Mini-bike excitement hits schools

PHOTOGRAPHS: ROGER EMMERSON

Out go toolboxes, candle-holders, metal stools.

Here come mini motorbikes.

By Roger Emmerson

The idea of the air-cooled mini-bike as a school project for Year 12 and Year 13 students has its roots in a reaction to the introduction of NCEA Technology back in 2002. Like many other technology teachers at the time I embraced the new curriculum, believing it was the right way forward for the future. How wrong I was.

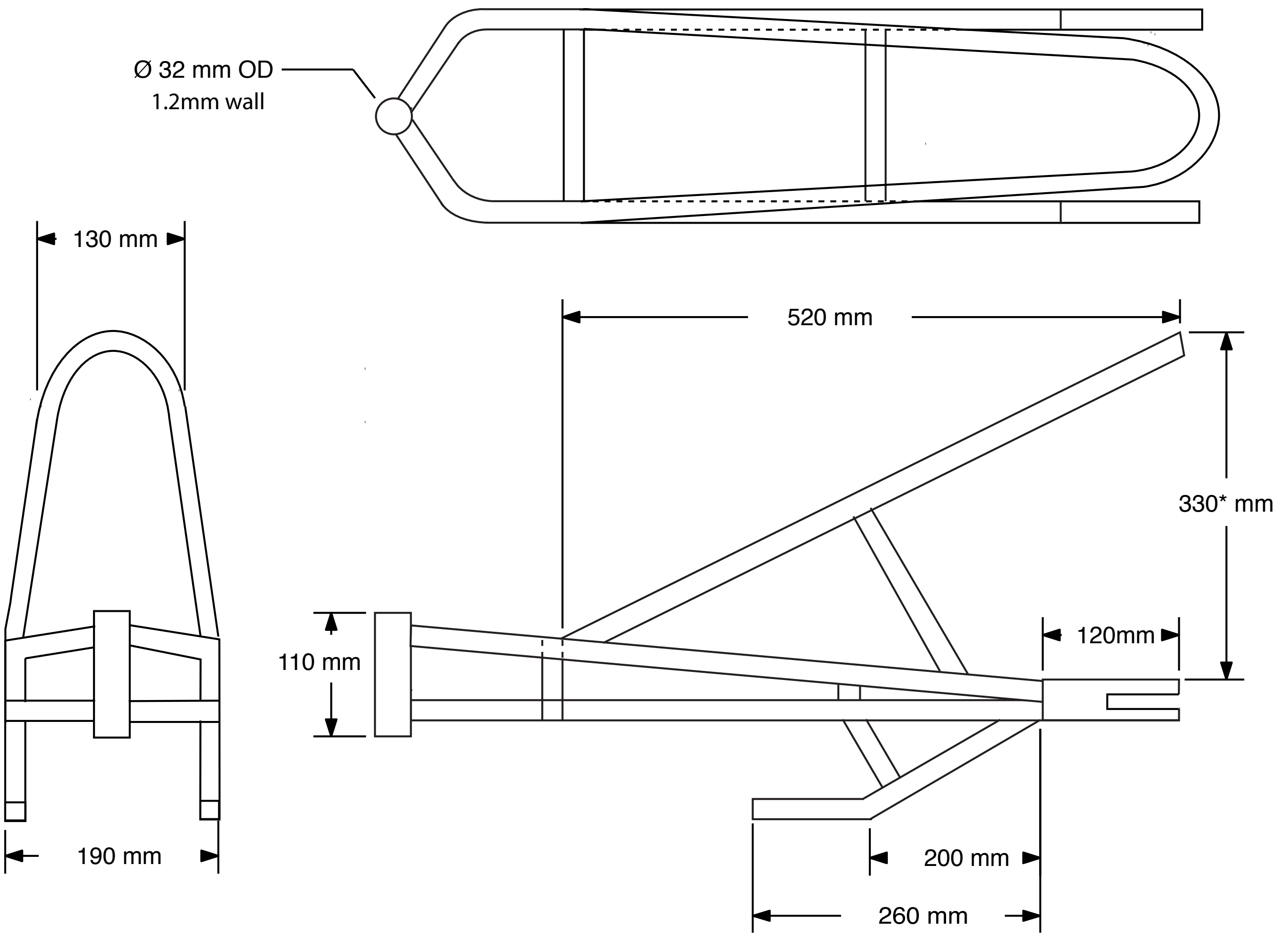
Student numbers went into freefall; pupils were walking away from the subject in large numbers. The previous year, 2001, I had pupils that achieved six A grades and five B grades in the old School Certificate. But in 2002 my morale and more importantly the morale of my students was at a low.

My opinion changed completely when an ex-pupil visited and said that the school's technology course had done nothing to prepare him for his apprenticeship as a cabinet-maker. Like others, I felt that we must change and deliver courses that prepared and equipped 17-year-old school-leavers with skills, experience and interest for future employment. I firmly believe that young people learn better and enjoy the learning experience if the learning vehicle is interesting and exciting.

About this time Competenz came to the rescue in the form of the

Year 12 student Troy Simonsen beside his 49 cc air-cooled machine.

Steel formed in hydraulic pipe-bender.



local East Coast Competenz manager John Edwards. A meeting of like-minded teachers resulted in four schools deciding to build petrol-miser vehicles. The finished vehicles and resulting theory work would be assessed via Competenz Industrial Unit Standards and the credits achieved would go towards Level 1 and 2 qualifications.

Tube-bending jig.

Enthusiasm

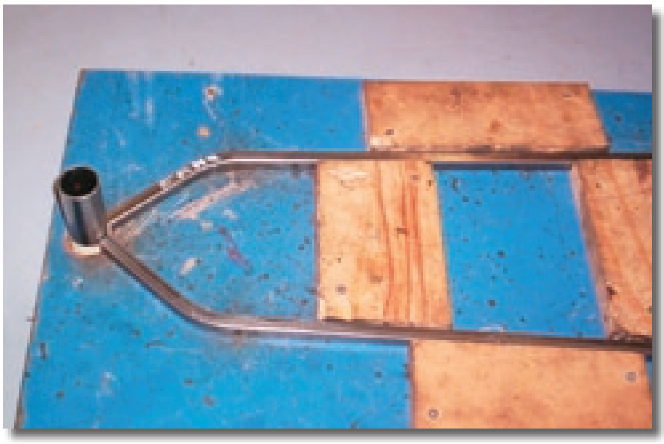
The decline in numbers and enthusiasm slowly started to reverse but of course, kids being kids—"who wants to save fuel and go as slowly as possible?"—the project soon morphed into teams of three building go-karts with golf cart wheels, powered by donated old chainsaw motors from a local shop.

The pupils' enthusiasm was soaring by raceday at the end of the year which was the high-point of the course. Pupils were in the workshops before school, at lunchtimes and after school. In fact, it was becoming increasingly difficult to keep them out. Some even resorted to climbing through unlocked windows to continue with their projects.

One student always became the leader of the project group. However, the problems of who did what part of the project for assessment purposes and, more importantly, who could buy the go-kart and take it home were insurmountable and a prickly problem.

Mini-bikes

The next year I decided to change direction and we started to produce very simple but crude air-cooled mini-bikes. For the first time in many years, the popularity of the subject was increasing and I had more pupils who wanted to study



Ladder frame jig.

Ladder frame jig.

Top frame jig.

Basic frame.

engineering and make the mini-bike than pupil places in the class. The new or should I say "old" traditional approach, albeit with a new interesting twist, was bringing rewards.

At the end of the year, pupils were being placed into work experience by the very supportive local Competenz team. These placings were becoming firm offers of employment at a rate of about six per year. This formed my philosophy of making engineering a fun, interesting and rewarding subject to learn and to teach. No more toolboxes, candle-holders, metal stools and tables. Inanimate objects were very definitely out.

Attitude change

Sure, this was only the beginning and looking back the bikes were very crude compared to what we expect from the pupils now. This change in attitude has been brought about by a number of factors: the coming together of four schools who wanted something better for their pupils, the entrance of Tools4Work as a provider of school-based pre-apprenticeship engineering qualifications and the fact that the project could be greatly enhanced by inter-school competition and rivalry.

To achieve this we had to formulate specifications which could be followed and achieved in the average school workshop and be guided by teachers that may not necessarily be motorcycle-orientated. The specifications are based upon the New Zealand Mini Moto specifications so that pupils could enter their "home-made" machines at events at local go-kart tracks. Some ex-pupils have done this very successfully.

Manfeild

The four schools started to produce mini-bikes based on these specifications last year. These specifications allowed for plenty of different design solutions. Each school went down its own design route. We still needed a track to hold our first true mini-bike competition on.

As I am now teaching at Feilding High School I decided to approach Manfeild Raceway, initially to use their large car park. They said why

SCHOOL MINI-BIKE SPECS

The engine must be no bigger than 50 cc air-cooled, two-stroke. Not permitted are gearboxes, suspension or chopper-style machines. The frames must be steel construction, brakes should be fitted front and back, the maximum seat height is 500 mm, the maximum length axle-centre to axle-centre is 850 mm and handlebars and footrest pegs must be fitted with nylon plugs.

First Fifteen test.

MIG-welded frame.

Headstock with golf kart bearing race inserted.

not use the 1.5 km circuit and ask the Universal College of Learning (UCOL) if they were interested in sponsoring the event. All of a sudden the brakes holding back the idea and the event came off.

The Manfeild publicity machine swung into action. Newspapers and national TV wanted to find out about this “new approach”. Why were pupils so enthusiastic about the project? I think we, the readers of this article, know why this project is so successful. It gives the pupils a positive and exciting learning experience with terrific outcomes that they can be proud of. They learn accuracy, machining skills, welding assembly and mechanical skills.

Construction

Every school has a different design ethos and requirements. The Feilding High School 2009 intake rose to 68 (50 Year 12 pupils and 18 Year 13 pupils), an increase of 50 or 270 percent over the total of only 18 pupils in Year 12 and 13 last year. This brought about a very different number of problems, from the number of skills that could be offered to the sheer logistics of building and storing 68-plus bikes. I made a decision to build two basic designs of lightweight construction, using 12 mm x 12 mm square tube in a geodetic construction similar to the Nortons and Ducatis of the 1970s.

For the headstocks we use 30 mm tube, for the triple clamps 6 mm aluminium alloy flat strip and for the front forks 20 mm steel tube or alloy bar.

The pupils make all the frame, axles, spacers, handlebars, motor mounts, exhaust brackets etc. The kit consisting of the motor, wheels, brakes, handlebar levers, exhausts and so on is supplied by Newmanz R/C Direct which source good-quality Chinese parts.

Triple clamps

The clamps are designed around our basic pattern. Two pieces of 75 mm x 130 mm x 6 mm alloy are drilled with two Ø 8 mm or Ø10 mm holes to house the front forks. These holes are dependent on the pupil’s choice of front fork clamping methods.

The centre hole for the pivot bolt is drilled Ø 12.5 mm. Both pieces of alloy are then bolted to a steel template. Excess alloy is then sawn off to save time as only one drill mill is available. The basic shape is then milled out. Finishing is achieved with a linisher, draw filing etc.

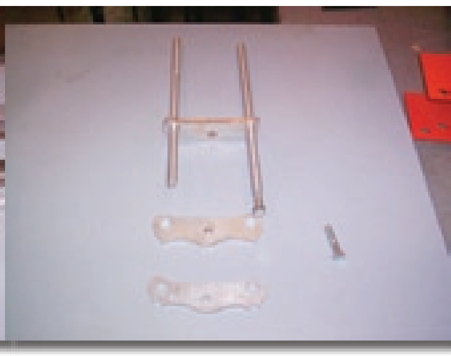
The basic shapes are then modified by each pupil to their own requirements e.g. clamping with pinch bolts, screw-threading of forks into the top and bottom yokes, bolts through the yokes into the fork legs. Different methods of clamping are encouraged and expected as this improves their thinking skills.

Fork assembly

The pupils have a choice of Ø 22 mm x 400 mm steel tube or alloy bar of the same dimensions. They are encouraged to weigh both samples. Of course they are quite surprised when the steel tube comes out lighter than the alloy bar. Most want to use the alloy so this encourages them to turn up the bar on the lathe, which is a good exercise in itself.

I encourage them to centre-drill, parallel turn, screw thread and taper turn. The more able pupils can save 50 percent of the fork legs’ weight, which brings the weight down lighter than the steel tube.

Front fork clamp assembly...1



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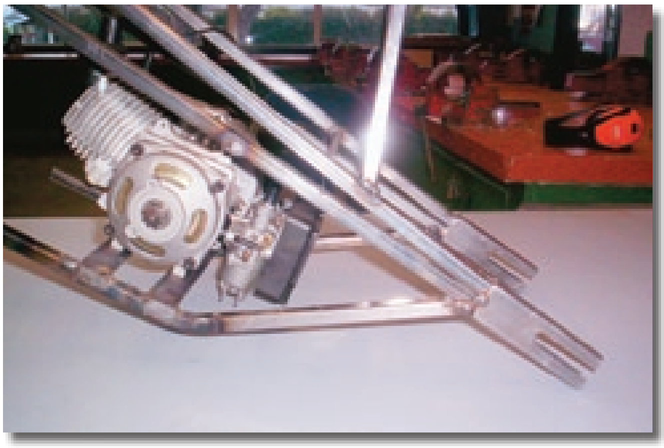


Rear forks and engine mount.

Handlebar construction.

Brake calipers are fitted via brackets. These are MIG-welded to the steel fork leg or as a steel sleeve which is passed over the alloy leg so that a steel brake caliper bracket can be welded onto the sleeve.

Headstock

The headstock is made for all frames from Ø 30 mm x 100 mm x 1.2 mm wall-thickness steel tube, faced off in the lathe. This replaces last year's method of Ø 30 mm bar drilled and fitted with bronze bushes, then line-reamed. Two ball bearing races from plastic golf trolley wheels are then fitted into the tube to support the central pivot bar.

Frame

The mini-bike frame is a basic ladder or geodetic form. We know that a round tube is considered to be stronger for frame construction. But for pupils learning new skills, the sheer amount to be made is challenging. Every tube must be filed with a "cod's mouth" for a neat accurate assembly which would bring about a lot of problems and waste.
I decided after a lot of research that 12 mm x 12 mm square tube with a 1.2 mm wall was a suitable alternative. Braced in a geodetic or ladder frame, it would be very strong.
The steel is formed with a hydraulic pipe bender. Each bend is checked with wooden templates. The bent tubes are assembled on a wooden jig and MIG-welded together. I believe wooden jigs are best as the frames are evolving every year. They are cheap, simple and can be quickly up-dated. Steel jigs tend to discourage upgrading due to their complexity, cost and time to build.
The frame racks are a standard shape and a basic requirement. The pupils can then introduce their own modifications to individualise the frame. Each frame is MIG-welded together and then must pass the 110 kg test. One of the First Fifteen boys sits on the frame and then jumps on it to see if it bends.
The frame weights are coming out at 3.225 kgs. Strong and light must be the catch phrase. The projected wet weight for the air-cooled bikes this year is 16 kgs and the water-cooled 18 kgs. These weights are regularly achieved.

Engine mounts

Another area which needs forward-planning and thought is the top engine-steady or motor mount. On the air-cooled engines, the motor sits on a cantilevered mounting coming off the frame, with the main motor-securing holes under the engine. Even with the mounting bolts secured with Loctite the mount will flex at high RPM.
A cradle frame could solve the problem but will put on as much as 1.5 kgs to the overall weight of the bike, with no guarantee that the engine will not come loose. The resulting movement of the engine and cantilever can strip the engine mounting and screw threads. This movement also allows the drive chain to tighten and slacken every revolution, resulting in the chain jumping the sprockets.
A good top engine mount / engine-steady is therefore essential. The water-cooled engines that are used with

Chain tension and steel sleeves for brake calipers. me.

RACEDAY

Once the bikes are completed and tested they are entered into the Schools Mini-bike Championship held at Manfeild raceway at Feilding. This is where the young engineers of the future show what they can do with their air-cooled and water-cooled machines.
The racedays are on October 20 and 21 this year and the number of participating schools has increased from four to 25. The event is again sponsored by Palmerston North-based Universal College of Learning (UCOL) and other local and national companies.

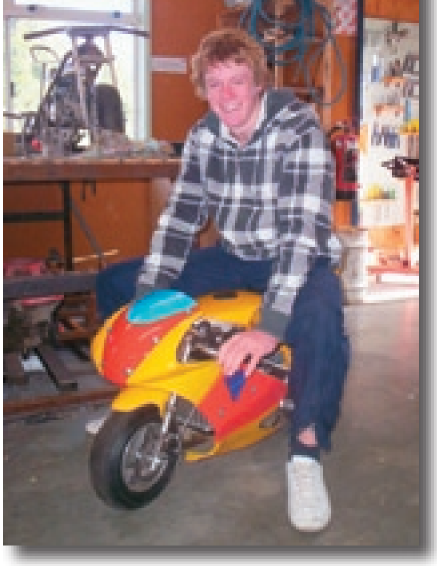
older pupils have a superior method of mounting. The air-cooled motors really need top engine-steady to be designed in a similar way.

Assembly

As with all projects, the assembly stage is critical. By the time the pupils have made all the components, they feel that they are finished and the assembly stage is just a case of banging it all together. In actual fact they are only 75 percent completed. The last 25 percent is the most challenging.

A number of pupils have constructed workstation trolleys on top of which are two parallel rails. The supports are spaced so the wheels fit snugly between them and a brace over the front wheel holds the rolling chassis perfectly vertical. The assembled chassis is held in this jig.

The engine on its mount is then positioned on the cantilever bearers. The centre-line of the engine must run parallel to the jig and the front and back wheel centre-lines. The engines are off-set to the right of the frame centre-line so the sprockets align.



Alastair Lillburn and finished bike.

The "chain run-out" or misalignment cannot be any more than 3 mm to 4 mm for reliable running or the chain will jump the sprockets. So it's a matter of CHECK, CHECK and CHECK again. With past experience, I have found that a chain tensioner of the compression type is most suitable. The pupil's welding can sometimes fail under tension when they are welding small delicate components.

If all is correct, the engine mount is tacked into place with a MIG welder. The pupils remove the bike from the jig and rotate the back wheel; they watch the track of the chain as it leaves the rear sprocket and correct its track with the chain adjusters accordingly. So far this year using this method we have had 100 percent success.

At the end of the course when they go for a job interviews and are asked what they made at school, they can show future employers the mini-bike.

** Roger Emmerson is the TIC Engineering at Feilding High School. Ph (06) 3234029*

Minibike engine kit supplier is Shane at Newmanz R/C Direct (www.newmanz.co.nz).