various trams to be stored and a whole series of different trams can be sent out for the entertainment of the public. The track layout uses just three points, all hidden, and a combination of reserved and street track. This shows that it is practical to build an entertaining and realistic scene without the need for over-complicating the trackwork or operation.

IN CONCLUSION

Building a layout is a most personal project. Inevitably there will have to be compromises, usually because of the restricted space. For example the current Manx Electric system has an end-to-end track layout like many of the layouts described above. However, on the Manx Electric the two termini are around eighteen miles apart. If this was reproduced in 'OO' gauge the total length of the model would be 417 yards long. Since most 'OO' gauge tramway layouts are less than ten feet long the need to make major changes clearly is apparent. So modellers reproduce a tiny part of a system. This may be a copy of a real tramway or be based on an entirely fictitious line. It all depends on what the modeller wants to get from the project.

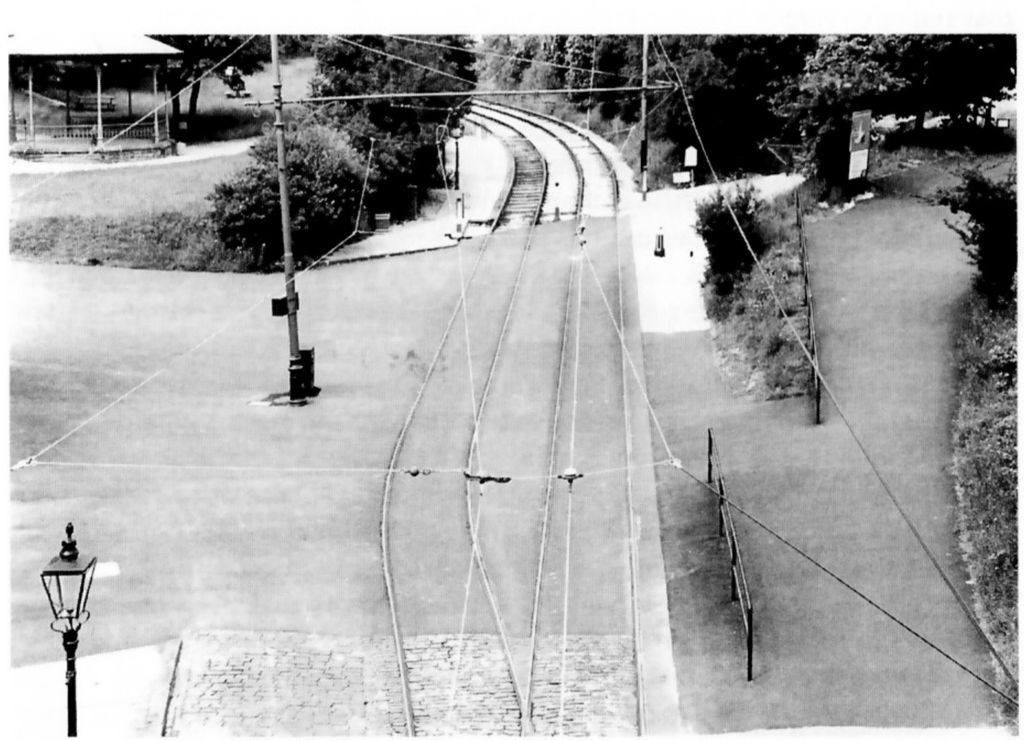
There is a tendency to think that trams can go round corners rather than curves. Compared with railways this is probably true, but even trams need space and 40 feet was considered the minimum radius, with strict speed restrictions. In 'OO' gauge this scales to about 6 inches. I have never had any problem with British traditional tramcars on this radius. However, the modern continental and British articulated tramcars need more space and the minimum model radius is around 8 inches. If you are using just small wheelbase four-wheel tramcars it is possible to have even tighter curves, possibly down to 3 inches. However, this does put stress on the tram motors and they do need well-laid track for trouble-free operation. I always suggest that you use as large a radius curve as possible in the space available.

Another aspect that should be considered when thinking about the design of a layout is making provision for an extension. Many modellers have found that once the layout is complete and all the operational possibilities explored they want further opportunities. By allowing for this at the design stage then extension boards can be added. If this is not done then there is usually no alternative but to start another layout. Where a layout is built on two or more boards which split for transport, the extension is simple as the new board can fit between existing units. On a single board there is more of a problem unless provision is planned from the start by adding a point or two and link lines built.

Finally a word to all railway modellers. The addition of a tramway to the scenic side of a model railway layout provides extra interest and movement that cannot be achieved in any other way. A tramway can be fitted into a very small space or very awkward shapes and will create an immense amount of added interest.

TRACK

The major difference between the tram and any other road vehicle is the fact that the tram runs on rails. When the only alternative to human power for hauling wheeled vehicles was the horse, only light loads could be moved and hence the size of the vehicle was small. Roads were far from the smooth clean tarmac we have today. Mud, stones and ruts were the order of the day. It was in the mining industry way back in the middle ages that people realised that a man could move more rock if it was placed in a container and slid along flat baulks of timber. Eventually this led to metal wheels with flanges running on metal rails. In America in the first half of the 1800s rails were laid in the streets and horse trams carried people for the first time. Not only could more people be carried in each vehicle, but more quickly and at no extra cost to the operator. Obviously just putting railway-type rail in the street was not practical. The rail had to be laid into the road surface so that it did not interfere with other road traffic. In the early days a number of different ideas were tried, with greater and lesser success. Indeed in Britain the first street trams, constructed in Birkenhead and London by an American called George Train,



There is nothing better than looking at real tramway track and the way in which it is laid. Here at the National Tramway Museum the main types of track are shown in a small space. Starting with the road laid out with setts, the surface moves to tarmac, then onto off-road reserved track.

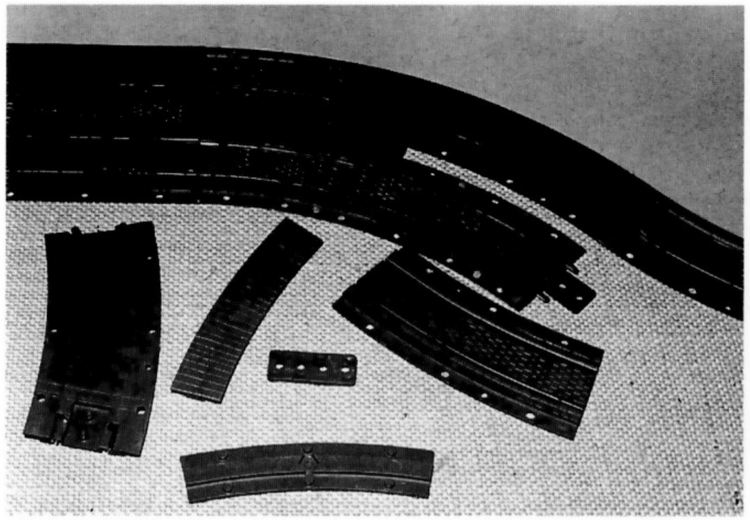
used a step rail. This caused problems for other vehicles and in London the routes were removed after less than a year. In Birkenhead things were a little better as the step rail was removed and replaced by the far better grooved rail. The small groove means that trams have wheels with a much smaller tread and flange profile than railway wheels, hence the need for a change in gauge on those systems where railway stock ran over the tramway track. An example is Glasgow, where the gauge was 4 feet 7¾ inches in order to allow the 4 feet 8½ inches gauge railway system to share tracks. It is this grooved rail that is universally used for all street tramways and is the type we normally model.

Unlike railways, the use of a non-standard gauge was quite common. The two most popular gauges were the standard 4 feet 8½ inches and the narrow 3 feet 6 inches gauge. However, it is worth checking on the gauge of the trams you are interested in. For example there were four different gauges used in one of the Yorkshire areas. Leeds had a gauge of 4 feet 8½ inches, Bradford had 4 feet, Halifax 4 feet 7¾ inches and Halifax 3 feet 6 inches. While there were logical reasons for each choice it did mean that where the tramways met each other passengers had to change tramcars. For a while, however, there was a special system of through running between Bradford and Leeds, using trams with wheels that slid on the axles in order to change gauge.

When modelling in OO, HO or N gauges it is usual for modellers to use the conventional standard for each gauge, that is a track gauge of 16.5mm for OO and HO and 9mm for N. Because of a quirk in the development of OO gauge back in the pre-war days, the track gauge is not in keeping with the scale. It actually represents a real gauge of 4 feet 1½ inches. So it is accepted that any gauge from 4 feet 8½ inches to 3 feet 6 inches can be used on the standard OO gauge. However, if desired, track can be made easily in any gauge using commercial rail and copper-clad sleepers.

When building a layout it is possible to make the whole thing on a reserved track basis, using standard 'OO' gauge model railway track and I have seen some layouts using just this principle. However, it does seem to me to miss out on one of the outstanding features of a tramway – the ability to run railed vehicles through a town street. So for me no layout is complete without at least some section of street running, if not the whole layout.

Now this brings its own challenges. Unlike model railways, there is no easily obtainable ready-made street tramway track. There are some that can be purchased and I will start by looking at the three commercially made ready to run tramway tracks. First to be produced was Hamo track, built for the Hamo tramway system. Hamo was a German manufacturer making solid German trams with diecast bodies and sturdy mechanisms in what was advertised as HO gauge. The track gauge was indeed 16.5mm but the tramcars always seemed a bit on the large side. Manufacture of the tramway system stopped about 30 years ago, but occasionally

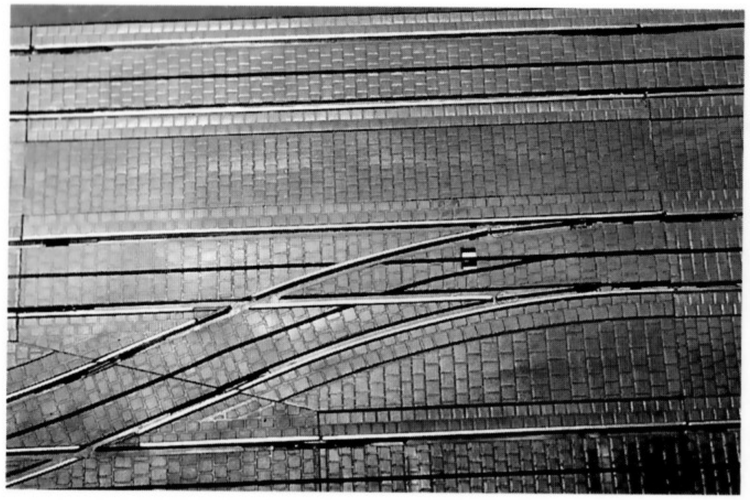


Parts of the Hartel track. The concept is imaginative but the pieces of track are a little small and putting it together is like assembling a jigsaw puzzle.

some of the track comes up second hand. The track was made with coated steel rails pressed from thin sheet. The street surface was only made between the rails and for a few millimetres either side. So to make a layout the street had to be built up anyway. In the range of trackwork were some nice points and crossovers. In my view the system was more for children playing table-top tramways and not for a real layout.

The next system was manufactured by the Italian firm Riverossi. They produced HO gauge tram sets with small four-wheel tramcars based on Milan, sometimes with trailers. Production ceased about 10 years ago. The track consisted of large (approximately eight inches square) moulded plastic squares. There was a single track plus all the road and a pavement either side. The squares came as either straight, curved (a quarter circle on the square giving a radius of four inches), a left-hand point, a right-hand point and a right-angle crossover. So quite complex layouts could be built. The main problem was that each square only had single track, so it was not possible to have the normal double-track layout. Another problem was that the curves were four-inch radius, far too sharp for all but small four-wheel cars.

Finally the German firm of Conrad produced tramway track in HO gauge under the Hartel label. This is still in production and consists of short lengths of straight and curved track that clip together with plastic mouldings to form the road surface. Left and right hand points are available, though they are somewhat expensive, particularly when compared to model railway track. Whilst the first sight of the track gives a favourable impression, there is a problem over the small size of the parts. I built an 8ft by 1ft layout using the Hartel track. It has seen many years service at exhibitions, but to my mind the track looks much too much like a jigsaw puzzle for my liking. In addition the street surface is not wide enough for the



Hartel points and track on my "London's Tramways" layout, showing the use of thin tape to represent the conduit.

normal street and so it is still necessary to build up a surface for the rest of the street.

In America Richard Orr sold grooved rail for 'OO' gauge tramways (Diagram 22). The rail was the right size for the usual wheel profile used by 'OO' gauge tramway modellers. Obviously the modeller had to make up the track, by soldering the rail to copper-clad sleepers. Point parts were available (bonded track for live overhead only) and any design of layout was possible. Curving the rail was a bit of a problem; a special curving tool was needed and of course the road surface still had to be built up. The final appearance of the rail was rather nice. It appears that Richard Orr has now sold the rail to Swedtram, where it is still available, as is the special curving

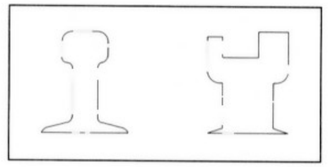
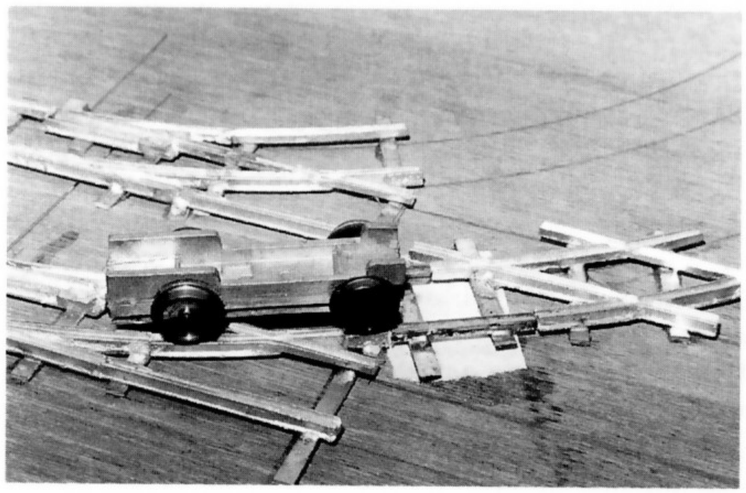
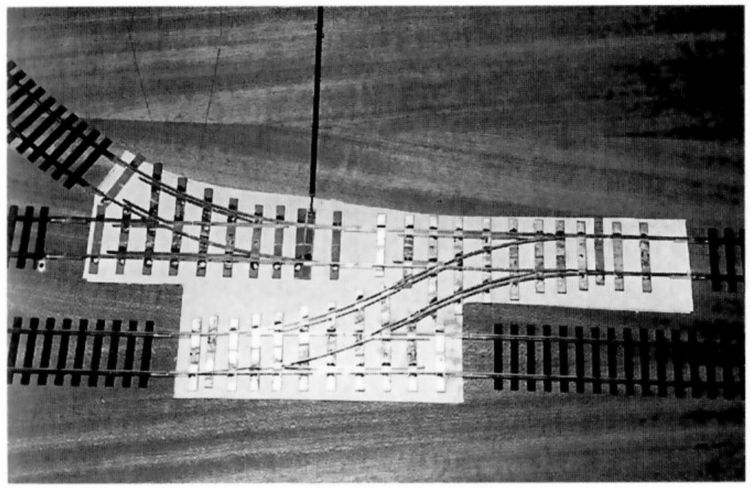


Diagram 22. Code 100 model railway rail and Richard Orr tramway rail.



The Tramalan grooved track point and crossover kits. Note also the use of an unpowered chassis to check that the rails are laid in the correct position.



Tramway points made by SMP. They are very similar to model railway points, however they are made to a far sharper radius. The crossover points are biased with sprung blades (replacing the rail blade with a strip of phosphor bronze pick-up strip). The third point is connected to a point lever by the rod and tube method.

tool. Point kits are available from Swedtram, but are very expensive. An alternative is to use the cast pewter tram point kits made by Tramalan, which are designed to match with the grooved rail. In true tramway practice the point blades are inside the groove and so it makes laying the road surface very much easier. The Tramalan points can also be assembled for two-rail operation.

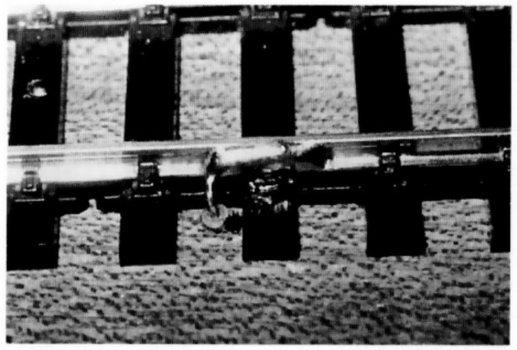
Ordinary model railway track can be used. Special tramway type points are made by SMP (available from the shops lists in the Appendix). They are similar to model railway points, but are much sharper in radius. Made from code 75 rail mounted on copper-clad sleepers they are compatible with code 75, Fine Scale 'OO' Peco track (though the points may need slight packing up as the copper clad sleepers are not as thick as the Peco plastic ones). Finally ordinary Peco Fine Scale 'OO' gauge model railway trackwork can be used throughout, including the points.

A word at this stage about the size of model railway rail may help. The code number of the rail is the height of the rail section in thousanths of an inch. So Code 100 is one-tenth-of-an-inch high. Using metric measurements I have compared the sizes of Code 100 and Code 75 rail. Code 100 is 2.5mm high and has a top rail width of 1.04mm. Code 75 is 1.90mm high and the top surface is 0.78mm wide. So the code 75 is roughly three-quarters the linear size of the Code 100. This means that when laid in the street the Code 75 looks much more realistic and it is far more flexible for the tight tramway curves.

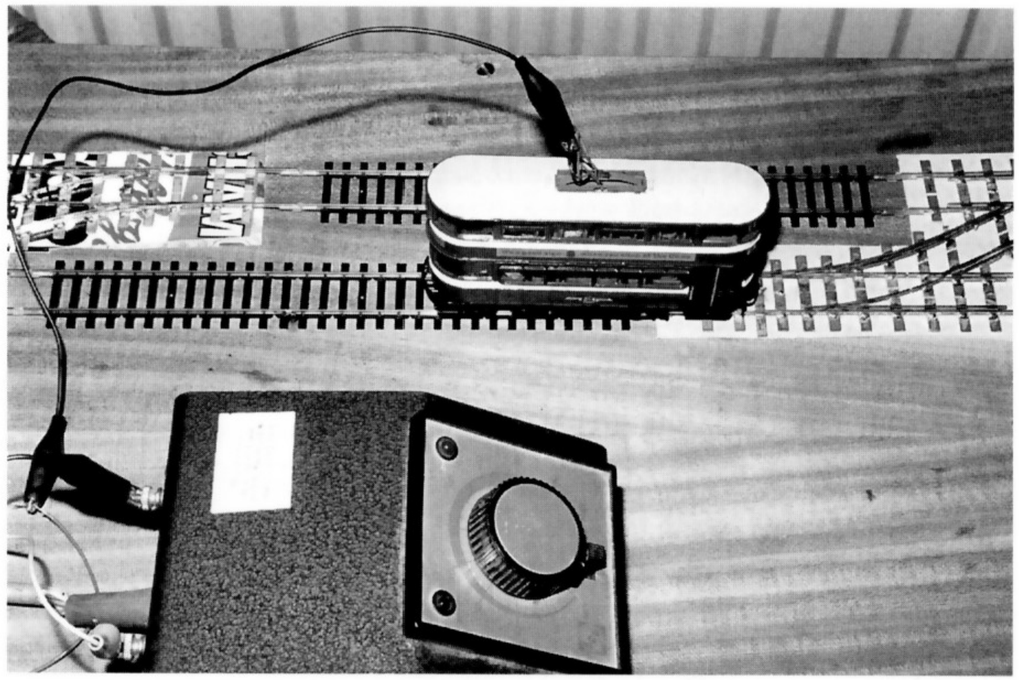
Whatever rail system you decide to use I do strongly recommend that you choose rail that is solid nickel silver. Do not use the plated variety. Some flexible track and some railway set track is made of plated steel. The problem with plated steel is that it only needs a slight amount of damp and it starts to rust. Having set the track into a street surface the last thing you want to do is to have to rip it all up because the rails get rusty. Solid nickel silver rail is only a few pence more expensive and this more than pays you back over the years. Similarly, for fixing the track

down never use steel nails or pins as they are very likely to rust. I always use solid brass pins.

Lay the track to the design you have chosen onto a firm and level baseboard. By now you should have decided whether to build your layout live overhead or two-rail or a combination of the two. So lay the track appropriately. Once it is down do plenty of test running. Check every one of your models on the track more than once. This may seem impractical if you are building live overhead, so what you do is to get a long lead of thin and flexible wire. Put a crocodile clip on the end, attach the crocodile clip to the trolley pole, pantograph or bow of the tram and the other end to the controller. By attaching the other terminal of the controller to the track you can run the tramcar. You just have to take care not to catch the wander lead on anything, or the tram will be pulled off the track. Test thoroughly



Connecting the rail to the power supply. Drill a hole in the baseboard at the appropriate place, thread the electrical wire through and solder the end to the rail.



Testing track laid for live overhead operation by clipping a 'flying lead' from the controller to the test tramcar. Care is needed as if the wire gets snagged the tram will be pulled off the track and may be damaged.

and where there are any problems sort out what is not right and re check and check again. This may seem a bit tedious, but it is so much easier to put things right now than later when the road surface is in place.

Once all is well with the track, cut the number of sections you have decided on. Again, always cut twice as many as you first thought of. It is easy to wire across a section and not use it; it is very hard to put in an extra section. To give you an idea, my first layout "British United Tramways", which was two plain ovals (no points) on a board three feet by 20 inches, had 12 sections and needed an extra two. My "London's Tramways", a terminus 8 feet by 1 foot has 24 sections. It all gets very crowded, but then that is what town street tramways are all about. To ensure that the cut rail does not drift out of place I use a technique of hammering in two brass nails outside the rail and either side of where the cut will be. I solder the nails to the rail and cut through the rail with a slitting disc in a modeller's electric drill.

Wire up all the track, using section switches. Construct the point operation. Most tramway layouts can be designed with many of the points being sprung biased. Chapter 8 shows this on the layouts described. This is very useful as it minimises the amount of point operation required. If you are using the SMP points you may like to modify the point slightly for sprung operation. Taking the point, solder the point blade to the sleepers, leaving the last 20mm. Cut the point blade with a razor saw and solder a strip of Slaters phosphor-bronze pick-up strip to the point blade so that it replaces the part cut off. Bend the strip to the bias required and it will act as a self-sprung blade. The spring is positive but not heavy, so it will not derail the models running through it, but it will always operate nicely.

Where it is necessary to have changing points I always recommend hand operation. Most tramway layouts are small and the edge of the board is never far from the point. I use the tube and wire method. Thread a steel wire through fine-bore brass tubing with a drop of oil. Solder the end of the wire to the point blade sleeper (in railway terms the tie bar, but as there is only one blade on the tram point this is not the correct term). Fix the tubing to the board with brass nails, putting a blob of solder on a couple if necessary. At the edge of the board use a point lever or even just bend the wire at 90° as a handle. The blade should normally be kept closed, to keep the strain off the point and operating system. Then pulled over when required.

After you are happy that all is well with the track you can start on the road surface. There are three main options. Using Das modelling clay, Polyfilla or similar plaster, or card, build up with a suitable surface. My

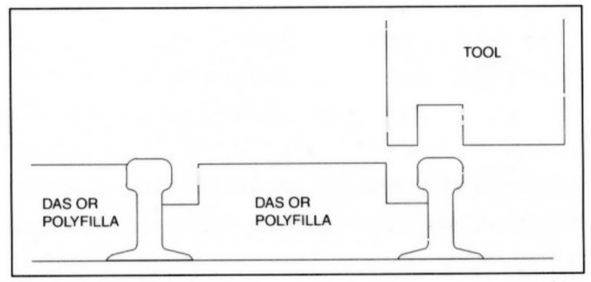


Diagram 23. Road formed from modelling clay or Polyfilla.

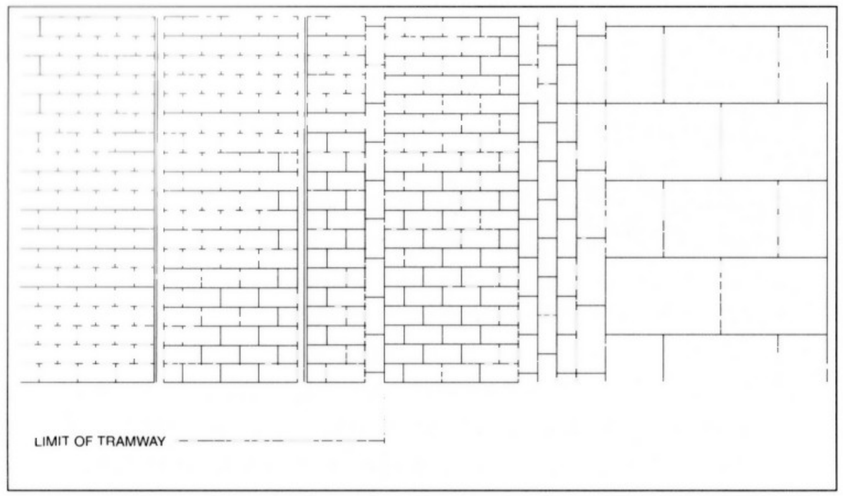
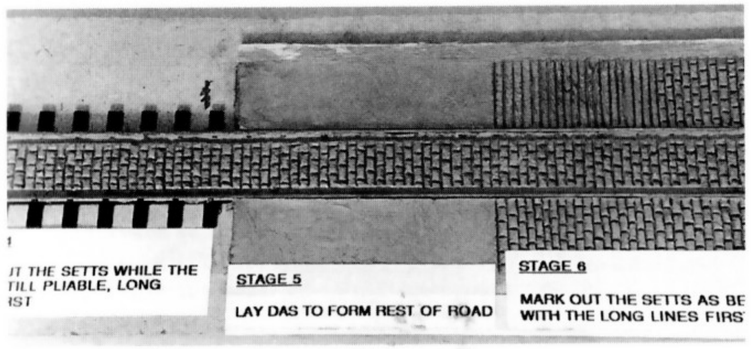


Diagram 24. Pattern of setts on street track showing the limit of the tramway's responsibility for road maintenance.

personal preference for small layouts is to use the Das. It is possible to get this in a terracotta colour which is better than the white. Lay some balsa strips along the edge of the road, where the pavement will be, as thick as the road surface. The technique is to fill between the rails first, and while the Das is still workable, level the surface (it should be just below the level of the rails) and cut out the grooves, using a tool shown in the Diagram 23. With a craft knife emboss a line between the rails and at right angles to them about 2mm apart. Using the point of the knife mark out individual setts about 4mm long. This is very time consuming (hence the reference to small layouts). The Das can be kept workable overnight by laying a damp cloth over it. It is practical, with a small layout, to do the marking while watching television! I have done it. The remainder of the road surface is treated the same way. The very good feature of this method is that all kinds of patterns can be incorporated in the setts. So the extent of the tramway's responsibility can be represented with a line of setts the other way, 6mm from the edge of the rail (Diagram 24). Curved track is represented properly and where one road joins another with curved track some really attractive patterns can be laid. The Das can be painted the chosen final colour. Here there are all kinds of choices. With Terracotta Das I use a slightly darker brown and wash the colour over, well thinned as it is like painting blotting paper. Then I polish the surface with old-fashioned shoe polish to give the sheen that I always associate with setts.

I have heard of a less time consuming ways of marking out setts. Both use the rollers for paper-hanging found in do-it-yourself stores. The first is to cut from Linka (a defunct system of building houses for model railways) brick moulds, strips to cover the surface of the roller. The moulds are rubber so easily cut and glued to the surface. This then forms a rotating mould. It is run over the still workable Das to make the setts. I have had good reports of this method, although I have not tried it myself. The other method is very similar. Here a sample section of road



Stages in the process of filling in the road surface using Das modelling clay. The groove for the wheel flanges is formed using the tool described in the text.

surface is made as described above and allowed to set thoroughly. Then some Das is rolled out flat and glued around the roller. Then, while it is still workable, it is rolled across the sample to pick up the pattern, and allowed to harden completely. Finally it is painted with varnish and when dry used as the rotating mould.

Using Polyfilla, or a similar plaster, is rather dusty. First mix the Polyfilla with black or dark grey poster paint colours so that the mix is the colour of the setts. Pour out the mixture over the track, smoothing it level for the road surface and let it set. The groove for the flanges must be cut when set, using a specially-made scraper. Then if required the setts themselves can be marked by scratching with a scriber. I have come across modellers who wait for the Polyfilla to almost set and then press a wide weave bandage over the top, which gives the surface a look that resembles setts. Now great care has to be taken around points with this technique. The Polyfilla has a habit of getting into the moving parts and jamming them up. So leave the points as a separate filling exercise and use card or plastic card to keep the moving parts free from plaster.

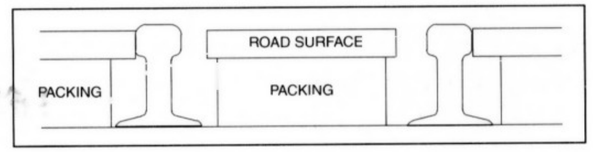
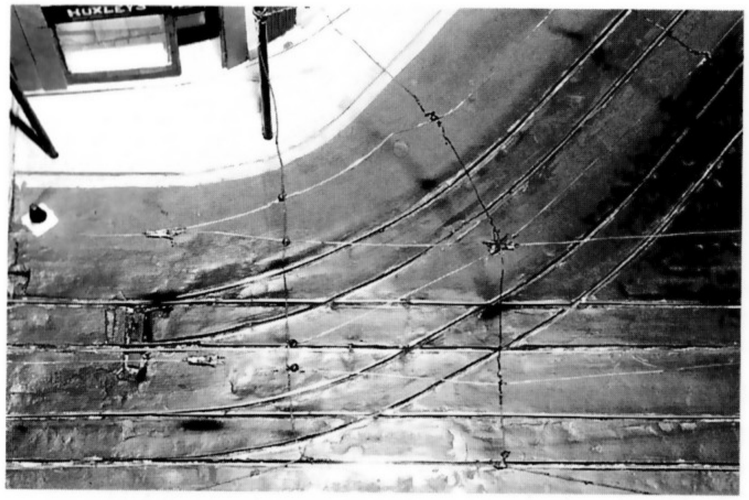


Diagram 25. Street track construction using the 'built up card' method.

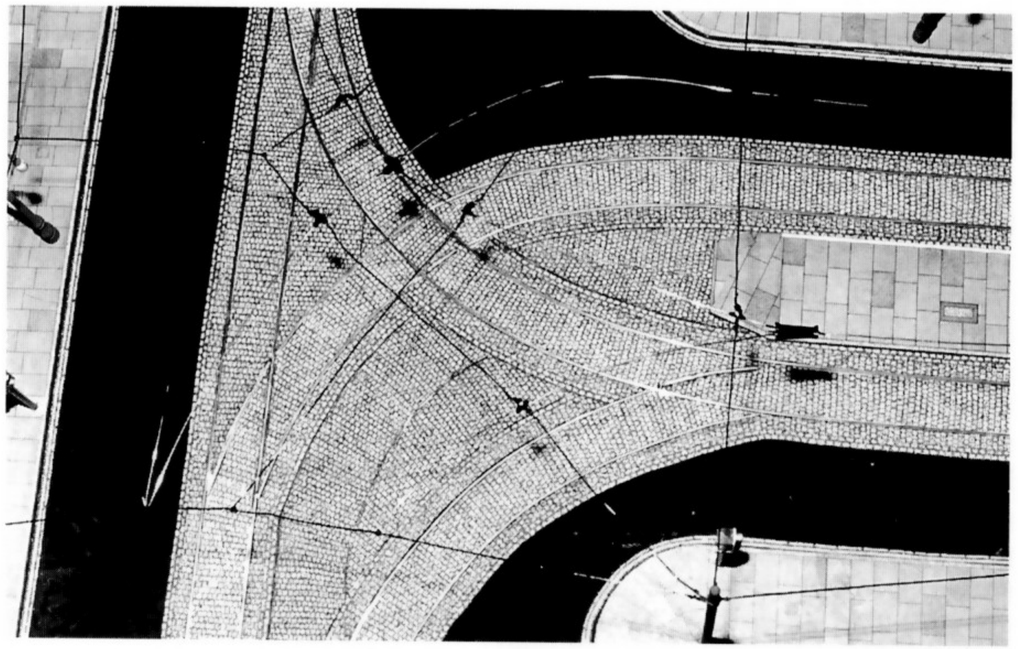
Many modellers prefer to use the 'build up with card' technique, Diagram 25. Here scrap card is glued to the baseboard to build up the road surface, and some form of decorative top layer is used. Building up the road surface is fairly straightforward and depends on what card you can lay your hands on. I would avoid corrugated card, which shows the corrugations and it has a habit of squashing flat, just after you thought you had it the correct thickness. So plain card, breakfast cereal packets and so on are all good sources. Build up the surface so that when the final decorative surface is laid the road is just below the rail surface. Do not forget to leave space for the groove when filling in between the rails.

Now comes the decorative surface. Here there is a wide choice and far more than I describe. The most recent material is an embossed card from Howard Scenics

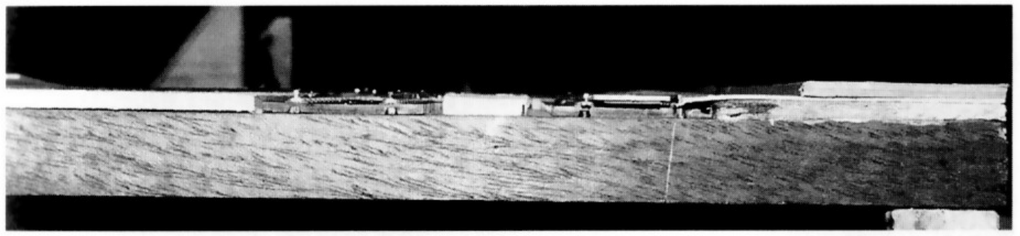


Here, on the "Liverpool Penny Lane" layout the road surface has been made from Polyfilla and left smooth to represent tarmac. The groove is made by soldering a nickel silver strip inside the rails and using it as a edge for the Polyfilla.

(available from the Tramway Shop or Alphagraphix see Appendix). Various patterns are available in 'OO' gauge; the one used for roads is granite setts. The card is easily cut and marking it out is also very simple. The card is laid over the rails and pressed down hard, particularly over the top of the rails. When turned over, the imprint of the rails gives the cutting line. In the case of the section between the rails the cut should allow for the grooves. The card is then glued to the



Here some of the continental self-adhesive 'cobbled' road surface is used on top of a card base to build up the road surface. The road surface is made from thin rubberised material that can be curved. However, it does shrink over time and seems to get grubby rather quickly.



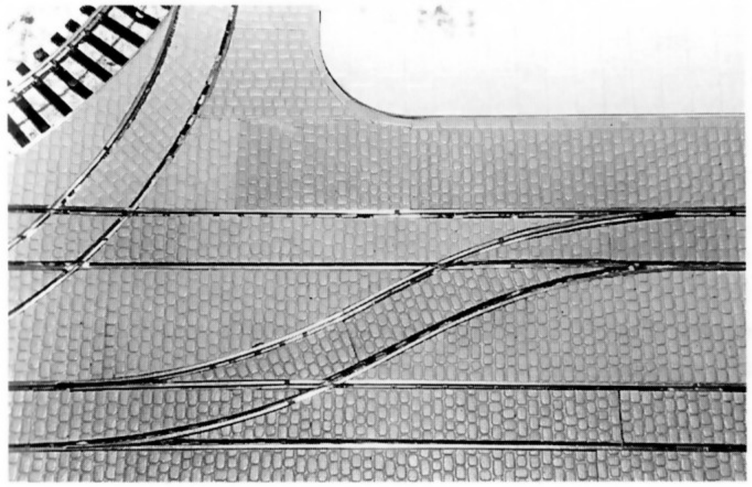
An end view of a built-up road surface using card of various thicknesses. This is "Meeting Street" and the final surface is the embossed 'setts' card from Howard Scenics.

packing card. It is then painted to the colour of your choice. The technique is great for straight track; it may be a little more problematic for curved track, where the pattern of the setts will not follow the rails.

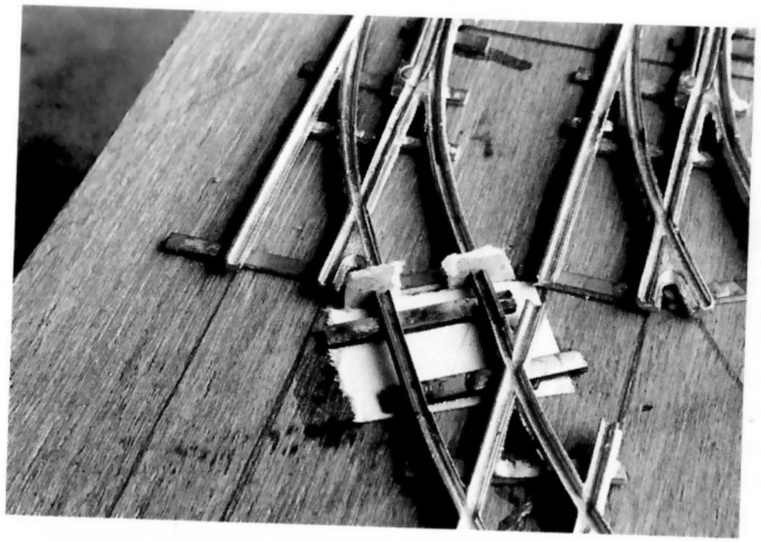
Wills make a tramways setts version of their moulded plastic modelling sheets. This could be used as the final surface in much the same way as the embossed card, except that the cutting out might be a little more awkward, given the material. It may be necessary to rub a pencil over the top of the rails first in order to get a line under the plastic when marking it out.

From the continental manufacturers come a variety of self-adhesive rubberised street surface sheets. These are printed with setts or cobble stones and can be cut to size. One of the advantages is that the material can be curved, so the pattern of the setts can follow the track. The major disadvantages appear to be that the material shrinks with age and gaps appear; it also seems to get very grubby fairly quickly.

For more modern layouts a tarmac finish can be used. Plain card can be laid and painted tarmac colour. I have come across road surfaces made from 'wet and dry' abrasive paper, laid black side up. These would of course not give any problems with matching the patterns of setts to the track.



Wills plastic 'OO' gauge 'setts' sheet has been used on this section of track. The sheet is fairly thick and rigid and is not the easiest to cut. However, the final result is attractive and it does show that patterns can still be formed from 'straight' pattern setts.



To isolate sections of track a gap must be left or cut in the rail. To ensure that the rail ends do not accidentally touch I slip a piece of thin card and glue it in place. When the glue is set I cut the card to the rail section.

If Das or Polyfilla are used a tarmac finish can be obtained by smoothing off the surface and painting an appropriate tarmac colour.

The final part only applies if you have decided not to put up overhead and want to represent stud contact or conduit. In stud contact the electricity was collected by a large skate fitted under the tramcar touching metal studs set in the roadway between the rails of the track. These were switched on by a magnet under the tram and, in theory, switched off when the tram went passed. In the model they will of course be dummies. The control of the trams would be through the two-rail system. So small rectangles of plastic card can be cut, painted a dirty grey and glued to the road surface. For complete accuracy visit the National Tramway Museum at Crich. The siding alongside the workshop is fitted with actual studs from Wolverhampton. The representation of the conduit system is much the same. In reality the model will use two-rail operation and the conduit is represented by either drawing a black line in the centre of the track or by sticking down some black tape 1/16" wide. From normal viewing distance this gives a very good impression of the conduit system.

Finally the key to trouble-free running is to keep the track surface and the wheels of the trams very clean. At exhibitions I have found that it is necessary to clean the track and all the wheels of the trams in service before each day's running. In some very dusty halls it is also necessary to repeat this half-way through the day. The rail surface should be cleaned either with a rag soaked in cleaning fluid, which has a danger of soaking into road surface and discolouring either side of the rails, or using the Peco rail cleaner, which is an abrasive rubber. The disadvantage of this is that it might remove any painted road surface, so regular maintenance is required to repaint the surface. To get to awkward parts of the track and not knock down the overhead, fix a track cleaner to the end of a stiff stick. This can be used to reach the rail surface.

There are also a few general considerations that should be kept in mind when planning and laying track. I have found that for double-track the best space (centre-to-centre) between the tracks is 1½ inches or, if a central traction pole is used, 2 inches. Do not forget that trams have a considerable overhang at the ends and these measurements may have to be increased on curves. Indeed on many actual tramways there were some curves where tramcars were prohibited from passing each other because they would be in collision. One way that the tramways used to avoid collisions on curves is shown in Diagram 26. It is crucial that you check the running characteristics of your track at every stage. Any problems should be corrected well before laying the road surface.

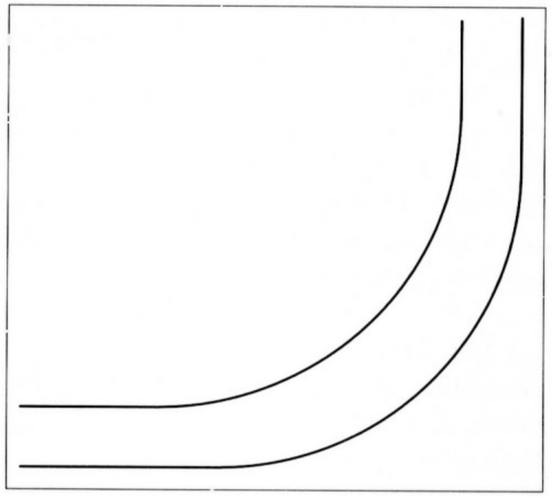
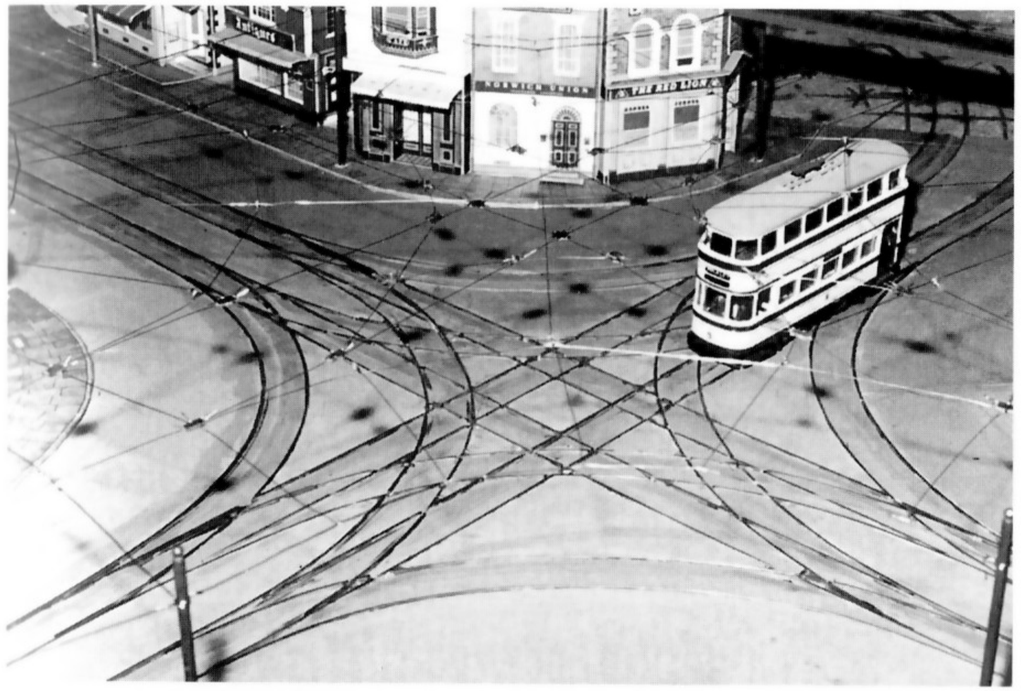


Diagram 26. How to increase the diatance between tracks on curves to prevent collisions.



The ultimate in track modelling is to make a 'Grand Union' junction. For obvious reasons this is seldom modelled. This one was on a layout built by Alan Williams when he had his shop in Birmingham.

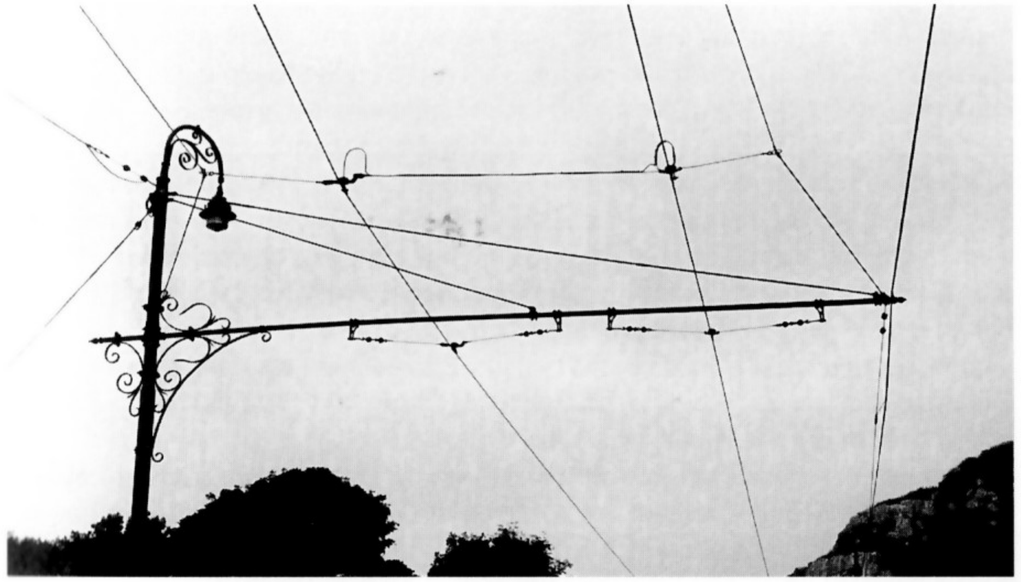
As part of the operation you will want to have electrical sections on the layout. These are always put on the track. So after laying the track the sections can be cut. The easiest way to cut the rail is by using a slitting disc in a modeller's drill. The rail is cut right through. I have found that in exhibitions when the temperature rises the rail expands and these gaps can close. As this is difficult to see the cause of problems can be rather difficult to find. So I slip a small piece of card into the gap and glue it in place. As far as sections are concerned the rule is always put far more sections in than you ever think you will need. It is very simple to link sections together; it is very difficult to cut a new section in a finished layout.

Throughout the construction of the track and road, always bear in mind track cleanliness. All road surfaces should be kept slightly lower than the top of the rail, so that the surface can be cleaned easily. Bear this in mind when planning the position traction poles too. Access to the track can be made much more straightforward by careful thought at the planning stage.

OVERHEAD

One of the features that really fascinates me about making model tramways is the overhead. There is nothing to compare with watching a model tramcar with a trolley pole running around a layout. The trolley pole seems to have a life of its own as it moves around keeping contact between the tramcar and the overhead wire. I get a slightly lesser feeling about pantographs and bows, which after all only move up and down. No it is the trolley pole that is fascinating. Not only to me either. At exhibitions the public certainly share my views and some stand and watch for ages. Indeed the most asked question (about 75% of the questions asked by the public is this one) is "do the trams get their power from the overhead?" Of course it is very satisfying to say "yes". One of my layouts, on which I ran a horse car, was by necessity two-rail and while the overhead operated, it did not carry the power. That was always difficult to explain. Well the real trams run from live overhead and I would certainly recommend following the correct practice and have live overhead on your layout.

Overhead is hung from traction poles. Here I will explain my own convention. I use the term trolley pole for the device on the tramcar that picks up the electricity from the overhead wire. Then for the larger poles that hold up the overhead I use the term traction poles. This is not a recognised convention, but to avoid confusion



A very long bracket-arm traction pole at the National Tramway Museum. Note the extra wires used for pull-off span wire connection. In this case the span wire is also used to electrically connect the running wires. The scroll work on the traction pole is typical of early poles and the street light was often incorporated into traction poles for corporation run tramways.