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INTRODUCTION

Bridges are key scenic elements on a layout

This dramatic scene on Tony Koester's 1950s-era HO layout is based on the real Nickel Plate Road's crossing of the Little Vermilion River. Note also the wooden road overpass at right and the arched highway bridge in the background, which is actually part of the photographic backdrop. Tony explains how he created the scene in Chapter 21.

Bridges are the focal points of many dramatic scenes, both in real life as well as on model railroads. From small culverts to huge viaducts, these structures enable railroads to cross highways, other railroads, lakes, rivers, creeks, swamps, marshes, dry washes, and valleys. Watching a train moving across a bridge is a highlight for operators and visitors alike.

2

Andy Sperandeo kitbashed this large concrete culvert using a highway bridge model as a starting point. Chapter 5 (page 24) explains how he built the bridge and installed it on the Kalmbach Publishing Co. club layout, the HO scale Milwaukee, Racine & Troy.

Creating a successful scene on a model railroad involves much more than simply placing a factory-built bridge model onto a layout and adding scenery around it. For realism's sake, you need to think like a real railroad engineer (the one who lays out the right-of-way, not the train driver). First, you must make sure the type of bridge chosen is appropriate for the railroad and era. For example, are you modeling a light-duty branch line in the early 1900s or a modern-era main line that hosts intermodal and unit coal and grain trains?

Regardless of how prototypical or how superbly detailed a model might be, a multi-span, towering stone bridge reminiscent of Starucca viaduct will look out of place on a weedy Midwestern branch line. Likewise, a tall, rickety frame trestle or spindly, thin-membered iron truss bridge won't look proper on a modern main line hosting six-axle diesels.

You need to follow sound engineering principles on your bridge and trestle models. Such things as installing a plate-girder bridge but not supporting the ends of the girders on footings, modeling a wood pile trestle without appropriate sway bracing, or not having piers properly located between the individual bridges on a multi-span crossing will detract from your layout's appearance and take away realism.

Along with large, dramatic bridges, look to add ordinary and mundane structures as well. Small corrugated-metal and concrete culverts, which keep water from undermining the right-of-way, are everywhere in real life. Adding several of these, along with small run-of-the-mill beam and girder bridges, will make your layout look plausible and more realistic.

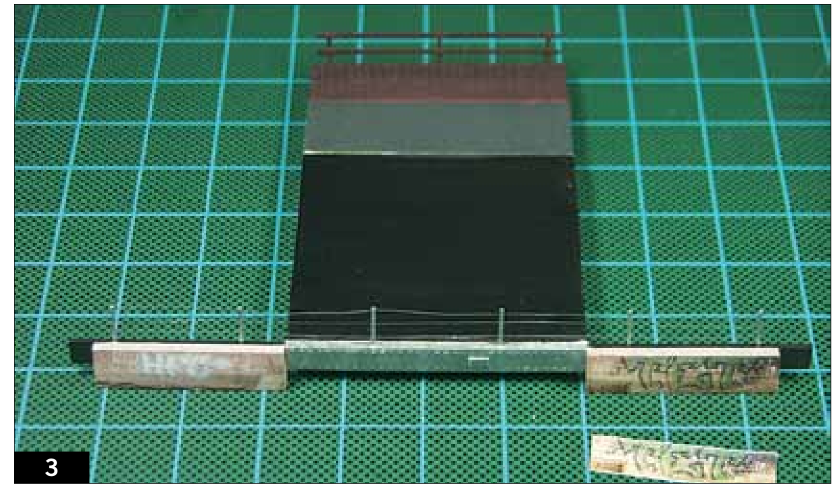
And don't forget highway bridges. Highway overpasses can help show the era being modeled, and can also serve as view blocks to separate scenes or disguise where tracks pass through a backdrop.

Each chapter in this book is a separate project or set of drawings that originally appeared as an article in *Model Railroader* magazine. Most are kitbashing and scratchbuilding projects in HO and N scales, but the ideas, modeling techniques, and principles are applicable to many other situations and scales. Use your imagination and creativity in applying these articles and projects to specific scenes on your own layout.

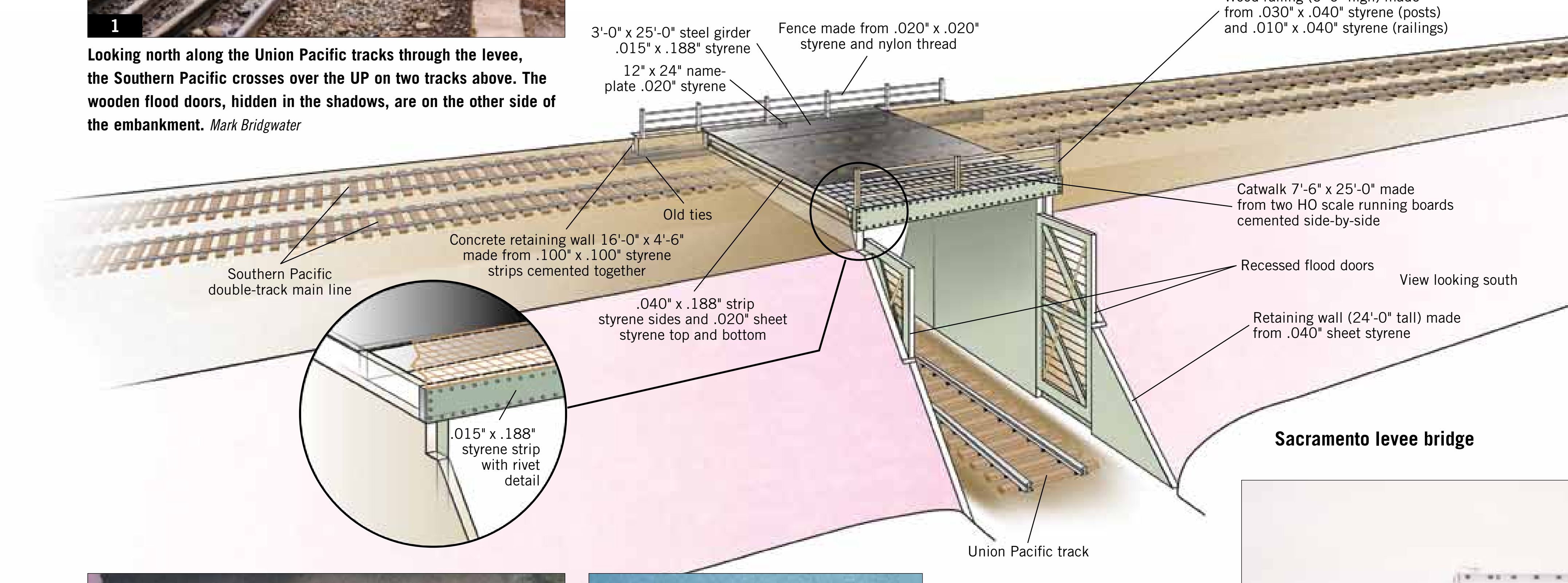
Chapter 1 is a great place to start, as veteran modeler Tony Koester provides a thorough overview of various types of bridges. He explains the history of each bridge type, how each is used in real life, why railroads install different types of bridges based on situations, and gives some modeling ideas for each.

Looking north along the Union Pacific tracks through the levee, the Southern Pacific crosses over the UP on two tracks above. The wooden flood doors, hidden in the shadows, are on the other side of the embankment. *Mark Bridgwater*

Fellow modeler Dave Montgomery and I started construction on the levee bridge by first cutting foam insulation board to represent the levee. The roadbed is made from a section of hardboard that has been beveled.



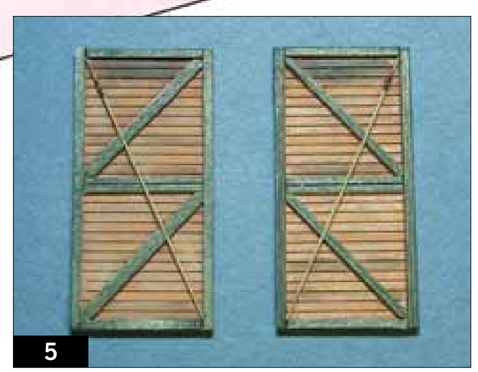
For the steel bridge, I started by making the sides from strip styrene. I added the rivet detail by pushing a dull pin into the back of the styrene. Next, I built the box span from styrene strips, covered it with sheet styrene, and cemented the rivet-detailed sides to the finished box. On either side of the bridge are two concrete retaining walls. I made these from styrene and formed the beveled cross-section by sanding them. After painting the retaining walls a concrete color, I weathered them with custom graffiti decals I made on my home computer. I dry-brushed the finished pieces with several other colors to blend the decals with the painted parts.



Sacramento levee bridge

This is a closeup view of the bridge railing cables on the north side. For the model, I made the posts from styrene strips painted silver. I represented the railing cables using nylon thread, also painted silver. *Mark Bridgwater*

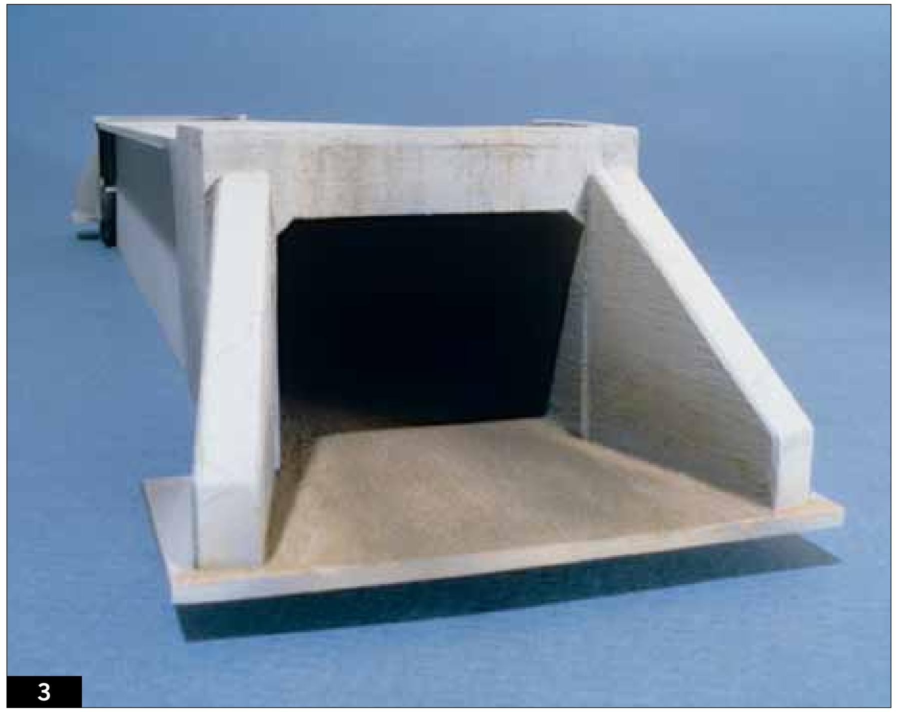
I made the retaining walls from some resin retaining wall scraps I had laying around. However, it would have been much easier to make the walls out of .040" sheet styrene.



My friend Dave Montgomery built the flood-control doors from stripwood, scribed wood panels, and brass wire.

For the brown walkway, shown here on the prototype's flood gate (south) side, I cemented two HO scale running boards side-by-side and added styrene fence posts and railings.

With the bridge mostly complete, I test-fit it in the foam levee. For the final scenery instructions, see the installation section on page 20.



For larger, rectangular-opening culverts, used for river or flood plain relief, Rand used .040" styrene for added strength. Being able to see completely through the culvert when installed on the layout adds tremendously to the realism.

These bridges are identical to square culverts except they lack a floor. Desert ranchers employ water-wise mechanics of their own—note that the barbed wire fence is staked only at mid-channel. The other posts merely serve as wire spacers, allowing the fence to swing away in floods and shed debris.

onto sheet styrene was equally realistic and much faster.

Concrete culverts follow different designs. On a pipe-style installation, **1**, the inlets are set flush to the riverbed and the outlets are set a minimum of one foot above the low-water channel level to prevent undermining the footings.

After 91 years of service, the culvert in **1** is near the end of its life span. Vibration from years of passing trains has cracked the interior pipe, and these cracks have grown from water erosion and fracturing caused by freeze and thaw cycles.

An easy modeling idea would be to follow prototype practice and repair the culvert by lining it with a slightly smaller corrugated metal pipe. This would only be done if the smaller opening could handle the peak water flow, otherwise a complete replacement would be in order.

Occasionally concrete pipe may be installed in the same manner as the iron pipe I'll describe later, but usually concrete culverts use short, enclosed sections and rely on wing walls to hold side slopes in check and to gather inflow and disperse outlet waters. These wing walls should stand 6" higher than the abutting ground and follow the angle of repose (the natural slope of the ground).

Railroads avoid curves as much as possible, so they often use long fills to cross relatively still bodies of water or swampy areas rather than go around them. In these cases culverts allow water to ebb and flow from one side of the track to the other.

I built a modern overflow culvert, **3**, from .040" sheet styrene. It is destined for a rainy marsh on my layout. The culvert's scale 6 x 9-foot opening is more than ample for this use; it could also handle a 12-foot-wide year-round river. A scale 4" x 8"-high lip on the top edge retains roadbed. The wing walls sit at a 15-degree angle to the main structure and open to a 14-foot width.

Unlike the first culvert, which used a vertical drop to prevent the water from digging backwards under the lip, this structure employs an eight-foot-long, flush-set spillway to carry the stream until it's less turbulent.

Short spans

The structure in **4** is technically a bridge because it carries track over a watercourse rather than providing a tunnel that carries water under the roadbed. Nevertheless, its construction is similar to a culvert.

In arid regions subject to violent flash-flooding, short spans made of concrete or wood are built over gulIies and sandy washes to avoid trapping the tremendous amounts of silt and debris carried by these floods. Rather than a concrete floor as in a culvert, pier and retaining walls have footings extending well below river grade to accommodate the scouring and refilling of sediments that are part of the river's natural hydraulic action.

Pipe culverts

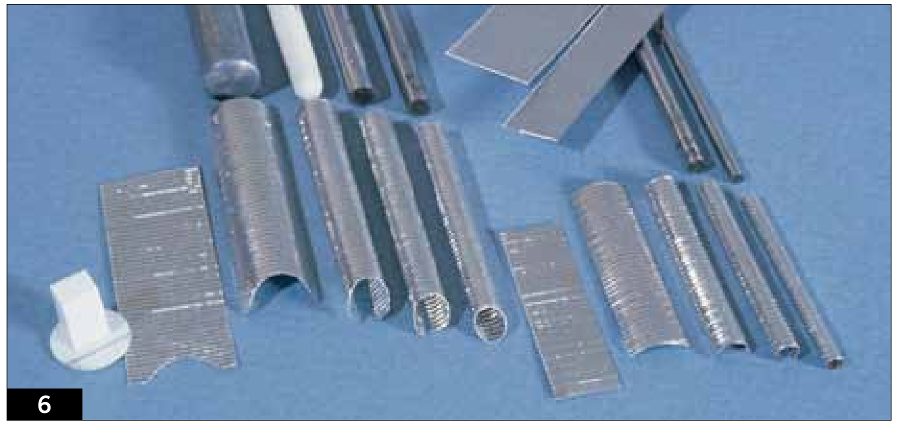
The last thing you'll need to make realistic corrugated-pipe culverts is the first thing you should make—real rust. Fill a paint jar half full of steel wool and ¾ full of vinegar. Periodically shake the bottle and in about a week the steel wool will have totally dissolved, creating a beautiful rust-colored solution.

Pipe is inexpensive, so it's the culvert of choice for smaller or slower-moving streams. Pipe installations may have a concrete or stone abutment around the inlet, **5**, but they rarely have wing walls. Instead a greater length of the inexpensive pipe is used to place both inlet and outlet well beyond the angle of repose.

I formed Campbell No. 802 corrugated aluminum into tubes for all my pipe culverts, from the small 6"- and 12"-diameter ones used in tunnels and low-shallows drainage to the scale 30" one shown in **5**. For a 12"-diameter pipe, cut strips of corrugated aluminum a scale 3'-9" wide by 10'-0" long. Use a sharp hobby knife blade and light, repeated passes so as not to damage the corrugations. For 6" diameter pipes, cut pieces 2'-9" wide by 8'-0" long.

Some 12" pipes have angled inlets. This larger intake area increases the water pressure in the pipe, which helps to flush out collected sediment. Cut-

This 30" pipe culvert is typically found where trackside ditches converge into small streams. The spillway has been lined with riprap to prevent erosion.



Rand gently rolls the aluminum over successively smaller-diameter forms to avoid crushing the corrugations. On the left is the template to produce angled inlets.

The first two pipes are "new." The others show the various degrees of corrosion achievable with etchant and the rust solution. The pipes with marvelous holes and loops of single ribs are slated for trash heaps surrounding replaced pipes along the right-of-way.

CHAPTER SEVENTEEN

Pin-connected through truss bridge

By Harold Russell

Eight-year-old Knox & Kane No. 58, a Chinese-built Mikado (2-8-2), crosses the Allegheny RR on a pin-connected truss bridge in 1996. *Photos by the author*

Originally built for the three-foot gauge Pittsburgh, Bradford & Buffalo RR in 1882, this pin-connected through truss bridge is located just southeast of the depot in Kane, Pa. It was converted to standard gauge in 1911 when the Pittsburgh & Western (successor to the PB&B) was owned by the Baltimore & Ohio.

This photo looks up at joint U1 from inside the bridge and shows the anchor for the upper horizontal cross bracing (the X bracing visible above the engine in the lead photo).

This photo of U3 shows the lattice bracing and how the tension rods and posts all join at a pin on the upper chord. Also note the solid turnbuckles.

In contrast to the upper joint, this photo at L2 shows how the center rod terminates at a separate pin through the post rather than the common pin on the lower chord.

On the north end of the bridge, the tracks begin curving at the pier on which the bridge rests.

Pin-connected truss bridges were popular, especially in the era of rapid construction, because the bridge could be prefabricated in the shop, broken down, shipped to the site, and easily erected by simply pinning the joints. Bridges could be ordered to specific dimensions, but bridge companies also offered certain lengths based on standard span sizes as essentially off-the shelf items.

Into the 2000s

The bridge continued in service for the B&O until 1982, when the 65-mile line from Knox to Mt. Jewett was sold to the Knox & Kane RR Co. In 1986 the K&K acquired the abandoned Erie right-of-way beyond Mt. Jewett, which included the 2053-foot-long, 310-foot-high Kinzua Viaduct, the fourth highest railroad bridge in the United States. The K&K ceased operations a few years after the Kinzua Viaduct was toppled by a tornado in 2003.

One of the bridge's concrete piers, which probably replaced an earlier stone one, shows a date of 1903. I don't know the bridge's load rating, but the relative thinness of its members indicates that it is only suitable for light to medium loads.

Principles of engineering

By 1882, material science had advanced to the point where precise engineering load calculations could be made so that no extra steel was used in the construction of a bridge. Thus the tension members of this bridge are as small as 1" in diameter.

Prototype bridges designed for a specific site and built in place are often skewed (the ends are angled) to match the angle at which the track crosses the valley. However, typical of prefabricated bridges, the Kane bridge is square. It sits on piers and connects to the banks via trestles. The south end of the bridge has a straight one-span trestle linking the bridge pier to solid ground, while the north end has a four-span curving trestle. The topography of your layout will determine the length and curvature for your application.

This bridge's small steel sections and generally diminutive appearance would be a real eye-catcher on a layout. The lattice and some of the delicate tension members could be duplicated by photoetching. Brass or styrene could be used for the heavier members such as the floor beams, stringers, posts, and chords.

As the photos show, the prototype bridge's color has weathered to a light grimy black. Avoid using pure black as it hides details. Weather the model by drybrushing it with Rail Brown, being sure to highlight all the joints and rivets.

So that it could be printed in HO scale, I've drawn only the left (south) half of the bridge as it's symmetrical about the center line.