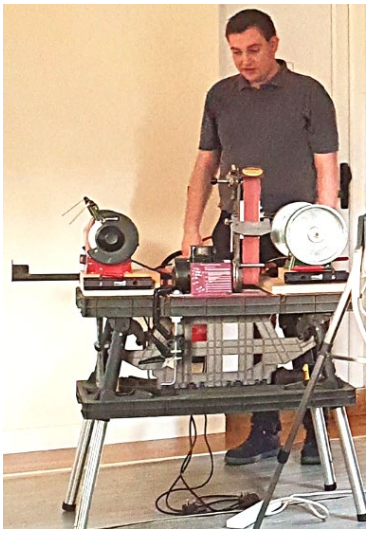
WSWC club meeting – Monday 20th June 2022

Sharpening talk and demonstration by Stuart Clarke

Club news



This month we enjoyed an informative talk from West Suffolk Woodturning Club member Stuart Clarke, where he covered some of the aspects of tool sharpening and steel materials. This is a complex subject and often the most frequently asked questions by newcomers and experienced turners alike. Naturally I've penned a full report within this newsletter.

Next month we have another of our popular multi-turn events, we are not sure what people may choose to show this time but it should be very enjoyable.

The weather has taken a nice turn to becoming summer and we all like the brighter days, however, I know my workshop is occasionally sweltering. I realised that it was a little too much when spraying some cellulose-based finish. This appeared to evaporate the cellulose base before the finish actually hit the wood! This resulted in a very sticky mess which I quickly removed, but resulted in a frustrating re-finish after which I locked up. The next day was cooler and the finish applied and worked fabulously.

Of course, the other effect is the increased drying out of the turned item as you work. I've heard some turners opt to spray water on the piece as they work it to retain moisture. It is frustrating when one can see visible cracks appearing as you work! For this reason, I also gave up turning some very well figured seasoned Apple wood. Apple, like many fruitwoods, is lovely but problematic at the best of times, but this was a nightmare in the heat.

I could actually hear it crack before they appeared on the surface and couldn't remove material fast enough to remove the stress. So, it was added to the firewood pile once again I went to go and hibernate in a cooler room to write up the newsletter and website!

Until the next time – keep cool, maybe a spray bottle of water and happy turning!

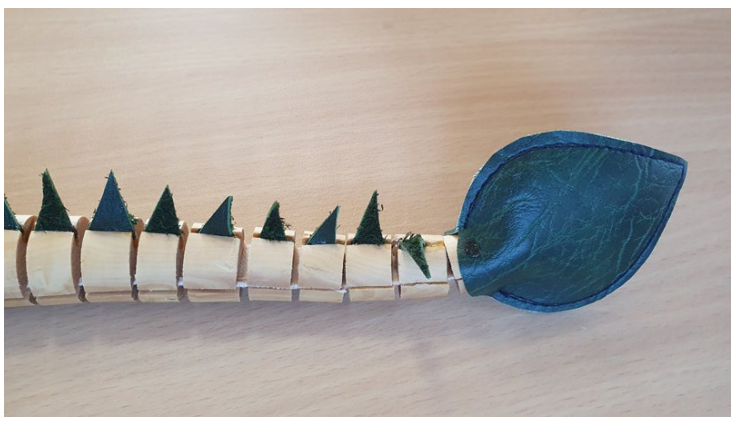
Neil

Display Table

Above and right: Large Spruce stumpwork turned vase by Eric Harvey

Right : A crisply turned Oak candlestick by John Cuckow

Above, below and right: Tic Challis - mixed media dragon puppet in boxwood and leather, with metal fixings. This is still work in progress



Sharpening talk and demonstration by Stuart Clarke

(With some additions in the write up - ed.)

About Stuart (in his own words)

"I started turning when I was 17. My 17th birthday was approaching fast and Dad asked if there was anything in particular I wanted, my response was "I would like to have a go at woodturning". I don't quite know why I suddenly had a desire to begin woodturning? Most 17 year olds ask for something related to driving lessons - not me. I went to see my great uncle who has turned for a fair few years and started to make a few bits and pieces out of softwood offcuts from Dad. In the May, I decided to go to weird and wonderful and found the club. I then had a bit of a break in my turning when I went to Coventry University to study civil and structural engineering for 4 years and achieved a Bachelors and Masters degree. Although I had some time over the long summers this invariably was taken up with other things. Having finished my degree in April 2020 there was little in the way of jobs available and what had been available had since been revoked due to COVID. I spent the lockdowns practising my turning and also starting to try cabinetmaking whilst on furlough from my job with the Uni and later on in the summer started to learn machining.

Only in late September did any jobs start to appear. I applied and was successful, not quite what I was looking for but a job. A few months later after realising the job was not for me, I moved on elsewhere. In my job now I am doing what I want to do so all worked out well. Most of my work is designing and drawing out residential properties extensions and alterations and commercial developments."

The talk

Stuart started his talk by stating that he would try and cover the basics of sharpening in his talk, and sharpen a few tools to show the method.

> *"...sharpening is something that every woodturner needs to do but doesn't necessarily like doing!*

He said and that sharpening is something that every woodturner needs to do but doesn't necessarily like doing. It is a very complex subject and there is a lot to learn, especially when looking at the range of materials, tool profiles and sharpening solutions.

Personal Protection Equipment (PPE) should be used when sharpening with any method, at the least googles and preferably a filter type mask or respirator !

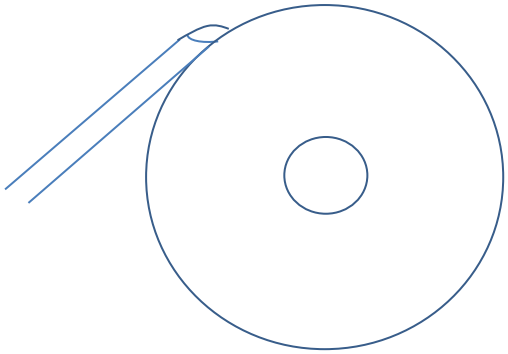
The first thing needed is a grinder or machine to allow us to sharpen and there are three basic solutions.

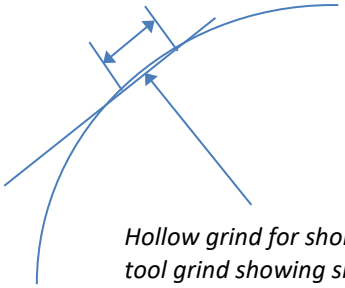
1. Bench grinders and dry grinding wheels

There are many bench grinders available, the most popular for woodturners is the 6", 8" and 10", the size determining the size of grinding wheel that can be fitted to the machine. Most run at high speed, typically 3000 rpm.

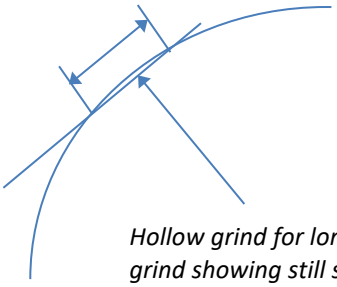
Stuart suggested that the diameter of the wheel is fairly inconsequential when sharpening tools with cutting edges of 20mm or less. The portion of the metal in contact with the relatively small distance at the circumference of the 6 inch wheel would still produce a minimum of what is called hollow grind.

Speeds of grinders is high and they can quickly remove a lot of steel, the peripheral speeds of 6" and 8" grinding wheels is 50mph and 70mph respectively. (Thanks, John Woods)





Hollow grind for shorter tool grind showing small hollow grind



Hollow grind for longer tool grind showing still small acceptable hollow grind

Stuart said that one thing common to most bench grinders is poorly designed or manufactured table rests in front of the wheels. Several after-market systems are available to upgrade bench grinders and many include options to add specific jigs as you require. One modular system is the One Way Wolverene system with sturdy platform tables and jigs for gouge fingernail profile grinds, skew chisels and V arms for standard grinds etc. Others include Woodcut's TruGrind and Veritas systems.

Below : One way Wolverine system
www.onewayeuropa.com www.hopewoodturning .co.uk

Most bench grinders have two wheels and very often fitted with a grey wheel made from unrefined hard silicon carbide grit that is far too coarse for sharpening delicate wood working tools and designed for coarse sharpening of carbon steel.

A number of suitable aftermarket wheels are available in different materials.

(if you purchase a wheel <u>ensure</u> the centre bore fits your grinders arbour diameter – ed.)

Wheels are made by using a hydraulic press and mould to compress grit into a binder, these are then fired at high temperature. They often require truing after fitting and on-going truing with a dressing tool. Wheels can become out of true and groves can wear as tools are repeatedly sharpened in the same portion of the wheel. Dressing the wheel also allows the wheels to continue cutting at a lower temperature.

Bench grinder fitted with white Aluminium Oxide wide wheels, the One Way jigs can be seen in the left and right on the base plate

At a minimum a basic aluminium oxide wheel is needed, but better wheels are available in finer grits and are friable. That is the surface or grit breaks down or splinters during use to expose a fresh cutting layer. These wheels are available in white, blue and pink as well as "ceramic", microcrystalline, rubies and sapphires.

Each wheel is produced for a specific purpose, the most common is their friability and grinding temperatures. Coloured wheels use higher grade binder or bonding agent and last longer, they operate with reduced heat due to this. Pink and red wheels have added chromium oxide, this makes the grit tougher and it helps to retains its shape with less dressing.

Dressing wheels are available in materials harder than the wheel; they can be simple like a devil stone or made of Diamond covered steel, the more expensive ones may use Diamond and Cubic Boron Nitride that is extremely hard wearing. To dress a wheel the tool is presented squarely with the wheel and moved from side to side whilst the wheel is rotating. As with any grinding operation it is advisable to wear eye protection and avoid breathing the dust, preferably using a respirator.

When looking at wheels, apart from CBN wheels, the standard measurement is grit size, for example 60 grit, 120 grit.

Stuart said that Microcrystalline wheels where first introduced to woodturners by Peter Childs of Little Yeldham, Suffolk. They grind twice as fast and much cooler than most of the other wheels, they are used in the same way but because they are self-sharpening in use they wear slowly and need less dressing.

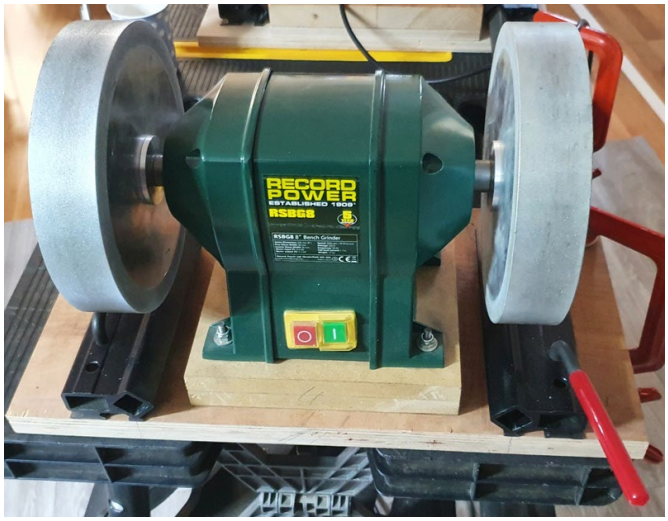
The wheels use hundreds of pyramid-shaped micro crystal grits which are bonded together to form clumps of grits in a process known as sintering. As the wheel is used the crystals fracture to release thousands of sharp microscopic cutting surfaces. Because the multiple edges are so tiny the resulting grinding finish is far superior to standard aluminium oxide grit and there is less chance of overheating and burning the steel.

Cubic Boron Nitride (CBN) plated wheels have been developed specifically for high-speed steel sharpening and consist of a steel or aluminium wheel electroplated to adhere a layer of diamond and Cubic Boron Nitride cutting grits. They are expensive but last a long time, require no dressing and produce a fine tool grind.

Soft materials should not be ground on a CBN wheel as it will clog the cutting surface, however using a hard steel or even using a rubber can remove it. Unlike Aluminium Oxide wheels these wheels are graded in mesh or micron measurements rather than grits. There is not a standard and many countries use different grit measurement systems.

As CBN wheels may use a steel wheel it is important to keep them rust free if a workshop is damp since problems may occur with delamination of the cutting surface.

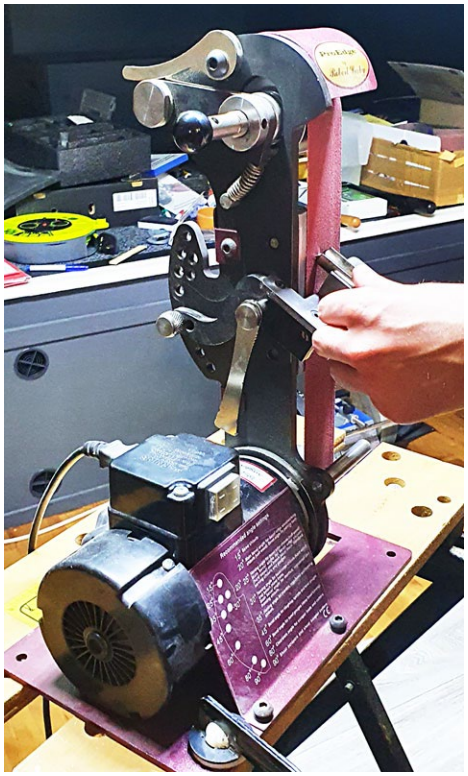
Above: Cubic Boron Nitride (CBN) wheel closeup



Above: Record power 6 inch bench grinder fitted with two grades of Cubic Boron Nitride (CBN) wheels

2. *Linisher belt type sharpening systems*

Although not a wheel full PPE should be used, preferably with breathing mask and certainly goggles at a minimum.



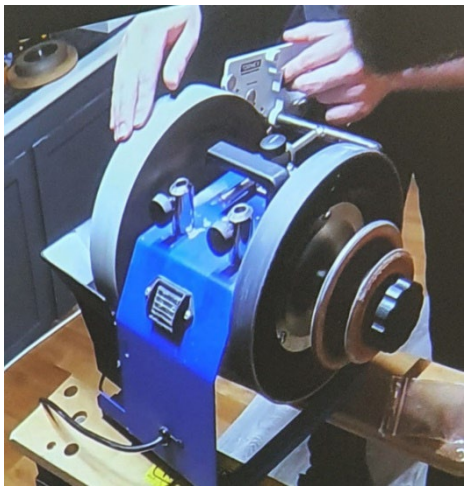
Several systems are on the market, most noticeably from Robert Sorby and Axminister Tools, but new models are starting to emerge from other companies. Typically, they use a motor driven 50mm wide belt with quality cutting platform and jig fixings. The current systems are modular.

The Axminster system is good as it has variable speed, allowing for potentially cooler cutting, the Robert Sorby is set to four hundred and forty metres per minute.

Different belts of various grits and materials are available, in Aluminium Oxide, Zirconium and Ceramics, costing typically four to twelve pounds per replacement. An advantage over aluminium oxide and other grinding wheels is they don't require dressing, however to their disadvantage the belts can soon wear to require frequent replacement.

Another option is to use friable 3M Cubitron Belts that use precision shaped ceramic grain that continually fractures into super-sharp points and edges that slice, rather than gouging or ploughing in to surfaces as traditional abrasives do. The advantage is the same as friable wheels as it lessens heat build-up helping to reduce heat-related stress cracks and discoloration. They also last longer but cost more to replace.

3. *Whetstone wheels*



These systems are water-cooled and use a granular stone wheel that runs at very slow speed, typically 120 rpm. The wheels are much softer than grinding wheels but produce a fabulous razor-sharp cutting edge. The most popular system is the T series from Tormek.

They are very long lasting and are ideal to sharpen and hone tools, however they cut little metal and are not so ideal for reprofiling of a tool or repairing after dropping etc. It can be done but the process will take a while.

Right: Tormek T7 whetstone water cooled system with honing wheels shown on the left of the photograph

Water cooled solutions excel in cool sharpening and don't generate heat in the tool. Sharpening is easy repeatable using the many optional precision jigs. The wheels are prone to damage from shock, for this reason they shouldn't be used on a bench where a hammer or other tools may be used. Very infrequent truing of the wheel is required with the use of a jig and dressing tip.

Different wheels are available including, Aluminium Oxide, Blackstone (silicon carbide), Japanese ultra-high grit for carving tools and diamond wheels. When using diamond wheels again precautions need to be taken as CBN wheels not to transfer atoms of material from softer materials such as carbon steel to the wheel.

Stages of sharpening

Generally, it is better to grind on different positions of the wheel or belt, to avoid spot wear and keep the tool moving to avoid flat spots.

1. ***Shaping***
2. ***Sharpening***
3. ***Honing***

Right : The three stages of sharpening

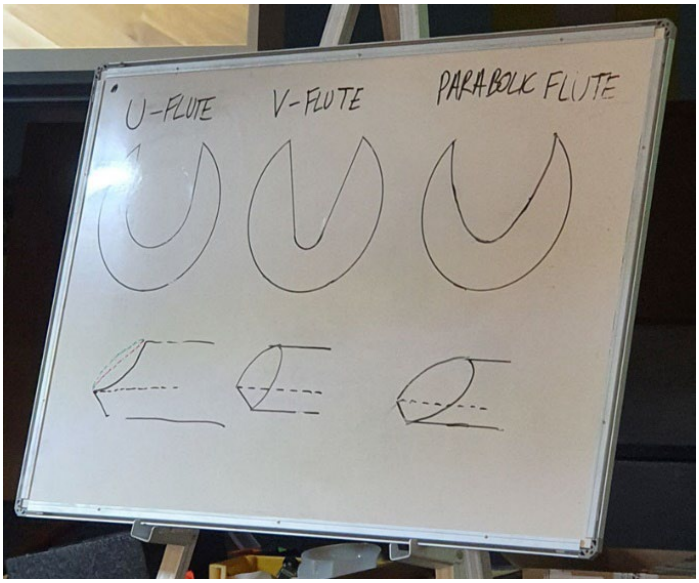
Keep the tool as cool as possible to avoid drawing the temper of the steel, often referred to as blueing. This weakens the edge making it brittle and jagged. Blueing of the steel occurs when the temperature rises to a point where it actually burns the steel, excessive temperature can also introduce heat related fracturing to the atomic structure of the tool steel resulting in further degradation of the tool overall. Bluing will require cutting back through to the fresh steel. It is not advisable to douse steel in water as it can cause micro fractures in the edge and change the steel structure.

- ***Shaping***

It is preferable to use a bench grinder to shape the tool profile and not whetstone due to their slow speed, for this reason it is advised that a bench grinder is kept in conjunction with a Whetstone system. Belt grinders and bench grinders can each do all three operations. Lower grits are required for reprofiling or shaping.

Shaping requires the tool profile to be cut to appropriate angles, such as forty-five degrees, typically used for standard grind, sweptback and fingernail grind for gouges and fifteen to twenty degrees per side for skew chisels, but many other angles are used. Therefore, the option is to use either free hand or jig guided cutting. The settings per tool need to be made for each jig, this may involve setting the protrusion of the tool from the jig and setting the angle of the jig or the angle of the platform.

Standard grinds for gouges can be as simple as using a support to rotate the tool through its cutting edge at a constant angle whereas sweptback and longer fingernail grinds require a more complex sweep through several angles. It is advisable to record the settings for each tool.



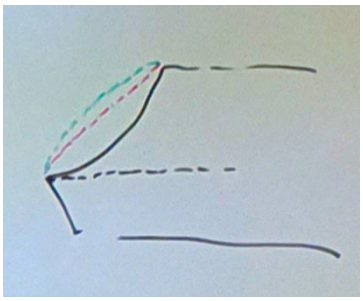
Above: Typical sweptback profiles shown for different gouge flute shapes. These work well for beginners.

- ***Sharpening***

Once the tool is re-shaped the shaping or profiling may not need to be repeated as long as the sharpening angles are accurately made for each tool, the idea is to remove the minimum amount of expensive tool steel. For this reason and to achieve a good edge sharpening uses higher grits.

A ‘sharpie’ marker pen can be used as a ‘teller’ to colour the area to be sharpened, as you sharpen the ink will wear off showing if you are sharpening is in the right area. Sharp edges do not reflect light, blunt edges do.
The old idea of testing the edge sharpness with your fingernail is not recommended, Stuart relayed the story of a time a fellow turner had done this, ended up with sepsis and had to later have his thumb surgically removed…

Ideally each side of top wing shape of a sweptback or fingernail grind should be flat but can be aggressive when cutting, the ideal is to be slightly convex for beginners but you need to avoid convex shaping.



Left: side view of typical sweptback gouge, the black convex line is to be avoided, the red indicates the ideal and the green shows the convex shape ideal for beginners

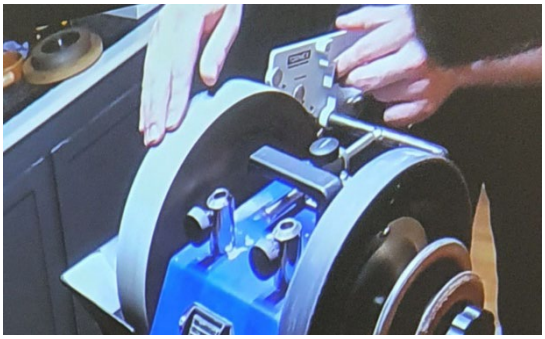
- ***Honing***

When a tool is sharpened it can raise a sharp wire edge or burr that can be taken to the wood and will naturally be removed, in fact a burr on a scraper is no bad thing. In the case of gouges, it may be preferable to remove. A diamond file can be used to remove this by gently wiping over the edge inside the gouge bar profile, keeping it flat against the sharpened edge. It is not advisable to use a slipstone for this purpose as they are soft. Tools can also be honed on leather, although this is not usually done with woodturning tools.

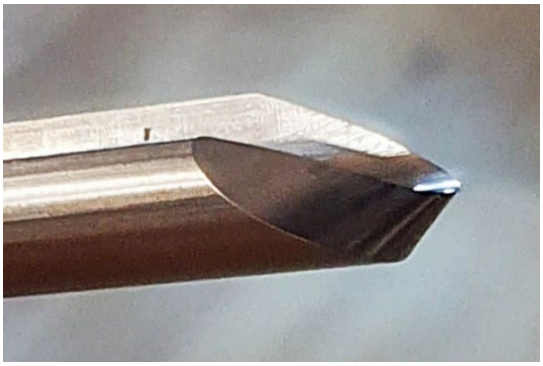
Tool sharpening on a Tormek

Stuart then proceeded to sharpen a tool on the Tormek T7 system using a jig. It was noticeable that the process was time consuming as the tool had an area that needed re shaping but the tool remained cool.

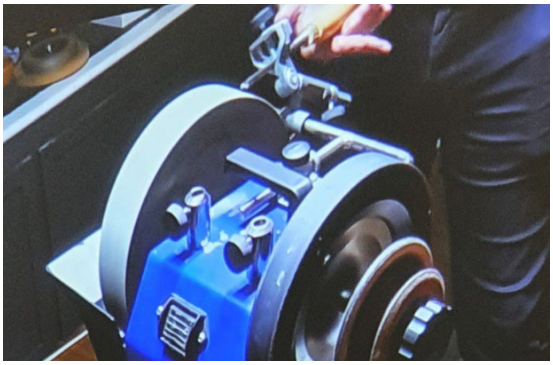
He then ground the fingernail profile, working each side wing first then the tip. Once re-shaped he changed the belt and sharpened through the grits with the final cut to blend it all together. He honed the inner edge using a diamond file. The resulting edge was perfect and probably the sharpest tool many people had seen, it was very impressive.



Right: setting the tool angle using a profile setting tool



Far right: sharpening a fingernail profile using a grinding jig.



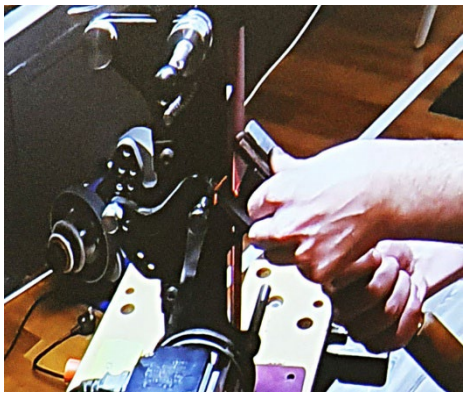
The result, a lovely honed and perfectly razor-sharp bowl gouge

Sharpening a gouge on the Belt sharpener

Stuart then set up the Robert Sorby pro edge. He was re-shaping and sharpening a roughing gouge. Firstly, he adjusted the platform to a sixty-degree angle and ground the tool upside down to produce a flat horseshoe effect right up to the edges of the tool, shown right.

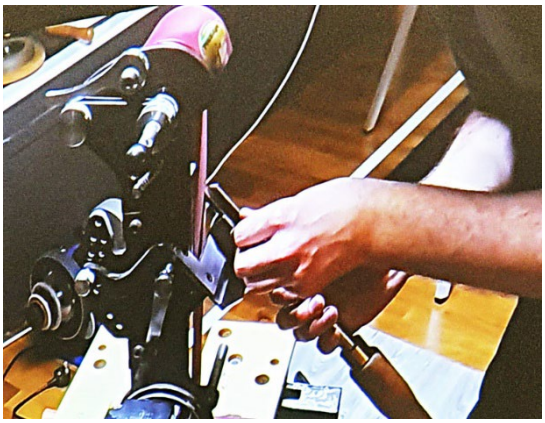
This would act as a material removal reference when shaping. He then set the tool the correct way up into a profiling jig, using a setting gauge to measure the tool protrusion.

Stuart used the vee block on the Sorby platform to rotate the tool for a standard grind. He worked on each side wing first then the tip. Stuart referenced back to the horseshoe shape to determine when he had removed enough material. Once re-shaped he changed the belt and sharpened through the grits with the final cut to blend it all together. Finally, he gently honed the inner edge using a diamond file.



Right: sharpening a standard grind roughing gouge using a vee block

Stuart then sharpened a sweptback grind bowl gouge using a long grind swing arm jig. This was inserted into a cylindrical bar with holes to suit various lengths of swept back grinds, which in turn was slipped over the machines bar rest. Again sharpening was in the order of wing - wing - tip



Above: creating a sweptback profile using a jig.

Dressing cutting tips

The small tips used for hollowing and scraping can be re-profiled using a tip holder, but it is easy to grind too much material away. They are best sharpened regularly on a diamond wheel or by rubbing the flat tops over a 300grit diamond file. Carbide tips can be sharpened but it depends on the flute shape.

Tool Steel variants

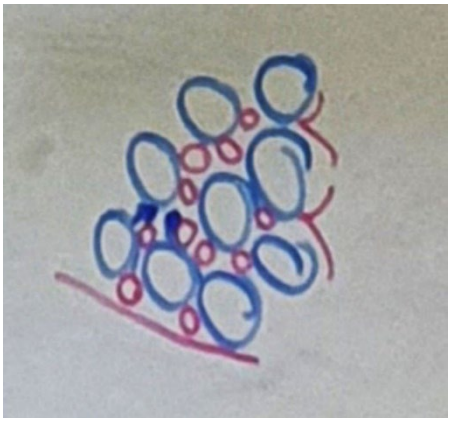
Stuart then discussed the various available tool steels. The older woodturning carbon steel mix tools had now largely been replaced by high-speed tool steel. Carbon steel was made by combining iron and carbon and although can be sharpened to a good edge they need frequent re-sharpening. They can also rust.

He said that tools marked as High-Speed Steel (HSS) are generally M2 tool steel containing additions of Chromium or Molybdenum. Other metals added to graded tool steel can include Tungsten (Wolfram) and Vanadium.

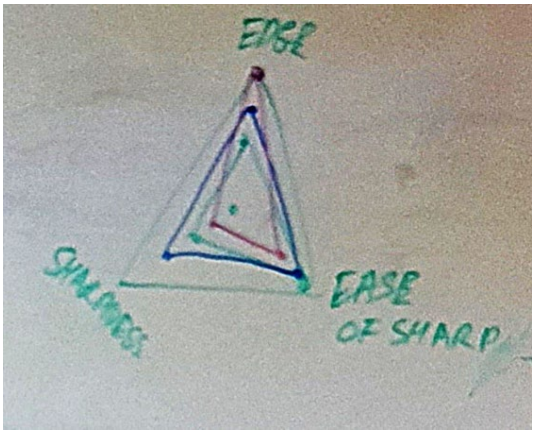
Higher grade steel may use Cobalt and will last longer, a typical top-end tool steel would be M42 which used Molybdenum and Cobalt, this steel may last five to ten times longer than M2.
As well as the chemical composition manufacturers have also introduced various additional steel tempering, for example using cryogenic freezing. These re-align the structure of the steel at atomic level and create smaller gaps between the atoms which are filled with crystals acting as a filler. Standard steel has larger empty gaps and the advantage is the strength and sharpness of the edge.
At one time sintered tools were introduced, these are formed using compressed powdered metal and heated to high temperature. The resulting small gaps and atomic structure allows them to approach the hardness of diamond cutters, be extremely long lasting and retain a particularly sharp edge.

Stuart's illustration of the atomic level of tool steel is shown left. The blue pen shows steel atoms and the red indicates the gaps between them. The red line shows the edge when sharpened.

Having the atoms closer together with minimum gaps, or filled with other additions results in less gaps along the sharpened edge. The principle of better-quality steel is clearly shown.



The simplified radar diagram (right) shows how manufacturers can balance tool steel against wanted properties, in this example; edge quality or retention, ease of sharpening and the maximum obtainable sharpness.



As a very basic illustration Stuart used the coloured pens to represent different grades of steel. Green is typical HSS, blue showing better quality hardened steel and M42 grade in red, demonstrating the issue sharpening such hardened material but with the highest edge retention. The nearer any point of the inner triangle is to the outer variables, the greater its property conforms to the desired ideal.

In his final words Stuart said that the technology of tool steel and sharpening is a vast and complex subject, his talk was only offered as a general insight that only scratched the surface.

Links and further reading

The link here is worth a read and gives a base set of bevel angles for people to start at and they can work from there.
http://www.goldturners.org/resources/Documents/Miscellaneous/woodturning_notes1.pdf

A good book that talks through sharpening in general, and one of the most well laid out and complete books on the subject is Taunton's Complete Illustrated Guide to Sharpening by Thomas Lie-Nielsen (ISBN 9781631860867). There is a chapter on turning as well as lots of other types of tools shown such as knives and scissors.

This was a very interesting talk, and not straight forward to write up...
It was very well received and I'm sure we all learnt something.

Thank you Stuart.