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The Amazing Bicycle Wheelbarrow Part 1

"The Ho Chi Minh" - a 10 Speed Wheelbarrow

A new variation on an Asian theme greatly extends the carrying capabilities of the bicycle. What is more it can be made in a home workshop and can save you lots of money throughout its working life. It's easy to ride too.

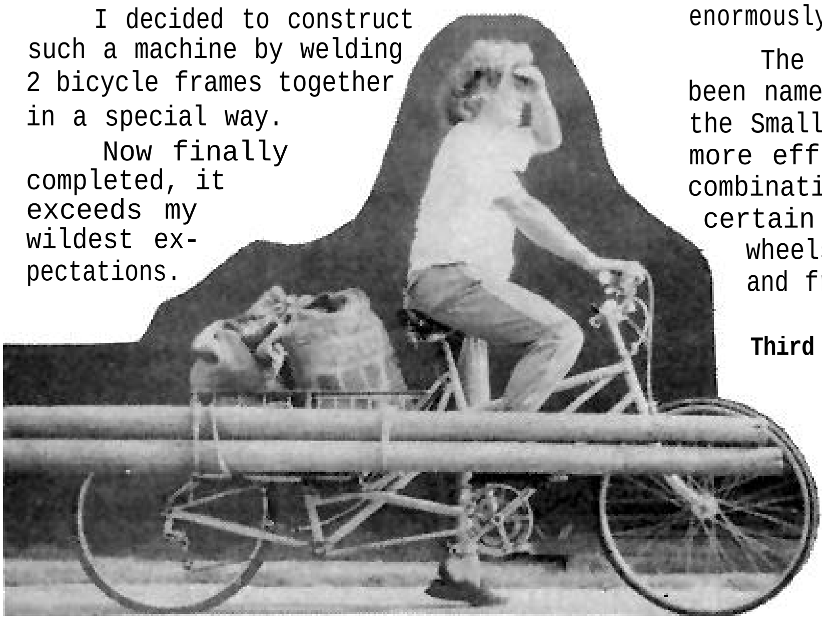
by Ian Grayson

The more I thought about it the more I became convinced that bikes are too short. They cannot carry all that needs to be carried and pulling trailers is hard work. The other option, a tricycle as used extensively in Asia for transporting bulky loads, is cumbersome. It is slow and difficult to manoeuvre in city traffic.

A hybrid came to mind - a cross between a tandem and a trailer, a sort of bicycle ute. Something that could carry cheap vegies from the central market 7 kilometres away by the boxload without breaking my back.

I decided to construct such a machine by welding 2 bicycle frames together in a special way.

Now finally completed, it exceeds my wildest expectations.



It is such a practical machine that I have all but abandoned riding my regular 10 speed in favour of it.

Luggage capacity on a normal bicycle is poor. Bikes are built primarily to carry the rider - luggage is an afterthought,

The mania for short wheelbases originates in the guest for stiffness and hence a marginal gain in efficiency, by racing cyclists. It has nothing to do with functionality for commuting or touring.

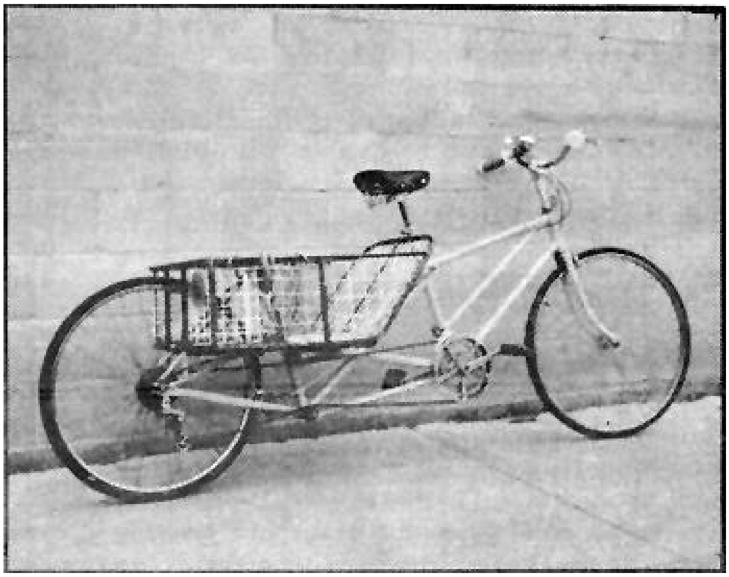
I decided to weld a basket along the length of my long bike - a big basket, "sculptured" around the rear wheel.

Although heavier than a normal bike, the trade off for functionality, carrying capacity and comfort make it well worth it. In any event the revolving weight, the weight that really counts, is not that greatly increased - just some extra chain. For a long bike it is also very stiff, the welded basked itself stiffens it enormously.

The "Ho Chi Minh" as the machine has been named, fulfils all the criteria for the Small is beautiful philosophy. It is more efficient than a bicycle/trailer combination and a tricycle for carrying certain loads by still having only 2 wheels on the ground - thus less drag and friction.

Third World

During my extensive bike travels throughout India and Asia, (having hardly had my bum off the saddle for six months during one stretch), I observed closely all the numerous and ingenious applications of pedal power.



Single speed roadsters are either loaded to the hilt or a long tricycle is used. There is nothing in between. The concept of lengthening a bicycle to increase its carrying capacity has been completely overlooked, despite the obvious need for such a machine. As a delivery vehicle it is ideal. (Posties and couriers in the city give it more than a second look!).

Its third world applications could be considerable. Its ability to greatly increase the range for much load carrying would greatly assist village life and inter village trade. Firewood collection and water carting would be made simpler and easier. Many of the loads being pedalled around in China and Africa for example, by cumbersome trikes, could be moved with less effort, more speed and more manoeuvrability by a machine of this nature.

It is this application which interests me most and I would be interested to hear from anyone or any organisation experienced or interested in promoting such an example of intermediate technology in the less "developed" countries where it would be of most use.

Long lengths such as ladders, timber lengths and bamboo poles can also be carried in a simple manner. By strapping them to the outside of the long basket along the length of the bike, from the front forks to beyond the rear wheel, they are thereby held rigid, and the leg stroke is not interfered with. 20 foot lengths can be carried in this manner - even whilst riding through city traffic.

A small child can also be carried around sitting in the basket, which is much safer being lower down.

As a workhorse on farm or commune it is a virtual 10 speed wheelbarrow. Bricks, building materials and timber can be hauled along narrow tracks. Not to mention fruit, vegies, firewood or compost.

A house or shack could be built in an area inaccessible to motor vehicles.

(For those like myself who abhor the motorised society with its casualties, waste and pollution, this opens up interesting possibilities...).

Bulk shopping once a week for an average family is literally a breeze on the Ho Chi Minh. We shop once a week only at the Adelaide central market and really load it up. The 14 kilometre round trip is easier on the Ho Chi Minh than on any other pedal powered option.

Another important feature of this machine, The most important feature, so far as any appropriate development applications in the third world are concerned, is its ability to be locally manufactured and maintained,

A single person with oxy-acetylene welding equipment and basic metal working tools can make this machine from basic old bike parts and scrap in about 3 weeks. I made my first one without any electrical tools - in fact without any electricity at all!

The only high tech. vulnerable and difficult to replace part of the bike is the gearing system (and possibly the cable technology).

Presently I am working on a 3 speed gearing system which is robust, maintenance-free, everlasting and can be made from recycled materials with no cable technology. (Comprising of 3 old different sized chainrings bolted together with a crude spring tensioner for the chain and a rod-operated changer.)

Self-sufficiency

For country dwellers a couple of these machines can offer real self sufficiency. Nearly all the self sufficiency advocates are car dependent. This car dependency is the Achilles heel of the self-sufficiency movement. This is not to deride all their useful projects, but in my experience the transport problem and the question of car dependency is always given least priority and often ignored completely.

Yet it is a fact that the motor vehicle is the single most wasteful consumer item.

Six million cars are scrapped in the USA alone, every **year**. How much acid rain and nuclear waste is spewed over the planet in order to feed such obscene consumption? For it is consumption that is at the heart of environmental crisis, nothing else. And the locomotive force, the prime mover in the economy which keeps consumption rising, is ever increasing motorisation of society - a force which has continued unabated in Western industrialised society since the end of the second world war - along with its multitude of by products. Highway construction, freeways, motels, drive in shopping centres, multi-storey carparks, the urban sprawl ...The list goes on.

That is why an energy efficient house

with a car in its driveway (and more often than not 2 cars!) is but an empty gesture. It avoids the heart of the environmental problem which is car dependency.

To me, using a bike for my everyday transport needs (as opposed to leisure rides) is a form of political statement, a statement of my beliefs. (As well as being good fun of course!).

Development of the Ho Chi Minh was an extension of this statement.

Low down weight.

This long bike has another attribute to its carrying capability - the weight is carried low down, a very important factor.

On a regular bike the load is carried too high, causing more rocking and swaying - this requires constant compensatory body movements therefore more effort. 60 kilos of luggage can easily be carried on this bike. (With stronger spoking in the rear wheel, even more. I have not yet tested its limits).

Incredibly, such weights actually feel much less than they are. Friends even claim it is easier to ride partly loaded than empty! This is due to the weight being carried not only low down, but also in between the wheels. It stabilises and lowers the centre of gravity compensating for the riders high up weight, thereby improving handling.

Drawbacks

Most readers would by now be a little cynical about the numerous claims I have so far made for the Ho Chi Minh and to be sure it does have just one short-coming over a regular bike. But only a minor one. Due to its length and larger turning circle, wheeling it around in crowds when walking is a minor hassle. Otherwise there are no drawbacks. All I can say is make one for yourself and try it out.

Don't let the extra length of the bike put you off. It rides like a regular bike in city traffic. If anything the Ho Chi Minh is certainly a more comfortable ride as the rider is no longer sitting so near to the top of the bumpy back wheel.

The slight reduction in the turning circle due to its length is hardly noticed. On a regular bike I never perform sharp turns anyway - its a bad habit in traffic. My turning circle is always kept within that of the Ho Chi Minh no matter which bike I am riding.

In the next issue of Soft Technology we will be featuring the construction details of the Ho Chi Minh.

TALK TO US !!

Soft Technology relies on its readers for fresh exciting and interesting information. We are always on the lookout to find out what you, the reader has been doing and would like to hear about. So talk to us! Let us know about the fresh, exciting and interesting things that you are doing so we can let other people know. Don't worry about being able to write we have trained experts who can decipher the most obscure scrawl.

Remember Soft Technology is a non-profit magazine produced by unpaid volunteers. To function it must have the support of its readers. So make the job of those hard working souls who produce Soft Technology a little easier by sending something in .....anything....as long as it isn't dirty or smells bad.

Talk to us!!

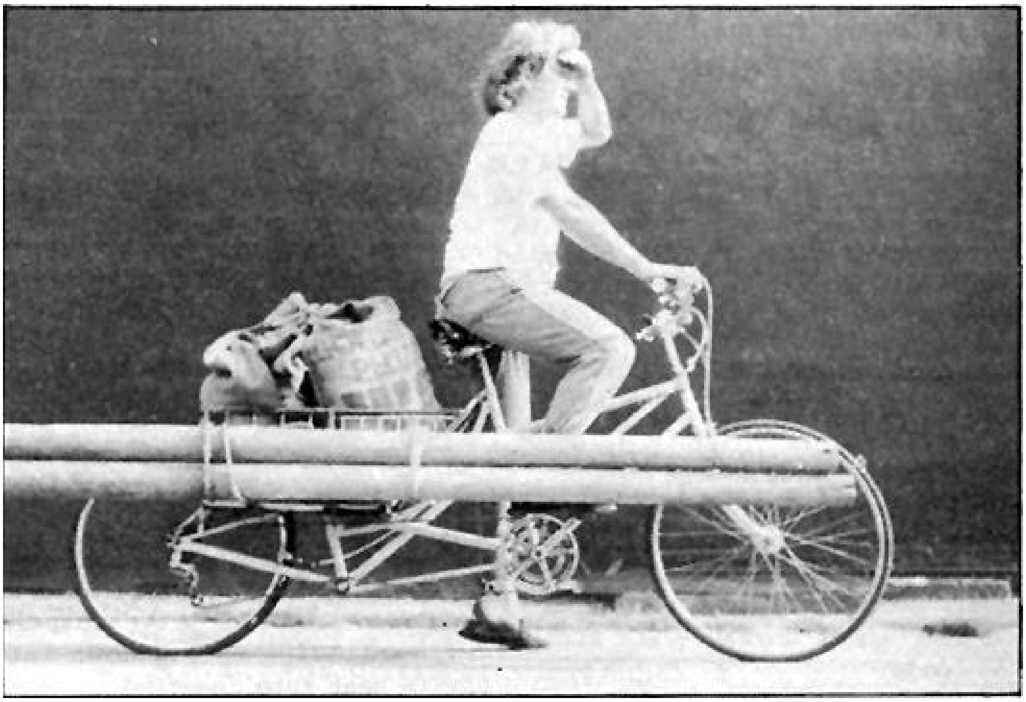
Building the Bicycle Wheelbarrow

In the last issue of Soft Technology we described a novel bicycle wheelbarrow named by its owner as the Ho-Chi-Minh. In this issue we show how you can build this practical and flexible means of transport.

By Ian Grayson

You'll need

- all the normal equipment from a ten-speed bike with preferably an alloy chainset
- 2 good old bike frames for welding together. The rear frame must be a woman's frame, the longest you can find, with a curved top tube of the old fashioned type. These old frames are easy to scavenge or find in junk shops.
- a long back brake cable and a long derrailleur cable. These are made for tandems and may need ordering but they are usually available.
- an extra chain and a idler wheel for taking up the slack in the long chain. A spare derrailleur jockey wheel will do, but a tandem idler wheel is better.
- if you can get it, a 2 l/2 foot length of oval tube for welding between the 2 bottom bracket shells. If not, a piece of old bike tubing will do, but it is then advisable to weld in steel plate gussets at the joins, to compensate for the round tubings lesser stiffness.
- an extra length of old bike tubing, an old downtube will do.



- two extra sets of detachable seat stays, taken from old frames.

Also, for the basket

- 5 lengths of l/2 inch square tube each 2 metres long. (The thinnest gauge you can find).
- one length of 5/8 square tube, 1 l/2 metres long. (The l/2 inch-square tube must be able to sleeve into it snugly when the ends are filed down).
- 4 lengths of one inch square tube for the baskets base each one metre long.
- 2 pieces of 1 inch angle iron each 20 cms long.

TOTAL COST OF THIS NEW STEEL IS ABOUT 15 DOLLARS

Also

- some mesh for the basket sides. Difficult to buy. Cut up some old second hand baskets from junk shops. (Using steel mesh gives many hitching points for loads and allows long lengths to be tied to the outside. In addition there is no air resistance.
- some ply to cut to shape for the base.

Tools

- basic metalworking tools including a strong bench vice and some clamps
- hacksaw and blades
- files
- access to oxy-acetylene welding equipment
- a dozen nickel bronze welding rods.

No jig is necessary but in order to clamp the frames together in a dead straight line a 4 foot length of angle iron is required or something similar, which is absolutely rigid with no flex. I use very heavy 3 inch angle.

NOTE ON WHEELS AND FORK RAKE

A longer bike needs a softer fork rake than a regular bike - about l/2 inch more. A 28 inch front wheel and a 26 inch rear will help soften the rake. I prefer the 26 inch rear wheel anyway - its much stronger for loads.

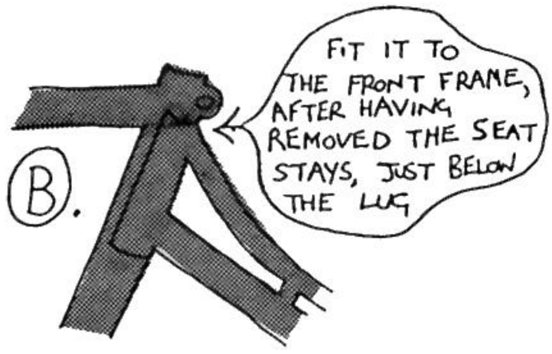
PRODUCTION STEPS FOR THE HO CHI MINH

Any fully experienced backyard tinkerer with basic welding skills can knock this extremely useful machine together in a couple of weeks.

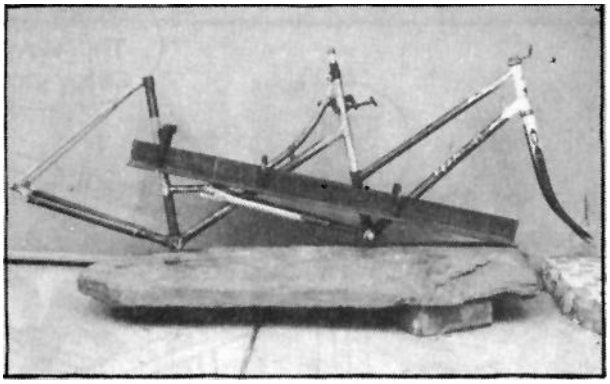
1. Select your 2 old bike frames carefully. Check for damage. Now...remove the seat stays from the front frame,
2. Next, remove the forks and bearing cups from the rear frame. Grab a hacksaw, and, holding the frame firmly in a vice, cut the headstem vertically in half. (Drawing A).

Scrape, sand or file all old paint from the cut area down to the bare metal in preparation for brazing. (Do likewise for all the subsequent welds).

3. Clamp it with vice grips or a clamp to the seat tube of the front frame, flush with the bottom of the seat tube lug. (Drawing B).



*WARNING- Do not clamp too hard as this may dent the tube preventing the seat tube from sliding up and down later. Clamp with seat tube inserted.



4. Before doing any brazing insert the wheels when the 2 frames are clamped together. See what you're aiming for. Check the fork rake - is it soft? Unfortunately, for reasons too long to discuss here, certain frame combinations sit together awkwardly. The main problem is that the front riders bottom bracket can end up rather high off the ground. Its still quite a feasible machine but it needs the seat up higher to compensate for it, thus restricting it to larger riders, It also requires a very slight hop on and off the pedals. Compare the pedal height with your regular bike. If you don't like it then proceed no further - try another frame combination,

5. Place the makeshift jig - the 4 feet piece of stiff angle iron, diagonally across the 2 lightly clamped frames so it touches the front frames downtube and both frames seat tubes. Clamp it to all these tubes. The 2 frames should now sit in a straight line. Insert front headstem and sight by eye along seat pillars and headstem to check straightness. If all is OK then braze the join. (Drawing (C).)

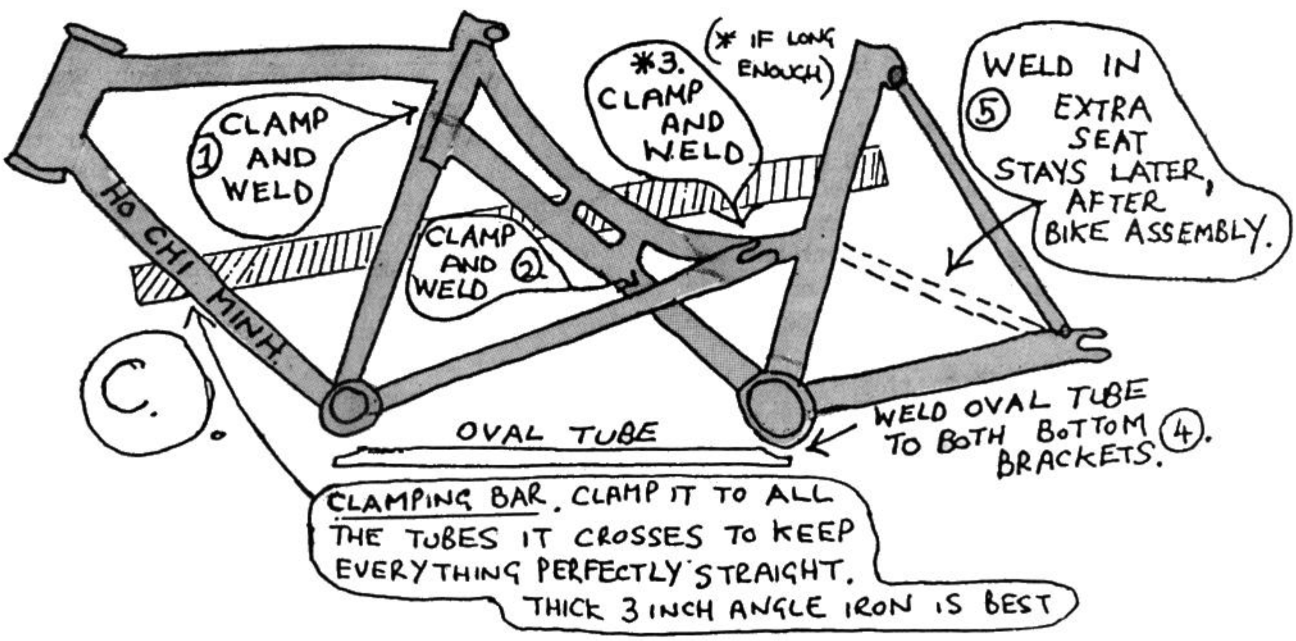
6. Clamp the front frames chain stays around the down tube of rear frame and weld. (If stays are long enough weld onto curved top tube as well for extra strength).

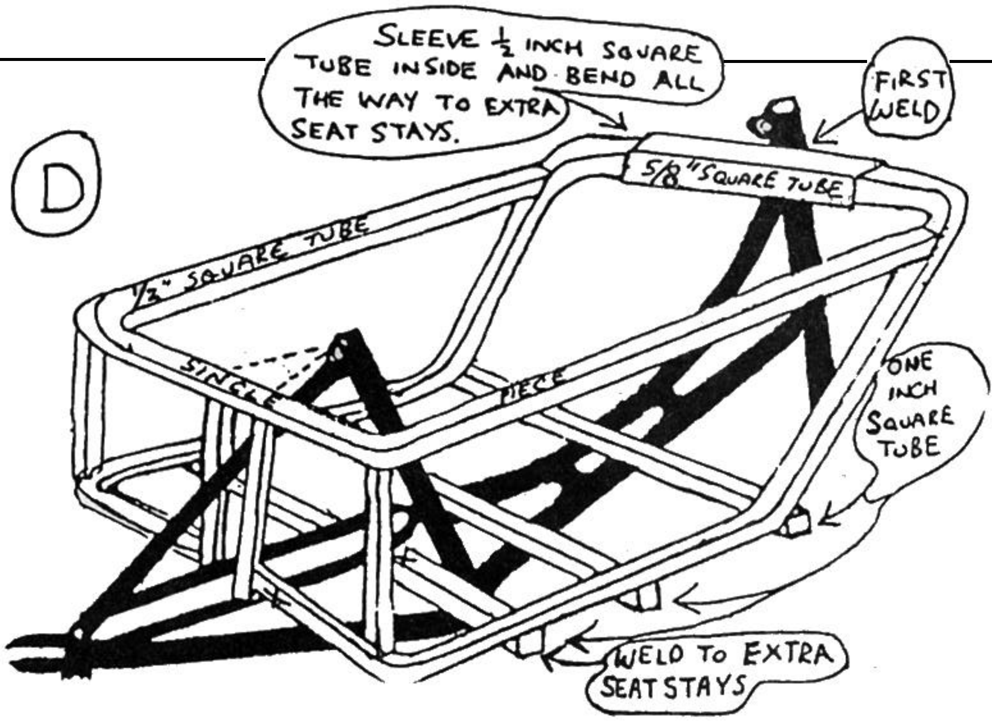
7. Cut a length of preferably oval tube, for welding between the 2 bottom bracket shells.

8. Mitre it to shape, clamp in and weld. Leave cups in shells to prevent heat distortion of the shells when welding.

Assembling the Ho Chi Minh

Assemble everything exactly as a regular 10-speed bike using a longer chain and the longer brake and gear cables. Bolt an idler or jockey wheel into the rear bottom bracket shell and run the chain over it. The chain should now clear everything - check it on all sprockets, especially the largest. If it touches the middle seat stays that are now welded in,





don't be afraid to flatten the stay a little - bike tubing is very strong. However this should not be necessary.

Test run the bike.

If all is OK then cut a pair of the extra seat stays to shape and weld them into the rear triangle half way up the seat stem. Ensure chain clearance. This may be a tight fit. If necessary flatten the offending stay to achieve clearance.

These extra stays are absolutely necessary - the rear of the basket is supported by them. **ENSURE THE SEAT STAY BRIDGE IS ALSO WELDED IN.**

Test run the bike again.

If all is OK then proceed to welding on the basket while the bike is assembled.

Welding on the Basket (Drawing D)

The 1 inch square tube can usually be bent to shape cold, even to 90 degrees provided the bend radius is soft.

FIRSTLY, Cut a 24 cm length of 5/8 square tube. File the inside at both ends to enable the l/2 inch square tube to be sleeved into it.

THEN Weld it onto the sliced top headstem lug of the rear woman's frame in the middle, (After removing the seat for easy access).

NEXT A 1 l/2 metre length of l/2 inch square tube has to be sleeved into the attached 5/8 tube and bent into shape.

Bend it slowly and carefully in a vice, little by little, constantly replacing it back in the sleeve for alignment and sighting by eye. The bend must finish on the extra seat stays two inches forward of the rear wheel axle. (Extending the base further than this point would result in whip and strain on the back wheel).

IMPORTANT As shown in Drawing (D), this outer base edge of the basket sits on cross supports of one inch square tube. Clamp the first 2 in position prior to bending the edge, so you can see what you're aiming for. **ENSURE THE CHAIN CLEARS THE CROSS SUPPORTS** - select your height accordingly. Weld nothing more yet. Ensure foot clearance on pedal stroke.

If everything clears then weld in the front cross support. (To strengthen it further, braze one of the 20cms long pieces of 1 inch angle iron across the curved top tube first, then braze the cross support in it).

This cross support is now your height guide, it should be as low as possible with chain clearance.

Now braze the outer bottom edge into the sleeve and to the cross member.

The second cross member will need to sit on about an inch of upright tube as a shim, to obtain equal height with the first.

CONTINUED PAGE 33.

BICYCLE WHEELBARROW ..... CONTINUED FROM PAGE 14.

THE OVERALL OUTER WIDTH OF THE BASKET IS 48CMS - 24 each side. The length depends on your frame. The height should be flush with, or slightly above, the top of the rear seat tube.

The top of the basket can be curved around in a single piece at the appropriate-height as shown in Drawing (D).

Brace it for strength with uprights where you deem it necessary - obviously the corners are required.

To brace the rear, where the top of the basket straddles the rear wheel, two vertical supports welded up from the extra seat stays are absolutely necessary. They may need staggering out, or bending a little at the bottom to get the support.

To screen the top of the rear wheel, (not shown in the diagram), cut another pair of seat stays very short and bolt them into the seat pillar with the seat bolt. Weld the other ends to the rear inside end of the basket, flush with the top, at a slight angle apart (not parallel). This also stiffens the basket tremendously, and doubles up as a kiddies seat if a cushion is lashed over the top. Enclose the sides with mesh or riveted plate, and weld short pieces of tube

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STOP PRESS! **- WITH HO CHI MINH BIKE**

To obtain maximum space in the basket it is necessary to eliminate the intruding seat pillar, and brace the rear wheel differently.

To do this cut the seat tube at the height of the basket base.

Then bend a piece of thick walled square tube (I use 13/16 inch 1.6 mm wall). Bend it cold around an old style 28 inch wheel. This would leave ample clearance for your 26" wheel (if you don't fully bend it).

Insert and weld in as shown in Diagram E.

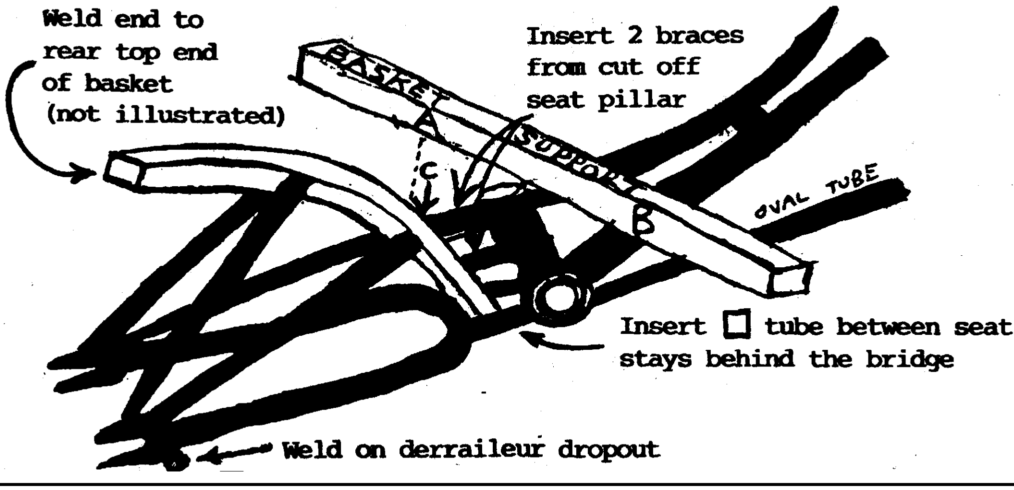
It must be braced from the cut off seat pillar.

To screen the wheel I insert 2 more curves of l/2" square tube from the rear top of the basket, about 1 1/2" from the supporting curve each side (not shown in diagram). I then taper them in to Point C and screen with tight mesh.

This modification takes 2 or 3 days and it is best to assemble and construct the machine first - then eliminate the intruding seat pillar.

With this modification maximum possible space utilisation is obtained in the basket.

Much is left out from this sketch for clarity. Points A, B, and C are points from which cross braces of square tube can be brazed for extra strength.



Right: Rolling along the Ho Chi Minh trail

across the gap at the top. (The dotted lines demonstrate the concept).

Also not shown in the diagram, a piece of 1/2 inch square tube has to be brazed between the 2 points marked x, along the extra seat stays.

Welding in the mesh is very fiddly - here you are left to your own devices.

The plywood base is best cut by making a cardboard pattern first then transferring it to the ply. Due to its unusual shape it is best to cut and insert it in 2 halves.

The seat pillar protruding into the basket can be a bit annoying sometimes but I have yet to find a load it interferes with. Doubtless, a tooled up factory with all its resources could eliminate it by bracing the rear wheel direct to the rear of the basket. Although this is quite feasible I am reluctant to interfere with the rear triangle at this stage, as that is the critical area for strength.

Finally, for those readers who are curious about the connection between the bike and its name - well the Vietnamese leader who ousted the mighty American war machine from Vietnam with peasant technology, Ho Chi Minh, used a similar application of the bicycle in his campaigns. In fact, although little mentioned in writings on the Vietnam war, extensive use of the bicycle technology was the deciding factor in Americas defeat.

American troups, although they had more logistic support in the jungles of Vietnam from their air force, still carried all their supplies and weapons on their backs.

The North Vietnamese adapted standard bicycles to haul huge amounts of supplies through the dense foliage and narrow tracks - not ridden but pushed, with the loads bolted across the crossbars in wooden crates. Rods were attached to the handlebars to assist pushing.

The Vietnamese supply lines stretched hundreds of miles using vast numbers of peasants - "Peoples supply columns", pushing thousands of bicycles in this manner. The manoeuvrability of the bicycle made this possible in the dense jungle.

The Americans meanwhile, were collapsing under their packs awaiting inaccurate supply drops.

Throughout the whole of the Vietnamese war the Americans' obsession with high technology was so great that they never even considered the damage that pedal power was causing them. They ignored it and never considered its use themselves. It was beneath them to even acknowledge that simple bicycles, in the hands of a peasant army, posed a major threat to the world's largest military power.

Thus were they defeated.

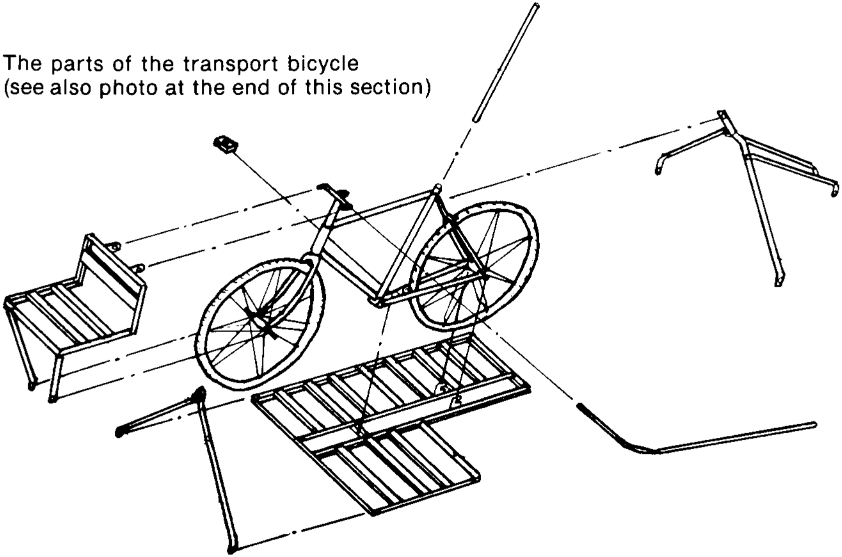
My long bike is named Ho Chi Minh because it is an extension of the load carrying concept which the North Vietnamese used. It was inspired by the concept, and simply takes it one step further by extending the bikes length and carrying capacity.

Transport Bicycle, dimensional drawings with text and photos, 17 pages, free to serious groups (we suggest you send one of your publications in exchange), or $2.00 airmail outside Africa, from the Dar es Salaam Liberation Support Group, P.O. Box 2099, Dar es Salaam, Tanzania.

MATERIALS: bicycle, angle bar, tubing, wood strips.

PRODUCTION: some welding and machining.

This leaflet describes a metal frame that can fit onto an existing bicycle for carrying large loads (up to 200 kgs.). The operator walks alongside the bicycle. The intent was to design a transporter that could be used on rough terrain where cars and trucks can't go, yet could carry loads much heavier than humans can carry. These objectives appear to have been met.



The parts of the transport bicycle
(see also photo at the end of this section)

BICYCLE TRAILERS
Two Wheel Designs

The versatility of the bicycle can be dramatically extended to the carriage of large and/or heavy loads with the use of a trailer. I've carried quarter-tonne loads in my time (not recommended for hilly, gravelly roads) and recall instances of cyclists carrying couches, wardrobes, friends, soil, pot plants, small boats and surfboards. Shopping is of course their main use.

The main consideration in trailer design is

- weight
- strength
- good cornering ability
- good positive connection to the bike/trike.

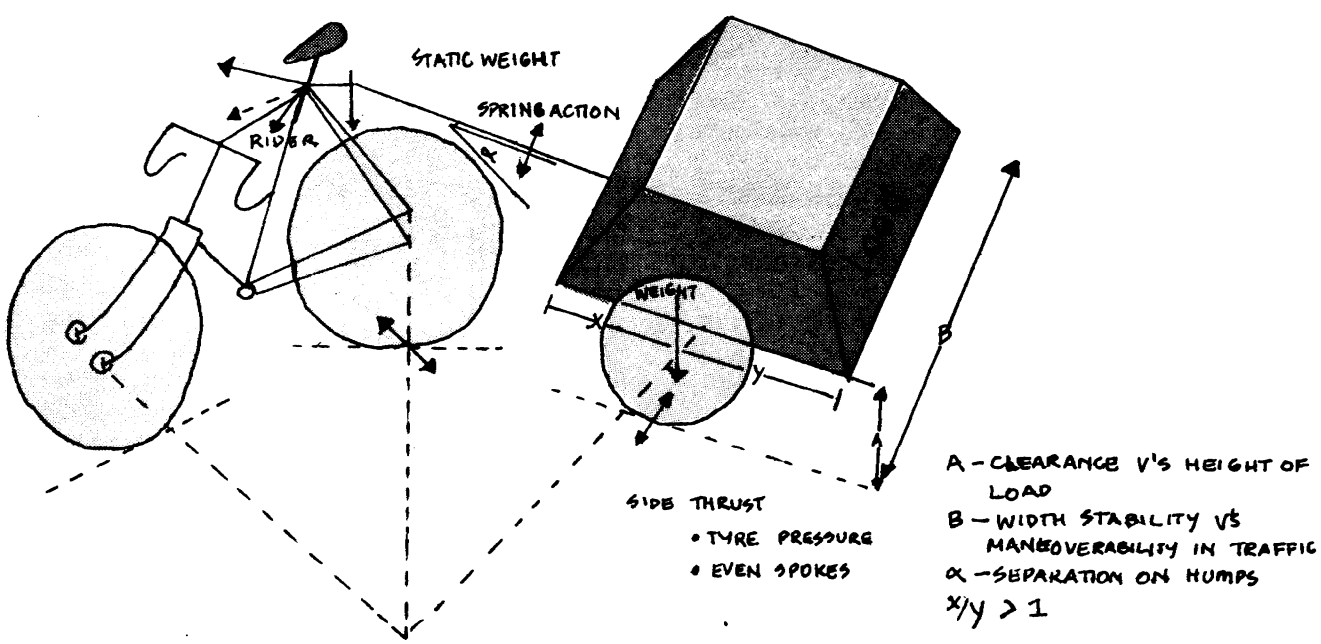
Secondary things to consider are

- ability to squeeze through traffic (and doors)
- capable of taking brakes
- versatile loading space
- robustness in collisions (posts, gutters)
- storage needs.

Dynamics

A ridden bicycle forms a very unstable system that requires constant correction from the rider. Whilst this becomes automatic quickly, the addition of a trailer can be unnerving to the inexperienced. Unexpected harmonic motions can cause control difficulties when carrying very long or unbalanced loads. Whipping and oversteering must be borne in mind when carrying

BASIC DESIGN CONSIDERATIONS



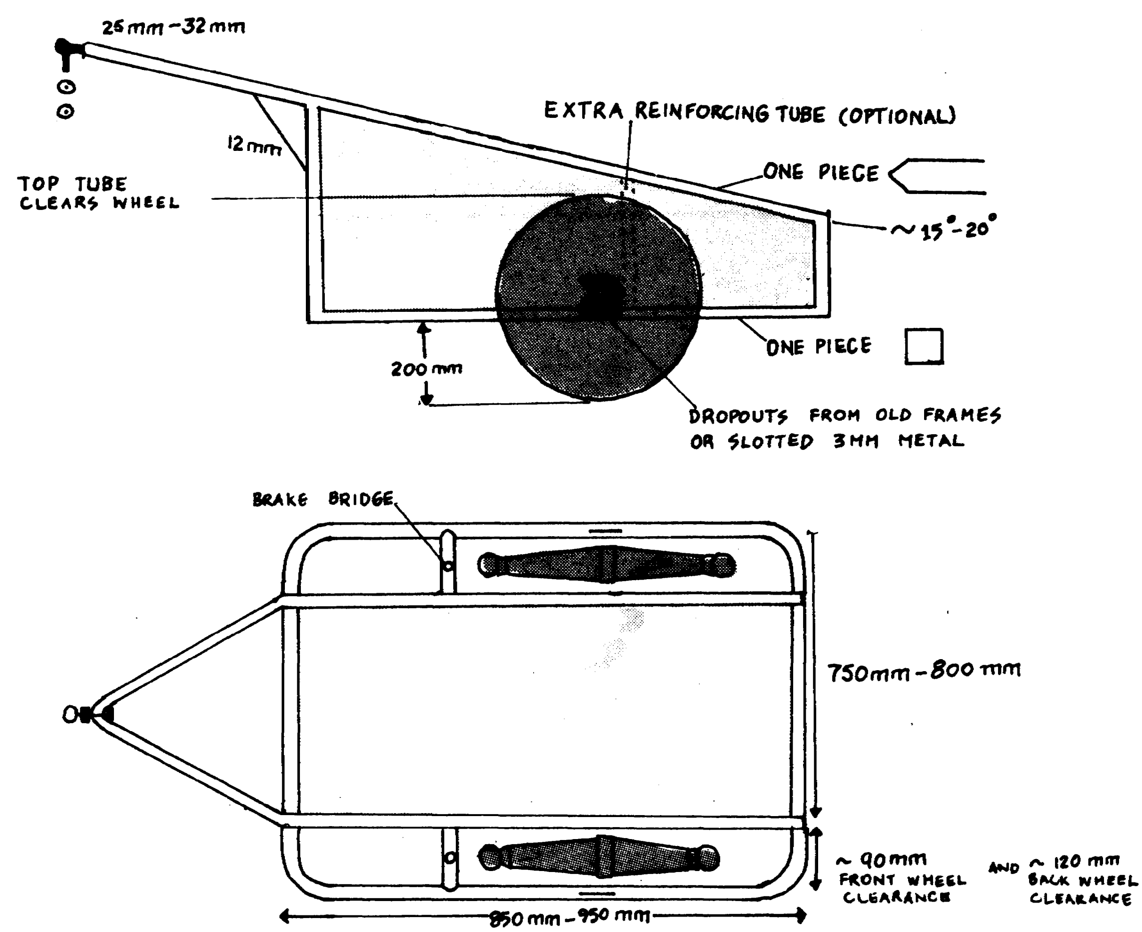
other than small loads. Sometimes the load will be much heavier than the rider so safety is a major factor.

Design

Trailer design must be based on the expected weight and the type of wheels necessary to support this load Bicycle wheels are very strong vertically, since they act as prestressed circular trusses. However, the larger the wheel the poorer the ability to resist the side thrusts associated with swerving, cornering and manoeveering along steeply (side) sloping roads. For this reason most trailers use 20" X 1.75" as found on dragsters and BMX bicycles, (solid 10" and 12" have had some use but are poor shock absorbers) although their lower inflation and wide profile make them less efficient rolling. They can statically support 200kg easily but dynamic shock loads super-imposed on cornering loads limit the total to about 250-300kg/pair.

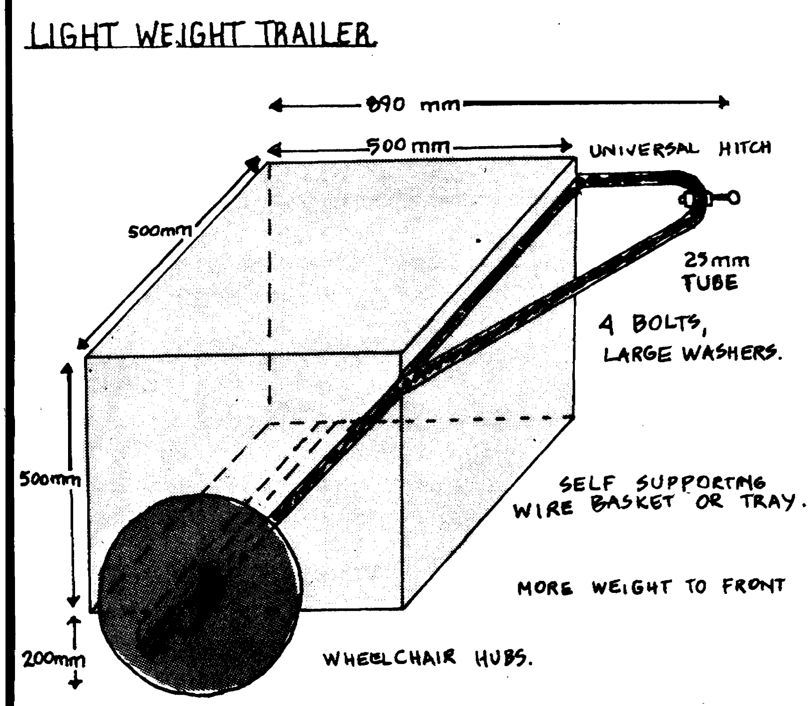
Wheels can either be supported at both ends, as on bicycles, or cantilevered, as on wheelchairs. The cantilevered construction gives a narrower profile but relies on heavier stub axles and local reinforcement of the trailer frame where it is attached. Most lightweight shopping trailers use wheelchair hubs, while the simple

HEAVY DUTY TRAILER



supported wheels are generally found on heavy duty trailers, wheelbarrows and delivery trikes.

The body frame is equally determined by the necessity for strength and good stability, The wheels need to be Located so that the load space is divided into two with a slightly Larger forward section. This prevents the trailer lifting the rider on sharp or unavoidable braking, as it tends to continue forward. Too much forward loading will unload the steering wheel of the bicycle. The frame must be capable of taking the load without splaying (scrubbing-will result).



The strut that connects to the bike must be rigid enough not to flex and hence transmit push-and-pull notions to the bike, These struts should be straight as possible so that the least possible 'springing' occurs. Unless at large diameter (35-40mm) or heavy wall thickness, the use of a single strut for heavy duty trailers is not recommended.

Most trailers use 25-30mm diameter mild draw steel tubing which is easy to work and weld/braze. It need be no more than a millimetre thick. Aluminium is more difficult to repair, and will need to be of larger diameter.

The use of an open frame will increase the flexibility for loads of awkward shapes and make it easier to tie down. Solid baskets and walls will be a Liability in the wind (except for small trailers), whilst the *open* design is relatively aerodynamic,

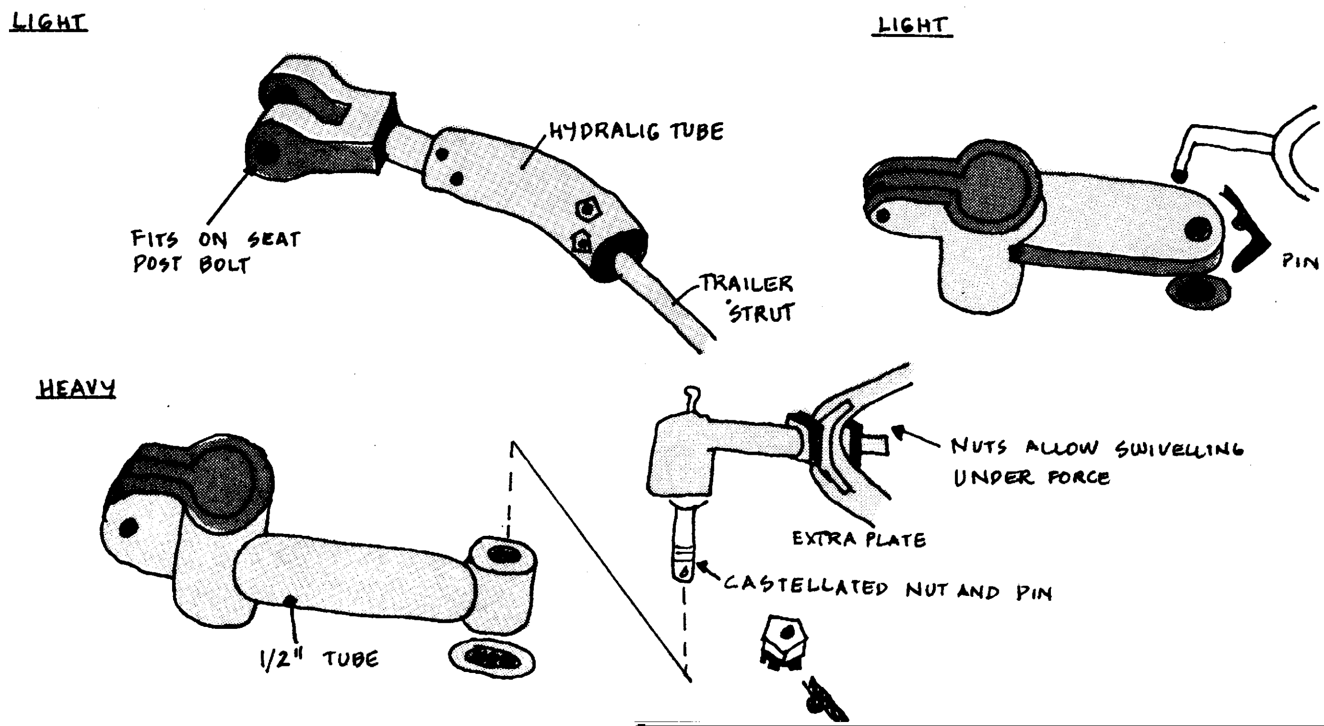
Hitches

Light weight trailers can use many flexible materials to form the hitch as well as universal joints. Steel reinforced hydraulic hose is favoured in recent British models, while simple draw-bar type pivots and springs are used on USA children's trailers. Small rod ends from machinery, such as go-carts, are light, reliable and of sufficient strength.

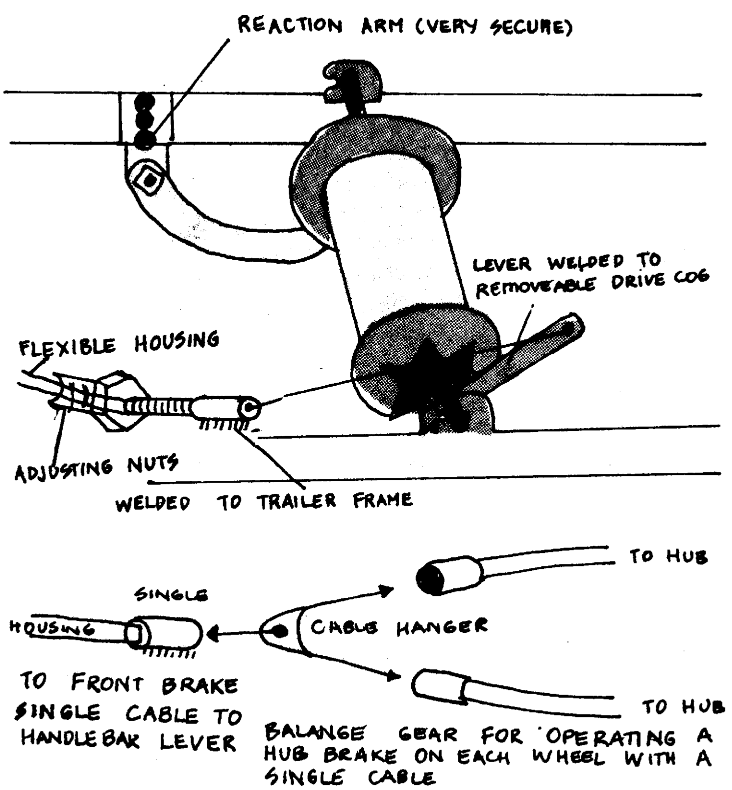
Heavy trailers must have ball joint universal hitches due to high impulse loads and tension. The rod ends from automobile steering systems are good (and cheap). To prevent the bike frame (and rider) being twisted on overturning a laden trailer, it is good practise to enable the joint to rotate under high stresses.

It is commonly attached to the seat post with a clamp similar in action to that of the normal seat clamp. Some fit onto the seat clamp. Low axle fittings have also been used, but this arrangement tends to limit steering to one side and introduces uneven loadings. On sharp turns it can push the rear wheel into a skid. Higher pitch points enable the rider to lean further into a curve to counterbalance the trailer's outward-bound momentum. Additionally, the pivot should be as close to the centre-of-turning gravity of the bicycle, so that the turning moment about the hitch is low. Hitches fitted beyond the wheel accentuate the "separateness" of the trailer, increasing control difficulties.

HITCHES



MODIFIED BACKPEDAL HUB



Brakes

Heavy duty trailers can adopt either standard rim caliper brakes, or internal expanding hub brakes. Caliper brakes are cheap and easy to fit on a bridge. The cable can replace the standard rear brake cable on the handlebar lever. Back pedal hub brakes will need modification to enable the control cable to turn the cog backwards. It will require more cable travel, so a separate long handbrake lever fitted into the bicycle frame is necessary. These brakes are robust and usually have stronger axles. Both types will need some balance gear and adjustment screws. Small drum brakes, though very good, are usually too expensive for common use.

The writer Wayne Kotzur actually makes and sells bike trailers. The heavy duty trailer (250kg max.) is $250 while the shopping trailer is $150 with a 1" square plastic coated trailer. For more information write to Wayne Kotzur at Inner City Cycles, 31 Glebe Point Rd., Glebe, 2037.

Four Wheel Designs

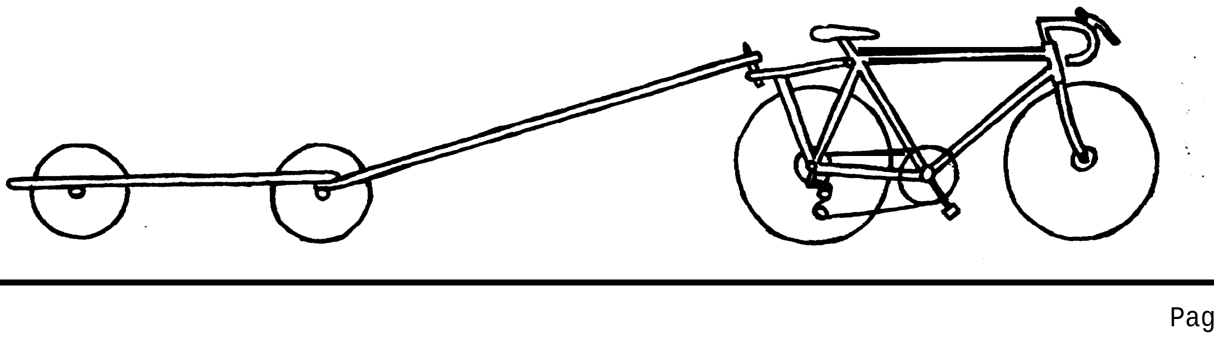
When you're carrying very heavy or very bulky objects (fridges, wardrobes, pianos, etc) a 4 wheeled bicycle trailer can be a big advantage. They are much more stable and exert much less pressure on the towbar when carrying these types of load than 2 wheeled trailers. They avoid balance problems due to poor load placement, sudden braking, etc. (as discussed in the article on 2 wheeled trailer design). However, 2 wheeled trailers are more suitable than 4 wheeled trailers for lighter and smaller loads, because they're more manoeuvrable, fit through narrower gaps in traffic, and are smaller and lighter 50 are a bit easier to tow.

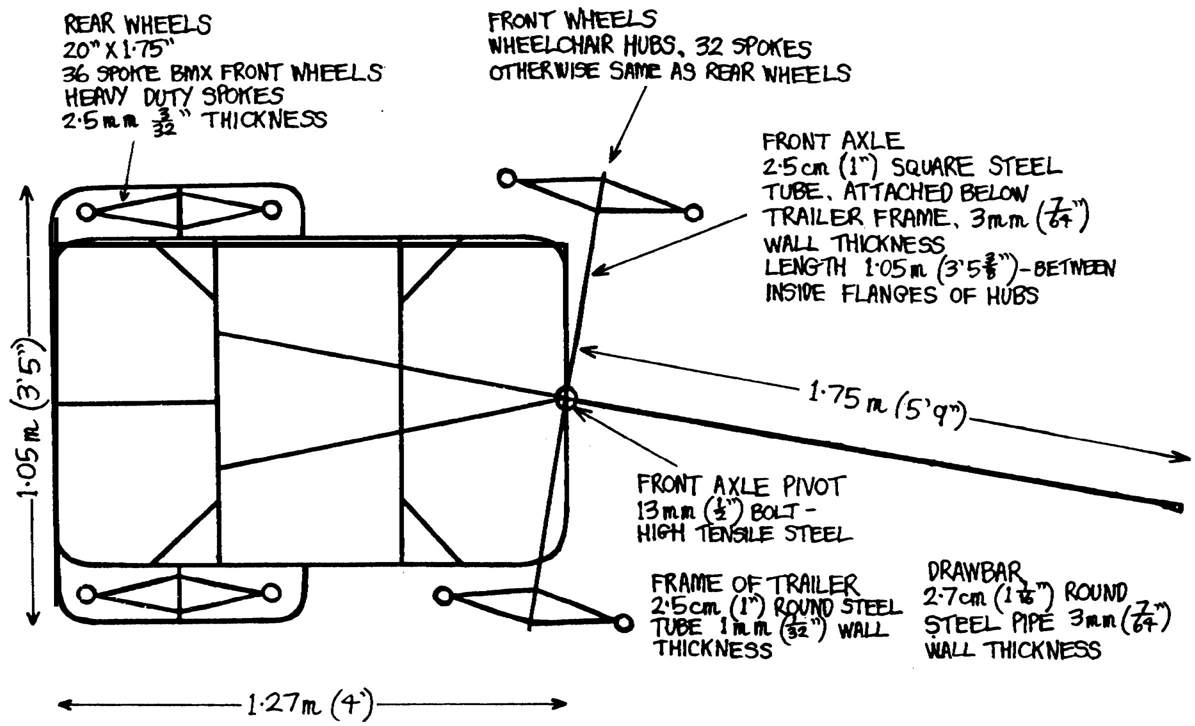
Because the weight is spread over 4 wheels instead of 2, the maximum load a 4 wheeled trailer can carry is roughly twice that of a 2 wheeled trailer. This gives a maximum loading of 500-600 kg. This is not allowing for other factors such as steep hills, bumpy roads, lack of low enough gears on the bike, strong headwinds, fitness or otherwise of the rider, etc. In practice the limitations to maximum Loadings are these other factors,

Watch out for bumps or potholes in the road - a heavy load that can be easily supported on a smooth road will rapidly destroy wheels that quickly travel over very rough sections of road. Steer around them, or if you can't, slow right down to a slow walking pace. Collapsed wheels aren't much fun.

Because the design considerations talked about in the 2 wheeled trailer article apply equally to 4 wheeled trailers (except for balance as already mentioned) I won't go into much detail here, except to point out a few ideas based on my experience with my own trailer. I have found the drawbar (the connecting strut between trailer and bike) made of 3/4" steel waterpipe is strong enough for the job. Waterpipe is labelled by its inside diameter - its outside diameter is 2.7cm (l-1/16") and wall thickness is 3mm (7/64"). You may find, like me, that you don't need brakes on your trailer, When the trailer is lightly loaded, I can stop from high speed quickly enough with just the brakes on the bicycle. When the trailer is very heavily loaded, I find I'm able to travel at only 15 k.p.h. or so, slow enough to stop safely just with the bike's brakes. The load regulates the speed! Anyway, it could be an idea to try your trailer without brakes before going to the extra work and expense of putting them on.

My trailer heavily loaded seems to head into a corner better than a heavily loaded 2 wheeled trailer. I think this is because the dynamics are different because it is articulated - it 'steers' into a corner like a car, reducing the tendency for the trailer and load to keep going straight. Maybe this is why I don't have control difficulties even though my towbar is mounted on the back of the rear rack on my bike - in theory an undesirable position (see the discussion in the 2 wheeled trailer article on the centre-of-turning and the desirability of mounting the towbar/pivot point further forward).



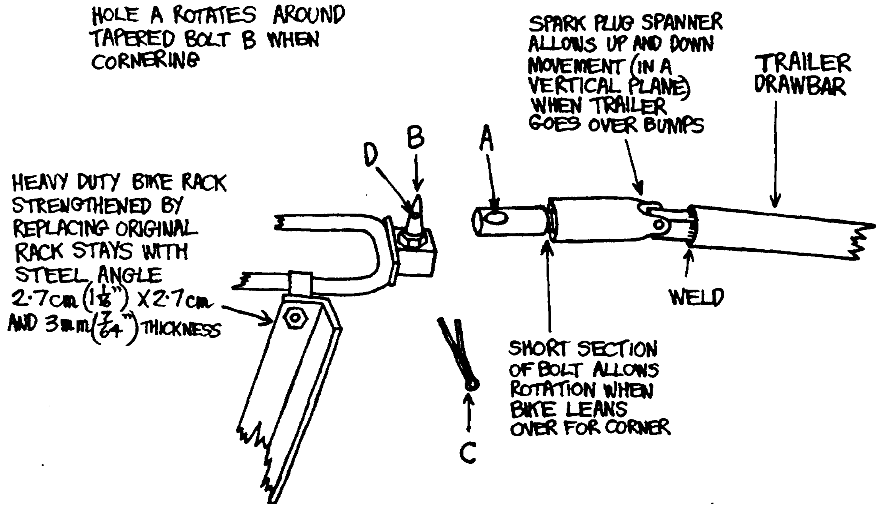


The drawings of the trailer should give you a fairly clear idea of how I built it. Modify the materials according to what you have or can get cheapest or free. Substitute materials only of equal or greater strength to those listed. I used round steel tube cut from discarded school desks for the frame, The pieces I then oxy-welded together. I rescued an old wheelchair from the tip, and dismantled the wheels to obtain the hubs. I took the hubs to a bike shop and had the front wheels built. The wheels were the biggest expense - about $90 for the 4 of them. Since I had the other bits and pieces of steel already lying around in the yard at home, the only other expense was about $15 worth of welding gas. So for about $105 I had the whole thing together.

For more details, please contact Tony Murphy, at the Alternative Technology Association, 366 Smith St., Collingwood, Vic. 3066, ph: 419 0250 or 419 8700.

The Alternative Technology Association is organizing an information night on bicycle trailers in August or September - watch your newsletters for a date. We'd like to get a few people to bring their own trailers to show everyone and generally pass a few ideas around.

So if you're interested in this please contact the Alternative Technology Association on 419 0250 or 419 8700.



Hole A is slipped over tapered bolt B, then split pin C is inserted through hole D. Split pin holds trailer coupling on towbar, and provides easy 'no tools' quick release of trailer, Split pin can be easily compressed by finger pressure to fit through hole, and on releasing pressure after insertion, springs back to position as on drawing, and can be reused many times.

The Law and Bicycle Trailers

I have been stopped by police several times - their immediate reaction is: "What you've got there is illegal!" So I was inspired to check on the law. In Victoria (I assume it's the same in other states though it would be worth checking) there is no law relat-. ing to trailers towed behind bicycles. This puts the responsibility for good design and construction on the individual builder. Providing people take this seriously, and don't build trailers that are unsafe and cause accidents, there never needs to be a law about bike trailers. A good way for it to stay:

This is all very clear when we're talking about carrying luggage, shopping, non-human passengers, etc. But when we start talking about carrying human passengers on trailers towed behind bicycles, things get more complicated. There is still no specific law on this, but a bicycle is considered to be a 'vehicle' in relation to road traffic law, and generally laws that apply to cars (having lights at night, staying below speed limits, etc) also apply to bicycles. There is a law prohibiting human passengers from being carried in a caravan or-trailer towed behind a car. 'This is for safety reasons - the caravan might come loose from the car, caravans are very fragile and don't offer the same protection from injury as a car during a smash, they don't have seatbelts, etc. But there is also a law allowing human passengers to be carried on bicycles providing they are properly designed and built for the purpose, or have been modified by the addition of a properly designed and built seat (e.g. a baby carrying seat).

When is a device towed behind a bicycle only a trailer, and when is it a properly designed and built vehicle for the transport of human passengers? When *is* it legal and when is it illegal? Of course there is no answer, and there won't be a definitive legal answer unless someone has the misfortune to be brought before a court (perhaps if passengers on a 'trailer' *were* killed or injured, and it was alleged such a 'trailer' was illegal and a contributing cause of the accident), I would argue that the safety concerns about car caravans don't apply to bicycle trailers because travelling on bicycles involves being out in the open unprotected anyway, whether you're on the bicycle or the trailer,

Don't get the idea I'm trying to discourage passengers from travelling on bike trailers - I carry friends on my own trailer. I am encouraging people to be safety conscious. To provide for the comfort and safety of your passengers, as well as putting yourself in a good position if the legality of your trailer should be questioned, I suggest the minimum you need is a seat and some footrest arrangement to prevent people's feet dangling on the road. The seat could be just an old kitchen chair with the legs cut off attached to the trailer frame, and the footrest could be a piece of board, both easily detachable when the trailer is used for other purposes. For young kids a boxed in compartment with fairly high sides is best. Seating can then be attached inside. It helps to have some particular physical characteristic to point to as satisfying the 'properly designed and built' requirement.

Make sure the linkage between the trailer and bike is very strong. If you've just built a trailer, test it carrying things around for awhile before carrying people. For after dark use, have reflectors and lights attached to the trailer. For daytime use, consider painting the trailer a light colour, or having passengers wear bright coloured clothes or a bike vest, Bicycle helmets for passengers are a good idea too, Anyway don't let all this talk of laws and accidents get you depressed, bike trailers are fun, it's like being a kid playing around in billycarts again!

TONY MURPHY

Solar Greenhouses Continued...

5.0 Conclusion

This type of greenhouse is not new. Its ancestry goes back to the Canadian Brace Research Institute which built such a structure in 1973. However, to the author's knowledge the existence of performance of such a greenhouse in Southern Australia has not been reported Certainly, the horizontal rockbed represents a novel technique not yet tried fro greenhouses. Operating experience and results from both the "active" rockbed adn the "passive" water barrel systems will enable conclustions to be dreawn as to the suitability of this type of greenhouse to our climate.