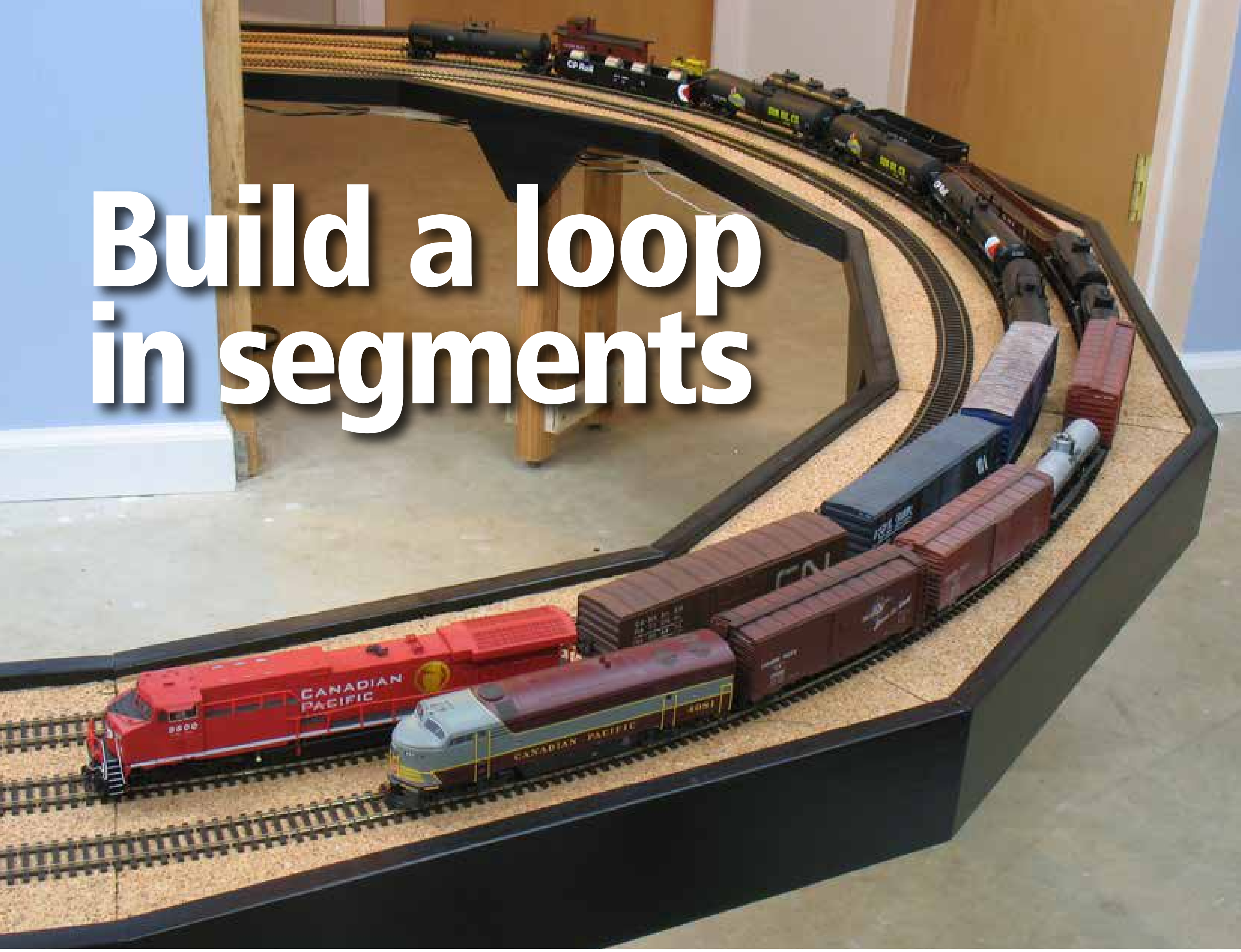
Build a loop in segments



The three-track staging loop on Dave Bonser's HO scale Columbia, Kootenay & Pacific Ry. was built in segments. The plywood trapezoids were ripped on a table saw and cut to the prescribed angle with a miter saw.

Trapezoid-shaped panels made it easy to construct this staging area

By Dave Bonser • Photos by the author

As general manager of the Columbia, Kootenay & Pacific Ry. (CK&PR), a freelance HO scale model railroad, I decided to add a three-track staging area in a return loop at the west end of the main line. Since my construction crew isn't very good at cutting arcs freehand with a jigsaw, I asked the engineering department to design the staging loop as a series of trapezoid-shaped panels.

The engineering department wanted to fabricate the panels off-site as they had a number of smaller pieces of material left over from previous projects that they wanted to use. With the plan in place, the engineering department started work on the loop.

How it works

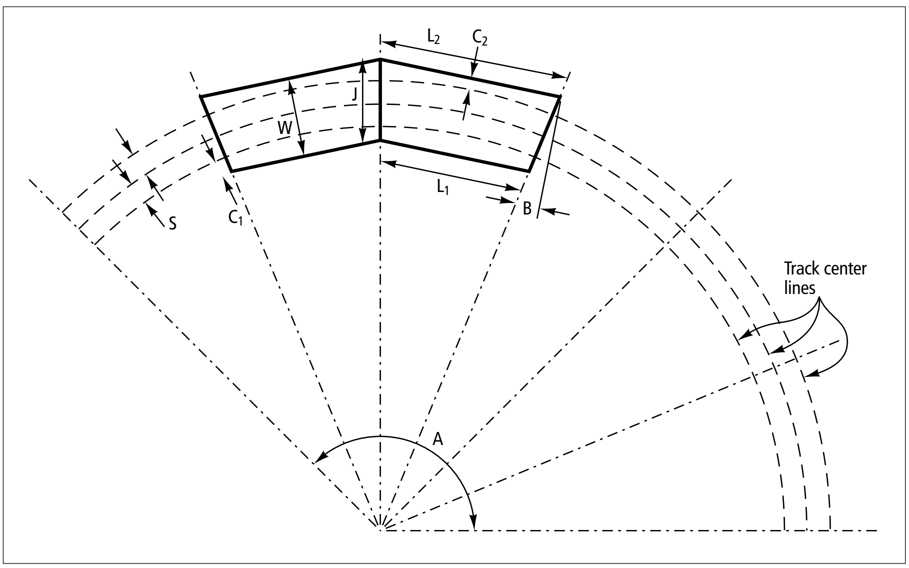
The loop consists of a series of equally sized trapezoidal panels joined on the angled edges to complete the curve. Since the panels are the same width, this allowed the engineering department to rip them on a table saw and cut them to length on a miter saw set to the prescribed angle.

Clearance below wasn't an issue, allowing the panels to be joined from below using small plywood rectangles as splice plates. Glue and screws were used to secure the plates.

The fascia, which extends above and below track level, makes the benchwork more attractive and helps prevent derailed cars from tumbling to the concrete floor below 1, opposite.

Once all of the panels were built, the engineering department brought them to my basement for final assembly 2. This was a simple matter of screwing the panels together through the splice plates. If vertical clearance below the roadbed is an issue, such as a helix, you could modify this assembly method by joining the segments with biscuits and reinforcing

❶ **Panel components.** Each trapezoid panel includes a plywood splice plate and fascia. The fascia extends above and below the benchwork.



❸ **Mapping it out.** This diagram shows some of the factors that determine the dimensions of the trapezoid panels. Among them are the length of the arc (A), the number of segments (N), the radius of the inner track (R), the number of tracks (T), the track spacing (S), and the inner and outer clearances to the edge of the benchwork (C_1 and C_2, respectively). Kellie Jaeger illustration

❷ **On-site assembly.** The trapezoid panels were delivered to Dave's basement for final assembly. He added cork sheet on top of the plywood before installing the track.

the joints by placing the outer helix spacer blocks over the joints.

Mapping it out

The design choices that determine the dimensions of the trapezoidal panels are shown in ❸. These are: length of the arc (A), the number of segments (N), the radius of the inner track (R), the number of tracks (T), the track spacing (S), and the inner and outer clearances to the edge of the benchwork (C_1 and C_2 respectively). Note that the critical inner clearance occurs at the inside of the joint, while the outside clearance point occurs in the middle of each segment.

If you choose to use a larger number of segments for a given arc, they'll be shorter in length and slightly narrower, making a closer approximation to a curve. This method takes more effort to fabricate and join together.

On the other hand, fewer segments use more material and may result in more restricted aisle clearances, since the outside corners stick out farther from the track.

Crunching the numbers

The engineering department created an Excel spreadsheet to calculate the required cutting dimensions. If you have access to Excel on a computer, you can duplicate this spreadsheet by typing in the given formulas in the corresponding cells in column D ❹ (next page).

To get new cutting dimensions, enter your preferred values (the green cells) and the results appear in the cells with formulas. Excel assumes that angles are measured in radians, so the angle in degrees is divided by $180/\pi$ in the trigonometric functions. You can also type the formulas in a calculator, being careful to omit the $180/\pi$ conversion from the formula.

The 180 degree curve on the CK&PR staging return loop has three tracks with an inside radius of 28", a track spacing of 2¼", and inside and outside clearances of 1½". Designing the arc with six segments gave us a cutting angle of 15 degrees, a width of $8\frac{13}{32}$", an inside length of $13\frac{23}{32}$", and an outside length of $18\frac{7}{32}$".

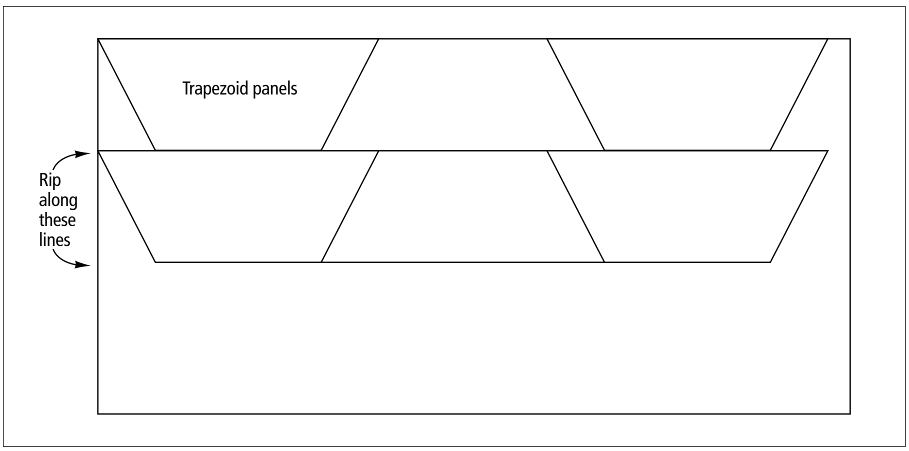
The arc joins tangent sections at each end that we cut to have the same width as the joint size of $8\frac{11}{16}$". (To convert from decimal inches given in the worksheet to thirty-seconds of an inch, multiply the decimal fraction by 32 and round to the nearest integer. For example, 0.648 is $\frac{21}{32}$").

Using Excel lets you try out differing numbers of segments and clearances to obtain desired values of the width or length of each panel. This is an advantage if you're using pre-ripped plywood or trying to maximize the number of

Segmented arc designer

Arc angle of curve (A)	180	degrees	
Number of segments (N)	6		
Radius of inner track (R)	28	inches	
Number of tracks (T)	3		
Track spacing (S)	2.25	inches	
Inside clearance (C_1)	1.5	inches	
Outside clearance (C_2)	1.5	inches	Formulas to enter in column D cells (blue)
Cutting angle (B)	15	degrees	= (D3 / D4) / 2
Inside length (L_1)	13.717	inches	= 2 * (D5 - D8) * SIN(D11 * PI() / 180)
Outside length (L_2)	18.221	inches	= 2 * (D9 + (D6 - 1) * D7 + D5) * TAN(D11 * PI() / 180)
Width (W)	8.403	inches	= D9 + (D6 - 1) * D7 + D5 - (D5 - D8) * COS(D11 * PI() / 180)
Joint size (J)	8.699	inches	= D14 / COS(D11 * PI() / 180)
Plywood sheet length	96	inches	
Plywood sheet width	48	inches	
Saw kerf width	0.125	inches	
Segments per strip	5		= MAX (2 * INT((D17 - (D13 + D19)) / (D12 + D13 + 2 * D19)) + 1, 2 * INT(D17 / (D12 + D13 + 2 * D19 + (D13 - D12) / 2)))
Strips per sheet	5		= INT(D18 / (D14 + D19))
Segments per sheet	25		= D20 * D21
Total arc angle per sheet	750	degrees	= D22 * D3 / D4

4 Crunching the numbers. An Excel spreadsheet made it easy to calculate the required cutting dimensions. This can be re-created on any computer that has Microsoft Office software.



5 Making the cuts. The calculations in the Excel spreadsheet helped determine the number of panels that can be cut from a piece of plywood. The rip cuts were made on a table saw. Kellie Jaeger illustration

panels that you can get from a full sheet or leftover piece of plywood.

The engineering department also provided calculations in the Excel spreadsheet to determine the number of panels that can be obtained from a given piece of plywood if they're cut as shown in 5.

An easier solution

Designing the return loop on the CK&PR as a series of trapezoidal panels made its construction much simpler, since it could be fabricated in sections in the workshop and assembled in place. In addition, this method used smaller pieces of plywood and didn't require curved cuts or bending to assemble.

Using the Excel spreadsheet to determine the dimensions eliminated potential calculation errors and made it possible to ensure that the available piece of plywood was used efficiently.

If you plan on adding a loop to your model railroad, trying building it in segments. MR

Dave Bonser lives in Roberts Creek, B.C., with his family. He is an engineer with BC Hydro, an electric utility. This is his first byline in Model Railroader.