

Most of us have mixed feelings about benchwork. Either the whole woodworking business scares us rigid, or we view the time taken to build benchwork as an unfortunate evil on the way to the fun stuff of running trains. In addition there seems to be a huge range of benchwork styles. So which one to build? I read somewhere that most people spend much longer agonising over their choice of a benchwork system than actually building it.

Well, here's a secret. All the common ways to build benchwork give good results. All you need to do is decide which best matches the layout you are planning. For example, will it be a flat industrial area or dramatic mountains? Will it have a permanent location or be portable? This short guide should help you choose what is best for you. You may find also that different construction methods work best for different parts of your layout. Don't skimp on materials though. Unreliable track work arising from poor benchwork will soon lead to disillusion with your layout.

If you are not sure that you have the woodworking skills to build a layout there are companies who will build your benchwork for you. Some people have also had good results by employing a local joiner.

This guide is in two sections. This first one will look at some ways to build fixed layouts; the later one will cover portable and modular layouts.

Tools

If you are going to build your own benchwork you will need some woodworking tools. Fortunately most of these are basic DIY tools, so there is a good chance you will have most of them already.

Drills and drill bits

An electric drill is almost a necessity and a cordless one will be much more convenient. A selection of drill bits will also be needed, depending on the size of screws you plan to use. Those in the left half of **1**



are twist drills. The inset shows how the large black twist drills have points to help centre them and "spurs" on their cutting edges to help them drill straight. To the right of these is a countersink bit. The two bits on the far right are combination bits used to drill holes for screws as explained later.

Saws.

It is possible to do the work with a hand saw and mitre block but a powered mitre saw (sometimes called a "chop saw" - see **2**) will be much easier and is almost essential for frame benchwork as explained later.

An electric jig saw will be needed if you are to cut curves.



Clamps.

Clamps are like staging tracks - you can never have enough of them! The pistol-grip style clamp at the top of the photo is very convenient as it can be operated with one hand.



Screws and screwdrivers.

It is much easier to use cross headed screws than slotted ones and you will need screwdrivers to match your screw sizes. If you have a multi-function electric drill, screwdriver bits for it will also be useful.

Besides these tools, you will also need a suitable wood glue. White PVA-based woodworking glue, like "Resin-W" and yellow aliphatic glue, such as "Titebond", are both good. For special situations, gap filling glues may prove useful. Water-based glues of the "no nails" type are one example. Polyurethane adhesives such as "Gorilla Glue" or "Evostik Polyurethane wood adhesive" are another. It is wise to see if you really need these special glues before spending money on them.

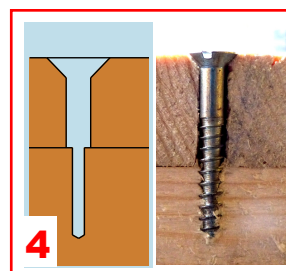
General tools such as a tape measure, spirit level, hammer etc will also be useful.

And don't forget.... work safely, including using eye protection.

Not strictly a tool but it is good to have some reference material. I can recommend the Jeff Wilson book listed in "resources" at the end of this part of the guide.

A note about screws

Traditionally, the proper way to fit wood screws is to drill two holes as shown in **4**. The smaller (pilot) hole accepts the threaded part of the screw. The larger (clearance) hole accommodates the screw's shaft and allows the two pieces of wood to be pulled tightly together. Besides these holes, you need to countersink the clearance hole to seat the head of the screw. This scheme works fine but is tedious. Unless you have three electric drills, you will be forever changing drill bits. The combination bits on the right of **1** avoid this by drilling the two holes and a countersink in one pass.



Some modern screws have features that also get around this problem. First, the point (**5**) is very sharp so that it bites into the wood without the need for a pilot hole. Secondly, the threaded part of the screw is designed to cut easily into the wood. Finally, the underside of the countersink head has ridges that enable the screw to cut its own countersink (**6**).

To use one of these screws all you have to is drill the clearance hole. The two pieces of wood are then clamped together and the screw driven home. The only proviso is that if the screw is near the end of the wood, a pilot hole will be needed to avoid any splitting. These screws are not expensive and are available from most outlets



Fixed layouts - “slab benchwork”

“Slab benchwork” is my term for benchwork that is built on a ready-made platform such as a flush door or a sheet of Styrofoam.

Flush doors are called “hollow core doors” in the American press. They are about 35 mm thick and come in various sizes. They are constructed from two sheets of very thin plywood, or sometimes hardboard. These are separated by a softwood frame that runs all the way round the edge. The softwood is typically 25 mm wide, or less, so anything screwed to the door needs to be really close to the edge as the thin plywood surface won’t hold screws. The interior of the door consists of a honeycomb of thin cardboard strips or a sheet of foam or fibreboard. The result is a strong, light and cheap unit. Best of all, from a model railroaders’ viewpoint, they are already built. In fact it is feasible to build a whole N-scale layout on a door.

A bit of work will still be needed though. First you must provide some sort of support. An easy way for a small layout might be to use cheap folding tables. Alternatively, for a shelf layout, the door could be mounted on shelf brackets. For a larger door-based layout, some sort of frame with appropriate-height legs would be needed. This will be addressed later.

As mentioned, the thin ply faces won’t hold screws. The surfaces are also so hard they don’t really take track pins. A way round this is to glue the track in place, which is a good approach anyway. An alternative is to bond some sort of sub-roadbed to the upper surface. A traditional material is Sundeala board but a popular recent approach is to use two-inch thick Styrofoam sheet glued to the door surface. This is the pink or blue variety used for insulation, not the white crumbly stuff used in packaging. An attraction of using the thick foam is that it can be cut away to model areas that are below track level. You will still need to glue the track as the foam won’t hold pins. You should use solvent-free glue so as not to attack the foam.

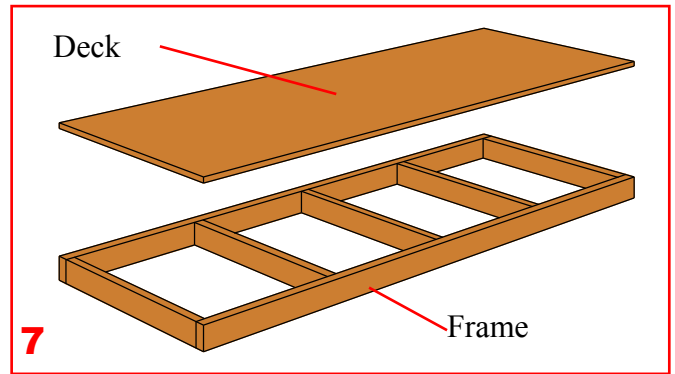
A final consideration is that the door construction and thickness make it difficult to mount switch machines to the underside. One option is to mount them on the upper surface and hide them in buildings etc. Another option would be to use manual turnout operation.

As an alternative to a door, some people have successfully used slabs of two-inch thick Styrofoam for shelf layouts, well-supported on wall brackets. Some have done away with wooden supports altogether but most have used some thin ply to protect the exposed edge of the foam and to carry electrical controls.

Although people have had success with this technique, some have reported their foam has become bowed after several years.

Fixed layouts - frame benchwork

Frame construction is the traditional way to make benchwork. **7** shows the basic idea. A rectangular framework carries a flat deck. The deck is referred to as “sub roadbed” in the USA and this term refers to any board carrying the track. The frame is traditionally made of 18 mm (3/4”) or thicker softwood. Its depth depends on the length of the board. For short units, say up to 4 ft long, a depth of 2” (50 mm) is strong enough. Deeper frames will be needed for longer ones. It may be better to use deeper frame members anyway, as they will provide protection for switch machines. For example Tortoise machines would need a depth of 4 inches. For building this type of benchwork, a “chop saw”, mentioned earlier is a really useful tool as it enables you to cut all the cross-members to exactly the same length and with square ends. If you don’t have one, somebody in your local NMRA group may be able to help, or perhaps you could get a local timber merchant to do this cutting for you. The cross members can be fixed using screws through the frame sides. These screws will go into the end-grain of the cross members. This will horrify woodworking purists but seems to work fine, particularly when a gap-filling adhesive of the “No Nails” variety is used for the joint.



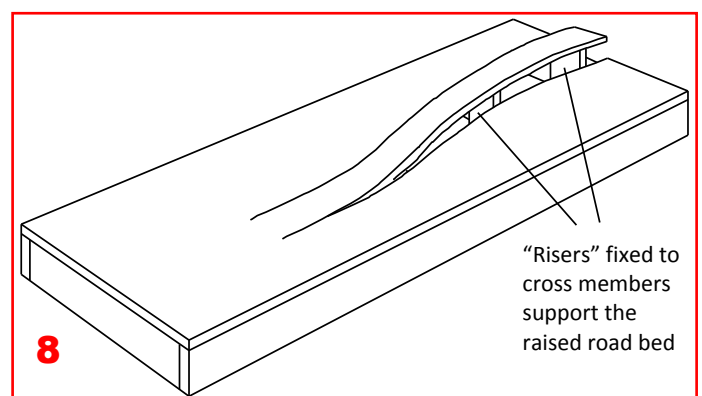
Softwood is the traditional frame material. Most people use it because it is easily obtainable and works, but plywood is more stable. You may be able to arrange for a timber merchant to cut the ply into suitable strips. For a home layout, 18mm (3/4”) thick plywood is suitable.

Plywood is a good material for the deck too, although some people use MDF. Chipboard has been found to be prone to sagging but people have discovered that sealing the surfaces with PVA glue is a long-term solution to this. Nine millimetre plywood has been found to work well in the UK if the frame members are about 12 inches apart. People in the USA use much thicker deck material. Author Tony Koester says that the reason he uses 3/4” (18mm) plywood is that it is hard to find one-inch ply locally!

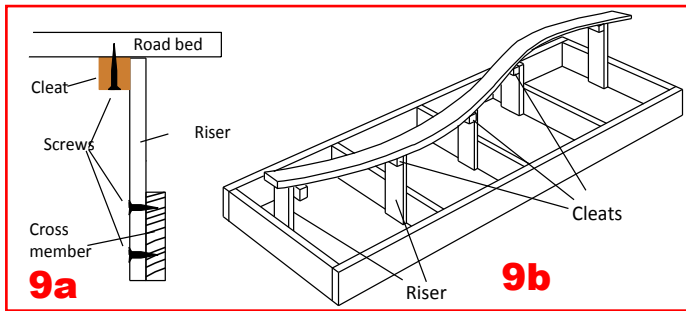
Although 9mm plywood takes screws well, it is hard to push fine pins or spikes into it. If you plan to use lots of pins, or to spike your own hand-laid track, you will need to add a layer of a softer material such as half-inch Sundeala board.

Gradients

One way to make gradients on a frame layout is to use the “cookie cutter” approach shown in **8**. You will need an electric jig saw for this. This approach is useful for the situation where a gradient starts from a flat area. The rising gradient is supported by gradually rising supports (called “risers”) fixed to the cross-members. This technique provides smooth transitions from the flat board to the gradient. Whatever type of gradient construction you use, it is critical to avoid sudden changes in gradient. Unwanted uncoupling will be the result if you don’t. If required, areas of the deck can be lowered or removed for lakes, rivers etc..



Frame baseboards are ideal for flat areas such as yards but can also be used for more scenic areas. An example is where a track is carried on an embankment (called “a fill” in the USA). The plywood sub roadbed is cut to shape using a jig saw and supported on “risers” as shown in **9b**. Raising the track like this allows for scenery to be below the track level, so it is good for embankments, bridges etc. In this case it is important that the plywood track base is well supported to avoid sagging. Every 12 inches is ideal. Because of its narrow width, the plywood sub roadbed should be at least 12 mm thick. This is one area where Tony Koester’s eighteen-millimetre plywood would pay off.



9a shows how one inch square softwood “cleats” can be used to enable all the screws fixing the sub road bed to be fitted from below. This allows the complete riser and cleat assembly to be moved if necessary without needing access to the top of the layout.

When fitting a length of track base like this, the whole length can be clamped to the cross members and adjusted for level (or gradient). Only when this is correct are the risers screwed to the cross members.

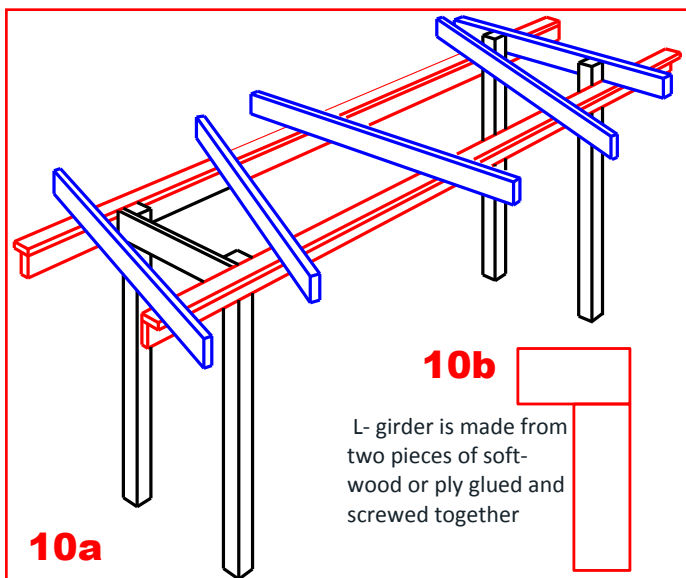
Fixed layouts, “L-Girder” benchwork

Although the frame layout design works well, it does have one or two drawbacks. As mentioned earlier, the cross members have to be cut very precisely. Also, they are always at right-angle to the side members. This can be a bit awkward when arranging the risers for an embankment that curves around a corner for example. In addition, any fascia will also be straight unless you make special provisions.

L-girder benchwork overcomes these limitations. The key elements are two longitudinal “L-girders”. Their construction is shown in **10b**. Two pieces of softwood (or plywood) have glue applied and are clamped together to form an “L” shape. This is one of those situations when you can’t have too many clamps. The girders are then nailed or screwed together. Most people use screws but Model Railroader project layouts have used nails from a nail gun. This ensures that the heads are below the top surface of the L and won’t interfere with any joists (see below). With screws you need to ensure they are properly countersunk. Whatever method is used the real strength comes from the glue and the resulting girder is very strong and non-springy.

The material used to make the girders is typically 18mm or 25mm thick. The top of the L is 44mm to 70mm wide. The size of the vertical piece depends on the gap to be spanned. Using 50mm deep material for the vertical member, the girder can span around 8ft; with 100mm it is claimed that a 20 ft span is possible.

For long spans it is probably better to use softwood rather than a similar thickness of ply. This is because you want the best resistance to bending. Softwood should be better for this as all its grain runs longitudinally.



Choose your wood carefully; good timber merchants won’t mind you looking through all their stock and only choosing the best. It should be straight and as free from knots as possible. If there are knots, avoid having any on the vertical member’s lower edge.

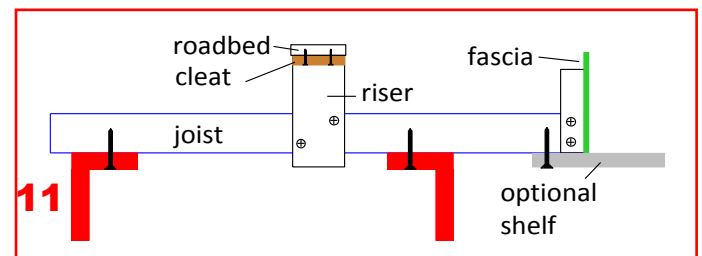
The overall arrangement is shown in **10a**. The L-girders are shown in red. They are fixed a suitable distance apart depending on the final width of the layout. Transverse elements, called joists, are mounted on top of these and are fixed by screws that pass through the horizontal part of the L-girder from below. The joists are shown in blue. In the USA, the joists are typically 4” x 1” but 2” x 1” works fine for 2ft wide layouts.

Although not shown in the diagram, the sub roadbed would be supported on risers in a similar way to diagram **9b**.

This arrangement is much more flexible than the traditional frame approach. First, the joists can be arranged at any angle and at any spacing. This makes supporting a curving road bed much more convenient. Also, the L-girders do not have to be parallel, so it is easy to make tapered baseboards.

Secondly the joists can be of any length, so they can overhang the outer edges of the joists (or not) as you require. By having overhanging joists of various lengths you can arrange a curved fascia along the front of the layout if this is appropriate. Finally, the joists don’t have to be cut so precisely as the cross members on a frame layout.

10a also shows two possible ways of arranging the spacing of the girders and fixing the legs. The nearer legs are fixed to a cross member that is like those on frame boards described earlier. The pair at the far end use one of the joists to space the girders and fix the legs. The legs would need some sort of diagonal bracing as explained later. This has been omitted from **10a** for clarity.



11 shows how the L girders, joist and risers are fixed. Note that all the screws are accessible from underneath. This means that the joists, cleats and risers can all be moved if plans change. For example, if a riser prevents the installation of a switch machine, the appropriate screws can be removed from under the layout and the complete joist/riser/cleat assembly moved aside and re-fixed.

It is possible to use an L-girder arrangement like this for flat layouts too. Just fix a sheet of plywood to the tops of the joists.

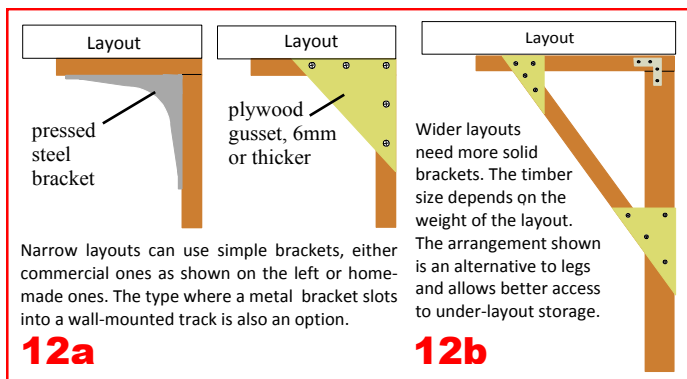
Finally, as shown in **11**, you can easily fit fascias and shelves.

Fixed layouts - supports

Narrow layouts, up to about 18” wide, can be mounted on commercial wall brackets as shown on the left of **12a**. Home-made brackets can also be constructed as shown in **12a** and larger ones can be made for wide baseboards as shown in **12b**.

The plywood gussets make it unnecessary to cut the softwood parts super-accurately or to make joints.

Something to be aware of is the weight of the layout. What seems light can become pretty heavy once the track, wiring, scenery etc has been added. The increase can be surprising if a lot of plaster rock castings and

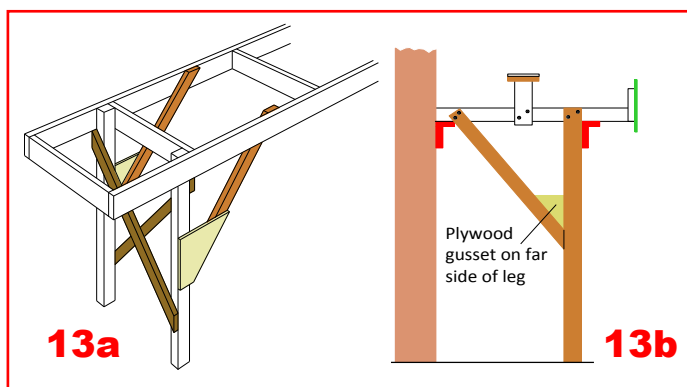


scenery has been added gradually. Heavy or very wide layouts will need some sort of leg arrangement.

For legs, the timbers don't have to be massive because wood is very strong in compression. It is possible to build very strong legs using vertical L-girders made from two pieces of 2" x 1" softwood. You pay for wood (roughly) by its volume so this arrangement will save around 1/3 of the cost of a 3" x 2".

The legs can be screwed or bolted to the longitudinal members of the benchwork. It is a good idea to adjust the legs until the layout is horizontal, then clamp them and screw or bolt them in place. You may also think it worthwhile to fit height-adjusters to the bottoms of the legs. These will be covered part 2 of this guide.

You will also need some sort of diagonal bracing to stiffen the legs. A suitable arrangement is shown in **13a**. Not all legs on a permanent layout require this much bracing.



You can save the cost and work of half the legs by fixing one side of the layout to a wall as in **13b**, which shows a possible arrangement using L-girders. Arrangements similar to 13a and 13b can be used for frame layouts or slab layouts. However, building something like **13a** to support a door-based layout does beg the question of why not add sheet of plywood and forget the door?

Something we haven't addressed is layout height. General opinion is that the optimum is around chest height. However, you may have special considerations, such as the layout being operated by children. If this or other circumstance force you to have a lower layout, remember you can always operate it from a seated position.

Although more strictly part of planning, access to the layout is a consideration. Duck-unders should be avoided if possible. You can construct opening gate or lifting sections. These are beyond this "basics" guide but they have been covered regularly in the model press.

Fascias

Some sort of fascia along the front of the layout is a good idea, either for cosmetic reasons or to carry throttle panels, turnout controls and the like. It can be made from thin plywood, hardboard or MDF.

11 showed how fascias can be added to L-girder layouts. For door-based layouts, a fascia can be screwed to the front edge. If it is made to protrude below the door, the overhang can be used to carry switches and other controls.

A similar arrangement can be used for frame layouts but the overhang might make the sides very deep. An alternative is to stand the fascia off from the side of the frame using small softwood blocks. The space created behind the fascia can provide clearance for the electrical components and wiring. If the fascia is screwed (not glued) into place it can be removed for maintenance. An alternative is to have it hinged along its lower edge. The top can then be held in place by magnetic door catches so you can simply flip it open for maintenance or to make changes. Another way is a fixed fascia and a small hinged control panel.

Wiring

Although wiring will be covered in a later article, some consideration should be given to it when designing the benchwork. For example, it is good idea to provide holes in any cross members so that bus wires and the like can be threaded through them.

"Optional extras"

A really useful addition to a fixed layout is to have a shelf along the lower edge if aisle space permits. It can be fixed to the joists or cross-members and cantilevered out as shown in **11**. Shelves are useful for holding car cards, switch lists, pens and the like. They will also become a parking place for coffee cups. It is a law of the universe that these will be knocked over unless you provide some sort of cup holder. (And even this is no guarantee!) A place to park throttles will also be useful and both "throttle holsters" and cup holders are available commercially.

It is worth varnishing or painting the finished woodwork. This will help prevent humidity changes affecting the wood. Some water-based paints are porous so, to be on the safe side, an oil based type should be used.

Resources

There are many books and videos that cover benchwork. One book that is very thorough is **"Basic Model Railroad Benchwork"** by Jeff Wilson. (ISBN:978-0-89024-836-2). It is published by Model Railroader and available in the UK. It has over 100 pages and covers tools and woodworking in addition to the technicalities of benchwork.

Model Railroader Video Plus on-line video magazine has many videos of MR's project railroads. These usually have step-by-step video of the benchwork part of the project. It is usually also covered in Model Railroader and other magazines.

There is also a lot of free benchwork information on the web. Try searching on *"model railroad benchwork"* for articles and (you guessed it!) *"model railroad benchwork videos"* for "how to" videos.

The companies below manufacture baseboards. They are listed (alphabetically) for your information but without any specific recommendation.

Elite Baseboards <http://www.elitebaseboards.net/>

Laser-cut baseboard kits <http://www.timhorn.co.uk/>

Model Railway Solutions

<https://modelrailwaysolutions.co.uk/shop/modular-baseboard-systems>

White Rose Baseboards <http://www.whiterosemodelworks.co.uk/>

... and don't forget, NMRA British Region's greatest asset is its members - ask around for help and guidance.

Next time

This section of the guide has covered fixed layouts. In the next part we will look at portable and modular ones.