EXPANSION LINK

BASINGSTOKE and DISTRICT MODEL ENGINEERING SOCIETY

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Editor Austin Lewis

Linda - the Ffestiniog Railway

Photo Austin Lewis

Sorry that this edition is rather late but unforeseen circumstances contrived against me - Editor

A Journey into CNC Machines - the Momus Router

Richard Holt

A friend and I each decided we would like to build our own CNC machine. CNC stands for Computer Numerical Control and it refers to the notion that a design held in a computer, can be used to guide a tool in three dimensions to produce the physical object. Rather than inventing the whole machine we decided to use a published design and the one we chose is called 'Momus'. The Momus project made certain claims which might be worth checking on completion. The cost of the very comprehensive set of plans was US $20.

The publicity showed the final machine to look like the image below.

Some of the design attributes that attracted us to this project are:

- Low construction cost
- Easy construction with simple tools
- No welding or machining necessary
- Fully enclosed
- Compact and self-contained
- High level of accuracy and precision
- High cutting speeds
- High machine rigidity at this price
- Capable of cutting a wide range of materials
- Competitive with light commercial machines costing many times more

The publicity also suggested an overall build time of 48 hours and a final cost of about £325 plus the cost of the stepper motors, electronics and spindle.

The base and lid of the machine are constructed from 2 off 8' x 4' sheets of ¾" 'cabinet grade' plywood. That is 18x1220x2440mm in metric terms. We were fortunate that we had a friend with a saw bench. This helped with ensuring the dimensions of the wood parts were reasonably consistent.

On 7th October 2014 we turned up with our sheets of plywood and our set of plans to make a start. We began by carefully measuring and cutting the parts. It's worth saying here, that as the plans originated in the USA, all of the dimensions were in imperial units. It became obvious, very early on, that we needed to keep careful track of the component parts. The design optimised the use of the plywood to leave very little waste.

Once all of the base parts had been made construction could begin. The base was designed as a torsion box, which is very strong. Rigidity is all when making any sort of machine tool.

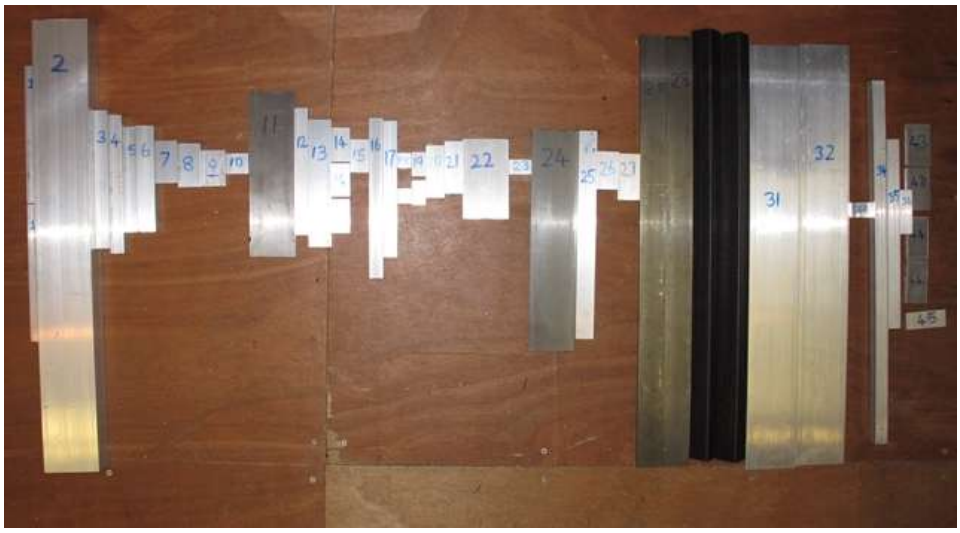
The ribs were glued and screwed onto the base board. The positions of the screws were noted, so that when the top was added we could avoid them.

With the top of the torsion box in place the front and rear sections were added, along with the side walls. One of the sidewalls was constructed to allow the electronics to be housed inside it. Both side walls would eventually support one of the machine axes.

Eventually the base was completed, and it was time to get out the sandpaper, wood filler and paintbrushes.

With the base woodwork behind us (there is still the lid to make) we could now concentrate on the metalwork. It turned out to be surprisingly easy to purchase lengths of aluminium bar with imperial cross section, but in metric lengths. The benefit of making two machines came to the fore when buying the metal, as minimum quantities didn't leave us with much left over. Our one compromise to metric came when we bought the nuts, bolts and washers. We found it far easier, and more economic to buy the metric equivalents.

The first task was to cut the various piece of metal to size. Again inventory control made subsequent handling a lot easier.

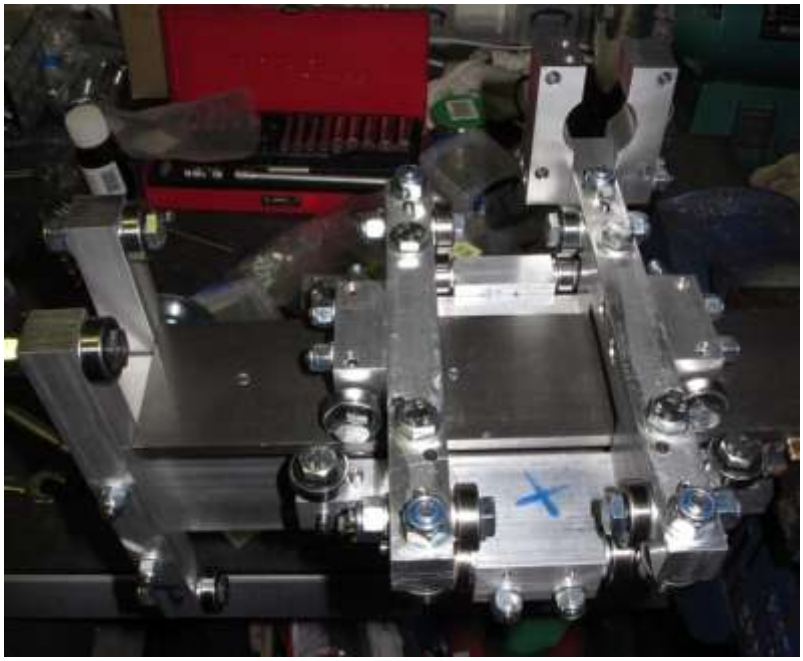


We chose our friend with the saw mill well as he also had a Bridgeport mill. This made manufacture of the metal parts easier, especially as we were making two sets of parts.

The first unit to come together was the main gantry. This will run along the walls of the wooden base and support the carriage which ultimately holds the working spindle.

The key part of the design is the carriage. Its assembly proved quite difficult as many of the component parts are 'handed'. Overall it needed to be dimensionally correct as well as maintaining perpendicular alignment. It wasn't always obvious when manufacturing the individual parts what function some of the myriad of holes would eventually perform. However, it was gratifying to note that we had managed to interpret the drawings correctly, as the assembly took shape.

All axes are controlled by standard ABEC7 bearings riding on cold rolled steel (CRS) rails. It was surprising how many bearing can be fitted into such a small space.



Once the bearings had all been attached it was time to offer the carriage onto the gantry, and see if it would fit.

The basic design concept can be seen. The bearing grips the top, bottom and each side of the guide rails. Adjustment of the bearings was by grub screws set to press on each of the axles. The use of metric bolts didn't seem to cause too many problems in the range of adjustment available.

Two of the axes of movement are controlled by stepper motors and rubber timing belts. This gives fairly repeatable movement, and removes the problem of backlash.

The third axis in this design uses a stepper motor and lead screw. This has the benefit of increased precision, but introduces backlash as the leadscrew is switch from drive to return.

There are various regimes to remove the backlash, the one we chose was to make an anti-backlash nut. The anti-backlash nut can be seen just below the 26 written on the main fixing block. A flexible coupling (called an Oldham Coupling) between the stepper motor (the black lump at the top of the picture) and the lead screw, helps to resolve any alignment problems between the two parts

A general view, from the rear of the machine, showing the completed mechanical assembly mounted on the side walls, and with the three stepper motors. In the side pockets the electronics to drive the motors is also visible.

And finally the lid was assembled and fitted.

So after a bit of filler and a coat of paint, the machine is completed on 2nd February 2016.

Some of the test pieces I've made on my machine have included wood, aluminium and brass items.

It took approximately 44 hours to cut and assemble the wood parts, 74 hours to fabricate and assemble the metalwork, and 6 hours to make the lid. A total of 138 hours against the published time of 48 hours – maybe the next one will be quicker!! My spend on the machine was only £7 over budget, and we managed to get a good deal on the stepper motors and electronic parts, with buying two sets.

Overall the Momus machine is 32” (w) x 28” (d) x 26” (h), and the useable bed area is 15” x 12” x 6”. The torsion box base has made it feel quite rigid. It will machine plastic and wood easily and engraves aluminium and brass quite well. With care it can also machine aluminium and brass, using light cuts and gentle feed rates.

Now all I need to do is to learn how to use it.

Richard Holt

AGM 2016

Don’t forget the AGM in November, probably around the 16th but the date is still to be confirmed.

RHEILFFORD FFESTINIOG - The Ffestiniog Railway

Porthmadog, Wales

by Austin Lewis

During this summer my wife and I, together with my brother and his wife, explored some of the many narrow gauge railways in North Wales. These were the Ffestiniog, the Welsh Highland Railway, the Llanberis Lake Railway and the Great Orm Tramway. Photos from these visits will form the basis of a few articles to come starting with the Ffestiniog Railway.

Parts of the following text are from the guidebook published by the Ffestinog Railway Company with my photos.

In 1883 the Ffestinog Railway began the use of steam locomotives to haul trains of empty slate wagons from the harbour at Porthmadog to the quarries at Blaenau Ffestinog. Two of these locomotives were named *Prince* and *Princess* reflecting the widespread interest in the marriage of the Prince of Wales, the future Edward VII, to Princess Alexandra of Denmark. A third was named *Palmerston* after the then Prime Minister who was also an investor in one of the Ffestiniog slate quarries.

Porthmadog station looking towards the Cob

Linda at Porthmadog station

Built barely more than 30 years after Stephenson's Rocket, these George England engines are the oldest surviving narrow gauge locomotives in the world. Remarkably, after 150 years, four of the six built still survive, two of them in regular use and a third – *Welsh Pony* - is currently being restored to full working order.

Photo of *Welsh Pony*, Ffestiniog Railway Company

The Ffestiniog Railway began its passenger services on the 5th January 1865, with tiny four wheeled carriages used to convey its first intrepid travelers. Victorian tourists soon discovered the railway and beautiful ornate bogie carriages were built to satisfy this new market. As the slate industry declined, visitors replaced the slate traffic and became the mainstay of the line but those same Victorian carriages remained in use until the outbreak of WW2. Since the reopening of the line in the 1950s the increased number of visitors has required the building of new carriages to cope with the demand. However many of the original coaches are still running and have

been returned to their former glory by the receipt of Heritage Lottery Funds. A new workshop has been built to allow full restorations to be undertaken together with training facilities.

Stone embankment of Cei Mawr

The journey starts from Portmadog along a sea wall named the Cob and past the first station and loco works at Boston Lodge. Climbing away from the coast up the valley past Boston lodge with its old locomotive shed rebuilt to it's former Victorian glory the line continues to climb through a short tunnel and past the Garth Quarry which started with the production of granite setts in 1870. After passing Minffordd and Penrhyn the track travels along a dry stone embankment, sixty feet high, known as Cei Mawr.

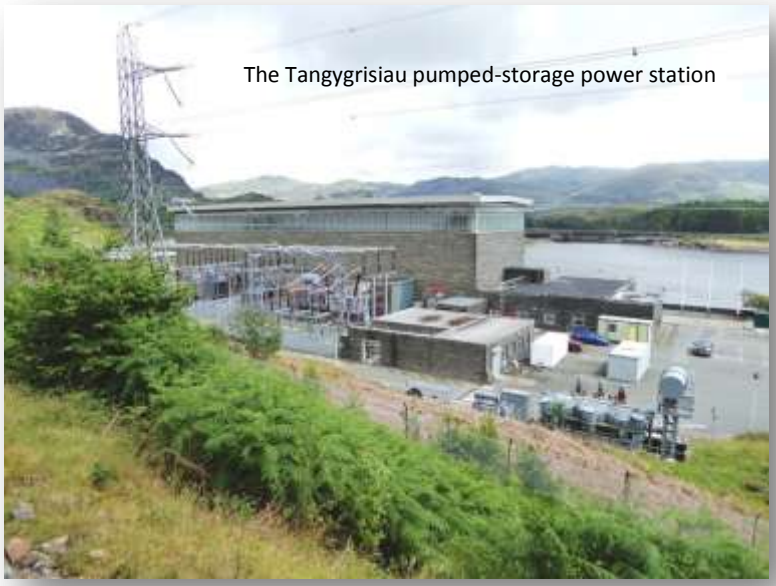
The train takes a sharp left and plunges into a deep curved rock cutting – Tyler's curve. Curve after curve the train approaches Tan y Bwlch. This station has a passing line and so a few minutes are spent here awaiting the oncoming train returning back to Porthmadog. A few minutes after leaving Tan y Bwlch the train slows to negotiate the short but very restricted, Garnedd tunnel which is only just wide enough for the train. This is a stark reminder to passengers, to never stick their head out of the window of a moving train on the Ffestinog railway.

Beyond a sweeping right hand curve there is a tiny halt with an intriguing name of Campbell's Platform. This was originally a private station for the use of Colonel Campbell, a solicitor, builder and licensed shot firer who lived in Dduallt Manor. Colonel Campbell did much of the blasting needed on the 'deviation' line above Dduallt in the 1960's and 70's. Passing under a bridge, the train enters Dduallt station. Going around in a spiral the railway crosses over itself at Dduallt, this being the only such spiral in Britain. In the late 1950s the route of the old railway from north of Dduallt was blocked by the construction of the Tanygrisiau pumped-storage power station and Llyn Ystradau reservoir which drowned the trackbed.

The old trackbed

The solution adopted was to build an alternative route – the deviation – to the west of the reservoir, with the Dduallt spiral being constructed to raise the level of the line to join with the old track past the reservoir.

The deviation



The Tangygrisiau pumped-storage power station

Towards our final destination – Blaenau Ffestiniog

Blaenau station

The footplate of *Linda* in its present guise as a 2-4-0STT (saddle tank with tender). The loco was built by the Hunslet Engine Co. in 1893. It has two 10 ½" diameter cylinders each with a 12" stroke. She is an ex Penrhyn Quarry Railway loco and originally built as a 0-4-0ST. Acquired by the FR in 1963 and coupled to a modified George England tender. Fitted with a superheater in 1969 and rebuilt as a 2-4-0STT in 1970. Wheel diameter is 2' 2" and working pressure 160 psi.

Earl of Merioneth / Larll Meirionydd. A Fairlie Patent double-bogie locomotive designed and built in Boston Lodge in 1979 and being the first Fairlie built worldwide since 1911. The loco was built with oil firing but she was converted to coal firing in 2006. She is fitted with a Hunslet superheated boiler and bogies were initially from *Livingston Thompson* but is currently running on bogies built in 1986/87 for another loco *Merddin Emrys*. She has four 9" diameter cylinders with 14" stroke, the wheels are 2' 8" diameter and working pressure is 160 psi.

End of the day and coaling for tomorrow

Basingstoke & District Model Engineering Society Ltd 2016 Calendar

(Issue 2)

January

1	Members Day (Friday)
5	Meeting Night
16/17	Maintenance Weekend
19	Bits & Pieces Evening

February

2	Meeting Night
13/14	Maintenance Weekend
16	Meeting Night
28	Driver/Public Running Training (Sun)

March

1	Meeting Night
12/13	Maintenance Weekend
15	Bits & Pieces Evening
29	Meeting Night

April

3	Driver/Public Running Training (Sun)
9/10	**Miniature Steam Gala**
12	Meeting Night
23	**Public Running (Sat): Queen's 90th**
26	Bring & Buy Evening

May

10	Stationary Engines
15	**Visitors' Open Day (Sun)**
24	Meeting Night

June

5	**Public Running**
7	Bits and Pieces Evening
18	Members Running & Barbecue(Sat)
21	Meeting Night

July

3	**Public Running**
5	Meeting Night
10	Members Running Day (Sun)
19	Meeting Night

August

2	Bring & Buy Evening
7	**Public Running**
16	Meeting Night
30	Meeting Night

September

4	**Public Running**
11	**Visitors' Open Day (Sun)**
13	Meeting Night
24	Members Running Day (Sat), incl. Fish & Chip Supper
27	Meeting Night

October

2	**Public Running**
9	Members Running Day (Sun)
11	Bits & Pieces Evening
25	Meeting Night
29	**Halloween Public Running (Sat Evening)**

November

8	Bring & Buy Evening
13	Members Running Day (Sun)
16	AGM (Date to be confirmed)
22	Meeting Night

December

4	**Public Running**
6	Meeting Night
20	Meeting Night

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