Calculation of curved turnouts

Definitions:

R_0 Radius of the diverging route of the straight turnout used as the <u>*base*</u> for the curved turnout

R_1 Radius of the main (former straight) route of the curved turnout

R_2 Radius of the diverging route of the curved turnout

C_n Curverture of the respective circular part of the turnout with: $C_n = 1 / R_n$

The curved turnout is build from a straight turnout by bending the base turnout as a whole. There are two possibilities to do this. Starting with a straight right TO you can:

1. bend the turnout in the same direction as the diverting route, that is, for a right TO, to the right. In this case you create a inward curved TO
2. Bend the TO in the opposite direction as the diverting route, that is, for a right TO, to the left. This creates an outward curved TO

Inward curved turnout

The base TO will be bend in such a way that the difference in the curvatures of the two curved routes equals the curvature of the diverting route for the base TO, as shown below:

$$C_0 = C_2 - C_1 \quad (assuming\ R_1 > R_0 > R_2)$$

This equation can be used to calculate the second radius of an inward curved turnout with one radius given. Using the definition of the curvature for a circle ($C_{circle} = 1 / R_{circle}$) one can derive the following two equations:

$$R_2 = \frac{R_0 \cdot R_1}{(R_1 + R_0)}$$

$$R_1 = \frac{R_0 \cdot R_2}{(R_0 - R_2)}$$

The first equation calculates the radius of the diverging route from the radius of the base TO and the (given) radius of the main route of the curved TO. The second equation calculates the main radius of the curved TO with the diverging radius as input.

Outward curved turnout

Similar equations can be derived for outward curved turnouts with the curvatures of the base TO being the sum of the curvature of the two routes of the curved TO, as shown below:

$$C_0 = C_1 + C_2$$

Note:

These equations are used by the German prototype. As can be seen the frog angle or number is nowhere to be seen in these equations – the German prototype is not concerned at all with frog angles, the frog angle is not even part of the turnout specification. The main parameter is the radius of the diverging route (in meters) and the second parameter is the “inclination” (for a lack of a better word) of the turnout as a whole, given as a ration 1:n – this looks similar to the frog number used in NA and is defined similarly (TO angle = tan(1/n)), but the angle thus derived is generally not the same as the frog angle as the German prototype commonly uses curved frogs. These turnouts have their diverging curve continued beyond the frog.

Below are the standard turnouts as used in Germany (radius in meter, inclination - sf = straight frog, cf = curved frog)

190 1:9 (sf); 190 1:7.5, 190 1:6.6, 190 1:6.3 (cf)

300 1:9 (cf), 300 1:14 (sf)

500 1:12 (cf), 500 1:14 (sf)

760 1:14 (cf), 760 1:18,5 (sf?)

1200 1:18.5 (cf)

Another bit of trivia: Outward curved TO are quite common in Germany, they are used sometimes in yard ladders and are often used in curved double-track crossings or as protection turnouts.

Disclaimer:

While the above equations are used in Germany the turnout geometry between a German and a standard NA is different and no guarantee can be given that these equations will provide useful or sufficiently accurate results under model railroad conditions.

I have not derived the two curvature relations, so I cannot provide any insight as to why these equations! For any further insight you would have to turn to an engineering text book on RR track design.

My source is a university script in German found via google:

http://www.fh-aachen.de/fileadmin/groups/bauingenieurwesen/verkehrswesen/Um_H6S.pdf

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