Jig design for routing

Carrying on from the last issue, router tutor Chris Yates continues the theme of router jig design by looking at the subject of jigs more closely

Carrying on from the last issue, in this article, I will examine why using router jigs may be the right way to go, as well as demystifying some of the whys and wherefores in designing jigs and also look at the construction of some practical jigs.

PHOTOGRAPHS BY LEWIS KWOK

Materials for jigs

Many jigs can be assembled from oddments of wood in the workshop. For jigs that will only be used a few times, then what is readily available will probably influence your choice as much as the task to be performed. For example, if you need simple end stops, then any material with a square edge that can be clamped to the bench or router table as appropriate will do. However, if you expect the jig to have relatively extensive use, or it is likely to take more than a few minutes to assemble, then it is worth choosing the materials more thoughtfully.

Many jigs will lend themselves to using sheet materials, the most common of which will be ply and MDF and each of these has its uses. MDF is generally easy to cut and form, even to more complex shapes. It can be finished to a smooth edge quite quickly and is cheap; however, it doesn't wear as well as plywood. Therefore, I tend to use MDF to make the master jig and only use it to cut the working jig from ply; this achieves the best of both worlds. Further, if you adopt this approach, the MDF master jig can probably be made from quite thin stock – say 6mm or 9mm thick – while the working jig can be made from more substantial ply, perhaps 12mm or 18mm. This will probably make setting router cutter depth simpler, as well as providing a larger wearing surface, helping to guard against inadvertent mistakes.

Jigs will often have a base on which the workpiece can be clamped, with the jig proper fixed above it. In such jigs, I like to use a relatively substantial MDF base – perhaps 18mm thick – and extend it beyond the edges of the jig itself. This facilitates clamping of the jig to a workbench without the clamps getting in the way of routing operations. It also offers a more secure fixing for any clamps that need to be screwed to the jig – more on this below.

Other sheet material that can be useful is clear acrylic or Perspex. I get mine from the waste skip outside my local plastics supplier – with their agreement. Such suppliers tend to generate waste in quite large pieces and most of my needs are smaller than A4-size and they are happy for me to have an occasional rummage. More specialist materials, such as Tufnol and other dense plastics, may be appropriate on occasion but they tend to be relatively costly and not available so conveniently. I don't think I have ever needed to use these for a shop-made routing jig, although I have used Tufnol for a variety of tasks in another hobby – railway modelling. As noted in an earlier article, many manufactured jigs are made from such materials because of their dimensional stability and hard wearing properties.

A mixture of threaded inserts with or without flanges and, on the left, rivet nuts; these are intended for insertion in sheet metal with a heavy-duty hand riveter, but which can also be used in wood. All the types shown have M6 threads

Another type of threaded fixing, this time for plastic and Tufnol

Jig hardware

At their simplest, jig fixings are those found in every woodworker's workshop, comprising a range of screws, pins and glue. To these I would add staples – I use a small electric stapler to fix thin components in place while the glue dries. This can be quite a time saver, as when I make a jig I usually want to use it straightaway. Not essential, but if you have one on hand, it can be useful as it is generally quicker than using screws.

I also use bolts – strictly machine screws, which are threaded for the full length of the shank – if I need to clamp either a workpiece or a jig very tightly or more than a few times and need to be able to pass the router over the fixing, precluding the use of any other form of clamping. You can either counterbore the top layer of the jig to get the hex or round-head bolt head below the top surface, or use countersunk bolts. In the latter case, if I expect to fix the bolt in place more than just a few times, I use a screw cup countersunk in the top surface, as otherwise the top layer of the jig will be worn away quite quickly. All bolts need to be screwed into some form of nut and the ones I use most often are pronged, or spigot, nuts. See the photo for examples of all this hardware. If you are fortunate to live near a fasteners and fixings supplier, they will probably stock most of these items, otherwise they are all available from web-shops or eBay.

Suitable bolts come in a variety of head patterns. I try to use hex or hex – Allen – socket as they are easier to tighten and loosen repeatedly, especially when using a cordless screwdriver or drill with appropriate bits. One last point: select high tensile bolts if you have an option, as they wear better and tend not to damage the nuts when they are tightened.

You will probably build up an assortment of miscellaneous hardware, such as T-slot bolts, handwheels and other fixings. Again, these are available in sets at a reasonable price from the major tool suppliers, but beware of the thread patterns enclosed. Many will use UNC threads, betraying their US origin, although some do have metric patterns. This may not matter for occasional use, but if you make jigs regularly, you will need to be aware of the thread patterns if you need to make or modify the fixings. For example, by substituting bolts of a different length. I'm afraid I gave up on the unequal struggle to standardise and have a supply of fittings in both UNC and metric!

Typical contents of jig kits available from the major tool retailers

These handwheels are all M6 and are widely available, as well as being included in some jig hardware kits

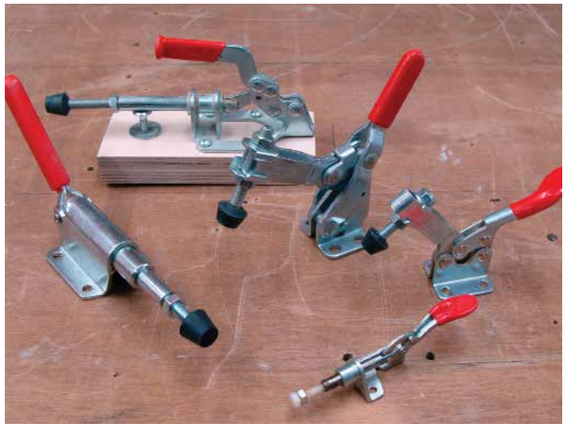
5/16in UNC versions of captive nuts for wood and plastic

Toggle clamps

If you make jigs, you will quickly come to appreciate the convenience of toggle clamps for holding the workpiece. They come in a variety of configurations, mainly 'pull-push' or hold-down, with a further option of the position of the handle in the clamped position. These days they are readily available from the usual major tool shops, as well as being available from web-shops. Two big name manufacturers are Good Hand and Bessey, the former often apparently rebadged by other suppliers. All appear to be fine for our purposes. See the photo for a selection of clamps I use regularly.

Some manufactured jigs come with toggle clamps fitted – for example, the sledge illustrated in the last issue. They are usually fixed with bolts so can be readily removed for use on other jigs and fixtures when not required on the original jig. If you have a jig where you need to use toggle clamps, they can be fixed with round head screws, provided the base is thick enough. Alternatively, you can fix them with bolts into spigot nuts fitted on the underside of the jig in suitable positions, although I usually manage with round head screws for most purposes.

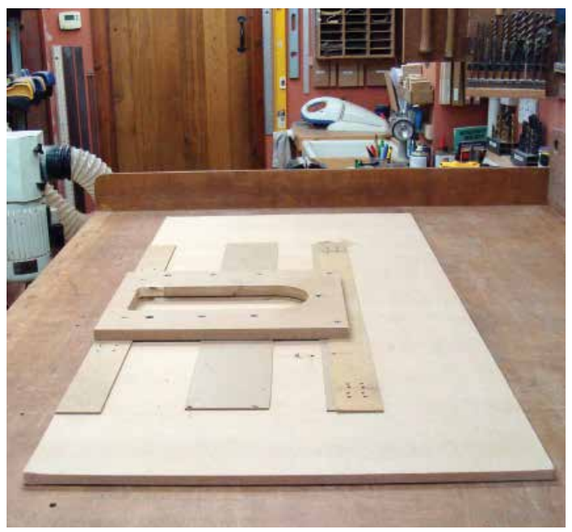
A quality ready-made sledge that came complete with three toggle clamps



A small selection of the clamps I use all the time. The larger push-pull clamp is mounted on a spacer block to ensure that it bears on the mid-point of the workpiece side

An assortment of M6 clamping fixtures and tightening tools referred to in the text. Using the bits with a torque controlled cordless screwdriver or drill can save a great deal of wear and tear on the arm muscles!

I made this jig when I offered to make a framework for a friend who was modelling Ledbury viaduct at 1:72 scale. The framework was in 2mm MDF and I found it was necessary to securely clamp the piers of the viaduct, as the material was not stiff enough to avoid being pulled into the router cutter. My friend is modelling 28 of the 31 prototype piers and I needed to cut, therefore, 56 arches in groups of four. Therefore the clamping bolts needed to be well seated in screw cups to avoid destroying the jig during use. It worked in the end!

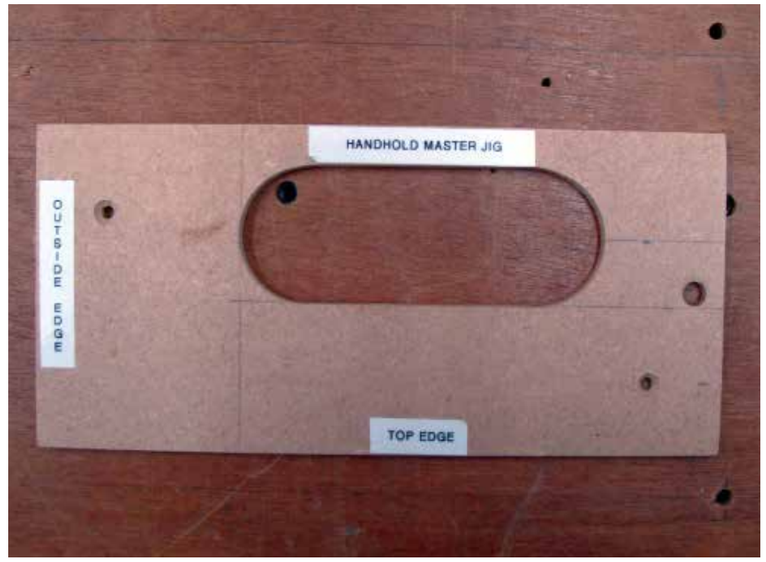


This is the same jig used for the model of Ledbury viaduct, but here shows the use of a sizeable baseboard on which to mount the jig. This was necessary in this case because the routed sections of the viaduct were quite delicate once machined and needed to be supported as they moved through the jig for each successive gap between adjacent piers to be routed out. If you look carefully, you can see a register pin to the right of the main jig, used to locate the MDF sheet for each successive routing operation

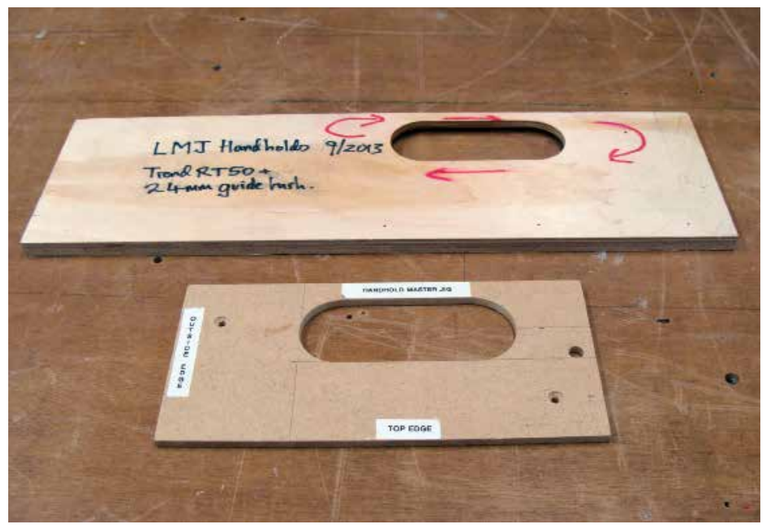
Master jigs

They won't necessarily help you to control the universe, but they might save you a good deal of time and frustration. Taking, for example, the handhold jig mentioned and illustrated below, it can take an appreciable amount of time to make the handhold opening to exactly the right size and to finish the inside edge smoothly. However, it will take only a microsecond to spoil it if you accidentally nick the edge with a router with the bit still in the plunge position – it happens! Therefore where the jig, or jig component if it is a part of a more complex jig, requires significant effort to make it in the first place, I tend to use the finished jig to make replicas of itself and then put the original – master – jig safely to one side just in case I need it in future. I then use the replica jigs without the same concern about accidental damage causing a lot of abortive work. Bear in mind that you can still damage the original, so take extra care when cutting the replicas, or the exercise will prove futile. Clearly this approach is much more relevant to shaped pieces, as a straight edge can usually be readily replaced if damaged.

The same approach can also be applied to bought-in jigs, where damage can prove very expensive and/or difficult to repair although any minor damage can usually be rectified by using a two-part filler.



A master jig will benefit from as much information as possible relating to its orientation as well as its intended use



My most used master jig, together with a copy jig used for a particular project. The size of handhold is easily adjusted by varying the sizes of guidebushes and router cutters. I only ever use the master jig to make daughter jigs, which I then use on projects. Note that the master jig is in thin MDF, while the daughter jig is made in more serviceable ply

Jig information

To finish this part, a few thoughts about shop-made jigs. When you have made your jig, and it is working successfully, make some notes about what it is used for and the sizes of cutters, guidebushes, etc. used with it, as well as the corresponding finished sizes of workpieces. I find that I accumulate jigs fully expecting to use them again in the near future, but find that by the time I actually go to use them again, I can't remember these details. I find the easiest way to record this information is to write on the jig itself in pencil, but any method will do.

The other thing I do when making jigs is mark on them the direction of movement of the router. It is surprisingly easy to move the router in the wrong direction and spoil the workpiece or the jig. I usually mark the jigs with coloured felt-tip pen showing the direction of movement. Similarly, if using the router base to position a router in a jig, mark the alignment of the router, e.g. 'trigger to RHS', as few router bases are actually symmetrical.

Record the orientation of the router as it is used in the jig if the machine base is used as a reference edge

Some bits of jiggery

When making an edge guide for a router to follow, remember that it will try to follow the edge very closely – imperfections included. Actually, if you are guiding the router using the edge of the router base, it will follow any high points on the guiding edge, so will tend to give a smoother cut line, by ironing-out any fractionally low spots. Similarly, if using a router cutter with a bearing, or a guidebush fitted to the router, against a guiding edge, it will tend to smooth out any dips with a nominal radius less than that of the bearing or guidebush, although if the opposite is true, they will follow the edge very closely and you will get an unintentionally slightly scalloped decorated finished edge on the workpiece!

Views will vary on whether or not to use the plunge lock on your router – it is really a matter of personal choice. However, bear in mind that if you are using a bearing-guided cutter, letting the plunge rise will probably bring the spinning cutter into contact with the jig edge and damage the jig as well as the workpiece; this can also arise if the plunge lock works loose or releases unexpectedly, so you need to keep an eye on this. Therefore, I tend to use the plunge lock if using top-mounted bearing-guided cutters, but may not always do so if using the router base or guidebush to guide the router. Similar considerations apply to a bottom-mounted bearing guided cutter, if there is a gap between the template and the workpiece.

The cutter shown on the left does not have a plunge capability, but the two to the right can both plunge and cut on their sides

Principle

Setting the depth of cut

Using the plunge depth stops on the router will give you accurate depth control. This is fine until you change the position of the cutter in the collet, perhaps after cleaning it midway through a long job. In this case, it is useful to be able to reset the depth of cut again. I do this by routing a plunge hole in a corner of the jig; however, this will not give precisely the same depth repeatedly, as the end of the router cutter is sharp and hard and the jig is relatively soft. Therefore, once the depth has been set and the depth gauge hole cut, rout it a tad deeper by using a washer that will just fit in the hole. Set the plunge depth to be deeper by the thickness of the washer, before placing the washer in the hole and resetting the depth gauge; this will ensure consistent plunge depth.

For routing through the thickness of the workpiece, the best approach is to use a spelch board under the workpiece – usually forming the base of the jig itself. Then, take light cuts to remove some of the surface where the cuts will be made using the jig as a guide and possibly a larger diameter end-cutting router cutter, then setting the depth of plunge becomes simple.

Stability

To ensure maximum stability, always check that the jig is firmly mounted on a bench or similar workplace and preferably firmly fixed in position.

Select the correct router cutter

If you are going to plunge the router cutter through the workpiece, make sure that it has a bottom-cutting edge. It is possible to ramp plunge with a cutter not designed for plunge cutting, but this is best avoided if possible, perhaps by drilling a clearance hole to the waste side of the cut line in the workpiece before placing the workpiece in the jig.

Manage the waste

Be prepared to have to clear waste from the jig, possibly partway through machining each workpiece if necessary. This is more likely to be needed if you have not already removed waste close to the desired cut line, resulting in heavy cuts. If you like the smell of smouldering wood in your workshop, then ignore this paragraph!

Also, if you will actually cut around an 'island' of waste, then you might want to consider how to avoid this. I never like leaving a loose piece of material near a spinning cutter, as it is too easy to make contact with it when removing the router, which often yields unpredictable results. At the very least, remove an area of waste wood away from the cut edge so that you can move the router a little way from the finished cut before releasing the plunge and removing the router, without the spinning cutter coming into contact with the freestanding waste.

Test the jig

As always, try some test cuts before starting on the workpiece. Use these test cuts to rehearse your movements, checking that router cable and dust extraction pipe don't snag or cause the router to tip and that you can see what you are doing and keep your balance and stay in control of the router at all times.

Other bits and bobs

There is a place for double-sided tape in holding workpieces in position, although I try to avoid its use because of the problems of removing the workpiece after machining – it can be too successful on occasions! One alternative is to use abrasive paper glued to the jig with the abrasive side in contact with the workpiece, although you will usually also need to provide clamping pressure to the workpiece to stop any movement. In such cases, simple shop-made cams or blocks screwed to the jig may prove adequate.

NEXT MONTH

In the next article in this series, we will finally get to make a couple of useful jigs F&C