



## HO Scale Free-Form Modular Model Railroading

### Standards and Guidelines

#### 1.0 Overview

The main purpose in the Credit Valley Free-Mo group is to have fun and enjoy the company of others who are looking for the same in operating our trains. The layout setup does not follow the traditional “endless circle” format of most other modular layouts. Instead it follows a “free-form” configuration that does not readily lend itself to continuous running. Trains from one point on the layout, traverse it and then terminates at the other end (or back at the starting point.) This format results in modules that are viewed both sides and that are designed to be reversible. (i.e. rotated 180 degrees.)

This type of operation requires end points, typically in the form of stub end yards or reverse loops. A layout may then take on the form of an “out-and-back” or a “point-to-point”. Other more complex formats are possible if “junction” modules are used, for example a wye module could allow a branch line operation.

Between the end points of the layout are modules which carry the main line from one end to the other. Large “**modules**” maybe assembled from small, easily transportable “**sections**” to create a large layout feature

#### 2.0 Definitions

##### MODULE

Any layout component (or group of sections” meant to be operated as a single unit in a fixed configuration. A module can have any number of sections. Both ends of a module comply with the Free-Mo physical and electrical standards as defined within this document.

##### SECTION

A part of a larger module, complete with bench work, track, scenery, etc. Except where otherwise noted, standards for module endplate do not apply to inner-section interfaces, as these are considered to be internal to the module.

##### ENDPLATE

The standardized end surface of a module that joins with an adjacent module in a Free-Mo layout. The physical aspects of the end plate are defined in the Frame Work description below.

##### FITTER RAILS

The 2” long removable rails and joiners used to bridge the joints between adjacent modules or sections.

##### TRACK (POWER) BUS

The continuous two wire bus feeding power and DCC commands to the track.

##### ACCESSORY (POWER) BUS

The continuous two wire bus powering electrical accessories such as turnout motors, structure lighting, etc.

##### LOCO (DCC) BUS

The continuous six-wire bus carrying DCC information among the Digitrax system components, such as throttles, boosters, etc.

## BOOSTER COMMON BUS

The continuous single wire bus carrying the Booster common/ground from the Command Station to each Remote Booster

## PIGTAILS

Common name of any of the connectors/wire assemblies used to connect the electrical busses together between modules.

## 3.0 Frame Work

“Frame work” refers to a module’s structural frame including endplates, interior supports, legs and braces. There is no requirement to use specific materials or construction methods; however, the basic trade-off is sturdiness versus weight.

Generally, dimensional lumber is discouraged due to warping issues.

## HEIGHT

The nominal module height measured from floor to top of rail shall be 50”, adjustable from 49” to 51” above floor

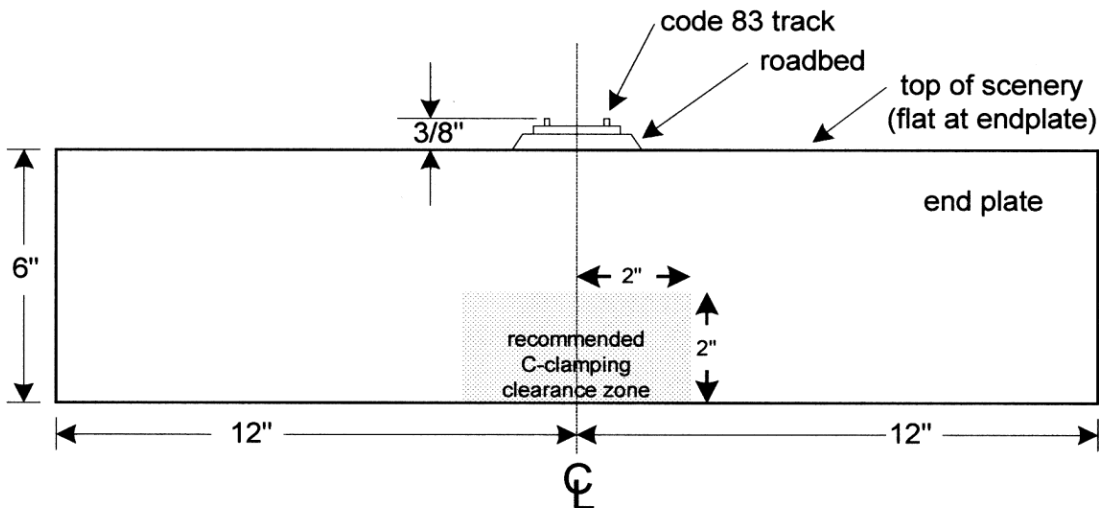
Suggestion: a height adjustment range of 2” is a minimum; a larger range is acceptable and recommended.

## WIDTH, LENGTH, SHAPE

See endplate specifications (below) otherwise free

Suggestion: modules over 6’ long are difficult to move and transport.

## ENDPLATES (SINGLE TRACK)



24” wide, 6” high from bottom to scenery top surface; roadbed and track adds 3/8” to top of rail.

Make endplates from 3/4” plywood or equivalent stable material to maintain flatness

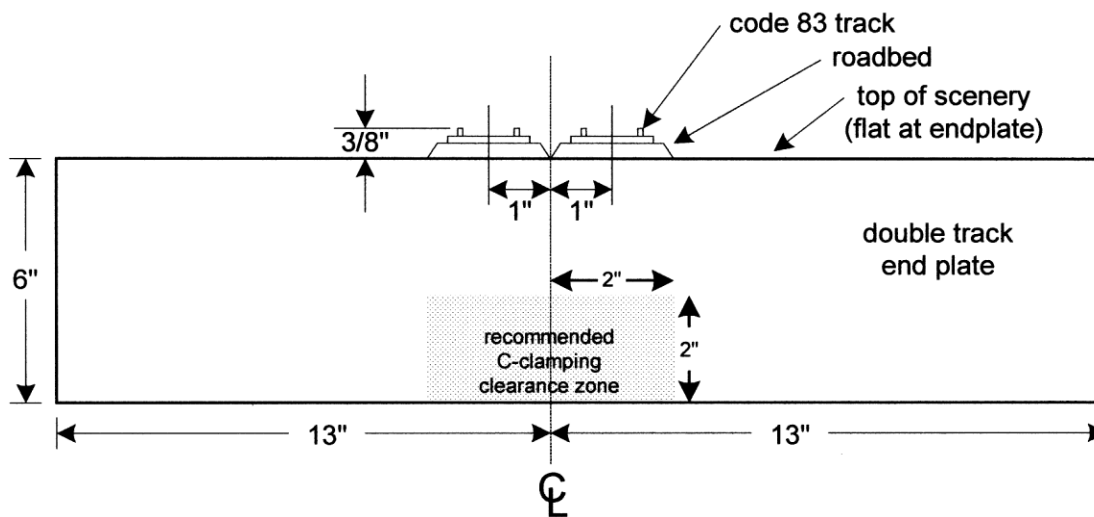
Color must be Benjamin Moore Davenport Tan

Endplates MUST be perpendicular to track both vertically and horizontally. They must be as flat as possible (e.g. not bowed, twisted, etc.) Material must be solid and sturdy for clamping to adjoining modules.

Suggestions:

1. To allow room for clamps, keep inner surface of endplate clear of obstructions (electrical terminal blocks, Loconet connections, etc. Recommended clearance area is 2” high by 4” wide centered at the bottom edge of endplate inner surface.
2. Cut handholds into endplates to assist transporting and positioning the module

## ENDPLATES (DOUBLE TRACK)



26" wide, 6" high from bottom to scenery top surface; roadbed and track adds 3/8" to top of rail.

Make endplates from 3/4" plywood or equivalent stable material to maintain flatness

Color must be Benjamin Moore Davenport Tan

Endplates MUST be perpendicular to track both vertically and horizontally. They must be as flat as possible (e.g. not bowed, twisted, etc.) Material must be solid and sturdy for clamping to adjoining modules.

### Suggestions:

1. To allow room for clamps, keep inner surface of endplate clear of obstructions (electrical terminal blocks, Loconet connections, etc. Recommended clearance area is 2" high by 4" wide centered at the bottom edge of endplate inner surface.
2. Cut handholds into endplates to assist transporting and positioning the module

## SIDES AND FASCIAS

Sides and Fascia must be smooth and made of a solid, sturdy material (plywood, hard board, Masonite).

Color must be Benjamin Moore Davenport Tan

Suggestions: Avoid protruding items like toggle switches to prevent accidental damage or injury; recess these items into cut-outs in the side/fascia

## TABLE TOPS / SUB ROADBED

Make table tops / sub roadbed from either 1/2" plywood or 2" foam. Must be built to prevent sagging or flexing and must be installed to comply with the endplate requirements. It MUST be perpendicular to the endplate both horizontally and vertically.

Color must be Benjamin Moore Davenport Tan.

## MODULE-TO-MODULE ATTACHMENT

Clamps are used at the endplates of the module, positioned near the endplate center (directly below the tracks)

Attachment of sections within a module may be at the discretion of the owner as long as it provides a positive alignment of the track and prevents both vertical and horizontal movement.

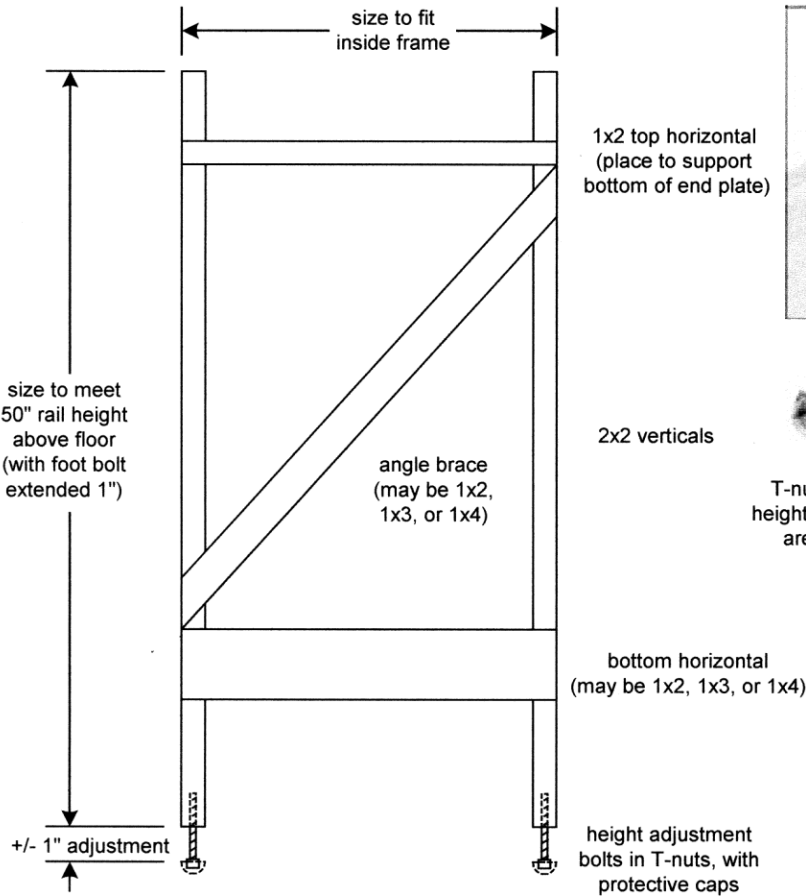
Suggestion: Use "deep-throat" C-clamps to apply pressure closer to the module top and draw the track ends together.

## LEGS

Each module must have legs that support the module free-standing. A module must stand secure and level independent of other modules.

Each leg must include vertical adjustment of plus and minus 1" minimum to compensate for uneven floors. Use a felt or rubber or equivalent bottom to prevent marking the floor

Legs must be painted flat black

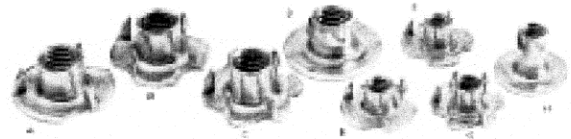


One possible leg design using dimensional lumber. T-nuts are mounted in the bottom for the height-adjustment bolts.



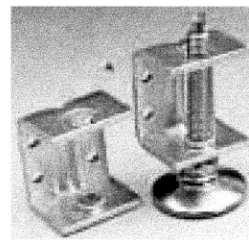
Visit Lee Valley Hardware at [www.leevalley.com/hardware/](http://www.leevalley.com/hardware/)

Folding brackets like these from Lee Valley (#00T16.01) can be used to build permanently attached fold-up legs. They lock into position both open and closed.



2x2 verticals

T-nuts like these may be used in the bottom of legs to hold height-adjustment bolts. Lee Valley #00N23.01 (item H above) are 1/4" Propell Nuts designed for end-grain installment.



bottom horizontal (may be 1x2, 1x3, or 1x4)

height adjustment bolts in T-nuts, with protective caps

Another option for height-adjustment hardware. Lee Valley #01S04.05 bracket and #01S06.03 (3" tall) or #01S06.04 (4" tall) leveler feet. These can be adjusted with a screwdriver from above, avoiding crawling around on the floor during setups.

## 4.0 Track Work

### GENERAL

All NMRA standards must be met.

### ROADBED

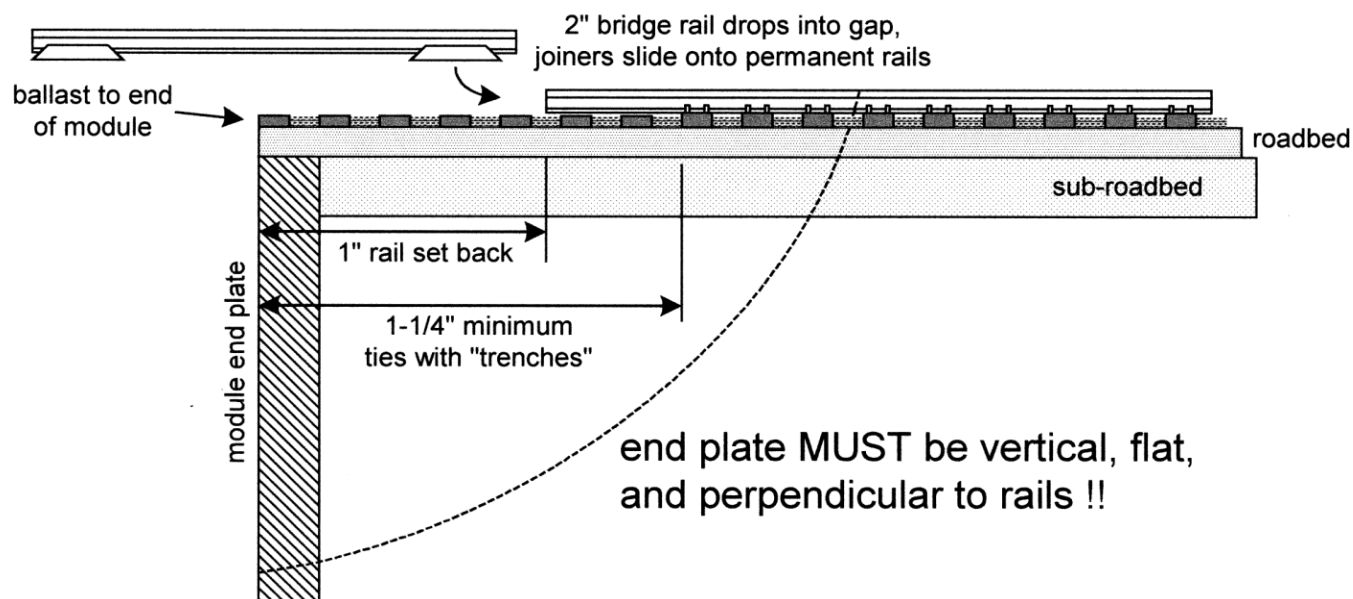
Material is free, but must comply with the 3/8" standard for the top-of-scenery to rail-top dimension. Sections may deviate from the 3/8" requirement

Suggestion: Standard HO scale cork roadbed used under flex track meets the 3/8" requirement

## MAINLINE LOCATION

The mainline must cross the module end plates centered on the 24" width and 12" from each side on a 26" width. It MUST be perpendicular to the endplate both horizontally and vertically. The mainline must be run straight and level for at least 6" from each endplate. Turnout points are to be no closer than 6" from the end. Otherwise its location is free (within limits of standards for curves and turnouts). This guideline insures that there is at least 12" of straight track between reverse curves.

## JOINING TRACK BETWEEN MODULES



Rails end 1" from end of module (outer surface of the endplates). Ties and ballast continue to the end of module. The ties within 1.25" (minimum) must accommodate installation of fitter rails with accompanying rail joiners, which are slid onto the module's fixed rail ends (typically these ties have a small "trench" where the spikes are found). Modules are connected with 2" fitter rails and rail joiners, which are dropped into the rail gaps and joined to the module rail ends

### Suggestions:

- use Atlas code 83 joiners on fitter rails (their profile provides a surface for pushing into place)
- use weathered code 83 rail for fitters
- where on the sections where rail smaller the code 83 is used, use the same code rail for the fitter rails.
- To enable DCC power districts the module must be able to accept insulated rail joiners at each end

## RAIL

All track must be nickel-silver commercial or hand laid. Mainline track must be code 83. Other track maybe smaller (e.g. Code 70 or 50)

## CURVES

Minimum radius is 42" for mainline including passing sidings and 30" for branch line. There must be 12" of straight track between reverse curves. Minimum clearance on curves will be 2" centerline to centerline.

## SUPER-ELEVATIONS AND GRADES

Super-elevation of mainline curves, vertical curves and grades are permitted, appropriate for mainline operation of contemporary long cars. The maximum grade is two percent ending 6" minimum from the endplate.

## TURNOUTS

Minimum of #6 with #8's recommended for the mainline. All mainline turnout controlled locally or through DCC. Point throw must reliably and completely close the point rails against the stock rails. Method of throw (powered or manual) is free as long as the mainline switches can be controlled from both sides of a module. Frogs must be powered routed from the stock rails (relying on the contact between point and stock rails to conduct power through points to the frog is to be avoided).

Note: DCC accessory decoders are allowed for turnout control as long as there is at least one other method available to throw the turnout (fascia buttons, hand throw, etc.). A listing of decoder addresses must be provided and means to allow reprogramming if necessary.

## CLEARANCES

All clearances (tunnels, structures, etc.) must meet NMRA Standards.

## 5.0 Electrical

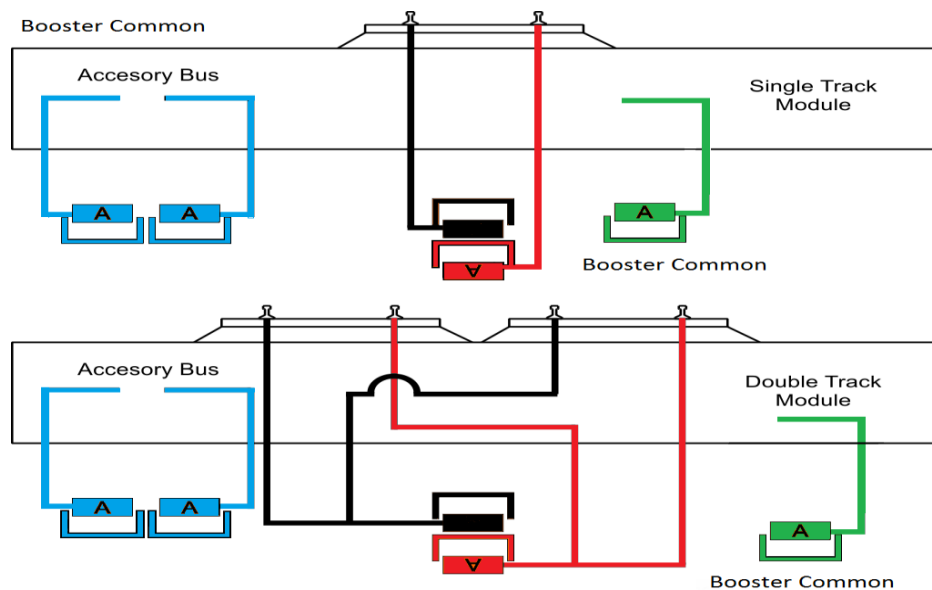
Four simple electrical "busses" run through each module and connect them together. Power to the track is routed over the Track Power bus, layout control is routed over the DCC Loconet bus, The Booster Common is routed over the Booster Common Bus and power for accessories is routed over the Accessory bus.

### TRACK POWER BUS

The track bus is a two wire power daisy-chain bus that jumpers the track power from one module to the next. The Track Bus shall be terminated on all ends with a pair of Anderson Power pole PP15-45 Standard Housing incorporating a 30-amp power contact for use with 12-14-gauge wire. The PP15-45 connectors shall be stacked vertically (hood up, tongue down). These pair are commonly called "pigtails". These connectors are left disconnected and insulated rail joiners used where an electrical gap between blocks is desired.

The "pigtails" must be 18" long and terminate within 6" of module endplates.

See the sketch below. It is recommended to define "direction/side" for a module (i.e. North/South, Left/right) to use as orientation keys during wiring. **The Credit Valley will use Red and Black Anderson Connectors for the Track Bus.** And a good way to verify the pigtails are correct is; **"When facing the module end plate, the red Anderson must be connected to the right-hand rail and the black Anderson must be connected to the left rail.**



Looking at the end of the Module

## DIGITRAX DCC AND LOCONET BUS

Free-Mo will use the Digitrax command control system.

Both tethered and wireless walk around throttles are allowed. All NMRA-compatible DCC decoders are allowed.

Each module must have a single 6-wire "RJ12" jack mounted on the underside within 6" of the endplate, used to interconnect the Loconet between modules forming a continuous network throughout the layout setup. Interconnection of modules is made with 24" lengths of "RJ12" 6-conductor phone cable with 6 wire clip-plugs installed at both ends. Install the clip-plugs so all wires run "straight through". These connect to the underside mounted jacks on adjacent modules.

Modules four feet or longer must have a single or dual "RJ12" or UP5 (recommended) mounted on each side of the module for operators to plug in their walk around hand-held throttles.

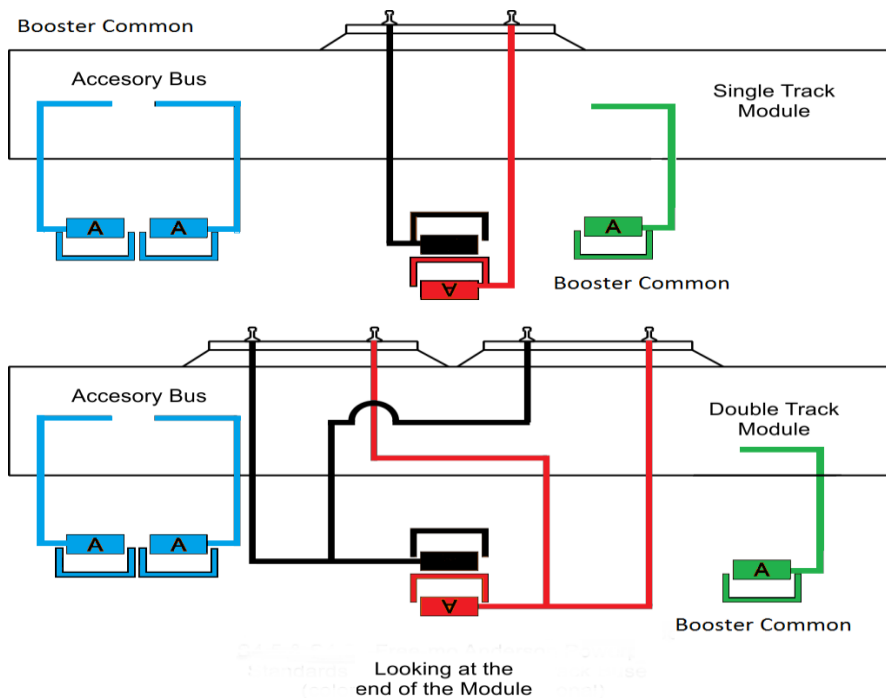
All wiring must meet Digitrax standards.

It is recommended that the UP5's be powered.

## ACCESSORY POWER BUS

This two wire bus is used to provide accessory power for use with such items as powered switches (i.e. Tortoises) and may also be used to power other accessories on modules such as lighting, animation and the like. It is used to carry a DCC signal similar to that found on the Track power bus (a separate booster is recommended to keep from robbing power from trains) or a separate 16V AC power supply.

The accessory power bus must be a minimum of 14 gauge and it is recommended that Blue color wires are used for the Accessory Power Bus. Since it is a AC signal the same color can be used for both wires. The Accessory Bus shall be terminated on all ends with a pair of Anderson Power pole PP15-45 Standard Housing connectors incorporating a 30-amp contact for use with 12-14-gauge wire. The PP15-45 connectors shall be stacked horizontally (tongue-to-tongue, hood-to-hood). The Credit Valley will use Blue Anderson Connectors for the Accessory Bus.



## **BOOSTER COMMON BUS**

Single wire bus is used to provide a Booster Common from the Command Station to each Booster Station. All modules shall incorporate one wire for a Booster Common that is 14 AWG stranded or larger. Booster Common shall be terminated on all ends with an Anderson Power pole PP15-45 Standard Housing connectors incorporating a 30-amp contact for use with 12-14-gauge wire. The Color will be Green.

## **PIGTAILS**

The Anderson Power pole PP15-45 connectors for the Track Bus, Accessory Bus, and the Booster Common shall be three separate sets of connectors.

## **6.0 Scenery**

### **TRACK/ROADBED**

The rail will be painted "Roof Brown" and the ballast used will be Woodland Scenic Grey Blend Fine B1393 or equivalent

### **END PROFILE AND LANDSCAPE**

A flat horizontal scenery profile is used at module ends. Scenic "ground level" at module ends is a nominal 3/8" below top of rails. Landscaping along the module ends must be designed to smoothly flow into adjacent modules - avoid features such as roads, lakes and so forth from running against the module end.

### **BACKDROP**

No backdrops are allowed as modules are viewed from either side.

## **7.0 Public Display**

### **SKIRTING**

Both sides of all modules must have skirting for use at public displays. Skirting to be black and must meet fire resistant code. Bottom edge of skirt to be even with the bottom of leg vertical member to ensure that it does not drag on the floor and to extend 2" past the module to ensure that there is no gap at module joints.

### **CROWD CONTROL BARRIER**

Each module that is 4 foot or longer must provide two barrier stands for every 5 foot of length.

### **PLEXIGLAS SHIELDS**

Free, but should be easily removable for access to track for cleaning, uncoupling cars, etc.