Laying Track With Real Trains Rail

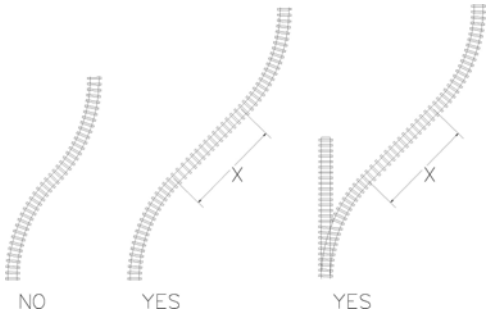
Location

You should select a location for your track that will prevent people and pets from being on, or tripping over, the track. Your location should be large enough to allow the full size of the track plus at least several additional feet along both sides of the track. This allows for the width of the train equipment and the passengers. It is not recommended that the track be placed near trees, posts, edges of high walls, etc. because a derailment could cause the train and passengers to hit or fall over these objects.

Curves

Curves are measured by the radius to the center of the track (half way between the rails). You should always make any curve follow the largest possible radius that your space allows. Tight curves limit the types of equipment, especially steam locomotives, that you can operate. Small locomotives such as our four wheeled switch engine can operate on curves as tight as 10 foot radius. Smaller scale equipment can go somewhat tighter than this but you should probably use this as a minimum for most work. Large diesels generally require 20 to 30 feet, steam locomotives 30 to 70 feet for 1 1/2" scale equipment. Larger scales need proportionately more room. Be sure that whatever minimum value you use is maintained everywhere since sudden kinks can develop when you are laying track and they will be much less than your minimum. We do not discuss cars here since most American prototype cars use individual trucks and the minimum radius is determined by the wheelbase (center to center distance between wheels) which is usually much smaller than a locomotive.

One issue to be aware of is what is known as a reverse curve (see drawing). If you have a curve that turns first one way, then the other you can create a problem if the two directions of the curve are too close together. This is not an issue of wheelbase but of coupler swing between two cars (or a locomotive and car) and usually shows up with your longest car, especially if it is coupled to something much shorter. To prevent problems separate the two curves by the length of your longest car (X in the drawing). You can reduce this somewhat if you have a tight place, especially since such an area will probably be limited to low speeds. Also be aware that this applies to the curve within a switch followed by either another switch or curved track.



Grade

Your location must also consider the "grade" of the track. Grade is defined as the amount of slope, or the change in elevation in a fixed distance. Grade is usually measured as a number of

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feet (meters) in 100 feet (meters) with 1 in 100 being called one percent, etc. Most trains will operate best with a maximum grade of three percent, but a better layout will result with a maximum of two percent. Steep grades require very careful operation and tend to be difficult for children or visitors. In general you will have a more relaxed and fun to operate railroad if you limit both grades and tight curves.

Grade is measured in distance along the track, not in a straight line. A track that curves back and forth takes a longer distance to reach another point but results in a lesser grade. You can check your selected location with a piece of string and a device known as a "line level" (a small bubble level that hangs on the string) available at most hardware stores. If your grade is too steep, you should relocate your track if possible. Moving of dirt (cuts or fills), bridges, etc. may also be used.

Earthwork

With your layout design finished you will want to begin to move dirt. Large construction equipment does not work well on making the narrow widths we need for our roadbeds. You should consider smaller equipment such as rototillers and walk behind loaders that are commonly used in gardening. Be sure that fills (areas where dirt was added) are firmly compacted. Slope the dirt away from the track either uphill or down as needed and try to keep this slope at an angle of 45 degrees to limit erosion with rain or irrigation.

Consideration must be given to preventing the growing of grass or other plants up through the track. Materials known as geotextiles are sold in home centers that can be places between the dirt roadbed and the ballast rock. Being porous these materials will allow water to soak in but stop weeds from coming through.

Construction of bridges, tunnels, ponds and similar features are beyond the scope of this paper but you must remember that they must be capable of supporting the weight of loaded trains, allow sufficient room for passengers and overall meet safety considerations.

Gauge

Gauge is the distance between the inside edges of the two rails. It is common to widen the gauge when going around a corner. The tighter the corner, the more the gauge is widened. Some layouts now use the wider gauge for all track. Our track gauges are offered in three widths, normal, wide, and extra wide to accommodate this design (see catalog). Some layouts use the normal width on straight (also called "tangent") track and the wide width on curves. Some use the wide width on straight track and the extra wide on curves. Any of these choices will work well but generally a somewhat wider gauge will allow better operation of long wheelbase steam locomotive and will result in less rail wear in curves.

Ties

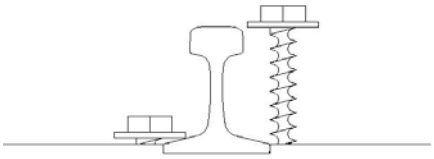
The most common tie material is still wood. Wood ties must be treated with a preservative to prevent deterioration in the ground. Preservatives are available from paint stores, can be applied by companies that do wood treatment (see the yellow pages), or can be made. Purchasing pre-treated wood is generally a waste of money since the treatment is designed for the way in which the wood is used in new homes. The treatment is on the outer surfaces but does not go to the center of the wood. When cut and buried in the ground this untreated core rots the same as untreated wood. There are new materials that replace wood in applications such as patio decks that are made of plastic or of compositions of wood fiber and plastics. These will last virtually forever but cost more.

In 1½" scale, ties of 2 by 4 lumber (actual size 1½" by 3½") set on edge (so the 1½" wide edge shows) are most common. These ties would be spaced 4" apart center-to-center (2½" between). Tie length is usually 14". 1" (and ¾") scales also usually use 2 by 4 ties because this standard size wood is easily available and because it anchors the track well into gravel ballast. 3" and 5" scale ties are usually 3 by 4 or 4 by 4 lumber, cut 25 to 30 inches long and spaced 8" to 12" apart.

Track Screws

The rail is attached to the ties using track screws. Our screws have a 5/16" hex head and a self drilling point. Installation is best done with a power screwdriver (first choice) or power drill having a magnetic insert hex driver bit to fit the screws. They may also be installed by hand with a socket wrench, nut driver, or screwdriver.

When installing track screws they should be placed vertically (see right side of drawing) and driven straight downwards. Since the base of the rail slopes it is natural to want to drive screws at that same angle but it is not recommended. Screws placed at an angle will allow the rail to move sideways out of gauge if they come loose. Screws driven vertically will maintain gauge even if loose. The screws should also be located so that the side of the screw does not cut into the edge of the rail. Install the screw until the head touches the base of the rail (left side of drawing). The screws should only slightly touch the rail. This allows the rail to slide through the tie as it expands and contracts with temperature.



When installing track screws at a joint between two pieces of rail the tie should be centered below the joint. The track screws should all be placed on one side of the joint to allow the joint to be disassembled. Use care in locating these track screws so that they do not interfere with the installation of the bolts and nuts that hold the joint bars.

Rail Drilling

It is necessary to provide for rail expansion and contraction. This is usually done by drilling the hole in the rail (but not the joint bar) considerably larger than the size of the bolt used to assemble the joint. This allows the joint bars to slide along the rail. The table on the next page is based on our standard joint bars. The movement amount given in the table is the amount one rail can move, from one extreme of its movement to the other. The total movement for a joint is twice this amount because there are two rail ends.

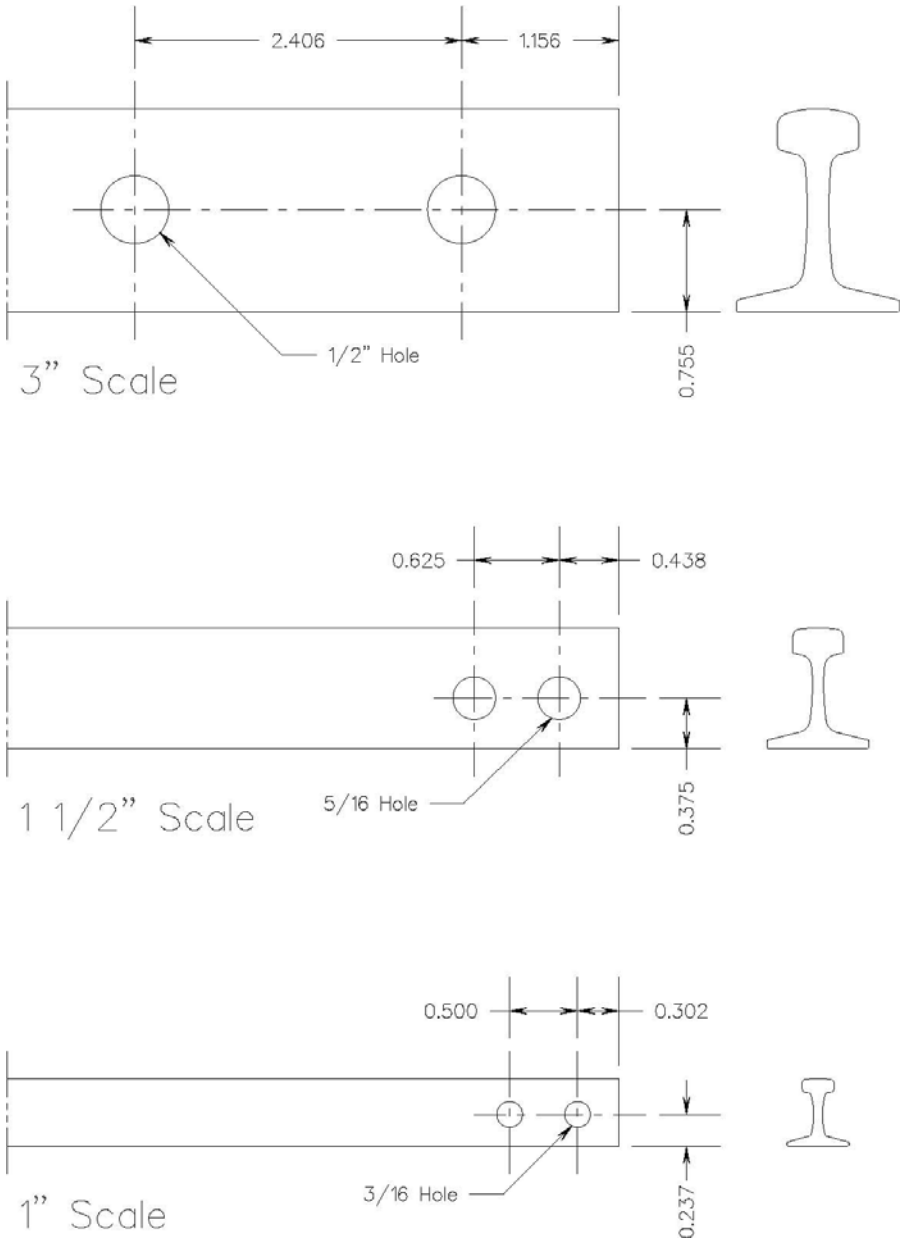
Scale	Bolt Size Used	Size of Hole in Joint Bar	Size of Hole in Rail	Movement of One Rail	Movement at One Joint
1”	#4	0.114”	3/16”	0.073”	0.146”
1 1/2”	#10	0.187”	5/16”	1/16”	1/8”
3”	5/16”	5/16”	1/2”	3/16”	3/8”

Size of hole in rail (3/16, 5/16, 1/2) gives the drill bit size you should use. The location of the holes in the end of the rail must be positioned so that when the gap between the rail ends is closed the bolts will be all the way against the side of the hole in the rail that is away from the end of the rail. The drawing on the next page shows the rail ends and gives the correct positions for the holes. You may also use our rail drilling jig which automatically provides these dimensions.
You will generally find it more productive to drill both ends of all your rail in your shop before starting to assemble any track

Joint Bar Installation

You will need to accurately estimate how much gap is needed between rail ends depending on the temperature at time of installation. For help with these issues it is recommended that you contact persons with experience in laying track in your area. In general, it is better to have a gap too wide than too narrow. Rail will seldom pull itself up out of the ground at low temperatures while it can much more easily develop kinks due to high temperature expansion.

To attach the joint bars place one on each side of the rails, use a machine screw or hex head bolt through the holes with the heads located between the rails (so that the nuts will be on the outside). Recommended bolt sizes for our joint bars are 4-40 x 1/2” for 1” scale, 10-24 x 5/8” for 1½” scale, and 5/16-18x 1 1/2” for 3” scale. Install nylon insert type lock nuts on to the bolts. While holding the bolt head with a screwdriver or wrench, tighten the nut with a wrench. These nuts are self-locking and become harder to turn before they are fully tight. Make sure that all bolts are properly, but not overly tightened. You must allow the joint to move so make sure they are not excessively tight.



Track Panel Assembly

If you are going to lay more than a small amount of track you may want to take the time to build a fixture that holds the ties at the proper spacing and then holds the rails at the proper gauge. There are about as many ways to do this as there are people doing it so no design is given here but a visit to a local club will usually show what they do.

In most cases where a lot of track is being laid the minimum radius of the curves is fairly large. In this case you will usually only build a jig and track panels that are straight. This is because it is possible to "bow" a straight panel to the needed curve. In doing this the rail slips under the track screws of allow the curve to be formed (remember that the rail must be free enough to move with changes in temperature). When laying track this way start with a straight section and assemble panels as needed. When you come to a curve you should continue to assemble two or three more straight panels in a straight line. Then drag the track sideways as needed to make the curve. Leave about half the last panel straight to better join the next panels to be added and curve it after they are added. When bending the panels this way you will find one rail getting longer than the other, simply cut off the excess and then drill new holes for the joint bars. Then add two or three more straight panels and repeat the operations as needed.

Rail Bending

If you are going to have tight curves you may need to bend rail before assembling it to the ties. The easiest way to do this is with a machine specifically intended for this which is available from various suppliers.

You may also bend limited amounts of rail by making a template. Use a piece of plywood that is thin enough to fit into the side of the rail below the head and above the flange (1/4" for 1" scale, 1/2" for 1 1/2" scale). Cut the edge of an eight foot plywood panel to a radius somewhat smaller than your final requirement. You need to allow for the fact that the rail will spring back by over bending it. Also, realize that you only need to come close as the final radius can be adjusted when laying using the natural spring of the rail. Use your plywood template by clamping the rail around the edge at one end and then working your way down the edge pushing the rail up against the edge of the plywood. The plywood template keeps you from making too tight a curve which would result in a kink. When you reach the end of the template, unclamp the rail, and reposition it to continue the bending further down the length of the rail.

Ballast

Normally 1" scale trackwork uses a gravel referred to as "3/8" minus", 1 1/2" scale uses 3/4" minus, and 3" scale uses the same or the next size larger. Crushed rock has sharp corners and will hold much better than other types of rock. If using wood ties make sure that the ballast is under, as well as around the ties to allow water to drain completely away from them.

If you are installing ballast over muddy or silty ground you should consider purchase of a "geotextile" (commonly known as a filter fabric, it can be placed under the ballast and will prevent it from sinking into, and mixing with, the soft ground. These fabrics also help control weed growth.

Ballast must be compacted firmly enough to hold the track. It is not recommended that you use concrete, paved areas, or other hard surfaces to support your track except where absolutely

required (such as a road crossing) since track must give under the passing load of a train. This also means that products such as rock dust or slag that will set up hard over time should not be used for ballast.

Laying Track

You will find that the simplest way to lay track panels is to place them directly on the dirt or geotextile of your roadbed. You should adjust curves and install joint bars to get a finished track before you install ballast.

Ballast can then simply be dumped over the track. Use a rod with a hook formed on its end (a sprinkler valve wrench from the hardware store makes a good starting place for this) to pull the track up through the ballast so that some rock is under the ties and use your judgment to establish the approximate level of the track. Add more ballast as needed and tamp the rock to hold the ties (the end of a shovel handle makes a good tamper). Use whatever levels or other equipment you have to gradually work the track into its desired slopes, curves, etc.

You should be careful to make sure the track is level from side to side. Variations up and down along the length of the track may look funny and will feel like a roller coaster but will generally not cause a derailment. Small variations from side to side on the other hand will cause all sorts of problems that are often hard for the beginner to find. Spend time and check this carefully.

Maintenance

You will find that newly laid track will settle no matter how careful you are in first laying it. Plan on some time to recheck and adjust your track during the first season of its operation. In areas where the ground freezes you must also plan on some work each spring as the ground thaws.