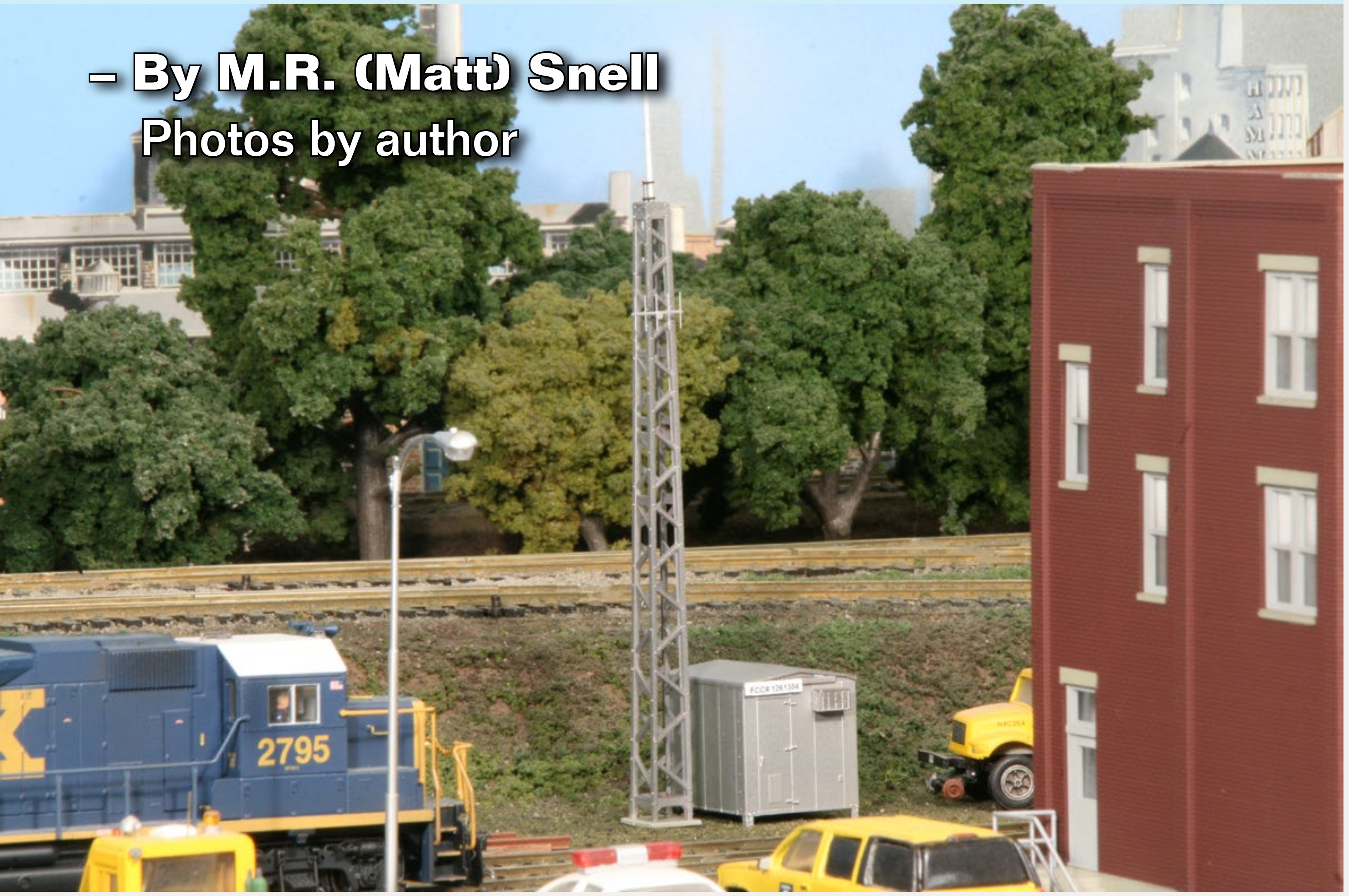
Modeling a railroad radio base station

– By M.R. (Matt) Snell

Photos by author



An inexpensive one evening project ...

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Over the last century railroading has undergone numerous changes as new technology has made train operation safer and more efficient. We've witnessed the development of advanced signaling systems, continuous welded rail, and high-capacity freight cars yet one of the most profound developments of the 20th century often remains unrecognized.

Radio has forever changed the railroading landscape, enabling train dispatchers to control their territories from hundreds or even thousands of miles away while eliminating the need for towers and wayside operators. No longer is a tower operator required to hoop up train orders. Instead, communication between train crews and dispatchers is now direct, facilitated by a series of wayside radio base stations carrying radio and data signals throughout the railroad.

Strategically placed to maximize signal strength, the exterior of a base station presents nothing more than a group of small antennas mounted on a tower accompanied by a nondescript equipment housing, making it a lineside detail that is easily overlooked.

1: The prototype used as the basis of this kitbash. It's located on the NS Chicago line.

Although plain on the outside, the interior is quite complex as groups of electronic devices receive and transmit signals enabling radio communication over large distances. Since our focus as modelers is in replicating the visible rather than the unseen, adding a radio base installation to a layout is a fast and easy project that fills a void in modern era detailing while demanding very little space.

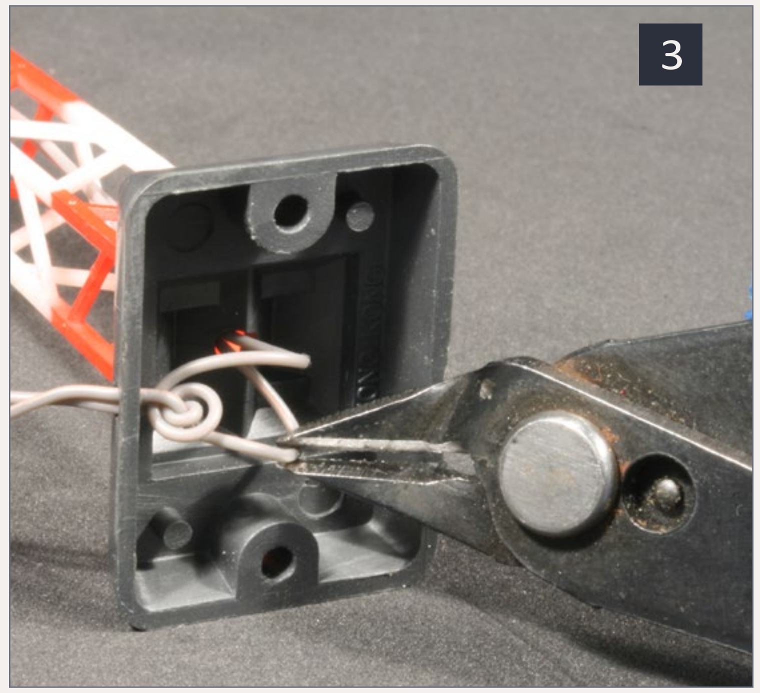
Study the real thing

Before we start our project, let's briefly look at a typical radio base station. Located at MP 193.85 of the Norfolk Southern's Chicago Line is an easily overlooked short lattice style tower and standard railroad style equipment enclosure, carrying a small sign displaying FCC ID# 1261384 in black lettering. A check of this Federal Communications Commission identification number shows that this particular tower was erected in February 2008 with an overall height of 22' 9".

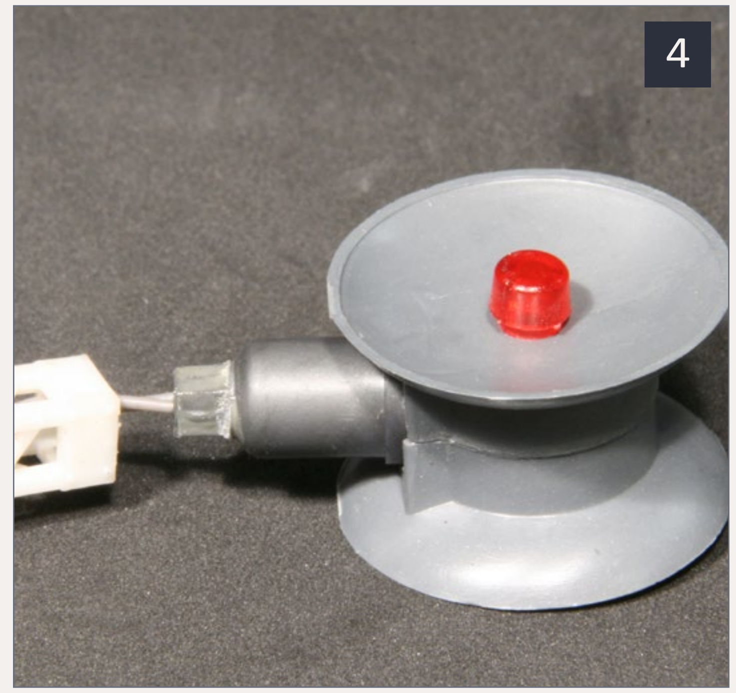
2: The Tyco microwave tower that is used for the kitbash.

A visual inspection shows it carrying one whip style antenna at the top, with smaller yagi antennas mounted on the lattice framework of the tower. This short tower requires no guy wires for stability. It is exempt from the FAA requirement of aviation orange and white striping with warning lights, a regulation generally applied to installations in excess of 200' above ground level.

Now that we've looked at the basic components of a base



3: Begin disassembly of the microwave tower by cutting the wires at the base.



4: Remove the microwave dish from the top of the tower.

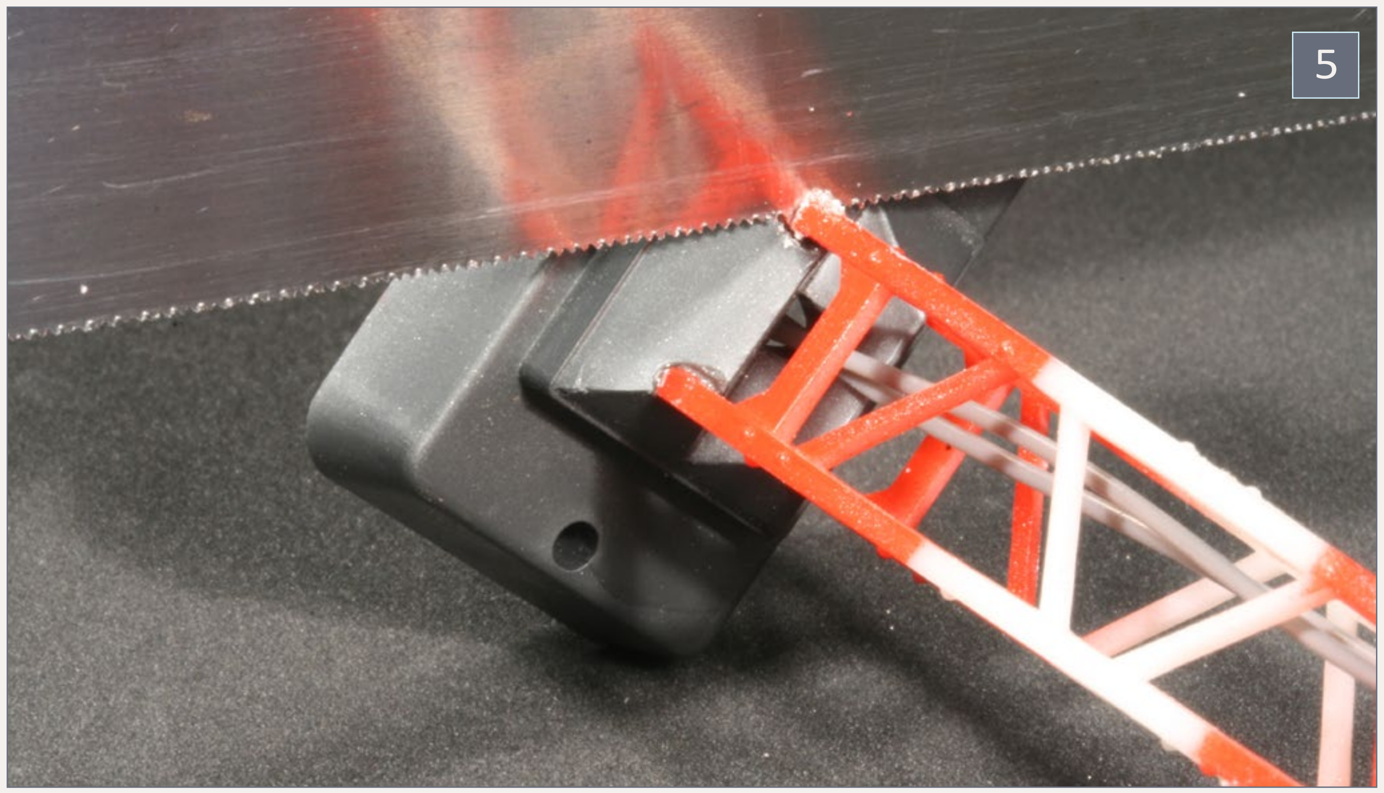
installation, we can begin constructing our own vignette using an accessory commonly found in the scrap bins of many train show vendors – the Tyco Microwave Tower. Originally marketed in the Tyco Light-Ups line, this model is still available today from NJ International (#525-1974). Although it's unreasonably short for its intended microwave installation, its 38' scale height and lattice framework make it ideal for kitbashing into a base station antenna tower.

First step: Disassembly

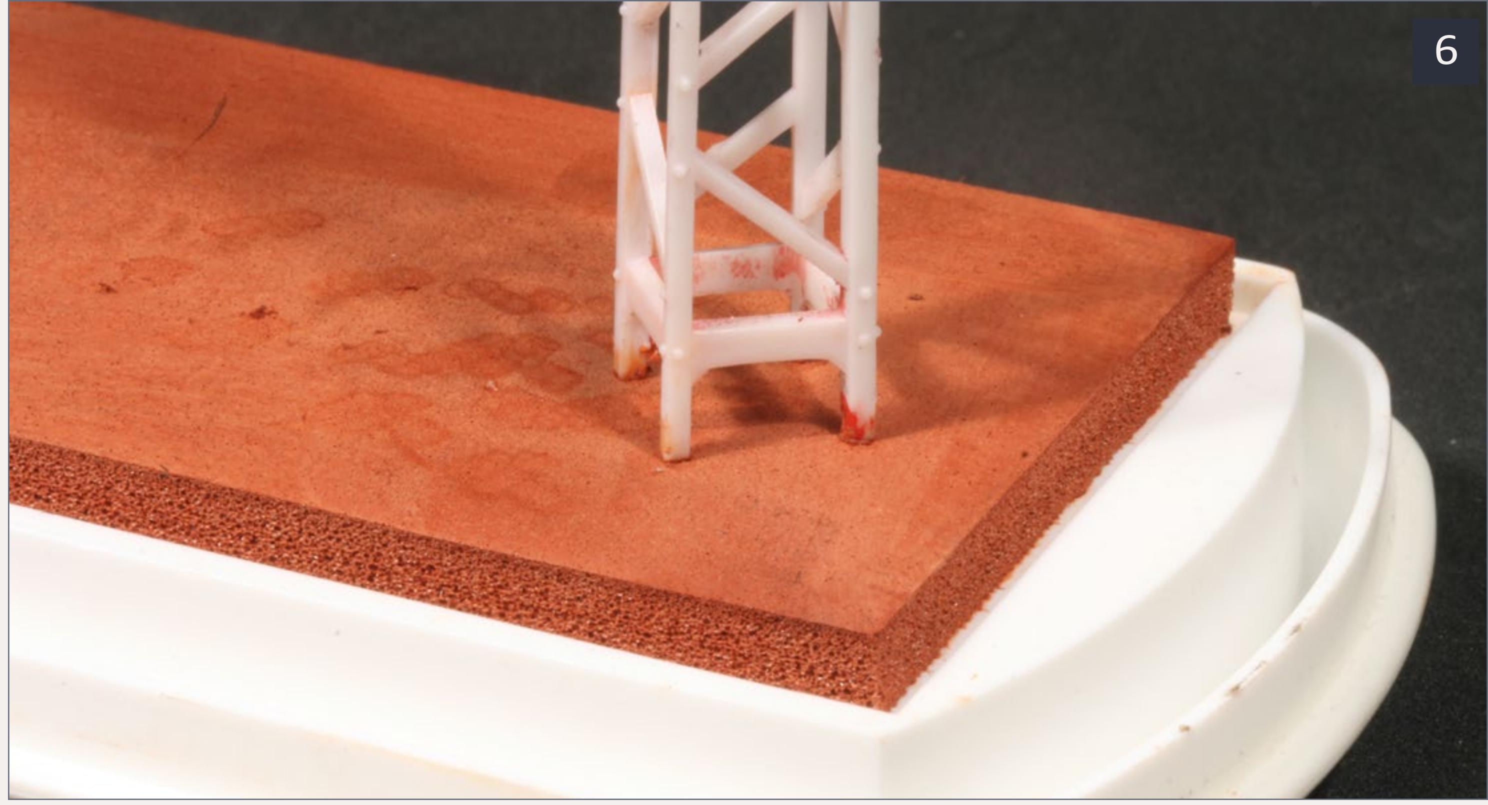
Initially produced in the 1960s, the Tyco tower is typical of many older accessories, with thick paint and copious amounts of glue making disassembly the first step in enabling the tower to be tailored to its new use.

As this was designed as an operating electrical accessory, we'll begin by cutting the two wires extending between the rear of the base and the microwave dish at the top of the tower, removing the wiring from the hole in the base. With the wiring severed, we can now remove the dish casting and bulb mount assembly from the top of the tower by gently pulling it intact from the tower. If it cannot be removed due to glue, cut or break off the small mounting stem of the bulb housing and leave it embedded in the top of the tower. The final step in tearing it down is to remove the crude oversize base from the lattice tower by carefully cutting through each leg with a razor saw. Leave as much of each leg intact as possible.

We are now left with a bare lattice tower that can be rebuilt from the bottom up, starting with a new concrete base. Unlike the Tyco accessory, the concrete base of a tower is generally small and low profile, easily replicated by a single square of Evergreen #4518 sidewalk styrene. Pre-scored into ½" x ½" squares, a single square presents us with a base 43 scale inches across and .040" thick, deep enough to rise above its surrounding ground cover, yet shallow enough to easily blend with its surroundings.



5: The final step in tearing it down is to remove the crude oversize base from the lattice tower by carefully cutting through each leg with a razor saw.



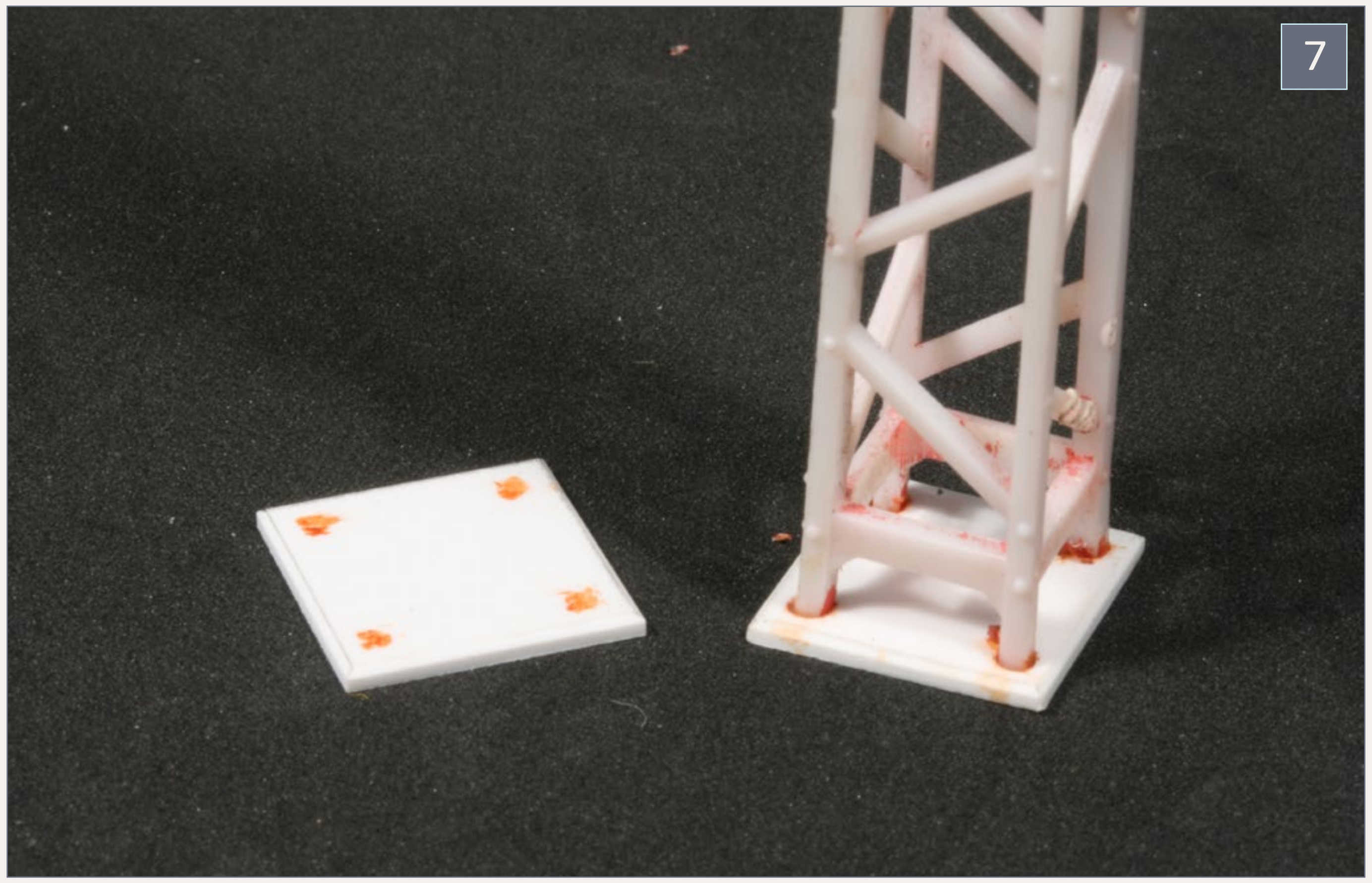
6: Level all four legs of the tower with a file. Take your time so that the tower will stand vertical and not lean to one side or the other.

Locating tip

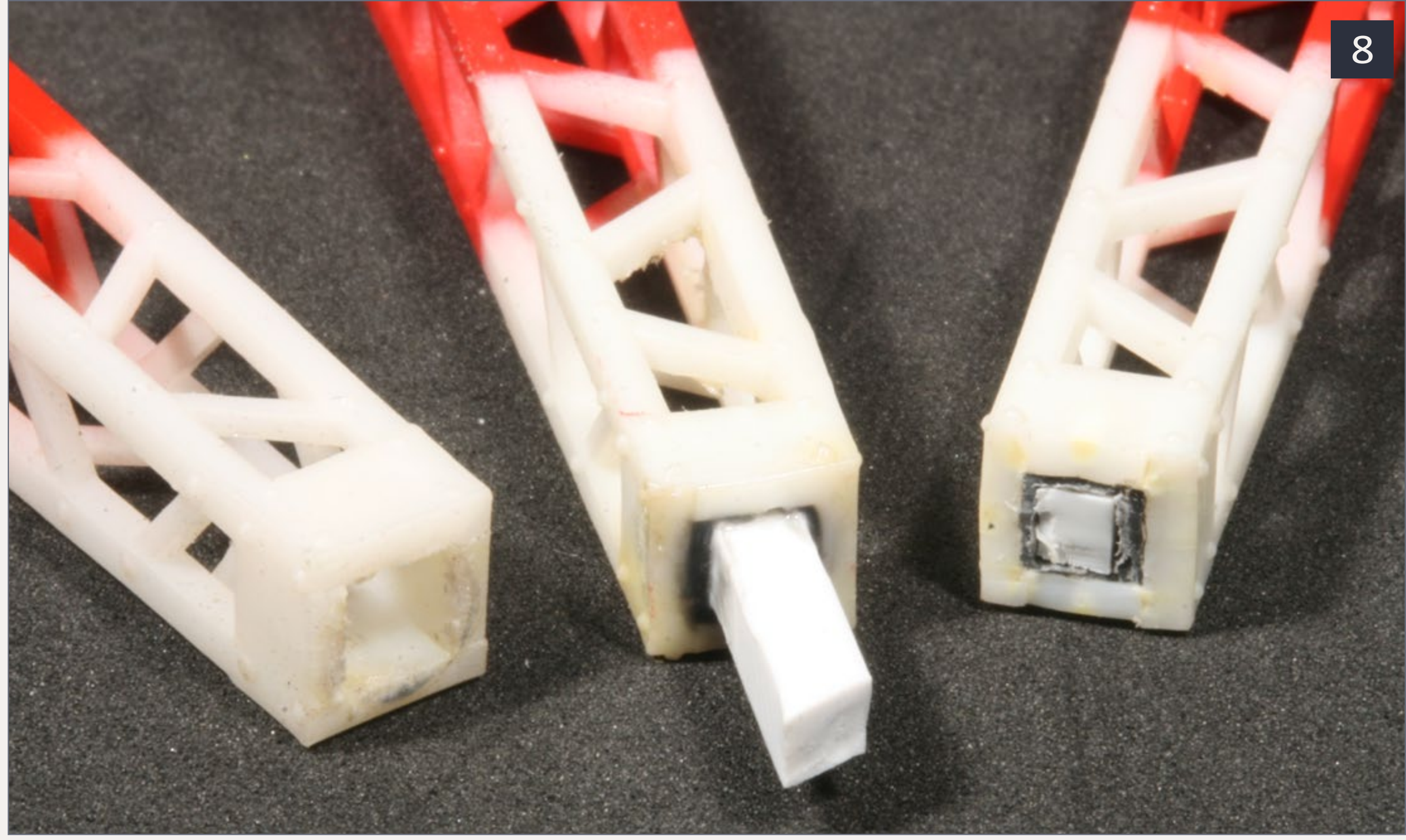
While creating the new base requires little more effort than snapping scored styrene, mounting the tower on it can be frustrating and time consuming. Anyone who has ever installed a detail with multiple mounting stems can attest how difficult aligning the drill points can be. Mounting the tower on the base requires drilling four holes, one for each leg of the tower. Rather than locate the drill points by measuring and marking intersecting lines, an easier way is to level all four legs of the tower with a file and then dip them into a stamp pad. Carefully place the tower on the base, allowing the bottom tip of each leg to transfer the stamp ink to the base, instantly creating accurate points that can be drilled with a pin vise.

With the base complete, we can move to the opposite end of the tower. Removing the dish and bulb assembly from the top of the tower leaves a large hole which must be filled to support the new whip antenna. If the bulb housing was removed cleanly, cement a short length of Evergreen #105, .100 x .100” styrene strip into the top of the tower and cut it flush. This will fill this large hole. The thick factory-applied red and white paint can be removed with Scalecoat 2 paint stripper, leaving a clean surface suitable for airbrushing a dull steel color

After airbrushing, the rebuilt tower can be further tailored to its new use by adding several antennas suitable for way-side base stations. A photograph of the Norfolk Southern



7: Dip the legs into a stamp pad. Carefully place the tower on the base, allowing the bottom tip of each leg to transfer the stamp ink to the base, instantly creating accurate points that can be drilled with a pin vise.



8: A short length of Evergreen #105, .100 x .100” styrene strip into the top of the tower and cut it flush. This will fill the large hole.

installation reveals a long omni-directional whip style located at the top of the tower. Replicating this style of antenna is almost effortless using thin brass rod which can be easily cut and formed. However, in this instance, looks may prevail over true prototype dimension.

Scale parts and visibility

In photography, we often encounter a phenomenon known as perspective distortion, wherein the angle of a photograph will change the way elements appear in the photo. Similarly, when we view an object such as a tower-mounted antenna, it may appear a different size or even a different color depending on factors such as lighting and the background it is viewed against.

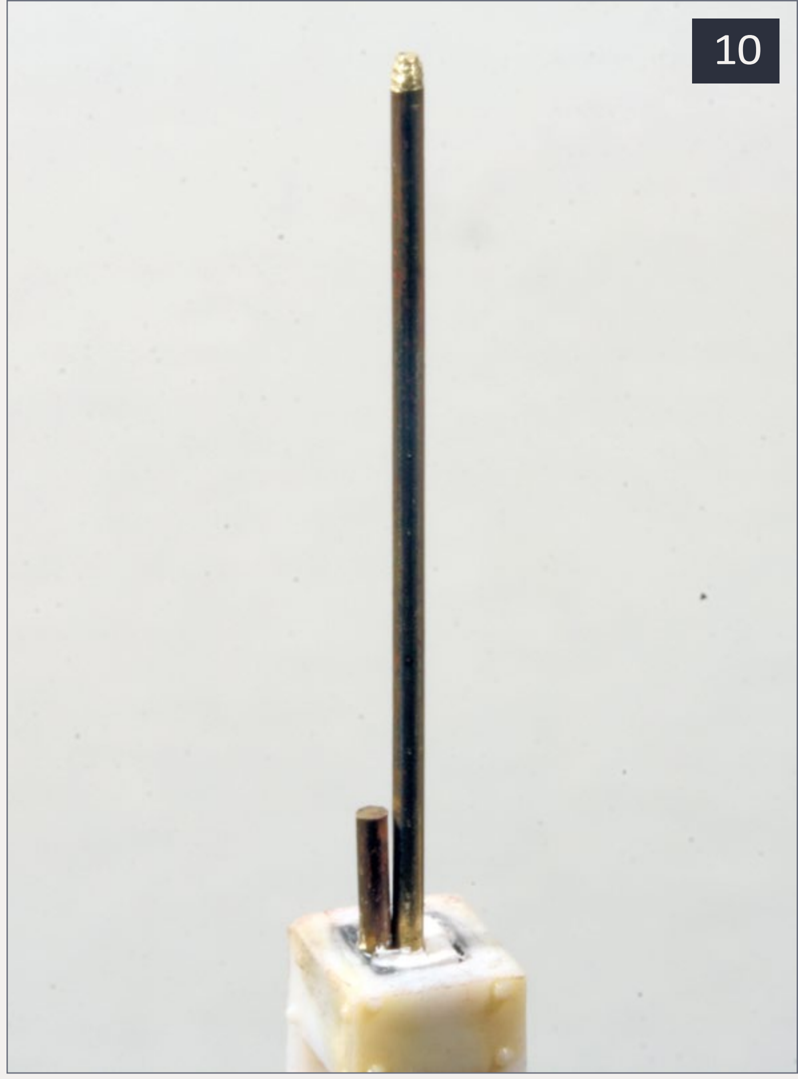
Keeping this in mind, I recommend using materials with dimensions that look good in your own individual situation, basing them on the angle of view, the proximity to the viewer, and the tower's surroundings.

9: The Norfolk Southern installation reveals a long omni-directional whip style located at the top of the tower. The smaller directional antennas have the look of an older style television antenna, often referred to as yagis.

For example, to create the base antenna for my own tower, I chose .033” diameter brass rod (Detail Associates #2509) whose scale diameter is nearly twice that of the typical prototype base antenna. Likewise, I doubled the typical 42-48” length, which makes the thick antenna appear thinner yet still provides enough mass to stand out amongst the trees and busy backdrops.

After choosing an appropriate size, it’s now simply a matter of constructing the antenna and its support pipe, then adding them to the top of the tower. Cut two lengths of rod, the first to a scale 24” and the second to the desired antenna length, adding 12 scale inches. Next, drill two holes of the corresponding rod thickness into the top of the tower, locating the two side by side and as close together as possible.

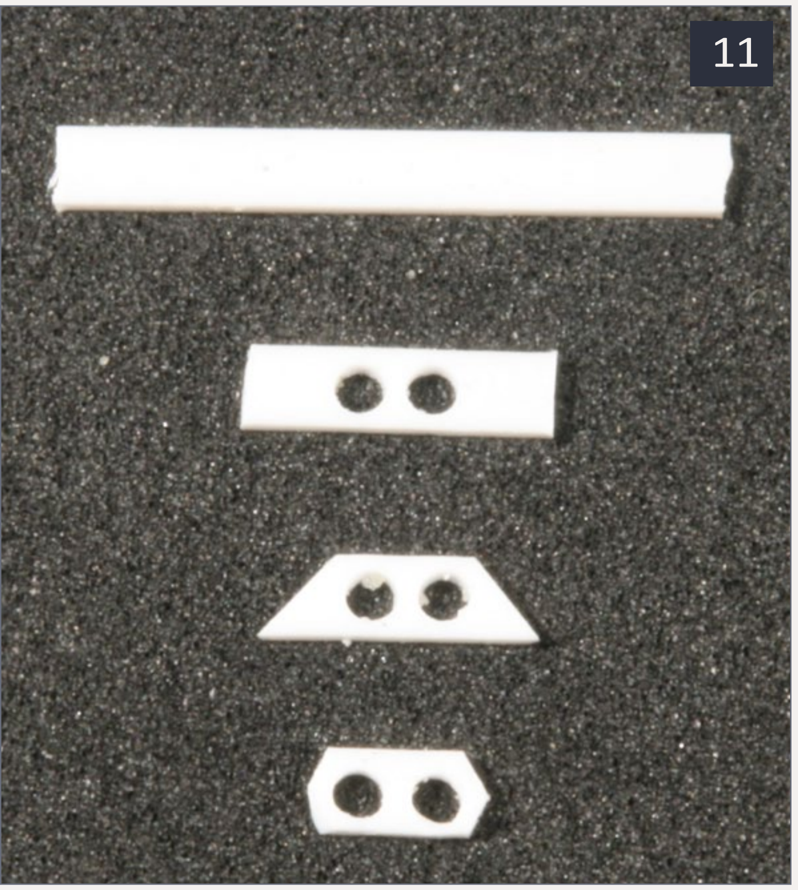
Cement the shorter rod in place, allowing half of it to extend from the top of the tower to form the support pipe. Then insert, but do not cement, the antenna rod into the hole adjacent to the support pipe.

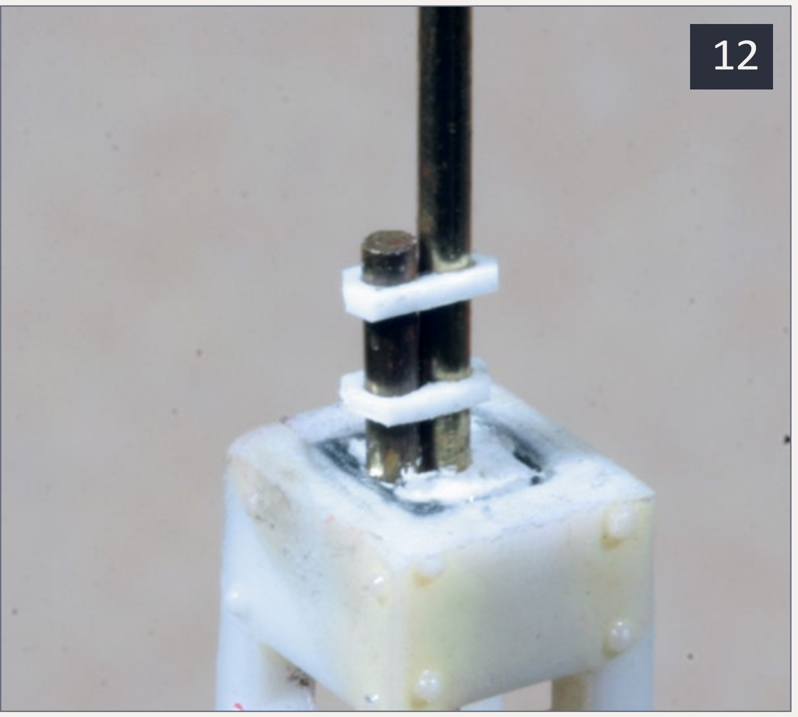


10: With both the antenna and support pipe extending upward from the tower, we can now fashion brackets from styrene strip to tie them together.

With both the antenna and support pipe extending upward from the tower, we can now fashion brackets from styrene strip to tie them together. Since very little material is required, almost any size of .015” or .020” thickness styrene can be used to form the brackets, provided it is wider than the rod diameter and longer than the horizontal measurement of the two rods mounted side by side. I chose two ½” long pieces of Evergreen .015” thick styrene strip, which were slightly wider than the rod stock. The plastic was left over from another project, now rescued from scrapbox oblivion.

Begin by drilling two holes side by side, one for the support pipe and the other for the antenna. Next, transform the rectangular strip into a long triangular shape by cutting at a downward angle from top to bottom, removing the excess material extending outwards beyond each hole. Finally, cut downward forming a long rectangular hexagon that will slide over both the support pipe and antenna. Then, test fit each tying bracket, further adapting them with a knife or file as necessary. Once you are satisfied with their look and fit, both the antenna and tying brackets can be removed for painting. When the paint has dried, permanently reinstall them to complete the long omni-directional antenna atop the tower.



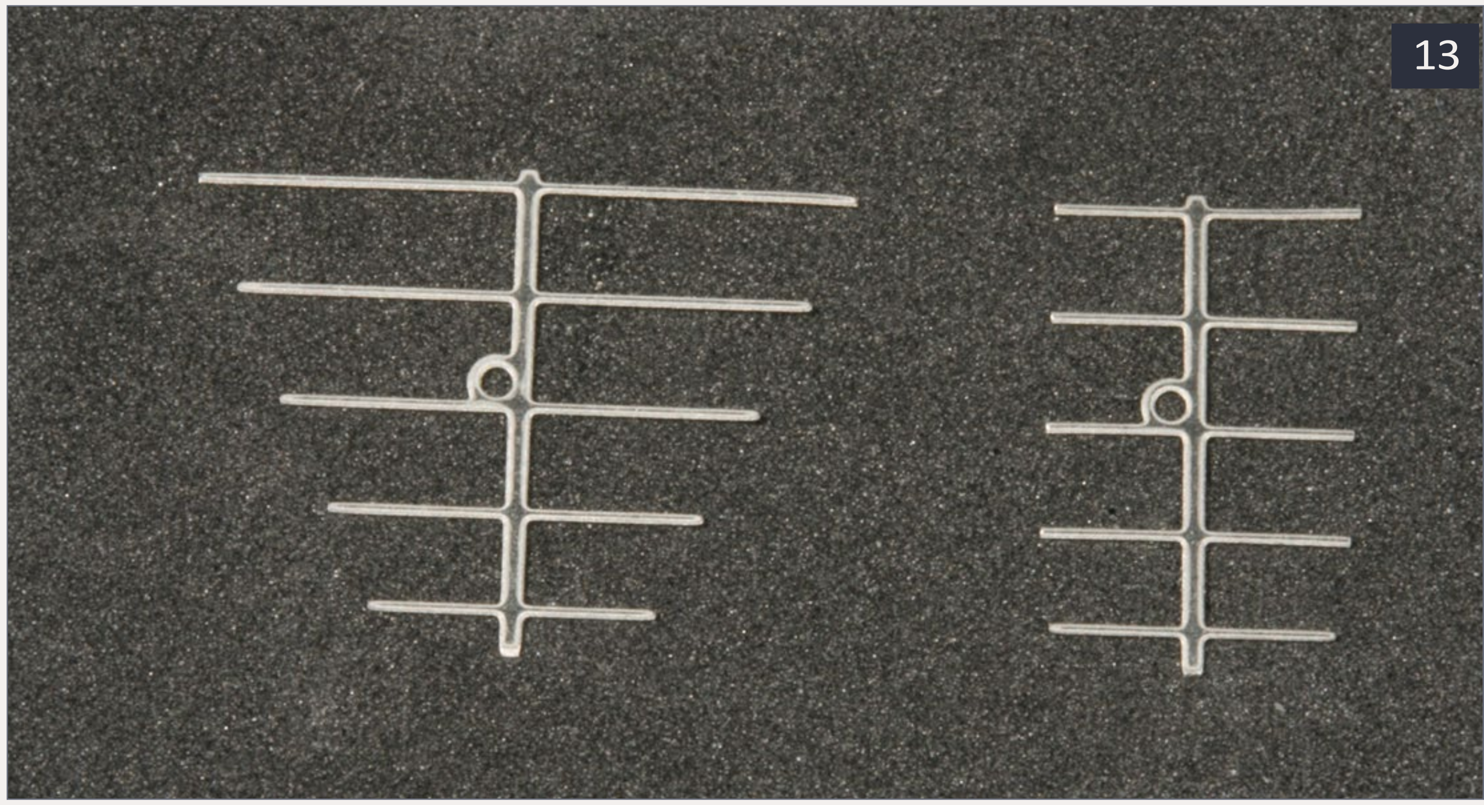


11 - 12: The brackets that tie the support pipe and antenna together are made from .015" styrene strip.

Add the small antennas

While the large whip antenna may be the most dominant feature of a base station tower, it is also common for a tower to carry multiple smaller antennas as well.

Often referred to as yagis, these smaller directional antennas have the look of an older style television antenna and are easy to replicate using Gold Medal Products #8705 rooftop TV antennas. Each photoetched metal kit provides us with three styles of large antennas that can be easily modified into smaller railroad band VHF antennas by simply trimming the thin metal, then mounting the antennas to the lattice frame of the tower.



13: The "yagis" are Gold Medal Products TV antennas.

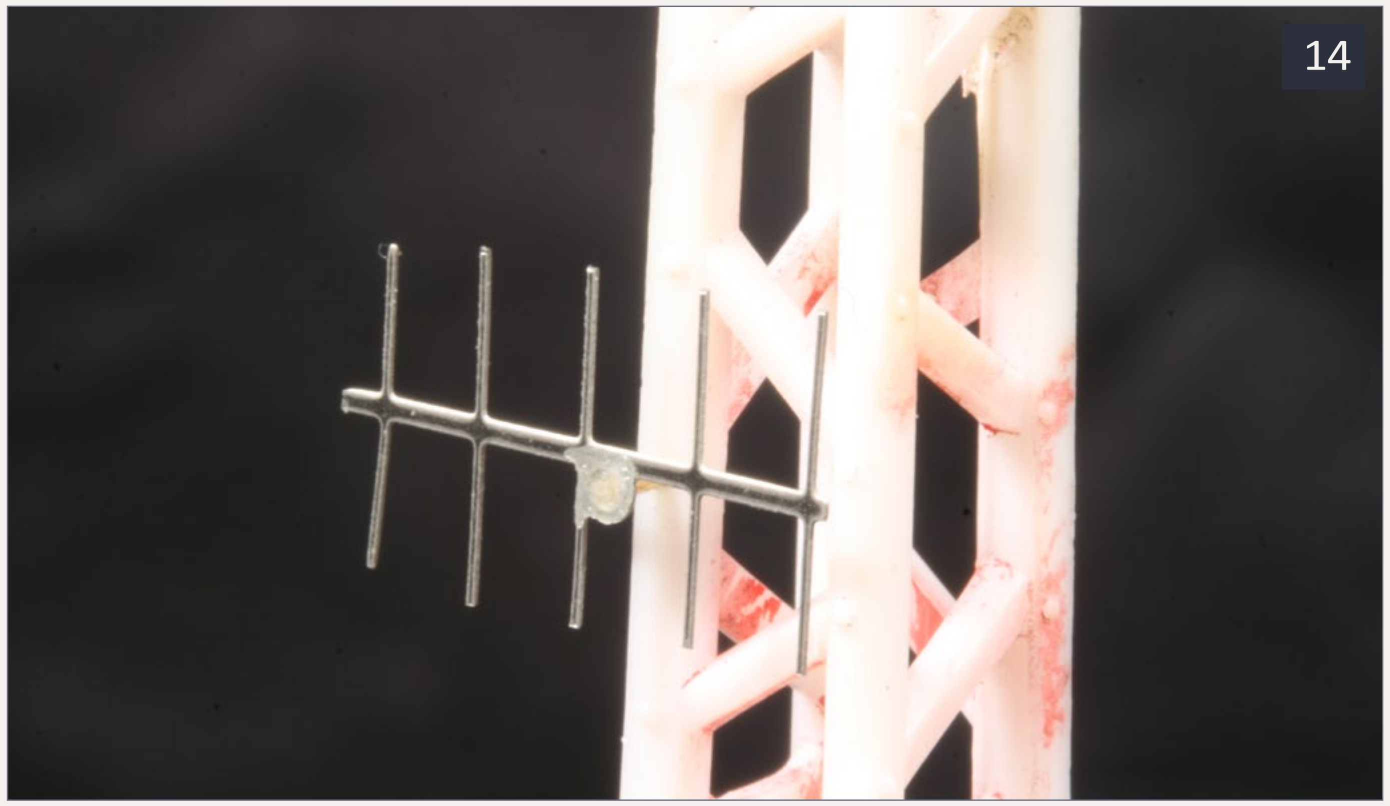
With the centerpiece of our base installation complete, we can focus on the ground level. With the electronics concealed in an equipment enclosure adjacent to the tower, all we need to model is the enclosure itself. A large electrical box manufactured by BLMA (#4312) has both the correct size and look for this type of modern installation.

While the enclosure generally follows the standards established by a particular road, one difference of a radio base enclosure is the addition of air conditioning. Radio equipment is temperature sensitive and it is common for a base enclosure to have a small window style air conditioner fitted, relieving the sensitive electronics from heat build up.

Replicating this requires nothing more than cementing a white metal casting to the enclosure. A Scale Structures #2467 window air conditioner provides a one-piece casting small enough to look appropriate without overpowering the front of the enclosure.

Make a sign board

The final step in creating our base station vignette is to add a small sign giving a hint to why this particular lineside installation is there. Creating a plain alpha-numeric sign similar to the one mounted to the Norfolk Southern enclosure is easy using a home computer with a spreadsheet program. All it requires is choosing the correct font, then typing in the characters several times using varying sizes such as 8, 9, and



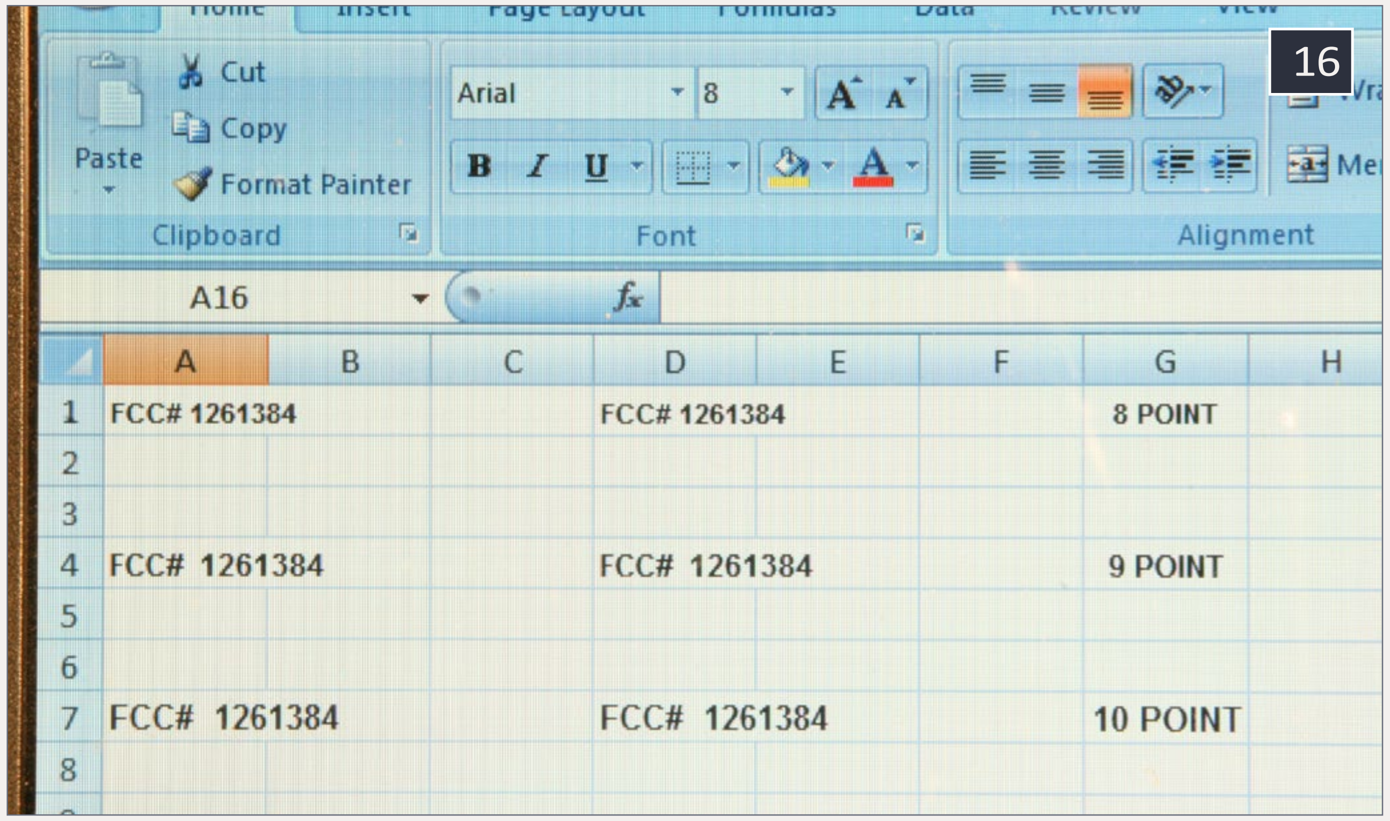
14: Each photoetched metal kit provides 3 styles of large antennas that can be easily modified into smaller railroad band VHF antennas by simply trimming the thin metal then mounting the antennas to the lattice frame of the tower.

15: The prototype equipment enclosure on the Norfolk Southern. I modeled my equipment cabinets after these units.

10 point type. This will give us a variety of sizes to choose from. Now the sign can be printed onto cardstock, reducing its size by printing using a reduced scale. Then cut the sign to size and mount it to the front of the enclosure, the FCC moniker telling everyone this is a radio installation.

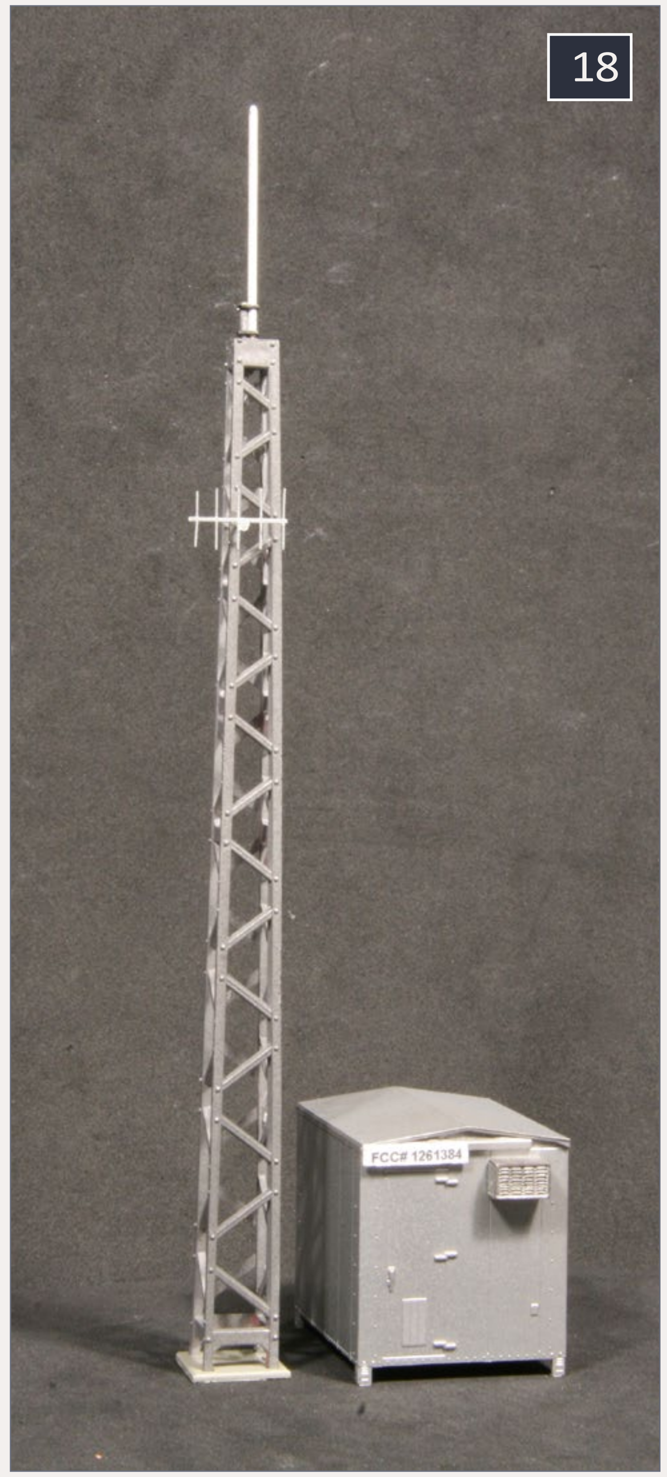
Adding a modern lineside detail to the layout does not require major effort or expense. It may also provide new life for an older accessory that we may have passed over as toy-like, giving it a home beside the latest of our high-tech scale models. ☑

Information continued on the next page ...



16: Creating a plain alpha-numeric sign similar to the one mounted to the Norfolk Southern enclosure is a rather easy task using a home computer with a spreadsheet program.

17: The completed equipment cabinet.



18: The completed equipment cabinet and radio tower ready for installation on the layout.

Parts List

Microwave tower – Tyco (out of production) or NJ International (#525-1974)

Concrete base – Evergreen #4518 sidewalk styrene

Filler for top of tower – Evergreen #105, .100 x. 100” styrene

Whip antenna and support pipe – Detail Associates #2509, .033” brass wire

Antenna brackets – Evergreen .015” styrene strip

‘Yagi’ antenna – Gold Medal Products #8705 rooftop TV antennas

Equipment housing – BLMA #4312 large electrical box

Air conditioner – Scale Structures #2467 window air conditioner

Paint remover – Scalecoat II paint remover for plastics (#640-10568)

Paint – Testors Steel, Floquil Concrete, Floquil Reefer White ■

M.R. (Matt) Snell has been a model railroader and railfan for 30 years. His interest in railroading blossomed while growing up in New Jersey surrounded by multiple freight and passenger rail lines including Amtrak's Northeast Corridor.

Presently residing in Ohio far from his railroading roots, Matt and his wife Debbie share the hobby, modeling the area he grew up in: north-central Jersey.

Their "Conrail New Jersey Division" layout has been featured in Great Model Railroads, Rail Model Journal, and in the Allen Keller Great Model Railroads DVD series. Matt has had articles in Railroad Model Craftsman, RailModel Journal, Scale Rails and Model Railroader, as well as online at railroad.net.

Railroad Radio

As modelers we commonly add detail castings representative of radio communication to our models without giving any thought to how radio systems work and how vital they are to modern rail operations.

Most railroad radio communication in the USA and Canada utilizes 96 radio frequencies located between 160 and 162 MHz on the VHF (Very High Frequency) radio band. The frequencies are standardized by the American Association of Railroads and each has been allocated a channel number between 2 and 97. Modern radios are capable of accessing the full spectrum. In the past, with simpler radios, leading locomotives had to be a home road unit equipped with the proper radio channels for the territory it was operating in.

In addition to the VHF spectrum, bands on the UHF (Ultra High Frequency) spectrum are also in limited use for End-Of-Train telemetry. Both bands can be monitored with a hand-held scanner, enabling railfans to hear conversations between dispatchers and trains, crews performing switching, talking defect detectors, and other rail operations.

While 96 channels are available, it is important to note that only certain channels are in use within specific geographic areas and that specific channels are also designated by road. This insures that everyone within a railroad district is using the same frequencies. The frequencies for a geographic area or rail line are generally listed in the railroad's employee timetable.

Listening in

Monitoring railroad communications can be more than just fun, it can help us learn how the prototype operates while also providing a useful tool for railfanning.

AAR Channel Designations

Ch	Frequency	Ch	Frequency	Ch	Frequency	Ch	Frequency
2	159.81	26	160.5	50	160.86	74	161.22
3	159.93	27	160.515	51	160.875	75	161.235
4	160.05	28	160.53	52	160.89	76	161.25
5	160.185	29	160.545	53	160.905	77	161.265
6	160.2	30	160.56	54	160.92	78	161.28
7	160.215	31	160.575	55	160.935	79	161.295
8	160.23	32	160.59	56	160.95	80	161.31
9	160.245	33	160.605	57	160.965	81	161.325
10	160.26	34	160.62	58	160.98	82	161.34
11	160.275	35	160.635	59	160.995	83	161.355
12	160.29	36	160.65	60	161.01	84	161.37
13	160.305	37	160.665	61	161.025	85	161.385
14	160.32	38	160.68	62	161.04	86	161.4
15	160.335	39	160.695	63	161.055	87	161.415
16	160.35	40	160.71	64	161.07	88	161.43
17	160.365	41	160.725	65	161.085	89	161.445
18	160.38	42	160.74	66	161.1	90	161.46
19	160.395	43	160.755	67	161.115	91	161.475
20	160.41	44	160.77	68	161.13	92	161.49
21	160.425	45	160.785	69	161.145	93	161.505
22	160.44	46	160.8	70	161.16	94	161.52
23	160.455	47	160.815	71	161.175	95	161.535
24	160.47	48	160.83	72	161.19	96	161.55
25	160.485	49	160.845	73	161.205	97	161.565

There are several ways we can listen in on railroad communications. The traditional way is to use a scanner, a radio capable of listening to communications in the VHF and UHF radio spectrum. Programmable radio scanners are available in both hand-held and mobile/base models with various features. A scanner for monitoring railroads should be capable of receiving the 160-162 MHz range, the frequencies reserved for railroad communications.

IMPORTANT: Laws governing scanner usage while in a vehicle vary from state to state. It is essential to verify the laws in your region prior to purchasing or using radio equipment.

A second way to listen to railroad communications is via live radio streams on the Internet. These online scanner feeds allow us to listen in on radio talk from various roads or regions around the U.S. For more information on live streams visit: **railroadradio.net**. ■

Information continued on the next page ...

Detailing A Radio Equipped Fleet

Careful observation of prototype equipment will generally provide us with evidence of radio equipment invisible from the outside. One telltale is an antenna, a detail many modelers have been adding to their fleets for years. Antennas for rail equipment are often specialized, and their style and placement varies from road to road. Antennas are optimized for performance in the service and the operating terrain.

Several of the most common are:

- The whip antenna. This style of antenna is most commonly found on vehicles and maintenance of way equipment. Some roads have chosen the whip style for locomotives and cabooses as well. Found in lengths from 12“ to 36”, this detail can be easily added using thin wire inserted into a small hole drilled into the roof of the equipment.
- The Sinclair antenna. Looking more like a large handle than a radio antenna, the Sinclair style is used almost exclusively by railroads. Commonly installed on the roof of a locomotive cab, the Sinclair is a detail that can be added using castings from Detail Associates, Details West, and several other parts manufacturers.
- The End-Of-Train antenna. Resembling a much smaller version of the Sinclair style, the EOT antenna is common to roads using end of train equipment that transmits on the UHF band.
- The firecracker antenna. Aptly named, the firecracker style is one of the most visible antennas, as it stands straight up from the roof it is installed on. While an easy detail to add using castings, it is also easily broken so a metal casting is recommended for models that will be handled.

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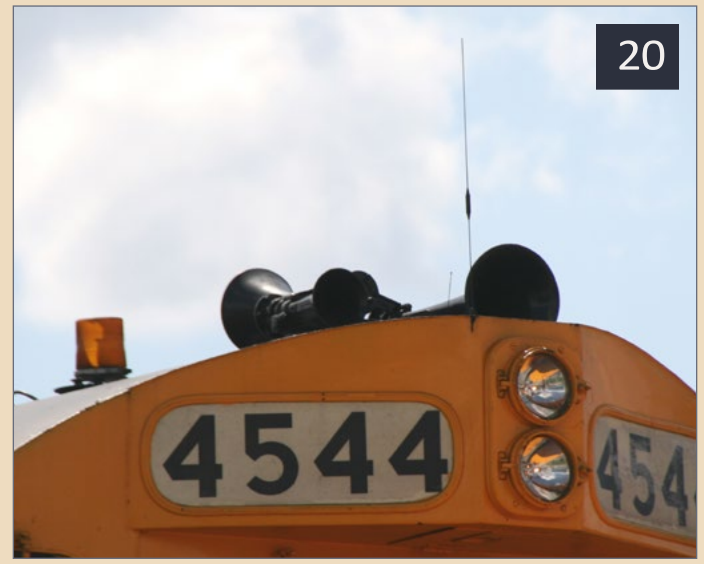

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19-20: The roofs of this maintenance truck and a locomotive show two installations of whip antennas. Whips are generally mounted near the center of a roof to create a ground plane which optimizes the performance of the antenna.

- The dome antenna. A more modern installation, the dome incorporates multiple antenna technologies within one enclosure. Found in square, octagonal and round styles, this detail is available from multiple manufacturers, including Hi-Tech Details whose white plastic molding requires no painting.
- The antenna array. Becoming more common as radio equipment becomes more advanced are arrays consisting of multiple antennas capable of transmitting and receiving data, voice and GPS data.

Information continued on the next page ...

21: The roof of this Norfolk Southern locomotive provides a clear contrast between the Sinclair style and the smaller EOT antennas. Multiple antennas often indicate the locomotive is equipped with additional specialized radio equipment for features such as DPU (mid-train helper) control, allowing the additional units to be operated from the lead locomotive.

22: The firecracker may be the most visible antenna, as it stands straight up from the roof. It also makes it the most susceptible to damage on our model locomotives.

23: This Norfolk Southern locomotive shows us the large square dome style that incorporates multiple antenna technologies into one protected unit.

24: This array on the roof of a CSX locomotive shows us a variety of antennas, including a small whip, a wide cone, and a small dome style. ■

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