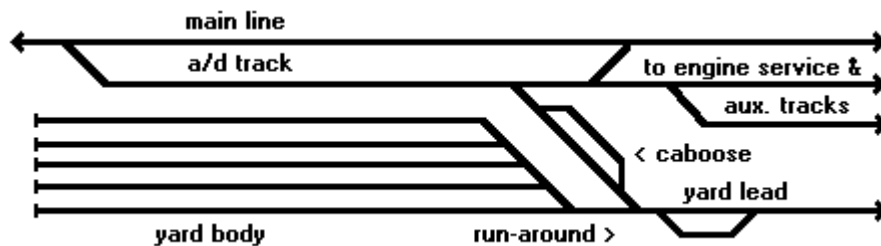


The Ten Commandments of Model Railroad Yard Design

By Craig Bisgeier

If you got here by a direct link, Welcome! I invite you to check out the rest of the website after you've finished with this article. Just click below on the [Welcome Page](#) link to go to the main page and the list of contents. Be sure to check out my Construction Journal, which shows the progress we're making on my 19th Century HO Scale model railroad.

Sample Yard Layout



You may find it helpful to print out this diagram before reading the article. Having a hard copy of the diagram to refer to as you are reading will probably be a big help for some of the more difficult concepts. This is definitely a case of a picture being worth a thousand words...

One of the most often modeled -- and misunderstood -- layout design elements is the yard. Nearly everyone has one on their layout, whether it's used simply for car storage or as an actual operating tool. Unfortunately, many of them don't work very well. Common design mistakes are made over and over again by beginner and intermediate modelers. They can't be faulted, though, because the info on how to design a good yard is very hard to find. Even when the hobby press gets it right, it's short-lived, because if you missed the issue you didn't see it. Most of the time you see poor examples ([like the hated Timesaver](#)) which are often published by the hobby press without comment, and therefore accepted by those who do not know better as good design.

So the "secrets" of good yard design are difficult to for most to uncover, because the good nuggets of information appear in wildly different places like out of print magazines or books, special interest publications, or even word of mouth among advanced modelers. not many modelers have that kind of library or access.

What is needed is a repository where all the good ideas can be collected, stored, edited and presented as one all-encompassing primer on the subject. It is my hope that this article is one source of that information for you.

Note: For the most part, these ideas aren't mine, but those of leading modelers in our hobby and of other modelers I've read about, spoken to or communicated with, or ideas I've heard about even fourth or fifth-hand. The sheer number of persons responsible is far too large to acknowledge everyone, so I'll just say thanks to the community at large for sharing this knowledge with me, and allowing me to share it with you.

What kind of yard to model?

The educated student of yard design will realize there are as many types of yards out there as there are types of jobs that need to be done. From small weedgrown branchline yards where the main track is the only lead, to industrial yards used as parts or materials warehousing on wheels and rails. From dedicated coach yards where passenger trains and cars are serviced and lay over for their next assignment, to sprawling division point freight yards with humps that take up many square miles. Each is different in form and is designed to perform one or more necessary jobs the railroad needs done.

The design rules that follow apply primarily to flat classification yard design. 'Classification' in this context is defined as the sorting of railroad freight cars into like groups bound for one or more similar destinations. This is the most common type of yard found on model railroads, and is also one of the most interesting to operate -- when executed well. **If your interest is in a different type of yard, some or all of these commandments may not apply, and the designer is warned to carefully consider the purpose and operation of the yard to be built and what is expected from it.**

These "Commandments" should serve to drive and inspire the design process, rather than enforce blind obedience to an arbitrary list of commandments. In other words: Read these rules, understand the reasons why things work the way they do, then apply the knowledge to your specific needs. Then apply them as you see fit, based on what you need done on your layout. Some compromise is inevitable. If you can do that, you'll never make a bad design.

Before starting, click here to learn about [Compression: Why it's evil and why you need it.](#)

1: Thou Shalt Not Foul The Main

Most modelers don't usually consider the main line as a part of the yard, but it is the most important track in it, or around it. The main line is the artery that carries the life blood of the railroad, passengers and freight. Just as in the arteries of a

living thing, if the mains become obstructed it causes major problems to the system. Prototype railroads go to great lengths to keep the mains clear, and so should you. Therefore, when beginning the design of any yard, we consider the first commandment before any other design rule. Ideally the main line should only have two turnouts leading to the yard, one at each end. And they are only used when complete trains either enter or leave the yard. I cannot stress the importance of this rule enough! The yard designer would do well to obey this rule religiously.

Exception to Commandment 1: When planning a yard for a lightly used branchline, or a small stub-end terminal yard, it isn't always necessary to keep the main clear. If the branch only supports one or two trains a day, and trains must operate per rule 93 (Movements within yard limits -- all trains must proceed at restricted speed and ready to stop for any obstruction) there usually isn't a problem with using the main, even as a lead track (see Commandment 2). Like all things, use common sense. David Barrow's South Plains District layout in Model Railroader a couple of years back is a good example.

2: Thou Shalt Provide A Dedicated Lead Track

After the main line, the most important track in the yard is the lead. The lead is the backbone of the yard, it is the track all others either connect to or branch from. The yard switcher should always be able get to any track in one forward move, and to escape back to the lead from almost anywhere in the yard in one reverse move. Therefore, as many turnouts off the lead that can be arranged so should be facing-point turnouts.

Confused? Try this. Think of the yard as a garden rake. The yard lead is the handle, the various tracks that make up the yard are the tines. As you go forward up the lead (handle), all tracks (tines) radiate up and away from the handle. None turn back in the other direction (unless it's a really old rake...). In this example, all the turnouts off the lead would be facing-point turnouts, with their movable points "facing" the base of yard lead.

Doesn't sound important? If you think about it, any track on a trailing-point switch that has to be served from the lead requires the switcher either to run around a car or cars, or to make a reverse move off of the lead to serve that track, and leave the lead. At the very least, this usually means two additional moves (delay), limited access to the track(s) being worked, and the possibility of fouling moving traffic across other tracks. As an example, see in the diagram below how the yellow switcher would have difficulty serving the trailing-point turnout on the left. The switcher, while classifying railcars or building trains, should never have to leave the lead track under any circumstances and should almost always work railcars from only one end (the front) where possible.



Because the switcher uses the lead to "drill", or move railcars in and out of the body tracks, the lead must be as long or longer than the longest yard track. This way the switcher never has to "double" a cut of cars to move it from one track to another. The lead can be disguised as a branch line or other kind of track if desired, but its true purpose should always be foremost in the designer's mind. Now, I understand it isn't always possible to have a full-length lead, but it is an important goal to strive for and believe me, your yardmasters will thank you for it.

3: Thou Shalt Not Foul The Yard Lead

Now that we've cleared the main and given the switcher a track of it's own to work from, we have to ensure the switching crew can do their job no matter what lunacy is going on around them. Therefore we try to keep the yard lead clear at all times. While designing the yard, try to avoid including crossovers or other trackage arrangements that interfere with the yard lead or the switch crews' ability to keep on classifying indefinitely. Yards with active tracks that cut across the lead will constantly be delayed and in turmoil. It can't always be avoided, but if you start off with this in mind it will help you avoid situations where this becomes necessary.

4: Thou Shalt Use Arrival / Departure Tracks

OK, if we can't use the main for anything, and we can't use the yard lead to move trains in and out, how the heck do we get trains off the main into the yard, and vice-versa? We have to include a special track, or tracks, called arrival / departure, or A/D, tracks. A/D tracks are sidings off the main with a connection to the yard lead, where trains are stored -- temporarily -- while they are broken down or built up. The yard switcher should be able to cross over from the lead, grab a cut of cars (or the whole train sans power) from the A/D track and pull it directly onto the lead to classify it, or pull a cut from the yard body and kick it into the A/D track in just two moves. The A/D track should never be used as an extra classification track because this will subvert its purpose as a holding track off the main. It may work for a while but as soon as another train arrives or you need to put another one together, you have nowhere to put it.

If you have space, it's good to have more than one A/D track so you can handle making or breaking more than one train at a time. Just make sure you can get to each one via the yard lead in just one move. I find it usually works well to place the A/D access track from the lead on the near end of the first A/D track, near where it joins the main, and then build a ladder track just beyond that for all the other A/D tracks.

5: Thou Shalt Provide A Caboose Track

Whether it's a double-ended siding or a stub, you need to have a place to store cabooses out of the way while classifying trains, but accessible enough to get to them fast. Usually the Caboose track is located off either the yard ladder, the yard lead or one of the A/D tracks. My personal favorite is off the A/D (where you

are building or breaking a train anyway), but any easy to get to location will work. It's a great place to display all your caboose models too. If it is a stub track, make sure it is accessed easily from the yard lead and that it is from a facing-point turnout.

6: Thou Shalt Provide A Run-around

Somewhere on or off the lead, be sure to provide a short siding or set of facing crossovers to an adjacent track. This allows the yard switcher to run around a car or two, especially a caboose. If there's no run-around it can be very difficult to tack a caboose onto the back of a departing freight train without making the engineer back his whole train into the caboose track, which is not very prototypical and upsets all the other conductors. A run-around is also very important if you have yard or industry tracks with trailing-point switches within yard limits. Provide enough length to run around at least one passenger car if possible. The longer the run-around the better, and more than one is better yet. However, if space is at a premium, just enough space to run around one long car is probably enough.

7: Thou Shalt Be Able to Reach Everything

Hey – it's a fact of life, derailments happen. Regardless of how good your trackwork is, there's always a super-light flatcar being shoved behind a heavy boxcar, or a hopper with out-of-gauge wheelsets somewhere waiting to pick a switchpoint or be forced off the track. S-curves conspire to throw your passenger cars off the rails. Locomotives stall on spots of dirty track, or on turnouts that have insulated frogs. None of these things are much of a problem as long as you can reach the spot of the accident, because it's quickly and easily fixed. The trouble starts when you locate tracks and turnouts outside your reach. Placing a critical turnout 36" or more from the layout edge doesn't seem like a problem when you have pencil to paper, but once the yard starts to operate, I guarantee it'll be your biggest headache.

Save yourself a ton of trouble and misery by planning your yard (and the rest of your railroad) so that your operators can reach everything easily. 24-30" is about the realistic limit for most people to reach and manipulate objects, any farther and they are likely to do more harm than good. Cars on tracks near the front of the layout get knocked over and scenery gets damaged by leaning people. If you must have tracks that extend past 30" deep, make sure the turnouts leading to them are in reach, since that's where most problems happen. And just because you are tall and can reach farther doesn't mean your friends or visitors can too, better take that into account. Layout height makes a difference too, as does distance between decks on multi-level designs. Plan for success.

If you must make your yard wider than you can reach from one side, all is not lost. Consider a shallow operators' aisle on the other side of the yard. This is a

great solution for double-track layouts, and can allow you to split the yard into two manageable halves, and do more work with two switching crews. Just 16" of aisle is all that's necessary, and a few feet to either side allowing the operator to reach the critical points around the turnouts. This can be a duck- or crawl-under without access to the rest of the aisles, as a yard operator generally stays in one place during a session.

A pop-up, however, is not a substitute. Don't design a yard that needs one to reach distant tracks because you'll be using it far too often. Either have a permanent operator back there and give him space to work, or don't bother.

8: Thou Shalt Provide Auxiliary Yard Tracks

Some of the best local operation in a yard comes from the auxiliary tracks often found in yards that don't directly contribute to revenue-producing activities like classifying cars. For instance, a RIP track (Repair In Place) is a feature of every decent-sized prototype classification yard but is seldom modeled. Usually several cars each day come through that need minor repairs, like fixing dragging equipment, replacing worn brake shoes or a damaged wheel bearing, or changing a cracked air hose. These cars are directed to the RIP track, where the problems are corrected. A short time later the car is sent on it's way. If you think of it as an industry track, it is an ideal element because it hosts any type of railcar, and is switched often. Other kinds of Auxiliary yards tracks are ready tracks for wreck trains or snowplows, icing tracks for reefers, a cleaning track for house cars, etc.. All of these make great additions if you can find room for them. And they don't need to be immediately adjacent to the yard either.

When you operate a classification yard set at a crew change or division point, you quickly find that a lot of engines spend a lot of time in your yard laying over -- especially in the steam era. Whether they are waiting for trains to pull out, getting much needed service, or just on standby, you need a place to hold them out of the way until they are needed. Your engine service tracks should allow direct escape from and to the A/D tracks so locomotives can get away fast and easily. These tracks can be dressed up with water towers or columns, coal docks, sand towers and houses, diesel fuel racks, ash pits and cinder conveyors, etc. You don't need to include a diesel house, roundhouse, or car shops (unless you have room for them!). These large space-hogging buildings can be implied by having the tracks run off the edge of the layout to where the building should be.

If you have more than one service track, concentrate the services along one of the tracks -- this will be the inbound lead. Locomotives are generally serviced as they arrive at a yard, not as they are leaving.

9: Thou Shalt Not Overcrowd The Yard

All yards have a certain threshold number of railcars they can hold and continue to function well. Go beyond this threshold amount and the yard quickly clogs,

making it very difficult to work with. Now, all yards have busy times where several trains arrive at once and the yard crew is overwhelmed for a short time. A clogged yard quickly becomes a bottleneck, brings the railroad to a standstill and frustrates everyone.

A good rule of thumb is to calculate how many average length cars you can hold in the body of the yard when all tracks are full, without fouling any of the turnouts. Then take that number and divide by two. This number is your threshold amount. Depending on your yard design it may be slightly higher or lower, but generally a yard that's half full -- is full. Start getting more crowded than that and things get clogged up fast. But don't be afraid if traffic surges now and then, driving the number of cars beyond the threshold -- as long as the yardmaster can clear some cars out of the yard in short order it isn't usually a big problem. If the condition becomes chronic, it's time to start pulling cars off the railroad.

A yard is a dynamic object, constantly in motion. Remember that the purpose of a classification yard is to collect incoming railcars, rearrange them and get them on trains that will take them to their destinations. But there is usually a limit to how many cars a yardmaster can classify in a set period of time, both on the prototype and model. If more cars are coming into the yard than the yardmaster can handle, the situation deteriorates and becomes unworkable fairly quickly. So, you could say there is a threshold amount of cars that can be run through the yard within a set period of time as well.

This threshold number depends upon the size and physical restrictions of the yard, how good the modeler is at classifying cars, and if the train schedules allow the yardmaster to get rid of cars regularly on outbound trains as quickly as they arrive. The schedule, or timetable, becomes very important as you start pushing the upper limit of throughput. Remember that on a large model railroad layout a big yard might have as many as 300-400 cars through it in a four hour operating session -- but if nothing happens for 3 of those hours and everything converges on the yard at once, no yardmaster is going to be able to keep up with that. Scheduling carefully can keep things busy most of the time without overwhelming the crew.

10: Thou Shalt Make It Easy To Run

OK, lets say you've followed all the commandments and designed yourself a great yard. You owe it to yourself and others who will operate the yard to give some thought to making the model-human interface simple and easy to run. After all, the best yard in the world won't get used if no one can figure out how to make it work. Here are some things you can do that will really help operability:

- ✳️ Provide a large, easy to read schematic control panel with color-coded track lines to differentiate what each track is. For instance, make the body tracks white, the yard lead red, the A/D tracks green, etc.. Label anything that might be unclear or vague. Physically separate adjacent tracks with different purposes to emphasize their difference.
- ✳️ Keep the mechanical complexity down. Wherever you have a crossover where two turnouts always operate together, control them with one toggle switch. Use a diode-matrix panel or similar control structure to automatically throw turnouts

in a yard ladder for a particular arrangement. "But isn't that complex?" you ask? Yes, but it makes a stressful job easier at ShowTime, so it counts as a simplicity plus.

- ✳️ If the panel continues to be complicated despite your best efforts, think about breaking it up into two or more sub-panels, especially if there are distinct groups of turnouts more than 2-3 steps apart. For instance, I recently operated on a layout where the entrance to the yard, an area with about 7-8 switches, was controlled by a separate panel from the yards' throat and ladder tracks. It helped keep the complexity on the main panel down, a welcome break.
- ✳️ Be very careful with your trackwork. Good trackwork makes running a yard fun and challenging, but bad trackwork can take a good design and render it useless. If cars keep derailing every time they are pushed over a bad turnout, or over a spot that's out of gauge, neither you or anyone else will want to work in your yard. As long as you're making an effort to design a good yard, put some effort into building it well too.
- ✳️ Provide a handout with a schematic diagram of the yard and a line or two describing the different functions of each track to new operators. It will help them get familiar with the routine and up and running in less time than if they had to puzzle it out for themselves. You can also distribute this handout to visitors, allowing them to gain an insight into how the operation really works.
- ✳️ Design to be able to reach everything easily, either from the front of the layout or from an operators aisle behind. Derailing a few cars in a spot you can only get to with a long stick is sure to ruin your night, and maybe other people's too. If you have to stand on your tippy-toes to reach and can only nudge it with your fingertip, it's too far away.
- ✳️ Before operating sessions, try to provide a schedule to the yard crew describing the types of trains arriving and departing during the session, approximately the time they come and go, and what type of freight or passenger equipment they drop off or pick up. This will help the yard crew organize their work, and be able to properly block the cars in most trains. A properly blocked train is easier for the road crew to run, and gets it's work done faster.

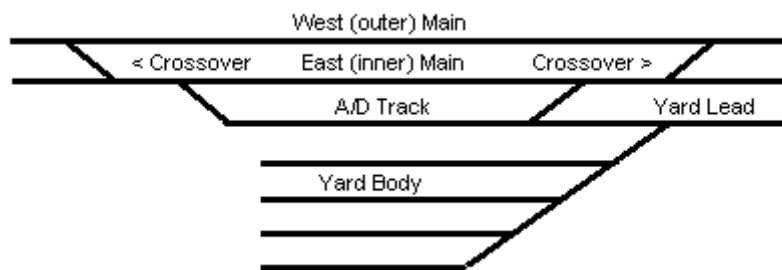
What about planning a yard for a double-track layout?

All of the examples thus far are based on a single-track railroad. Double track mains on the prototype often mean there are similar but separate yards on either side of the main, one for each direction of traffic. The only time the two yards interact with each other is usually on transfer runs, where cars that have to go back the other way get handed off from one side to the other. This happens a lot, with backhauls often being the primary reason. On the prototype each yard often has its own set of crews, with one yardmaster who supervises both of them.

Track arrangements vary, but for the most part you find the main tracks usually both go through the center of the yard, or they split apart at each end and each goes around its own yard. Either method allows trains moving in one direction not to be fouled by trains moving in the other direction. Obviously this is impractical

on the model railroad. Most of us can't model two separate yards in a space we are hard-pressed to build just one (but there are notable exceptions). So the first compromise is often to use just one yard regardless of whether the railroad is single or double track.

The next question is likely to be where to place the yard in relation to the mains. Ideally, you would like to route each main around the outside of the yard (located in the center), with separate A/D tracks to either side, all of which are connected to the yard lead. However, like a separate yard, this is probably not practical because of space considerations. The second compromise is to have both mains pass on the same side of the yard, with a pair of crossovers from the far main to the near main at either end, which allow trains on the far main to cross the near main and move into the A/D track(s). See the image below:



It is not an ideal solution but is probably the most practical, taking up the minimum amount of linear space to accomplish (only 2 extra feet to either end assuming a pair of #6 crossover turnouts, in HO scale). If you can afford the space, by all means route the mains around either side of the yard and include the extra A/D tracks. It's also a good idea to route the mains to the back of the yard, so traffic moving by will not be menaced by the ubiquitous stray elbow or shirtsleeve.

There are some other considerations to take into account in the interest of keeping traffic moving smoothly in your yard. Double track railroading means a significant increase in traffic over single track. The layout designer should keep in mind that unless separate directional yards are implemented a single yard will quickly be overwhelmed. As discussed earlier, most model railroad yards will have a cars per hour limit they can move successfully that won't change regardless of the number of mains in service. Consider having several through trains in the schedule that do not stop at this yard, but run nonstop through from staging at one end of the railroad to the other, or stop at a different yard. This will keep the traffic density on the mains high without slamming your yard personnel.

To help improve the cars per hour ratio, there are a few things you can do:

- ✨ Assuming you have the space, design the yard to be at least partially double-ended, and include a moderate length switching lead on the far end. Assign a switcher (and crew) there whose responsibility is to handle activity on that end of the yard, like pickups and setouts, picking and setting cabooses, blocking of

outbound trains and other tasks that might be difficult for the primary switcher crew to get to. This allows the primary switching crew to focus more on classification. If the secondary lead has an escape track for the switcher, road engines can also use it to hook up to their trains or escape to service.

- ✱ A running track to get to the other end of the yard and a decent-sized runaround are absolutely essential. A double-ended caboose track that adjoins the running track is also very important.
- ✱ An answer to needed cars per hour improvements may be to have several leads that can switch different areas of the yard at the same time. Useful for very large yards, there may be a lead and ladder for tracks 1-5, and another parallel lead and ladder for tracks 6-10. They would share an interchange track between the two body areas where they could switch off cars bound for the other's tracks. This doubles the amount of work that can be done, but suffers a bit from inefficiency, and it may be problematical to move cars in and out of A/D tracks. The net improvement is probably closer to 50%, assuming the crews can work in concert. A potentially serious drawback is the need for two switching crews to occupy the same space in the aisle. But with proper planning this difficulty might be minimized

Last Thoughts:

I realize that it takes a pretty fair-sized yard to fully implement many of these concepts. The modeler with a smaller space, however, still has much to gain by using these criteria to help design the small yard. Perhaps there isn't room for a full length caboose track. But an extra 18" track off the end of the ladder track will hold 2, maybe 3 hacks, and the inclusion of a short run-around, possibly also used for a nearby industrial switching area, lets you do quite a lot of operating within a little space. You don't need 2 or 3 A/D tracks, having one that also functions as a siding off the main line will work, even if it's not ideal. But no matter the size, you always need to have a lead as long as your longest body track. The trick is to be creative in how you design, and do the most with the space you have.