Lighting Your Structures

and

LED 101

A clinic for

Cascadian International 2010 Conference

of

The Pacific Northwest Region

NMRA

* * *

Presenter

Glenn Edmison

PNR Division 1
Bend, Oregon

My Layout

The Oregon Short Line Railroad
N-Scale 1:160
Five X Nine Walk Around Layout
Ceiling Suspended.

Add lights to your structures

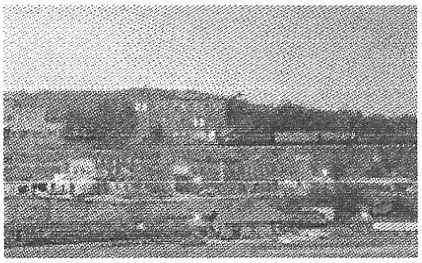
Easy ways to enhance "life" after dark on your layout

John Underhill

Interior lighting adds another level of realism to the buildings on a layout. The effect of interior lighting is magical in a darkened train room when the only visible light comes from the windows and doorways of town buildings and rural structures. The effect becomes even more exciting as the headlight of a speeding locomotive flashes past in the darkness.

To capture this realism, it's important to think about a prototype building's appearance at night - a large office building might have lights on only in the lobby and one occupied office. A house might have a light on in only one bedroom. On the other hand, a large industrial plant that operates 24 hours a day will be fully illuminated. However, if the plant has only a day shift, its lights will be off at night except for the loading dock.

Once you've figured out what activities need to continue through the night, you can determine the number of lightbulbs you'll need to install.



As twilight fades into darkness, the realism of John Underhill's HO layout is enhanced by the structure lighting effects that illuminate store display windows, apartment interiors, and other centers of activity. *(Lloyd Loring)*

Intensity makes a difference

Close observation of buildings at night reveals that the rooms display different levels of light. See **fig. 1**. You can easily alter the brightness of the lamps by operating 12-, 14-, or 16-volt bulbs with a 12-volt power supply. The different lamp ratings mean they'll deliver varying intensities of light.

You can also control the intensity of the light by placing bulbs at varying distances from the windows, using different sizes of bulbs, and making rooms of varying sizes. Adding white styrene or painting the walls white behind the bulb, as shown in **fig. 2**, or installing a white ceiling reflects more light and raises the intensity of light in a room.

The best time to install interior lighting is while the building is under construction. I install the bulbs after I've completed the structure's floor and exterior walls, but before adding the roof. At this point access to the interior is easy. Lighting can also be installed in a finished building by removing its roof or floor.

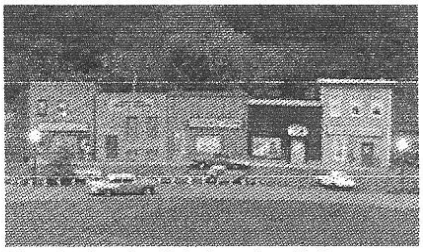


Fig. 1. Exterior lighting shouldn't overpower the interior illumination, or the viewers won't notice or be able to see into the various lighted rooms. *(Lloyd Loring)*

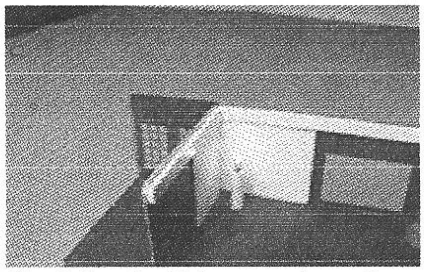


Fig. 2. A vertical tube supports most lightbulbs inside John's buildings. The white walls behind the lamp reflect light in one direction, while an extra layer of styrene keeps light from showing through the thin plastic walls. *(Lloyd Loring)*

Concealing the source

The view into a building is important, because you don't want visitors to see a bright bulb inside. To avoid this problem, I set each building on the layout and mark its exact location so I can return it to the same place.

Look for interior locations where a bulb can be concealed from view. Then check the location by looking into the windows and open doors from every possible viewing angle. I also look at the building from different heights, by bending down or using a stool.

Once satisfied, I mark the hidden bulb locations on the floor of the building. Then I check under the layout to be sure nothing will be damaged when I drill the holes for the wiring.

One room at a time

For modeling purposes, I call each interior space that will be illuminated a room. This room can be the entire building or just a portion of it.

I carefully check each room for light leaks at the corners, ceiling and floor joints, and around the window and door frames. Many of my model buildings didn't include floors, so I made my own from wood or styrene sheet.

To check for light leaks, I use a flashlight or a 12-volt bulb with 18" wire leads connected to a power pack. The long lead wires let me slip the lamp inside the structure so I can easily check all the joints.

This is also a good time to check the walls. Some building walls are so thin that light shows through. If this happens, I either paint the interior walls flat black or add another layer of material to make them thicker.

If a building has several rooms, I give the same attention to all the walls and joints to avoid any light leaks.

Beware of light on the sky

Sometimes the light from a window will fall on the backdrop. Raising or relocating the bulb will often solve the problem. I've also had to close a few windows by covering their openings from the inside with wood or styrene painted flat black on both sides.

Windows that face away from the viewer can be used to produce a handy footlight effect. I cut an opening in the back of the building and install a bulb inside that will illuminate the area behind the building. If necessary, I add a false wall to mask the bulb from the balance of the interior. [Evergreen sells black styrene sheet that's perfect for this job. - *Ed.*] In this case, I'm careful to ensure that the additional exterior light doesn't show on the backdrop.

Replaceable bulbs

It's desirable to be able to replace a bulb without having to take a building from the layout or lift off its roof. To keep the bulbs accessible, I mount them on vertical lengths of Plastruct no. 228 3/16" styrene tubing (see **fig. 2** on page 77). Each removable tube passes through the layout and the building's floors to support a bulb at the correct height.

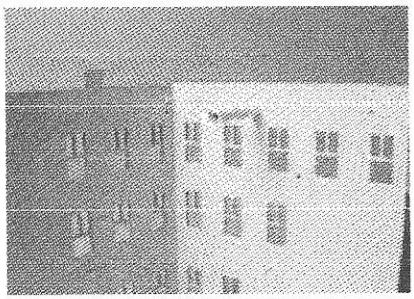


Fig. 3. On tall buildings, bulbs can be supported by horizontal tubes through the side or back walls. After the light tube is in place, John adds floors and other interior partitions to direct the light into specific rooms. *(Lloyd Loring)*

Using my bulb location mark, I drill a 3/16"-diameter hole through the floor of the building. Then I reposition the building on the layout and use the 3/16"-diameter hole in the floor to locate a ¼"-diameter hole through the layout.

To determine the length of the tubing, I measure the lamp's elevation inside the building, add the layout's thick- ness, and add about ¼" to provide room to tape the lamp's wires to the tube.

After measuring the tube's length, I record it beneath the building on the underside of the layout. I also include the name of the building and the length of the tube near the spot where the tube comes through the layout. Remember, the bulb must pass completely through the tube and protrude ½" beyond its end to ensure full illumination and avoid overheating. Then I cement the tube into the floor of the building.

To light the upper floors of my taller buildings, I use horizontal instead of vertical tubes. They enter the tall buildings from the back where they're out of sight, as shown in **fig. 3**.

As before, the bulb should protrude about ½" beyond the end of the tube. The wires from the bulb are run down the rear wall of the building.

With all of my bulb leads exiting under the layout, I connect all the wires to Radio Shack no. 274680 terminal strips with screw terminals.

Most of my lightbulbs are Micro-Mark no. 82590 C grain-of-wheat bulbs, 12- or 14-volt 1/8"-diameter bulbs, or Miniatronics no. 1801420 2.4mm, 14-volt lamps. The wires on these lightbulbs are long enough and stiff enough for the bulbs to be easily pushed up through the tubing and to be held in position.

Other manufacturers offer lamps in a variety of colors, sizes, and voltages that can be used for all sorts of special effects. In addition, light-emitting diodes offer even more options. All it takes is a bit of imagination and some ingenuity to add your own realistic lighting effects. **MR**

Interior Detailing

The need for interior details depends upon the viewing distance. At moderate distances (4 to 6 feet), interior details won't be seen, so lightly frosted plastic windows will block the view into an empty room. Painting the walls flat black and adding a hidden bulb will provide some variety.

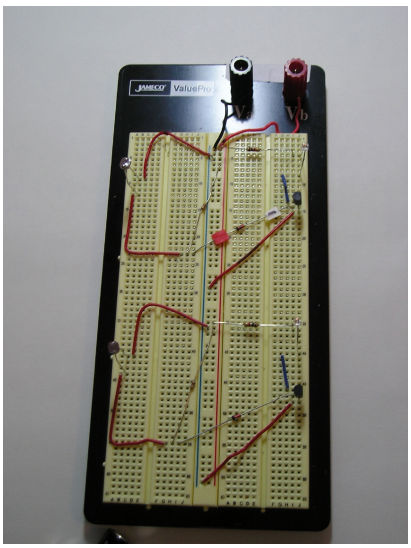
At closer viewing distances, a few simple details will provide the illusion of activity inside a room. One trick I use is to place a pair of figures just inside a window, facing each other, as though they're having a conversation.

Adding visible details inside rooms can be fun and doesn't have to take a lot of time. [See Mike Tylick's article "Quick and easy interiors," in the August 2006 MR.] In HO and N scales, there's no need to superdetail desks with miniature pencils and paper clips. All you need to do is create an impression, and the viewer's imagination will fill in the details. I simulate furniture with small wood blocks painted in light colors to contrast with the walls. I place this "furniture" near the windows and then add a figure or two in front to distract the viewer's eye.

Adding color to the walls of the rooms attracts attention because light reflects off the walls. If the viewer is close enough to look inside, light-colored walls work well, but then the room will need to be detailed.

An angled view shows only a small portion of the interior wall. In these cases, I glue a framed picture on the light-colored wall and finish off the room with a figure looking out the window. *-J.U.*

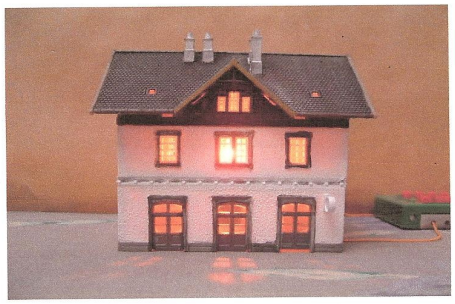
Built-up Lighting Board
(Note LEDs in parallel on strip brass – 1 resistor. Test before mounting)



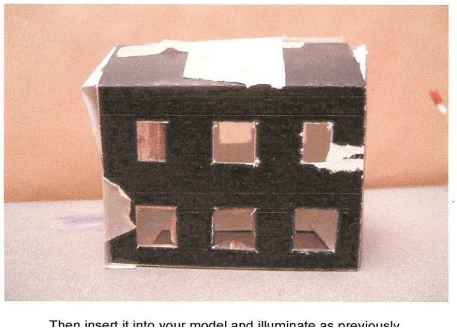
Two vital pieces of equipment - LED Tester and Breadboard

Some Ideas

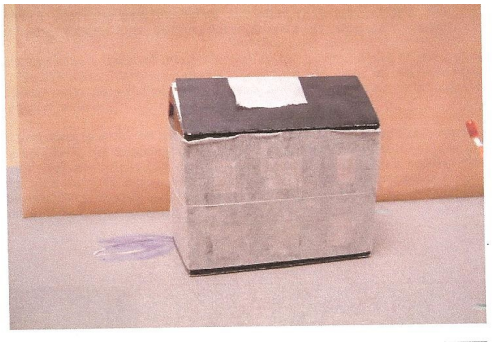
Here is a collection of related ideas:



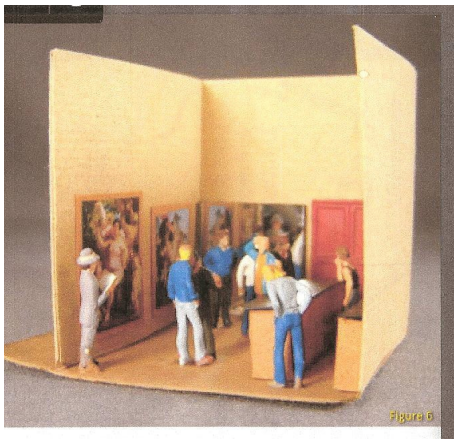
A lighted building



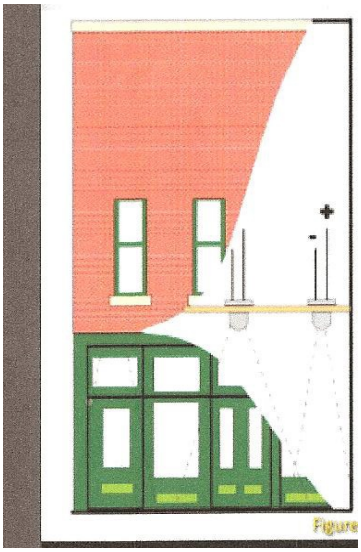
Make a cardboard liner



Mask the windows to reduce glare

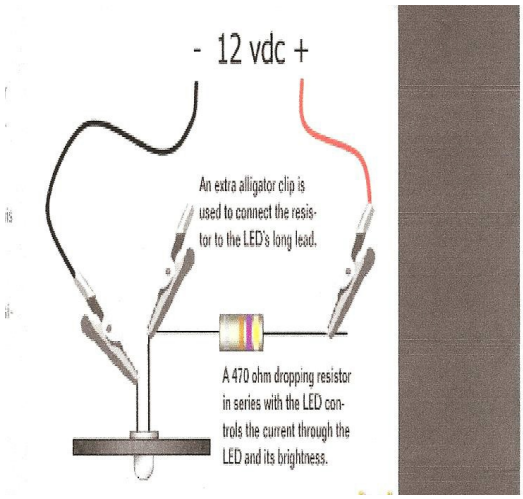


Develop an interior scene



Mount lights through ceiling

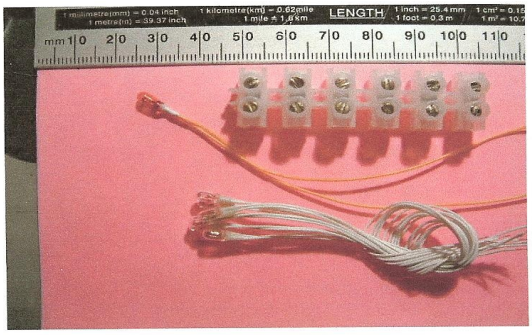
Use shrink tubing for insulation, protection



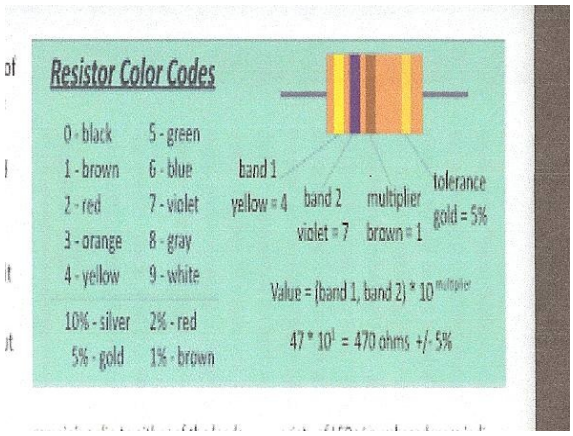
Typical hookup for LEDs

Colors of common LEDs

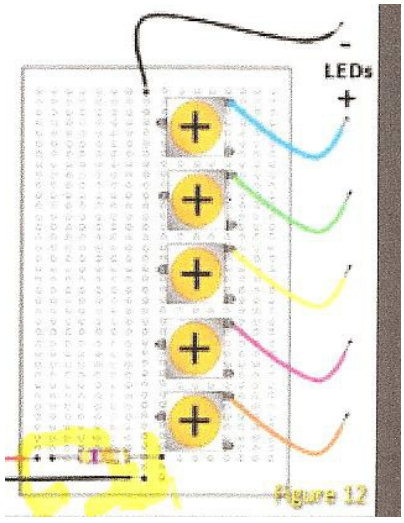
Sizes of common LEDs



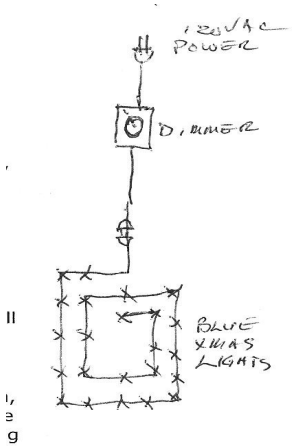
Use Euro connectors



Resistor color Code



Use trimming resistors



Night light system idea

Lighting Effects Make Model Railroads Come Alive

In December, 2009 I stopped procrastinating about adding lighting effects to South Point. I had been stalling because a lot of the wiring has to be done beneath the benchwork and it's awkward to work under there at the best of times. Some of the holes beneath the buildings would be difficult to reach because South Point is over 5 feet above the floor and Underhill North hidden staging is under the upper benchwork. Furthermore, many of the buildings did not have lights installed when I built them and were not partitioned. Few had interior details.

The first job was to upgrade the buildings with interior partitions and to add some interior window treatments. Fortunately, I had installed some grain-of-wheat bulbs in the Magnusum kits and had glued in blinds cut from colored paper. I started adding details, including people, to the other buildings.

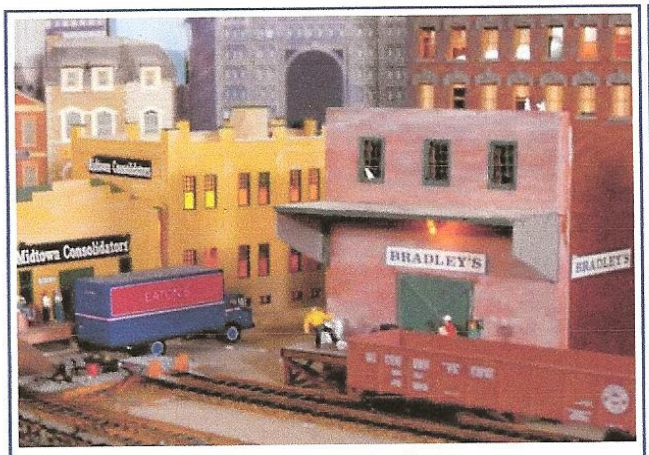
I had been inspired by several articles on lighting layout scenes and adding lighting effects in the June, 2009 issue of *Model Railroader* magazine. These articles cover using bulbs, placing lights, wiring, and choosing a power supply.

My first task was to see what voltage I had used for the buildings I had wired years ago. I first used an AA battery to see if any of the bulbs were 1.5 volts. If they didn't light I used a DC power pack and a meter to creep up the voltage. Most of them turned out to be 12 volts. A few may have been 14 volts. What I couldn't tell was the amperage draw. Grain-of-wheat and the bulbs from Miniatronics are usually around 30 milliamps. The 14 volt bulbs could be as high as 80 milliamps. Some of the screw-in bulbs I had used on control panels probably drew more current. You need to keep track of how much current you're drawing. I was using an inexpensive DC power pack and some leftover transformers in the 300 to 400 milliamp range. By the time I had installed a bunch of lights I had totally fried a Miniatronics transformer by exceeding its rating. It didn't have a fuse or circuit breaker when we opened it up. The transistors were blown. Now I have downloaded the schematic for a universal power supply I will need to build to give me the amperage I require. Even a small city like South Point can soak *up a lot of juice!*

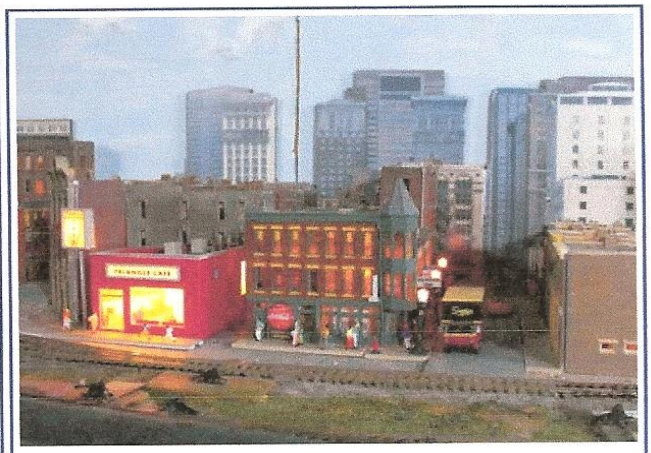
Here are a few tips I've picked up over the years:

- Check buildings for light leaks along seams
- Paint interiors black if light glows through the walls
- Add diagonal partitions so you can't see through the building. Use black cardboard, matte board or something similar
- Wire bulbs in parallel, not series so if one burns out they don't all stop working
- Set the voltage below the maximum. If using 12 volts, set around 10 volts. Bulbs will last longer
- Use miniature two-prong connectors between the building light(s) and the wiring bus. This way you can unplug the building if you have to change a bulb
- Add the amperages of the bulbs so as not to exceed the rating of your power supply (as I did)
- Use the same size bulbs and supplier as often as possible. It's easier to keep track.
- Write down what you used. Write it inside on the the walls or tag the wires

Now that I've started I plan to add some chase lights, neon billboards and maybe some sound modules. This will occupy me off and on throughout 2010. For now, here are a couple of photos taken over Christmas, 2009. The photos reveal I have a big seam in the backdrop to fill. That's another project.



Dusk comes to the city


Initial lighting effects at South Point

Most of the bulbs I used were 12 volt grain-of-wheat bulbs (about 1/8", 3 mm). However, in the photo above I used a 1.5 volt grain-of-rice bulb above the freight door at Bradley's. I added a 560 ohm resistor to one lead so that I could connect that light to the other 12 volt bulbs. I used the smaller bulb so it didn't look too large above the door. Some of the buildings simply have a bulb underneath the building instead of inside the building. I've seen modelers use Christmas tree bulbs to do this.

All wires go to terminal strips below South Point and from there to the power supplies.

Another method is to use fiber optics from a bulb hidden under the benchwork. This method is good for automobile lights and similar purposes. Sometimes an LED will work. Be sure to add a resistor in this case. A method described in the *Model Railroader* article that I have not tried is copper foil tape as used for stained glass windows. You can solder to it.

Lamp shades can be made with a #2 washer and a grain-of-wheat bulb. I have some metal shades left over from Campbell kits. Brawa makes an assortment of street lights that plug into spring-loaded sockets. I used two-prong plugs for the ones in the top photo above.

There are many commercial products for street lights, traffic lights, etc. Check the Walthers catalog or the selection at your hobby shop or online store.

Experiment. If you don't like the effect, change it. Lighting effects certainly make scenes come alive. They're worth the extra effort. I'm happy with the results at South Point so far.

Special Lighting Effects for Your Model Railroad

Special lighting effects are an excellent way to spruce up your train layout. Viewing night scenes on a model railroad is awe inspiring. Picture your lighted steam engine weaving in and out of towns with street lights, lighted neon signs and marquees, lighted billboards at the edge of town. In the background, there is a glow of the sunset behind the mountains. Add some sound effects of the chuff of the engine, the clickety-clack of rail cars along with ambient city sounds, and you have the makings of an awesome model railroading experience.

You're thinking, *How can I do all that*??

Lighting effects are not that difficult. In fact, with the electronics available now, it's easy. Read on...

Street lamps

If you have a small town or city on your layout, or even just a group of shops or houses, the addition of streetlights to the scene is an easy way to use lighting effects to enhance the realism and character of the town.

There are many different types of street lamps available in multiple scales from various manufacturers, including Model Power, Life-Like, Miniatronics, Brawa, Vollmer, etc. You can find old-style gas lamps all the way up to modern streetlights. There are not only the tall standing street lamps, but also many types of operating wall mounted lamps available. Just browse the Walthers catalog to find many of these lighting effects or visit the Miniatronics website (www.miniatronics.com).

To install the streetlamps, drill a hole smaller than the base of the lamp and thread the wires to the bottom of the layout. Then use silicone glue to seal the base of the lamp to the layout surface. They should be placed out evenly along the street, 2 per city block on average.

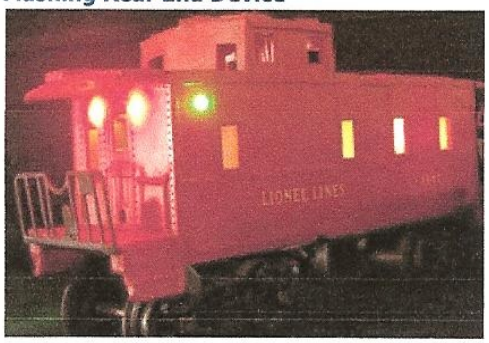
Wiring can be done in series or parallel from an AC power source. If you wire them in series (connected end-to-end), the lamps have to divide the voltage, so that the bulb of each will be dimmer than it would be otherwise. Also, if one lamp is burned out, they will all go off. If you wire in parallel (using 2 bus wires with feeder wires going to each lamp, or if you use a power distribution block), all the lamps will have full brightness and if one goes out the others stay on. Thus, parallel wiring is really the preferred method. It's much easier to troubleshoot when a light burns out.

You can use a combination of parallel and series wiring for your lighting effects, if you wish, by placing groups of similar lights on the same street in series controlled by one switch; then, this group could be placed in parallel with other groups of lights, each group controlled by it's own switch. This would provide better organization and control if you have a lot of lights in your city.

Make sure your lamps can handle the voltage from the power source; otherwise they will burn out quickly unless you put a resistor in the circuit. This is especially true for LEDs. To find out how much resistance you need to add, subtract the supplied voltage (by the power source) minus the voltage rating of the lamp and then divide by the current (ampere) rating of the lamp:

Resistance needed (ohms) = (supplied voltage – voltage rating of the lamp) divided by current (ampere) rating of lamp (in amps, not milliamps).

You can add a rheostat from Radio Shack, if you wish, which works like a dimmer switch by increasing or decreasing resistance in the circuit to control the brightness of the lights. The wattage of the rheostat required = the lamp current (in amps) X the supplied voltage. The resistance (ohms) rating for the rheostat can be estimated by dividing the voltage rating of the lamp to be controlled by the current rating for the lamp in amps, then multiply by 5.



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Lig
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Power from the track