Micro Engineering Company

ASSEMBLY INSTRUCTIONS
TALL STEEL VIADUCT
Light Weight Bridge
75-513 HO 150 ft, 75-540 HOn3 150 ft

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I. GENERAL
• This Micro Engineering Tall Steel Viaduct models a light weight bridge that is found throughout the U.S. on modern as well as early twentieth century railroads. This type of bridge is used to span deep valleys with a stronger, more permanent bridge than the wooden trestles it often replaced. The bridge can be built for straight or curved track down to a 24" radius. As assembly proceeds, it's fun to see how the weak, floppy individual parts go together to form a strong, sturdy bridge.
• Most parts in this kit are made of injection molded styrene plastic and can be glued with MEK solvent or a styrene cement (such as Testors®). We strongly recommend using a glass tube cement applicator. If using Delrin® plastic track, glue it and the white metal parts with a cyanoacrylate (CA) or a rubber based cement (such as Pliobond®, available from Micro Engineering).
• Read each instruction step completely before proceeding with that step. Refer to the photos and box label for reference.

II. TALL STEEL VIADUCT ADD-ON KITS
• Tall Steel Viaduct bridges can be customized in a variety of ways or entirely new bridges can be designed and built. There are a number of basic and add-on HO-HOn3 Tall Steel Viaduct kits for increasing the length, height, or configuration of the basic bridges. See the Micro Engineering Tall Steel Viaduct brochure sheet for a list of these kits.

III. NOTES
• Figure 1 identifies the major assemblies and subassemblies of the Tall Steel Viaduct. For the purposes of these instructions, the bridge stories are numbered from the bridge deck down. The Tower Height Extension kit #75-546 adds one or two more stories, identified as the fourth and fifth story, to the base of the stock, three story bents.
• The sequence of assembly for the bridge is: 1. Construct the **bent assemblies** (two); 2. Construct the **bridge spans** (three); 3. Construct the **bridge deck**; 4. Attach **Bridge Flex-Trak** to the bridge deck. 5. Attach the bridge deck to the bents.
• Parts **(6)**, **(7)**, **(8)**, and **(9)** have excess plastic that extends from their gusset plates at one or both ends. The excess plastic should be trimmed from these parts. Parts **(10)**, **(11)**, **(12)**, and **(13)** have similar extensions off their ends that are part of the part. Do **not** trim the extensions off these parts. See figure 2.

IV. PARTS
• The parts photo and parts list are shown in figure 2. The part numbers are keyed to the photo. Extra parts that will not be used are included in your kit. The sprue configuration and the number of sprues of some HOn3 parts is slightly different than that shown in the parts photo and list.
• Some sprues have a molded in sprue number. Keep the parts on their sprue until ready to assemble so the parts

Fig. 1 Assemblies / Terminology

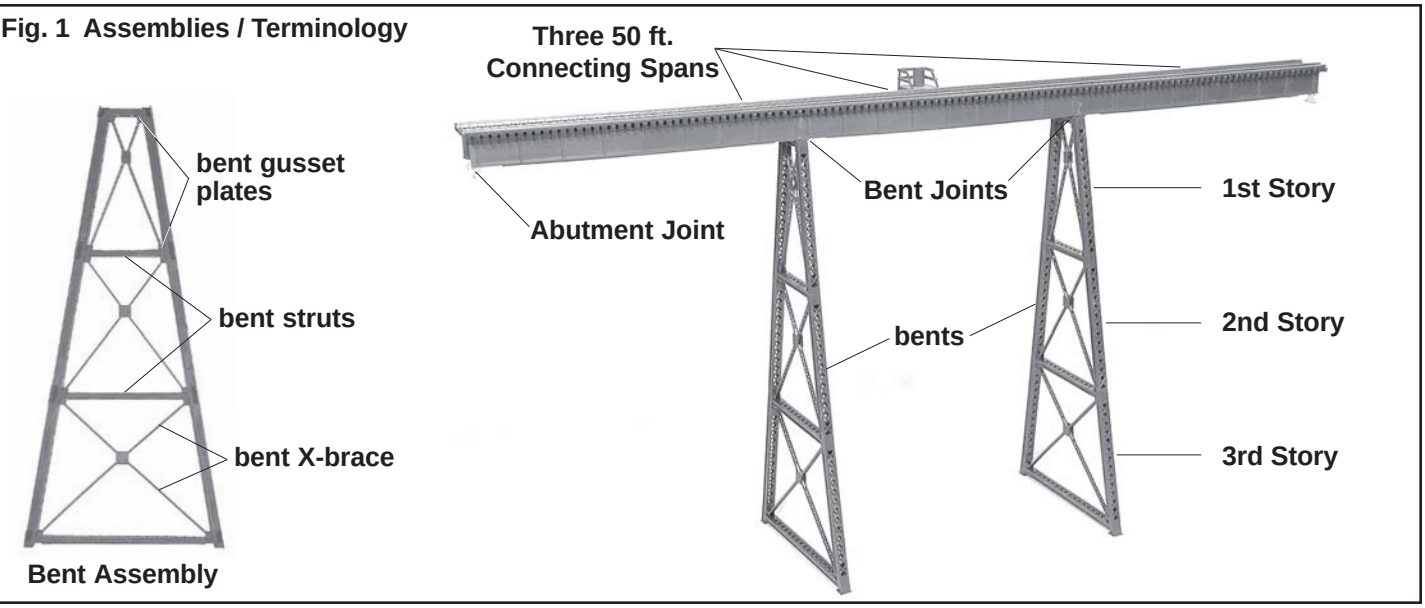
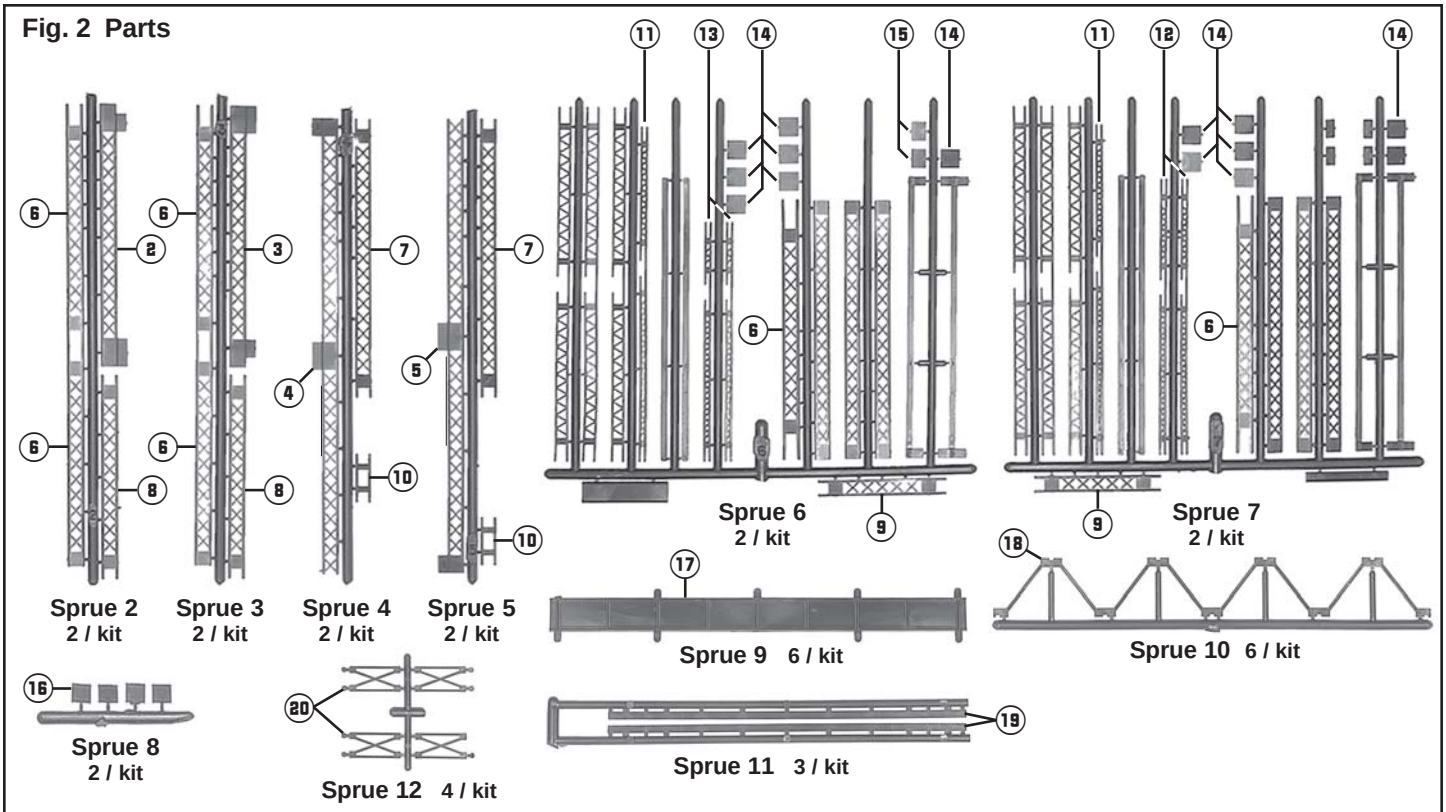


Fig. 2 Parts



Part No.	Part Name	Sprue No.	Parts Needed
1.	**bent half** (not shown)	1	4
2.	**outside bent lattice, lower LH**	2	2
3.	**outside bent lattice, lower RH**	3	2
4.	**outside bent lattice, upper LH**	4	2
5.	**outside bent lattice, upper RH**	5	2
6.	**inside bent lattice**	2, 3, 6, 7	12
7.	**bent strut lattice, 3rd story**	4, 5	4
8.	**bent strut lattice, 2nd story**	2, 3	4
9.	**bent strut lattice, 1st story**	6, 7	4
10.	**bent strut brace, top**	4, 5	4
11.	**bent X-brace, 3rd story**	6, 7	4
12.	**bent X-brace, 2nd story**	7	4
13.	**bent X-brace, 1st story**	6	4
14.	**large rivet plate**	6, 7	8
15.	**small rivet plate**	6	4
16.	**bearing plates**	8	8
17.	**50' girder**	9	6
18.	**50' lateral bracing**	10	6
19.	**50' reinforcing plate**	11	6
20.	**50' X-brace**	12	15
21.	**bridge shoes, white metal** (not shown)	---	4

remain keyed to the sprue number. When cutting the plastic and white metal parts from their sprues, file or trim off any flash, ejector pads, or gate nibs. Use care when handling the parts as some are thin and easily broken. If a part breaks, lay it on a flat surface and cement it back together. The Micro Engineering Rail Nipper #48-102 is excellent for cutting these small parts.

V. ASSEMBLY

Bent Assemblies

1. Cement two **bent halves (1)** together.

Lay a bent half flat on the work surface with its spacers up. Place another bent half on top of the first with its spacers down. Place a thick, heavy straight edge on each side of the bent assembly to align the edges flush. See fig 3. Be sure all edges of both bent halves are flush with one another. Apply cement between a spacer and the bent half and apply pressure until dry. Repeat at each spacer.

Tip: If the bent assembly develops a warp as assembly proceeds, lay the bent on a flat work surface and place weights on it after each work session.

Tip: On many bridges, some of the bent legs are shortened to fit the terrain. If using a shortened leg(s) cut the bent halves and other parts to the correct length before assembling.

2. Trim the gusset plate extensions off parts **(2)**, **(3)**, **(4)**, and **(5)**.

Note in Fig. 4 that parts **(2)** and **(4)** are shown after their gusset plate extensions were trimmed off and parts **(3)**, and **(5)** are shown before the extensions were trimmed off. Place the parts on the work surface with their

rivet sides down. With a razor knife, trim off the two gusset plate extensions, cutting along the outside edge of the raised rib.

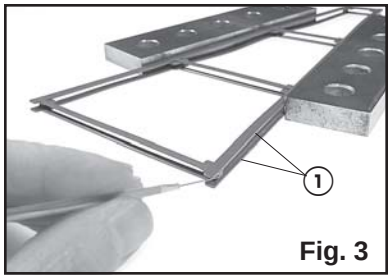


Fig. 3

3. Cement the **outside bent lattice**, parts **(2)**, **(3)**, **(4)**, and **(5)** to the bent assembly. Figure 4 shows their general position. (For clarity, the parts are shown flat in figure 4, they would actually be on edge if cemented to the bent halves.)

Note that all bent lattice parts have a raised rib along each edge on one face. To assemble the outside bent lattice, lay part **(2)** flat on the work surface with the rib side up. Place the bent assembly on edge on top of part **(2)** so the ribs are on the outside of each bent half. See fig. 5. Cement in place, one edge at a time, while holding the bent half against the rib. Be sure the end of part **(2)** is flush with the end of the bent. Repeat with parts **(3)**, **(4)**, and **(5)**.

Note: If building a four or five story bent using the Tall Steel Viaduct Height Extension kit #75-546 in conjunction with this three story bent, trim off the entire bottom gusset plate on parts **(2)** and **(3)** before cementing them to the bent assembly. Then cement parts **(4)** and **(5)** before parts **(2)** and **(3)** so they can be aligned flush with the top of the bent assembly.

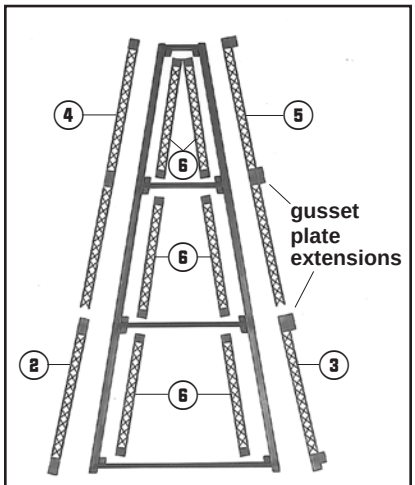


Fig. 4 Bent lattice

4. Trim the excess plastic from the gusset plates of parts **(6), (7)**, **(8)**, and **(9)** but not **(10)**. Important: See **III. Notes** on page 1.

5. Cement the **inside bent lattice** parts **(6)** to the bent assembly. Figure 4 shows their general position.

To assemble, pick up the bent assembly and hold part **(6)** against the bent edges, with its ribs outside each bent half. Apply cement along one edge at a time. See Fig. 6.

Tip: Check these parts for fit before cementing as it may be necessary to file the ends shorter so they fit between the bent gusset plates without bowing.

6. Cement the upper and lower **bent strut lattice**, parts **(7)**, **(8)**, and **(9)** and **bent strut brace**, part **(10)** to the bent assembly. Figure 7 shows their general position.

Assemble as in step 5. See Fig. 6.

Tip: It is easier to install both the upper and lower part of each story at the same time.

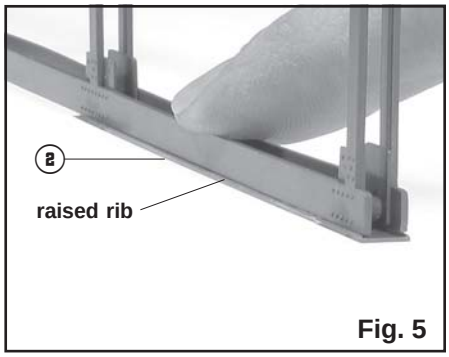


Fig. 5

7. Cement the **bent X-braces, 3rd, 2nd & 1st story** parts **(11), (12)** and **(13)** to the bent assembly or substitute truss rods for the X-braces as described in step 9. See fig. 1, 8, 10, & 11.

Position, but do not cement, a bent X-brace, part **(11)**, between the bent gusset plates at the upper right corner and lower left corner of the 3rd story. See fig. 8. Position the bent X-brace with the notch facing up and its lattice straps toward the top of the bent. Align the X-brace at each end with the rows of rivets on the bent gusset plates. Position the second bent X-brace, part **(11)**, in the opposite two corners in the same way but with the notch down. Adjust the position of the two X-braces so their slots are centered on one another. Turn the bent assembly over and adjust the position of each X-brace on the opposite side gusset plates. Once both bent X-braces are positioned correctly, without bow, cement the four ends to the gusset plates on both sides of the bent assembly. Repeat for the 2nd and 1st story X-braces.

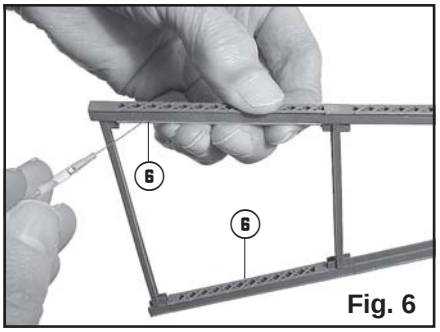


Fig. 6

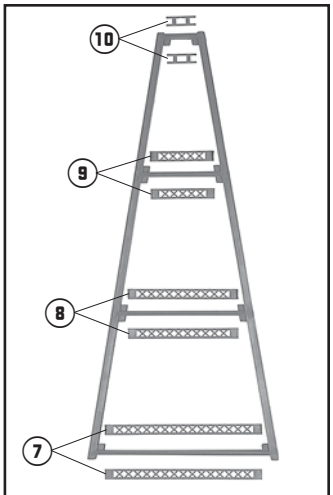


Fig. 7 Bent strut lattice

Tip: If the X-brace bows when positioned in place, it may not be pushed far enough under the gusset plate or it may be a little long. If long, remove the part, trim a little off each end, and check for fit again.

Tip: If the bent assembly is warped, adjust the X-braces as above, place the bent on a flat surface, place weights on it, then readjust and cement the x-braces.

8. Cement the **rivet plates** at the intersection of the two X-braces in each story. Use the **large rivet plates** part **(14)** for the 3rd and 2nd story bent X-braces and the **small rivet plates** part **(15)** for the 1st story bent X-braces.

Apply cement on the edges of the X-braces at their intersection. Using tweezers, place a rivet plate on the cemented area and align the rows of rivets on the rivet plate with the X-braces. See fig. 9. The edges of the rivet plate should also be vertical and horizontal. Once in correct position, apply pressure to the rivet plate so it makes contact and is cemented to all three X-brace edges. Turn the bent assembly over and cement a second rivet plate to the opposite side of the two X-braces. Be sure the two rivet plates are aligned with each other when viewed from either side of the bent assembly.

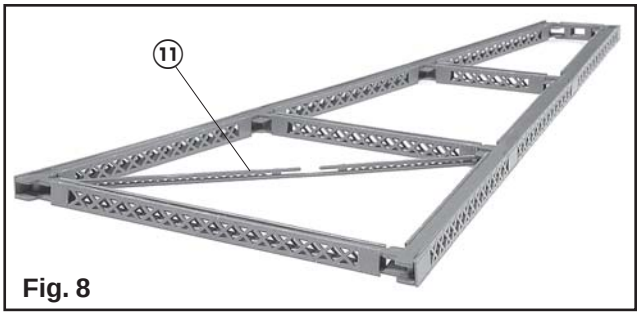


Fig. 8

Note: The rows of rivets on the rivet plates will not align precisely with the 2nd story X-braces.

Tip: Some rivet plates are easier to align and cement by laying the assembly flat on the work surface and working from the back side.

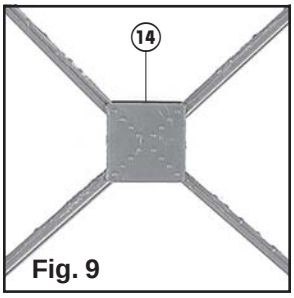


Fig. 9

9. Truss Rod Modification: Narrow gauge or light weight steel viaducts often used truss rod X-braces instead of the cross-laced lattice X-braces. To use truss rod bent X-braces, substitute .018" dia. brass wire (not included) and Grandt #4019 turnbuckles (not included) for the bent X-braces parts **(11), (12)** and **(13)**. The truss rod modification will require 24 turnbuckles and three 36" lengths of brass wire. See fig. 10 & 11.

Cut the brass wire to 4 9/16" lengths for the 3rd story, 3 7/8" for the 2nd story, and 3 5/16" for the 1st story. Thread a turnbuckle on the wire and cement the wire to the back side of the bent gusset plates with CA cement. Each leg of the X will require a pair of truss rods back to back, so each story will have four truss rods, each bent will have twelve.

Tip: The turnbuckles were often located near the center of the truss rods as shown in fig. 10 & 11. Alternatively, they were sometimes located approximately six feet above the bent struts so the turnbuckle could be reached and tightened by a worker standing on the bent strut.

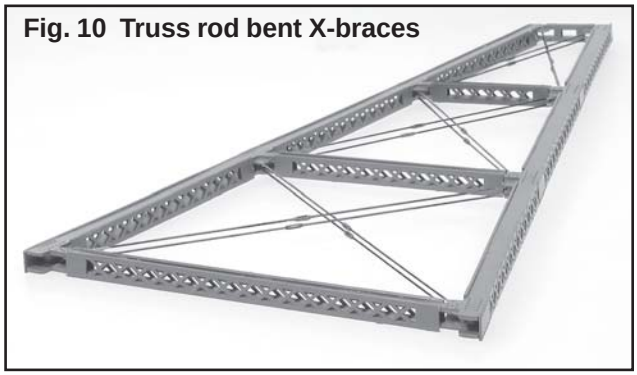


Fig. 10 Truss rod bent X-braces

10. Cement the **bearing plates** part **(16)** to the top and bottom of the bent.

Position the bearing plates against the top and bottom of the bents, centered on the four sides of the bent leg. See fig. 12. File or sand the bottom edges of the bent legs, if necessary, so the bearing plates sit level.

11. The first bent assembly is complete. Assemble one more bent assembly.

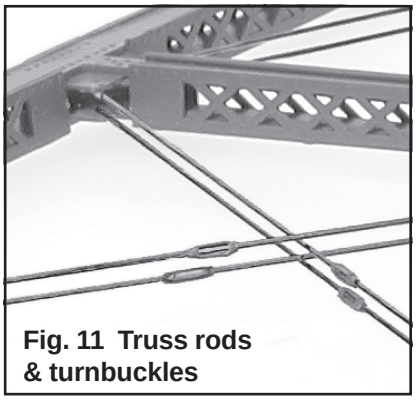


Fig. 11 Truss rods & turnbuckles

Bridge Spans - straight track bridges

Note: If you are building a curved bridge, some of the girders will need to be shortened before assembling the spans. See **Bridge Spans - curved track bridges** on page 5 before assembling the bridge spans.

12. Orient the **girder** part **(17)** correctly on the work surface.

Note that the girders have a number of vertical angles, each with an adjacent row of rivets. See fig. 13. The bridge span should be assembled so the row of rivets on the center vertical angles, on the inside face of both girders, are toward the same end of the bridge. Place a girder on the work surface so the row of rivets on the center vertical angle is to the left. With the girder in this position, the lateral bracing will be cemented to the bottom edge of the girder.

13. Cement a **lateral bracing** part **(18)** to the girder.

Hold a lateral bracing on edge with the five rivet plates down and the rivet detail to the outside of the bridge. See fig. 13. Match the notches in the rivet plates with the appropriate vertical angles on the girder. Starting at the center vertical angle cement the rivet plates against the inside edge of the girder flange. Hold the rivet plates square to the girder while the cement dries.

Tip: To avoid breakage when cutting the lateral bracing from its runner, place

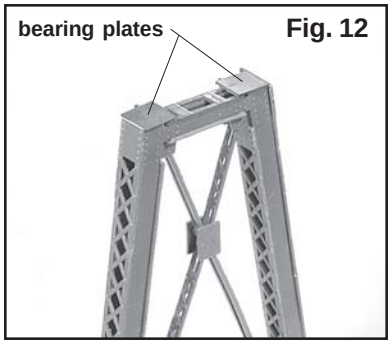


Fig. 12

the part on the cutting board with the runner off one edge of the board.

14. Cement the second **lateral bracing** part **(18)** to the second girder.

Align and cement the girder and lateral bracing in the same way as the first girder in steps 12 & 13.

15. Cement the **X-braces** part **(20)** to a girder that has lateral bracing on it.

Note that the girder X-braces have three angle flanges on one side (called the 'flange side') and one angle flange on the opposite side. Place an X-brace on the girder, positioned on the rivet side of the center vertical angle with its flange side facing away from the vertical angle. See fig. 13. Cement the X-brace against the vertical angle and against the lateral bracing rivet plate, holding it square while the glue dries. Cement the other four X-braces to the same girder locating them at the other lateral bracing rivet plates. Position them in the same manner, i.e. on the rivet side of the vertical angles and with their flange side facing away from their vertical angles. Some of the X-braces will be facing left, some will face right.

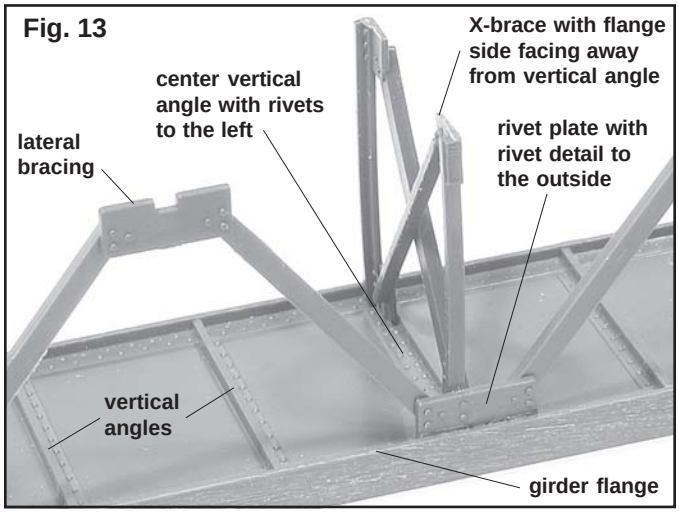


Fig. 13

16. Cement the two **girder assemblies** together to form a span.

Place one of the girders on edge with the lateral bracing down. Place the other girder on edge with the lateral bracing up and slide the two assemblies together. See fig. 14. Use rubber bands to hold the span assembly together while positioning the bracing as described in steps 13 and 15. Cement the X-braces to the opposite girder. For the bridge deck to align properly span to span, it is important that the two girders of each span be square. As with a prototype bridge the lateral bracing keeps the girders square to each other. Remove the rubber bands and place the girder assembly in a square as shown in fig. 15. Cement the lateral bracing while holding the girders against the square.

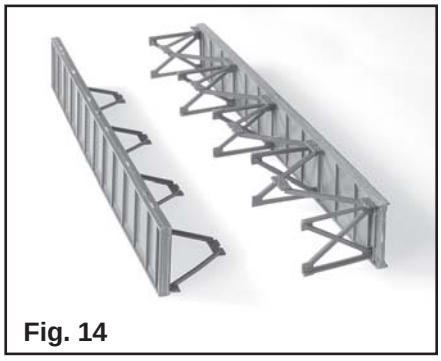


Fig. 14

Tip: Assemble the span in one work session, cementing the lateral bracing immediately after cementing the X-braces so it is easier to square up the span.

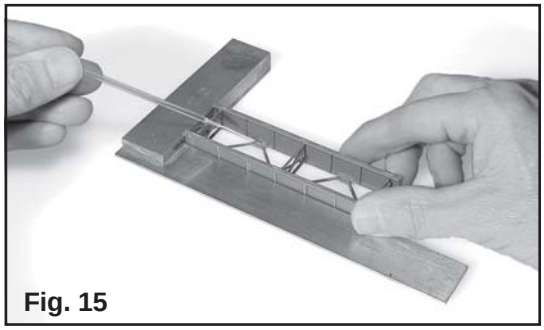


Fig. 15

17. After the cement has dried sufficiently, place the span on a sanding block and sand off the draft angle and parting line from the edges of the top, bottom, and ends of the girders. See fig. 16.

18. The bridge span is complete. Assemble two more bridge spans.

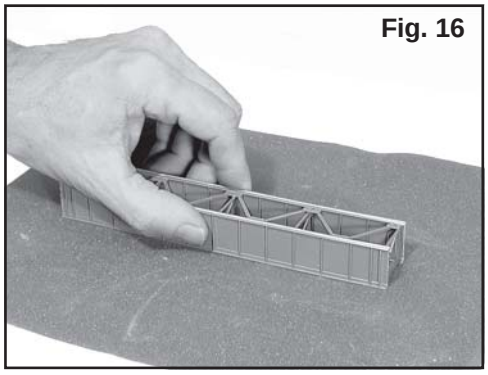


Fig. 16

Bridge Spans - curved track bridges

Construction - To build a curved TSV bridge the spans are assembled at an angle to one another. To do this, some or all of the girders on the inside of the curve will need to be shortened before assembling the spans. Which inside girders to trim and how much to trim are determined by the **radius** of the curve, the **joint lengths** at each joint (where two spans meet) and the **joint type**.

Configurations - TSV bridges can be built in several different configurations utilizing various components (See fig. 1, table 1 & 2.)

- **Span types**: are **tower spans** or **connecting spans**.
- **Joint lengths**: can be a 50 ft. to 50 ft. span, a 50 ft. to 30 ft. or a 30 ft. to 30 ft.
- **Joint types**: joints supported by towers are t**ower joints**, by bents are **bent joints**, by abutments (at the ends of the bridge) are **abutment joints**.

The bridges in these instructions use three **connecting spans** with 50 ft. to 50 ft. **joint lengths**, **bent joints** and **abutment joints**. Since there are no towers, there are no **tower spans** or **tower joints**.

Radius determination - There is a minimum **radius** for TSV bridges as determined by the tie overhang of the girder edge (see table 1 & fig. 17). The curve causes the ties to be displaced from their straight track positions.

If the curve is too sharp, the ties will not overhang the edge of the girders enough for prototypical appearance. Table 1 also lists the span angle and tie overhang for reference.

Tip: The pdf document **Curved Tall Steel Viaducts** is available from Micro Engineering. It has more details including a table listing the trim amount for all three types of **joint lengths**, 50 ft. to 50 ft., 50 ft. to 30 ft. and 30 ft. to 30 ft.

19. Use table 1 to determine the **trim amount** for the track **radius** and **joint length** at each joint. Then use table 2 to determine whether to trim by the full **trim amount** or half the **trim amount** and which girder(s) to trim based on the **joint type** at each joint.

Since the bridges in these instructions only use **connecting spans**, **bent joints** and **abutment joints**, it can be seen from table 2 that half the **trim amount** should be trimmed off both ends of all three inside girders. See fig. 17.

20. On the work surface, lay out and orient the six girders for the three spans as described in step 12. Using a razor saw and miter box trim both ends of the inside girders of all three spans. See fig. 18.

Although the "trim amount" in the table is shown in thousands of an inch, the actual amount trimmed is not particularly critical if your layout allows you to adjust the track radius to match the assembled bridge. It is important to be consistent when trimming each girder so the angle between girders is the same at each joint allowing a consistent radius throughout the curve.

Table 1 Girder trim amounts for curved TSV bridges

Curved Track Radius	Joint Lengths		
	50 ft to 50 ft Spans		
	Trim Amt.	Span Angle	Tie Over-hang
Str Trk	0	0	.120"
24" R	.272"	16.1°	.021"
27" R	.242"	14.4°	.035"
30" R	.218"	13.0°	.046"
36" R	.182"	10.8°	.062"
42" R	.156"	9.3°	.074"
48" R	.136"	8.2°	.083"

Table 2 Amount to trim and girders to trim

How much to trim, full or half, & which girder ends to trim are determined by the joint type.

Joint type	Amount to trim	Girder(s) to trim
Tower joints	Full trim amount	Connecting span girder only. The tower span girder is not trimmed, it must remain full length to fit the towers properly.
Bent joints	Half trim amount	Both connecting span girders.
Abutment joints	Half trim amount	Connecting span girder, at the abutment end.

21. Assemble the three **connecting spans** following steps 12-18 but with the following additions or changes:

a. Step 13. Fit a **lateral bracing** part **(18)** to a shortened girder and then trim the end rivet plates on the lateral bracing as necessary so they do not extend past the ends of the girder. Cement the trimmed lateral bracing to the shortened girder.

b. Step 14. Cement the second **lateral bracing** part **(18)** to a full length girder.

c. Step 15. Cement the **X-braces** part **(20)** to the shortened girder. It may be necessary to locate the end X-braces on the opposite side (non-rivet side) of the vertical angles if the rivet side has been trimmed off. These X-braces should still face the same direction as if located in their normal position.

d. Step 16. When cementing the two girder assemblies together for each span, the square cannot be utilized as shown in fig. 15. Because the spans have a shortened girder, the square cannot be placed against the girder ends. Instead, place the square against a vertical angle on the outside of one girder and visually align it with the corresponding vertical angle on the inside of the other girder.

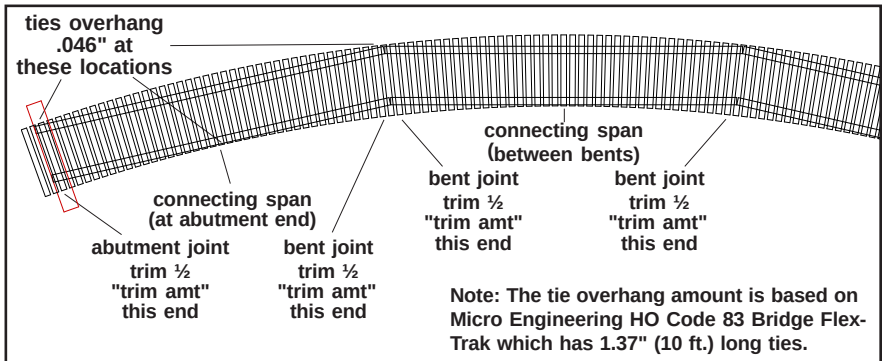
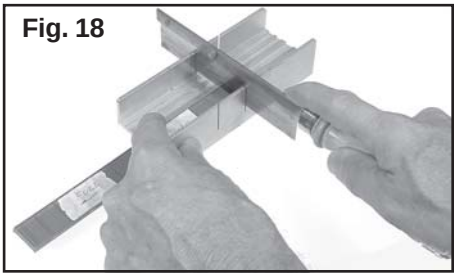


Fig. 17 Three 50 ft. girders with a 30" radius curve



Bridge Deck

22. Fit and cement the three **bridge spans** together.

Place the three spans end to end on a flat work surface. The face against the work surface will be the top of the bridge. On each span, sand the girder ends, as necessary so they make full contact and are square against the

girder ends of the adjacent span. For a curved bridge, make a full size drawing showing the locations of the angled spans for the track radius used (similar to fig. 17 but without ties). Use the drawing as a template to file or sand the shortened girders to attain the proper angle and alignment between spans. For a straight track bridge, use a straight edge to align the three spans. See fig. 19. Apply cement between the girder ends to cement the three spans together. Use weights on the spans to insure that the track side of the girders are flush with each other.

23. Center and cement the **reinforcing plates** part **(19)** to the bottom edge of each girder.

24. Cement a **bridge shoe** part **(21)** to the end of each girder at the abutment ends of the bridge.

Tip: Use CA cement for the white metal bridge shoes.

25. Paint and weather the **bents** and **bridge deck** at this point, before installing track and final assembly.

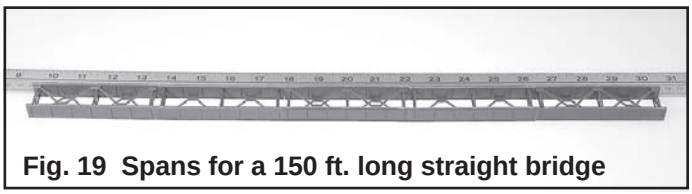


Fig. 19 Spans for a 150 ft. long straight bridge

Bridge Track

Micro Engineering Code 83 or Code 70 **Bridge Flex-Trak** is available separately in 36" lengths and includes a pair of lighter weight guard rails, guard timbers with bolt head detail, and four barrel platforms with barrels. The track is not included with the Tall Steel Viaduct kit because a one piece length needed to span the bridge does not fit in the kit box. The following instructions are for use with the Micro Engineering Bridge Flex-Trak.

26. Shape the **Bridge Flex-Trak** to fit the straight or curved bridge deck.

Use the bridge deck, a straight edge, or a drawing as a guide to bend the track so it fits the deck properly. Adjust the position of the ties so they are spaced evenly. Trim the ends of the track. You may want to trim the rails to different lengths and longer than the bridge deck, extending them onto the regular track so the rail joints can be staggered.

27. Cement the **guard timbers** to the top of the ties.

Position the guard timbers, with the bolt head detail up, two scale inches (.023") in from the tie ends. See fig. 20. For curved bridges cut the guard timbers to shorter lengths and install them at an angle to follow the curvature.

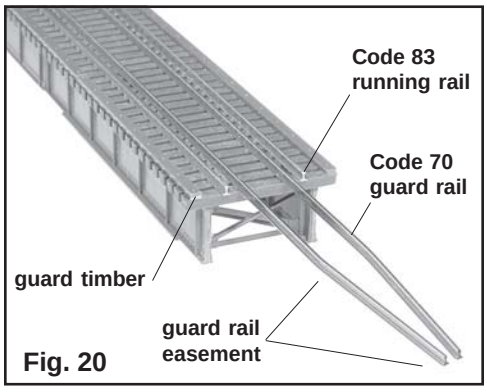


Fig. 20

28. Cement the **guard rails** to the Bridge Flex-Trak.

On prototype bridges lighter rail than that used for the running rails was usually used for guard rails. Extend the guard rails 20 to 40 scale feet (2□" to 5□") off the ends of the bridge, onto the regular track. Using CA or Pliobond, cement the guard rails between the rows of guard rail spikes molded on the Bridge Flex-Trak. Form the easement at the guard rail ends by curving the last 1" to 2" of the guard rails in toward the track center until the rail ends almost touch. See fig. 20.

29. Assemble the **barrel platforms**.

Use two weights to hold the right frame upright, with its railings to the outside. Place the platform on the right frame with the planks running side to side and then slide the left frame under the platform. See fig. 21. Position the platform square with the right frame and flush with the outside face of the side railings and apply cement. Repeat for the left side frame. Cement the two back railings in place with their wood grain detail to the outside. Position and cement the barrel, without its lid, in the center of the platform. Do not attach the barrel platforms to the track yet.

Note: Barrel platforms were used during the steam era to extinguish fires on bridge decks. Use one or two Barrel platforms spaced one half or one quarter of the bridge length in from each end.

Fig. 21

30. Paint and weather the **Bridge Flex-Trak** and **barrel platforms** at this point.

31. Cement the **Bridge Flex-Trak** to the **bridge deck**.

Lay the bridge track up-side-down on a piece of cardboard and position the bridge deck in place on top of the track so it is aligned correctly with relation to the ties. Place a pair of straight pins on each side of a girder in several places. See fig. 22. Remove the deck and apply cement to the top edges of the girders. Put the bridge deck back in place on the ties and place weights on the deck until the cement dries.

Tip: Use Pliobond cement, cat. no. 49-102 to cement the bridge deck to the track ties.

Final Assembly

32. Cement the **barrel platforms** in place between ties.

Locate the barrel platforms on the bridge as outlined in step 29. Insert the frame timbers between ties and push the platforms in until the diagonal frames are just short of the guard timbers on the Bridge Flex-Trak. Cement the side of the platform timbers to the side of the ties with CA cement. Be sure the platforms are level.

Tip: If the platforms sag, lightly sand or file the bottom of the main frame members.

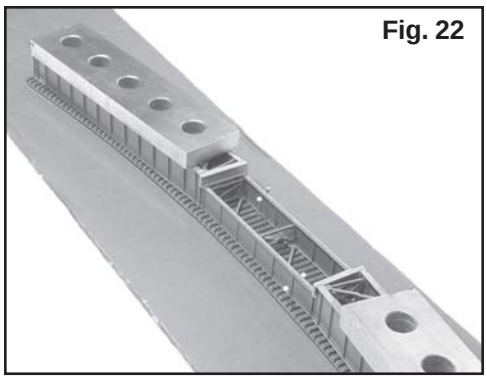


Fig. 22

33. Cement the **bents** to the bottom of the **bridge deck**.

Place the bridge deck up-side-down on the work surface. Cement the bents to the bridge deck centered on the joints where the bridge spans meet. Be sure the bents are square to the bridge deck.

34. Install the **finished bridge** on your layout.

The bridge shoes should rest on bridge abutments and the bents on bridge piers, installed on your layout.