# Preparation of templates for loose-heeled turnouts in P4

David Smith's book deals in part 2 entirely with the preparation of B & C type turnouts. It is not difficult to prepare similar templates for loose-heeled switches but it is helpful to have the transition point of the turnout radii, which is not given in his book.

It would seem helpful to publish the GWR Chief Engineer's Office Paddington/Aldermaston drawings which as a matter of interest have been made available by the Scalefour Society on http;//www.scalefour.org/resources/permanent _way_notes2.htm

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010 R1787 gives the arrangement of the switch chairs.
011 R1734 Chairs (1) crossing chairs 1C, 2C & BC
012 R1735 Chairs (2) crossing chairs 4C, 5C, 6C
013 R1755 is the table of loose-heeled leads. This is identical to that published in David Smith's book except that he does not give the dimension "T", the distance of the tangent point from the 4½" opening of the turnout radius plus half the gauge.
014 R1737 Chairs (3) switch chairs SS, 1S, 2S etc
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**Drawings to illustrate the setting out of templates**

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Read carefully David Smith's early chapters on 00 and BS95R rails and chairs. Each had their own chairs and fishplates and whilst the difference between 00 and BS95R was essentially in the depth of the rail head and thus the height of the web, it does determine whether 14" timbers with Z chairs are used or BS95R chairs with L1 chairs on a 12" timber.

It is my view that if the model is of a period earlier than 1923 then 00 should be used throughout. If it is after 1930 and on the main line then relaying could well have meant replacing all the chairs with BS95R. On branch lines 00 would have continued well into later GW life as it would have been financial reckless to throw out chairs that still had many years of life left in them. Consequently 00 chairs taken from the main line in the 1930's would likely have been used again in branch line work if the 00 chairs needed replacing.

New work in the later 1930's would have been all BS95R and flexible B & C switches.

David has reduced many dimensions to 4mm scale but I prefer to use full size dimensions and reduce them as required. Those in feet are multiplied by 4 and those in inches divided by 3.

It is assumed that the template will be prepared using CAD. There are several packages available like TurboCAD or DesignCAD, but check out that they can plot out to your printer.

 

For this exercise we are going to draw a 10' switch with a 1 in 6 crossing, using 00 rail with 14" timbers and Z chairs- just cut down a standard chair to 2mm width. If using BS95R and L1 I am not sure how to produce L1 chairs – presumably severely cut back standard chairs.

**Figure 1**

First draw a circle the radius of the turnout curve (339 feet), 1356mm. The turnout curve is always on the centre line of the turnout so it needs to be offset either way by 9.415 (half 18.83) giving the outer radius of 1365.415mm.

Draw a tangent horizontally to the right, to this circle; this being the straight stock rail. From the tangent point draw a circle the distance of dimension "T" from R1755, in the case 16' (64mm). That gives the far end of the nominal length of the switch, 10' in this example, and the position of the 4½" opening, RF to RF.

Set up another circle radius 10 feet (40mm) from this point to determine the position of the toe of the switch on the straight stock rail.

From the toe set up a circle the radius of the lead of 50' 6" (202mm) and drop a vertical down from this. Offset the straight stock rail a distance of 4' 8½" (18.83) to form the straight point rail. The point where the vertical line crosses this point rail is the intersection of the "vee".

The original centre line turnout radius plus half the gauge curve should also run through this point or be extremely close to it. You can ignore the very small difference as I do and leave the intersection of the crossing between the straight and the curve. Alternatively you could move the tangent point slightly to suit or move the "vee" so that its intersection coincides with the intersection of the straight and curved rails.

The lead lengths are usually quite accurate but remember that full sized trackwork was always calculated by hand and laid out by measurement in those days.

Draw the "vee" independently using a "T". Set out the long leg of the "T" a length equal to ten times the crossing angle. Draw two lines either side at right angles to form the head of the "T", each side having a length of 5mm. Thus the long leg is 60 and the head 10. Draw lines from the ends of the head to the bottom of the "T" to give the crossing angle.

Rotate this crossing angle so that one line is parallel to the point rail and position it so that the intersection of the two legs is at the intersection point of the "vee".

**Figure 2**

At a point 40mm (10' switch length) from the toe is the position of the 4½" opening, RF to RF. Draw a circle 4½" radius (1.5mm) and drop a vertical its centre. The point where this vertical meets the circle is the offset point for the switch radius.

Run a curve equal to the switch radius of 480' (1920mm) from this point back to the toe.

Next either offset this line 8mm to the right or draw a circle from the toe 2 feet longer than the nominal switch length, that is at 12' (48mm) and drop a vertical line from it. Extend the switch curve to this line so that the curved switchblade's overall length is 12' from the toe, running along the straight stock rail and is at the switch radius throughout.

The turnout + ½G curve should be trimmed back to this line, and should meet the switch curve at this point. They are joined together. The remainder of the turnout curve + ½G is trimmed at the crossing "vee" unless the curve is to extend through the crossing out on to the branch, as it regularly did on the Great Western.

The main elements of the turnout are now completed and the other rails can be offset by 4' 8½" (18.83).

**Figure 3**

From the toe run a circle the length of the planing, 6' 4½" (25.5mm) and drop a vertical to the opposite rail, the straight closure rail.

The final task is to put in the joggles at the toe on both stock rails.

**Figure 4**

Draw a 0.2mm radius circle and a second 2mm radius circle at each toe. Draw a line vertical between these circles and extend this line to hit the outside diameter of the 0.2mm circle. (On my CAD I have to extend them much further and then trim them back).

Draw a line from the intersection of this vertical line with the outside of the 0.2mm circle back to the intersection of the 2mm circle with the straight stock rails to the left, thus forming the two joggles.

On the straight stock rail side simply draw a line from the end of the joggle to the planing point and trim that to the right side of the stock rail going towards the crossing. This is the position of the slight set that is put in the stock rail to restore its alignment.

The curved stock rail side is a little more complicated. Draw the joggle the same way. Break the curved stock rail at the planing point and rotate the section between the planing point and the toe such that it intersects with the end of the joggle and forms that offset.

**Figure 5**

Note in figure 5 where the heel points are. They are in fact at the mid point of the end of the switchblades and the closure rails and not at the RF.

**Figure 6**

Set up a line bisecting the crossing outside of the crossing. On a flexible crossing using B or C switches the timbers are set at right angles to this bisection line. With loose-heeled switches they do not but you have to initially offset the 1C to 6C timbers as shown, as if you are building a B or C switched turnout. David Smith's book (page 34) gives the dimensions but you might just as well use Paddington drawings R2998/9 where the distance from the intersection to the nose is given. This is actually 11/16 x N (the crossing angle). For a 1 in 6 it is 11/16 X 6 = 4⅛" as R2998 shows.

David Smith's book (page 112) gives the dimension from the nose to the centre of the BC timber as **3"** whereas R2998 gives **4"** below a 1 in 6 and **5"** for all angles 1 in 6 and above.

*I think the explanation for this is that David is setting out a B switch which uses a 12" timber for the BC plate and being 2" narrower than the 14" used for a 00 loose-heeled switch, the dimension is truncated by 2". Since we are laying out a 00 loose-heeled switch using a 14" timber in this position then the **5"** dimension **must** be used.*

*Of course if you are laying out a loose-heeled switch for the intermediate period (late 1920's onwards) using BS95R rail and chairs with a L1 chair on the same timber in line then in that case the BC plate would be on a 12" timber. By that time 14" timbers had been discontinued and the Z chairs were obsolete. The offset would still be 5" otherwise the geometry would go awry. The BC plate would overhang the timber on the nose side.*

The wing rails are dimensioned along their lengths from the intersection. The distance from the intersection to the ends of the point rails is given as 12'. I run this down the bisection line and then drop off lines at right angles to set the final length.

**Figure 7**

Draw lines perpendicular to the straight stock rail from the intersection of the 1C to 6C timber centre lines with the crossing bisecting line, as shown. These are the centre lines of the 12" timbers, which with loose-heeled switches are always at right angles to the straight stock rail. At the rail ends at either end of the crossing put in a line joining the ends and then a vertical at right angles tot he stock rail from the mid point. Use these lines to offset 13" (4.33mm either side) to give the centre lines of the two timbers either side of these rail joints. At the 6C end place a timber mid-way between the 6C and the last timber before the joints.

 

The BC plate timber is always a 14” timber when the rail is 00.

Now lay out the timbers at the switch. The drawing R3794A has a small sketch bottom left, which shows the spacing of the timbers from the joint to the toe timber, the toe being 4” back from this timber’s centre line. The first stretcher which carries the operating rod is 13” (4.33mm) further along. The remaining stretchers are shown for the various switches above, for the 10’ switch it is 25½” (8,5mm) but you may disregard this as it is near impossible to fit. *What I have done is to drill out the switchblade and solder a 0.5mm nickel silver wire across and then cut it through so that on the main turnout road it appears to be one but on the branch road the angular movement misaligns the two halves.*

Note that the main timbers start at 9’ and gradually increase in 3” increments down the turnout. They are set by offsetting the curved stock rail 1’ 6” (6mm) and 2’ 0” (8mm) and trimming the timber length to increments of 3” within these two lines as figure 7 shows.

Being an 00 turnout the stock rail is 24’ 6” long to the joint. Draw a line vertically at this joint and space the joint timbers 13” either side. However this is whaer the Z chairs come in so it is not that simple.

**Figure 8**

You will note that the drawing has three broken lines parallel to the straight stock rail near the switch, the straight closure rail near the crossing and another the other side of the “vee” parallel with the straight point rail. They are spaced 1’ 3½” (5.17mm), 10½” (3.5mm) and 1’ 9” (7mm) respectively.

These are the minimum clearance lines for two standard chairs placed end to end on the same timber and inside them 00 and Z chairs must be used on 14” timbers.

1’ 3½” is the minimum clearance between the last tied chair of the switches, the 3S chair, and the next timber that can take two 00 chairs end to end. Within these limits a 00 chair is placed on the main road and a narrower Z chair placed on the branch road as figure 8 shows. The 00 chair and the Z chair are side by side and are always placed on 14” timbers.

10½” is the minimum clearance between the last chair of the wing rails and this distance.

1’ 9” is the minimum clearance between the last chair of the “vee”, the 6C chair and this distance.

On a 1 in 6 crossing these last two limits do not give rise to the use of Z chairs. As the crossing angle rises they will come into play.

On the 14” timbers the 00 chair predominates and is always on the main line. At the joint 24’ 6” out from the toe joint where a vertical line was placed, this line is offset 13” (4.33mm) either side and this is the centre of the 00 chair, see figure 8. The distance between this chair and the centre of the 3S chair is divided up so that the distance is no greater than 30” (10mm) and 00 chairs are placed at those centres, as figure 8 shows. Z chairs are then placed on the switch side of the 00 chairs on the curved road and the 14” timber placed under them accordingly.

Likewise the other side, keeping the 00 chairs on the main road. Outside of the joint with a 10’ switch an additional 00/Z/14” is required and this would be at the same spacing.

The remaining 12” timbers with 00 chairs between this last 14” timber and the joints at the crossing are again spaced at no more than 30” apart. However you should note that the spacing between the last Z chair and the first 00 chair may exceed 30”. You could, being on the branch take it out to 32” but no more. Better to reduce the spacing of this first timber to keep it down to 30”. Space out the remaining 12” timbers equally up to the crossing joint timber.

Note that I always offset the RF by half the railhead width 1⅜” (0.45833mm) and place a circle 1.2mm diameter on the centre line of each timber to represent the hole one would have punched through a Brooksmith timber at that point if one was using his track building method. It is the centre of the rail when lying in the chair so it is still relevant whatever method of construction you are using.

Finally place the check rails at the crossing. For a 1 in 6 crossing these are 11' 6" long with 3' 6" end splays. Place the check rail on the straight stock rail side first. Note that the knuckle more or less lines up with the knuckle of the crossing wing rail as you would expect. In fact I make the ends line up as figure 8 shows as they have to be clear of the chair jaws on the 5C and equivalent chair at the other end.

On the branch side one could line up the outer splay radially with the wing rail as the a full line on the drawing shows. However that leaves the splay chairs unequalised and the dotted lines shows the slight displacement necessary to equalise the splays.

Figure 8 could have been reduced to fit the page. I thought it more helpful to leave it full size and cut off the last two timbers and turn them sideways so this template could be used intact. Do not forget that photocopying can reduce lengthwise dimensions fractionally but it may be too small to be important.

Finally, once past the joint after the 6C timber the first timber runs through both roads as shown. Blocking out timbering is always a hit and miss affair. Generally there would be just the one long timber past the joint and then it reverts back to 8' 6" timbers 10" wide. The first one to place is hard against the through timber on the outside of the branch road with the main road timber placed just clear of the inboard end of that. The chair spacing should not exceed 30" but there are occasions such as here where it might be necessary to go up to 32" with 33" the maximum, to get these to fit. The inboard end of the first branch timber can be cut back short to assist in closing up the main road timber. It might be necessary to cut back the end of the main raod timber but one quickly wants get them interlaced and left at 8' 6" long.

All timbers in 00 loose-heeled turnouts are 12" wide except those that carry 00 and Z chairs which are 14" plus the BC timber at the crossing. BS95R loose-heeled turnouts only use 12" timbers.

**Further reading.**

David J. Smith's GWR Switch and Crossing Practice, a design guide for 4mm modellers, published by the Great Western Study Group.

British Railways Track, the early bull head rail editions published by the Permanent Rail Society and long since out of print. The Great Western is barely covered by this book as the GW in general ploughed its own furrow when it came to permanent way work. However the many calculations and much other information is valuable and if you come across an early copy it is worth buying for a few pounds.

Great Western Magazine from 1924 onwards published a series of articles on GWR Standard Permanent Way Practice by F.T.Bowler. They followed two lectures given to the South Wales section on June 23rd and October 27th 1923.

A large number of working drawings of Great Western switch & crossings are held by the Swindon and Wiltshire Record Office, which used to be at Trowbridge and in recent years moved, I think, to Chippenham. Take a digital camera as they did not have photocoping facilities for large drawings and that may still be the case. Hopefully today they have all been catalogued.

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