



# Animal Cart Programme

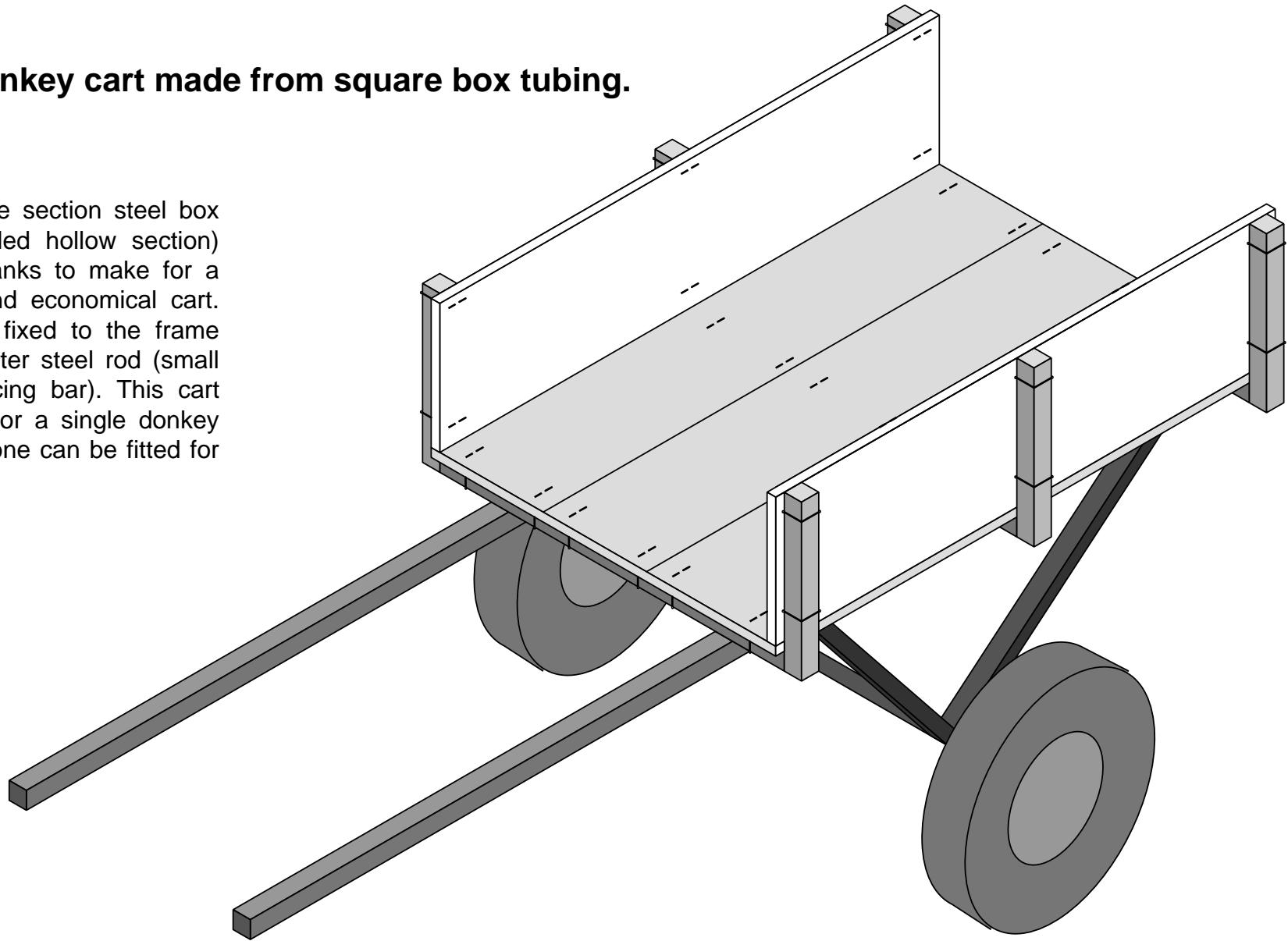
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TECHNICAL  
**23**  
RELEASE

## STEEL FRAME AND WOOD DONKEY CART

**Figure 1: donkey cart made from square box tubing.**

Cart uses square section steel box tubing (RHS rolled hollow section) plus wooden planks to make for a quickly made 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 but one central one can be fitted for two animals.



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

## Introduction

Not enough farmers in Africa have animal carts. Those who have carts can take their produce to places where they can get the best prices. They can also get into town and buy fertilizer and better seeds and move stuff around their farm easier. The trouble is that carts are too expensive for many farmers. The question is 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 find that you can make the body for about \$<sub>US</sub> 35 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 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. And of course 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, a hacksaw, and a drill able to make a 6mm hole in wood. In fact you can make the drill yourself. You might 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.)

You will see that there are no mitres and funny 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 - again it saves a little time. But you will find that the carts look better if you take trouble to get things square and even etc.

These carts have been tested a bit in Nigeria, but we have not tested them enough. The only problems which we have found so far have been breaking of the animal shafts and we have cured this by welding some strengtheners (bits of 8mm, 10mm or 12mm round bar or re-bar) to the top and bottom of these shafts. (Re-bar means concrete reinforcing bar). The

construction tends to be a bit light in Nigeria, because they sell very thin wall square tubing (much less than 1mm thickness) there. If you used tubing with a wall thickness of 2.5mm or more you probably would not need to put these strengtheners on. 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 like this 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 \$<sub>US</sub>. The square box tube (sometimes called rolled hollow section or RHS) is nominally 2" or 50mm on one side. You can often buy it in a variety of wall thicknesses. It's best with a 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 above. 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.

2) Next weld the three U-shaped frames together. You might find the method shown in Figure 2 the easiest way to support the components during welding. It's quick and if you do not tighten the clamps too tight to start with, you can tap the bits with a hammer until everything is square and

component	material	number of lengths and length required [no.xmm]	total material in cart [mm]	materials' cost in Nigeria [\$us]
animal shafts	50x50 RHS	2x3150	6300	8.94
body frame bottoms	50x50 RHS	3x1100	3300	4.68
body frame sides	50x50 RHS	6x300	1800	2.55
axle struts	50x50 RHS	4x600	2400	3.40
shaft strengtheners	8mm to 12mm round bar <sup>1</sup>	8x600	4800	1.02
axle strut braces	8mm to 12mm round bar	2x850	1700	0.36
axle fixing studs	M12 threaded rod or bolts	2x100	200	0.64
axle fixing loops	6mm dia re-bar or similar	2x200	400	0.04
plank fixing staples	6mm dia re-bar or similar	30x250	7500	0.80
tray bottom planks	1"x12" or similar timber	4x1800	7200	4.26
tray side planks	1"x12" or similar timber	2x1800	3600	2.13
tray ends	1"x12" or similar timber	2x1100	2200	1.30
TOTAL->				30.12

<sup>1</sup> 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.

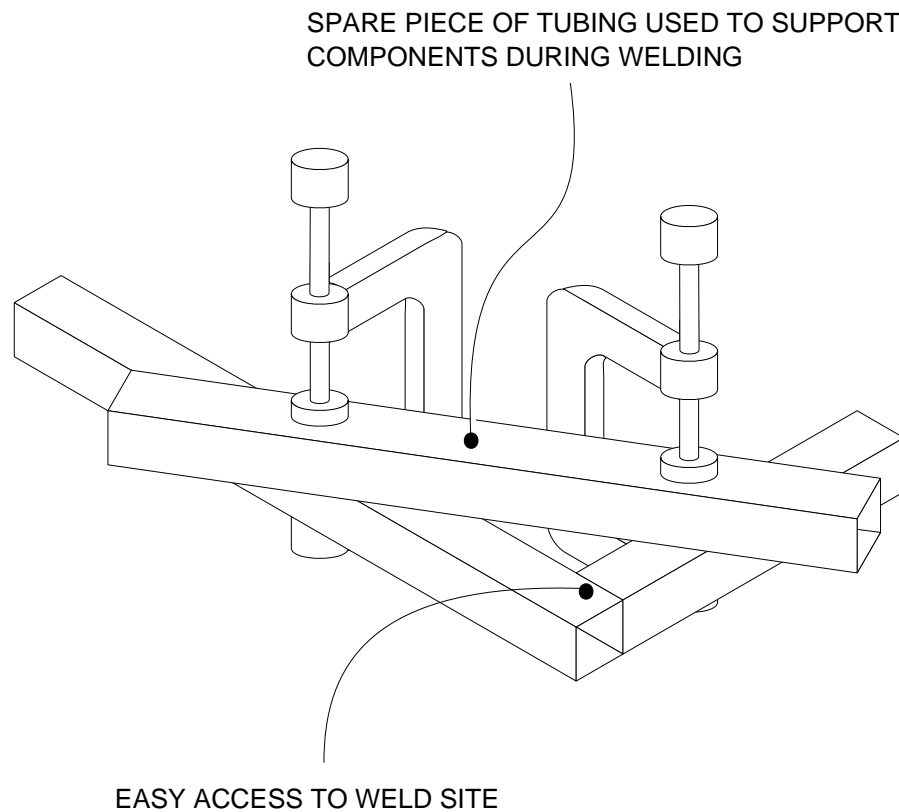


Figure 2: supporting components during welding.

straight. Then tighten the clamps before you weld.

- 3) Then take two axle support strut pieces and weld them together to make an L shape. When you do this you need to weld only two edges together to leave a space for the axle as Figure 3 shows. You can then weld this L piece to

an animal shaft.

Repeat the process using the first sub assembly as a pattern for the second, but remember that the second assembly must be a mirror image of the second. In other words you will need to put the first assembly upside down on the ground and assemble the second one on top of it, as shown in Figure 4. make sure you do not weld the two assemblies together!

- 4) 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.
- 5) Now you can weld the three U-frames on top of the animal shafts after you have checked for squareness etc.
- 6) Nearly there! Now you need to bend the staples to hold the wood onto the square tube. You could make up a jig for this with some bolts in a piece of wood or you can just bend them in a vice. They do not have to be very accurate, but as usual the more accurate the better. To fit them, drill a hole 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 a hammer 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

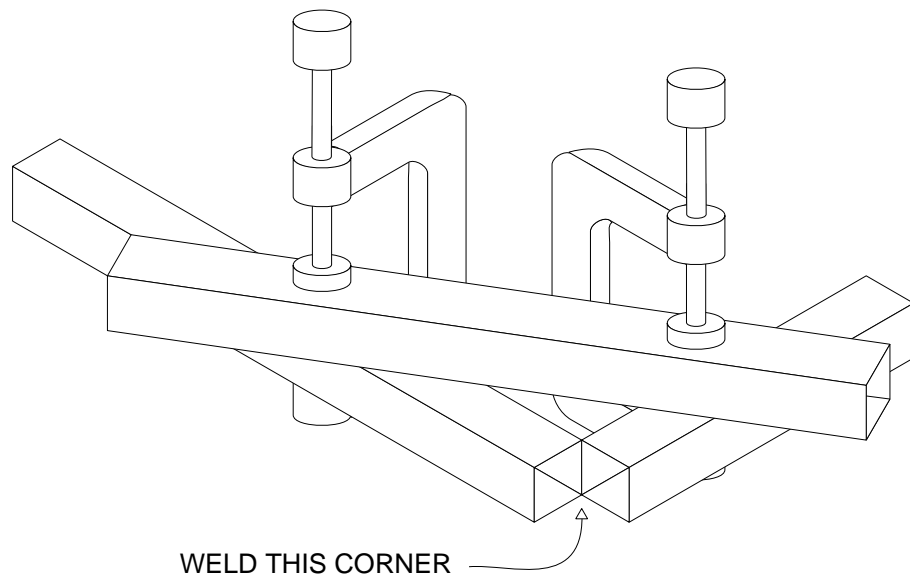


Figure 3: welding axle supports.

all is in the right place, weld the staple to the square tubing with a couple of substantial tack welds, as shown in Figure 5. Then put the rest of the staples in in the same way.

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

## Modifications

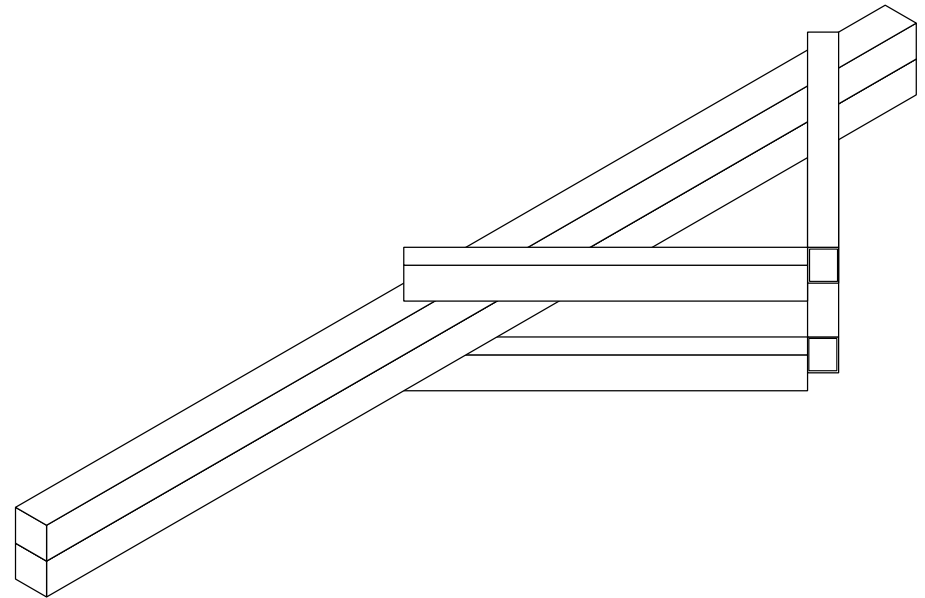


Figure 4: welding animal shaft and axle support struts assemblies.

There are many different versions of this cart. This one has sides, for example, but you could make these removable by not using staples to fix the sides. A good way to fix the side planks might be to leave the steel uprights in place and tie the planks to the inside of these with bits of truck inner tube as giant bungees or elastic bands. This is an appropriate way because it is cheap and very easily repairable, but the farmers may want some flashy looking thing which will be very expensive to make. You will probably find that things like latches take as much time as the basic parts of the cart.

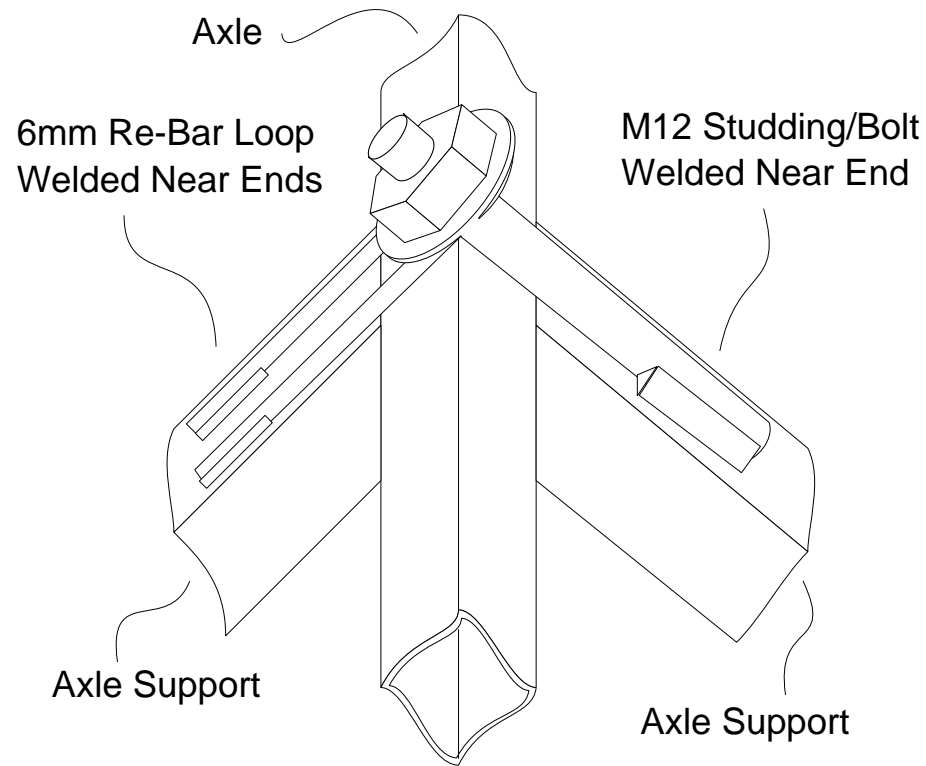


Figure 5: method of fixing axle to axle supports.

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

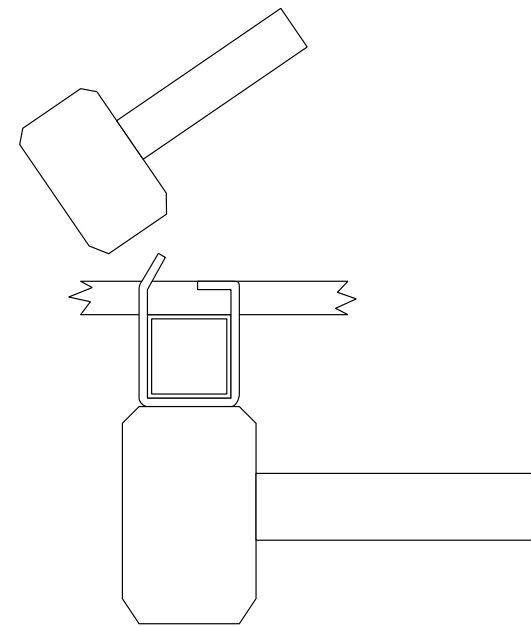


Figure 6: Using two hammers to clench wood fixing staple.

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 a lot 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 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 - nevertheless you can make either type of cart in only a few hours, if you are reasonably set up with tools and materials.

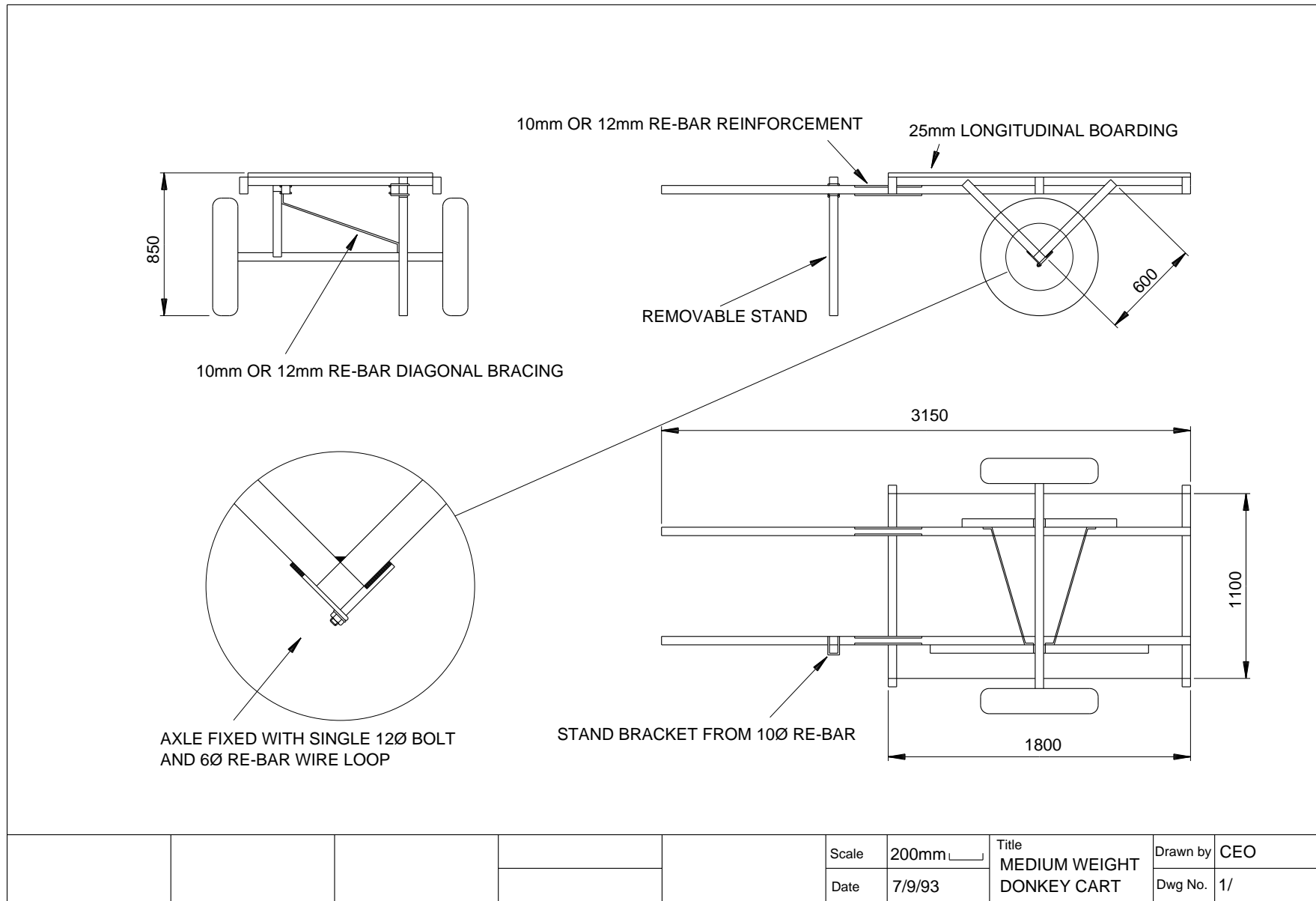
The DTU has also been working on new designs of wheels, hubs and bearings to bring down their costs and make things more locally manufacturable. For example it has pioneered a system of hubs using water pipe which do not need machining to make a roller bearing hub. Obviously friction is very low with 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. Still they are reasonably cheap - we can make them in Nigeria for about \$<sub>US</sub>20, they only take one man a day to make, and they do not need any special tools.

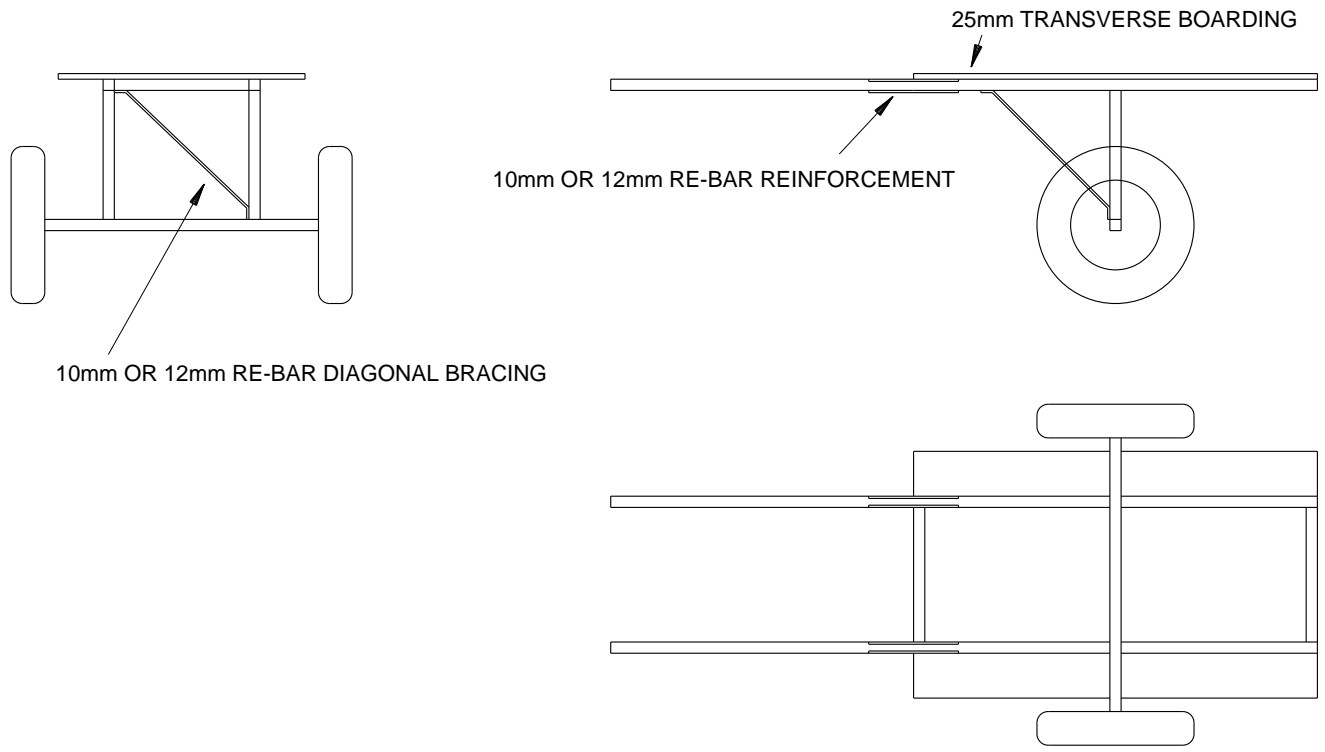
Other hub designs using, for example aluminium castings, are in production in Nigeria and we are trying to reduce or eliminate the machining in these. Also wheel designs in steel sheet, cast aluminium and timber are in manufacture or under development.

## Cart Drawings

Two drawings of carts are shown in the following pages. The first one is simple, but quite strong and easy to make, and is the one for which we have shown the list of materials. The second cart is lighter and even easier to make. You can use this cart with small donkeys.







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