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Adhesives used in model railroading

Model railroaders use a whole host of different materials in their modeling. Some are fairly general and will bond just about anything. Others are very specialized to the materials. The following are properties of adhesives most commonly used in the hobby.

Acrylic matte medium is sold in virtually all art stores and many craft stores.

ACRYLIC MATTE MEDIUM

(Example: Liquitex Matte Medium) Available at art stores. Although it's initially milky in appearance, matte medium dries clear. When thinned, it's ideal for adhering loose scenery or ballast to layouts. Although thinned white glue will also work in those instances, it leaves a sheen, whereas acrylic matte medium doesn't. Some modelers believe using acrylic matte medium on ballast makes the trains quieter because it doesn't dry to be as rigid as white glue.

CONSTRUCTION ADHESIVES

(Examples: Liquid Nails for Projects, Loctite PL 300 Foamboard Adhesive) These adhesives are usually used for large scenery surfaces made from layers of extruded foam insulation, and occasionally for tracklaying. Look for those made to be used specifically on foam insulation, because others may contain chemicals that can dissolve the foam.

Two varieties of foam-safe adhesives by Loctite.

SILICONE ADHESIVE/CAULK

(Examples: GE All Purpose caulk, DAP Alex Plus and Alex Fast Dry) Even though the names contain the word "caulk," these products act well as flexible, removable adhesives. Many modelers will use these caulks (either clear or white) to hold track in place on cork roadbed. If the track needs to be moved or removed, it's a simple matter to slip a knife between the roadbed and track and break the seal.

Silicone caulk, in either clear or white, will work effectively as an adhesive.

CONTACT CEMENT

(Examples: Pliobond, Walthers Goo) These cements work well on dissimilar materials and usually remain slightly pliable after they cure, making them ideal for applications with vibration or expansion properties. They're also perfect for joining larger sheets of wood, paper, or plastic laminate (e.g. Formica) to wood. Apply contact cement to both pieces to be joined, then wait until the glue is no longer tacky or shiny before pressing parts together. This is one of the few adhesives that will work on "engineering plastics" such as Delrin, but using it on styrene or similar plastics should be avoided because the solvents of these cements can "off-gas" for weeks or months and distort the plastic.

Although Walthers Goo and Pliobond are both contact adhesives, when cured Goo is much more rigid than Pliobond.

CYANOACRYLATE ADHESIVE (CA, ACC, "SUPER GLUE")

(Examples: Zap, Jet) Sometimes generically called "super glue," these adhesives are ideal for joining dissimilar materials, especially wood, plastic, metal, and resin. Humidity in the air and on pieces to be joined activates the adhesive. Formulations range from thin and watery to thick gels. Joints using thin CA must be very close-fitting to obtain a good bond. Use gels in vertical applications where running is a problem or where materials are porous (e.g. ceramics or wood).

A CA accelerator will cure a CA joint in seconds. CA should be stored in a cool, dry place, and storing it in a refrigerator or sealed canister with silica gel will greatly prolong its life. CA will cause fogging on clear plastic and won't work on acetal plastics (such as Delrin). Acetone, CA debonder, or nail polish remover with acetone will work for freeing accidentally glued parts or fingers.

The "Zap" family of cyanoacrylate adhesives is one of several popular brands. The adhesive comes in a variety of thicknesses.

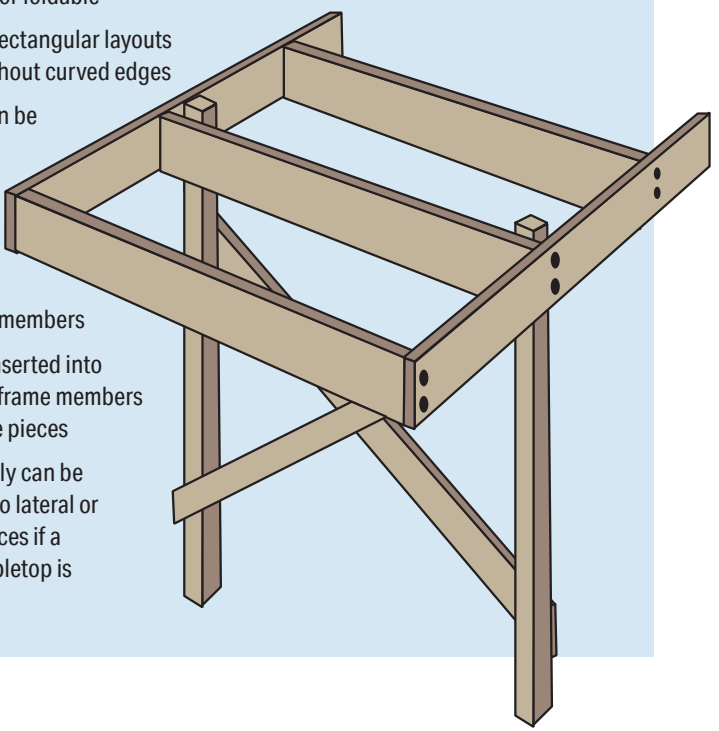
Benchwork basics

Benchwork is literally the foundation of any model railroad layout. There are several different types of benchwork, and your layout may be built on only one type or a mixture. The object of the game is to do whatever it takes to support the track and prevent your layout from falling down.

BUTT-JOINT BENCHWORK (box frame, open frame)

In this type of benchwork, sometimes called box-frame or open-frame benchwork, the layout is supported on a frame of 1 x 3 or 1 x 4 dimensional lumber arranged in a grid. Though frame elements are commonly rectangular, odd-shaped arrangements may be needed for some layout configurations. Frame members may be secured with glue and screws or brads driven through the sides and into the ends of the joists, or cleats of 2 x 2 lumber can be used to reinforce the corners. Plywood can be placed directly on top of this framework to form a flat tabletop, or risers can be used to elevate sections of subroadbed above tabletop level.

- ✓ Ideal for self-contained, portable layouts, especially when legs are detachable or foldable
- ✓ Perfect for rectangular layouts or those without curved edges
- ✓ Tabletop can be thin
- ✗ Requires precise cutting and fitting of all frame members
- ✗ Fasteners inserted into the ends of frame members can split the pieces
- ✗ The assembly can be vulnerable to lateral or bending forces if a plywood tabletop is not used



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L-GIRDER BENCHWORK

L-girder construction is one of the most popular and versatile methods of making benchwork. The construction consists of a 1 x 3 or 1 x 4 board (the "web") topped with a 1 x 2 or 1 x 3 board (the "flange") attached with glue and screws to form an "L" cross-section. Horizontal joists are then attached with screws drilled up through the flange of the L-girder, and risers are attached to those to support the subroadbed at the needed height.

- ✓ Allows a wide degree of design flexibility
- ✓ Sturdier than butt-joint benchwork because fasteners don't go into the end grain of the wood
- ✓ Easy to move framing members if switch machines or other "below grade" items need to be installed in a specific spot
- ✓ Accommodates "free form" layout edges more easily (just make the joists longer or shorter)
- ✓ Easy to assemble
- ✓ Joints don't need to be cut precisely
- ✓ Uses less lumber than butt-joint framing

HOLLOW-CORE DOORS

Literally made from a hollow-core door (available at most home centers), this benchwork is ideal for modelers just starting out with a small layout. The benchwork is manageable in size and sturdy enough to support itself. Add commercially available folding table legs for a portable layout or module.

- ✓ Lightweight and easily portable
- ✓ A typical door (2′-6″ wide by 6′-8″ long) is ideal for a small N scale layout, but is too narrow for a turnback curve in HO scale (an 18″ radius curve needs a minimum 40″ wide table)
- ✓ Great for shelf layouts and multi-deck model railroads where benchwork thickness is an issue
- ✓ Construction material costs are minimal
- ✓ Benchwork can be built very quickly
- ✗ Unless more material (such as extruded-foam insulation board) is stacked on top of the door, below-grade features like bodies of water are not possible

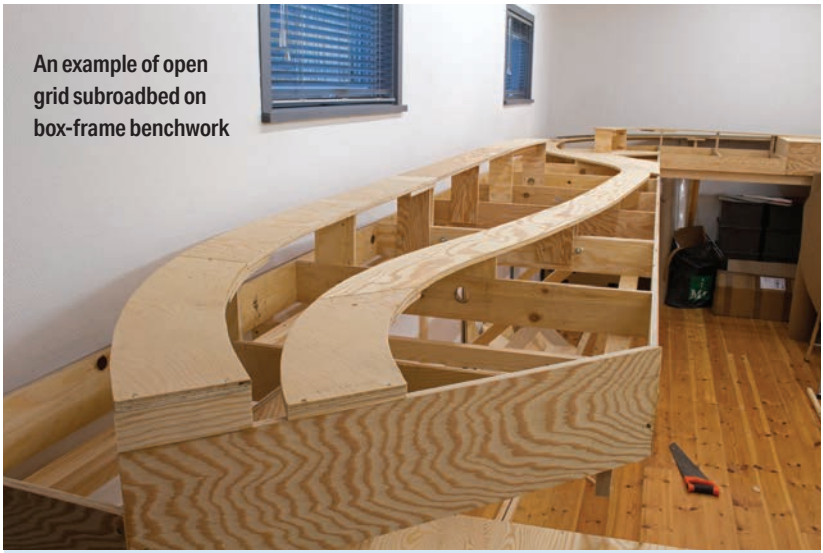
PLYWOOD TABLETOP

A flat piece of plywood (or hollow-core door) is fastened directly atop the benchwork. This lets the modeler get a quick start on a layout.

- ✓ Great way to test out track configurations; easy to rearrange track segments as needed
- ✓ Inexpensive, thin plywood can be used, since the benchwork frame adds rigidity
- ✗ Makes it difficult to model below-grade scenery like waterways and overpasses
- ✗ Adding elevated track is difficult

TYPES OF SUBROADBED

There are a few ways to support trains, and each of these methods can be used with any of the benchwork types outlined above.



An example of open grid subroadbed on box-frame benchwork

Pelle Søeborg

OPEN GRID

Instead of using a full piece of plywood atop the benchwork as in tabletop construction, open-grid consists of a "ribbon" of plywood or other material – the subroadbed – slightly wider than the track's roadbed, following the path of the track. Areas where there is no track are removed. The subroadbed is attached to the benchwork by risers of different lengths, allowing changes in elevation. The space between the tracks is filled in with hardshell terrain, extruded-foam insulation board, and/or flat plywood for areas like towns.

- ✓ Changing track elevation is straightforward
- ✓ Easy to add "below grade" scenery like ponds, ravines, ditches, etc.
- ✓ If you plan your saw cuts well, a lot of subroadbed can be cut out of a single sheet of plywood
- ✗ Thicker plywood (at least ½", preferably ¾") must be used to prevent warping and sagging
- ✗ Difficult to adjust the track plan after subroadbed cutting and construction has begun

Drill and tap sizes

Model railroaders are always having to drill holes in various materials for machine screws and bolts. Although some manufacturers sell drill bits and taps as a set, this chart will make it easy to find the correct sizes if you need to replace a drill or tap or if the set gets separated.

Thread size	Outside Diameter	Tap Drill	Clearance Drill
0000-160	0.021	#78	#73
000-120	0.034	#71	#63
00-112	0.047	#61	#56
00-96	0.047	#62	#56
00-90	0.047	#62	#56
0-80	0.060	#55	#52
1-64	0.073	#53	#48
1-72	0.073	#53	#48
2-56	0.086	#50	#43
2-64	0.086	#49	#43

Adapted from Kadee #246 Tap and Drill set instructions. Used with permission.

IMPORTANT: Because cutting tools may shatter when broken, always wear eye protection.

To drill and tap a hole, determine what size machine screw or bolt you'll be using, then use the chart above to choose the correct tap drill. Use a pin vise or drill press to make the initial hole. Install the tap in a pin vise (not a drill press), dip the tap in oil (for metal only), insert the tap into the hole, and slowly turn clockwise. Be sure to hold the tap parallel with the hole. Reverse the tap a half-turn at frequent intervals to break the chips loose from the tap. Remove the tap after five or six complete turns.

A clearance drill creates a hole large enough for the machine screw or bolt to pass through without engaging the threads and is usually the size of the bolt's shank adjacent to the head. This is useful when two parts are to be held together with bolts; the clearance drill is used on the part that will hold the head of the screw.

Stationary bridge types

It would be impossible to depict on these pages every variation of every type of railroad bridge ever built. In fact, dozens of articles about bridges have been published in *Model Railroader* magazine, and Kalmbach Media has published a number of books on the subject, the most recent being Jeff Wilson's *The Model Railroader's Guide to Bridges & Trestles.*

These drawings will help you quickly identify a general bridge type.

In his article "Bridge Basics" printed in the October 2008 issue of *Model Railroader*, Tony Koester mentions these bridge do's and don'ts:

- Most railroad bridges are deck girder bridges, some disguised as truss bridges. Be sure that both ends of each beam or girder are supported by an abutment or pier or tied to a truss at a panel joint.
- Don't butt a bridge to an abutment; rather, rest it atop a shelf on the abutment. Gravity pulls downward, so support each span from below.
- A bridge's height-to-length ratio is typically around 1:10. A long, thin bridge made by butting several girders together will require intermediate support at each girder joint.
- The rails on a curved bridge can't arc outside of the supporting beams or girders placed under the ties.
- Trusses or girders themselves shouldn't be curved.
- Stone arch bridges require an arching row of stones that spring upward to a centered keystone.
- Suspension bridges and railroads don't mix.

COMMON BRIDGE TYPES

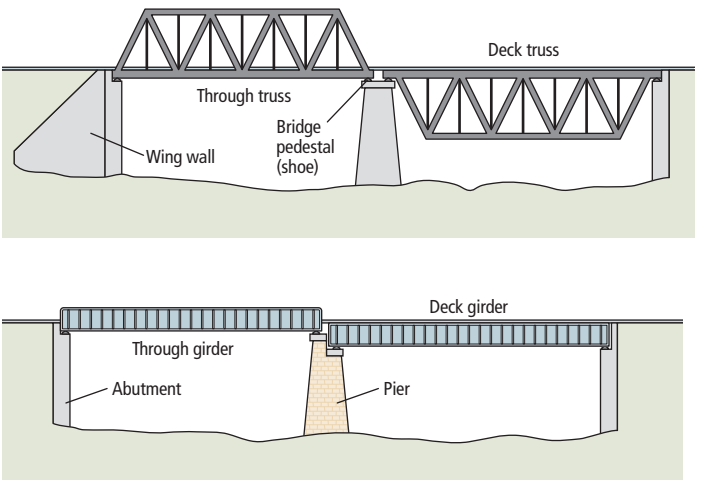


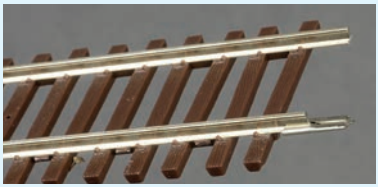
Illustration by Rick Johnson

Joining different sizes of rails

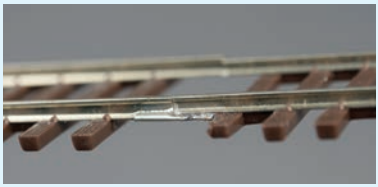
Many modelers trying to create a prototypical look for their layouts use a heavier rail for their traffic-heavy main lines and a lighter rail for less-traveled sidings and spurs. In such a case, a "transition rail joiner" is needed.

MODELER-MADE TRANSITION RAIL JOINERS

An age-old solution for transition rail joiners is to slip a joiner halfway onto the larger size rail and flatten the open half using a vise or pliers. The smaller rail is then soldered on top of the flattened portion. It's important to ensure both the tops and inside edges of the two railheads align so that wheels don't catch on the joint.



A code 83 rail joiner is flattened to accommodate a smaller code rail.



A piece of code 70 rail is soldered to the top of the flattened rail joiner.

In most cases, the flattened portion of the rail joiner can be bent up or down to compensate for different sizes of rail.

COMMERCIALLY AVAILABLE SOLUTIONS

It's important to note that rail joiners are generally not interchangeable between brands of rail, so check with the manufacturer of the rail you're using to see if they make transition rail joiners in your scale.

Atlas Model Railroad Co. makes these transition rail joiners:

- Code 100 to code 83 for HO scale
- Code 80 to code 55 for N scale

MicroEngineering makes these transition rail joiners for HO:

- Code 100 to code 83
- Code 100 to code 70
- Code 83 to code 70
- Code 70 to code 55

Other manufacturers make rail joiners that fit more than one size rail:

- Atlas Model Railroad Co. makes "universal" rail joiners that fit both its HO code 100 or code 83 rail.
- Peco makes joiners that fit its HO code 83, 75, and 70 rail, and N scale code 80 and 55 rail.
- Lionel makes HO joiners that fit both its code 100 and 83 rail.

Sector plates

A sector plate is an efficient space-saver when a modeler's layout space is too tight for a full track ladder. The sector plate is a track or tracks mounted on a board that pivots at one end so it can align with one or more approach tracks.

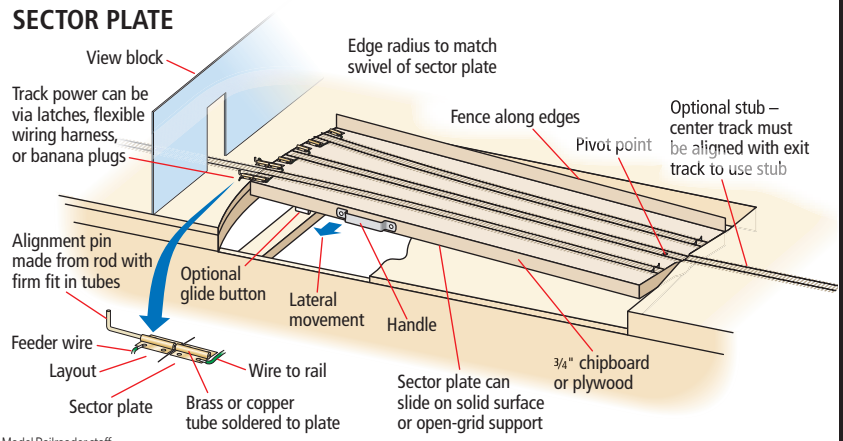
Depending on its length, a single-track sector plate can store one or more engines with several cars and, when rotated, transfer those engines and cars to a different track.

Conversely, some sector plates contain several tracks, each of which will store an engine or two. Tracks in this configuration are designed to allow any of the sector plate tracks to line up with any of the approach tracks.

Most often modelers will include some sort of indexing device to make it easier to line up the sector plate track with the permanent track. These are often simple mechanisms, such as a hinge pin in a hole on the plate that lines up with holes on the surface beneath it.

A guide to constructing a sector plate can be found in the article "Build sector plates to save staging space" on page 60 of the December 2008 *Model Railroader*.

Sector plates are popular in Europe, where modeling space is at a premium. Since they are not prototypical, sector plates are usually built on hidden, behind-the-scenes trackage, though some modelers have incorporated them into open areas with scenery.



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Static grass: How tall is it?

Static grass has become increasingly popular in recent years to represent both short and tall grasses and weeds. Made of a synthetic material, many scenery manufacturers produce static grass in a wide variety of colors and lengths (most often measured in millimeters).

Static grass is applied with a commercially produced or homemade electrostatic applicator that applies a static charge to both the grass fibers and the surface being scenicked. This charge makes the grass stand on end while its glue dries.

Use this chart to determine how tall in scale inches the various lengths of static grass are:

Static grass length	Actual height	O Scale	S Scale	HO Scale	N scale	Z scale
12mm	0.46 in	22 in	30 in	40 in	74 in	102 in
10mm	0.39 in	19 in	25 in	34 in	62 in	87 in
6 mm	0.23 in	11 in	15 in	20 in	37 in	52 in
4 mm	0.15 in	7 in	10 in	13 in	24 in	34 in
2 mm	0.07 in	3 in	5 in	6 in	11 in	16 in

A Noch GrasMaster is used to apply static grass to a piece of foam core. As the strands pass through the sieve on the applicator, they receive a positive charge. A clip touching the foam core gives the glue a negative charge. This attracts the grass strands, while their similar charges make the strands repel each other, forcing them to stand straight up.