retaining bolts and loops on at this stage so that you can use them in the next stage. Figure 4 shows a good way to fix a square axle on.

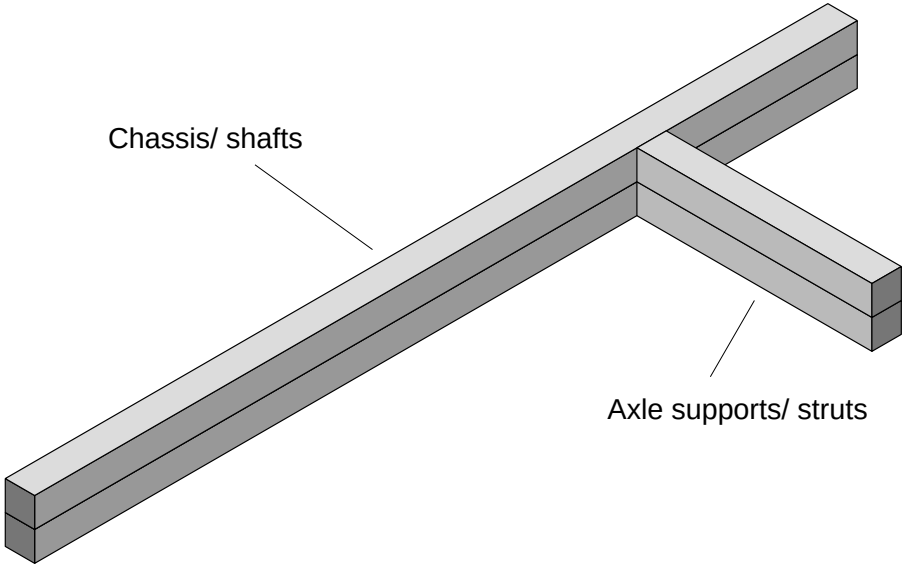


Figure 3: welding animal shaft and axle support strut assemblies.

4) Now you can weld the three cross pieces under the animal shafts after you have checked for squareness etc.

5) Next you need to weld on the various reinforcements to the square tube. These are the axle braces and the pieces where the shafts might get broken - over the axle supports and at the front of the load tray/ wooden planking. Figure 5

shows the frame nearly ready for fixing the planking.

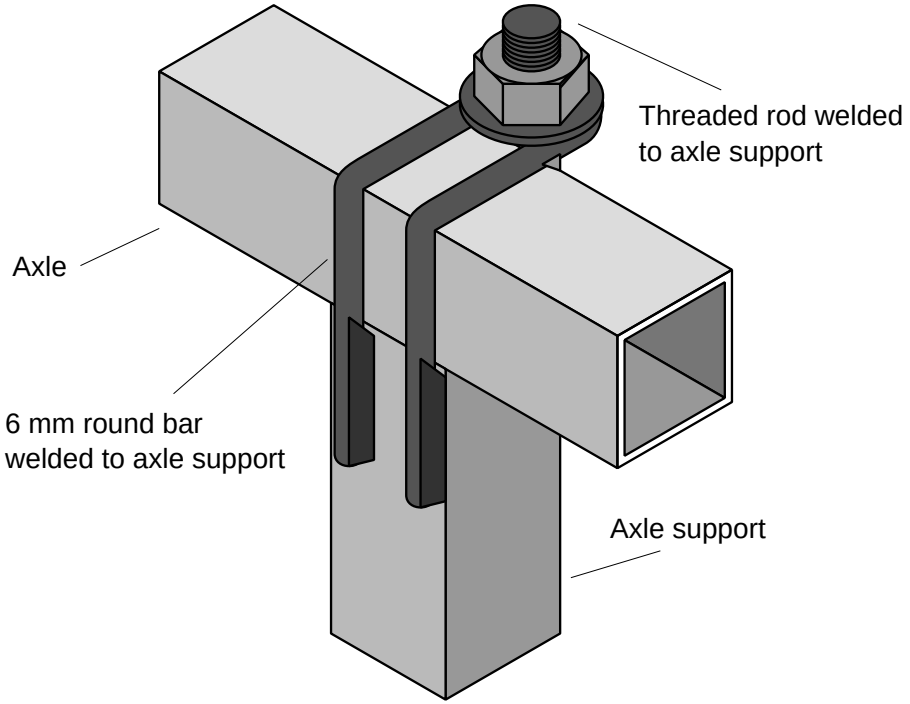


Figure 4: method of fixing axle to axle supports.

6) Nearly there! Now you need to fix the wood onto the square tube. You can do this with staples or studs. Staples use more steel but studs need more welding. Figure 6 shows the choices - staples are like big U s, and studs are just pieces of 6 mm wire sticking up which you bend over the wood.

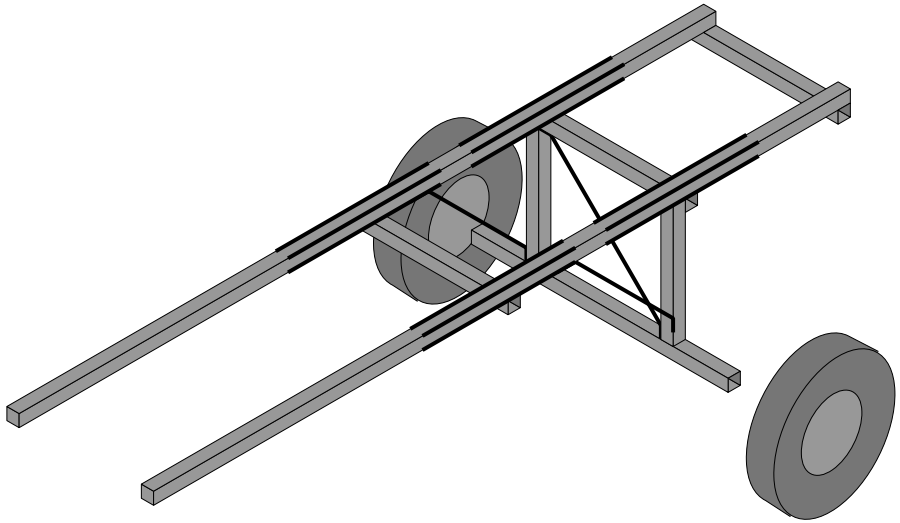


Figure 5: cart frame before planking.

To make staples you can make a jig from some bolts in a piece of wood or you can just bend the staples in a vice. They do not have to be very accurate, but as usual the more accurate the better.

To fit the staples, drill a hole in the plank both sides of the tubing and push both legs of the U through the wood using a hammer if necessary. When it's through, hold another hammer or something heavy against the bottom of the U whilst you knock the protruding legs over with another hammer. You might find this easier with someone to help you. Then clench the legs by knocking them into the surface of the wood to leave the surface flush. Once you

are happy that all is in the right place, weld the staple to the square tubing as shown in Figure 6. Then put the rest of the staples in in the same way.

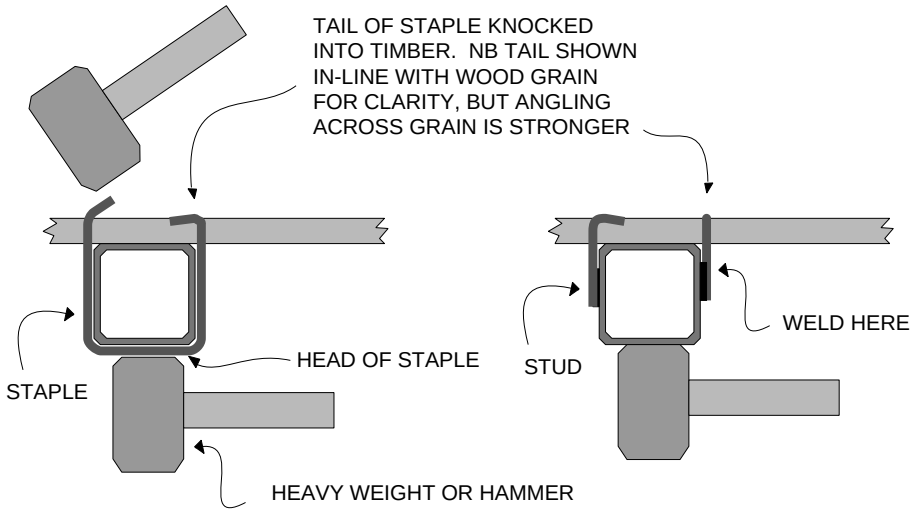


Figure 6: fixing wood with staples or studs.

If you want to use studs, weld them on to the side of the square tube as shown in Figure 6. You can either drill holes for them as described earlier for staples, or you can bring them up past the edge of the planks, which saves drilling holes.

7) Paint the cart. You've finished it!

Modifications

There are many different versions of this cart. The one shown in this document has no sides, because it is for one donkey and is as light as possible. It is good for everything except loose materials such as sand, but you can always put this into sacks. To fix ropes for tying firewood or sorghum stoba etc, you can cut slots or notches in the ends of the planks as shown in Figure 7, which shows two ways of doing it.

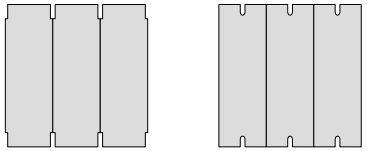


Figure 7: notched ends in planks to tie rope to.

You could put side planks on a cart like this using the same 6mm wire/ round bar/ re-bar to tie them on. This would be cheap and very easily repairable.

A danger with building carts is that the farmers will want something flashy looking which will be very expensive to make. You would probably find that things like hinges and latches take as much time to make as the basic parts of the cart.

If you want a cart with permanent sides you could build our medium weight donkey cart.

You can try longer and shorter carts and you can make them

wider or narrower. When you do this, check the length and width of the planks of wood that you will use - you do not want to find that you are two inches short of being able to get two runs of plank out of one piece of timber, or that its just too narrow and you have to fiddle about and waste time filling the gap with an extra little strip.

Another thing is the height of the cart. No-one seems to know why some carts are made high and others low. Its better for the animals if the load tray is low particularly if the carts will be operated over rough ground. But you may find that farmers want a high load tray to keep loads dry if they are fording rivers a lot, or it may be a status thing (if you are wealthy enough to own a cart, your eye level must be above a pedestrian's). Or it may be that it's too tiring to load a low cart - if, for example, you have to bend your back twice for each bundle - once to pick it up off the ground and again to put it down onto a low load tray. We have also found that farmers usually want the body to come out over the wheels so they can load on lots of straw or light materials.

Other DTU cart developments

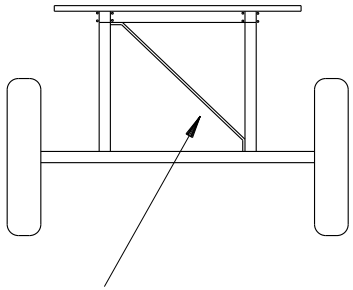
The DTU has been working on a range of cart body types for use with both donkeys and oxen. It has designs for both wooden and steel framed types. The wooden types are cheaper in material terms, but the steel framed ones are easier to make because the joints are more straightforward - but you can make either type of cart in only a few hours, if you have all the tools and materials you need before you start.

The DTU has also been working on new designs of wheels, hubs and bearings to bring down their costs and make things more locally manufacturable. For example it has worked on a system of hubs using water pipe which do not need machining to make a roller bearing hub. Friction is low with these hubs and they usually give good milage before being worn out too - we usually get 15 000 km before they are very badly worn, but they may need cleaning and relubrication several times before they get this far. But they are reasonably cheap - we can make them in Nigeria for about $\$_{US}20$. They only take one man a day to make and they do not need any special tools.

Other hub designs using, for example aluminium castings, are in production in Nigeria and we are trying to reduce or eliminate the machining in these. Also wheel designs in steel sheet, cast aluminium and timber are in manufacture or under development.

Cart Drawings

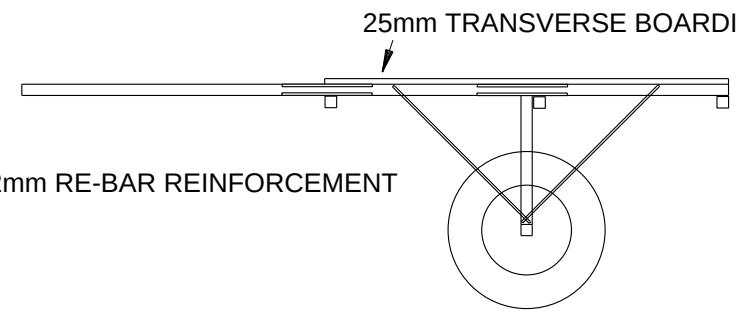
The drawing for the cart is shown on the following page and the list of materials has been shown on a previous page.

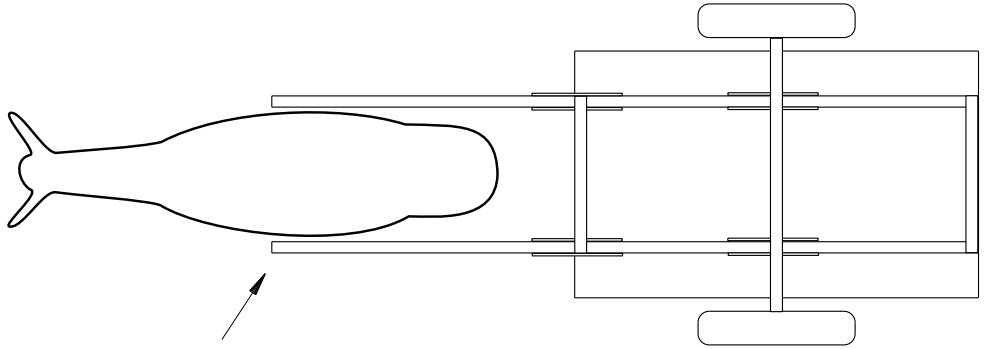


10mm OR 12mm RE-BAR DIAGONAL BRACING

25mm TRANSVERSE BOARDING

10mm OR 12mm RE-BAR REINFORCEMENT





NB LOCAL HARNESSING SYSTEMS MAY NEED LONGER SHAFTS
IF SO MAKE SHAFTS 4M LONG

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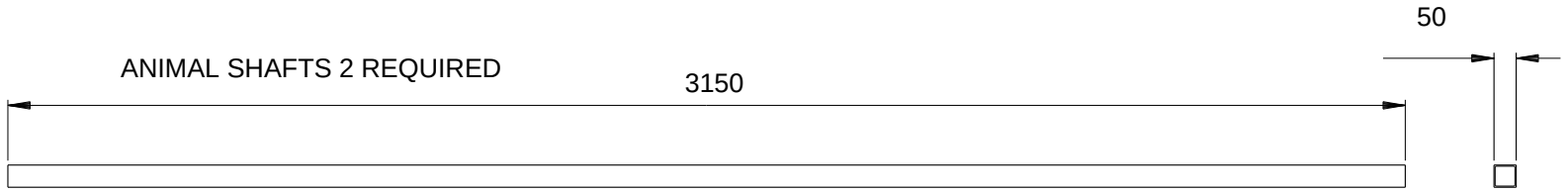
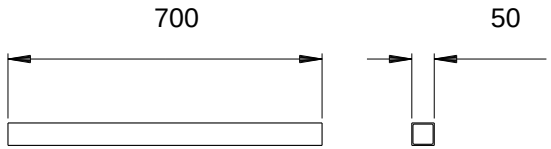
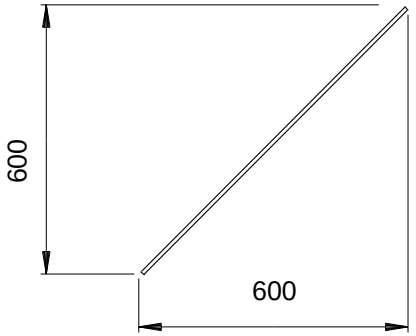
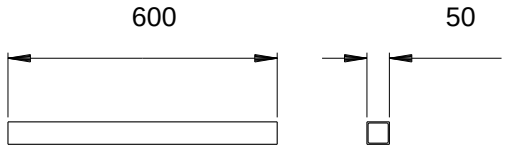




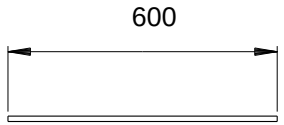
CHASSIS CROSS PIECES 3 REQUIRED



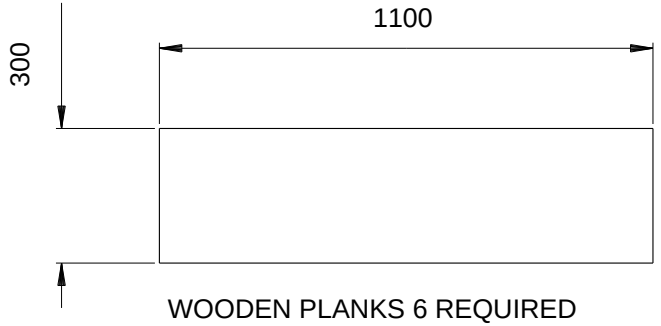
AXLE BRACE
12 mm DIA.
BAR
5 REQUIRED



AXLE STRUTS 2 REQUIRED



CHASSIS STRENGTHENERS
12 mm DIA BAR 8 REQUIRED



WOODEN PLANKS 6 REQUIRED

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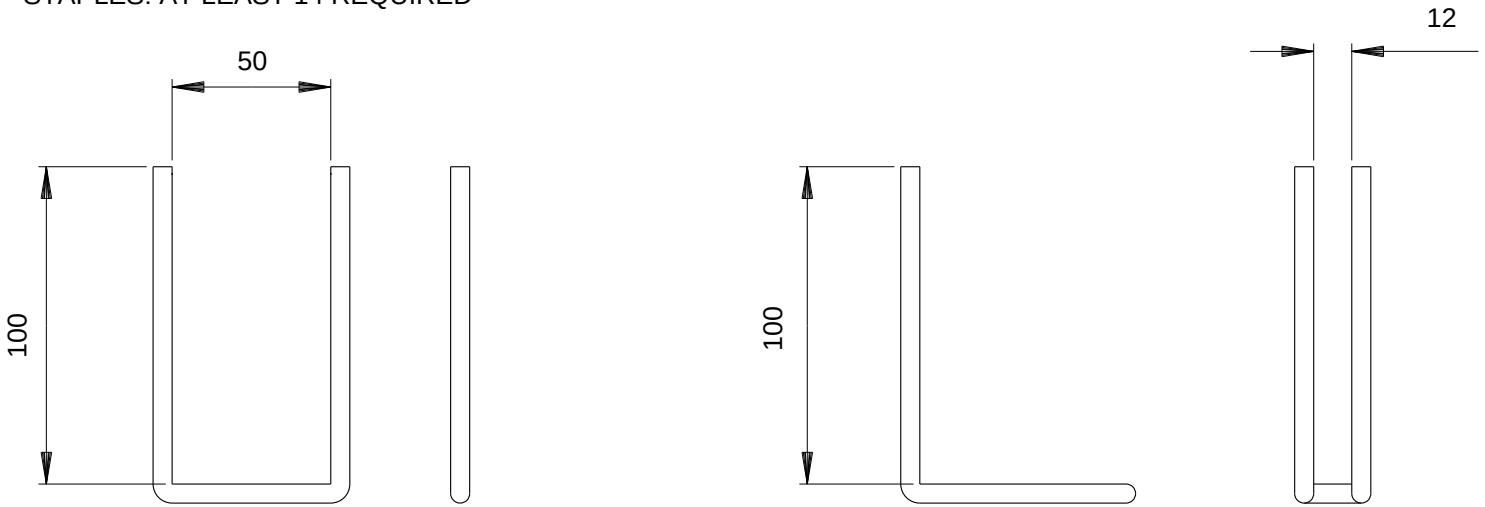
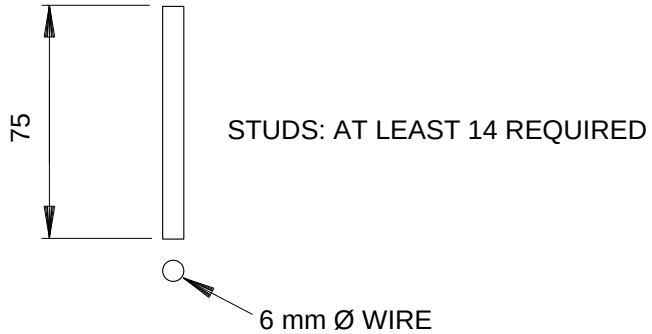
					Date	13-7-93		Dwg No.	2/3

STAPLES: AT LEAST 14 REQUIRED

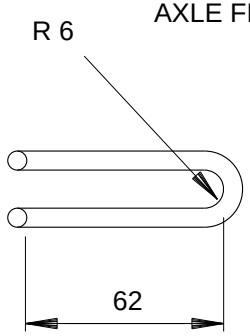


NB STUDS AND STAPLES ARE ALTERNATIVES



STUDS: AT LEAST 14 REQUIRED

AXLE FIXINGS: 2 REQUIRED



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