

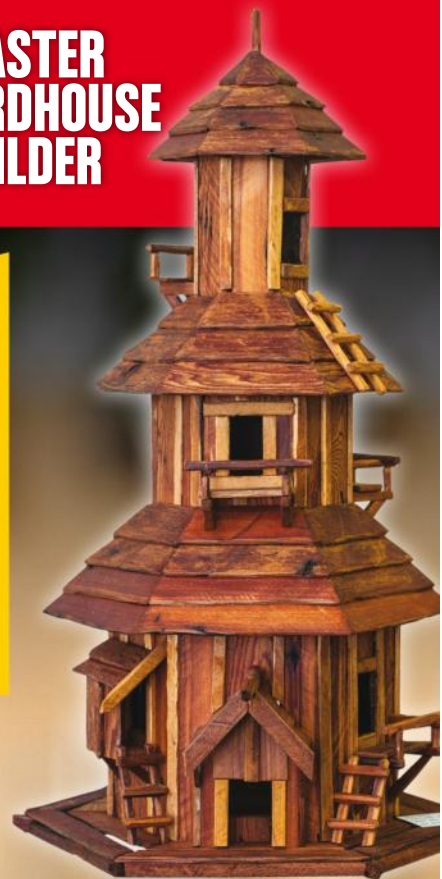
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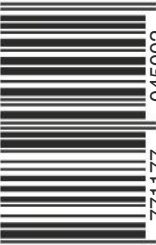
WHERE DREAMS ARE MADE REAL

JULY-AUGUST 2018

ISSUE 79

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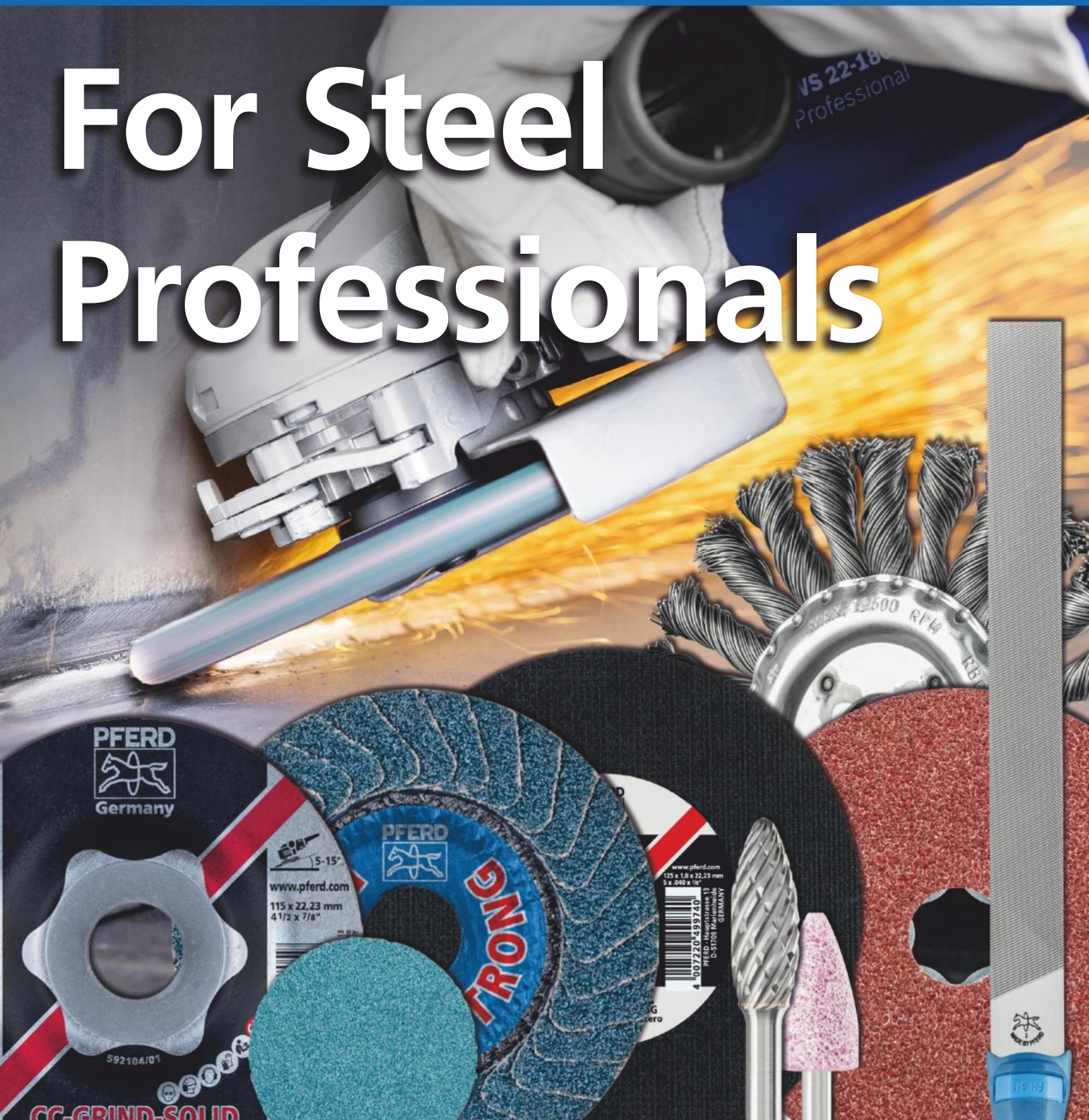


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The penny has just dropped

I have only been the editor of this magazine since last June so, to be honest, I still have an awful lot to learn.

I take advice and direction on what articles should be published in *The Shed* from our readers first, of course; then our great team of writers; and my friends and colleagues. I'm not sure that anyone can be an expert on everything shed-like but frankly, almost all of our crew of writers are pretty well clued-up on a wide range of subjects.

The ex-publisher of this magazine, Jude Woodside, seems to be totally clued-up on everything shed-related because anytime I have a query on almost anything, he has the answer. Impressive. We are very grateful for his continued involvement in *The Shed* as a writer and our technical editor, as I'm sure many of you are too.

So, I am learning what content you, our readers, like to read, and we strive to achieve provide that in each issue, but I must admit, I was a bit perplexed by the constant fascination by so many of our readers and writers with knives and knife making. I just couldn't see what all the fuss was about — that is, until I met a knife maker recently.

As one of our major articles this issue is on that subject, and because there is a knife makers' show coming up in Auckland later this year, I figured that I had to know more about this passionately followed craft that I understood so little about.

Well, as soon as I held one of these knives

in my hand at the workshop of Brent Sandow, the penny dropped. I got it.

These handmade knives are works of art. The look and the feel of the steel. The shape of the blade. The way the handle sits and feels in your palm. The exquisite bone or wooden handles looking just like precious jewels. The balance of it as it sits in your hand. The maker's skills in creating this instrument are apparent for anyone to see once you get up close and personal. The phenomenal range of tooling and equipment that is required to make knives such as these made my jaw drop.

I have always wondered what folks would want with a knife the likes of which we have featured being made over the years. Are there really that many hunters out there? But now I get it.

Appreciating these knives for the creative gems that they are is already enough for me. I see why so many of our readers seek information on how they are made, and even the skills to make one themselves. To be honest, I am sure there may be some who just collect knives or even put them on display in glass frames — that would not surprise me in the slightest.

Different shapes, beautiful steel, different uses, different handle finishes. Works of art.

I'm in, now I want one, or two. Penny delivered.

Greg Vincent
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THE WHERE DREAMS ARE MADE REAL
Shed

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Steven Price turns an accident into an opportunity



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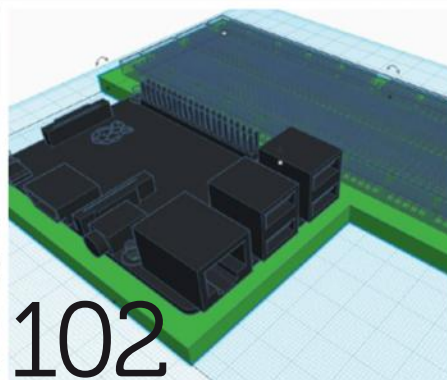
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FROM INJURY
TO

Inspiration



A multistorey birdhouse with seven different house compartments, as well as balconies, fire escapes, finials, and a hexagonal porthole window



Sanding a totara batten



Using a bandsaw to make finials, window tops, and other fine work

A BUILDER TURNS ADVERSITY INTO AN OPPORTUNITY TO UNLEASH HIS CREATIVE TALENTS

By Helen Frances

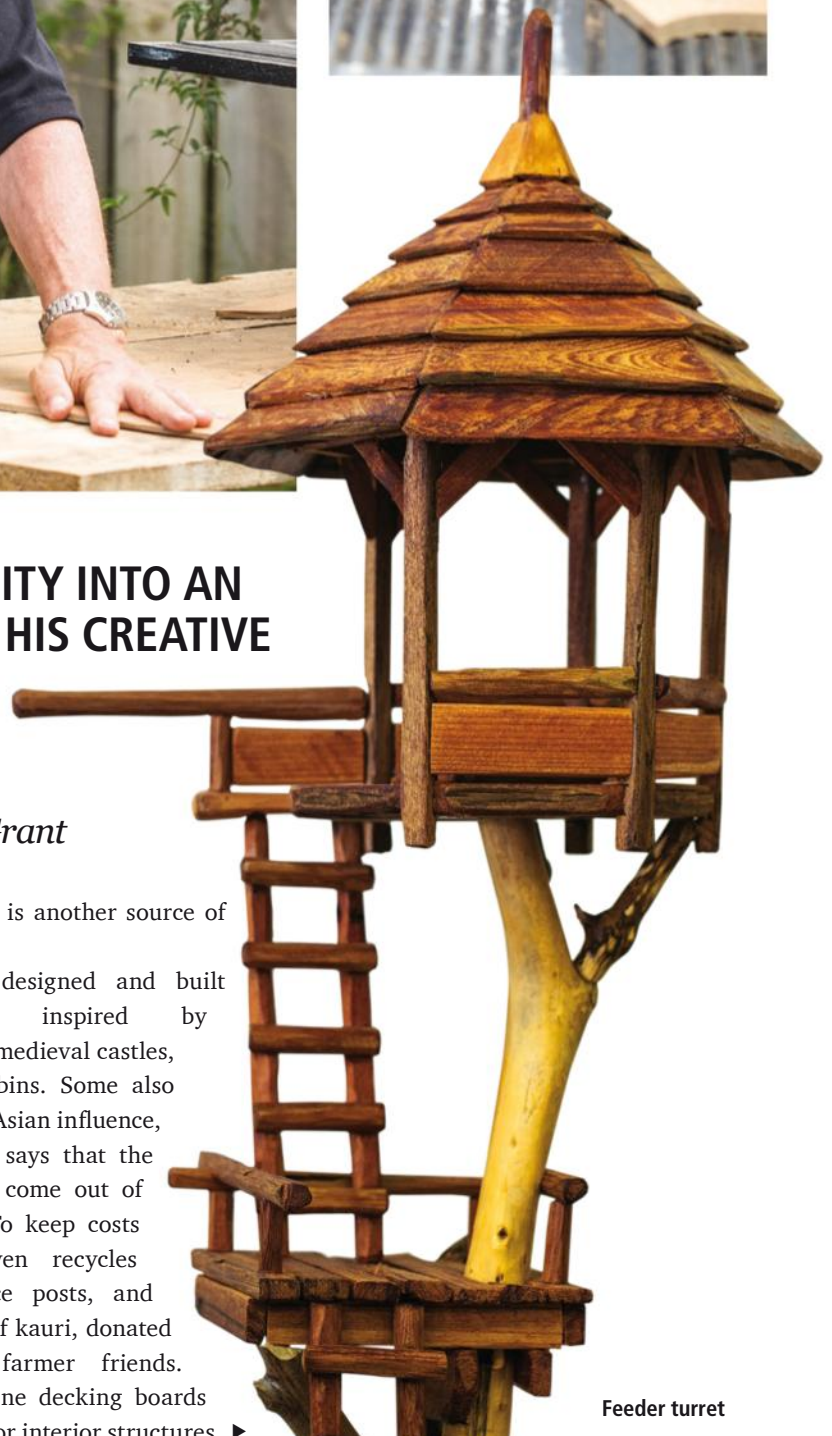
Photographs: Tracey Grant

When builder Steven Price suffered a severe neck injury at work he turned the accident into an opportunity. The Whanganui sheddie no longer mounts scaffolding; instead he designs and constructs much smaller buildings. His timber birdhouses tickle the imagination, but they won't fly away or fall apart because he draws on his many years of experience in the building and construction industry to make them solid and durable.

As a stimulus for his design ideas Steven browses books in the library then takes his pencil to the drawing board. The *Treehouse Masters* television

programme is another source of inspiration.

He has designed and built birdhouses inspired by windmills, medieval castles, and log cabins. Some also suggest an Asian influence, but Steven says that the designs all come out of his head. To keep costs down Steven recycles totara fence posts, and even a bit of kauri, donated by local farmer friends. Recycled pine decking boards are useful for interior structures. ▶



Feeder turret



Considerate neighbour

His shed is a movable feast. He stores wood in his gardener's shed and uses a friend's bandsaw to rip totara fence posts into workable lengths, then, weather permitting, he finishes them off at home in the yard with his smaller power and hand tools — a small bandsaw and a “little old sawbench” with which he rips the smaller pieces of wood. “It’s quieter for the neighbours,” he says.

The kitchen table becomes a workbench on which he prepares all the component parts then screws and glues the birdhouses together. A large one can take him up to 40 hours to make.

At Expressions Gallery in Whanganui his largest ‘windmill’ birdhouses are the first things you notice when you walk in. The windmills are made from totara board and kauri battens, and the vanes are kauri. He has designed them, and all his other large constructions, so that the

bigger pieces can be lifted off for ease of transport. It also allows easy access for cleaning. The parts are all marked and only fit together one way, checked in around the rafters, so that the wind won’t blow them off. The weight also helps to keep them stable.

Design rules

Steven says that the size of the timber by the time he has cleaned it up dictates the height of the main body of the windmills, and during construction he has learned instinctively to apply the rule of thirds.

“I go with the flow. When I started doing the roof I realized [that] it looked too high so I cut that one down. With a bit of playing around I’m getting to know that if that one is 600mm then the next one should be 300mm, or 900mm — you go in multiples of three.”

The roof of the windmill is a Dutch





Left and below: Installing corner battens on a tower structure. Once fitted, they are taped and/or stapled until the glue dries



Measuring and levelling ... building know-how creates a stable structure



Below: A lot of wood whittling with a Stanley knife to create a rustic look

Below: Three years outside and this miniature log cabin has weathered well



gable. He achieves the uneven, rustic roofing effect with a Stanley knife.

"If you square everything up it makes it look too straight. I use a Stanley knife to whittle the curvy edges. It takes a while to make all the curves, but it looks very natural."

As a thank you for the totara fence posts, he made a birdhouse for his farmer friend and it's proved very popular with the feathered locals.

Naming the birdhouses

The gallery owner has given the birdhouses names. 'E-wok Village' is a fantastical series of ladders and platforms that branch up to a feeder from a driftwood stand, sourced on Castlecliff Beach. And 'Pagoda Temple' has a distinctive Asian flavour, but Steven says the design "just came out of my head".

A log cabin, one of his earlier models,

He has designed and built birdhouses inspired by windmills, medieval castles, and log cabins



Log cabin with whittled shingle roof

Under construction



Three-storey hexagonal tower — every entry point has different detailing. To make a hexagonal shape Steven makes 30-degree cuts

has a shingle roof, each individually whittled. But the shingles took too long to make so these days he uses long whittled planks to make the roofs.

After sketching a design, Steven calculates and prepares all the materials he'll need. He rips totara battens down to 5–7mm thick, and they become the base for the walls and roof. On the roof they overlap by 10–15mm. He glues and staples them together (or uses masking tape to hold smaller pieces) until he gets the right-sized roof he wants. When he's finished he pulls the staples out, fills the holes with glue, sands, and coats the wood with linseed oil. He uses strong exterior PVA glue.

"I've had one birdhouse gathering moss outside for three years and it's still holding together as well as the day I built it," he says.

You can contact Steven about his birdhouses on 027 863 3934. 

A large one can take him up to 40 hours to make

A wishing well pot plant holder suitable for ferns



On the kitchen table a hexagonal tower with an annex is taking shape. Steven has designed it with reversed battens, windows with pointed arches, and balconies with little braces. He made the six panels up flat on the table and got his girlfriend to hold them in place while he screwed the panels onto the plywood floor structure inside.

The valleyed truss roof of the annex is quite intricate.

"If I wasn't a builder by trade I don't think I'd be able to do them. I put it together as a truss roof. If I hadn't, I imagine it would've gone all higgledy-piggledy and dodgy as. So I found a way to make trusses and worked from there, making the ridges and valleys. Once I've formed the roof I get a piece of paper and cut it to the size I want for the size of the roof panels. Then using the paper as a pattern I cut them out of the totara battens," he explains.

For this birdhouse the roof panels are vertical. Five vertical panels will be butted tightly together, not overlapped, as he usually does. If they were horizontal he says that the pieces would get too small and split. Fascia boards will "tidy it up" and, as it is a work in progress, further down the track he will put in some little windows, finials, and an exterior staircase.

"The more wood I put on them the stronger they become. By the time I'm finished with this turret with all the pieces on it, it will probably just bounce if I drop it."

Steven also makes picture frames for his pencil drawings. He does a lot of art, mainly depicting Whanganui's heritage buildings. The city boasts 11 per cent of New Zealand's heritage buildings, so there is no shortage of subject matter. He draws from photographs, preferring to do that rather than be distracted by rubberneckers and chatty bystanders.

"After being injured and at home a lot I just picked up the pencil to keep me occupied," he says of his drawing.

With a neck full of titanium and other "scaffolding" Steven is doing what teachers told him he should do when he was at school — pursue his creative talents. And prompted by people telling him his timber creations look like doll's houses, that could be next on his shed assembly line.

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Saturday saw conference members visit Carbatec for some tool demos

Shed power

MENZSHED CONFERENCE – 27-29 APRIL

There's something to be said for the power of numbers. It seems that sheddies will be an even more vital part of their communities in the future if sheer numbers are anything to go by. By 2020 there will be more New Zealanders over the age of 65 than under the age of 15. By 2036 this group will constitute 22 per cent of the population, as against 15 per cent today.

Menzshed members throughout New Zealand attending a recent conference heard how the growth in the senior population and extended life expectancy are redefining what it means to be old.

"We are all ageing. It matters to all of us that New Zealand is a place where we have the opportunity to age

positively and well," Diane Turner, director of the Office for Seniors, said in her opening address at the Menzshed New Zealand 2018 conference, held at Saint Kentigern College, Auckland, over 27-29 April.

More than 34 Men's Sheds were represented at the conference, including one from Australia, and they covered a diversity of operations, activities, and membership.

A programme aimed at offering different perspectives on what members needed to be aware of when setting up and running successful sheds in communities included topics such as health and safety, the health and well-being of senior men, governance

and management, and insurance.

There was plenty of time for questions and answers, swapping experiences, and learning about different initiatives run by enthusiastic groups of sheddies, including a tools-for-schools project and a predator-traps programme.

The keynote address by Dr Phil Wood, chief advisor to the Ministry of Health, on the health and well-being of senior men was particularly pertinent for a conference that had the theme of Sheds and Sheddies Making a Difference.

Diane Turner addressed the need for communities to be aware and cater for the needs of a growing senior population. She said that New Zealand has joined the World Health Organization (WHO) global network for creating age-friendly communities, which was a very positive step in considering the needs of seniors and encouraging social participation.



Right:
The Australian
Men's Shed
attended too



Adopted in 2015, the WHO model has scope across eight domains: outdoor spaces and buildings, transportation, housing, social participation, social respect and inclusion, civic participation and employment, communication and information, and community and health services. Consultation and workshops are being held throughout New Zealand aimed at drafting new strategy, which will be launched mid 2019.

But the highlight of the conference was the opportunity to network with like-minded people, swap tips, and share anecdotes.

It was all capped off with visits to three Men's Sheds — at Auckland East, in Manurewa, and on the North Shore.

Men's Sheds aim to keep men connected and involved through community-driven initiatives, and the conference was testament to how successful they have been in achieving this.



Robin and Batman cruise in



The 2 1/2 day conference was well attended



The Carbatec visit was a popular choice

The Shed online



What's happening online at theshedmag.co.nz?

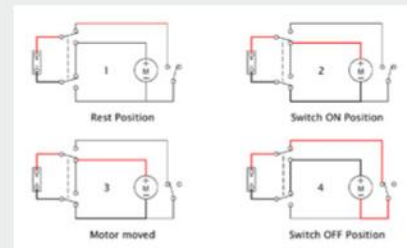
Every week we upload new content on *The Shed* website joining the 100s of articles and videos already on the site for readers to discover and enjoy. The past two months' new uploads include:



- an article by John Stichbury on making model engines and spark plugs



- a short video of Oamaru stone carver Sean Briggs at work in his mobile shed



- the launch of our Build a Useless Machine competition



- four introductory articles on understanding Arduino.

These are just some of the new uploads to our website these past two months. Visit theshedmag.co.nz to enjoy even more.



Rainwater suggestions

Having depended on rainwater for many years I think there are better ways to improve the quality of water captured from a roof without buying a range of off-the-shelf products that cost quite a bit of money (*The Shed*, Issue No. 77).

Normally, if it's all of the roof water

being captured, the downpipes link up to one 100mm diameter pipe which will either surround the house underground or perhaps run through the crawl space. This pipe feeds up the side of the tank and into the inlet. The simplest way to ensure the first flush is diverted is to simply install a diversion valve in the pipe as seen in the picture of our tank. All I do is leave the valve open so if there's just a small shower the water doesn't go into the tank — during summer that's most of the time. I keep an eye on the weather forecast and after a bit of rain I go out and shut the valve. It sounds like a hassle but I don't find it is. It's just part of being aware of the weather. The same idea could be used if it's only one downpipe being tapped into.

Another tip is to make sure the waste pipe from the valve is a loose fit so it can easily be removed and the cap of the diversion fitting can be unscrewed. I do this from time to time to clean larger bits of crap that block the outlet. This would not be necessary if a rain head or some sort of gutter guard is used, which is what I would have next time.

I would also put the diversion valve

lower down the side of the tank and use a much bigger one so all the water that sits in the pipes around the house can be flushed out from time to time.

As for the calmed inlet and floating outlet shown in your illustration, these seem unnecessary if the first flush is diverted, plus if you need to get into the tank to attach them they would be very difficult to install.

Finally, I wouldn't install the tank siphon the way it is shown — it looks very likely to drain the whole tank.

Carey Hablous

Via email

Thanks for your email, Carey.

Most of the products mentioned can be easily made by any DIYer — you don't have to purchase the kits. The siphon will not empty your tank — it has a hole to break the siphon once the water level gets to a normal level. The real advantage of the siphon is simply to take advantage of the fact that you will have to spill water anyway, so why not use it to make sure that the waste water comes from the base of the tank, where most of the sludge will be, not from the fresh input? — Jude Woodside, Technical Editor

Letter
of the
MONTH

Letter of the month prize



Our winner this issue will receive a state-of-the-art 8M Milwaukee tape measure. These tape measures are sturdy, built to last, and will give many years of reliable service to every busy sheddie.

Letters should be emailed to editor@theshedmag.co.nz, or posted to Editor, The Shed magazine, PO Box 46020, Herne Bay, Auckland 1147.



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SHAPING

Shea Stackhouse in his workshop



STEEL

A CUTLER DEMONSTRATES THE PROCESS OF
MAKING A DAMASCUS KNIFE

By Jude Woodside

Photographs: Jude Woodside



The billet of Damascus steel that Shea forged

Shea Stackhouse looks too young to be a cutler at only 25, yet he has been making knives since he was 16. Having been taught jewellery and blacksmithing earlier in his varied career, both of these skills have contributed to his current practice. He works from a small but relatively spacious workshop in Wainuiomata, where he not only produces some exemplary knives made with his own Damascus steel but also runs weekend day courses in his workshop teaching knife making, Damascus steel making, and even blacksmithing.

The beauty of a small knife

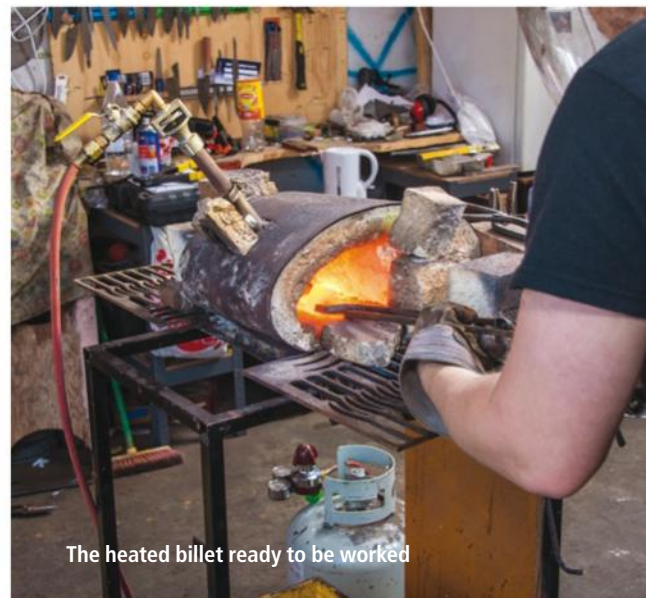
Shea owns a very nice power hammer that dominates the workshop; it is more than 100 years old. He made his forges

— a small one for knife making, and a larger one for Damascus steel and blacksmith work. He also made many of his own tools, including hammers. The advantage of owning a power hammer is the ability to make tools easily.

Shea makes a variety of knife styles, especially chef knives, but his favourite knife profile is a small utility knife, a traditional Finnish design known as a *puukko*. Of all the many elaborate knives that get made in his workshop, he finds the most appreciated are cooking, utility, and small hunting knives.

Hunters don't usually carry large Rambo-type knives in New Zealand — you are unlikely to encounter a bear in the woods, but a knife to skin a beast is of value.

The beauty of a small knife like this, apart from its utility, is that it doesn't



The heated billet ready to be worked



The power hammer saves time when drawing out the hot steel

require much metal to make. The one shown finished here page 22 was made from a small billet sawn from a larger piece of home-made Damascus.

Let's make a *puukko* knife

When the billet is hot enough, turning a bright orange-red, Shea begins to work it on the power hammer. The power hammer isn't strictly necessary for this sort of knife but it does make short work of stretching the steel out. After several heatings and poundings from the power hammer he turns to the anvil to shape and fashion the knife blade outline.

On this occasion he is able to use a newly minted hammer that he has only just finished making for himself. Shea likes to film his work and there is a video of him making this hammer on his YouTube channel, Stackhouse Knives.





The anvil and hammer are still necessary to get the shape right



He also made many of his own tools, including hammers



Above: Reheating the knife blank
Below: The knife taking shape from the hammer



Drawing out the tang

With the hammer on the anvil he is able to form the shape of the blade. He focuses on developing the tip — though not making it too sharp, as that would cause the tip to overheat — and generally forms the outline of the knife. As the steel is hammered it tends to bend in one direction and the knifemaker can use this tendency to ‘draw out’ the steel into the profile he wants.

With the blade nearly formed he turns again to the power hammer to draw out the tang. This type of knife traditionally has a long, tapered rat-tail tang, usually attached to the pommel by tapping the end of the tang and screwing a through bolt to it, or peening it in the pommel.

Descaling as you go

He works on the tang on the anvil too, being careful not to flatten the blade

material too much close to the shoulders. “I like to keep a bit of meat around the shoulder,” he says. This is potentially the weakest part of the blade, where it is attached at the handle, and leaving more steel here contributes to the strength of the blade. It’s important to regularly clean the scale from the knife as you progress — the last thing you want is to hammer the scale into the knife metal. It is very difficult to remove later. It requires regular brushing with a wire brush.

Once the knife is shaped to the right proportions it can be put back into the now-cooling furnace to allow it to ‘soak’ and relieve any stresses that the persistent beating may have induced — in other words, allowing the metal to relax or, in technical jargon, ‘normalize’. Normalizing the steel results in a more fine-grained homogeneous structure that is easier to



The knife blank with the bevels and shoulders marked out



Grinding the shoulders to shape



Rough grinding the blade and shaping the profile and the bevel

This is potentially the weakest part of the blade, where it is attached at the handle

work and less likely to crack or warp. It is allowed to cool in air so that it remains annealed and soft for the initial grind process.

The shape of the bevels and the shoulders is drawn on the piece directly with marker pen and the first grind is started. Shea likes to define the shoulders and rough out the bevel areas, beginning to grind the blade to shape. He does most of the preliminary work on a large linder using a new 60-grit ceramic belt. With the scale largely removed he marks out the shoulders with a straight edge and scribe and files them to the line.

Hardening the blade

At this point, with the outline of the knife formed, it can be hardened. It is only the blade itself that needs to be hardened so the tang does not need to be placed in the

forge. When the metal reaches its critical temperature — a bright orange-red — it can be quenched. Shea prefers to use soya oil for quenching, but almost any oil will do. However he cautions against using



Cleaning up the shoulders for a sharp edge. This pays off later when the bolster is fitted

used engine oils because of the impurities and their tendency to catch fire.

Austenitic steel

Steel has a crystalline structure and undergoes several changes when it is heated and cooled. Carbon steels have an 'austenitic' temperature, the point at which they are no longer magnetic. Stainless steel is austenitic at room temperature so it is non-magnetic, but other steels — including tool steels — require being heated to their critical temperature, which is usually between 1050°C and 1090°C.

When austenitic steel is quenched the structure changes to 'martensite', a very rigid crystalline structure that is also very hard. However, being very hard it is also brittle, so the steel must be tempered to allow the martensite to alter slightly so that it becomes less brittle. It's important



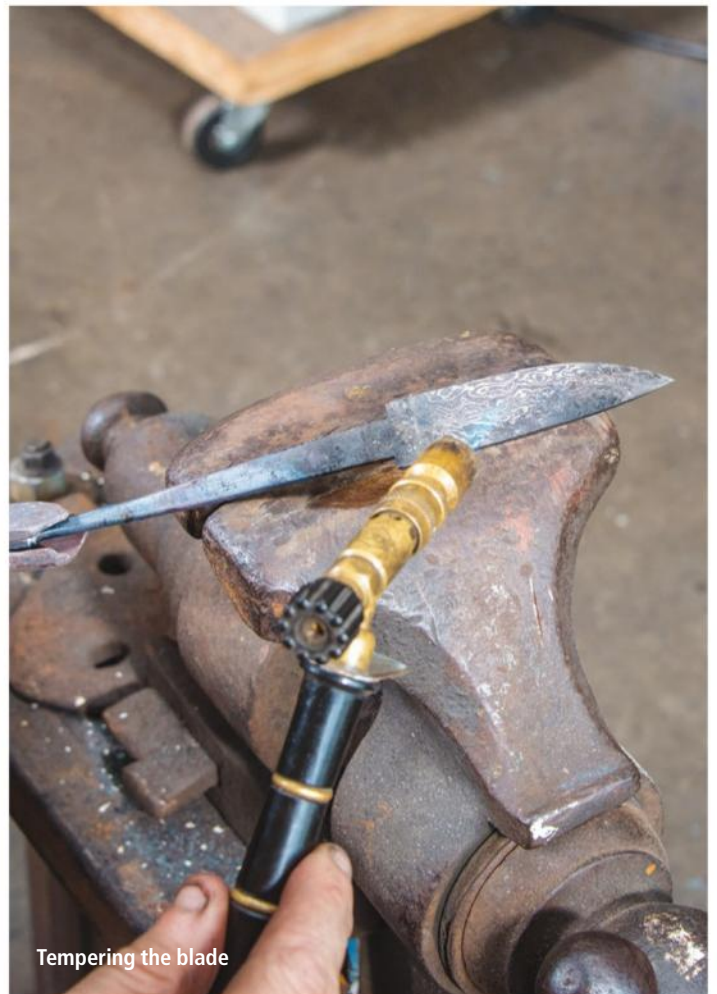
The rough-ground blade



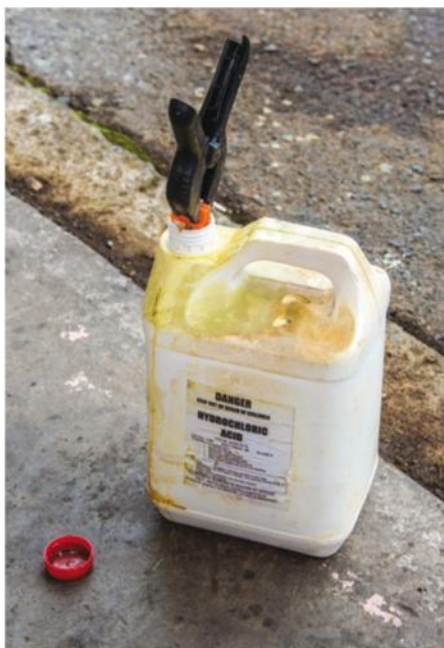
Heating the blade for hardening



Quenching in oil



Tempering the blade



Clockwise from top left: Grinding the first of a succession of grinds; the blade after successive grinds up to 240 grit; the etched blade showing the Damascus pattern

Far left: Etching in acid
Left: Cutting out the slot to fit the tang
Below: Marking the position of the tang for the first bolster

that the steel be allowed to cool to room temperature first before the tempering is carried out; however, tempering should be done within an hour of quenching. Shea dries off the oil and begins tempering almost immediately.

Tempering for the knife's use

To temper the blade it must be heated to a straw yellow colour — usually about 220°C — with a directed flame like a propane torch, although it's possible to do this in a domestic oven. It can be difficult to see the change in colour in

bright light, so it's best to do this in a shaded place. Here it is possible to see the colour in the picture. The actual temperature of the tempering varies between 220°C and 350°C depending on the usage of the knife.

For example, a knife used for camping, that will need to withstand a good deal of rough handling without breaking should be tempered at the higher temperature — a blue colour, especially along the spine. A knife intended for the kitchen, which is required to maintain its edge, requires a cooler temper.

Shea is aiming to get a straw colour

on the sharp end of the blade and a light blue colour along the spine. This will keep the blade edge hard and the spine slightly softer to absorb impact.

Final grinds and polish

Now comes the more focused grinding, running through a range of grits on the smaller belt linisher. Shea starts with 40- and goes to 120-, 180-, and 240-grit belts, successively polishing out the scratches from the previous belt. Given that the blade is now hardened it takes a while to do this and it pays to persevere. The blade must, of course, be regularly



Marking the tang on the handle



Peening the tang

cooled to ensure that overheating doesn't damage the temper.

The final part of the preparation is hand-sanding the blade to achieve a high polish with 320 and 400 grits. He clamps the blade to a piece of hardwood and, using water as a lubricant, works down the blade at right angles to the belt grinding marks to remove the last traces of the 240 belt.

Etching out the Damascus pattern

With the blade polished it only remains

It's important that the steel be allowed to cool to room temperature first

to etch the steel to bring out the Damascus pattern. Normally Shea prefers a lighter acid like citric, but in the interests of time, here he resorts to hydrochloric. After only 20 minutes the

pattern is clear on the blade. The acid must then be neutralized in a baking-soda solution immediately and the knife washed and dried.

The handle

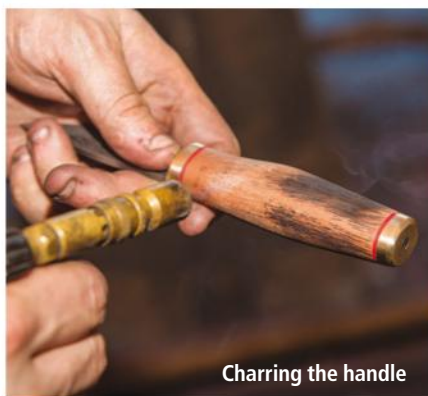
The bolster is 6mm brass; the blade is laid out on the brass material and the width of the tang at the shoulders marked off directly on the brass. The opening is scribed onto the brass piece and it is centre-punched at either end for 3mm holes to be bored within the opening. ►



Rough-shaping the handle



Shea likes to finish off by filing by hand



This stage can involve a lot of drilling and tedious work with files to get the opening right. But Shea leans on his jewellery experience and uses a jeweller's saw to cut the opening so that it requires only a modicum of clean up with files. The fine jeweller's saw can be threaded through the holes and cuts the soft brass with ease.

The bolster is fitted after some trial and error. It is important that the fit is tight around the shoulders for aesthetic



reasons and to prevent dirt and water entering here. Further decoration is provided on the handle by a piece of coloured plastic shim; this too has to be cut and fitted. The handle is jarrah. This knife, as mentioned previously, is inserted in a hole through the handle and held in place with epoxy, and the end is either tapped and screwed or peened in place over the pommel.

The pommel is also a piece of brass but it requires only a hole bored to take the tail of the tang and not a slot. Shea drills a slight countersink at the hole to accommodate the spread steel of the peened tang. First he squares the ends of the handle with a large rasp, again this is a critical step to ensure a tight fit against the bolsters.

He marks the location of the tang on the side of the handle stock, and also marks the opening and the end of the through bore. The larger end is drilled out first and the other end bored out with a smaller diameter drill. Once the hole is cut and the tang fits Shea tapes over one end and fills the hole with quick-setting epoxy. He has found an epoxy that is both reliable and unaffected by heat or movement, having tested a few. With the blade in a vice the handle is fitted over the tang and the pommel and its associated plastic shim is attached.

Final finishing

When the epoxy has set he peens the end of the tang to hold the pommel in place and secure the handle. Now it only remains to shape the handle and polish the lot. Again the linisher is called into service to shape the handle and the brass bolsters. A ceramic belt makes short work of the shaping. When he is satisfied with the shape of the handle he finishes the shaping by hand with a file.

Shea likes the look of a charred handle. He uses his blowtorch for the process. The charring can help to harden the handle but he is mainly doing it for effect, plus the light charring contributes to a better grip. It's important to keep the flame moving and not let the torch burn too deeply into the handle stock. A polish of the handle with some oil and the knife is done. 

Shea Stackhouse has a website — stackhouseknives.co.nz — where he displays a gallery of his work and that of his wife, Lena, who makes jewellery. He also has a Facebook page and a YouTube channel, Stackhouse Knives, with several videos of him at work.



TEACHERS TAKE A BUSMAN'S HOLIDAY

FORGING AHEAD

Knife making is undergoing a resurgence at present. It may be the fact that it requires only a modicum of equipment. You only really need a file and gas torch.

Of course the more elaborate the knives you make, the more gear you will need, but this is one of those hobbies that can grow with you. Naturally, having a forge, some sort of anvil — even if it is only a lump of hard steel or a bit of railway line — a grinder, and a hammer will extend your options and none of these is particularly expensive. There are a number of knife-making classes springing up all over the country to cater to this interest. Shea Stackhouse runs classes in basic knife making, making Damascus steel, and blacksmithing through his website (stackhouseknives.co.nz).

The week after *The Shed* visited him for our article on knife making, he held a class for two enthusiastic teachers taking advantage of the term break. Sam Dockery and Ben Reay teach science

subjects in Auckland and Hawke's Bay, respectively, but both are keen to come to grips with the art of beating steel into something useful.

Easing into it

Shea gives his students a safety briefing and then starts with the basics, guiding

them through the art of using a hammer to mould hot steel. They first forge a point on the knife blank, then, using the horn on the anvil, they create a curve in the blade, all the while heating and reheating the steel.

It looks easier than it is, and it takes both participants some time to get comfortable with handling the red-hot steel with tongs and using a hammer at the same time. The point of the first exercises is to get familiar with the tools. Ben has had some previous experience with another knife maker and has tried a few things at home without much success — due mainly to not being able to get the steel hot enough. But as he heats and forges the steel, he is beginning to get a feel for how it should be done. Meanwhile Sam forges on (pun intended). The men draw out the point and create the drop head on the drop-point hunter knives they are making. This is a full-tang knife, so it requires some work on the tang to shape it into a useful form. ►



Ben Reay mastering the hammer technique



Left: Ben Reay and Sam Dockery come to grips with the art of forging knives
Above: Sam Dockery making a rough grind



Grinding the blade through the grits

Graduation — the students show their work

*This is one of those
hobbies that can
grow with you*

Grinding and the handle

Once the basic shape is established it's time to start the rough grind. Then the knives are heat-treated and tempered. Tempering is a delicate operation and Shea does this so they can get the idea and see the subtle colour changes.

Once the knife blade is tempered the students get the opportunity to practise their grinding skills through successive grits, learning to create bevels and keep the grinds even.

With the knives ground it's time to tackle the handles. Holes are bored through the handle to accommodate brass pins. The handles are made from pieces of *Eucalyptus saligna* (blue gum). The handles are roughly cut to shape on a bandsaw. Full-tang knives require scales so the blanks must be split also on the bandsaw. The scales are epoxied and pinned through the tang. After the glue has had time to set, the scales can be



shaped on the grinder again and finished by hand. The last stage is sharpening the knives on a stone and honing on a steel and a leather strop, and then the participants have a long-lasting memento

of their first day making knives.

Shea's classes take a full day but the price is inclusive of materials and the participants leave with a knife of their own making and a newfound passion. 📖

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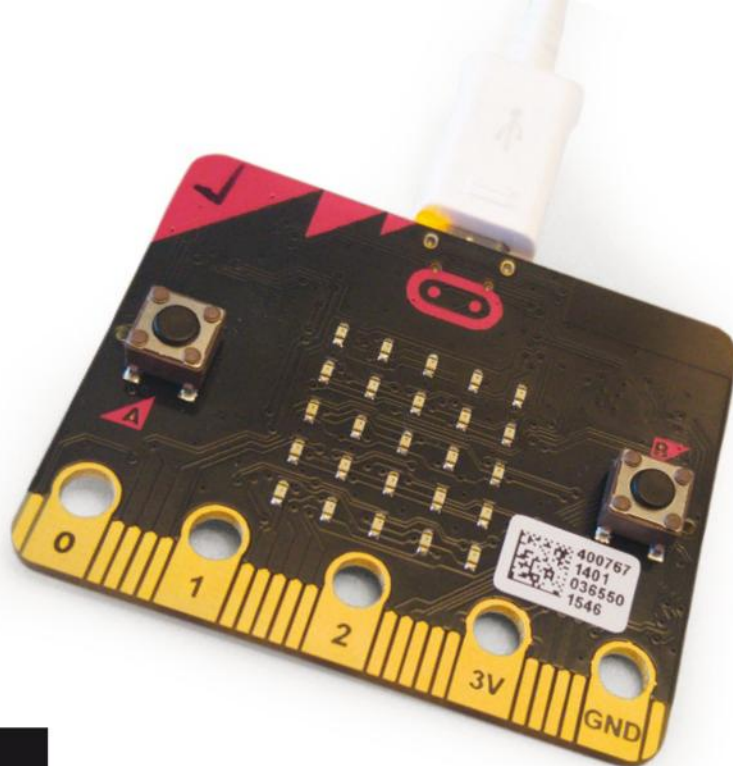
THE BBC MICRO BIT IS A
POWERFUL MICROCONTROLLER
PERFECT FOR HOME USE.
HERE WE LOOK AT MAKING A
SOIL HUMIDITY SENSOR

ALL IN ONE

B I T

By Enrico Miglino

Photographs: Enrico Miglino



The Micro Bit board is an incredible and powerful microcontroller device that is the perfect budget solution to create home experiments for newbies and hobbyists, as well as for developing advanced home projects. In our first project, we will look at how to make a soil humidity sensor. To make the construction easy, I have used some 3D-printed components, however these are easily replaced with common materials.

What is it?

The BBC Micro Bit is a board designed for education, as well as the graphical programming language Blocks — something similar to the Scratch language — specifically designed to teach programming, microcontrollers, and robotics to children; for teaching STEM; and for making robotics experiments.

Based on the ARM Cortex M0 processor, the Micro Bit board includes everything you need to start. To make a comparison with the popular Arduino Uno, imagine it as a sort of all-inclusive electronic device replacing the Arduino and a bunch of Arduino Shields. The Micro Bit board consists of:

- a 32-bit microcontroller CPU running at 16MHz

- 16KB of RAM
- Bluetooth Low Energy (LE)
- a radio link to communicate with radio-controlled toys and other Micro Bit boards
- 25 individually programmable LEDs
- two programmable buttons
- a triple-axis accelerometer and inclinometer, motion sensor
- a digital compass
- a temperature sensor
- a light sensor
- a USB connection
- 25 easy-to-access I/O pins (analogue, digital, and pulse-width modulation [PWM]).

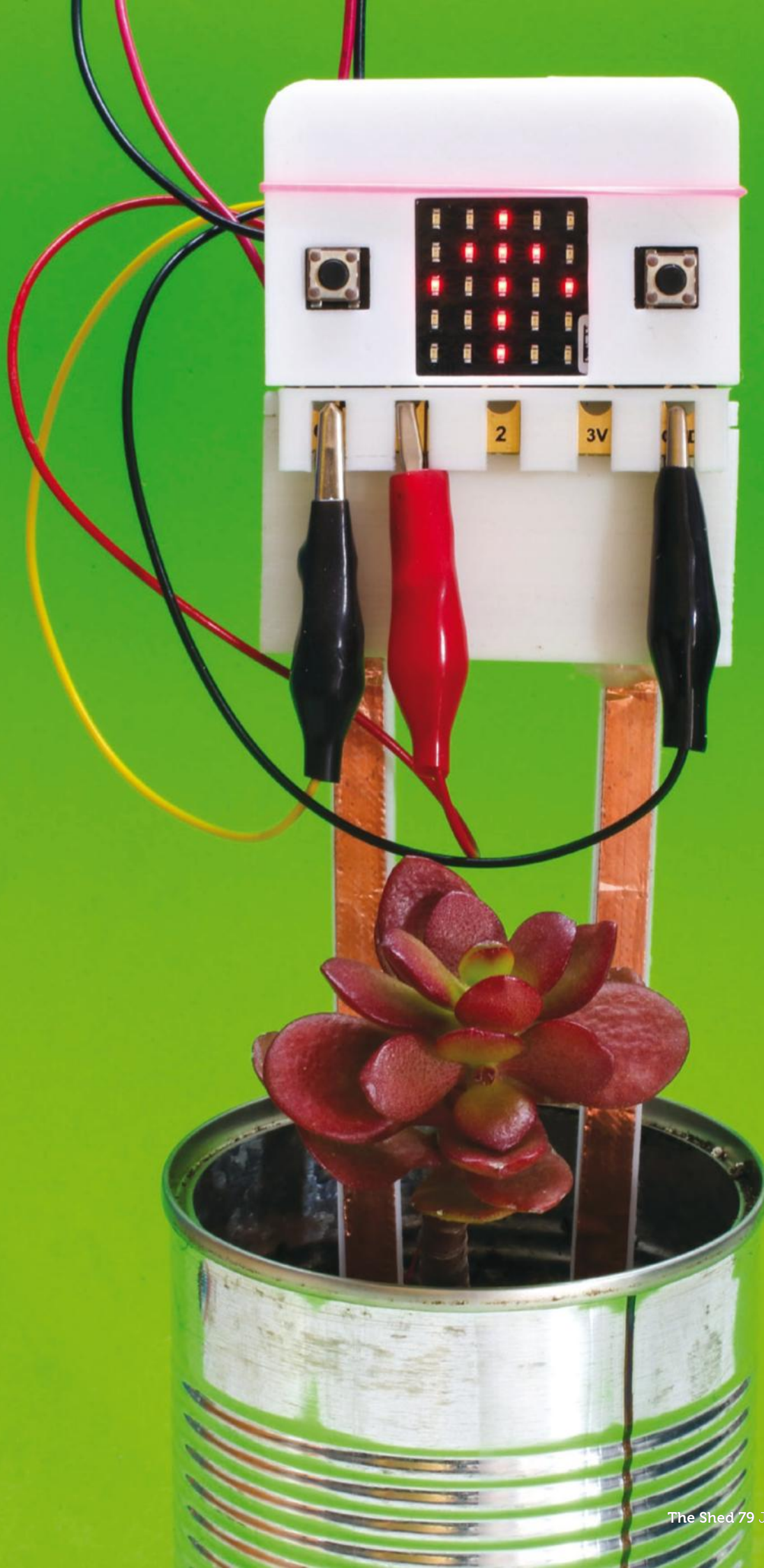
The BBC Micro Bit is available

To make a comparison with the popular Arduino Uno, imagine it as a sort of all-inclusive electronic device replacing the Arduino and a bunch of Arduino Shields

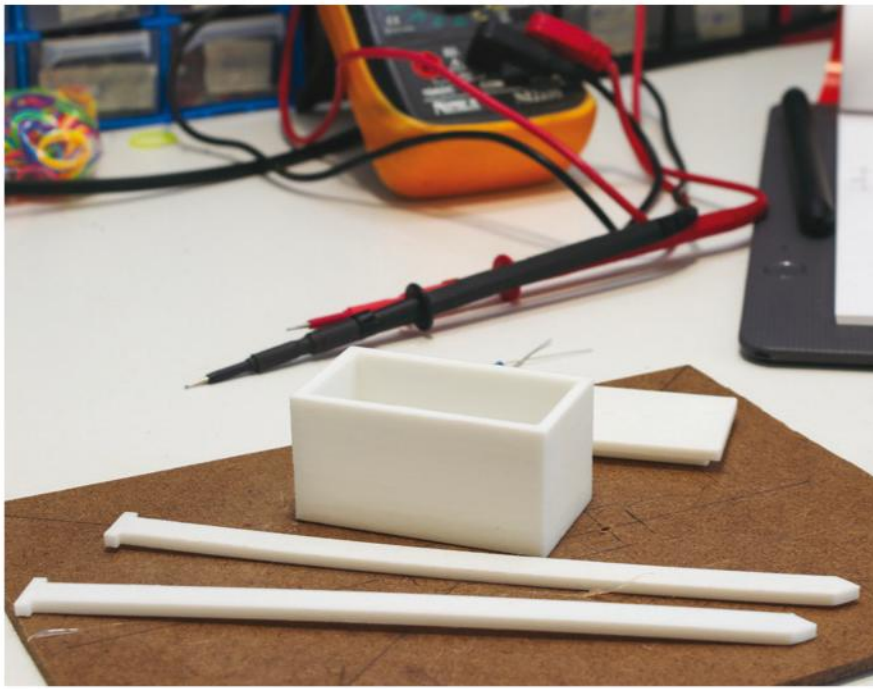
online from the distributor Kitronik — kitronik.co.uk/microbit.html — which ships to New Zealand. ►



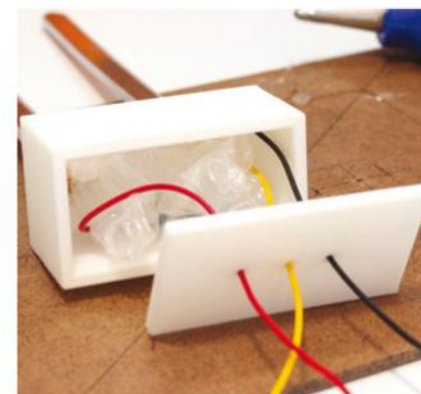
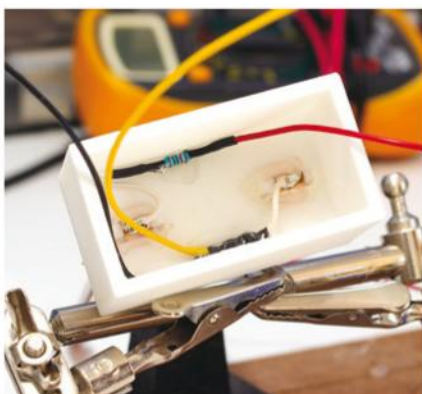
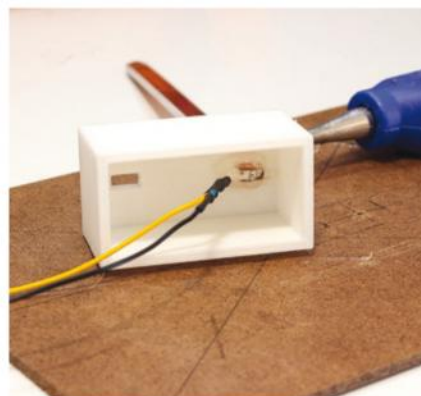
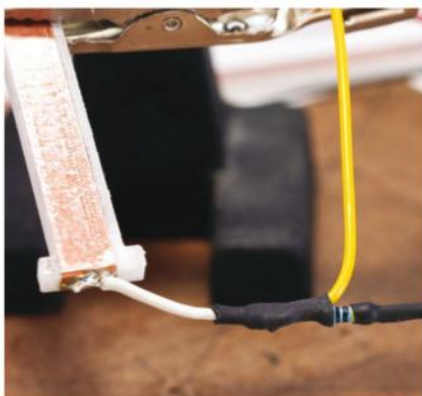
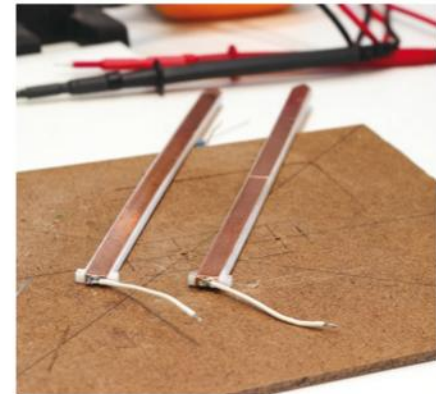
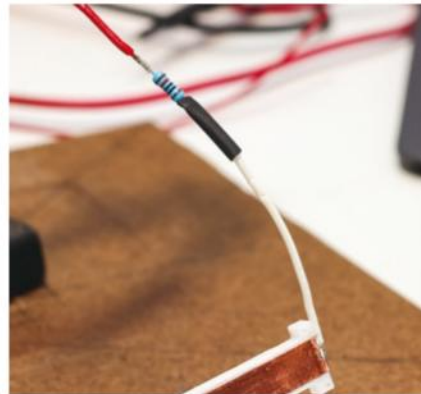
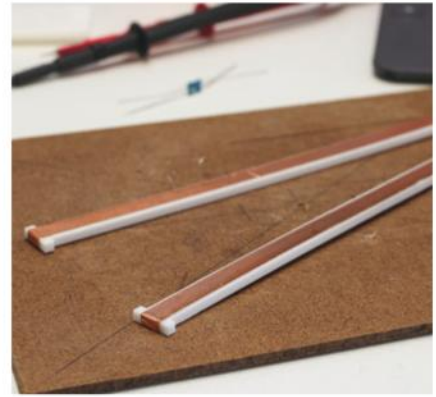
Above and below: The two sides of the BBC Micro Bit board



The volunteer plant used to see the Micro Bit and sensor in action in the real world



The steps to building the soil humidity sensor. First, the probes are 3D printed before being covered with adhesive copper tape. They are then inserted into the circuit box and hot-glued to fix them in place and keep them water-resistant. After soldering the two resistors to the sensor cables, the box is closed and hot-glued to prevent any dirt and humidity from damaging the circuit. The last step is crimping the crocodile clips to the sensor cables



Taking care of plants

The humidity level is basic information for any kind of plant watering system. Depending on the kind of plants we are growing, the terrain humidity is a good indicator of the health status of the plant and a helpful way to know when it is time to water the soil. It would not be difficult for this simple project to evolve into something more complex, including checking the environment temperature and the daylight intensity for the best time to water the plant. By adding the control of a water pump (the board can support it) we can reach the next level — an automated plant watering system.

In this project I have used three different containers filled with soil — respectively, wet, humid and dry — to set up the sensor readings in all the possible conditions. (When testing and calibrating I used sand instead of soil as it is easier to set as dry, humid, or wet.)

Components

The only part requiring assembly is the sensor itself. Below is a list of components to be used to assemble it, as shown in the step-by-step images:

- the 3D-printed soil sensor case — alternatively you can use a plastic box and a couple of wooden kebab skewers
- some electric cable
- copper adhesive tape — this can be replaced by aluminium cooking foil
- 1m Ω resistor
- 10k Ω resistor
- three crocodile clips
- a potted plant that will survive after the experiment.

The build

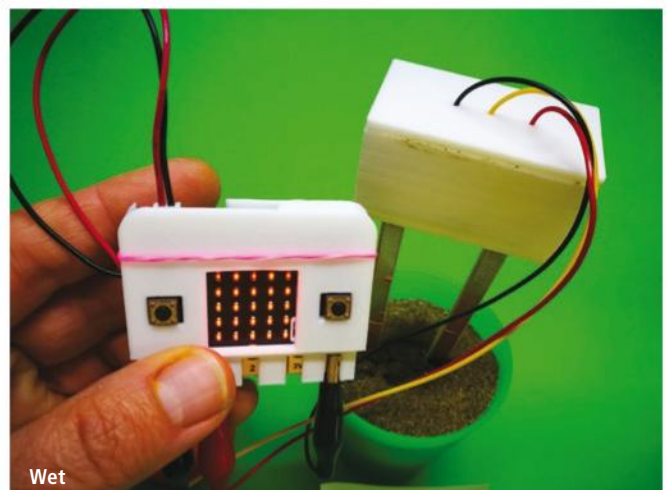
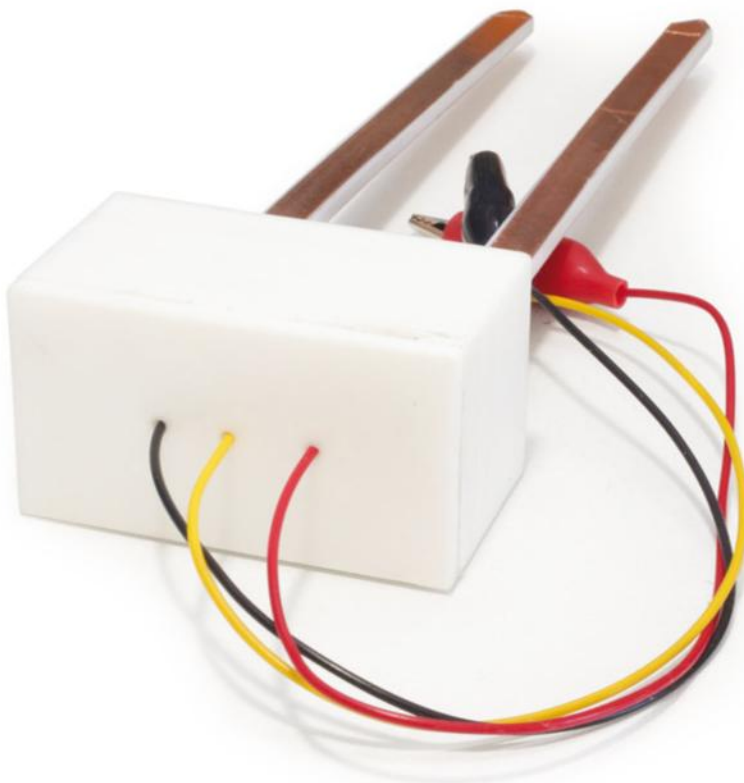
The first step is the creation of the humidity soil sensor. This build requires some soldering and gluing. The board will power the sensor, then the soil resistance is read, comparing the value with the internal resistance of the circuit. This circuit works in a similar way to a potentiometer, where the variable resistance is read from the soil.

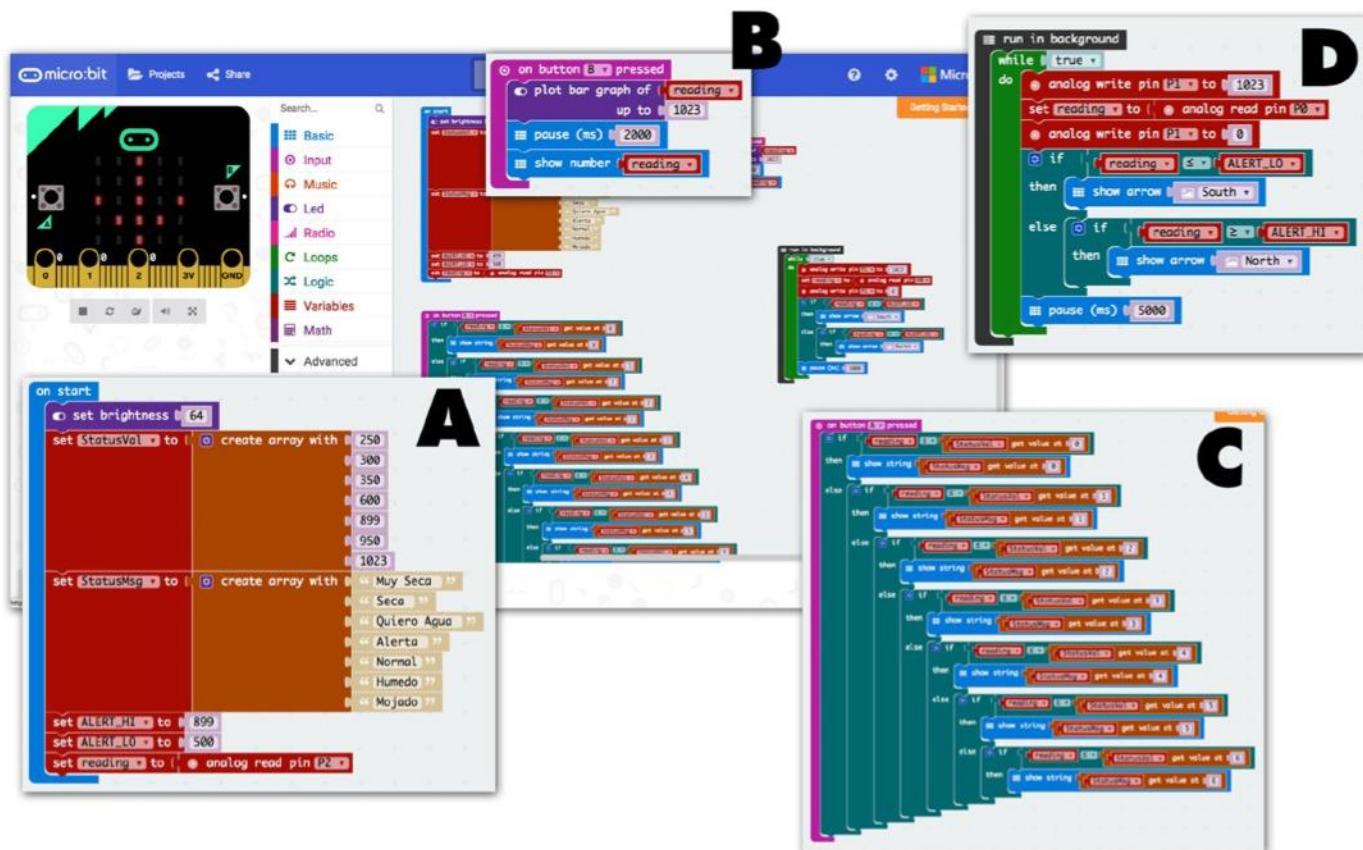
After assembling the sensor, connect it to the Micro Bit. Plug the GND (black) cable crocodile clip to the GND ring of the Micro Bit. Then plug the data (yellow) cable crocodile clip to ring one of the Micro Bit. Software will set up this pin as an analogue input for signal reading.

If we power the circuit, attaching the power (red) cable crocodile clip to the 3V ring of the Micro Bit, the circuit works. Keeping the sensor always powered will drain a lot of battery and we don't really need a continuous reading to monitor the soil humidity level. What would be sufficient, for example, would be a reading every five seconds.

For this reason, we will connect the circuit power to ring two of the board. Software will set up this pin as 'digital output', powering the circuit only when it is needed, setting the pin value to 1. This simple change drastically reduces the power consumption. ►

Below: Before setting the final programme a test version is created to see the numeric readings of the sensor in the three experimental conditions — dry, humid, and wet. The analogue values are read in these three conditions, then used to set up the final programme. Based on the numeric values retrieved by the test programme, I define a range of readings to identify the three humidity soil conditions to monitor. Depending on the humidity level of the soil the Micro Bit displays an up arrow, indicating too much water, or a down arrow, meaning it is too dry





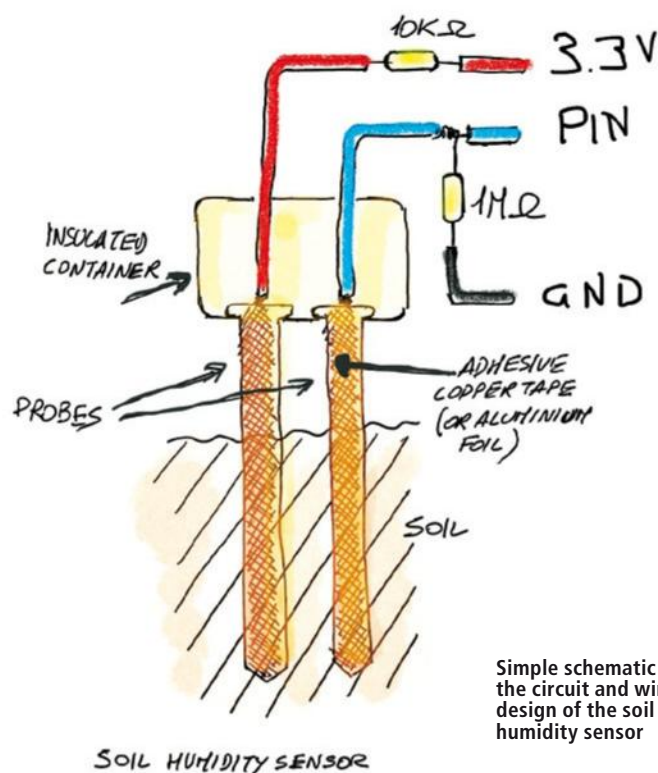
Above: The Micro Bit web programming environment. Some details on the programme blocks:

- (A) Block running once when the programme starts. It creates an array of messages shown in the various conditions of the programme and sets the reading value ranges corresponding to the humidity levels
- (B) Event generated when button B is pressed: shows a graph on the LED matrix corresponding to the numeric soil humidity reading. Converts the analogue value to a graph
- (C) Event generated when button A is pressed: a short text message scrolls past depending on the soil humidity reading
- (D) Background activity: periodically reads the sensor value and displays an arrow showing instantly if the humidity level is high or low

The software

Now it is time to programme the board. One of the most interesting characteristics of the Micro Bit is how easily it is to programme. Here you could consider using Blocks, the graphical language, but the Micro Bit also supports JavaScript and Python. Blocks programming hides behind the corresponding JavaScript source code. It is possible to switch between the two versions of the same source — Blocks and JavaScript — with a one-click command. This is a good way to learn the logic of a more complex programming language.

Programming is easy — you don't need to install any development environment; you only need the browser. The board can be programmed with a PC, tablet, iPad, etc.



Simple schematic of the circuit and wiring design of the soil humidity sensor

To start writing down the code blocks, you should go to the <https://makecode.microbit.org> site. The web programming interface includes the main area where you put the blocks, a left-side column with all the available standard blocks organized by features, and a simulator — a small graphical Micro Bit design that instantly runs the code you write to see

what happens step by step.

The corresponding JavaScript source of this experiment and more detailed information on the software logic can be found at the GitHub repository: https://alicemirror.github.io/SoilMoistureSensor_microbit/, and you can find more on the Micro Bit board at the official site: <http://microbit.org/>. 



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Smart sound))) solution





1. A drill press fitted with a 40mm diameter, carbide-toothed, Forstner-style bit was perfect for the job. This gave a smooth and clean hole that required minimal clean-up
2. Three pieces of wood prepared and ready to glue up

TURN UP THE VOLUME WITH THESE SIMPLE TO MAKE LOW-TECH PHONE SPEAKERS

By Raf Nathan

Photographs: Raf Nathan

Smartphone speakers are a great small project for woodworkers. Basically a simple sound box amplifies your phone and becomes a desktop speaker, without batteries or wires. You can expect a surprising boost to volume and sound quality.

There are a number of designs that pop up on the internet, as it is not a new concept by any means. I made four design variations for this project.

The phone needs a relieved section,

In theory this should have given an improved sound quality but actually, to my ears, it made little difference

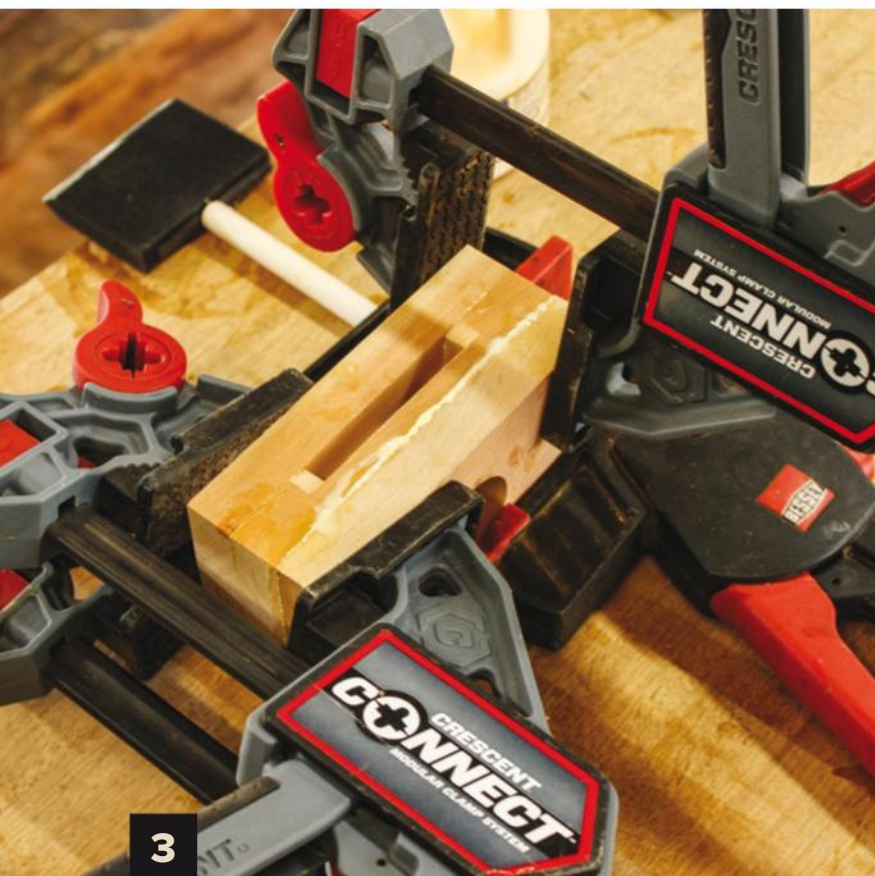
or cradle, to drop into that is about 20mm deep. You will have to measure



according to the phone model you have. At the bottom of the cradle is a slot to carry the sound into a larger hole which is the speaker.

The first two designs that I made were glued-up boxes that, interestingly, were not as good at amplifying as the third design, which uses a drilled-out solid square section of wood.

Designs one and two use three pieces of wood — the backing board, a centre board with a cradle to house the phone, and a front soundboard. ►



Clarity of sound

The first design, made from Oregon, worked quite well, and then for the second design, made of King Billy pine, I used a thin soundboard, like on a guitar, for the front. In theory this should have given an improved sound quality but actually, to my ears, it made little difference.

The third design used a solid piece of West Australian she-oak, with a drilled-out cradle and a 40mm diameter speaker opening. To improve the design from a lump of square wood I bevelled all the outside edges and the front of the

*If we are fine
woodworkers then
surely we can add in
some details*

speaker opening. This worked well, as the hardwood seemed to add more clarity to the emitted sound and the beautiful she-oak grain makes it a desirable object.

For the final design I added a five-degree

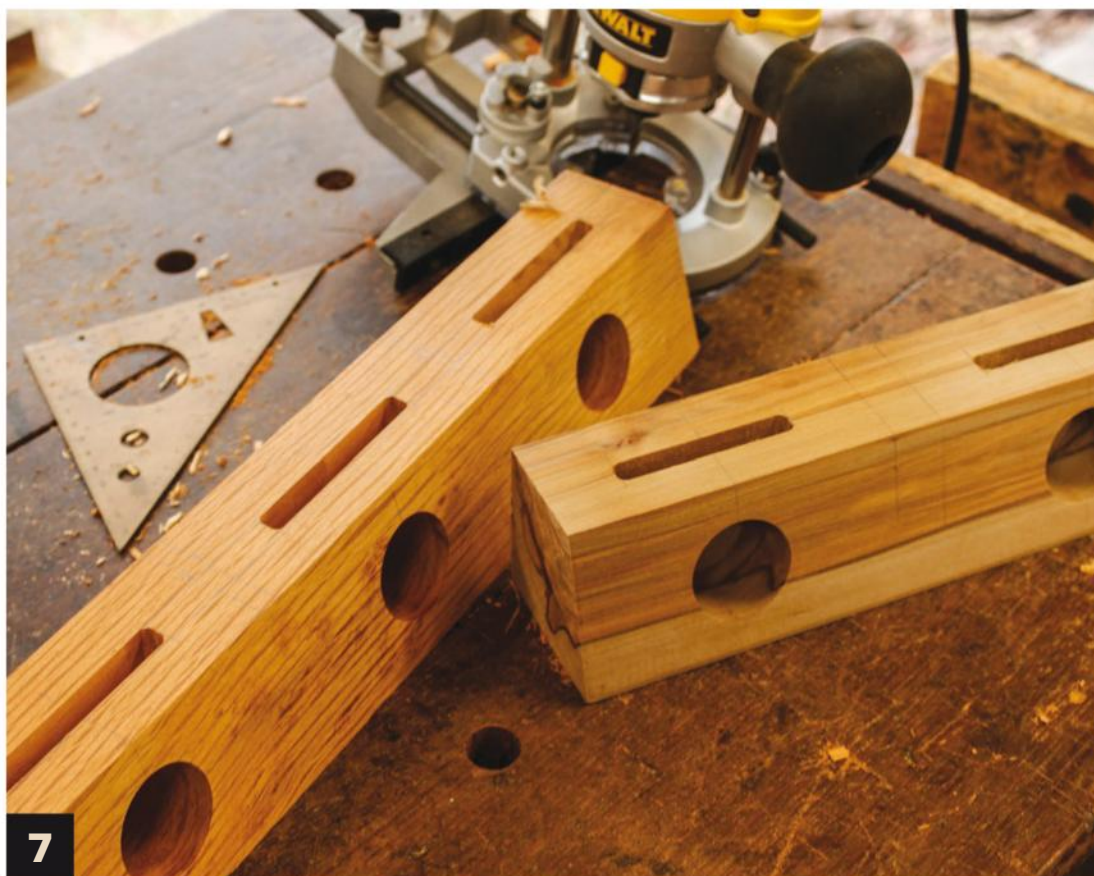
angle to the front, which does no more than make it a more complex-looking object. The speaker hole was, however, drilled at five degrees as well, so the hole remained perfectly round. Anyone can cut off a chunk of wood and drill a few holes, but if we are fine woodworkers then surely we can add in some details.

You can have some fun experimenting with shapes and different local New Zealand wood species. These speakers are a great gift item and they do work well. 📱



- 3. The three pieces all glued up
- 4. Design three has the same 40mm diameter main speaker hole. A 9.5mm Forstner bit was used for the cradle drilling. Using the same settings on the drill press, a smaller 6mm drill bit created the sound slot
- 5. Design three, almost finished
- 6. A bevel was added using a laminate trimmer and a 45-degree cutter

7. After finalising the design, I made a small batch of speakers from she-oak and leatherwood. For efficiency and safety I left the wood long when machining and cut the individual boxes to final size last. A five-degree angle was sawn into the front and the main speaker holes were then drilled, also at five degrees to the face. The phone cradle was routed out with a plunge trimmer. With all machining completed, the speakers were then sawn off



The resulting batch of phone speakers in the variations described



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Caught — a brass and glass sculpture

HEART OF GLASS

A WHANGANUI GLASS ARTIST SHARES HER PASSION FOR A VERSATILE MEDIUM THROUGH WORKSHOPS AND EXHIBITIONS

By Helen Frances

Photographs: Tracey Grant

Parts of Carmen Simmonds' cast-glass studio glow with the ethereal, often surreal, treasures that emerge from their creator's imagination and the searing heat of her kiln. Radiantly coloured dolls' heads, glass lace and crochet, headless dancing dresses, ballet shoes, lilies in milk bottles, flowers, and other organic forms are at once beautiful and disturbing.

Then there is the other side — the chemistry and chemicals, machinery,



Lace teapot

and tools; hours of modelling, firing, grinding, sanding, and cutting.

But this studio is also a home. Carmen and her husband Glen live at her work studio — a 100m² shed on their 8.5-hectare lifestyle block in Brunswick, Whanganui. The shed was originally intended as Carmen's full-time studio but when they sold their house in town they had nowhere else to live, so they moved into the shed "to camp for a while" and have stayed, still temporarily, for eight years. ►



studio

BULLSE

Carmen holding
The Decision — the head
opens to reveal words
inscribed with a Dremel



Please Do Not Throw Me Out — entered into the 2018 Sarjeant Gallery Te Whare O Rehua Whanganui Arts Review

It's a medium people like. Glass is very alluring and you can do anything with it.

Another, architect-designed shed house is in the planning stages and will be built on their property further down the road.

"It's actually really comfortable living here," Carmen says. "I can get up in the morning — because we have the bedroom, lounge, and kitchen all in one room — take three steps in my dressing gown and slippers into my studio, and start working. Quite often I have to get up in the night to check my kiln, so everything is handy. It's going to be so inconvenient to have to walk up the paddock to here."

Love of glass

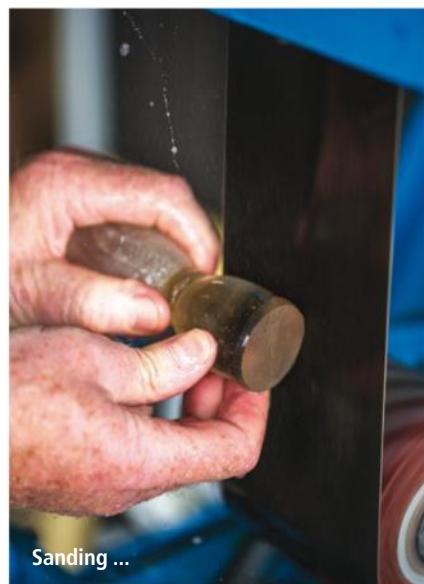
Carmen has a science background and worked as a lab technician doing quality control. She discovered a love of

glass and photography while studying for a Bachelor of Fine Arts at the Universal College of Learning (UCOL) and went on to do a Master of Art and Design at the Auckland University of Technology (AUT).

She has been very successful in her career; her glass work is exhibited within New Zealand and internationally and has been bought by collectors in New Zealand, Australia, the UK, and the US.

"It's a medium people like. Glass is very alluring and you can do anything with it," she says.

Core cast glass, where a shell of glass is created, is her preferred way of working, and she also makes open cast or solid glass objects. An experimenter from way back, she likes to adapt tools



and machinery rather than buying more expensive glassmaking equipment.

Tools, machines, and materials

Carmen sources worn dental instruments from her dentist and has adapted machines such as a wet-belt finisher from a glass factory; a wallpaper steamer to melt the wax out from the plaster mould; Dremel; sand blaster; linisher; compressor; flatbed diamond grinder — an air-driven cut-off tool modified with a diamond blade; drills; and crockpot to melt wax, or frypan for small amounts. The tools all have diamond drills and blades.

"Being a Kiwi you do tend to do the number-eight wire thing," Carmen says. "I realized that when I went to overseas conferences; they have all the machinery and tools, whereas we have adapted things and made them work for us. So it is totally doable. For example, I have an auto parts washer and I recycle water through it when I use the Dremel if I have to cut or drill the glass, because you always need water. It acts as a constantly flowing tap. I also have a cut-off tool I got from Super Cheap Auto and instead of having a steel blade on it to cut off metal I have adapted it for a diamond blade so I can cut off chunks or things I don't like on the piece."

Two three-phase electric kilns represent considerable investments, and she can cast anything from very small objects up to 20-plus-kilogram sculptures. There is a separate kiln room because of the toxic fumes, and a cold working area. Her studio space occupies one-third of the building at present.





... and sandblasting



Above: Nick, Carmen, and another workshop participant refining wax moulds using worn dental instruments



Nick sanding the bottom of a shot glass to make it level

Below: Checking the shot glasses are level before the next process, making the plaster mould around the wax



Working with colour

When she started out, Carmen used salvaged glass, which is an option for beginners: “I couldn’t afford to buy glass, so I smashed up car windscreens, house window glass — anything that wasn’t laminated that you could smash up into small bits. But unfortunately when you cast some of that glass it can come out a bit cloudy.

“People use Steinlager bottles and they work reasonably well but you have to heat it quite hot to make it run into the moulds. You work with whatever colour the glass is.”

She uses materials from Gaffer Glass, a company that was originally formed in New Zealand and provides glass in many colours.

“In my workshops I get students to

The CoLab inaugural glass artists’ conference, 15–17 February 2019

Carmen is President of the New Zealand Society of Artists in Glass (NZSAG). The CoLab, the first joint international conference, when the New Zealand Society of Artists in Glass will combine with its Australian counterpart, Ausglass, will be held in February 2019 in Whanganui. “There will be glass artists from lots of different cultures around the world and lots of activities. We want to show people what you can do with glass,” Carmen says.

During the three-day event, exhibitions will be open to the public and a wood-fired beach furnace, a centuries-old glassmaking tradition, is planned on Castlecliff Beach.

“It’s a traditional way of making a furnace using driftwood under a dome in the sand and will be heated up over

several days,” she says.

On Thursday, 14 February, the day before the conference begins, several Whanganui-based glass artists will open their studios to visitors, which Carmen says will be “great opportunities to meet hosts in their natural environment and see their studios and artistry first hand.” Visit colabconference.com/ for more information.





Using a peeling knife to gently remove the plaster mould from around the glass after kiln firing

work out the colours as though they are painting a watercolour so they can create a flow,” she says. “You can’t really predict how it’s going to turn out but you can give it a good shot by placing coloured glass in certain parts of the mould and making sure it flows in the right way.”

Glass workshops

Carmen has taught workshops for many years, both for beginners and those with some experience. She teaches mainly hollow-form core casting.

“In two days people learn what they could take six months to learn and they often return to consolidate. Glass casting can be applied to many areas. A brewer wanted glass handles for his beer taps, and other people have ordered glass figurines for the front of their cars. A bronze caster made sculptural figurines

and another person cast a full-sized replica of his father’s head,” Carmen says.

The workshops provide all materials, including glass, and use of the tools and machinery, and for a small charge there are two bedrooms for hire in another shed annexe. She runs a course every month.

Workshop participants are mainly women but she says that men are starting to get interested now too. The gender differences are complementary.

“Men ask the technical questions. ‘Annealing’ is the cooling part of the process so men will ask what the machines are used for and how you finish the pieces off. The women tend to be, ‘Oh my God, look at the pretty colours!’ The guys are far more process oriented and practical. It’s nice to get a guy and a gal because you get two different ways of thinking.” ►

“When I came to Whanganui I discovered it was the centre of glassmaking in New Zealand”

All dressed up

Carmen took the wearable art dress she made in 2016, *Wedding in Paradise*, to Corning, New York, with funding support from Creative New Zealand. It was part of the Glass Art Society Glass Fashion Show, with more than 100 other international artists. The dress, which is made from cast-glass ferns, flax flowers, weta, huhu bugs, and pohutukawa seeds sewn on fibre-optic fabric, and vintage materials, copper wire and aluminium, weighs 10kg. She has also collaborated with other artists in multimedia projects. In 2010, for a Sarjeant Gallery Arts Review, Carmen and Whanganui weaver Leonie Sharp created a full-sized cast-glass and feather sculptural dress entitled *Those Who Should Venture*. “A woman had to be bolted in and model it walking around the Sarjeant Gallery,” Carmen says. The work stands in the Whanganui i-Site and represents the pioneering women of the Whanganui region and the title is based on an 1860s advertisement in a British newspaper asking for women to come to New Zealand.

Carmen made the glass bodice, decorated with lace kowhai flowers and fern fronds. The bodice is symbolic of the settler women’s fragility and strength; the woven skirt represents the flora of the region — grasses and seeds — and the natural environment from mountain to sea.

Carmen also worked on a project for the Whanganui Memorial Centre with artists Jim Dennison and Dean Flavell and created a cast-glass column commemorating the Anzacs.

Those Who Should
Venture



Wedding in Paradise



Close-up of fern detail with
the fibre-optic fabric



How to make a basic cast-glass object



Silicone is spread onto an object to create a mould, then wax is poured over the mould to create an impression. This is then attached to a larger object using a warm implement to refine the wax



Silicone rubber moulds: decorative, textural objects

Ahead of time prepare embellishments with which to decorate the main form. Decorations can be anything that appeals. Organic materials work well — leaves, flowers, bark, seeds, or materials such as lace, buttons, jewellery, etc.

Resists

To avoid sticking, and depending on the material, apply either spray-on polyurethane, which protects porous objects and stiffens soft, delicate materials such as lace, or Vaseline, applied with a paintbrush or your fingers. This stops the silicone sticking to metals, plastic, and glass. Detergent solution can be used to keep fabric or paper materials moist.



Using silicone rubber

Apply silicone rubber (e.g., Ados RTV Acetic Cure silicone from Mitre 10) to your object's surface with a caulking gun. "I do it on magazine glossies like *New Zealand Woman's Weekly*, because it peels off easily," Carmen says. Pipe the silicone on in overlapping runs to avoid air bubbles. You can also squirt it into soapy water (which stops it sticking), take it out with your fingers, and apply. Alternatively, you can wet your fingers with detergent and water, then spread the silicone gently and evenly over the textured surface. Take care not to trap air under the surface. Make the silicone rubber mould 1cm thick. Leave 12–24 hours to cure. Once cured the silicone can be peeled off the form. Clean the interior with

soapy water if needed. It is now ready to be used, many times. The next process will use wax.

Making wax moulds for lost-wax casting: Nick's shot glasses

Use microcrystalline modelling waxes to make the form. These waxes are easy to work and burn out cleanly at a low temperature without catching fire. Nick made three shot glasses. Here is the process he followed:

1. Melt wax in a crockpot (you won't be cooking stew in it again) to a temperature of around 80°C.
2. Fill two small balloons with water — water-bomb style — to the size you want your form to be. One will be the base and the other the top.
3. Dip around two-thirds of the balloon in wax. Remove and allow the wax to harden and cool down — you can



Dipping a water-filled balloon into wax to create a form





also dip it in water. Repeat the process about seven times to create a 'slip', or 'shell'.

4. Pop the balloon with a Stanley knife or pull it out.
5. Join the two balloon shapes at the apex of the curve to make top and bottom, and anchor with wooden skewers or toothpicks, which will burn away in the kiln. Then add more wax (a thin sausage) around the middle and smooth it out using small metal instruments, such as a spoon or knife, ground to a shape that suits you, and heat over an alcohol burner flame.
6. Add on any premade decorations. (Nick used berry moulds on one and, on another, a latticework of flax on the outside with a flower shape in the bottom of the glass.)

The goblet forms can be sculptural pieces or functional.

Refractory mould

When the wax mould is finished, make, or 'invest it with' the refractory mould. Make the refractory mix with a 1:1:1 ratio of water (to mix), plaster (to hold the form), and silica (to stop it breaking up in the kiln).

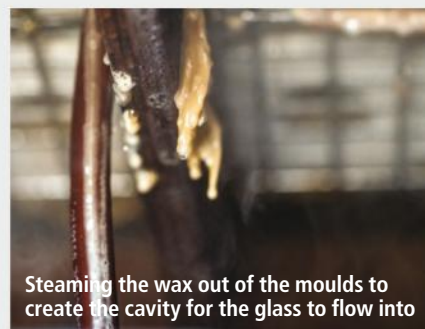
Use clean water and allow the plaster to 'slake' for two–three minutes before mixing. Gently stir without making air bubbles. The mix is like whipped cream. Next, with your hands, mould the plaster around the piece. Do lots of layers — in the kiln, if one layer goes, the next will hold it. The internal layer around the wax is the important one because it catches

all the textures, so it needs to be sound. These are the 'core moulds' and they have an internal and external surface. The base, or 'sprue', which is the other cup form, is solid. That is where the glass will go in through a feed. The glass pieces sit in the top and melt down into the sprue then in and around the bottom cup form. Allow the refractory to cure for 24 hours to reach maximum strength.



Applying the first coat of plaster using a paintbrush to ensure all the detailing is picked up. A mask guards against toxic fumes

Building plaster around the object, making sure it is evenly coated



Steaming the wax out of the moulds to create the cavity for the glass to flow into

Losing the wax, or 'cire perdue'

Make sure the steamer heats up the mould from bottom to top, so that it is too hot to touch. Steam out the wax. "You don't want any wax left in it as it makes marks on the glass," Carmen cautions. "We want a clean surface. The wallpaper steamer is gentle."

The process begins with a positive, goes to a negative, then back to a positive. "Ideally once the mould has been steamed out, leave it long enough to dry (a week or more) before putting it in the kiln," she says. "Moisture from the mould can rust the kiln. But I don't have time when running the weekend workshops."



Many colours of glass are available from suppliers

Glass

Work out how much glass you will need. Carmen uses the water-displacement method: First mark the water level on a jug. Pour water into the mould up to the level you want the glass. Next, tip the water out of the mould and see the difference between the mark on the jug and the water level, then put glass into the jug to make it up to that level.

Continued ...



The balloon is popped and extracted before adding details





Removing the blocks from the hot kiln

Kiln firing

The firing process is very technical and has to be followed step by step according to a schedule. If you don't have a kiln, Carmen reckons sheddies could do 90 per cent of the glass-casting process themselves and take the object to a kiln for firing — you can take your objects to a facility that hires out kilns, or you could ask a glass artist to do it for you. Carmen heats up the kiln slowly to let the mould dry out, then holds it at 800°C to let the glass run in and the air come out. During the firing process, the glass melts down through the hole in the base of flower-pot reservoir — which is placed on top of blocks sitting on top of the plaster mould — into the mould, filling the empty cavity left by the wax. "Hold for a few hours then crash the kiln, cooling it fast to stop the glass flowing. Then crash it down again to the annealing temperature during which all the particles of glass slow down and lock into position so you don't get any cracks," she says. "If you don't anneal properly, you'll get cracks in the glass. Hold at annealing temperature for the recommended

time of the glass manufacturer, which lets the mould and the glass cool at the same time. Then cool through several stress points until it reaches room temperature. It can take days or weeks. You need to work it out logically according to how thick the glass is." The workshop students' objects are usually ready after four days. "I try out lots of different things. I put on my firefighter's outfit and I'm in there with my gloves at 800°C putting glass in and taking pots out with different reservoirs if I'm trying to mix glass in a



Wet-belt linisher

certain way," Carmen says. "There are lots of things you can do when glass is molten as long as the refractory mould is good with no cracks. It's quite fun but you can't be scared of heat."

Removing the mould

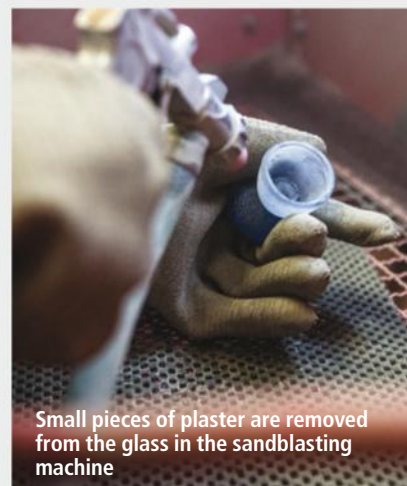
Take the mould off carefully. Be gentle; pick away with a blunt peeling knife, always mindful of where the glass sits. "Pretend you are an archaeologist, and don't chuck it in water because the plaster can expand and crack glass," she says.

Use a toothpick and toothbrush to clean away the plaster.

Finishing

Carmen uses various machines to refine the glass object and "sort out any problems". The wet-belt linisher does soft edges and the diamond flatbed levels the flat base of the shot glasses. Nick smoothed off rough bits around the rim using the Dremel and then air-dried his shot glasses before avsandblasting. The sandblaster creates tiny, even pits in the surface of the glass with a mixture of air and garnet. Once that is done the glass can be put into acid, which eats into the fine holes.

"Sometimes I use sugar acid, which gives a durable satin finish," says Carmen. "Otherwise I squirt the piece with silicone once it is sandblasted. This protects and gives a nice sheen. You have to wear long gloves and a mask when working with sugar acid, and be fully covered as it is quite toxic."



Small pieces of plaster are removed from the glass in the sandblasting machine

Running water and a Dremel remove imperfections around the rim



Nick Price's shot-glass forms ready for finishing

"I put on my firefighter's outfit and I'm in there with my gloves at 800°C"

Carmen opens the kiln lid to check the glass firing



Blokes making dresses

A while back, several men attended a course and she gave them one of her dresses as a project to render in glass.

"They had to rearrange the dress into something of their own creation — like a figurine," Carmen explains. "It was a challenge but they were thinking about how their partners would like it. Some have gone on to making glass a big part of their life now. I got them to chop up their wax impressions of the dress and put it back together again in glass in a way [that] they thought was interesting, using different colours. As part of the process they made their own small silicone moulds."

Nick Price, a British ophthalmologist on a short-term contract in Whanganui, was doing his second workshop with Carmen.

"When I came to Whanganui I discovered it was the centre of glassmaking in New Zealand," Nick says. "I love the glassmaking process and I'm planning to set up a little glassmaking studio back home. I'll get my own kiln and kit."

Nick made four shot glasses, which he decorated with organic forms. He

had brought animal-making balloons to create different shapes, then decided to go with the oval shot-glass forms.

"The most challenging part is coming up with artistic ideas, designs, and patterns," he says.

Carmen has a website at which you can find out more: carmensimmonds.com/. 



Nick uses the air compressor to remove particles of plaster from his work

Installing a kitchen

FROM PLANNING TO FINISH,
WHAT YOU NEED TO KNOW ABOUT
FLAT-PACK KITCHENS

By Lachlan Jones

Photographs: Adam Croy and Gary Hatfield

Kitchens are the heart of a house, the control room around which everything revolves and a room that gets a lot of use, more so than any other. It's also a workplace where meals are prepared and often consumed. It's a hard traffic area that sees a lot of action. Kitchen styles are constantly changing and traditionally there has been a trade-off between functionality and design within a set budget.

How do you integrate oven, hob, fridge, sink, pantry, and all the implements that grow to fill the space available and still have the stylish environment you want? Flat-pack kitchens are a viable option in terms of cost and quality, as well as configuration, for every kitchen size and type.

What is a flat-pack kitchen?

Flat-pack kitchens are mass-produced modular kitchens that can fit a number of different-sized homes and kitchens within a range of budgets and tastes. The 'flat pack' term comes from the fact that the kitchens are generally manufactured in bulk, then the required pieces are sent to be assembled and installed on-site by a builder; kitchen installer; or, in some confident cases, the homeowner/sheddie.

The flat-pack kitchen means a lot less mucking about on-site and is a uniform product that can be put together in no time (by someone with the patience and know-how). ►



Our completed, installed flat-pack kitchen, just waiting for the bench top to finish the job off



The old existing kitchen was dated and darkened by the ceiling-hung units

Below left: Work begins on stripping the old kitchen. It pays to completely redecorate before the installation of the new kitchen





Above and below: The cabinetry for this install was assembled on-site, but sometimes off-site is a good option

“The flat-pack kitchen means a lot less mucking about on-site”



Flat-pack kitchens have made their mark on the Kiwi construction and renovation scene and are now a firm favourite, having bypassed their previous cheap-and-cheerful reputation. They now offer better quality, plenty of options, and more palatable pricing than ever before.

The kitchen used in this project is from New Zealand kitchen manufacturer Peter Hay Kitchens (peterhay.co.nz). Once our homeowners had chosen the components off the shelf, so to speak, the flat packs were delivered on-site to be installed by Gary Hatfield from Home Skills. The flat-pack kitchen components have all that a purchaser could want in terms of size and shape — even components for filling in that awkward small leftover gap that you have no idea what to do with. There is a

jigsaw-puzzle piece available to complete any space.

The project — the old kitchen

The old kitchen was dark and rather worn out. As the main route into the house, there was a feeling of being disjointed from the rest of the house. There was a lack of any flow into the living room as a high unit above the bench blocked the kitchen from the living room. The decor was a bit dated, too. The owners had embarked on a project to renovate the entire home, from the bathroom to the bedrooms, including new lighting, new floors, new carpeting throughout, as well as the updated kitchen. This included all new appliances, which meant that the home owners were able to start from scratch. ►

Demolition

While the cabinetry was being assembled for our project kitchen, the demolition of the old kitchen was getting underway. Drawers and doors were removed first to allow the plumber to disconnect the taps to the sink and dishwasher. The electrician arrived shortly after to disconnect and make safe the connections for the oven, hob, and various power points. Then the appliances were removed and the benches and the rest of the kitchen cleared to make way for the plasterer, who needed to repair the hole where the oven tower had stood and the ceiling where the floor to ceiling cupboard had once been. The old linoleum was lifted.

Design

Kitchen installer Gary visited the owners of the home and spent some time with them, measuring up the space and discussing their requirements. At this early stage it's very useful to know what appliances will be needed and it's important to have the actual dimensions. There are regulations and manufacturers' specifications around the placement of refrigerators. Failure to accommodate them can lead to failure of the appliance and a voided warranty. Fridges need space to circulate air or they will overheat.

Ovens too require some thought over placement. When ovens are in a tall unit with the oven at bench level, there is a regulation about how far the oven has to be off the ground.

Once the plan is finalized the kitchen designer/cabinetmaker will draw a floor plan and elevation, which will show where all the cupboards, appliances, and bench top will go. This is then translated into a computerized drawing that generates a 3D illustration so that the clients can visualize what they have planned. At this stage final details can be decided on and modifications made. From this plan a fixed price is negotiated. Once the homeowners are happy with the



concept drawings and pricing, a deposit is paid and the manufacturing begins.

Computer-aided

Most kitchen manufacturing is done in large factories by computer-aided manufacturing. Computer-controlled machines cut, shape, and pre-drill the parts for later assembly. This makes the turnaround faster and the production far cheaper overall.

If the kitchen is well planned and coordinated with the other trades, the standard time for completion is around a week. Once the kitchen cabinetry is installed then flooring and splashback templating can occur. ►

There are rules about space around electrical appliances. Failure to comply can void warranties

There are regulations and manufacturers' specifications around the placement of refrigerators

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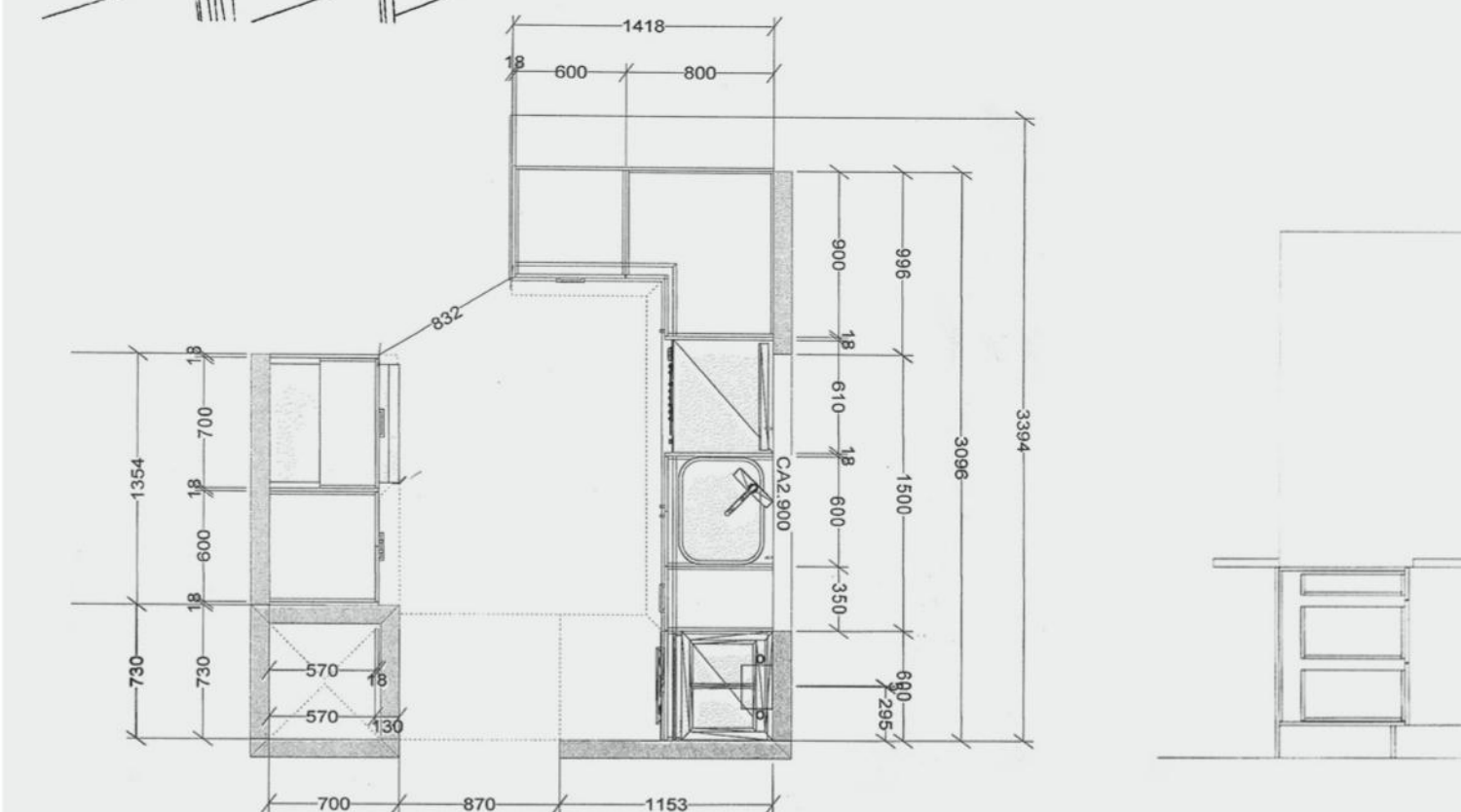
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CAD drawings are done during the planning stage. From these drawings, the correct modular parts can be ordered. The value of good plans and planning cannot be overstated

If the kitchen is well planned and coordinated with the other trades, the standard time for completion is around a week

Once the kitchen is cut and edged it must be assembled into its component units. This can be done on-site but it is often better for the joiner or cabinet maker to do so off-site and then deliver the units ready-built. It's also a chance to check that the parts are correct and will join together as they should.

At the same time as the sides, doors, and drawers are being made, the chosen bench top is being created in another factory.

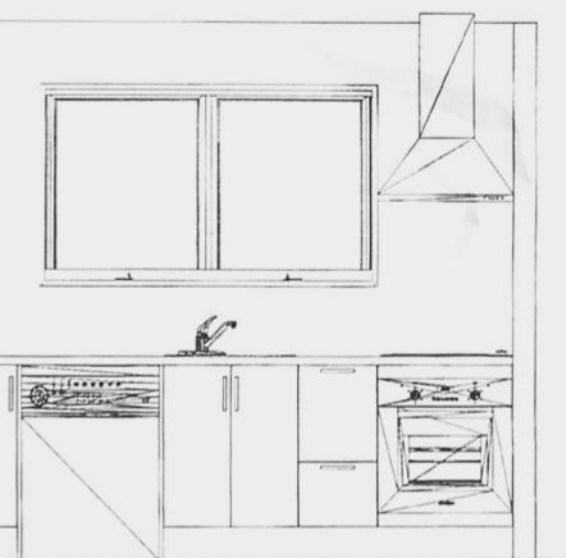
As we all know, particularly in older properties, very few walls are square. Over time walls can move and shift out of plumb. So bench tops are always ordered larger than required. This is to

allow the installer the chance to scribe the bench to fit the variations in the wall. Often the wall can undulate very slightly but just enough to be obvious when you put a large straight edge like a bench against it. It's those unsightly gaps that the scribing corrects.

Materials

Most kitchens are constructed from MDF with a veneer covering, frequently a pressure-laminated one like melamine, which goes by a number of different brand names. During the 1980s and 1990s, it was common to see kitchens constructed from particle board. You can still get kitchens manufactured in this material at the low end of the market. It has a number of drawbacks, principally that the material lacks density, meaning that it has less holding power for screws and other components.

You can often see older kitchens in which the doors, hinges, and all have parted from the cabinets. This is usually due to the particle-board cores. MDF is denser and now comes in a moisture-resistant version especially useful for kitchens. It needs to be specified when ordering the kitchen. ►



Maximizing storage space is key when renovating a kitchen



Flat-pack kitchens these days use robust hinges and MDF board for increased strength. Cabinet legs can be adjusted up to 10cm in height

Cabinets

Cabinet joinery, especially what you don't see, is important. A cupboard or cabinet made from a light material might need to have a batten across the back for support. When there is a solid back, you can screw it wherever you like. The installer putting the kitchen in need not stress out about where the nogs are. They can fix the cabinet anywhere and into anything because they are not restricted by a thin 3–6mm MDF back. If you screw through a thin back, it bows and your cabinet can pull away from the wall, so you need to put extra support in, or extra nogs.

The likes of Peter Hay Kitchens offer

bespoke cabinets for corners, small areas, and skinny recesses.

Benches and cabinets can be sprayed with lacquer. Generally for kitchen use, paints will have to be two-pot lacquers or epoxy based, and this is sprayed directly over a moisture-resistant MDF substrate.

Drawers

Drawers ain't drawers anymore. Nowadays they are 'systems' that integrate with other hardware such as hinges and slides. Most modern drawers are made with manufactured sides of powder-coated steel that are screwed to the base and have the drawer front



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Soft-close drawers are now a common feature in modern kitchens. Ensuring straight lines when installing will keep the soft-close drawers on track. It pays to choose quality drawer runners



It pays to invest in high-quality drawer hardware — it will keep paying for itself for decades

clipped on. Be aware that some drawer systems may be made of plastic.

The powder-coated steel sides incorporate part of the slide mechanism. The systems allow for some adjustment to achieve that perfect fit. There are many styles and an equally wide variety of prices for drawers, which may be full extension, self-closing, or soft closing.

These are the parts that get the most wear and are often the first to fail. It pays to invest in high-quality drawer hardware — it will keep paying for itself for decades. Poor-quality fittings will inevitably result in problems and regrets. It pays to get it right because retrofitting hardware such as drawer runners is difficult and 'difficult' usually means expensive.

Talk to your cabinetmaker and listen to their recommendations. They have to stake their reputation on your furniture and they don't want it to fail. Drawers in kitchens especially often have to carry very heavy loads and that means they need slides that can bear that load.

A kitchen designer recommending some hardware might never have had to deal with opening up the packet and reading the instructions on how to



install it. The installation can be tricky, so ensure that you or your installer reads and re-reads the instructions.

Stone tops

Stone tops such as granite, marble, and even polished concrete are very popular and they present another difficulty. It isn't practical to scribe a granite top to size, so these tops are usually measured by the stone suppliers and templates are created from plywood or thin MDF from which the final shape is cut.

Stone benches represent planning





How many drawers, what type are required, and where they should go are all easily solved with options aplenty

Kitchen install tips and tricks



We have collected some basic tips for people wanting to renovate their kitchen or build a new one.

1. Plan, plan, and then plan some more: Consider what appliances you want and their size. Do you want a wall oven or a free-standing one, a double fridge or a single, a single- or two-bowl sink? What about bench top material? What type of hob do you want/need and how it will be powered?

2. Budget: Be realistic. If you have a modest budget, stick to that. Know what is affordable for what you have.

3. Space: Work out your plans with a sketch. Does it include a dining area? For flow and storage, is it a walk-through kitchen? What views do you want from your workspace? What storage do you need?

4. Choices: Things you need to decide on include flooring, wall coverings, colours, cooktop, splashback, tiles, window dressings, sink style, cabinets, handles, lighting, and bench finish.

5. Management: Work out how to manage during the building phase. Expect at least a week without a kitchen.

6. Tolerances: Allow tolerances for the standard units. There may be a need for filler panels between some of the units. These will not look out of place, but you're better off allowing a bit more room than having it too tight.

7. Surfaces: Make sure all of your surfaces are in the right place for what they'll be used for. Think about meal prep, dry spaces, wet use, 'hang out' areas. Ensure there is power where you'll need it for toasters, coffee makers, slow cookers, and the like.

8. Levels: All soft-close drawers and cupboards will not close properly if the levels aren't correct. Ensure your levels are true before installing your units.

9. High units: Get rid of high units when possible. Instead, do full wall units from floor to ceiling or have nothing at all when possible.

10. Touch to open: These units are the trend currently. Be aware that they are very sensitive and most light brushes will open them.

11. Colour scheme: You'll seldom go wrong with white on white in the kitchen.

12. Engineered stone: This will be cheaper than granite. Colouring is also often more uniform, with more colour options available.

13. Production line: Kitchens from Peter Hay Kitchens are built on a production line in Auckland. Most kitchens (90 per cent) will be able to work around these standard units, only sometimes requiring some packing out to ensure a good fit into the space available.

14. Breakfast bar: When building a breakfast bar, avoid an overhang of any less than 280mm, otherwise you'll likely find little room for your legs and feet under the bar.

15. Windows: Don't forget to factor in where your windows are and optimize placement of units for sun and light. Over the sink is best and other light sources are worth considering for cooking, access, and general use of the space.

16. Vacuum warning: Do not let the builder use your vacuum cleaner. Building dust and debris can ruin a domestic vacuum cleaner. A builder's industrial-strength machine is needed to clean up.

problems of another kind too. The weight of a granite top must be considered in the design of the cabinets that will support it and they will frequently need reinforcing to prevent them from sagging or bowing under the weight.

Paint

While the kitchen is clear and after all the holes are patched it can be a good idea to paint the walls and ceiling at this time. It will be more difficult to do so after everything is installed. It's worth considering one or other of



The flat-pack manufacturer will offer a wide array of handles and cabinetry finishing to suit each customer's personal preference



Left: You can never have too much easily accessible storage in a kitchen



The drawers are assembled and fitted to the cabinets and the kitchen begins to take shape. The cabinets are finished with adjustable feet that can be adjusted up or down by up to 10mm and keep the cabinets off the floor and allow the tops to be levelled, taking up any variations in floor level.

On-site

There is constant checking of measurements against the plan and levelling the cabinets and assembly. If the measurements or level and square are not correct at the beginning then nothing else that follows will ever be level or sit/fit properly.

The floor will be laid up to the legs and then kickboards put in front of the cabinets to hide the legs. The ready-assembled cabinets are easy to work with compared with the days when cabinetmakers had to build the plinths and cabinets, cut them to fit, and then ended up with panels that had to be scribed all around. Now of course, people can get the look they want cut to their specifications, with panels, handles, and cabinet fronts that can be varied in colour and style.

The cabinets are clamped to hold them in place while fitting them tightly with screws where they are less likely to be seen. A temporary brace holds two of the cabinets steady where the sink goes until

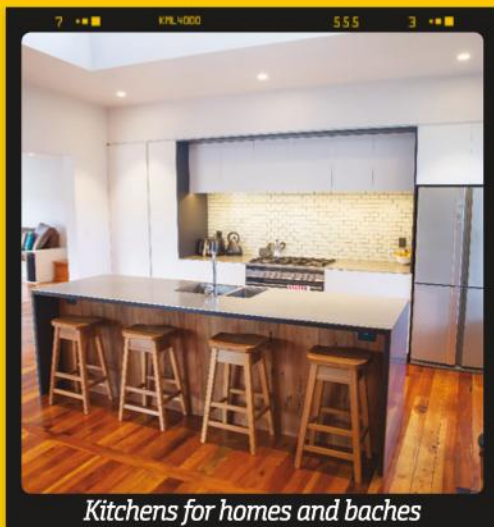
the specialist kitchen paints too. Resene has a paint that contains silver ions, which have natural antibiotic properties and keep surfaces free of mould and odour-causing bacteria, particularly in damp or humid areas.

Assembly

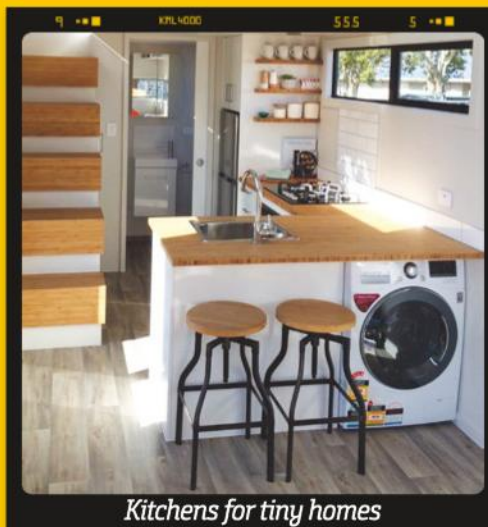
The cabinets are screwed and glued together. The design allows for the various components to slot together with mortises and tenons cut into the edges to add rigidity to the pieces. Cabinets that are butt joined (simply attached end to side) can have more play, especially as the pieces move over time and shift out of alignment.

[P]eople can get the look they want cut to their specifications, with panels, handles, and cabinet fronts

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the installer has screwed the backs into studs in the wall.

The basic height of a working kitchen bench is 890–900mm. Measurements that need to be allowed for when judging the height include 10mm for tiles and 5mm for an underlay.

With a cabinet near a power point or a cupboard door opening towards the wall, there will need to be some packing to allow for the door opening.

The bench tops themselves are joined with special toggles and have the holes cut out of the supporting substrate to accommodate these.

Good planning makes perfect kitchens

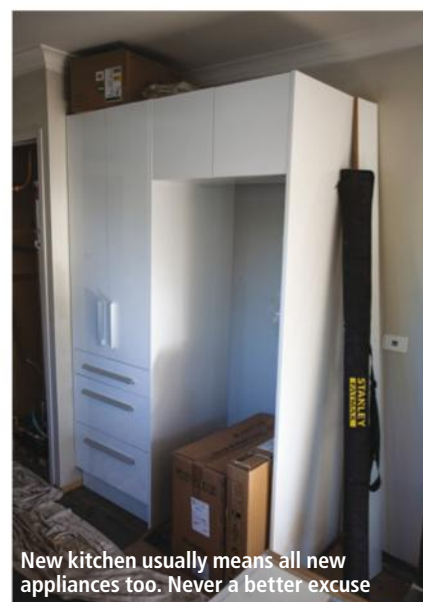
Early planning ensures that the homeowners decide on a single, one-and-a-half, or two-bowl sink, and for the hob. Provision for the plumbing in the first case and wiring in the other is built in before

the bench is finally in place.

Once the bench is installed, the electrician installs the hob, oven, and the extractor. The plumber reconnects the sink and dishwasher. If people install their dishwasher themselves rather than a plumber, one of the aspects to remember is the heat shield on the underside of the bench above the dishwasher. Steam coming up from the opened door can affect the material in the bench.

One of the last elements to go into a new kitchen is the splashback, with the colour adding a highlight to the kitchen scheme.

It's important not to forget to notify the insurance company for an existing house insurance that work is being done on the house so that contract insurance can cover any damage during the renovations. Also ensure that any tradesmen coming and going in the house use proper coverings and protection. 



Thanks

Thanks to Gary Hatfield of Home Skills (homeskills.co.nz) and Peter Hay Kitchens (peterhay.co.nz), as well as the homeowners for letting us into their home to follow this installation.

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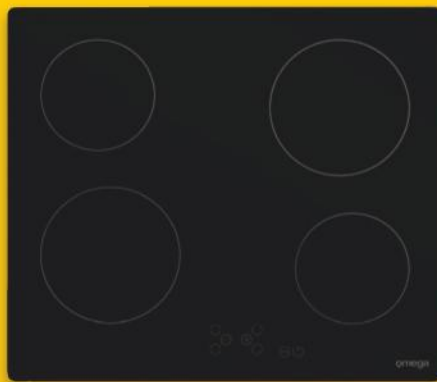
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IN PURSUIT OF PERFECTION

PRECISION AND ARTISTRY COMBINE
IN THE CREATION OF A PERPETUAL CALENDAR
SKELETON CLOCK

By Jon Addison

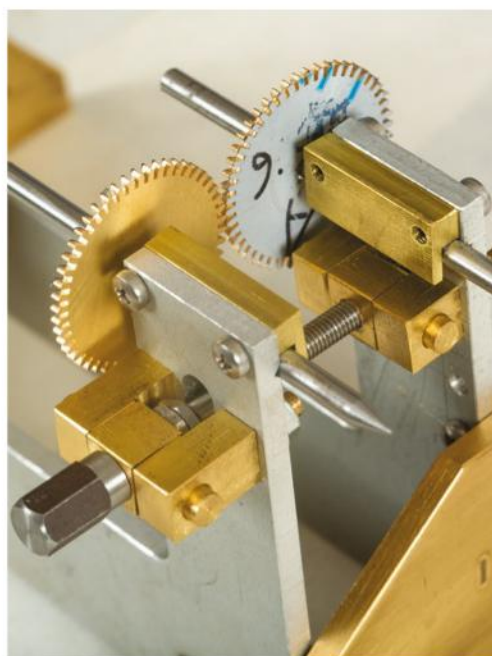
Photographs: Adam Croy



David Curry in his workshop. His next project, a dauntingly complicated perpetual calendar skeleton clock.



Clockwise from top left: Skeleton-clock parts; the German digital display that David added to his lathe; a home-made cutting tool; a lamp that David made to project magnified images of gears; a disc and the cutter that will turn it into a gear wheel; the jig that David made to ensure perfect gear meshing



“The engineering has to be right so that the parts work properly, but they also have to look right”



If David Curry were to be summed up in a single word it would almost certainly be ‘precision’. But that wouldn’t be enough; it would be absolutely vital to add ‘artistry’. Putting them together amounts to a search for perfection, so perhaps that’s the word to use.

Here’s an example: David is at present building a dauntingly complicated perpetual calendar skeleton clock, which has 38 gears, one with 165 teeth, all of which have to be individually machined. Clearly precision is paramount. But the levers and some parts of the frame look a little utilitarian, so he’s redesigning them with a few artistic flourishes. For inspiration he looks to a skeleton clock

that was built in 1855.

“The engineering has to be right so that the parts work properly, but they also have to look right,” he says.

The clock tells the time; has a second hand; notes the day, date, and month; and knows whether the month has 30 or 31 days. David is adding a second chiming system so that the half hour, three-quarter hour, and quarter hour chimes have different tones from the full-hour strike.

Making tools

Clock gear teeth can be pretty small so David knocked up a little projector from a torch and a lens to enable him to project

magnified images of the teeth to check that their shape is right. Although at a glance the teeth on a small clock gear may appear to be triangular, in fact the form results from two arcs drawn from the gear centre, so the sides are gently curved.

Needless to say, the tooling to achieve this isn’t exactly simple. And while it’s possible to buy gear cutters for the larger gears, they are expensive, so David makes all his own from scratch.

“I probably spend as much time making the tools as I do making the clocks,” he reckons. “And making the tools is the most challenging part of the whole project.”

The four-tooth gear cutters are machined



A gear wheel set up for the tooth cutter, with the dividing head at left



Left: A completed skeleton clock
Right: The home-made tooth cutter at work

from flat-ground plate tool steel, and then tempered. It takes considerable time to get the correct arc on the sides of the teeth. “They have to be visually correct as well as working properly,” David points out. “It took me two months of research to work out how to make them before I even started on the lathe.”

He has a dividing head to ensure that the teeth are perfectly spaced around each gear.

Digital measuring system

He has also built what he calls a ‘depthing tool’, which has a pair of shafts culminating in fine points. The shafts can be adjusted together and apart. David fits a gear to each shaft and adjusts their engagement (or depth) until they mesh perfectly. Then he uses the points to mark the clock frame for the final shaft locations. He says that he’s “never seen one for sale”.

David bought his first lathe, a Myford ML7, in 1961 when he was just 16 years old. “It cost £110 but I was only earning £310 a year,” he remembers. The lathe in his Orakei workshop in Auckland now is an Austrian-made EMCO Maximat V10,

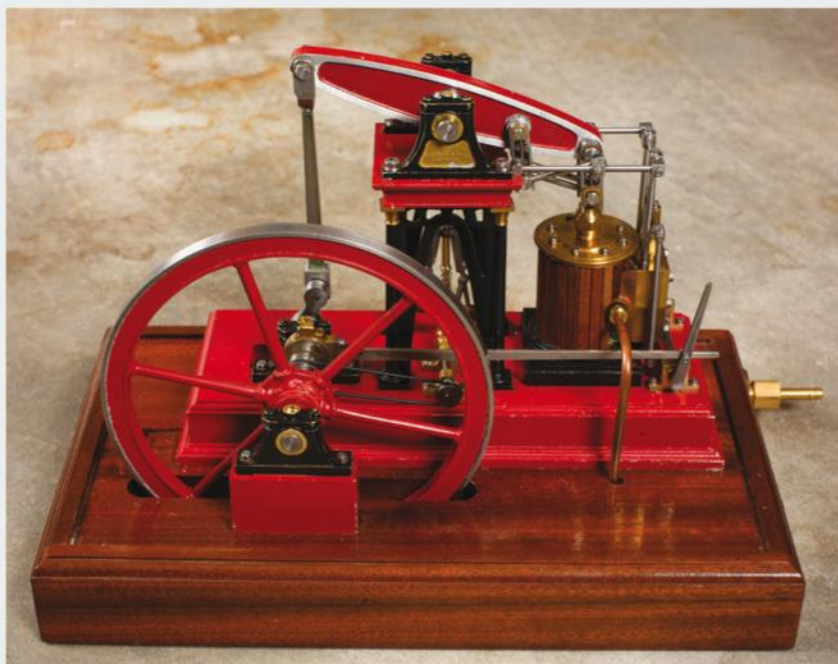


which was originally his father’s. It’s fitted with a small vertical mill. He has added a German-made digital-display measuring system, accurate to five decimal places. That’s precision!

“I couldn’t work without it,” David says. As well as giving him the precision he requires, it also enables him to switch from Imperial to metric measurements at the touch of a button. Clock plans are invariably in Imperial, but he prefers to work in metrics.

Most clocks have lantern pinions — the type that look like two discs with rods between them to engage the gear

Steam engines



A close look at the long bolts that clamp the heads onto the cylinders of David's model steam engines will reveal that they are machined with a slight taper towards the top: "They just look better that way," he says.

He started building steam engines in 2014 when he inherited a partly built kitset from his father. After completing it he decided that he could do better, so made another four.

"The last one I made is an oscillating steam engine, something only a clockmaker could build," David says. "I thought I wouldn't be able to improve on it, so I haven't made any more."

Most of the little steam engines are models of real ones built for display at shows and can be run on compressed air, chuffing away just like the real thing.

David buys kits to get the major cast components but machines all the other parts himself. All, that is, apart from the wooden bases, which are made for him by a friend. "I'm no good at woodwork," he says.

The work is surprisingly demanding. For example, delicate 2mm diameter operating rods are machined from 1/4 inch (6.35mm) square bar so there are no joins at the square ends where they pivot. Such a fine piece is flexible

David's collection of model steam engines shows the precision and workmanship in the huge variety of parts required

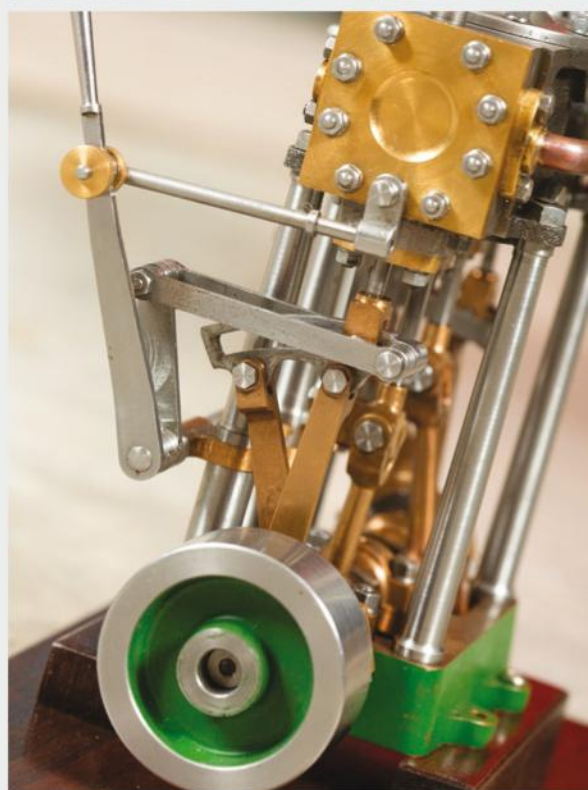
"I thought I wouldn't be able to improve on it, so I haven't made any more"

in the lathe so requires a careful and experienced touch.

For the painted parts David uses automotive spray cans, which can be found in practically any colour.

He also made a compound steam engine, in which steam is first expanded in one cylinder then exhausted in to a second cylinder to increase the energy that can be extracted, and thus the efficiency, of the engine.

"Before I started it I didn't even know how a compound engine worked, so there was a bit of learning to do," he says.





Above: A selection of tools that David has made to machine clock parts
 Right: A gear-tooth cutting tool ready for work
 Below: Details of skeleton clocks give an idea of the patience required to build one

"I probably spend as much time making the tools as I do making the clocks"



teeth. But David feels this is not elegant engineering, so he machines tiny pinions from steel bar, using cutters that he makes on his lathe.

Although precision is required in making the clock levers and frames, this is achieved by painstakingly hand sawing them from brass sheet and finishing each part by hand. A fretsaw with a wire-type blade is used for the cutting. The only parts of the clock that he doesn't make from scratch are the main springs.

Restoring clocks

David estimates it will take about 12 months to complete the perpetual calendar clock, but says, "Once I've made all the tooling it actually comes together quite quickly."

It will be the second clock that he's built from scratch, but he's also worked on or restored parts of old family-heirloom clocks, including a pair of English grandfather clocks, one from 1680 and the other made in 1720. He says the 1680 clock probably came from a stately home, as when it was made





David Curry in his home workshop

most houses still had dirt floors, so the clock cabinet feet would rot, but the feet on this clock are as original.

David had worked on vintage cars, racing cars, and built model steam engines, and was scratching around looking for a new project when he spotted an article in *The Shed* about building a skeleton clock. His background in clockmaking goes back much further, though.

“School bored me because I tended to believe what I could see with my own eyes, so I left at 15 for a job at the post office workshops in Wellington, and started in the clock workshop,” he explains. “They had wind-up clocks in every post office in those days.

“However, after a few months a watchmaker from Rahunu joined the workshop. It was suggested that wind-up clocks were becoming a thing of the past and I was transferred to the electrical instrument section.”

David says many of the post office staff had come through the Depression when they had to make do with whatever they could lay their hands on, and were very skilled and willing to pass on everything

“School bored me because I tended to believe what I could see with my own eyes”

they knew. “They gave me the start-up skills, which I have continued.”

He then got a job at the Department of Scientific and Industrial Research (DSIR) physics-engineering laboratory, where he made test equipment from the ground up for scientists and industry, which required mechanical and electronic skills.

It was a career that equipped him perfectly for his exacting hobbies later in life — and at 73 years old, he’s still learning. ▶



Head to *The Shed* website — theshedmag.co.nz — to see a video of David Curry talking about his clockmaking process and his passion for all things mechanical.

The inner working of a skeleton clock that David has made from scratch





Classic cars — the red Aston Martin and two Brabham BT18s that David restored, along with the ignition-system pickups and amplifier circuit board he made to fit 1970s V12 Jaguars and V8 Aston Martins

Plenty of sheddies work on or restore vintage and classic cars, but David went a step further, designing and building a car part that he sold around the world. The part was an electronic ignition system for V12 Jaguar and V8 Aston Martin engines from 1971 to 1981. "In those days most engines used mechanical contact breaker points, but they couldn't keep up with the 600 sparks a second needed for the V12 at 6000rpm," David explains. "So Jaguar used an electronic ignition system, originally designed for the Cosworth Formula 1 engine, that wasn't very reliable." So he developed a more modern system using the 'Hall effect' pickup — essentially a magnetic pickup. These days such a system is commonplace, but David had to learn how to make and use nylon moulds to cast high-temperature epoxy fittings to locate the pickup in

the distributor, and to develop parts such as an angled grommet to protect the output wiring so as to fit within the original mechanical componentry. Soon afterwards the internet "changed my life" by providing a channel to market the ignition systems to Jaguar V12 owners all over the world. It became a successful small business until David tired of sitting at his workbench making the parts, assembling the units, and packaging them for dispatch. His interest in cars has been lifelong — his father owned vintage cars and even had Bugatti parts in his garage. Along with the skills David learned at the post office, he completed a panel beating course to prepare for restoration work. David's first car was a 1930s Riley 9 Kestrel. "I had to rebuild the wooden body. I owned a few 1930s Rileys, which were well balanced and nice to drive,"

he recalls. "On their skinny tyres they could go sideways everywhere." He graduated to a more advanced Alvis Speed 25, one of just three that came to New Zealand, and then to an Aston Martin DB4. He paid \$5K for it and kept it so original that it still had maps used by the first owner in the glovebox. Three E-Types followed, the first a very early model that David didn't like at all, then one of the last six-cylinder versions. Finally he bought a V12 coupé, which he liked so much that he kept it for 30 years. He also flirted briefly with motor racing, restoring two Brabham BT18 single-seaters, one ex-Graeme Lawrence and the other ex-Roly Levis. David raced in classic events before selling the cars. "I consider myself a very lucky individual," he says. "My father took me to motor racing meetings, which aroused my interest, and I ended up owning cars [that] I loved."



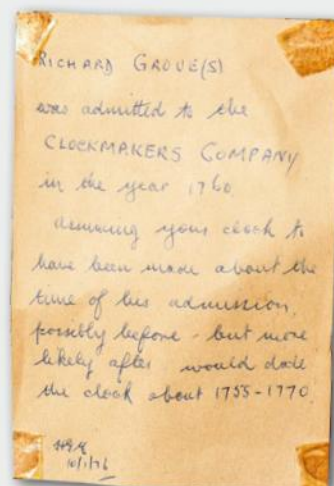
The Curry family Grove grandfather clock with the original unrestored face above and the restored face left

Polish that high-quality antique clock face too much and it will soon be ruined, as the silvery finish is a very thin coating over brass plate.

Many old clocks have faces printed on paper, but better ones have silvered brass faces, with the numerals, markings, and decorations hand-etched and filled with engraver's wax. The 1720 grandfather clock in David's living room originally had a silvered face, but it had been polished off. Some owners feel that that's a nice patina, he says, but there comes a point at which patina turns into damage — and this clock was near that.

So David resorted to the silvering process used when the clock was first made and restored its face to its original state. The engraver's wax, which is mixed with shellac, is quite durable, but if it is beyond salvage it is still possible to buy the wax, which can be melted into the engravings after they have

been completely cleaned. In David's clock the wax was as original. The first step is to remove the damaged silvering, taking the face back to the brass using fine sandpaper. Great care has to be taken to remove as little material as possible because some of the fine engraving will be quite shallow. Once the brass is exposed it has to be kept perfectly clean — a single finger mark can spoil the silvering. The coating is achieved by first cleaning and then graining the dial, then rubbing the silvering powder, followed by a finishing powder, into the surface of the brass, washing away any excess. These days many restorers will finish with a coat of clear lacquer to protect the silvering, which, over time, will bear the marks of fingers touching it during spring winding or other handling. With or without the lacquer, the face needs just an occasional wipe — never a polish.



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Max Laver and a custom-built flat-bottomed dory made from macrocarpa



Mac N Sea

A LANDLOCKED BOAT BUILDER HAS A THRIVING BUSINESS MAKING CRAFT FROM MACROCARPA

By Ray Cleaver

Photographs: Rob Tucker

Piopio, in the heart of the King Country — a landlocked area with a village population of about 400 — is the last place you'd expect to find a boat builder. But boat builder Max Laver is well settled there and business is thriving.

Boat repairs, restoration, and making small craft by hand are the specialties of Max's business, where he works with fibreglass and timber, and specializes in custom-built dinghies.

"We focus on how well we can make a dinghy, not how cheaply," he says.

Max is a marine surveyor as well as a boat builder.

He spent two years in Lowestoft in England learning City and Guilds-level wooden boat building and finished his time doing two more years of learning in New Brunswick, Canada.

In 2009, after many years spent boat building, Max decided to study marine surveying and the two qualifications work hand in hand. "I didn't excel at school as a kid, but I loved to build," he says. "I didn't do well at maths except when it meant building something. It all made sense then."

Now aged 51, Max's business is humming along and his big workshop on the main street of Piopio has many projects underway, not to mention a



Another extension of the fibreglass side of boat building is this 4.2m trimaran that Max is developing as a fishing motorboat. It is made from two pieces — a hull and a deck. He says it will compete in the aluminium boat market

No waste



Michael Piner making toys from scrap wood

Scrap wood doesn't get thrown away at Laver Marine. Working at his own bench in the Laver workshop is 83-year-old Michael Piner, happily making children's toys from leftover wood. Michael also has seafaring connections. He went to sea aged 14 and worked with waterfront companies after coming to New Zealand in 1960.

He works three mornings a week making trucks and tractors which he gives away as presents or sells and donates the proceeds to the Starship children's hospital. "I've always loved working with wood and it keeps me fit and out of trouble. It's a good way to coordinate the brain and hands," he says.

variety of things going on in a number of sheds out the back.

Yacht tenders, duck-hunting boats, rowboats of all sizes, sail boats, and even custom-made boats for flounder fishing all come out of Max's workshop.

The road to Piopio

Originally from the UK and Ireland, Max was raised in Canada and after years travelling and working around the world, he is now ensconced in Piopio.

Why Piopio we ask? There's always a woman involved, is the reply.

Max met his wife Rachael in 2007, and in 2013 the couple moved to Rachael's hometown, Piopio, where they set up Laver Marine. Rachael works for the company doing the admin work.

Max enjoys variety. He recently recreated an authentic copy of New Zealand's first school bus — a 30-seat Model T — which was one of three custom-made buses that carted kids to a consolidated school in Piopio (which was also a first, centralizing a lot of small country schools into one). The story of that bus build is coming up in a later issue of *The Shed*.

The boats

Inside the front door of Laver Marine

From little boats to fibreglass truck bins



Jason MacKenzie working on a big fibreglass bin

Working with fibreglass on boats has led to some diversification and experimentation for Max. In a back shed is the construction of a giant fibreglass mould for the manufacture of bulk transport bins. Max has been experimenting with special resins that can stand 180°C–200°C. Twelve layers of fibreglass cloth are put on under a vacuum that sucks in the resin. “Using fibreglass on the boats has led to some expansion. It’s a big jump but pretty interesting,” says Max.

“I didn’t excel at school as a kid, but I loved to build”

is a beautifully finished, custom-made, flat-bottomed wooden dory, made to use in Kāwhia for flounder fishing. “It’s a New Zealand design with macrocarpa on ply and mac ribs,” says Max.

It is ‘carvel’ built, whereby the wooden planks are fastened edge to edge, rather than ‘clinker’ built, where the planks overlap.

“The planks are cold-moulded and bent by hand, set by a jig and wedges, and glued. I use a West System two-pot epoxy,” he says.

Macrocarpa

Max uses a range of wood to make his dinghies but one of his favourites is macrocarpa. ►

Canadian canoe



The outer stem of the canoe

A special project dear to Max’s heart is the construction of a Canadian canoe. This is his own canoe and it’s 6m long. Despite its length the canoe is very light and designed to be carried by one person. It is made from rot-resistant western red cedar that Max imported from Canada and made by a strip-planking method, consisting of many thin strips of wood. Each strip is 6mm thick and 12mm wide and bent around a frame. There is an inner and an outer stem and the strips are glued to these using a jig and wedges.

The strips are joined with PVA and covered with an epoxy cloth. There are no ribs and the teak seats and gunnel contribute to the structural strength of the hull.

“It’s a very labour-intensive job, involving a hell of a lot of sanding,” says Max. “I’ve been working on it for a few years, on and off, and I’ve put maybe 600 hours into it and there’s still a lot of work to go.

“It’s a project [that] I’m doing for myself and couldn’t put a price on it. I’ll get it in the water eventually.”



Max and his six-metre Canadian canoe



The dory ready to go flounder fishing on the Kāwhia Harbour



Max and Rachael at Laver Marine

*“It’s easy on the tools
and the more I use it
the more I like it”*

Macrocarpa — good for boats

Large, spreading macrocarpas (*Cupressus macrocarpa*) are a common sight in rural New Zealand, usually growing alongside homesteads and farm buildings. Macrocarpa (also known as ‘Monterey cypress’) was brought to New Zealand in the 1860s and planted for shelter.

It is a species of cypress native to the central coast of California.

Macrocarpa is a low-to-medium-density softwood that looks and works like kauri. Both the heartwood and sapwood of macrocarpa are naturally borer resistant, which makes them ideal for interior housing purposes.

The New Zealand Farm Forestry Association says that macrocarpa is now a well-known decorative softwood timber that is very popular in New Zealand. The appearance is similar to kauri, and quarter-sawn material has a speckled appearance. The heartwood is golden brown in colour, sometimes with a pinkish tinge. When freshly cut, macrocarpa has a fragrant, spicy smell.

Max and his shed full of locally sourced macrocarpa



Macrocarpa is relatively easy to mill, dry, work, and finish, and is suitable for interior and exterior uses.

It is used extensively in the joinery, furniture, and boatbuilding trades, and has a low shrinkage factor from green sawn to dry.

Max sources all his macrocarpa locally and has a shed full of timber waiting for various projects.

“Mac. is a really underrated timber,” he says. “It’s really user-friendly and is great for outside projects, provided it is oiled properly.”

“We use it a lot for boat building and outside furniture. I have found [that] it can sustain exterior exposure in its natural state for some time. We have untreated mac. furniture in our yard that is over three years old and shows no rot or deterioration.

“It’s easy on the tools and the more I use it the more I like it.”

He seals the macrocarpa with his own brew of Danish oil. He mixes one-third boiled linseed oil with one-third turps and one-third of a varnish called ‘Bondall Monocel’.

There are five models in the Laver Marine range. The Teddington was the original rowboat, followed by the larger motor boat, the Putney. The Romney fishing or duck boat is another option for rowing or motoring. The Nelson Lugger, a sailing dinghy, has recently been added to the fleet. The Shepperton is a cathedral-hull design that is extremely stable with plenty of inboard space, ideal for fishing, ship-to-shore, or pleasure boating.

Max’s range of small boats can be seen at dinghy.co.nz.

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IT'S GOOD TO BE

CO CO CO A R M

My most-used squares

I still keep them in the original cardboard boxes even though I purchased them more than 50 years ago

Right: Checking the squareness of a child's chair rail using a Moore and Wright five-inch square (Model 402). See the October–November 2010 issue of *The Shed* for details on making this children's furniture



ALL WOODWORKERS NEED SEVERAL SQUARES BUT NOT ALL SQUARES ARE CREATED EQUAL

By David Blackwell

Photographs: David Blackwell

We need a range of squares to use for the many different situations that we encounter in the workshop. For instance, we need a square to set up our machines — it is vital that your sawbench cuts square when you want it to. The blade obviously needs to be at right angles to the table and the sliding table or sledge needs to be square. The same for your planer.

The fence should be set square and you should regularly check that it remains square. Imagine the consequences of spending considerable time cutting mortise and tenon joints for fine furniture only to find that they fit poorly due to the machined timber not being square. Errors also tend to compound over a project.

Tools for life

The most important point is that we must know that whichever square we use is sufficiently accurate for the purpose we intend to use it for. Generally speaking the type of squares available at the big box stores are made for the carpentry profession and the DIY market. These squares obviously fit the purpose, as, in most cases, reasonably accurate is good enough.

In my workshop I have several precision engineer's quality squares of varying sizes, and a number of other squares. My engineer's squares are Moore and Wright and I still keep them in the original cardboard boxes even though I purchased them more than 50 years ago. Sadly Moore and Wright,



Squares kept in their original boxes and combinations in a drawer

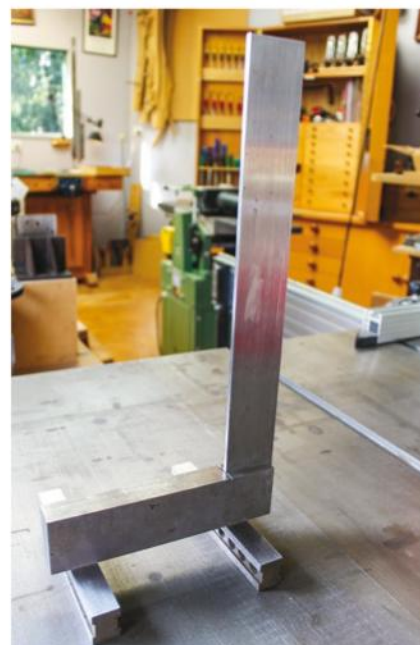
an English toolmaking company, no longer exists.

I have two sets of combination squares, a Mitutoyo brand one, which is still very accurate and in excellent condition, even though I purchased it in the late 1960s, and a Chesterman brand one, which I inherited from my father. This I estimate is 60–70 years old, probably purchased in the early to mid 1950s. It is still accurate enough for most things I do, probably accurate to less than 0.001 of an inch over 8–10 inches. As a generalization, most combination squares available in hardware stores are, again, made for the carpentry trade. I have numerous other squares that I have acquired from relatives' estates over the years, but I would never use them except for when I was welding up a trailer or something similar.

Beauty can be skin deep

Recently, an acquaintance, who is an excellent model-making engineer, gave me a square that had belonged to his father. It has a wooden butt with brass and is in beautiful condition but is not really square for my type of woodworking. Even the blade tapers by several thou and the wooden butt will move with the changes in humidity. I will not use this square but it sits in pride of place in my display cabinet.

From time to time each square needs to be checked against something that you know is accurate. I tend to use my 12-inch Moore and Wright square, as it is the square that is still in brilliant condition and I know I can trust that it is square. I do not have a surface plate but I use my sawbench top, as it is a ground surface finish that I know is flat.



Top: The 12-inch Moore and Wright sitting on parallel blocks, ideal when an extra bit of height is required
Above: Checking the fence on the planer



Squaring aids

I also have two precision angle plates that I made about 50 years ago out of large angle iron. I used these on my old milling machine. These were surface-ground and I find them excellent reference points when I want to check if one of my squares is still square.

I also have a couple of pairs of spacer blocks, originally made for use on my milling machine. These were case-hardened and ground together so I know

A small square I made probably 50 years ago using $\frac{1}{8}$ -inch gauge plate. It was marked out and then cut with a hacksaw before being carefully filed square. It is very accurate and a square that I use almost daily in my workshop. This one is small but larger squares could easily be made. A great way to improve your metal-filing skills



Checking the squareness of the saw blade

In fine woodworking the last thing you want on the piece you are making is any sort of oil residue

that they are exactly the same height. They are handy when I need to lift a square a little for a particular job.

I use squares a great deal when I am making something in my workshop, and it is common for me to have several squares out on my workbench at any one time. They are certainly one tool I could not do without.

An old woodworker's tool. No longer accurate enough to use but a beautifully made tool and now a collector's item

Storage and maintenance

Precision tools hate moisture and so it is important for both the longevity of the tool and its continued accuracy that they are stored and maintained. My workshop is reasonably well insulated, excluding the roof, and while I keep it as dry as possible, unfortunately from time to time moisture does create some problems. I keep one of my historic sports cars in the workshop and while I try never to put it away wet, sadly at times I have no other option.

One way to help stop moisture is to lightly oil the tool (I use WD-40) and this can be sufficient for solving a short-term problem, but in fine woodworking the last thing you want on the piece you are making is any sort of oil residue. I tend to keep my tools totally oil-free and, as I use my tools very regularly, I very quickly notice if any moisture issues arise.

Over the years I have made drawers for my tools and each time I've made the drawer sizes to take my precision tools, often in their original boxes.

Squares are a very special precision tool. I suggest you always buy the best quality you can afford, and if you look after them they will last for generations.



on the move

MAKE A SET OF LOAD SKATES

By Geoff Merryweather

Photographs: Geoff Merryweather



Moving machinery and heavy items around the workshop is a common job for most sheddies, especially those with an addiction to Victorian-era cast iron.

While using bars or pipes for rollers works, as shown by the builders of the Egyptian pyramids, they won't work if you have feet or obstructions, and are difficult if you are working by yourself.

'Load skates' are small, heavy-duty roller skates that fit under the load, and

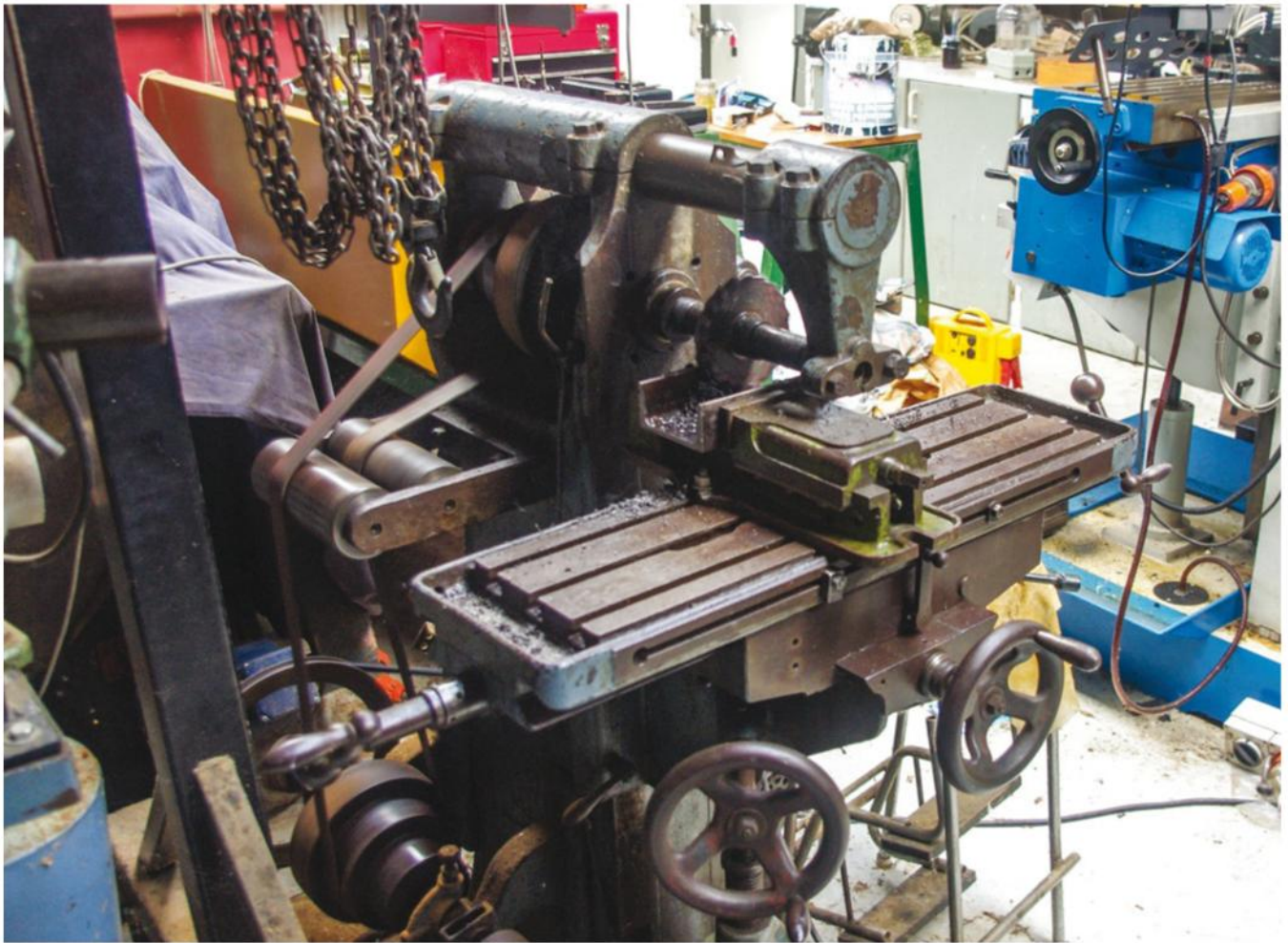
you will generally need a set of four. This load skate is made from 100x50mm steel channel, with rollers made from 40mm pipe with ball bearings. The bearings are cheap 6004RS-model bearings, which are a snug fit into 40mm pipe, and cost \$2–\$3 each from online suppliers.

As this project was built out of materials to hand, I only had tapered flange channel, so I used my horizontal milling machine with a side and face cutter to remove the taper. If you use

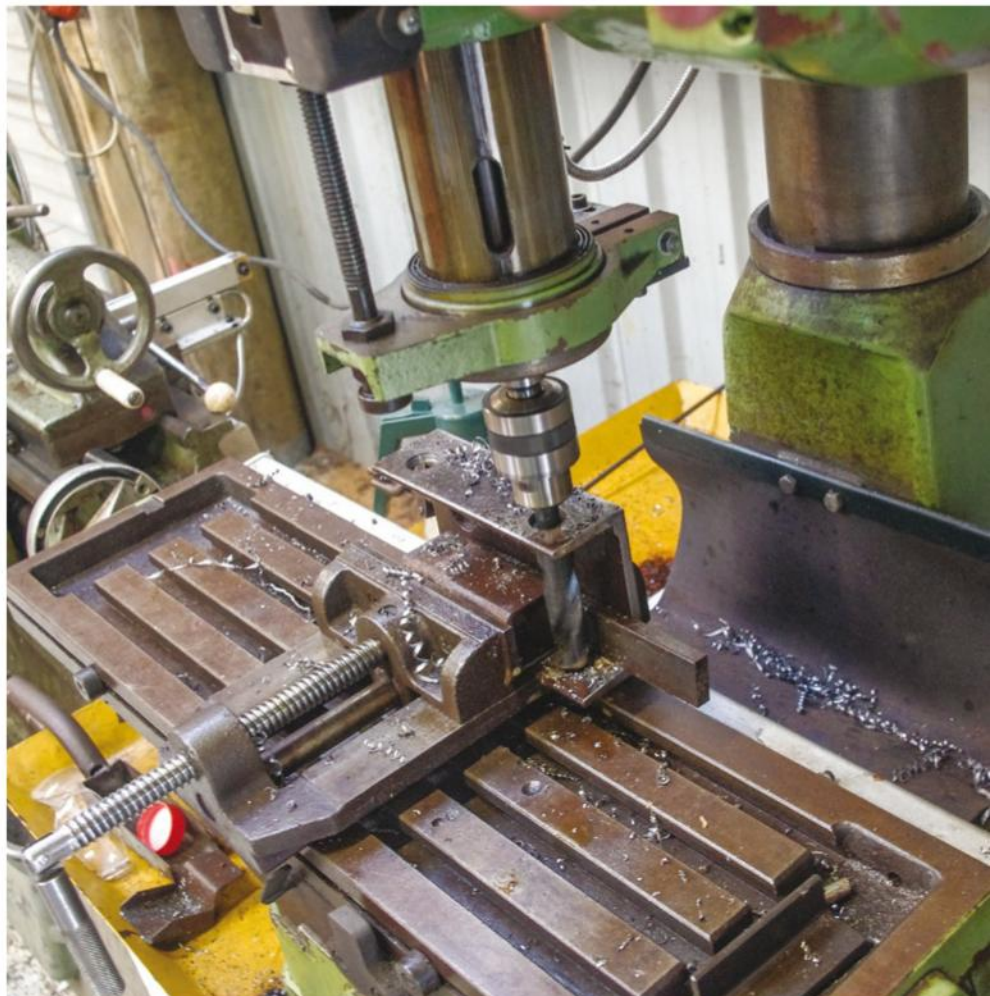
parallel flange channel (PFC) then you should not need to do this. An alternative is to make some spacers with one side cut to match the taper.

Mark up and drill 20mm holes for the axles. If you have enough travel in the drill-press quill, then drill the final-size hole all the way through from one side to make sure that the holes are in line.

The axle and wheel assembly is made from 20mm shafting, 40mm pipe, 20mm washers as spacers, and the 6004RS



Above and below: Milling
the sides of the channel
Right: Drilling the axle holes





Left: Welded frame
Below: 6004RS bearings
Bottom: Axle assembly



Depending on the wall thickness, the bearings will be a snug fit in the pipe

bearings. Depending on the wall thickness, the bearings will be a snug fit in the pipe if the weld seam is removed.

I bored the ends on the lathe to 12mm deep, but if you don't have a lathe because you need some load skates to move it, then use an air grinder or file to remove the weld seam inside. Press in the bearings and use some locking compound to retain them.

Weld in a 40x40mm box section piece and 25x25mm angle on the ends as reinforcing. Drill a hole in the end angles to allow for a rope or handle to be used to position the skate under the load without putting your hands underneath.

Stake the axle ends with a centre punch or a tack of weld. If your channel is wider than mine, you can drill and tap for a set screw.



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High price to pay *for* CHEAP USB CHARGERS

BE AWARE OF THE ULTIMATE COST OF PAYING FOR
CHEAP CHARGERS THAT DON'T CONFORM
TO REGULATIONS

By Mark Beckett

Photographs: Mark Beckett

I was in one of those \$2-type shops in our local mall looking for some 12V-to-USB adaptors, when I spotted some cheap mains USB chargers. Presumably, they were being sold here in New Zealand as they have the pins angled. I bought one to examine more closely.

Unfortunately, the regulations in New Zealand require the live and neutral pins to be insulated and these were not,

so I imagine they were produced for the Chinese market, and someone has imported them for sale here. Besides the plug issue, I was interested to see if the internal construction complied with the New Zealand regulations. My first impression of the charger was that it had some markings.

Before doing anything, I decided to see if it passed an electrical safety test.

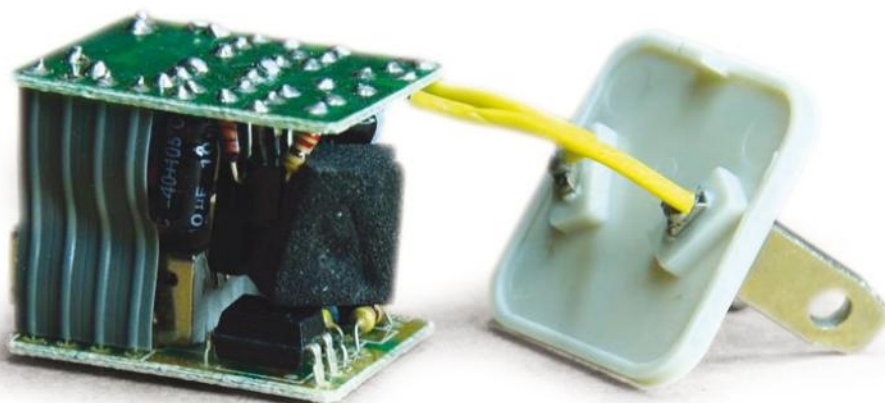
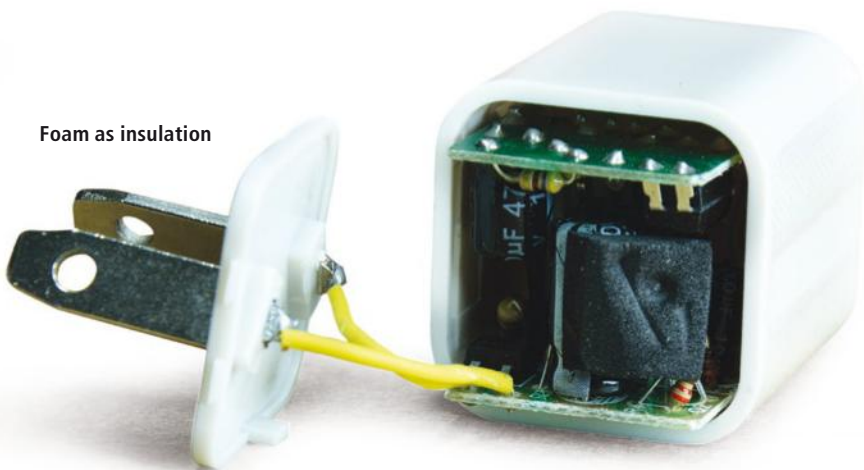
For those who may have missed the Electrical Safety feature (February/March 2017), as this is marked as double insulated, you test it by applying 500V DC between each of the mains pins and any metalwork that a user might make contact with. In this case, the only metalwork is the metal surround of the USB outlet, and it passed with no issues. ►

*The point of this is to
make Shed readers
think about the cheap
electrical equipment
they may buy*



First impression was it had some markings

Foam as insulation



Internal construction

What's the problem?

There are several parts to an electrical safety test and, apart from the insulation-resistance test, they are visual checks without dismantling the device. The first is a check to ensure that the markings are present and readable. This includes manufacturer, voltage, and current/wattage along with any certifications or conditions (indoor only, etc.).

You also need to check for damage to the mains cord to ensure that there is no compromise to the double insulation or exposed conductors.

Damaged plugs and sockets are checked and, since March 2006, both the live and neutral pins have needed to have a section insulated.

This post on Trade Me's Trust and Safety blog shows why this rule is in place: trademe.co.nz/trust-safety/2013/7/26/plugs-must-have-insulation-on-pins/.

It is also important to check for damage to the case to ensure that the user is not exposed. When doing this check on the charger, I observed the issue of end-cover/-plate retention.

It seems that the end simply clips into place, and there is very little force

It seems the end simply clips into place, and there is very little force required to expose the mains pins

required to expose the mains pins.

If you twisted or applied sideways pressure while it was plugged in, it would easily come apart.

Does this pass?

In my capacity as a qualified electrical service technician (EST), the charger that I bought fails on two counts.

The uninsulated pins, and the retention of the end cover, fails the physical retention test used to test fixed cords, which could expose the user to harm.

Some people may respond with: "You just switch it off at the wall and then remove it ..."

I would counter that with: "Show me

a one- or two-year-old child who knows how to do that."

Internals

There is no requirement to check the internals unless the device is being certified for use. However, this shows why I cannot recommend buying one of these — regardless of the price. I've seen the internals of other models and this was no better. There is nothing but a piece of foam stopping the mains pin from making contact with the components, and it is already showing signs of contact.

The pins are embedded into the end plate, but it is very thin and I doubt it would take much force to push through, or become detached and stay in the wall outlet.

I suspect the internals are the same for each market, and that they simply change the end plate and pins to suit.

Is there a better way?

The electrical test does not require items to be dismantled, so if the end had been glued on, it would then have passed the retention test.

This does not mean the device is safe; safety is determined by a certification authority, which will test the device. The testing includes abnormal conditions that may result in explosion, fire, or excess heat.

I would have expected a piece of plastic material behind both pins to separate the mains from the internals. Any force on the pin would have required punching it through this plastic, which while possible, goes well above the standards.

As the photo shows, there are components behind the pin that could be damaged, which may cause failure, overheating, or a flash over when plugged in.

I didn't study the internals to see if they meet best practice for isolation, or protection from excess voltage. The component selection is done based on

cheap manufacturing, so it's unlikely to last particularly long.

Name brands and poor manufacturing

At work we have some commercial version monitors and one of the models used a name-brand external power pack. Over time this suffered from excess heating and the cases became brittle, allowing the two halves to separate and exposing the user to high voltages (400V DC).

So despite being a reputable brand, it wasn't a shining example.

Conclusion

The charger I bought is a cheap Asian-sourced supply that is illegal for sale in New Zealand and I have no intention of using it.

Australia seems to have tightened up its rules after the death of a woman using a cheap USB charger (see smh.com.au/nsw/faulty-usb-phone-charger-blamed-for-sheryl-aldeguers-death-20140627-zsoc8.html and rt.com/news/168772-faulty-usb-electrocutes-woman/).

Should I report it?

This is an electrical device, but the regulations regarding the sale of such items is not governed by the same department that makes the regulations.

The Electrical Safety Regulation makes it as clear as mud (legislation.govt.nz/regulation/public/2010/0036/latest/whole.html#DLM2763501):

14A Manufacturer's instructions

1. This regulation applies if a manufacturer or importer supplies a fitting or appliance with manufacturer's instructions that —
 - a. expressly apply in New Zealand; or
 - b. are silent as to where they apply.
2. The manufacturer's instructions must be such that, if the fitting or appliance to which they apply is installed, tested, maintained, or connected in accordance with those instructions, the resulting fitting or appliance will —
 - a. comply with these regulations; and
 - b. be electrically safe.
3. A person who does any prescribed

electrical work involving a fitting or appliance to which manufacturer's instructions apply is entitled (if acting in good faith) to rely on the manufacturer's instructions as complying with subclause (2).

4. A manufacturer or importer who supplies a fitting or appliance to which manufacturer's instructions apply commits an offence and is liable on conviction to a level 2 penalty if the manufacturer's instructions do not comply with subclause (2).

In my opinion, the charger fails under clause 22(b) and clause 23(c):

22 Electrically unsafe low voltage fittings

A low voltage fitting is deemed to be electrically unsafe if —

- a. the unearthed conductive parts of the fitting are separated from live parts by no more than basic insulation; or
- b. the fitting is intended to have, or is supplied as having, a safety function, but does not in fact serve that safety function.

23 Electrically unsafe appliances

1. An appliance is deemed to be electrically unsafe if —
 - a. the voltage at which it operates ►

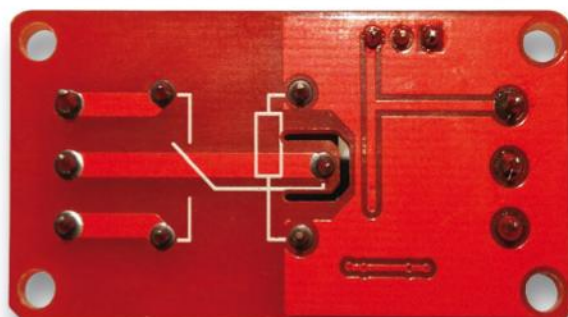
Turn off your chargers

Modern chargers use electronics to change the 230V AC into 5V for our devices.

Leaving them plugged in and turned on while not in use simply wears out the components, which can have a 1000- or 2000-hour rating.

They are also a leading cause of fire in New Zealand, so do yourself a favour and switch them off when not in use. It won't save much electricity but it may save wearing the charger out or prevent a fire.

This shows why I cannot recommend buying one of these — regardless of the price



Q. Which unit is safer for switching mains voltages?

A. The red unit has the isolation gap in its printed circuit board (PCB), which means it has greater separation from the low voltage side and is therefore much safer

Australia seems to have tightened up its rules after the death of a woman using a cheap USB charger

safely is not appropriately and adequately marked on the appliance; or

- b. it is not constructed so as to be safe under both normal and abnormal conditions; or
- c. the accessible unearthed conductive parts of the appliance are separated from live parts by no more than basic insulation ...

In my opinion, it would appear that if this charger went to test, it would fail.

I'm not sure why our electrical industry makes it so difficult to find the necessary information and, worse, makes you pay to get the actual standard they want you to comply with!

The good news is that Trade Me has a very tight policy on the sale of electrical goods, and will remove any listings with illegal plugs.

It also provides some very good advice at the following webpages:

- trademe.co.nz/trust-safety/2013/7/26/plugs-must-have-insulation-on-pins/
- trademe.co.nz/trust-safety/2013/1/15/unsafe-electrical-adaptors/
- trademe.co.nz/trust-safety/2012/11/30/foreign-plugs-cannot-be-listed-on-trade-me/

You can report any listing and Trade Me will send you an email advising you of the outcome. I have reported a couple and the listings were removed.

The point of this is to make *Shed* readers think about the cheap electrical equipment they may buy. I'm not suggesting that consumers pay excess money for the same product made in the same factory with a different sticker attached, but do think about it.

It could be your child or grandchild who it affects.

Maintaining compliance standards

New Zealand and Australia have the same standards and, unfortunately, there are lots.

Worst of all, these are not free, yet people need to comply or ensure that they are aware of the issues and there is

continual reference to these standards for compliance.

Some of the regulations fall under standard AS/NZS 3100:2009 and below are extracts from that.

8.8 Mechanical strength test

8.8.1 General

Equipment shall be subjected to blows, with an impact energy of 0.5 ± 0.05 Nm, by any means having the same performances as the spring-operated impact-test apparatus described in Clauses 8.8.2 to 8.8.4.

The aim of this is to ensure that the device or appliance remains safe.

8.8.4 Criteria

After the test, the sample shall show no damage within the meaning of this Specification; in particular, live parts shall not have become exposed so as to impair compliance with Clauses 5.1 and 5.2, and there shall not have been such distortion as to impair compliance with Clause 4.1.3. In case of doubt, supplementary insulation is subjected to an electric strength test as specified in Clause 8.4.3.

Appliances using a cord are subject to a test to ensure it stays connected.

The cord shall then be subjected 25 times to a pull of the value shown in Table 8.6. The pulls are applied in the most unfavourable direction without jerks, each time for 1 s.

Unless varied in an individual specification, accessories shall be subjected to a pull of 65 N.

Immediately afterwards, the cord is subjected for 1 min to a torque of the value shown in Table 8.6.

Table 8.6 - Test values for cord pull test

Mass of equipment kg	Pull N	Torque Nm
Up to and including 1	30	0.1
Over 1 up to and including 4	60	0.25
Over 4	100	0.35

For Type X attachments having a specially prepared cord and Type Y and Z attachments, any additional sleeving used for cord protection purposes shall not be totally displaced from its anchorage point when tested. The sleeving shall be tested separately after the cord anchorage test in accordance with the method specified in this Clause; however, the pull shall be 30 N and the torque test shall not be applied.

During the tests, the cord shall not be damaged.

After the tests, the cord shall not have been longitudinally displaced by more than 2 mm and the conductors shall not have moved over a distance of more than 1 mm in the terminals, nor shall there be appreciable strain at the connection.

For the measurement of the longitudinal displacement, a mark is made on the cord while it is subjected to the pull, at a distance of approximately 20 mm from the cord anchorage or other suitable point before starting the tests.

After the tests, the displacement of the mark on the cord in relation to the cord anchorage or other point is measured while the cord is subjected to the pull.

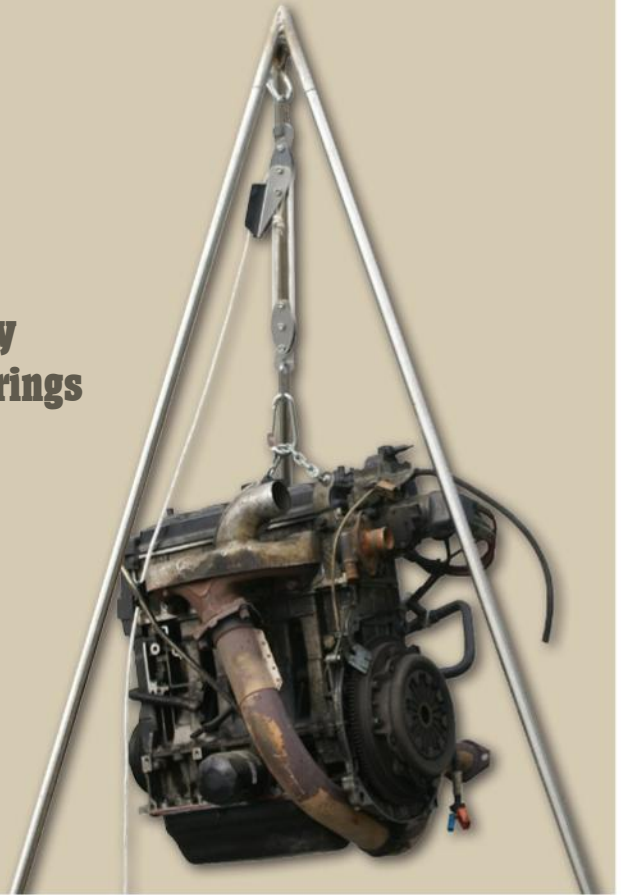


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TOP DRAWER

A while ago I ordered a pan brake from a well-known local Australian engineering retailer with a view to making a set of drawers out of steel sheet. I assumed that it would fairly straightforward — simply bend the drawers into shape using the fingers on the pan brake. A brake would make everything accurate. What could possibly go wrong?

I had made the stand for my lathe (part one of this article; Issue No. 78) with the idea of adding drawers and a cupboard to the base to store all my lathe and mill tools, and ostensibly for the tools I envisaged acquiring. I therefore made sure that the openings were quite accurately sized. You can't

add drawers if the space you are adding them to is not square or the sides are not parallel.

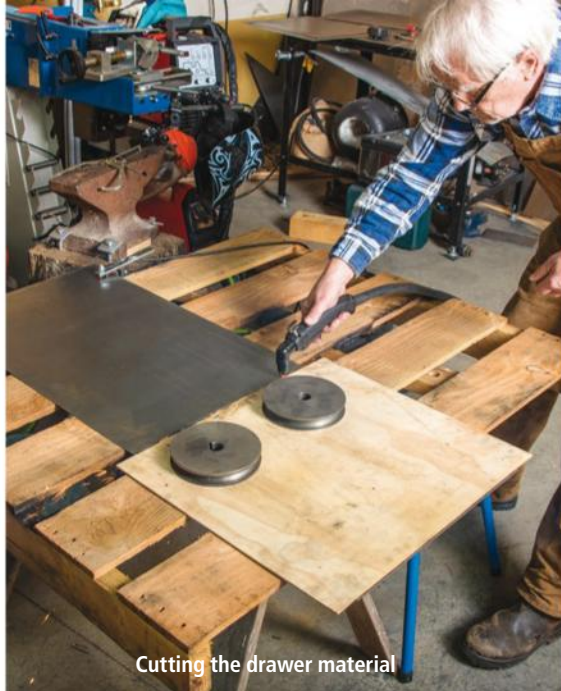
I quickly ran into the first limitation — the pan brake could only handle drawers up to 60mm

Ordering materials

I ordered some drawer slides of the appropriate length (350mm) and worked out the width of the slides

and thus the width of the drawers. The drawer slides are rated at 45kg. I couldn't be sure what weight I would be likely to load but this should suffice. I elected to run with eight drawers and make the second opening in the frame a cabinet to house larger components like the four-jaw chuck. After some fiddling I settled on two drawers each of 75mm, 70mm, 60mm, and 50mm deep, separated by 10mm.

I bought three sheets of cold rolled steel, 1mm thick. This is within the limits of the pan brake and I had hoped the material would be stiff enough given that the drawer had to span over 500mm width. I broke the material down into half sheets to make it easier to handle.



Cutting the drawer material



Putting the crease in the drawer base

IN PART TWO OF OUR LATHE- STAND BUILD A FEW LESSONS ARE LEARNT MAKING THE DRAWERS

By Jude Woodside

Photographs: Jude Woodside

I originally intended to fold up the drawers using the fingers on the pan brake and I did in fact make a couple of drawers this way, but I quickly ran into the first limitation — the pan brake could only handle drawers up to 60mm. The other problem was the fact that although the drawers looked good I couldn't be sure that the sides would be rigid enough. I did try to add a 10mm margin that I folded on each side but I had to hammer them flat and that caused some distortion to the sides.

Bending rigidity

Whenever you add a bend to a sheet of any material, you introduce some rigidity. You can see this yourself with a flat piece

of paper. If you hold a page up by its ends it will bend in the middle but put two folds in it and it gets a bit more rigid. Now add another bend to the edges and see how much stiffer the paper becomes.

I could only apply a stiffening bend to one face of the drawer, at the rear. The centre was still a bit loose, so I decided to try adding very slight bends diagonally across the floor of the drawer. This did tend to make it a bit stiffer but they also tended to create a dip in the centre.

It's very hard to bend drawers or anything else to an exact size. Metal has a tendency to stretch and this must be accounted for. There are formulae for the process and I did employ them but I lacked absolute measurements of



The diagonal creases in the drawer



The Smootharc Elite TIG 230 AC/DC welder



All-folded version. Note the seam around the edges. This proved to be rather time-consuming to make, as it had to be hammered into shape

The best way to use my plasma for high-tensile steel is flat out at close to its maximum amperage

things like the radius of the bend. I was using 1mm steel, so I assumed it to be somewhere between 1mm and 1.9mm. In the end after a couple of attempts I



Cutting out the drawer sides

realized that it would be considerably simpler if I bent the majority of the drawer and simply welded some steel sides on. I could then ensure that the lateral measure of the drawers would be precise. The opening was 531mm and the drawer's slides are 12.7mm each in width, so that left me a drawer width of 505.6mm rounded down to 505mm.

I elected to use plywood to attach the slides to the cabinet. I felt that the additional 0.6mm or so could be adjusted for and I could use spacers if necessary.

Plasma cutter

All the drawers were one width so I started by cutting sheets to the 505mm dimension and then marking out the wall height of each drawer, plus a 10mm overhang to build stiffness into the rear



Setting up to weld the sides



Welding the ends

wall. Then each drawer was cut out and the walls marked. I first bent the 10mm stiffening flap for the back and then proceeded to bend the back and front piece. It helped to over-bend the front and back slightly so that the springiness could help to hold the sides while I clamped them in position.

I had some 3mm Cor-Ten steel left over from the outdoor heater project from *The Shed* Issue No. 76, so I cut the drawer sides out of this with the plasma cutter. I have found that the best way to use my plasma for high-tensile steel is flat out at close to its maximum amperage and with an air pressure of around 90psi. The plasma worked flawlessly with the 1mm cold rolled steel on 35A at 60psi, but I was getting some missed areas with the lower amperage and pressure on the thicker material. ►

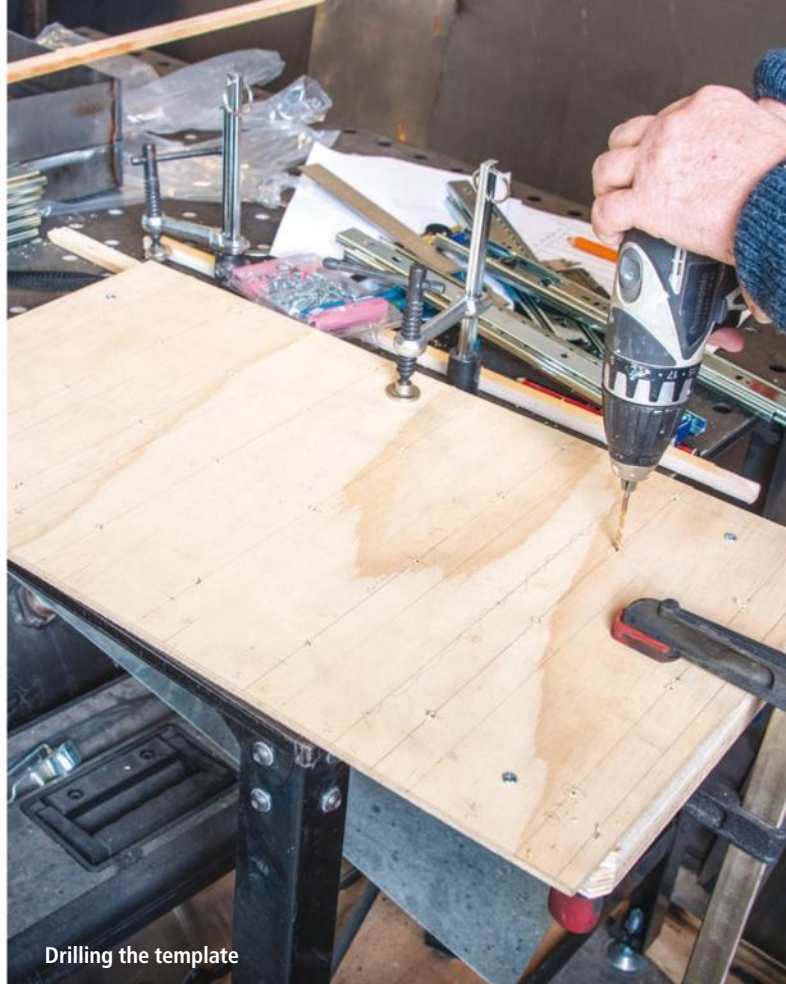




Tacking the sides of the drawer



The finished weld. Perhaps not as professional as I would have liked but effective



Drilling the template



Riveting a slide in place

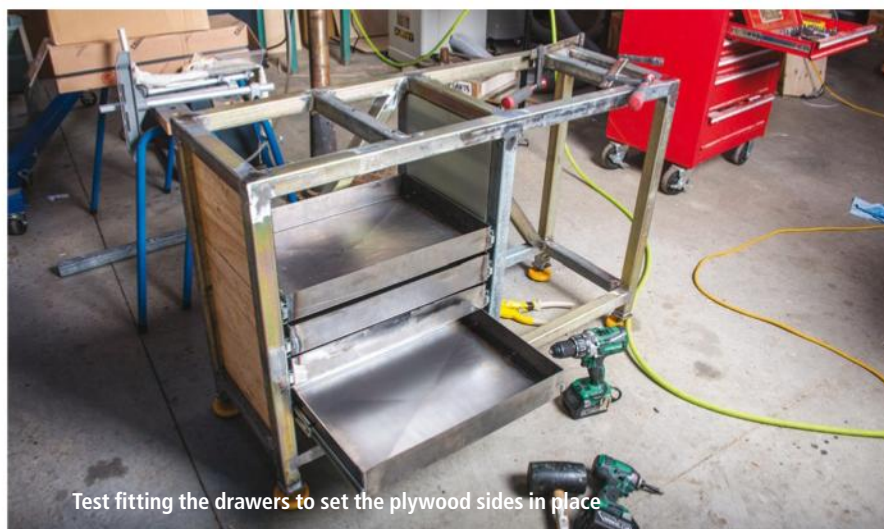
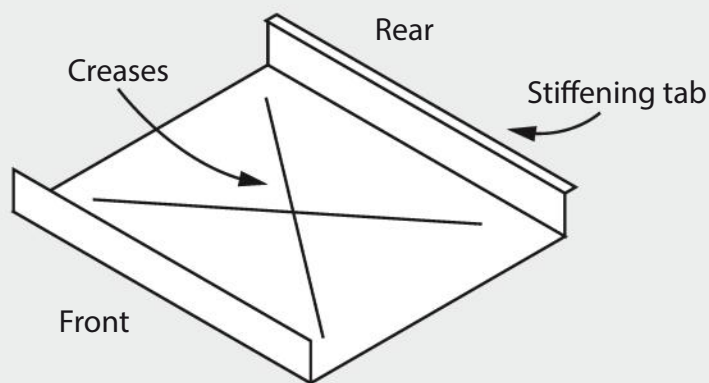


Laying out the drawer slides



Setting the drawer slides onto their plywood base

Drawer folds



Test fitting the drawers to set the plywood sides in place



Attaching the brackets to the sides



Welding the brackets

The first attempt resulted in some ugliness as I merrily melted great holes in the drawer material

Stuck into the new TIG

I recently acquired a new AC/DC TIG welder (Smootharc Elite TIG 230 AC/DC) from BOC and I was itching to have a go. My TIG experience has been a bit limited up until now but this machine will enable me to tackle stainless steel and aluminium. The machine has a number of useful features, including high-frequency start and pulse, and spot-welding modes. However, I wasn't going to call on it to get too fancy at first. I planned to simply weld the drawer to the sides without any filler rod using the drawer material as filler. I had initially had a go at welding up the sides of all the folded drawers using 30A. I eventually got the hang of that but I had to abandon the idea when I elected to use the 3mm material as the sides instead.

Oops, take two

The first attempt on the heavier gauge sides resulted in some ugliness as I merrily melted great holes in the drawer material. I was using around 125A and that was clearly far too high. I settled, after some experimentation, on 80A and that seemed to work reasonably well as I got used to moving at the right pace and just allowing the weld pool to form on the edge of the sides and gradually incorporate the drawer material. It is important here to make sure that the two metals are in tight contact. I employed three clamps and on reaching the ends used my trusty hammer to eliminate any gaps.

I found it useful to clamp the ends too before I washed the arc down the edges. The trick is to focus the heat on the heavier metal first. I made a few tacks along the length and then went back to run a bead between the tacks, alternating either end to try to prevent too much distortion.

When I got it right it worked beautifully and there was a smooth, almost seamless transition between the two metals. Where I strayed into the drawer material too far, or lingered too long, or where the contact between the two surfaces wasn't perfect, I had to refill the resultant holes, which I managed to do successfully.



Cutting the drawer fronts



Bending the edges of the top cover



Test fitting the drawers

This was a very useful practice with TIG and by the end my control of the weld was getting quite good.

Cutting the timber sides

With the drawers welded up I cut the timber for the sides and primed them. I then began to lay out the position of the drawer slides. I cut a piece of 4mm ply to the same dimensions as the sides and used this as a template to mark out the screw holes for the slides so I could transfer this

to both pieces accurately, remembering to flip it for the right-hand piece. With the holes drilled in each wooden side I primed and painted them.

To get the positions of the sides right I needed to test-fit the drawers and that meant attaching the drawer slides to the drawers. I did contemplate welding the slides to the drawers, but since I figured — correctly as it turned out — that I might have to remove the slides for adjustments I elected to rivet them instead.

With slides in place on a few of the drawers I test fitted them to hold the ply sides in place until I could get the angle-iron brackets that I had cut and pre-drilled to be screwed and fixed. I had cut the sides to be a relatively tight fit in the lathe-stand frame so fitting the brackets was relatively simple. Once the brackets were in place I MIG welded them through holes I had pre-drilled in the brackets. I did consider TIG welding them but in the interests of speed I elected to use the MIG.

Fitting the fronts

Once the drawer side supports were in place it remained to add the fronts to the drawers. I had ordered some 2.5mm cold rolled sheet that in the end became 3mm cold rolled sheet, making the drawers slightly heavier than I anticipated. However, I think I can use all the weight I can apply to this structure for stability. I plasma cut the fronts and cleaned them up on the linisher, then cut them to length. The fronts were also riveted to the drawers and I added the handles. To make sure that I got the handles right I used the first front and I took some care to get the holes for the handles accurate as a template for the rest.

I did have some fun and games getting all the drawers in. Some were tighter than others — I suspect this is because I wasn't as scrupulous as I should have been with the width when I was welding, coupled with the tendency of the drawers to distort a bit. But with some shuffling and some judicious grinding of



Riveting the covers



Setting out the door



Welded end on the door



Adjusting the fingers on the brake



Painting the unit

the sides I eventually ended up with eight functioning drawers.

Does the job

The cupboard required a floor that I was able to cut from a scrap piece of 3mm cold rolled steel. I then cut a piece of plywood to fit in the gap behind the middle-drawer slide support. This piece needed to be cut and routed to fit over the brackets holding the side piece in place. It isn't as pretty as I would have liked but it is largely unseen.

The top and sides were bent up from 1mm cold rolled steel too. This was the first time I had to deploy the fingers on the

brake since the drawers only needed to bend on one plane. Remember to account for the extra depth of the end pieces when you measure up the top. I wanted the top to cover the two side pieces. I remembered that but forgot about the extra 1mm for the back so that ended up being riveted below the fold for the top. I put the two side pieces in place and wedged the top over them, then riveted the whole lot to the frame.

Like a bought one

The last piece was the cupboard door. I considered doing this as two doors

I did have some fun and games getting all the drawers in. Some were tighter than others

but elected in the end to make just one big one. It too was cut and folded from 1mm steel. I riveted the hinges to the drawer and screwed the other side to the frame. The door is held closed by a magnet catch.

Before attaching the door I spray-painted the structure with etch primer and a top coat to match the lathe itself. I took the pan from the lathe to the Autopaint shop here and got them to match the colour; that way the whole thing looks as if it is one unit. The holes to locate the lathe were drilled and the lathe remounted, but this time I added plenty of silicone sealant around the holes and around the base of the lathe itself. The idea is to prevent any coolant or oil finding its way into the drawers. The old cabinet leaked oil.

All in all I am quite satisfied with the outcome. I have certainly learnt a lot in the process and it is much tidier outcome than what I had previously.

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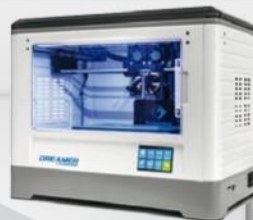
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SHORTCUT TO LEARNING THE MAGIC OF 3D PRINTING DESIGN

IN PART FIVE OF OUR 3D PRINTING SERIES,
WE EXPLORE THE FEATURES OF TINKERCAD
THAT MAKE IT PERFECT FOR NEWBIES

By Enrico Miglino

Photographs: Enrico Miglino and Cristina Manfredini

The growing popularity of 3D printers over the past few years has contributed to a wide diffusion of CAD applications.

Today it is possible to choose from a large range of different applications. If you have never experienced the use of 3D CAD it is not easy choosing the right application, and considering all the options can be confusing. In fact, one right choice does not really exist. Your choice will mostly depend on the use and kind of modelling you want to do, but by reducing the range of options to a smaller number of applications the decision will be a lot easier. In this and the next part of our 3D printing series, we will focus our attention on two applications useful for those who will be making their own designs for 3D printing, both developed and distributed by Autodesk — Tinkercad and Fusion 360.

These are very popular applications and I am not sponsored by them (I

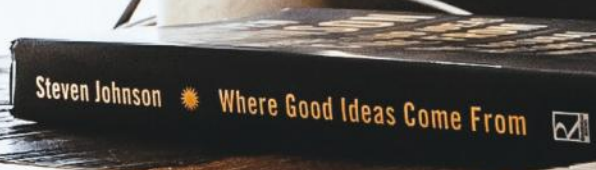
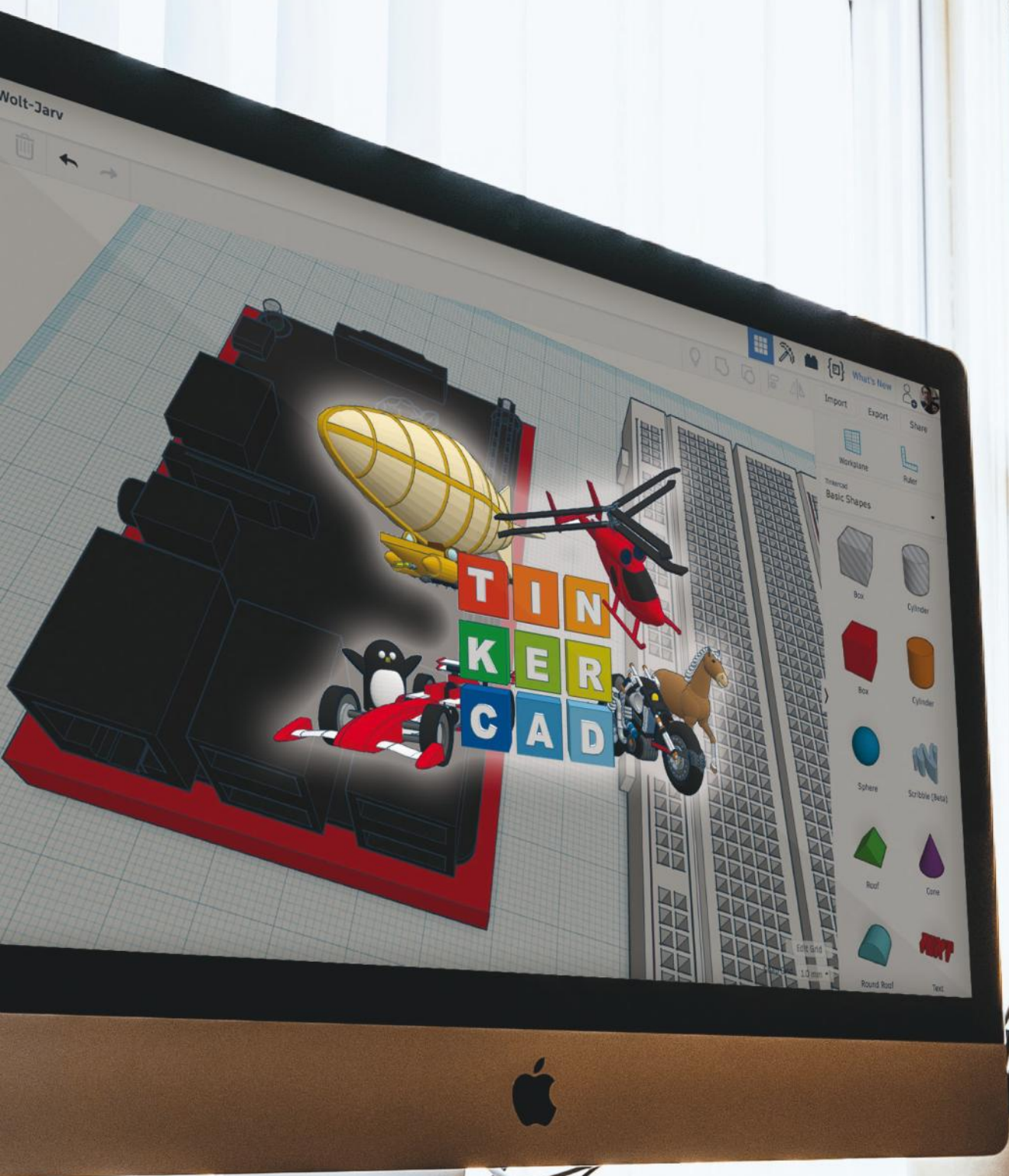
primarily use Rhino 3D for my designs). The reason for my choosing them is to provide comprehensive support at two levels: a beginner's 3D design approach and an advanced approach with free and easy-to-use applications without special hardware requirements. This will cover the widest range of users — children, constructors, hobbyists, engineers, designers, and others.

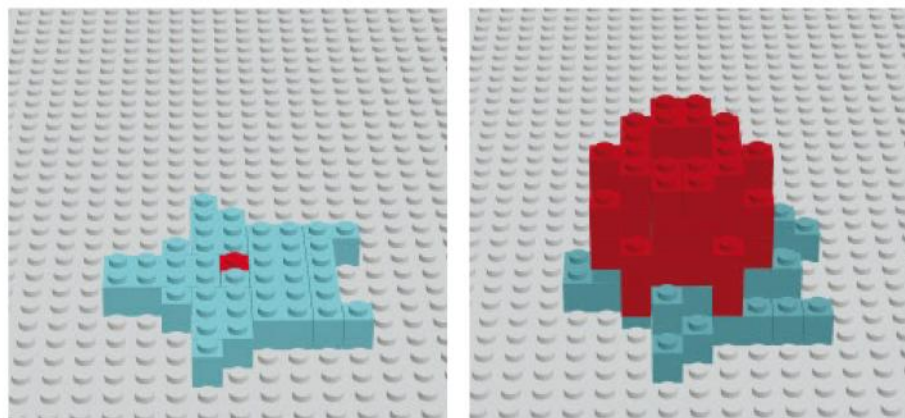
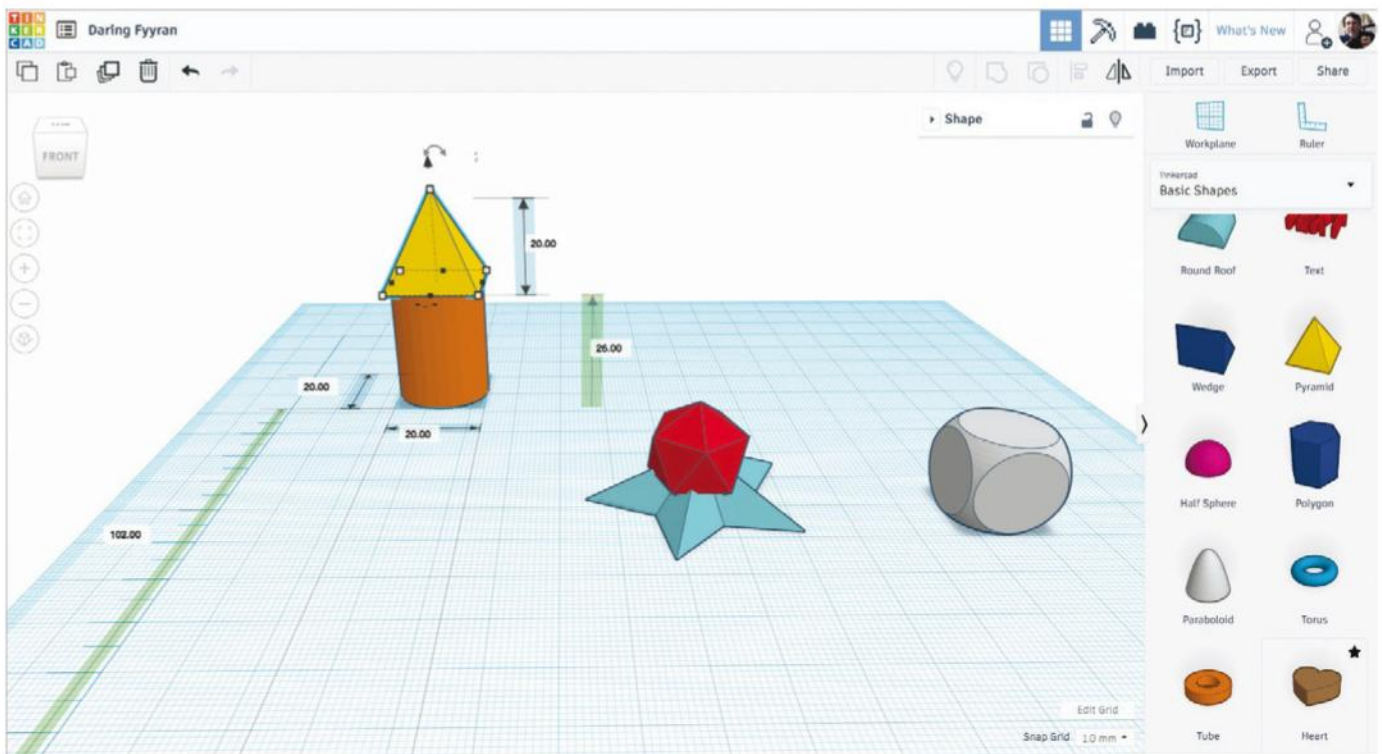
Software icon

Starting in the early '80s, Autodesk became popular with its AutoCAD software, 2D CAD drawing software for architectural and mechanical design.

Created by Gary Yos in 1996 and published by Autodesk, the advent of 3D Studio Max represented a big jump in the world of the 3D solid modelling applications market. During the last decade the Autodesk 3D modelling platform has continued to evolve with continuous improvements. Today there are many competitors, but this







Pressing the Bricks button, the 3D scene has been converted to a set of Lego blocks. Depending on the selected detail level, the blocks assume different proportions. Similarly, when an STL model is sliced by the 3D printing software, this Tinkercad feature creates a series of layers according to the dimensions of the model and the bricks' thickness. The images show some of the layers of the converted design. In practice, a Tinkercad 3D design is converted to the assembly guide of the corresponding Lego model

software remains an icon in the world of 3D design.

More recently, Autodesk has invested a lot of effort in releasing CAD design solutions for personal use, a signal that this category of users represents a growing and interesting market area.

Trying to track the evolutionary path of 3D modelling software's popularity, we find three main initiatives. Initially, 3D CAD use was limited to mechanical design and a small range of professionals in other disciplines. With its second update, 3D modelling applications started to gain the interest of animators, filmmakers, artists, and home users.

This interest resulted in the creation of affordable 3D modelling software oriented to design and animation. The introduction of the first version of open-source 3D modelling applications like Blender was met with an enthusiastic response from the digital community. The popular Blender 3D software can also be used for designing 3D printing objects but can be very complex and quite difficult to learn. CAD for 3D printing really needs fewer options and a user-friendly workflow.

Low-cost printers

In the meantime, the large diffusion of low-cost and DIY 3D printers has

Above: A simple 3D scene created by placing some basic primitives on the workspace. The solid primitives have then been positioned and resized. You will note that by selecting an object (the yellow pyramid), it is immediately quoted. The selected object can be easily rotated, resized, and deformed using the control points shown

intensified their users' demand for free and reliable software to easily design 3D-printed objects. The diffusion of 3D printers moved the open-source developers' community to create specific 3D modelling software to produce stereolithography files (STL).

Over the last few years, Autodesk has also moved into this market with the two applications mentioned: Tinkercad — easy to use, online, and totally free; and Fusion 360 — a more professional 3D modelling application that is also available with a free license for personal and non-commercial use.

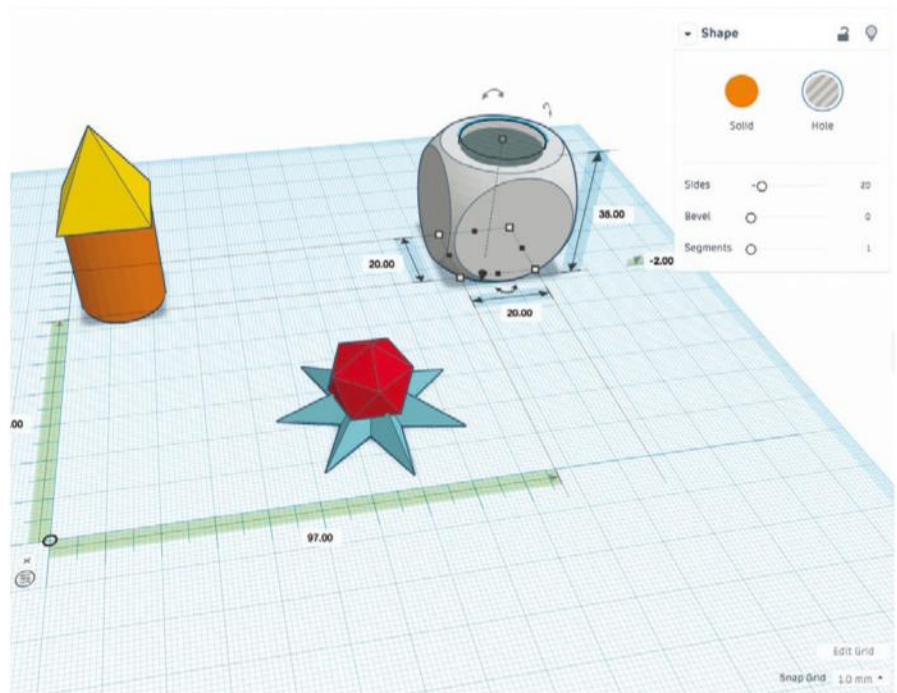
Tinkercad

Tinkercad (tinkercad.com/) is an entry-level application. The first stable and almost complete version was released in 2012, and it was the first browser-based 3D design CAD for the masses.

Able to run on any browser, the programme is platform independent and no special hardware is required. You just register on the site and launch the programme. The user account you

Right: When using primitives made of complex polygons, by selecting the object you also have access to a set of modifiers. For example, the rounded die in the image when selected shows a pop-up with three sliders: Sides, Bevel, and Segments

This software remains an icon in the world of 3D design



create to use Tinkercad gives access to all the Autodesk applications.

When you first run it, the web application proposes a tutorial series of lessons to explore the main features. Previous design knowledge is not essential and it is perfect for a newbie. After completing the tutorials you will be able to draw some simple models and experiment with the design features and controls, primitive usage, and the spatial editor workplace.

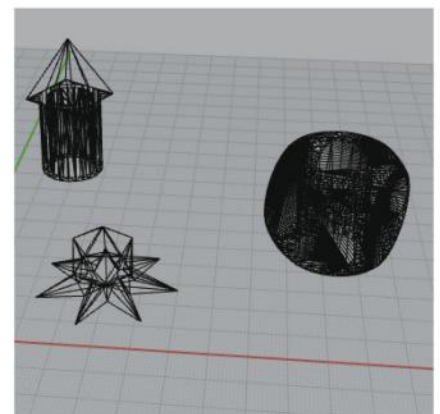
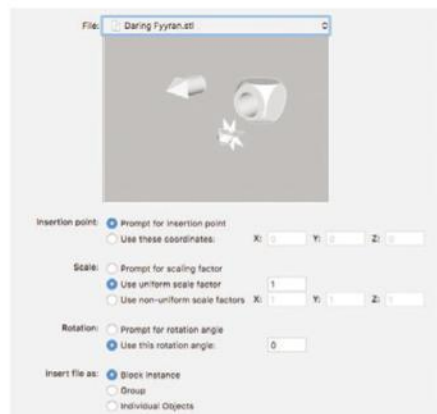
The programme features are designed to be easy to use and are aimed at hobbyists, children, and casual 3D printer users.

With Tinkercad you can easily draw 3D models directly, working in a user-friendly 3D modelling space. Using it is like drawing and assembling objects in the virtual environment of a 3D printer.

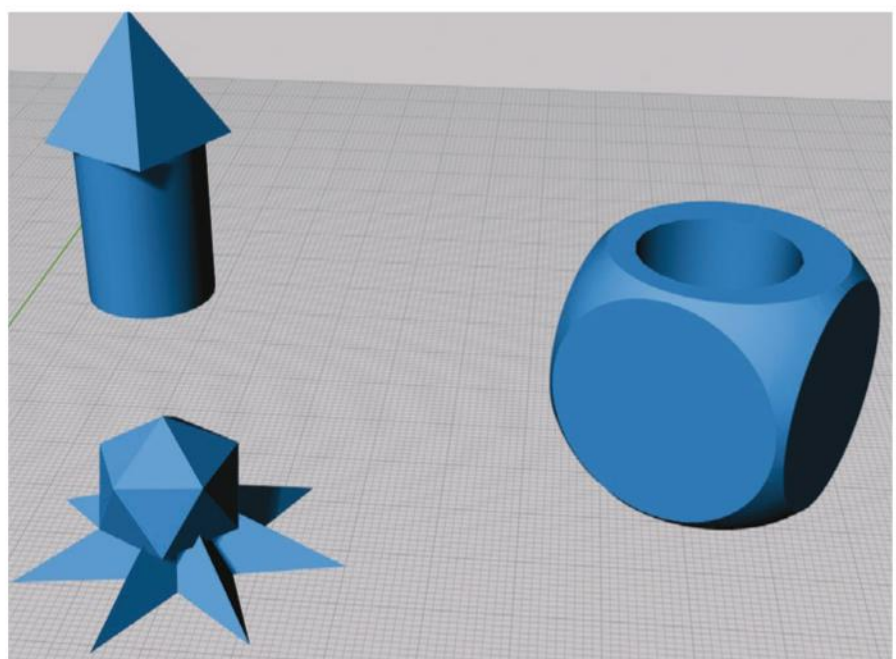
After signing into the online application, the main menu at the top of the page shows the programme areas, from where you see the available group of options:

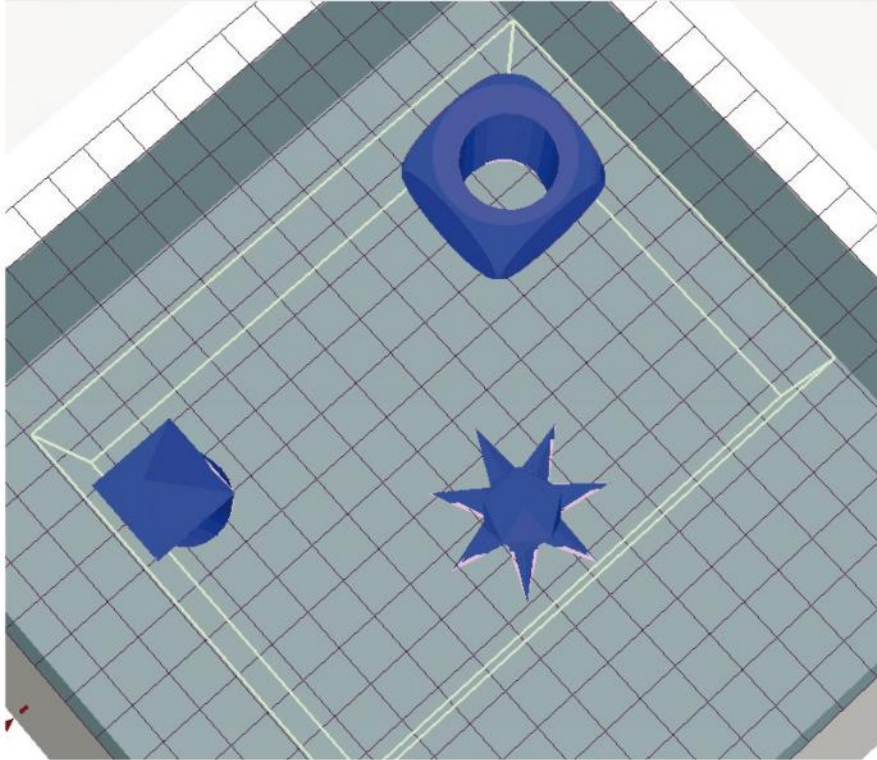
- Tinkercad for ...
- Gallery
- Community
- Learn
- Teach

As the application is browser based, it is perfect for classroom teaching. The process is easy: the teacher creates a classroom account and the authorized



Above and below: This series of images shows what happens when importing an STL file created with Tinkercad into Rhino 3D, a commercial 3D-modelling programme. After importing, the STL file is just a single object, a solid element that can only be repositioned, scaled or rotated. In fact, the STL file format is the output representation of a solid object





Left: The previous example scene exported to STL shown in the 3D printing software Repetier

students can access the same models and the group, including the teacher, can interact and share their progress. One of the Teach menu options is Parent. With Tinkercad it is also possible to teach 3D modelling and 3D printing in small groups or at home.

In fact, Tinkercad is an application tailored for building models destined

for 3D printers, optimized for a step-by-step learning approach to 3D modelling that is very enjoyable and pleasant.

Teach yourself

Users without any previous knowledge wishing to self-learn can start at the Learn menu, where they will find six easy lessons on 3D modelling

techniques and three others on how to add simple electronics components to the models.

The Learn section includes a lot of video tutorials; fully documented projects to improve your skills through making toys, moving objects; and more, presented in increasing levels of difficulty. The tutorial projects guide the user to build their own models and provide useful suggestions and tips along the way. It is a very interesting way of learning the programme's commands and features, as well as acquiring the correct 3D modelling methodology.

The Gallery section is a great source of inspiration: it provides access to hundreds of ready-to-print projects shared by other users.

Obviously, you can also save your designs. When sharing your work you decide if it will be available for further editing and use by other users, or only loaded in the STL (non-editable) format for 3D printing, depending on the kind of Creative Commons (<https://creativecommons.org/>) license — you decide.

The menu options

The first menu option, Tinkercad for ..., offers some interesting surprises: there are six different design categories:

- Pokémon
- Planters
- Minecraft
- Fidgets
- Bricks
- Circuits

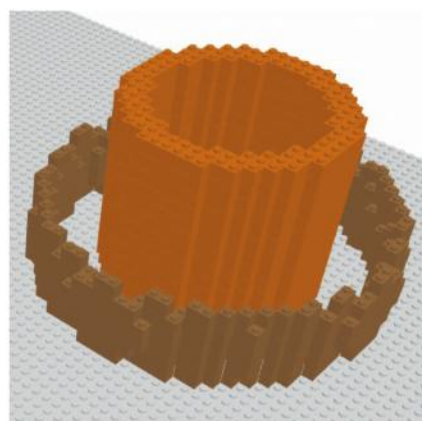
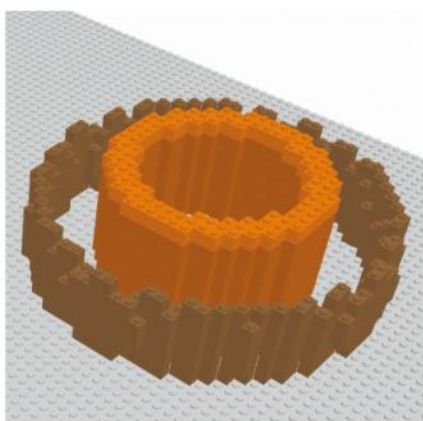
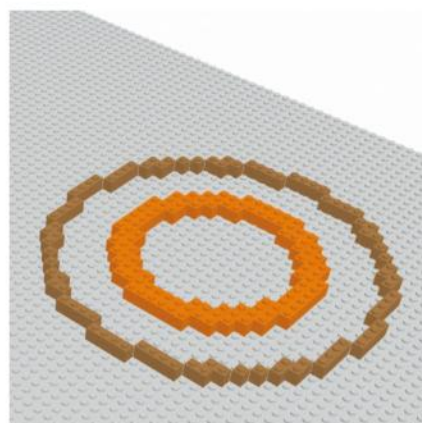
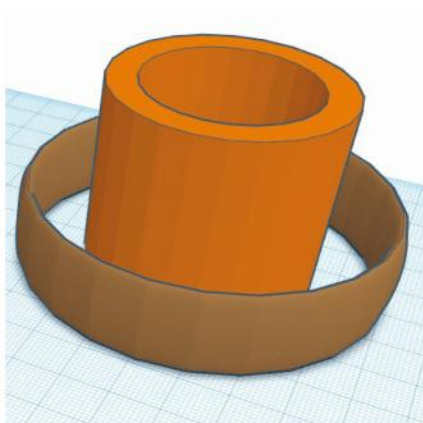
Pokémon

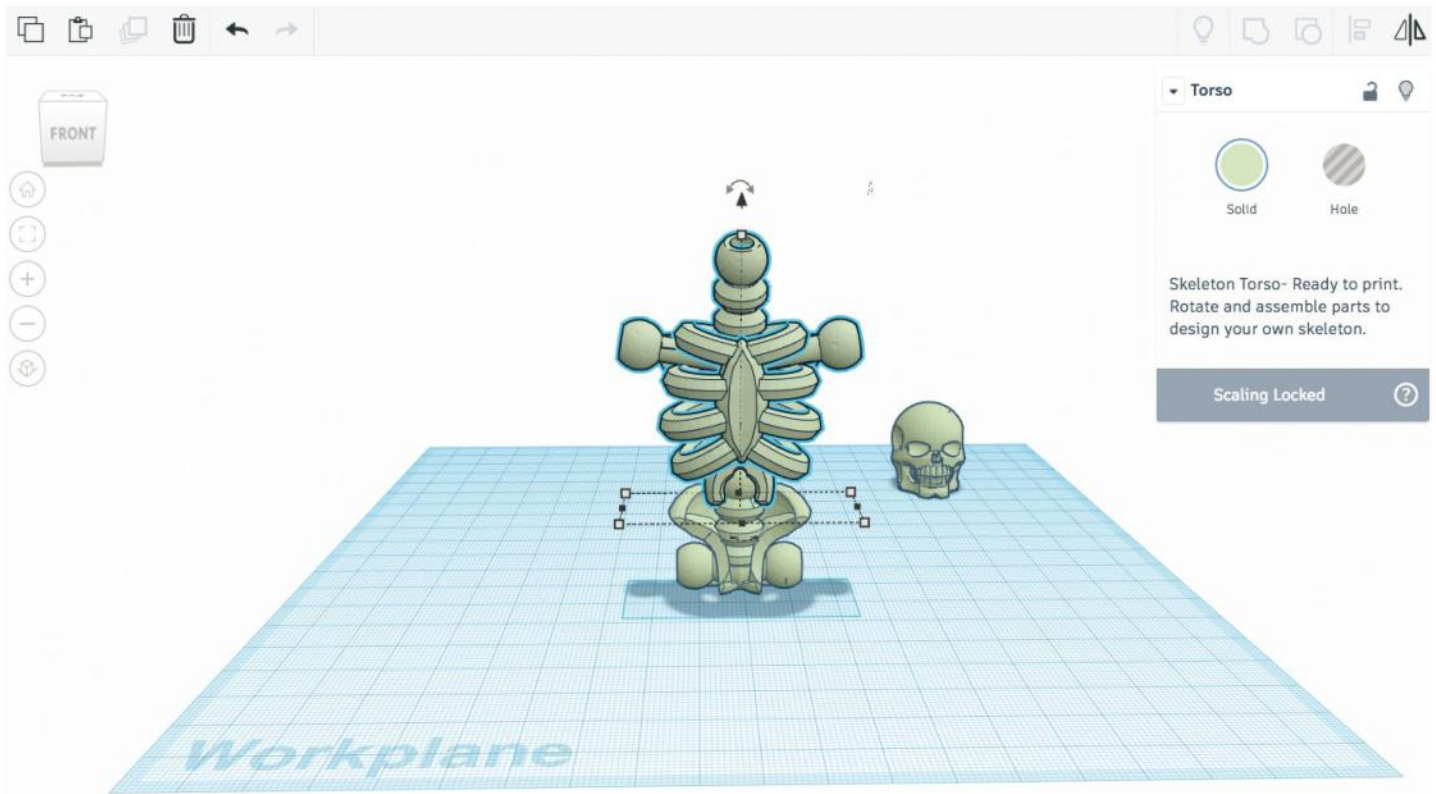
This option invites the user to design their own *Pokémon* characters, to subscribe to a *Pokémon* community, and gives access to an array of pre-built *Pokémon* subjects.

Minecraft

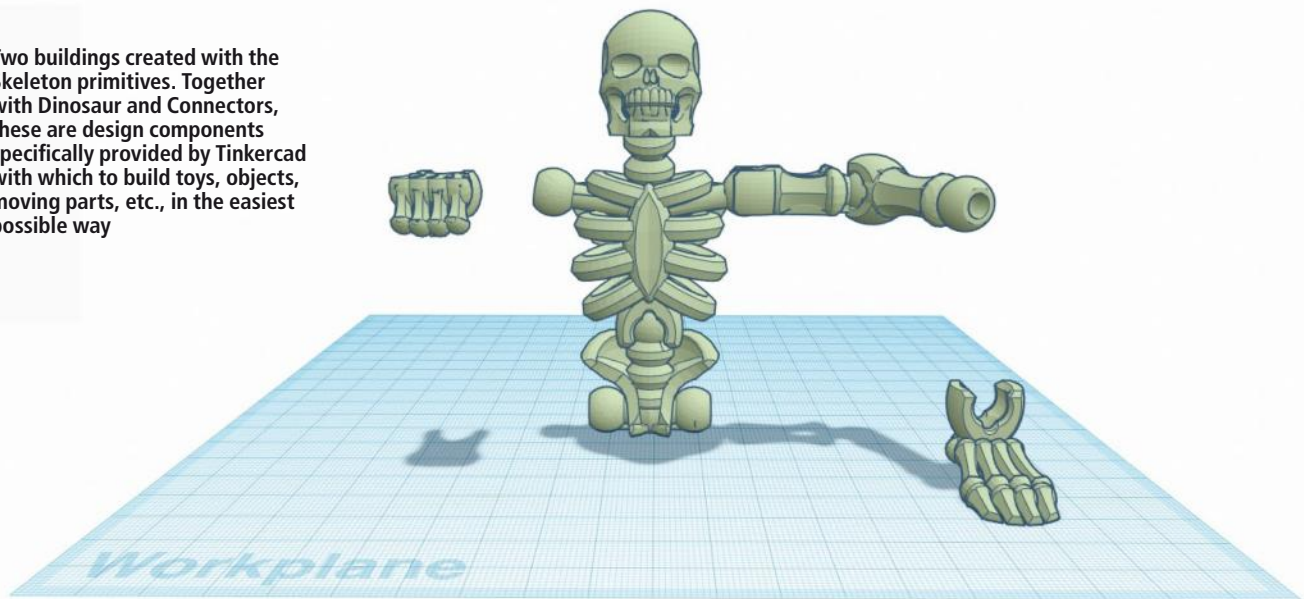
One of the most popular computer

Another composition designed to be transformed in Bricks. The images show some of the layers to build the corresponding Lego model





Two buildings created with the Skeleton primitives. Together with Dinosaur and Connectors, these are design components specifically provided by Tinkercad with which to build toys, objects, moving parts, etc., in the easiest possible way



games for the current generation of teenagers is *Minecraft*. A cool feature of Tinkercad is the option to transform 3D objects and characters into perfect *Minecraft* style. At any point of a design, you can just press the *Minecraft* button to see the same objects in a *Minecraft* scenario. You can orient them in the space as you want and export image files.

Bricks

And what about the Bricks button? By pressing this button your 3D model will be converted to a realistic Lego model that you can build with the famous coloured blocks. In this mode,

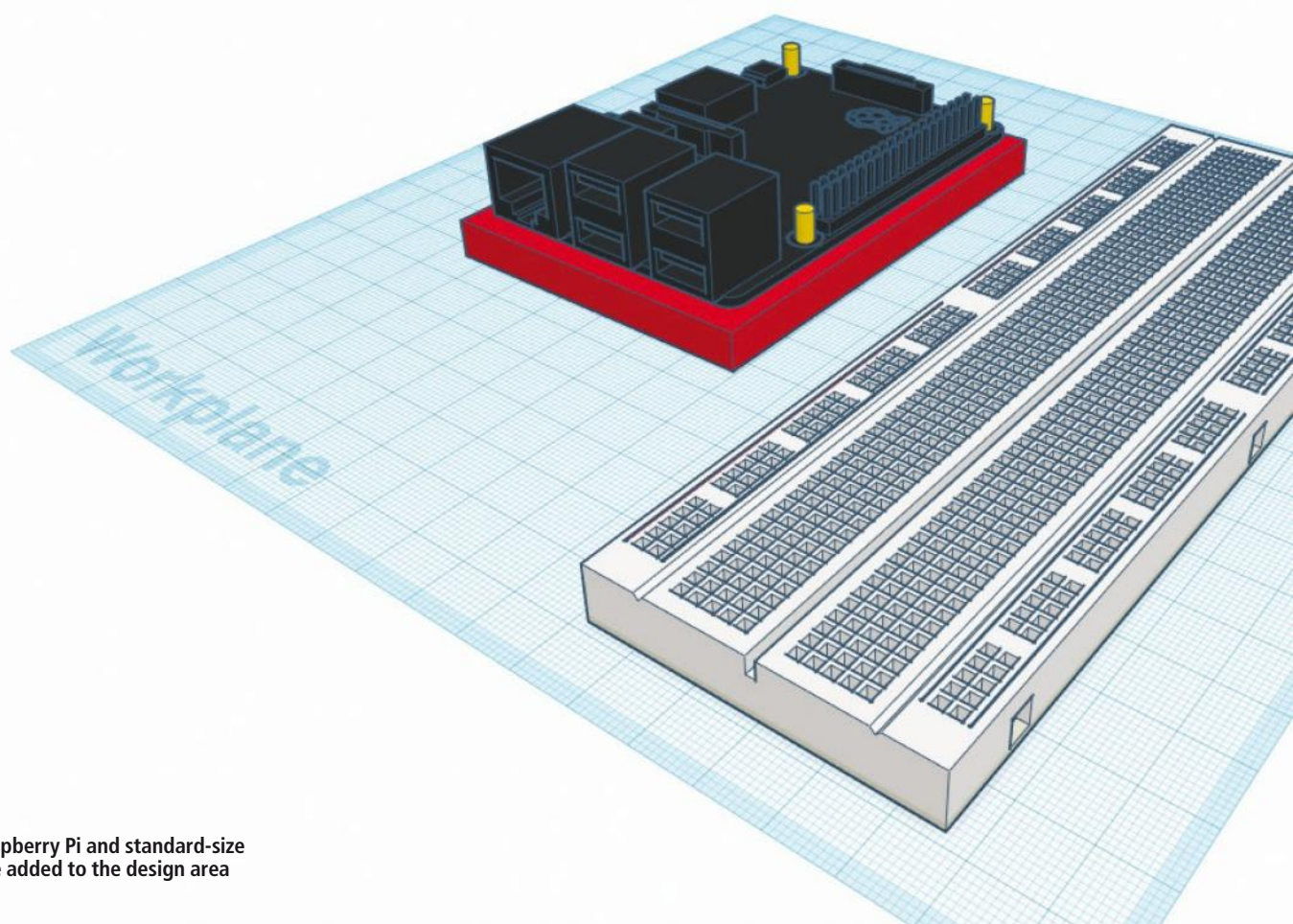
Running on any browser the programme is platform independent and no special hardware is required

the design is represented by layers that can be scrolled one by one — it is a sort of building instruction for your own original Lego model.

Circuits

Circuits is a sort of customized version of the programme that includes a wide range of electronics primitives: breadboards; discrete components (resistors, capacitors, LEDs, potentiometers, etc.); and the most used IC (integrated-circuit) components (shift-register, half-bridge, power regulator, etc.) next to the inevitable presence of the most popular makers' boards: Arduino, BBC Micro Bit, and Raspberry Pi.

Through this section you can build 3D-printable cases as well as animated toys and more complex objects,

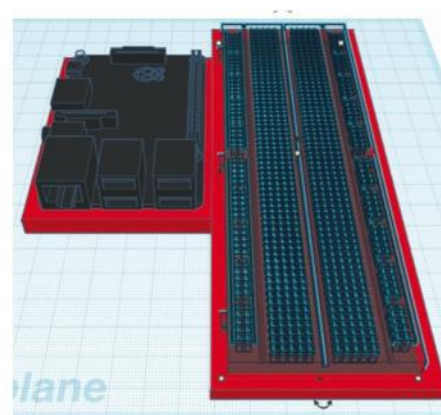
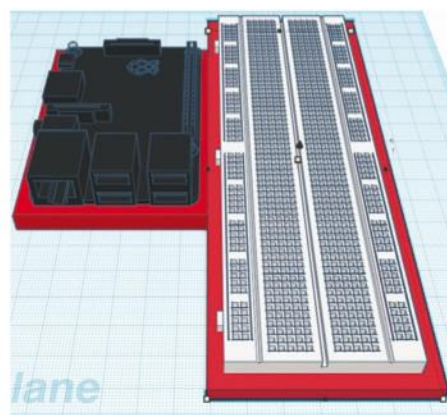
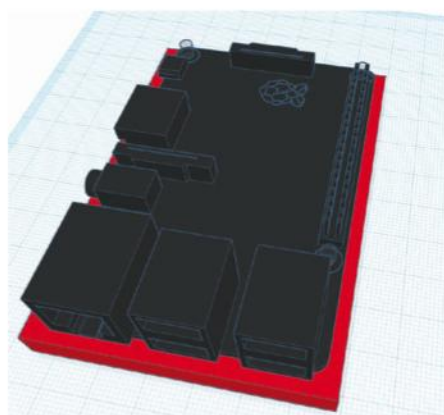


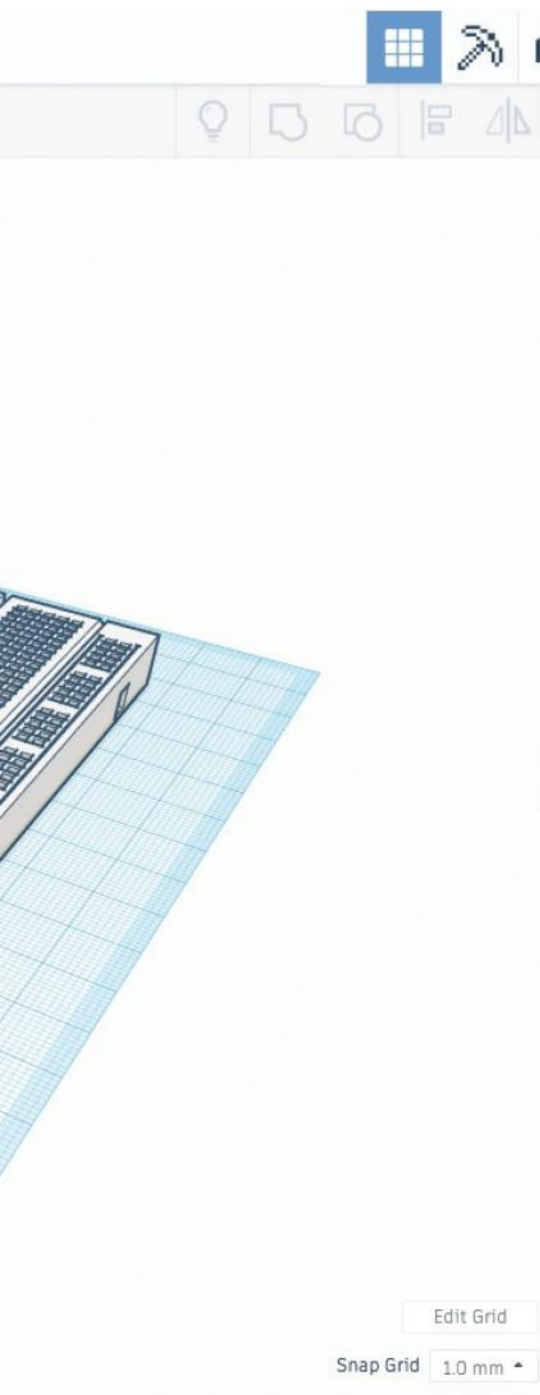
Step one: A Raspberry Pi and standard-size breadboard are added to the design area

Step two: The Raspberry Pi is placed over a rectangular block (red) with four cylinders aligned to the four holes of the Raspberry Pi

Step three: The four cylinders that pass through the red base are selected and converted to holes. When an object is set as a hole, its volume is subtracted from any other object it is included in, also partially

Step four: Another red block has been placed in correspondence with the breadboard. Both electronic primitives, the Raspberry Pi and the breadboard do not lie on the ground base but are elevated to a proper height





An example of how electronic parts can be embedded in designs to create — for example — cases, circuit containers, or animated objects, including electronics

The Gallery section is a great source of inspiration: it provides access to hundreds of ready-to-print projects shared by other users

including your favourite boards and circuits, improving the design speed and quality with a minimal effort.

Planters and Fidgets

These two sections are essentially similar to the others. Planters (referring to making strange and creative plant vases with a 3D printer), is just a page containing a series of links to other users' creations and a PDF guide. Fidgets the same. So these two sections are just there to make the application more attractive and do not really add any value to the application itself.

Graphic primitives

Every CAD application has a series of primitives used to design complex 3D objects, applying 3D Boolean operations, joining, engraving, etc.

For example, you can place a cube on the ground plane, then put a sphere over it, then join the two objects, making a single one.

As well as joining components, you can

subtract one object from another, split an object into parts, create holes, and so on. Complex models have been made easy by Tinkercad thanks to the wide range of available primitives, the full list of which is accessible from the drop-down menu to the right of the design editor. The best way to explore the potentialities is by trying them one by one. With a minimum of practice and experimentation, you can save a lot of time and achieve some very good results.

Make your own primitives

Tinkercad offers another surprise dedicated to more experienced users.

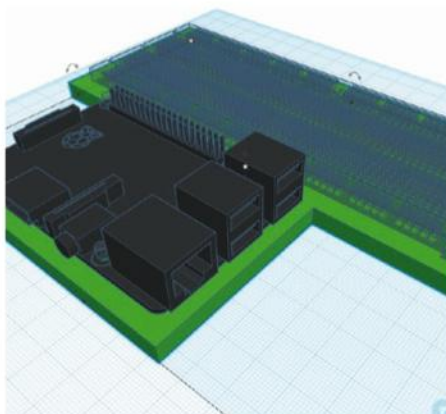
If the 3D primitives and helpers available by the application do not cover all your needs, you can create your own primitives with the Shape Generator (the last available option in the Primitives drop-down menu).

When generating a new shape, you are first asked to select one of the basic 3D geometric figures from a list (or leave null to start with an empty editor). After this step, the Shape Generator editor starts.

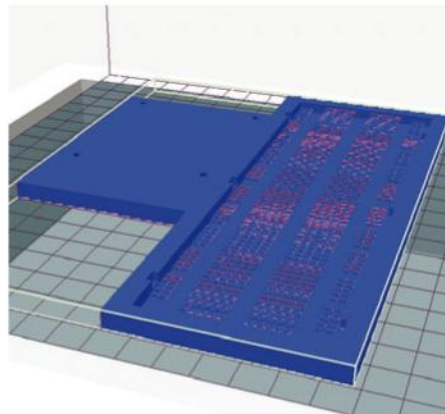
For a complete description of the Shape Generator, you can read the extensive Tinkercad documentation online, but it is worth mentioning one particular feature — the editor area is divided vertically into two parts. On the right side, there is the 3D space, while on the left there is a JavaScript editor.

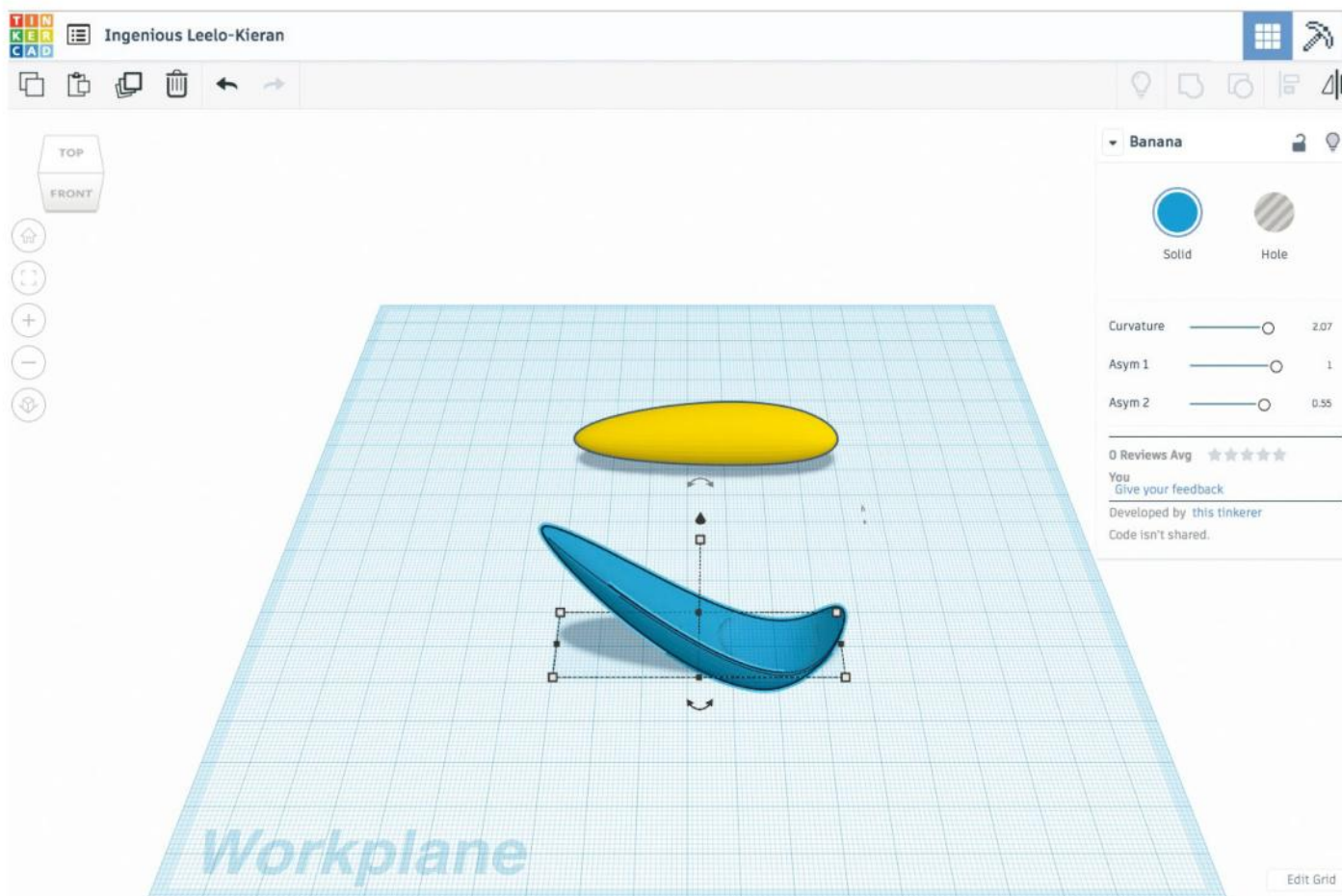
Starting from the selected primitive you can try changing some parameters on the JavaScript side and, after saving your changes, these are rendered immediately on the right side. This approach is useful to learn the maths behind the 3D modelling design. ►

Step five: The breadboard is also set as hole, so the breadboard volume will be subtracted from the base. The two parts of the base are grouped together, making a single object. The new green colour assigned to the base is arbitrary to show the change



Step six: Only the parts that should 3D printed are exported: the base and the holes, the four cylinders, and the breadboard. The image shows the resulting STL file in the 3D printing programme Repetier





Pros and cons

If you want to start the adventure of learning the magic of 3D design, Tinkercad is perfect for you. It is great way to create 3D printable objects and has a lot of helpful features.

If you plan to start with an easy-to-use CAD system, specifically tailored for 3D printing, but your plans are to eventually evolve to more complex platforms (e.g., to design some stuff for 3D-axis routers), this is not the best choice for you. However, Tinkercad is one of the best ways to learn the basics of the 3D modelling, especially when you consider the limits of the application.

File-format limitations

Tinkercad only exports files in STL format ready for 3D printing. The files can't be reused in any other application or opened for editing.

Some CAD programmes can import the STL files, but once imported, the contents are not editable, and is just a sort of locked object that can only be resized. This is probably the biggest downside of this application.

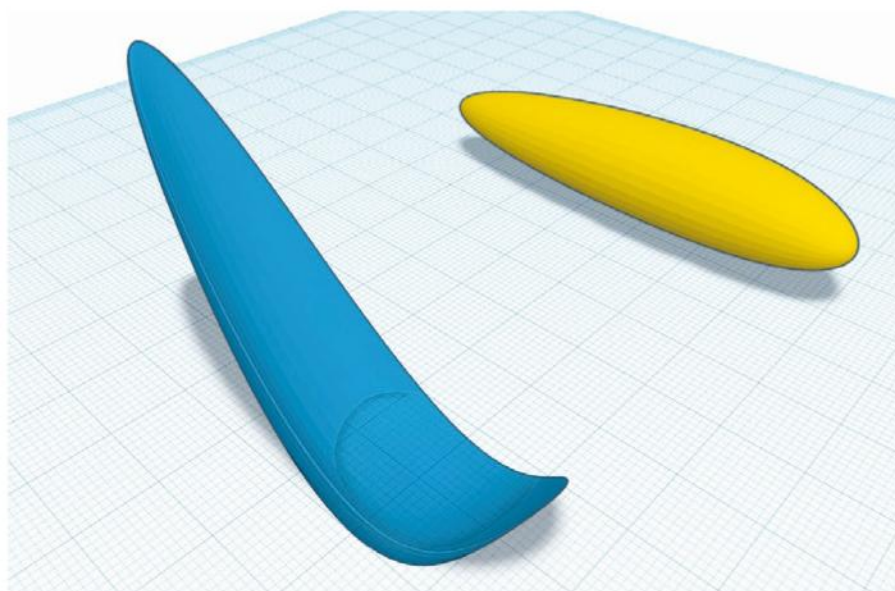
Internet needed

Unlike other browser-based applications, Tinkercad can only work with an active Internet connection.

As a matter of fact, the CAD engine is

somewhere on an Autodesk server. If you have not got a good Internet connection (at least 2MB ADSL is recommended) you can experience some serious performance issues.

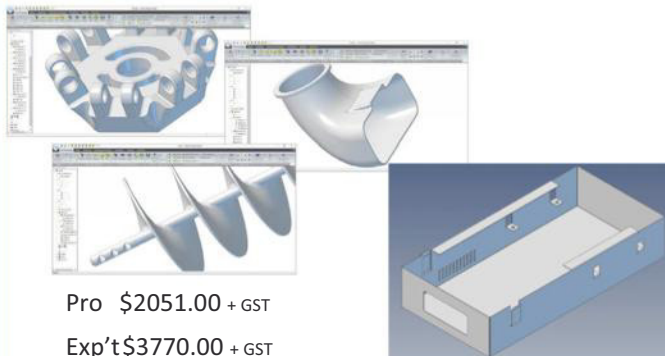
Above and below: A simple example of how the Shape Generator works — two views of a design using the new primitive in its original form (yellow) and after applying some deformations (blue)





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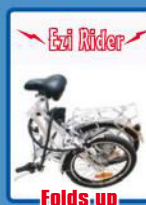
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If you're installing a new boundary fence, avoid any quarrels with your neighbour over who's going to face the 'wrong' side. Stratco Good Neighbour Fencing provides an egalitarian solution: a fence that has clean, attractive lines on both sides. It's easy to install with each steel panel fitting into profiled fence posts and tracks, and provides excellent screening — nobody gets a raw deal.

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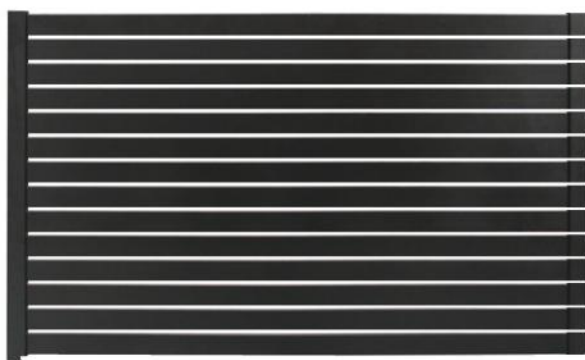
Choose from two four-piece sets, which come in a sturdy cases (Set L contains 6-, 12-, 18-, and 25mm, and Set S contains 10-, 16-, 18- and 20mm) at \$92.94. Or there's the seven-piece metal wall rack set, containing 6-, 10-, 12-, 16-, 18-, 20, and 25mm chisels for \$185.27.



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We don't need to tell you how important it is to keep your gas welding equipment maintained, and now's a great time to do it — BOC Gas & Gear currently have 30 per cent off flashback arrestors. According to the AS4839 safety standards, you should leak test your connections before every use. You should also inspect your flashback arrestors and regulators weekly, test them every six months, and replace them every five years. Make use of that 30 per cent discount before it ends on 31 July 2018.

For more info contact your local BOC Gas & Gear or visit www.boc.co.nz.



PAINT BEATS THE PRESSURE

It's this time of year that rising damp or efflorescence problems are going to make themselves known, with hydrostatic pressure causing moisture to rise through the pores in concrete, damaging the film sitting on the surface, usually through the blistering or flaking of the coating. New Resene HydraBlock is a transparent two-pack low-VOC waterborne epoxy barrier coating for application on interior concrete surfaces, such as masonry, walls, in-situ concrete, walls/floors, and plastered walls. It has excellent adhesion and is tolerant of application over damp surfaces.

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ACQUIRING A NATURAL SHARPENING STONE LEADS RITCHIE ON AN INTERESTING QUEST

By Ritchie Wilson

Photographs: Ritchie Wilson

I wanted a natural sharpening stone and didn't want to pay for a Japanese water stone, many varieties of which I have seen for sale in Japan. Some of these cost more than \$100. Arkansas and Washita stones from America are similarly pricey.

I came across a reference to Māori using stone from Lyttelton Harbour for sharpening and I thought that I could collect a stone from their old quarry, shape and flatten it, and I would be in business — and my cash would stay safely in my wallet. It was while I was trying to get more information about local sharpening stones that I was struck by the similarities between sharpening steel and stone tools. Both use abrasives to wear away two flat surfaces that meet at the cutting edge.

First Kiwi-made tools

For the early Polynesians, arriving at a new, previously uninhabited Pacific island would have been like being given the keys to Pak 'n' Save. Large flightless birds and plentiful sea mammals, with no fear of humans, would have provided easy eating for generations. Because of the typically very long voyages undertaken to find new land, replacing stone tools as they wore out or broke was not so easy. They had to do it themselves using the materials at hand. In the South Pacific and Hawaii the best material was the volcanic rock, basalt, of which the islands were composed. When Māori arrived in Aotearoa 800 years ago, they would have been evaluating the stone outcrops' potential for toolmaking and tool sharpening from the very first. ►

The hardness of abrasives

Abrasive	Hardness by Mohs scale	Chemical composition	Occurrence
Diamond	10	C	Diamond plates, sandpaper
Silicon carbide	9–10	SiC	Oil stones, grinding wheels, sandpaper
Aluminium oxide (alumina)	9	Al ₂ O ₃	India stones, grinding wheels, sandpaper
Glass	7		Sandpaper
Silica	7	SiO ₂	Sand, sandstone, Japanese water stones
Rouge	5.5–6.5	Fe ₂ O ₃	Jeweller's rouge





EPING SHARP



A few of the adzes in Canterbury Museum's collection. Some have been smoothed over their entire surface; others roughly shaped, with only the cutting edge ground smooth. The first Europeans in New Zealand describe how Māori would fill any idle moments by polishing their stone tools. This shows the high regard in which these objects were held

Grit numbers



The abrasiveness of sandpaper and oil stones is indicated by a number. The higher the number, the finer the abrasive, so 100 is coarse and 1000 is very fine. Generally only two grades are used in sharpening tools. The Norton aluminium oxide sharpening stone I bought recently had medium (120 grit) to remove metal quickly, and fine (180 grit) to give a more polished finish. Similarly the Māori classified their hōanga into two types: matanui, for rapidly removing material, and matarehu, for a smoother finish.

Obsidian — a perfect knife

It is thought that these first arrivals to New Zealand were very accomplished sailors, so they had the mobility to quickly explore their new home and identify suitable toolmaking stones in many, especially coastal, places.

They soon discovered the volcanic glass obsidian, called 'matā' by the Māori, at several sites — the best came from Mayor Island in the Bay of Plenty. Obsidian was valued because fragments naturally have very sharp edges, which make them useful as knives. Larger blades for the very important woodworking adzes were hard to make from obsidian and many different stones

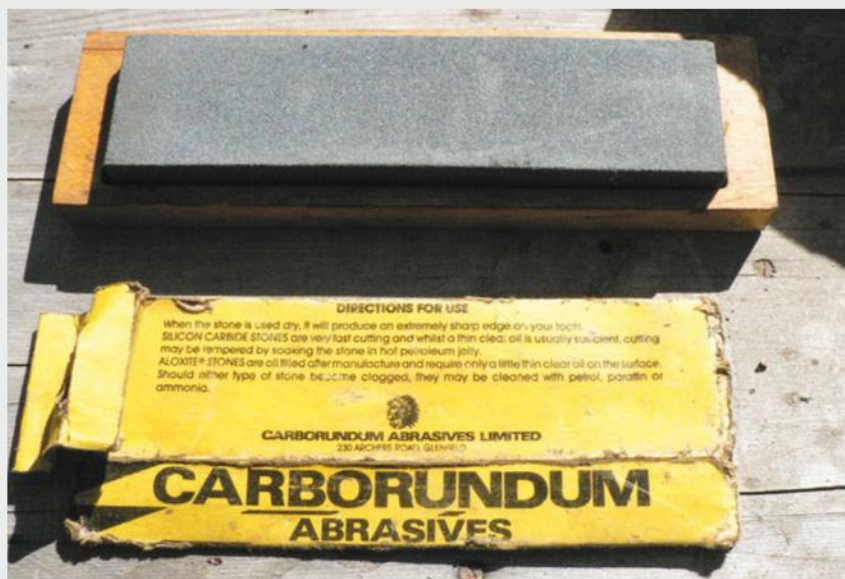
were used for this purpose. The fine-grained basalt from the Coromandel region was preferred in the early days of Māori settlement. Later, the hard, grey sandstone greywacke, of which the Southern Alps are made, was most commonly used, although the supreme nephrite — pounamu — from the Arahura and Taramakau Rivers on the West Coast of the South Island, was most valued.

The need for sharpening

Adzes (toki) and chisels (whao), whatever they are made from, have to be sharp to cut wood. Māori used either a mixture of sharp sand and water on a hard, flat stone, or a flat piece of wetted



A common sharpening sequence



1. If the edge is chipped it needs to be ground straight on a grinding wheel and the bevel reground without overheating.
2. The bevel and the back of the blade are flattened on a coarse oil stone, which gives a rough surface but removes metal quickly.
3. Repeat Step Two with a fine oil stone, typically on the opposite side of the stone from the coarse abrasive, which leaves a smoother finish. This will produce a thin, just visible wire on the cutting edge.
4. Using a flat surface and an ultra-fine lapping powder such as rouge, lap the two sides meeting at the edge to remove the wire.
5. Strop the edge on leather or a cloth wheel to ensure the wire is gone.
6. If the tool is only slightly blunt only Steps Three to Five are needed.

Above left: A carborundum stone
Far left: Thin oil is needed to lubricate the oil stone
Left: Sharpening a plane cutter on the India stone

Below: An adze blade being formed.
(Reproduced with permission from Clive Fugill, *Te Toki me te Whao: The Story and Use of Māori Tools* [Oratia Books, 2016])



sandstone, to sharpen and polish stone tools. Evidence of the use of sandstone outcrops for this purpose can still be seen at some locations, usually very near to water. Sand and sandstone are both a result of the weathering of quartz. The small, hard, sharp-edged silica crystals, made by the break-up of lumps of quartz, scratch the stone being sharpened, abrading it away. The final polish was achieved by using red ochre (kokowai), which contains rouge, applied with, perhaps, animal skin. Traces of the red, very fine abrasive can be seen on some toki.

Steel arrives

Contact with European sailors resulted in major changes to the tools of the Māori long before any significant impact was felt in other aspects of traditional Māori life. Carvers made increasing use of steel chisels made from nails.

Whatever they are made from, [they] have to be sharp to cut wood

Adze blades were made first from barrel hoops, then from cutters from carpenter's planes, and finally were largely replaced by European adzes and axes.

The stone adzes were then used for gardening; abandoned; or, if pounamu, reshaped into hei tiki. Stone adze heads are continually being discovered and handed into our local museums.

These new metal tools were sought after by Māori because metal makes a more durable cutting blade that holds an edge better and is probably sharper too, but sharpened in the same way as stone blades.



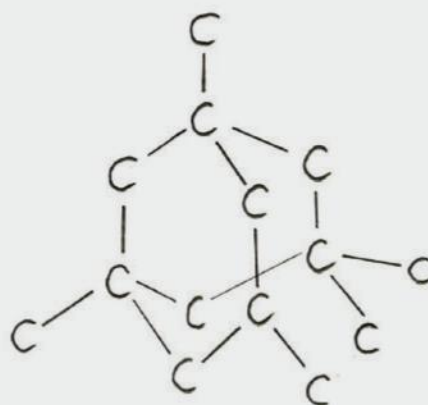
A sandstone grindstone lubricated by a water bath. In the background are samples of the various timbers grown at Orton Bradley Park in Lyttelton Harbour

Why are abrasives hard?

Diamond is made from carbon atoms linked by unusually strong chemical bonds in a rigid three-dimensional lattice. This structure is very difficult to deform so is 'hard'. Diamond is, of course, the hardest substance known. Silicon carbide has a similar structure to diamond except that every second carbon atom in the lattice is replaced with a silicon atom, silicon and carbon being very similar chemically. Again this forms a rigid three-dimensional lattice, but the atoms are not as strongly bonded together as in diamond, so the structure is less hard.

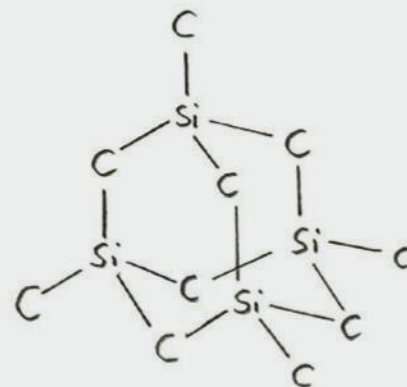
Silica, again, has a similar structure to diamond. It has silicon atoms linked by oxygen atoms to also form a rigid three-dimensional structure. This is, however, less rigid than either diamond or silicon carbide, so silica, while hard, isn't as hard as the other two. As there is an oxygen atom between all the silicons there are twice as many oxygens as there are silicons.

Aluminium oxide and rouge are similar to each other, but different from the



Diamond structure
C = carbon

first three because they are 'ionic'. 'Ions' are atoms that have an electrical charge. Both aluminium oxide and rouge contain metal ions with an unusually large charge. Rouge has iron III ions and aluminium oxide has aluminium III ions and both have oxide (oxygen) ions. In both, the small metal ions surround the larger oxide ions, which in turn surround the metal ions. Due to the high charge on the metal ions, the forces holding the ions together are very strong and so the ionic structure is rigid. Again this means



Carborundum structure
Si = silicon

the substances are hard.

Other metals which form ions with a high charge, such as chromium, would have oxides that are hard and would, perhaps, be suitable as abrasives. Iron III and aluminium III ions do have the advantage over many other metal ions in that they are not toxic (as far as we know).

All of the discussed form crystals with straight edges and sharp points suitable for abrading metal or stone particles from a surface to form a cutting edge.

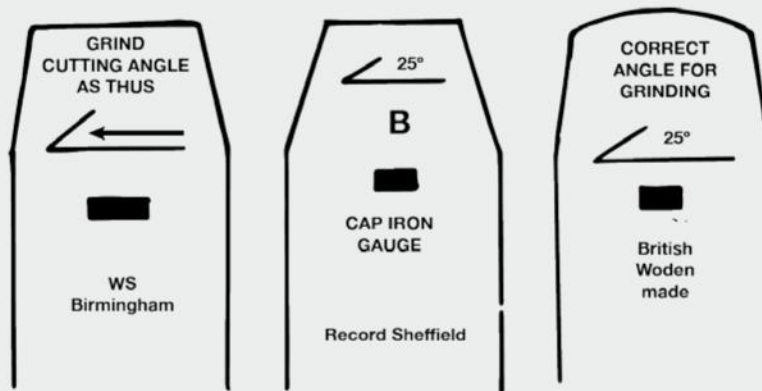
Plane cutters and chisel blades, like Māori adze blades, have cutting edges formed where a bevelled front meets a flat back. The smaller the angle between the two surfaces, the sharper the edge, but the more likely it is to chip and the longer it takes to sharpen. A compromise is needed, which usually results in an angle of about 30 degrees between the ground faces. In his book on scything, "The Scythe Book", "The Scythe Must Dance" (2001), Peter Vido called it "the compromise between penetration and durability".

The sharpening angle is important in plane cutters that are held at a fixed angle to the surface being worked, and instructions as to the correct angles can sometimes be found engraved on the chip-breaker of the plane. The plane

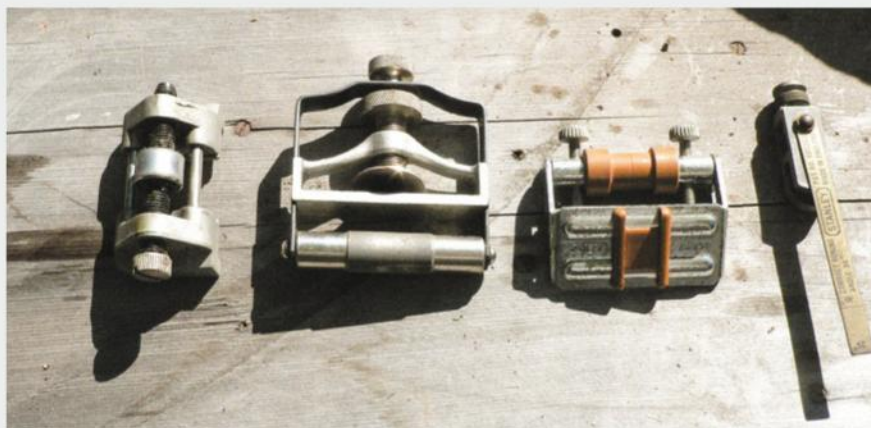
works best when the cutter is sharpened to the indicated angle. Thin plane cutters are more easily sharpened than older, thicker ones because less metal has to be removed.

Many devices have been invented to aid the sharpening of cutters to a particular angle and examples, both cheap and

expensive, are still available today. These sharpening jigs work by holding the cutter at a fixed angle to the surface of the sharpening material. Some hold the cutter at an angle to the direction of movement also, so that the cutting edge is also at an angle to the length of the cutter, which may provide a better cutting action in use.



A Stanley 140 plane cutter in a Millers Falls 240 sharpening jig, which allows the edge to be sharpened at an angle



Sharpening jigs (from right): two Stanley; Millers Falls 240; Eclipse 36. These hold a cutting tool so that its edge is sharpened at the correct angle

The cutting edge of a metal tool is also formed by the grinding of two surfaces that meet at a line. Again, small, hard, sharp crystals are used to scratch the metal to make the flat surfaces. The harder the crystals, the harder the metal that can be sharpened. The smaller the crystals, the finer the scratches and the sharper the edge. The larger the crystals, the faster the edge is sharpened.

Hard, crystalline materials

When we look at a list of hard crystalline materials, we see many of the substances that we use for sharpening in the shed. Diamond, silicon carbide (carborundum), silica (sand), aluminium

oxide (alumina), rouge (iron III oxide), and glass are all used as abrasives and all sharpen in the same way as the sand slurries of pre-European Māori.

Before the last century water stones were the usual sharpening material. These were made of sandstone, which is a sedimentary rock consisting of silica crystals that have been bonded together by heat and pressure deep beneath the Earth's surface. The hard silica crystals on the face of a water stone removed metal from the surface being sharpened and plenty of water kept the metal cool and washed away the mixture of lost metal particles and detached, broken silica crystals called 'swarf'. This allowed new sharp crystals to be uncovered and

brought into action. As the stones were used they were worn away and stopped being flat and so had to be flattened using a flat, hard rock and a sand slurry — just as the Māori did.

Water stones revered

The best water stones were highly valued, as they continue to be today, and were traded widely around the world. The first Europeans to settle in New Zealand would have brought a water stone in their swag as well as the classic axe and a Bible. If they were English the stone would have probably been a Charnwood Forest stone from Leicestershire, but there would have been a variety to choose from — some,



Above: A hōanga from Canterbury Museum's collection. It has been worn to a dish shape by generations of sharpening

such as Turkey stones, from as far away as Lebanon and Syria. Māori called water stones 'hōanga', and an example of these was a sandstone from tiny King Billy Island in the South Island's Lyttelton Harbour. Some hōanga were so revered that they were named and had stories composed about their history. One famous example near Rotorua was said to have been brought from Polynesia on the *Arawa* waka.

Finer abrasive oil stones

Until recently, oil stones, consisting of silicon carbide crystals of a uniform size embedded in a bonding agent, were universally used by workers in Western countries to keep a sharp edge on tools. Being manufactured, oil stones were relatively cheap and consistent. The 'oil' in the name refers to the light

Sandpaper



The abrasive particles are glued to a sheet of paper, cloth, etc. to form sandpaper. My old woodwork teacher used to insist that sandpaper was called 'glasspaper', because the abrasive used back then was glass powder. Today neither glass nor sand (silica) are found on sandpaper. Instead, the familiar substances silicon carbide, aluminium oxide, and diamond are used. As there is only one layer of abrasive the sandpaper has a limited life — the abrasive particles being broken or detached from the backing relatively quickly. On the other hand, sandpaper is cheap and flexible. An effective and inexpensive (though short-lived) whetstone can be made by taping sandpaper to a flat base.



A Stanley 60½ plane cutter in an Eclipse 36 sharpening jig

Below: Different-shaped oil stones



mineral oil which was used on the stone to lubricate and cool the abrasive and to allow swarf to be moved away from the sharpening surface. Oil stones are also commonly made from aluminium oxide (alumina), which has generally finer abrasive particles and so produces a sharper edge more slowly. These are called India stones. Some natural stones, such as Arkansas stone from America, are also used as oil stones but are much more expensive.

Diamond days

The serious woodworker of today would almost certainly use diamond as a sharpening material. Diamond is so hard that it is worn away by sharpening much more slowly than other abrasives, so only one layer of diamond is used. This is bonded to a (hopefully) flat surface that incorporates depressions to remove swarf so that the diamond crystals aren't clogged with metal particles. Using the plate wet apparently makes it last longer.

The diamonds used are relatively inexpensive because they are manufactured. They are sorted by size so that diamond plates of various coarseness, although not very fine, can be produced. Diamond plates are unrivalled in removing metal quickly and in sharpening very hard alloys like high-speed steel, but struggle to produce a mirror finish on the tool and hence a really sharp edge. Diamonds are also excellent conductors of heat, so the surface being sharpened shouldn't overheat and lose temper. 'Temper' is the hardness caused by the heat treatment of steel.

Japanese water stones

Japanese tools are increasingly being used by both professional and amateur woodworkers, as are Japanese water stones. These have as abrasives the familiar silica particles, but their difference is that the particles are embedded in a clay matrix. This makes the stone softer than sandstones with the advantage that new sharpening particles are continually being uncovered as a tool is moved over the stone, leading to rapid sharpening.

The disadvantage is that the stone wears quickly and has to be frequently

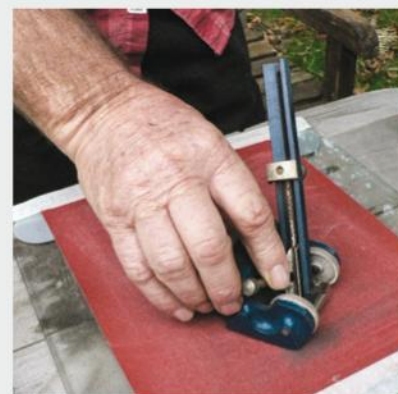
Sharpening drill bits with the Eclipse 39

Pictured is the drill-sharpening jig I use. It is the Eclipse 39, a British-made device whose inventor won British Invention of the Year competition in 1970. The abrasive material is sandpaper taped to a flat surface. I use the plate glass top from a damaged set of bathroom scales.

The drill bit is accurately positioned in the jig and pushed over the sheet of abrasive. After a few passages across the surface the drill bit is repositioned and the other facet of the drill's cutting surface is sharpened. The process is repeated until two good cutting edges are produced.

It is rather a long and demanding procedure, but has the advantage that a completely inexperienced amateur can transform a blunt drill bit into a useful item.

I have seen seasoned metalworkers sharpen drills freehand on a bench grinder in just a few seconds and produce quality results. That is obviously a better way, especially for large bits, but requires skill which I suspect was hard won; there being plenty which can go wrong.



Sharpening a drill bit with the Eclipse 39 jig

flattened (or 'trued') to maintain a flat sharpening surface. Diamond plates would be suitable for this, or specialized flattening surfaces used with silicon carbide powder could be used. Japanese water stones were originally natural, being quarried at numerous locations in Japan, but are now mainly manufactured, several companies producing various brands. Like other sharpening stones they come in a variety of abrasive particle sizes, some of which are very fine, perhaps the finest available. Finer particles equal sharper edges but slower sharpening. Overall Japanese water stones provide a sharper edge for less sharpening effort, which means that they can be sold at a premium price.

The old name for sharpening

As a child I used to see a council worker regularly cut the grass verge of our road with a scythe. Every 10 minutes or so he would take a round oil stone out of a leather pouch attached to his belt and wipe it a few times along the cutting edge. This process was called 'whetting', the old name for sharpening, and he would have been said to have 'whet the

edge' of the scythe. The oil stone would have been called a 'whetstone'. He would have periodically oiled the stone's surface with an oil-soaked rag from the pouch. I can't remember him having an oil can concealed about his person; perhaps it was in another belt pouch. Or was it in his ... Truck? Unlikely. Bicycle? Horse? It's a long time ago. ►

A Japanese water stone





Left: The piece of Orton Bradley Park sandstone
Above: The cut stone
Below: The 'as found' op-shop chisel
Bottom: Sharpening the op shop's Marples chisel on the Orton Bradley Park sandstone whetstone

I was aware that getting a sharpening stone from tiny King Billy Island in Lyttelton Harbour would be problematic because it is administered by the Department of Conservation (DOC) as part of the conservation estate. Without much hope of success I contacted DOC, the local iwi, Te Hapū o Ngāti Wheke, and the Otamahua / Quail Island Ecological Restoration Trust, who are all stakeholders in the island. The DOC's position was that nothing should be taken from conservation land without permission, unless I had a prospecting licence. So that was that. Interestingly King Billy Island is known as 'Aua' to the Māori. Another meaning of 'aua' is "I don't know". A situation reminiscent of the Indigenous Australian word 'kangaroo', which has the same meaning.

I rang the Geology Department at the University of Canterbury and talked to one of the professors. He told me that there were other sandstone outcrops in the ancient volcano caldera that forms Lyttelton Harbour. These are the remains of the seabed that the volcano thrust through millions of years ago. One is at nearby Orton Bradley Park, which is owned by a charitable trust. I applied to the park manager to get a small block of the sandstone, to which he was agreeable. On the day, we trudged through the rain and mist to

the quite extensive, well-fenced quarry which was last worked more than 40 years ago. The manager thought it was unwise to approach the workings too closely, especially as water was running down the rock face and a rock fall was not out of the question. There was plenty of sandstone rubble among the gorse bushes below the quarry face, and he very kindly gave me a plate-sized piece. We discussed whether Mr Bradley, the original owner, would have used the sandstone to make grinding wheels such as the ones in the old sawmill on the property.

The manager thought that the grindstones were probably English, but he pointed out that one of them, powered by the overshot water wheel, had '1900' carved into its side. Would you do that to a purchased grindstone, or would the rough sides of the grindstone indicate that it had been made on the property with stone from their quarry?

The animal-welfare organization where my younger daughter worked before she went back to university has a bench-top manufacturing business behind it owned by Shane Boyd. For a small fee Shane cut the Orton Bradley Park stone into three pieces with the 450mm water-cooled diamond blade of his Italian computer numerical control (CNC) bench-top machine. This produced a 200x100mm



sharpening area. The surface came up well, with a creamy colour with red-brown flecks. I used water as a lubricant, just like the Orton Bradley Park grindstone, as I slowly sharpened a chisel that I found at an op shop to a near-mirror finish. Result! A big thank you goes out to Clive Fugill, Vicki Blyth, and Lisa McDonald from Canterbury Museum, as well as the staff at the beautiful Orton Bradley Park for their help in the writing of this article. 📦



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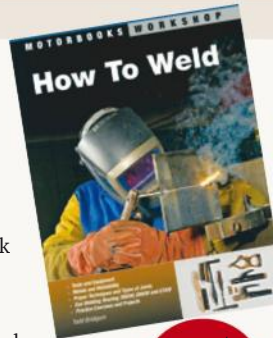
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How to Weld

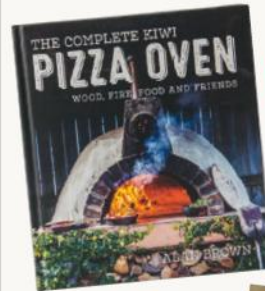
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Men and their Sheds

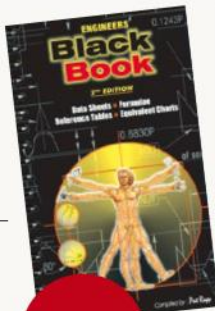
Something for everyone in this coffee table book, beautifully presented in a salute to that unique place where things are fixed and friendships formed, where invention begins and the amazing history of things is kept alive. Some contributors stress the benefit of sheds as a therapeutic tool, but their real gift is that they're incubators of dreams, fostering creativity, skill, achievement and pride. This book's 224 pages make it the perfect present for every Sheddie.



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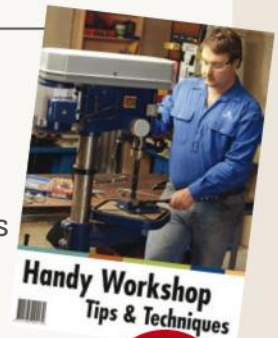
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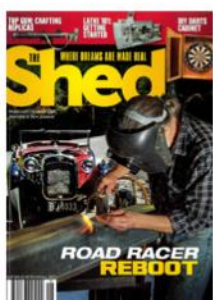
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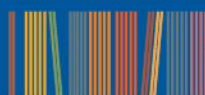
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Truth and dare

By Jim Hopkins

There are some young geezers, still wet behind the ears, who simply refuse to believe it when you tell them that there was a time when delinquent lads were flayed with pliant bamboo rods as punishment for their transgressions.

These same callow whippersnappers, cosseted in cotton wool, roll incredulous eyes when you insist that entire cities used to warm themselves with coal, pumping a volcano's worth of sulphur into a starless sky for weeks on end. Or that long-distance travel once involved being hauled by great, black, steaming K-class locos that used to stop for extended periods at remote sidings to refuel with ... water!

Reared on tablets and twaddle and schooled by mollycoddling post-Freudians convinced one rebuke will cause lifelong trauma, our millennial YouBook and Facetube yooves cannot comprehend such unfathomable things.

Yet I, like you, know them to be true. For I, like you, was one of those delinquent lads bamboozled for badness. And I biked about on freezing nights when 30,000 smoking chimneys fouled the air. And, for four fab years in the fab four '60s, on long weekends and school holidays I'd cross the alps to hang out with a pal, riding the rails to Greymouth, then taking the bus to Blackball, where much of the coal that went up those chimneys actually came from.

Not that pollution — or any other kindred scourges — particularly bothered us. We were too busy having fun,

roaming bush tracks, startling fat wood pigeons, climbing tailing mounds, tossing red-lichened rocks into dredging ponds. There was an abandoned mine in the hills behind Blackball where a fire had started and coal was still burning underground 90 years later. The scree slope above was treeless, just bare stones with little wisps of smoke seeping through cracks in the earth.

Best of all, the favourite summer spot, was a place that always offered some different dare — the big weathered timber Blackball Bridge, spanning the wide Grey River. It was an imposing thing, a rough-hewn pioneer structure built with purpose for a purpose — to get trains in and take coal out. You could climb under it and over it and up its angled wooden flanks. And we did, for we had no fear.

But one thing we didn't do, indeed a thing so rare and risky that it's hard to believe anyone's done it, is something I only heard about, along with other wondrous tales, a few short days ago.

The man telling the stories was Allan Ferrari; 76 years old and not a relative of Enzo's — "The name's as common as Smith over there." Born in London in 1942, Allan came to New Zealand in 1953. Builder, linesman, hunter, pilot, he's as tough as goat's knees and has been in and out of sheds all his life. In 1964 he moved to Reefton and started playing darts. Well, one thing led to another and soon he was the West Coast champion, then a national rep and selector.



Which meant going to tournaments hither and yon. Unhappy driving for hours on end, Allan and a mate did the sensible thing and bought a plane. They flew their little Cessna 150 to working men's clubs all over the country. One day, Allan thinks it was in 1978, the match was in Greymouth. So he took the plane. As you do.

Match over, it was back to Reefton. And since some of the team had travelled by car, that meant there had to be a race. And Allan had to win. So he banked the 150, dropped it down to take a shortcut just above the Grey River, and flew that little aeroplane straight as an arrow, right under the Blackball Bridge.

Straight under? You bet! First and only time it's ever been done, Allan thinks. When he told that story, the older me remembered the younger me, standing on the bridge. And I imagined me watching a little plane zooming under the deck.

Or, better still, being in it. Because, now I know that it happened, I've never wished to be anywhere as much as I wish I'd been in the cockpit of that wee Cessna on that great day.

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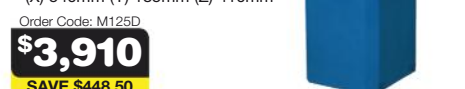
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