DATA SHEET

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Sheet #:	**D3b.3**
Title:	**CONSTRUCTION OF SPIRAL EASEMENTS AND SUPERELEVATION**
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INTRODUCTION

There are a number of methods for constructing spiral easements and/or superelevation curves. The more popular methods are:

1. Flex Track
2. Bent Stick
3. Metal Ruler
4. Template
5. Tangent.

The formulas for calculating the different parts of an easement are given in Data Sheet D3b.1 and are not repeated here.

METHODS

FLEXIBLE TRACK

This is a method used by many modelers is an approximation of an easement curve that can be constructed anywhere. The minimum curve is as specified in Data Sheet D3a. For many modelers, this is close enough. For the modeler who wants to get closer to the prototype, one of the other methods should be used.

1. The following approximations are used for HO scale:
   - Separation at point of tangency called 'X' = ½" (one half inch)
   - Length of easement is 9" (nine inches) to either side of the point of tangency (where they meet).
2. Lay out the straight portion and the curved portion offset from each other at the point of tangency (where they would meet) by ½“
3 .Mark off 9" along the curve and straight portions away from the offset point of tangency.
4. Put the flex track down along the straight portion leading up to the 9" mark and along the curved portion away from the 9" mark. The flextrack will automatically create a transition between the straight portion and the curved portion that is an approximation of an easement curve. The flextrack can then be secured in place if it is mounted on the roadbed directly. Otherwise, Step 5 and 6 must be followed if the flextrack was put on sub-roadbed for the drawing of lines.
5. Draw a line from the stright track centerline to the curved track centerline if the flextrack is put on the sub-roadbed.
6. The flextrack can then be picked up and the roadbed installed if the lines were drawn on the sub-roadbed and the flextrack can then be installed on the roadbed.

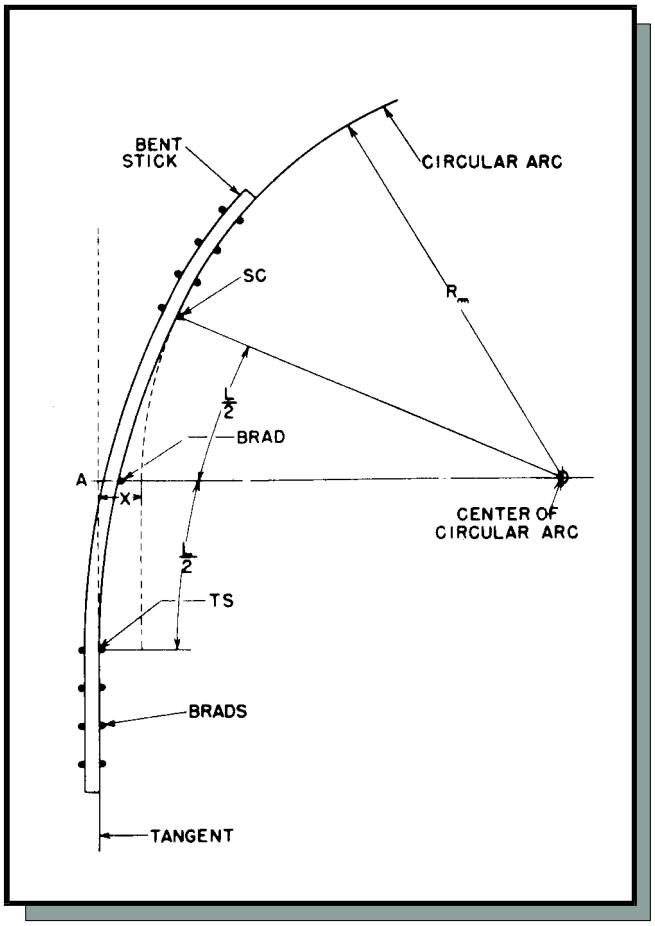
BENT STICK

This method is relatively easy, requires a minimum of calculations, can be readily varied to suit different conditions, and small errors of alignment are readily absorbed and not noticeable. The materials required are a few brads or finishing nails, a few clamps, and a suitable stick.

This method may be used to lay out the center of the track, any line parallel to it (one of the rails), or an edge of the roadbed. It can also be used to lay out a master template for your particular conditions.

BENT STICK - continued

The stick is usually of wood. smooth and straight-grained, of uniform cross-section and free from cracks or knots which cause it to bend more easily in one place than another. A piece of unkinked rail. if long enough, could also be used. The stick should be flexible enough to bend to the sharpest curve radius used and still spring back when released.



1. The tangent or straight section is laid out first.
2. The curve radius is laid out next offset from the tangent section laid out in Step 1. The offset is called 'X'. 'X' is a function of the curve radius(R) and length(L) of spiral easement. Once the size of 'X' is determined the curve radius can be drawn offset from the tangent section at the tangent point by 'X'.
3. Measure and mark ½ L from the tangent point along the tangent and along the curve.
4. Drive a double row of brads or nails along the tangent and curve lines away from the junction starting at the 2 marks made in Step 3. 0ne row of brads or nails should be on the curve and tangent lines. The other row of brads or nails should be the thickness of your stick along the first set of brads or nails.
5. The stick is placed inside the two rows or brads or nails. The stick should be held firmly so that it conforms to the tangent and circular curves and forms a smooth curve between them.
6. The line of the track may then be drawn along the stick to transition from the tangent section to the circular curved section.

METAL RULE

This is a variation of the ***Bent Stick*** method. It uses a long (usually a 3' rule) metal ruler and lays out the easement between a straight section and a curved section as described above. The approximations mentioned above can be used.

TEMPLATE

This method is often used when pre-cut roadbed is used or when cutting or forming roadbed upon which fully or partially finished rail and tie assemblies are mounted.

TEMPLATE - continued

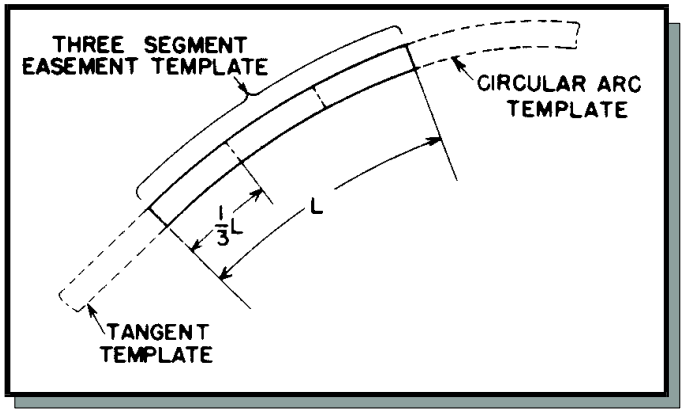
It is suggested that the minimum radius (per Date Sheet D3a) and all easements be of the same length to ease construction. A template can be made for each curve encountered or one template is made for all the curves that will be encountered with slots for a pencil to mark the lines for any particular curve.

The rail and tie assemblies are laid in the center of the easement roadbed. Eye accuracy is sufficient if one looks along one rail and eliminates any irregularities found.

The TEMPLATE can be laid out using any of the other methods covered or a series of circular arc segments of uniformly decreasing radii can be used. Data for constructing such a template for use in various scales is provided below.

	Q, O, O_{17}	S	OO	HO	TT
Circ. Arc Radius, Rm	**66"**	**48"**	**36"**	**30"**	**21"**
Length of Easement, L	**39"**	**30"**	**24"**	**21"**	**15"**
Length of Segment (1/3 L)	**13"**	**10"**	**8"**	**7"**	**5"**
Radius at D=1/4 L	**264"**	**192"**	**144"**	**120"**	**84"**
Radius at D=1/2 L	**132"**	**96"**	**72"**	**60"**	**42"**
Radius at D=3/4 L	**88"**	**64"**	**48"**	**40"**	**28"**

The easements are constructed by using three short uniform curve templates having lengths equal to 1/3L and having radii as given in the above table. Thus in HO scale, use 3 curves each 7" long having radii of 120", 60" and 40". Be sure that the templates for the uniform curve segments have their ends carefully squared and then fit them end to end as shown in the figure to the left and trace around their complete outline to form one template for the full easement.



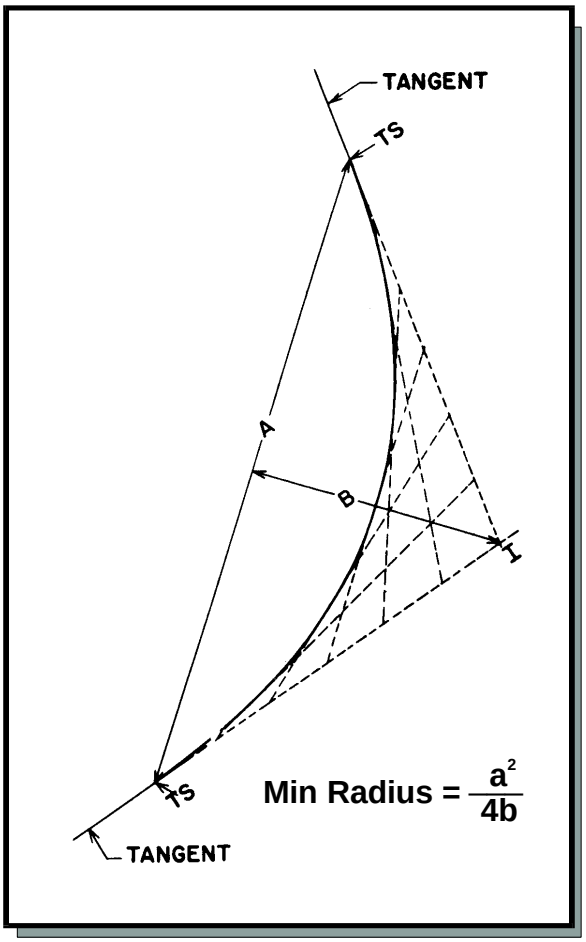
Although these easement templates will be found adequate for ordinary mainline construction, easement templates of other lengths or leading into circular arc curves of other minimum radii may be readily constructed by this approximate method by using curves of lengths = 1/3 L and of radii as determined at the quarter points from formula R=L/D*Rm (where L=arc length, D=arc length from beginning, Rm=minimum radius in circular arc). Thus, for an easement 24" long leading into a 42" radius curve, use 3 - 8" long curves having radii of 168", 84" and 56".

TANGENT

This method is easy to lay out on flat bench-work and is good for changes less than 90 degrees. It is more difficult for sub-roadbed on risers but can be done if flat surfaces are provided along the two tangents.

This method provides a parabolic curve between the two headings. The parabolic curve joins the two sections with a double easement without any curve of uniform radius in between.

1. Lay out the two headings as straight lines to their intersection called 'I'.
2. Determine where the end of the two headings (tangents) are called 'TS' and draw a line between the two them. The line is called 'A'. Try 200 scale feet for 'A' first.
3. Calculate the minimum radius = $A^2/4B$. If the minimum radius is less than that recommended on Data Sheet D3a, increase the distance of 'TS' to 'I', re-measure 'A' and 'B' and recalculate until the minimum radius is greater than that recommended in Data Sheet D3a.
4. Divide the two 'TS' to 'I's in a convenient number of parts such as 6.
5. Connect the 'TS' points with lines to each of the points from Step 4 on the opposite leg. These lines are all tangent to the easement between the two headings (tangents). More lines can be used, if greater accuracy or definition is required.
6. The curve between the two headings can then be drawn either free-hand or with the aid of a stick just touching all the lines from Step 5.



FLEXIBLE

Strips are cut for one track width. The strips are turned on edge and notches are cut on one or both sides. If` on one side, the notches are cut 2/3 to 3/4 through. If on both sides, the notches are cut halfway through and staggered from side to side. The notches are about 1" apart. This will make flexible strips that can be attached to the sub-roadbed and bend for curves of 18". Use multiple strips for multiple tracks.

The notches can be filled after the strips are put in place.

The notches can be filled with plaster or similar material, a paste made with glue and saw dust or HOMASOTE dust. Another method is to cover the strip with HYDROCAL soaked paper towels or plaster impregnated gauze.

TRACK and ROADBED

There are a number of commercially available track and roadbed combinations. Each one has its own features. However, they all have a simulated ballast base, ties (which may be separate or integral with the "ballast") and rail. Their attachment technique varies with the type of item used. It is recommended that the manufacturers recommendations be followed.