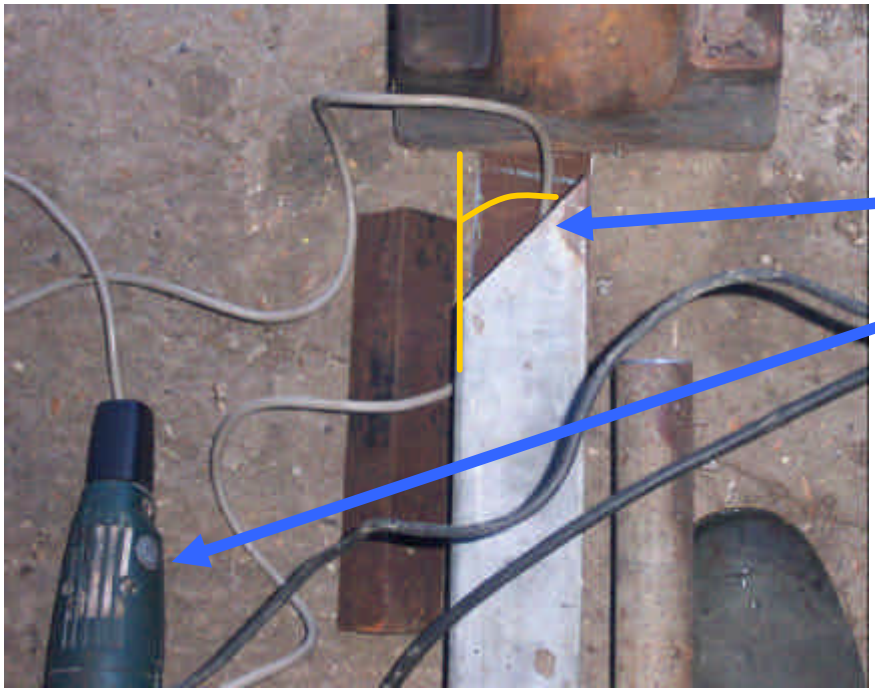
TOWER CONSTRUCTION

Due to the design specification that Mr Bigin has set, that the materials must be re-used I started this tower design by getting what materials I could find. I was lucky enough to find a local farmer who was taking down an old rotten barn. I had asked him if there was any descent metal tubing, box section or pipe that I would be able to use on this school project. He gladly gave me these two U shaped door hangers. These are clamped to the top of the door opening and big doors with appropriately shaped wheels are slid up and down the track thus opening and closing the door that they are attached to.

I found these two pieces to be very strong and so decided to use them to construct the tower with. Each piece is 5.5meters long which means the tower will be 11meters tall.

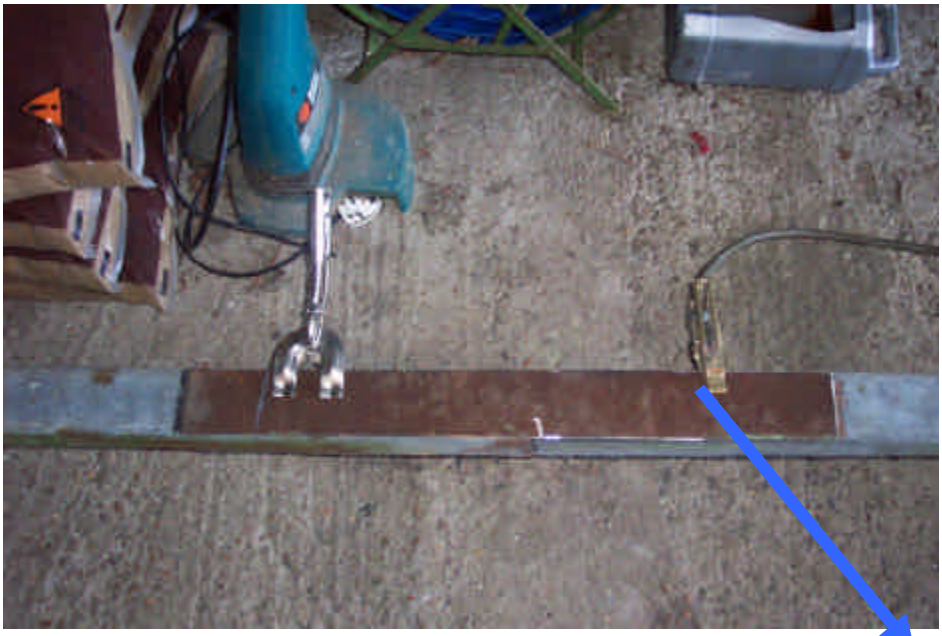
To start with I decided to make a hinge between the two pieces out of some more 3mm steel sheet which came from an old 1000litre oil container from a local scrap merchant. This will give two sections: one that stays up right in the tower base box and another that can be lifted to erect the wind turbine. I then found out that masts on old sailing ships used a 45 deg angle on the ends of the mast so that they lock them self into position when force was applied to them. This is what I did with these two bits, I cut a 45 deg angle into the ends with an angle grinder



As you can see this is one piece of the U tubing with the 45 deg angle cut into it with the angle grinder on the left of the photo.

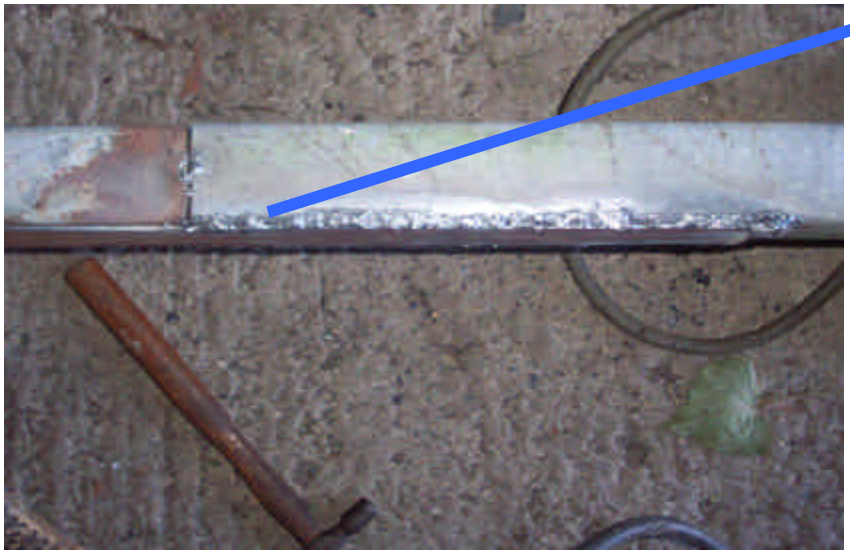
I made the hinge for the tower out of 3mm steel sheet that I cut into strips that are the same width as the U tubing. I simply drew on the sheet steel against a straight edge using a piece of chalk. Then I cut this hinge piece with the angle grinder again.

Once I had cut two of these plates out they where welded onto the bottom piece of U tubing. An arc welder was used which uses electricity to melt and fuse metal together. These welds where amply strong enough to hold the tower hinge together.

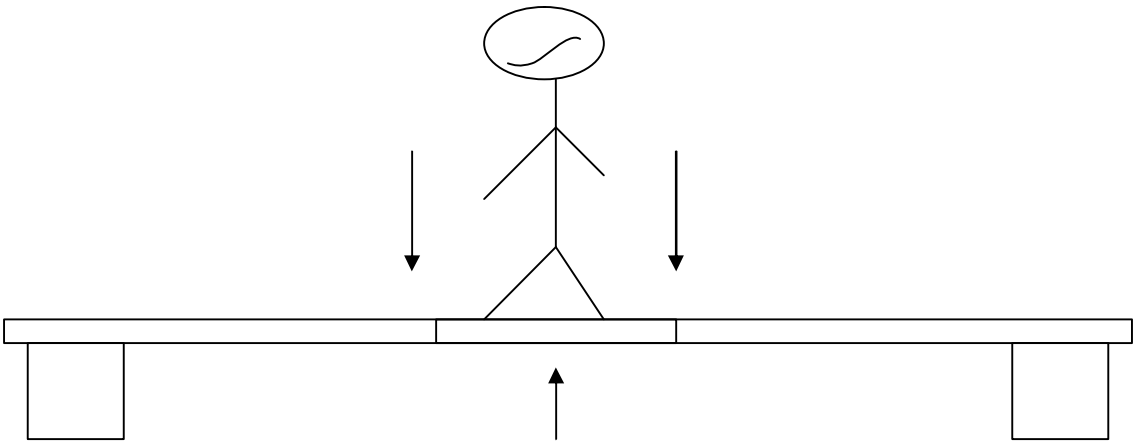


These pictures show the weld on the hinge piece and it also shows where the two pieces of U tubing are arranged. As well as the tower joined via the hinge.

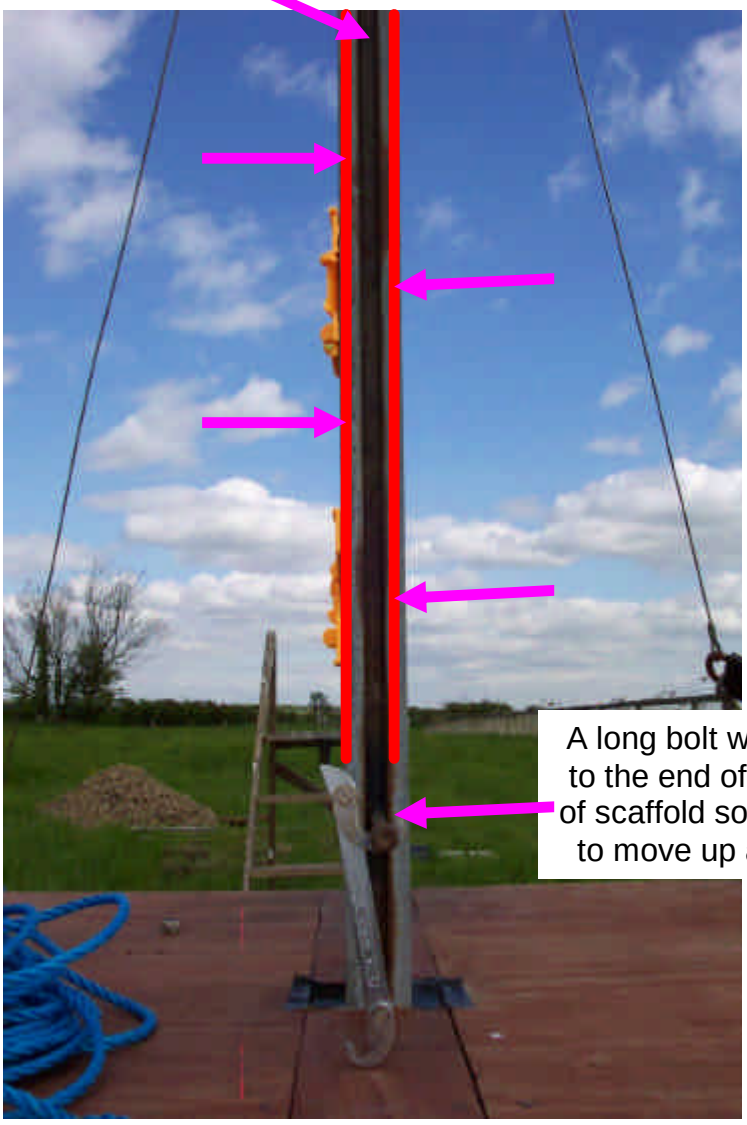
After the plates had been welded on I drilled two holes through the hinge and the top piece of U tube. The top hole will have a bolt though it to act as a pivot point and the second whole will have a bolt through it when the tower is erected. This second bolt will act like a lock to stop the top piece from moving



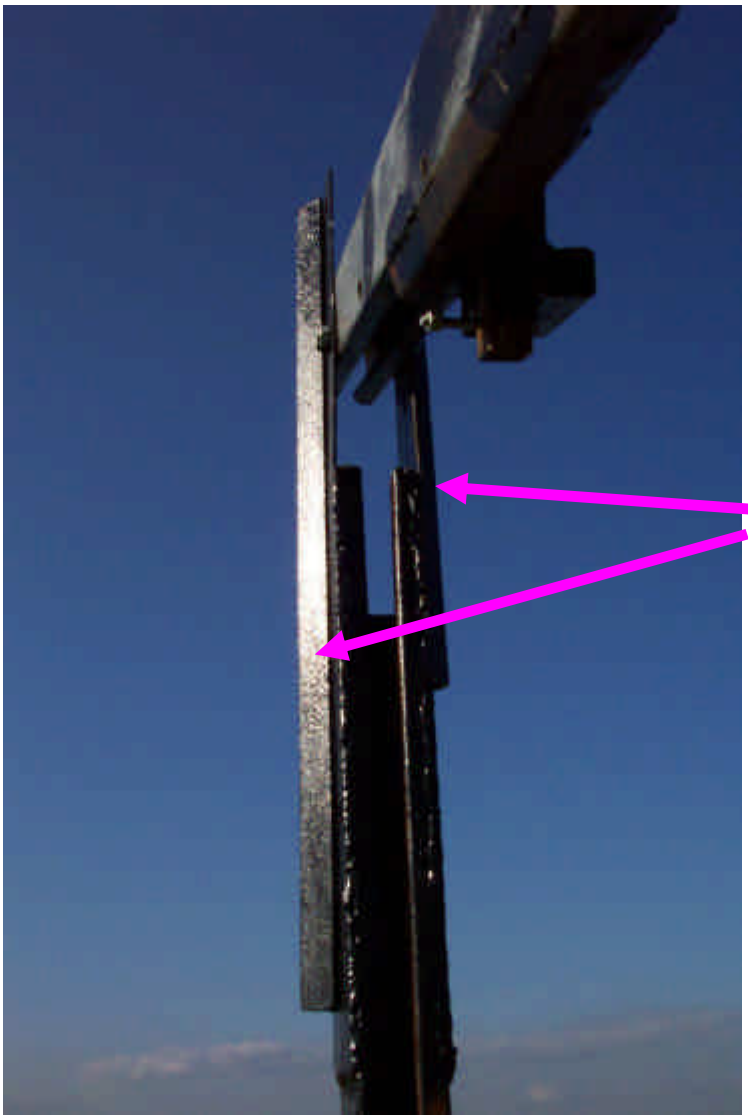
I tested the tower frame to make sure it was strong enough to hold the wind turbine. I did this by suspending the tower on two stands at each end of the tower and then I stood in the middle and bounced to simulate the wind which will try to do the same.



I found that there was a little movement so I decided to cut a piece of a scaffold pipe that I push up and down in side the tubing between the hinges so that the hinge area is supported internally. This piece of scaffold can slide down when the tower needs to come down or be lifted.



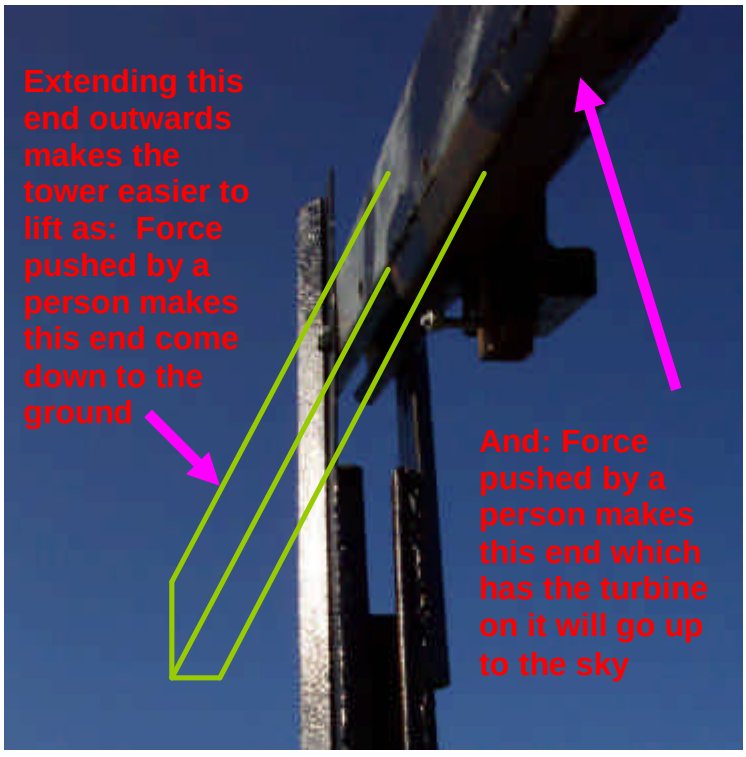
A long bolt was welded to the end of this piece of scaffold so it is easier to move up and down



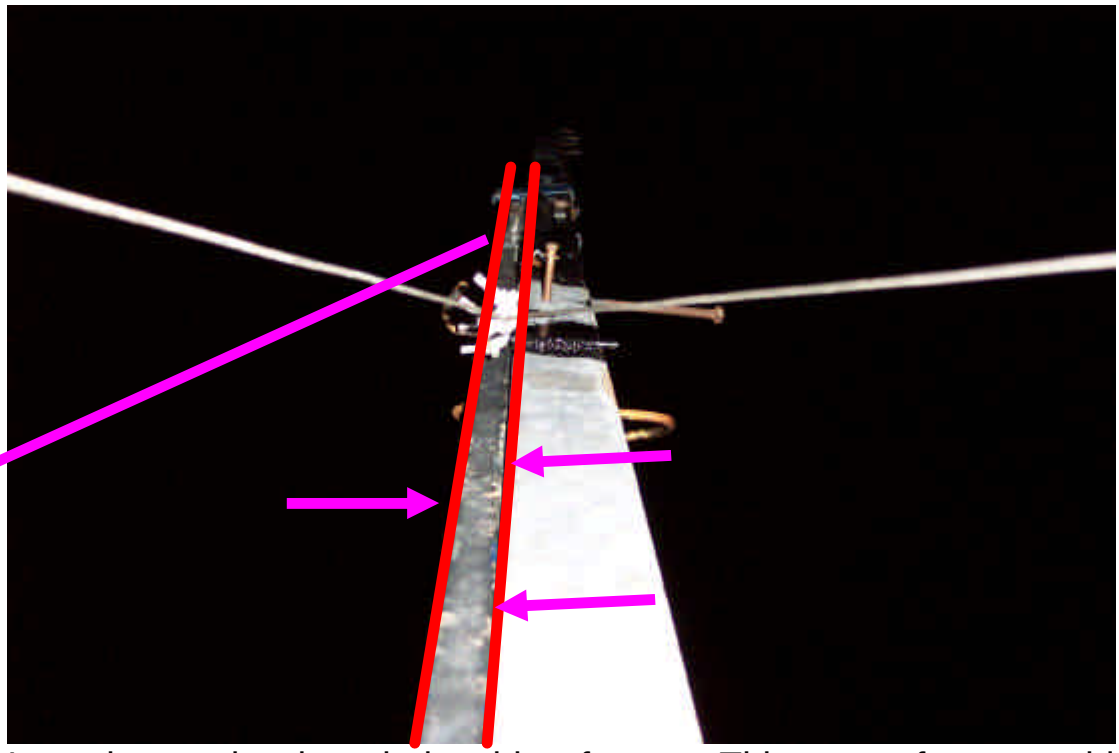
I continued to test the tower by tying to erect the top piece without any thing on it. I found that it was very difficult and that my hinge was simply not rigid enough to take the top tower piece. So I had to add some sort of extra bracket and I came up with the idea of using angle iron to stop left to right movement. But only one side was welded the hinge could still be tightened up.

This proved to be very effective and stop all of the left and right movement and it has also helped to transfer the vibrations into the tower base as well.

There was still the problem of being able to erect the top part of the tower easily. So I looked in some steam engineering books and saw how old large steam engines used a leaver to transfer the kinetic forces. This design is a bit like a seesaw, the wind turbine sits on one end and you push the other end to lift it upright. This is a large alteration that I could only do once the tower was constructed.



Here you can see the tower in its erected state, you can also see the extended leaver which is made from the same box section that



I used to make the wind turbine frame. This came from an old partly rotten boat trailer and is approximately 4.5 meters long.

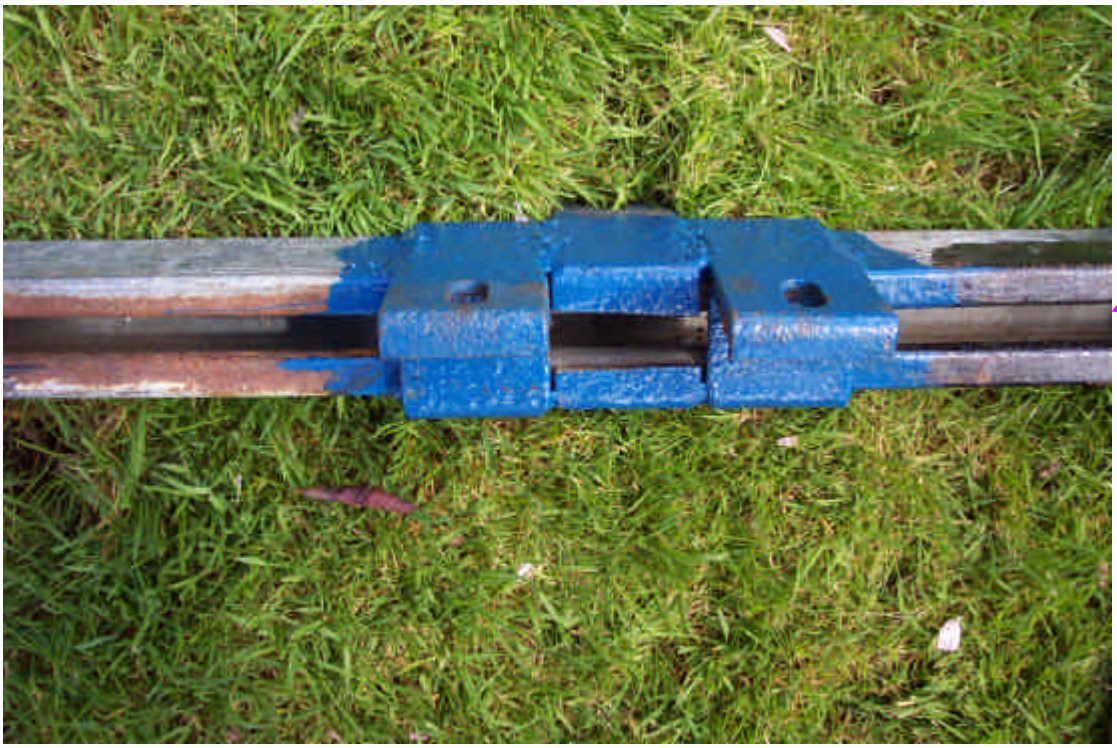
This picture shows how the extension pole has been welded to the top piece of the tower. I have also painted it to stop it from rusting which will increase the metals life time.

A bar was also welded to the other end of the extension piece to make it easier to control the tower during lifting and lowering. This also got a coat of paint to stop it from rusting.

The top part of the tower needs some means of attaching the YAW bearing from the wind turbine frame. To do this I decided to use more scaffold clamps as they our very strong and are designed to cope with large forces such as the ones the wind turbine will exert. These also got welded to the top of the tower. But this time I got a professional welder to do this as it is imperative that this all holds up to the forces of the wind turbine blades pushing and vibrating on and down the tower.

I also asked the professional welder to weld the YAW bearing which is smaller then the clamps can hold into a 1 meter long piece of scaffold. This scaffold can now be clamped by the scaffold clamps.

The picture shows the hangers which here used to hold the U tubing to the barn. I simple cleaned them up and welded them to



the top part of the tower this is where the guy rope from the ground anchors will be tied to.

The tower is now completed.