DTU

Animal Cart Programme

TECHNICAL
26
RELEASE

LOW-COST STEEL & WOOD OX CART

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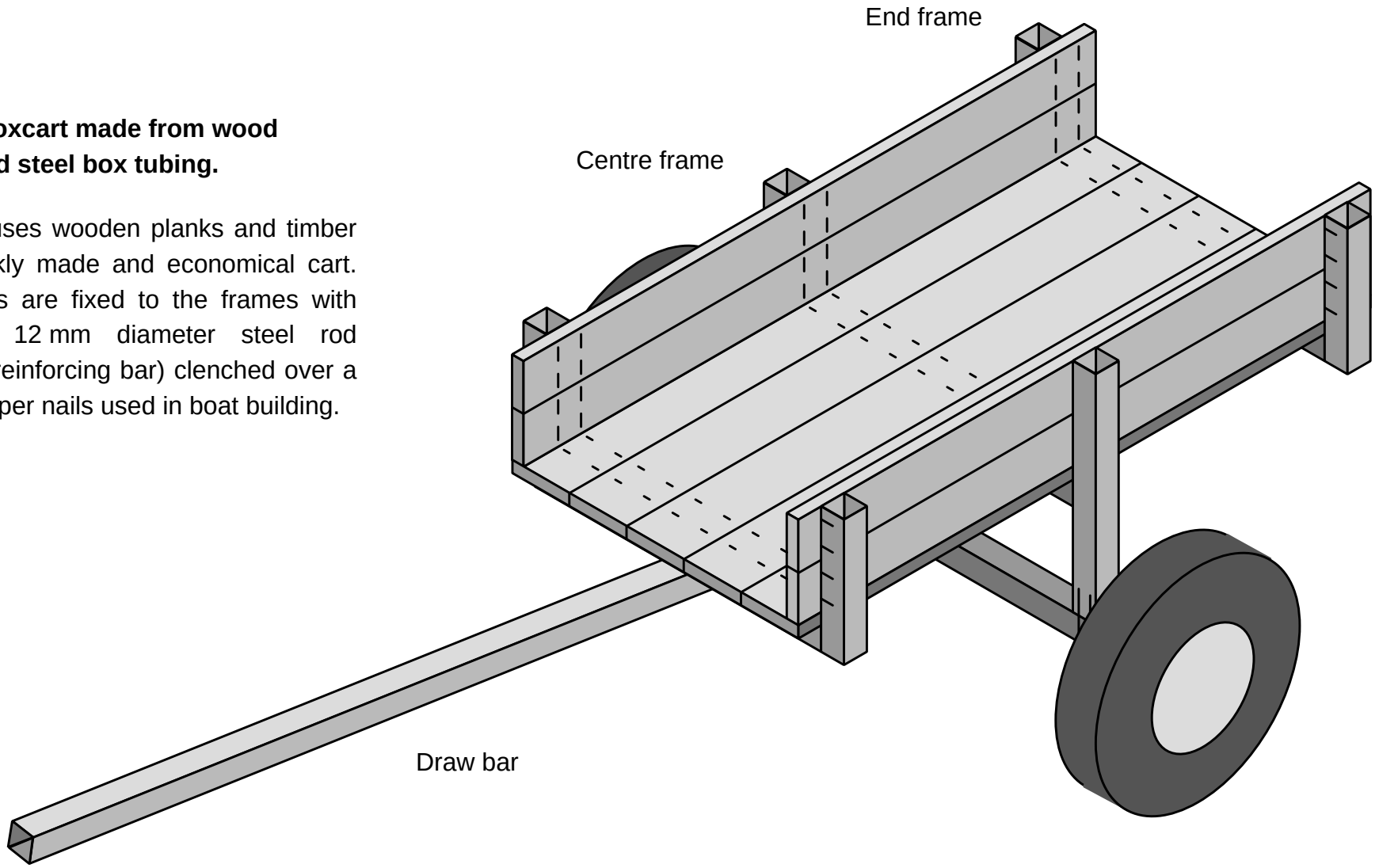
Figure 1: oxcart made from wood planks and steel box tubing.

This cart uses wooden planks and timber for a quickly made and economical cart. The planks are fixed to the frames with 6 mm to 12 mm diameter steel rod (concrete reinforcing bar) clenched over a bit like copper nails used in boat building.



Ox Cart Body Made From Steel Box Tubing and Timber

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 things around their farm easier. The trouble is that carts are too expensive for many farmers. The question is what can be done about it?

What you need is a body which fabricators and carpenters can make quickly with simple tools. These cart makers will probably be in the small market towns used by the farmers. 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.

Carts are made in many different places. Some carts are made in factories in industrial countries and some are made in factories in Africa, 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 carts are expensive. Even if they do have the axles, 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 $\$_{US}60$, depending on the cost of the materials and labour. Once you get organised, two men can probably make one body in a day. This is quite a lot faster than most carts can be made and it follows from the simplifications which we have made to the design. We've designed these carts to be easy to make.

Idea Behind Design

The idea behind the design of oxcart 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 simple welder, a woodsaw, a hacksaw, a hammer and a drill able to make a 10 mm or 12 mm hole in wood. (In fact you can make the drillbit yourself if you have to - read our booklet **Making a flatbit** - it's not too difficult.) You might find that a couple of 4" or a 5" G clamps (or something like it) are useful too. (The symbol " means inches so 4" means about 100mm because there are about 25mm in an inch.)

The cart frames are fixed together by welding and the wooden planks are fixed to the frames with clenched steel bar. This is a bit like the way small boats used to be fixed together. It's called clenching. What you do is make a holes through the wood to be fixed, put a giant staple made from 6 mm, 8 mm or 10 mm diameter re-bar (concrete reinforcing bar) over the steel box tubing and through the wood so it sticks out about 50 mm, and then knock the ends over with a hammer so they lie on the surface of the wood. You can tighten the joint more by putting a big hammer or something hard and heavy under the staple as shown in Figure 5 and then hitting the ends harder. If you put some washers (or something like them made from sheet steel) on the re-bar before you bend it over it will make the joint a bit stronger still. It does not make a very rigid joint, but you will find that the flexibility gives the cart some resilience so that it takes knocks better.

You will see that there are no mitres or complicated angles or joints to cut so you save time when making the cart. Also the exact lengths of the components are not very critical - again it saves a little time, but you will find that the carts look better if you take a little trouble to get things square and even etc and welding is easier with good square ends.

These carts have been tested a bit in Nigeria, but we have not tested them enough. We think that they are strong enough, but we cannot be sure. Really to get a reasonable price you need to experiment a bit to see how the farmers treat their carts and what they expect their carts to stand. It's no good saying it must be strong enough so that they cannot ever break it - somebody will always break anything. It is very expensive to make something unbreakable. At least you can repair these carts 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 into $\$_{US}$.

TABLE 1: cutting list for steel and wood oxcart.

component	material	number of lengths & length required [No.×mm]	total material in cart [mm]	materials cost in Nigeria [$us]
animal draw bar	80×80 box tubing	1 × 3 600	3 600	12.77
frame bottoms	80×80 box tubing	3 × 1 000	3 000	10.64
end frame sides	80×80 box tubing	4 × 415	1 660	5.89
centre frame sides	80×80 box tubing	2 × 750	1 500	5.32
tray bottom planks	30 × 150 or similar timber	6 × 2 000	12 000	3.87
tray side planks	30 × 150 or similar timber	4 × 2 000	8 000	2.58
tray ends	30 × 150 or similar timber	2 × 1 000	4 000	1.29
plank fixing staples	8 mm dia re-bar or similar	60 × 400	24 000	2.55
axle fixing studs	M12 threaded rod or bolts	4 × 150	600	2.55
axle fixing loops	8 mm dia re-bar or similar	4 × 550	2 200	0.23
TOTAL->				47.69

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 80 × 80 box section steel into the right lengths, as in the cutting list, then cut the bottom and side planks. Lastly cut the 6 mm or 10 mm dia or whatever re-bar for the fixings (the staples etc).

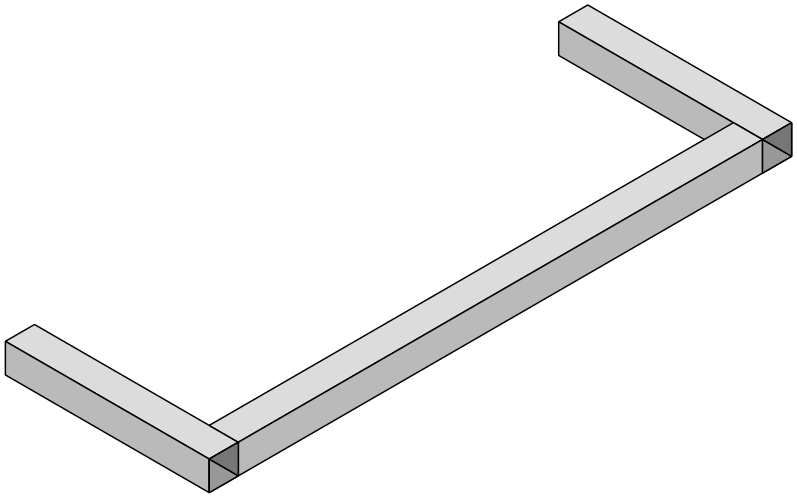


Figure 2: finished end frame.

2) Next make up the two U-shaped front and back frames (endframes). If you have a couple of G clamps you can use them to hold two pieces of the frame together during welding as shown in Figure 3. It's quick and you can tap the parts with a hammer until everything is square and straight and then weld.

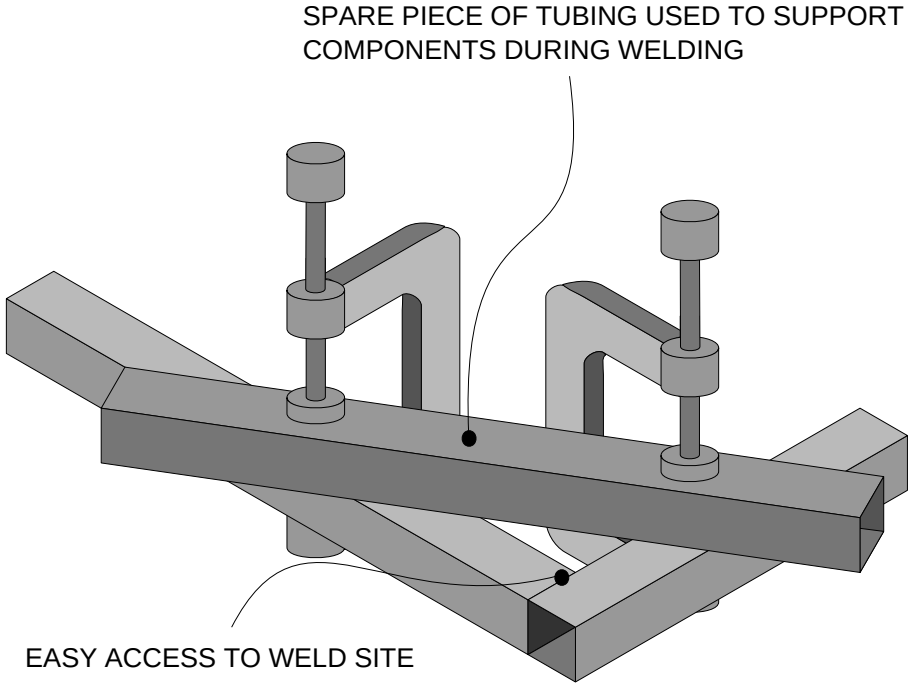


Figure 3: holding frame components during welding.

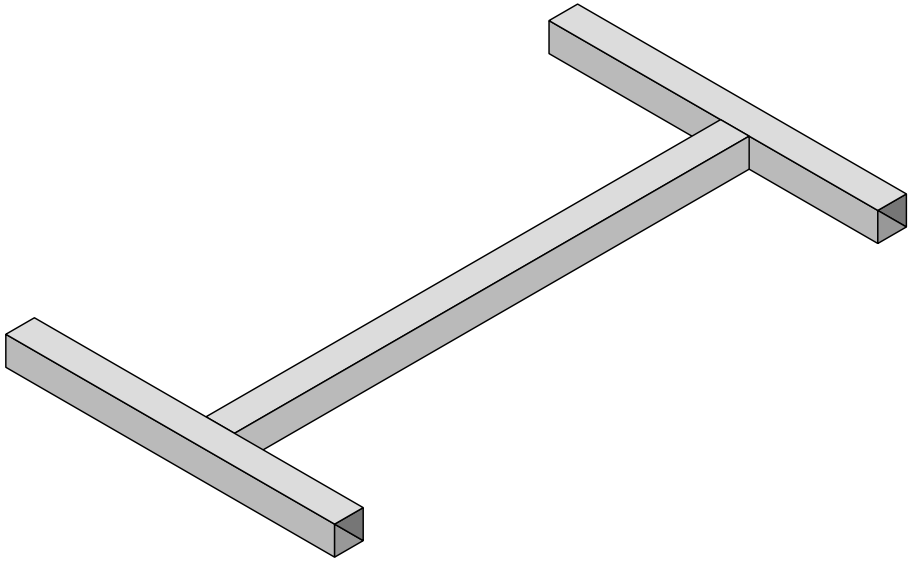


Figure 4: a finished centre frame.

3) Then make up the frame that goes in the middle (as shown in Figure 4) - the one which supports the axle.

4) Next you can fit the side and the bottom planks to the end frames and then the middle frame with staples or studs. Figure 5 shows how these staples and studs can be tightened with a hammer and a weight or another hammer. You need to fix the staples in the right place with a small weld. Studs are another way of fixing the planks. Studs are just short lengths of round bar welded to the sides of the box section as shown in the right of Figure 5. This saves round bar but means more welding.

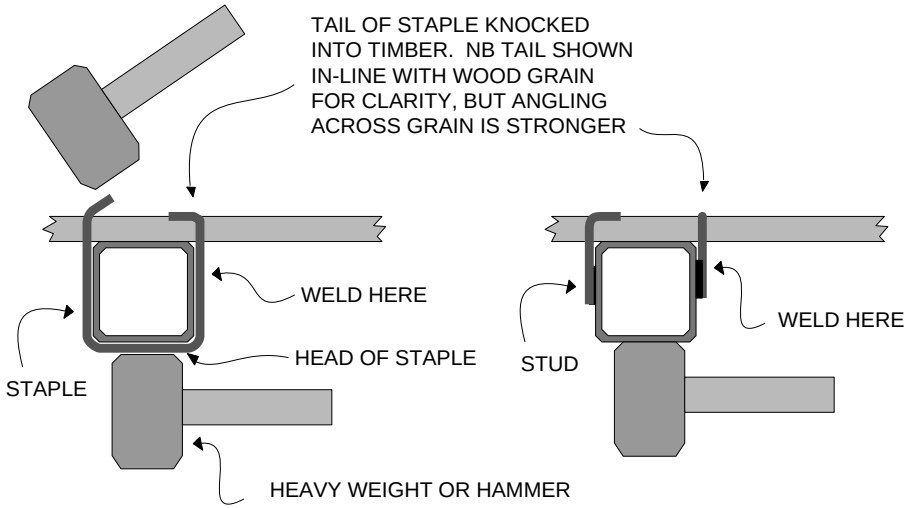


Figure 5: tightening staple or welded stud.

When you bend the end of the stud or staple over you can either bend it in line with the grain of the wood or across the grain, as shown in Figure 6. Bending it in line as shown on the left lets it go into the wood nicely and looks neat, but bending it over across the grain gives a stronger joint.

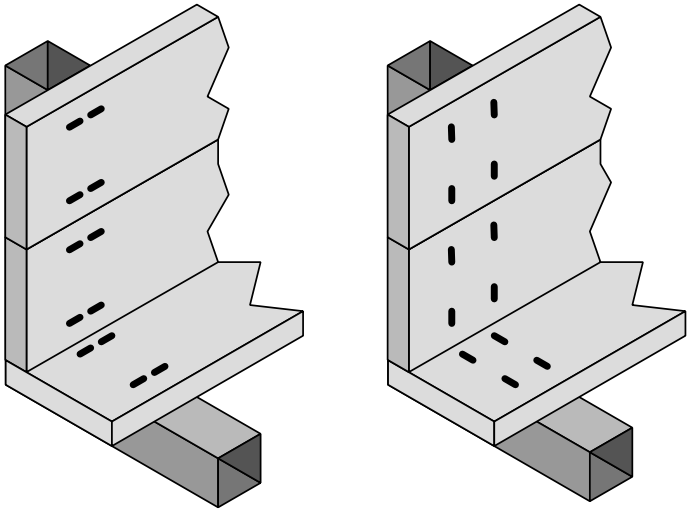


Figure 6: studs or staples bent in line with grain (left) or across it (right).

One thing we have not tried is bending the staple or fixing over the edge of a plank instead of putting it through a hole.

5) Next fix the axle with a one or two loops of round bar and some threaded rod and nuts and washers as shown in Figure 7. If you can get big threaded rod (say 16 mm and some 10 mm plain rod, you can fix the axle with one loop and threaded rod, but if you have only 12 mm then you must use two loops as shown.

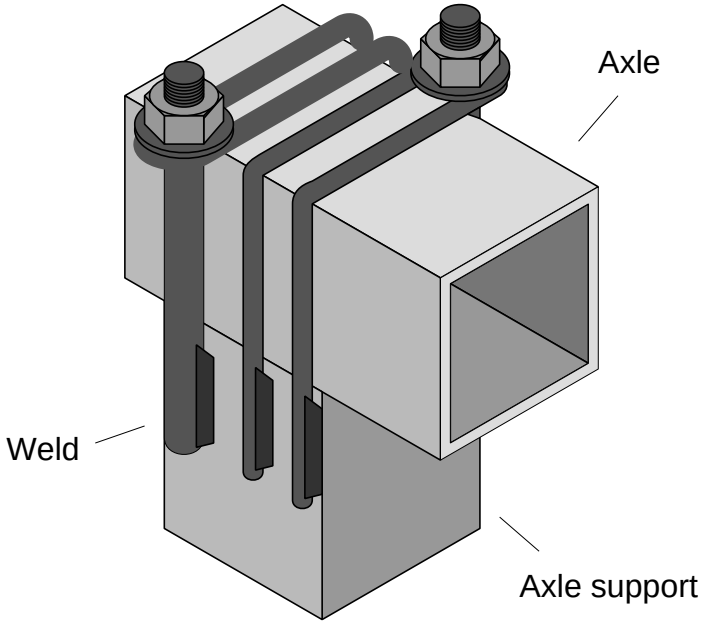


Figure 7: method of fixing axle to axle supports.

6) Nearly there! Now you need to fix the draw bar (or pole or dissel boom - there are so many names for this!). It is best to fix the draw bar to the body so it can be taken off and replaced if it gets damaged. A good way to do this is with stops made of short lengths of box tubing, and round bar welded on as shown in Figure 8. The stops carry the main loads and it is easy to cut through the re-bar hoops if you need to change the draw bar. You will need to put new hoops on of course when you put the new draw bar on.

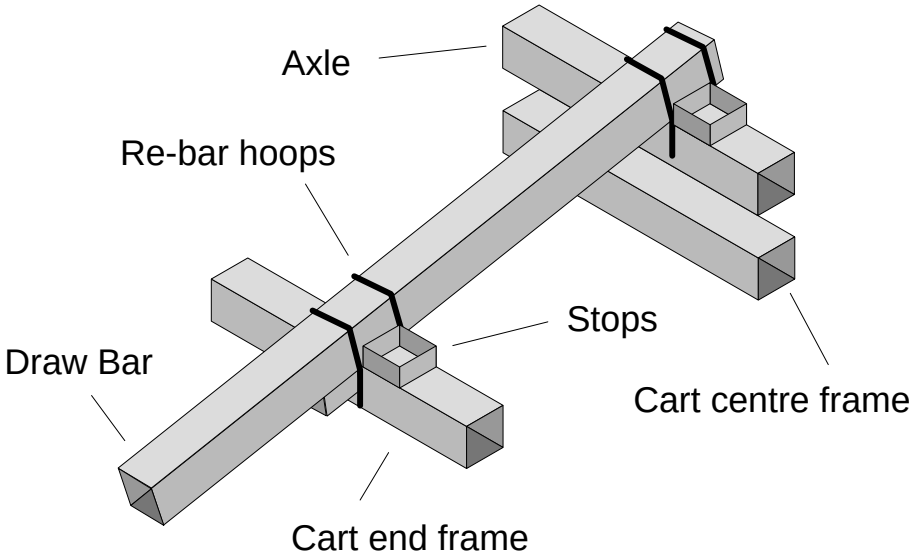


Figure 8: method of fixing draw bar to body. (View of cart upside down.)

7) If you want to make it so that the ends of the load tray can be removed easily you can do so in the way we have shown in Figure 9. Here a piece of the box section steel is fixed to the side planks by clench bars or bolts and stops the end being able to fall out. It is better if box does not touch the bottom planks because then it is easier to clean the corners. The end can be tied to these end stops with rope or inner tube rubber. This is a good 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 longer to make than the rest of the cart. Explain to the farmers that they will cost extra too!

8) Paint or creosote the cart. You've finished it!

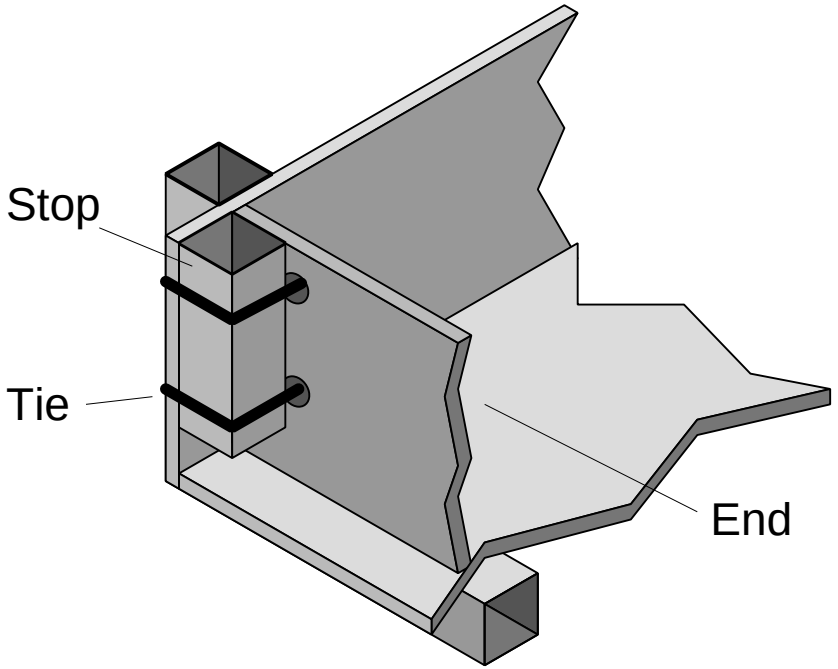


Figure 9: method of fixing ends with rubber or rope

Modifications

There are many different versions of this cart. You can try longer or 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 fit in a narrow strip.

Other DTU cart developments

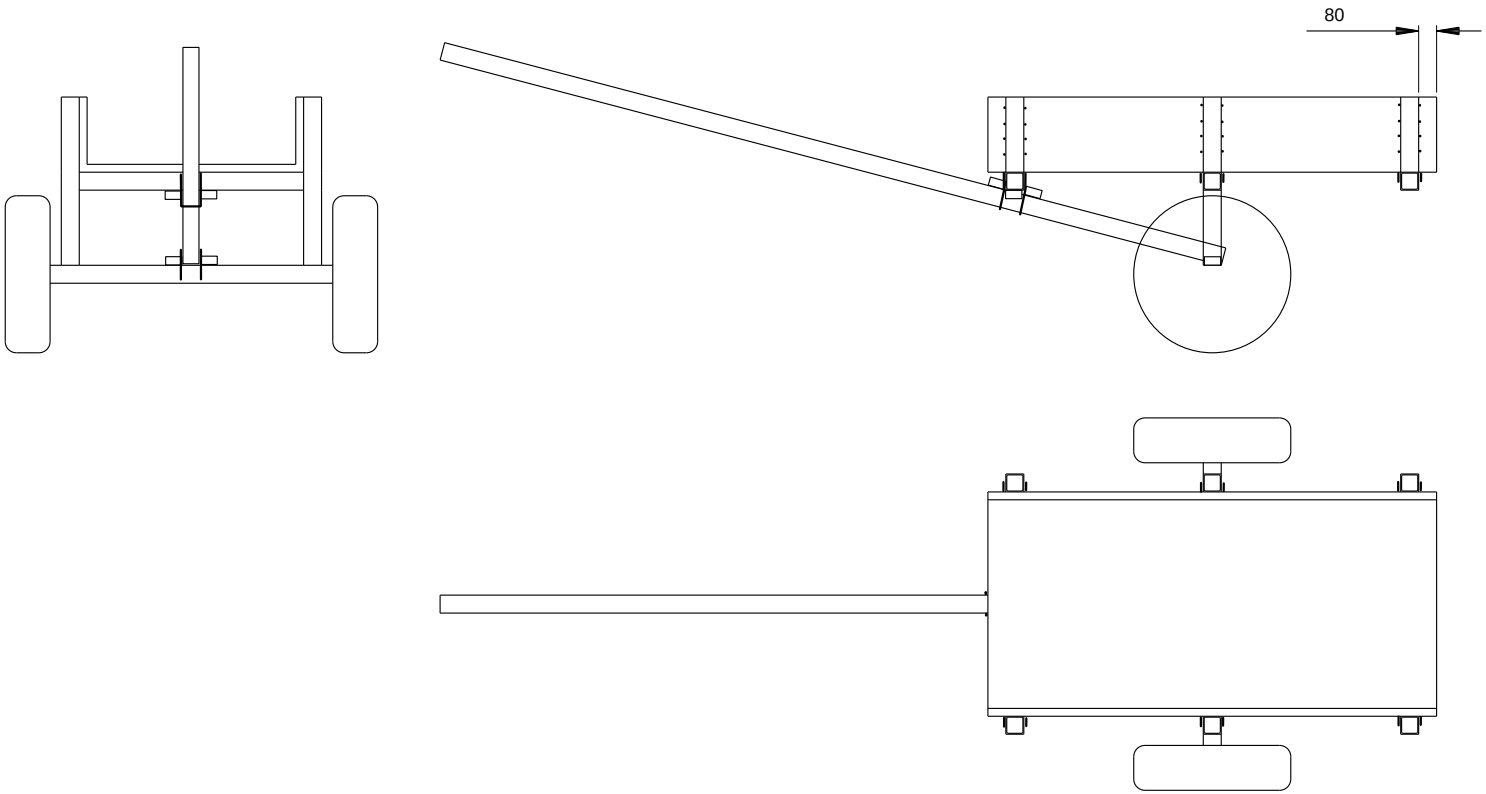
The DTU has been working on a range of cart body types for use with both donkeys and oxen. It has designs for wooden and steel framed types. The wooden types are cheaper in material terms, but the steel framed ones are easier to make because the joints are more straightforward - nevertheless you can 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 steel pipe such as water pipe which do not need machining to make a roller bearing hub. Obviously 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. Still they are reasonably cheap - we can make them in Nigeria for about $\$_{US}40$, they only take one man a day, 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

You will find two drawings on the next pages, the first one gives a general view of the cart, and the second gives a view of the main components. As we have said you can vary the size of the cart quite a bit and even make it much longer if you add extra frames. You could even make a four wheeled cart like this!



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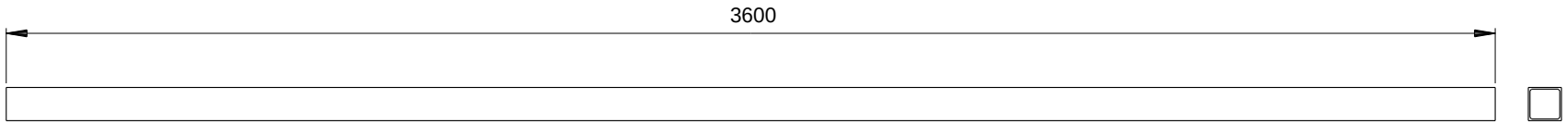
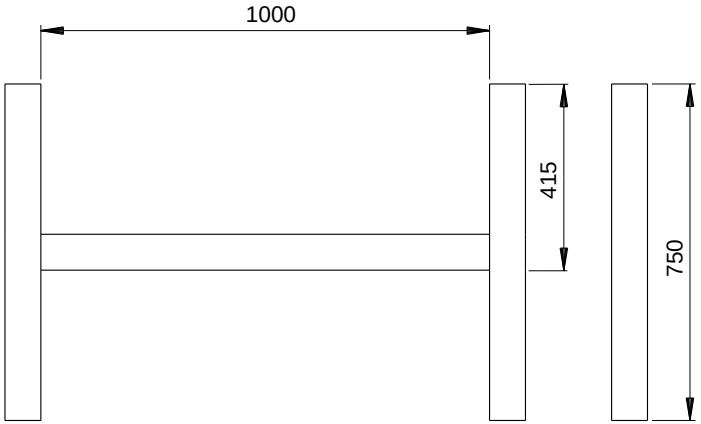
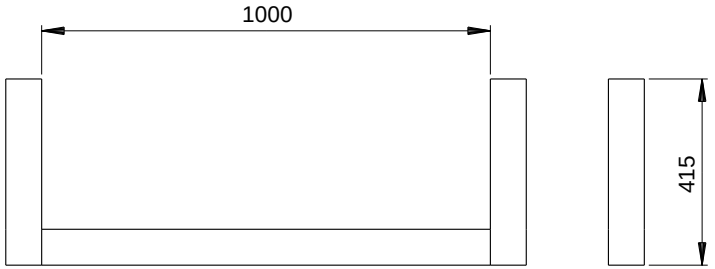
BOOM: 1 REQUIRED

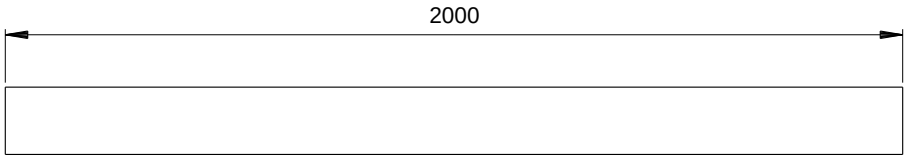




MIDDLE FRAME: 1 REQUIRED

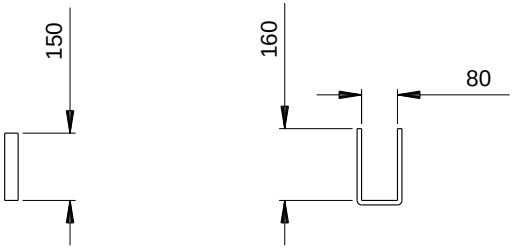


END FRAME: 2 REQUIRED



PLANKS: 10 REQUIRED

STAPLES: 60 REQUIRED



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					Date	9/7/95		Dwg No.	2/2