**Core Layout and (optional) Personal Module Construction Guide**

In an effort to help anyone interested in building a module for the ETE Great Lakes modular layout, we have developed this guide to not only provide the module construction requirements for the core layout, but also to provide an option for anyone building a personal module who would like a reliable and flexible construction guide to follow along, using readily available materials and simple tools.

**First, let’s take care of a little Q and A…**

*Q: What makes this Construction Guide different from the Module Specification?*

A: The Module Specification outlines the requirements for a module. This Construction Guide provides one method and multiple suggestions for building modules that meet the specification.

*Q: Why not just add the Construction Guide to the Module Spec?*

A: We don’t want to limit the creativity and ingenuity of our members by saying, “you have to build modules like this!”

*Q: So why create this guide at all?*

A: Two reasons. First, the core layout will be made from modules constructed using this guide, and second, a construction guide provides a baseline for constructing personal modules which module builders can choose to follow, either completely or partially.

*Q: What do you mean by ‘core layout’ and ‘personal modules’?*

A: These definitions are found in the specification itself. In short, the core layout modules are those modules that form the core layout for the chapter. These modules (and ONLY these modules) will be stored in the trailer, and will represent the standard layout that gets displayed at shows. Personal modules are those modules that are constructed by our members that may or may not follow this construction guide, but remain in the possession of the builder, and that are then stored and transported by the individual member to shows. These modules will only be incorporated into the layout when the module builder/owner is present at the exhibit/show.

*Q: Why the distinction?*

A: We want to make sure that any member with a basic understanding of the set-up process of the core layout can help set up any core layout module. To make sure that happens, the core modules need to be built the same way, connected the same way, and not have unique or complicated modifications that require ‘tribal knowledge (knowledge in the hands of only the module builder)’ to complete. Think of it this way: your mechanic can fix your car because the manufacturers build them all roughly the same way. If you decided to build your own car your own way, you couldn’t expect your mechanic to know how to take it apart, fix it, or put it together. Think of the other ETEGLers as the mechanics.

*Q: If I want to build a module that is a little different from this guide, does that mean it can’t be a core module?*

A: It depends. Any deviation from this construction guide will need to be reviewed in advance by the ETEGL MOD SQUAD. If the modifications aren’t too severe or complicated and/or don’t violate that ‘tribal knowledge’ rule, then approval is likely. But failure to have the MOD SQUAD review modifications might render your module unusable in the core layout, resulting in anger, unhappiness, and wasted effort. Let’s avoid that with a simple email for confirmation, okay?

*Q: I want to build a corner module and this guide only addresses straight modules.*

A: For now we are only publishing a guide for straight modules. If you are interested in constructing a corner module then please reach out Joerg Walter.

*Q: Can we move on, please, and get to the guide itself?*

A: You bet. Just one more thing: Be sure to address any questions you have to modsquad@etegl.org.

**The Basic Module Framework**

The modules themselves are constructed largely of wood. There are a total of 16 pieces of wood needed. Six of those comprise the legs, and the remaining ten pieces include two end plates. Let’s focus on the eight pieces that comprise the actual layout frame. These include:

2 backing pieces for the end plates

2 cross braces that provide ‘squareness’ and a mount for the legs and electrical connectors

1 stiffener under the roadbed to provide support for the roadbed and a place to run wiring

1 roadbed, the piece that sits under the track (and more)

1 rear side piece

1 front side piece

The backing pieces, cross braces, and stiffener are all standard sizes across all modules, with only the stiffener needing to be cut, depending on where you source your lumber. The remaining three pieces will need to be cut based specifically on the design of the module. Let’s talk about that in more detail.

**Understanding the Roadbed**

On the old layout, the top of the module was made up of a 2x4 piece of plywood screwed to the frame. Module builders were free to slap track onto the plywood any way they wanted and build scenery around that. The new spec is designed more for trains to run *through* scenery versus *over* scenery. This now requires some thought on the part of the module builder, since the roadbed piece will need to take into account the track plan that is desired on the module. If your module is a simple straight-track-no-switches design, you’re going to use a 1x6 piece of wood, 48” long, with 0.5” trimmed off the length, giving the roadbed piece a length of 47.5”. Why 47.5? Because you’ll be adding a ¼” thick end plate to either end of the module so it meets up perfectly with the next module on the layout. Other than that little trim you won’t need to cut it any further. The 5.5” width of the wood is sufficient for both the track and to anchor the scenery (assuming you are using a traditional scenery construction technique).

However, if you plan to either curve the main line or add switches, the 1x6 will not be wide enough. You’ll probably need to use a wider piece of wood, and will likely need to be cut. The easiest way to explain this is by using a few examples.

Example 1: An Outcropping

Let’s imagine a module concept where you’d like to have the main line curve around an outcropping of rock at the back of your module. For the sake of reliability, it’s probably best if the track sits on one single piece of wood. In this case, you might need a wider piece for the roadbed. This would then be cut in a gentle horseshoe curve shape to follow the double-S-curve of the track.

Example 2: A siding

Perhaps your module design includes a siding and a small freight depot on the inside of the main line. You’ll want to have a wider roadbed piece to support that extra track. In fact, you might even want to make it wide enough for the freight depot itself, possibly even for the access road.

Example 3: A Grade Crossing

Consider a situation where you have a grade crossing with a switchman’s house. To simplify construction of the module, you could use a single piece of roadbed to provide the base for the road, the switchman’s house, and the track.

In all of these examples, the decisions of what the module will include in terms of scenic elements have to be made before the roadbed wood can be selected and cut. The same goes for the side pieces, as we’re about to discover…

**Understanding the Side Pieces**

In order to reduce the cost and complexity of the module design and to improve durability, it has been decided that the front (spectator) and rear (operator) side pieces will be selected based on the scenery and landscape contour that the module will incorporate, both in front of and behind the track.  This way, a single strong 48” long piece of wood will serve to complete the module frame and anchor the scenery without the need for additional pieces which then would need to be cut and attached. This is a similar concept as we are using for the roadbed.

Like the roadbed, this complexity requires some forethought by every module builder on how the landscape will look, because the front and rear side pieces will be selected (and cut) based on what the module will eventually look like.  Again, the easiest way to explain this is by using a few examples.

Example #1:  A Grade Crossing

Let's imagine a module where the tracks run along a hillside with a cut in the hillside for a road that then crosses the tracks via a grade crossing perpendicular to the track.  To keep the road flat, the rear and front side pieces might look something like illustration #1.  The crossing gate was added to show where the road is.  Remember, the end plate is 3.5" high in the front and 5.5" high in the back, so those are our 'starting points' for the front and rear side pieces.  Let's start with the rear piece.  This is the back of the module as viewed by a spectator.  Since the scenery rises above 5.5", a 1 x 6 x 48" piece won't do.  Instead we'll need something taller.  Because the ground level rises to a maximum of 7.5" above the bottom of the module frame, we can use a 1 x 8 x 48" piece.  In the middle (or wherever the grade crossing is), the ground level drops to 4.5" so that it is level with the top of the track bed.  For the front, we need to come up to the level of the track bed, namely 4.5" from the bottom of the module frame.  We'll need something other than a 1 x 4 x 48".   In this case, we can use a 1 x 6 x 48" and cut it down, making sure (again) that we are at 4.5" high at the spot where we want our road to be when it reaches the front (spectator side) of the module.

Example #2:  A Small Town

For our next example, we want a few buildings sitting behind the tracks and level with them.  The buildings extend to the back of the module, so we won't be able to put a hillside or anything behind them.  The rear side piece should then be flat at track height as much as possible.  In this case, we can use a 1x6x48" and trim it down to 4.5" for the majority of its length.  The only areas where the ground level has to come up is at the very ends.  For the front side piece we aren't going above the 3.5" of the template end plate, so we can use a 1 x 4 x 48" which then can get cut down a bit so the scenery drops off in front of the train tracks even a little further, and with an uneven contour that looks more realistic.

Example #3:  Tunnel

This one is a little more complex.  In order to add a tunnel to such a narrow module we might want to have the ground level in the front and in the back be roughly the same height with the tunnel passing through the middle.  In this case, we would need really wide pieces for both the front and the back.  The illustration shows that both the front and rear side pieces would be cut from 1x16x48" boards.  By designing a tunnel in this fashion it avoids the extremely unrealistic situation in which a tunnel is bored when the trains could just go around it.  In our example I put the 'peak' of the mountain at the back of the module and had a little drop-off toward the front.

Now that the theme of the module and its associated scenic elements have been identified, it’s time to start putting the module itself together.

**The Legs**

All modules are required to have four legs. This is a departure from the old spec, where we only had legs on one end. That allowed us to save weight, but resulted in complications with set-up and tear-down, where three or four people were always required when it came to holding modules and putting in track or alignment pins. The new spec calls for four legs, so one person can set up a module, and only two people are required for moving it into position (dragging modules across the floor is not recommended).

The legs themselves should be 40” long. They will sit slightly inside the sides of the module, and with the adjustable feet in the bottom can be raised or lowered as needed. Folding brackets mentioned in the spec are very useful in that they help lock the legs in the up and down positions. They provide good stability and are fairly inexpensive. Construction here is important in terms of keeping the legs parallel when attaching them to the cross brace (not to be confused with the table leg brace). The table leg brace at the bottom of the legs (one on each pair) should be attached first, and adding a second temporary brace further up can help insure that the legs are parallel. Since the legs on both sides fold up and ‘nest’ with each other, it’s important to make sure the legs are correctly offset. The distance between the outside of the legs on each end of the module should be 21”. This will also be the length of the table leg brace. The table leg brace should be between six and ten inches wide, and made of 1/4” – 1/2” plywood. The easiest way to complete the leg construction is to attach the folding leg bracket to the legs first and then to the cross brace. It is important that they are mounted straight, i.e. parallel to the leg itself. If not, the leg will be crooked when extended down from the module. [add bracket position on cross brace here]. When building the legs, remember that one table leg brace should be on the inside of the legs and one table leg brace should be on the outside of the legs, which then allows the legs to ‘nest’ up inside the module. If you build the two sets of legs side-by-side and identically, you’ll automatically have one brace on either side, since you’ll rotate one set of legs 180° when installing them.

One item of note: The legs should always be secured when in the ‘up’ (for transport) position. Although the brackets lock the legs in the ‘up’ position, the weight of the legs will bend the brackets over time, and the constant bumps in the road can cause the brackets to fail, dropping the legs onto the module below. The solution is to secure the legs in the ‘up’ position with an additional securing method. We recommend the use of hook-and-loop fastener which can be stapled to the cross brace situated at the bottom of the module legs that are on the outside when the legs are folded up (see illustration).

**The Module Frame**

There are four pieces of wood that make up the module frame. Two of those have already been discussed, namely the front and rear side pieces. Hopefully you have already decided on the thematic elements and scenery for your module, and have already cut the front and rear side pieces with the proper contour. The two endplate doublers make up the ends of the basic frame. These will sit just inside the front and rear side pieces. It is important that the module is square and not skewed. The cross braces that the wire connectors and legs are attached to serve that purpose quite well! Feel free to place those provisionally within your frame to maintain squareness before you glue / nail / screw the four frame pieces together. Remember, the end plates go INSIDE the front and rear side pieces, so the module is 48” long. Also, the two endplate doublers should be ¼” recessed inside the front and rear side pieces. Why? Because each end plate is ¼” thick, and the idea is for the overall module to be 48” long so the track goes right to the ends. Think of it this way: the side pieces should be flush with the end plates when assembled. Also: If you haven’t already mounted the legs to the cross braces (highly recommended!), now is a great time to install them, and then install the cross braces with the legs attached, on both ends of the module. Not only does that help ensure that the module is square, it also provides self-standing capability for the module to make work easier.

**The End Plates**

All modules are required to have the chapter-specified end plates on each end where the module (or modules, in the case of super modules) meet up with the rest of the layout. It is important that the end plate is level and at the correct height. As important (or even more so) is that the track goes all the way to the end of the module. That includes the end plates! If your roadbed piece is already cut to 47.5” long, it should rest upon the two endplate doublers and go right to the edge! Then you can provisionally clamp the end plates to the end plate doublers as a test. The track alignment ‘nubs’ sticking up from the endplate should be the only part of the end plate that sticks up above the roadbed. The space between the nubs, namely the space where the track rests, should be 42.25” from the floor. The end plates should be perfectly flat on the outside, with no screws protruding outward. Because of this, it is recommended to glue the end plate to the end plate doublers and use a series of clamps and a spare piece of wood to press the end plate to the doubler as the glue dries. Once dried, it’s time to drill three holes in the doubler using the end plate’s holes as guides- two ½” holes for the alignment pins and one 8mm or 5/16” hole for the table leaf pin below the track. It’s VERY important that these holes be straight, so ideally you should have someone watch you as you line up the drill.

**Roadbed and Stiffener**

With all four sides of the module completed and the legs supporting it, it’s time to add the roadbed piece. Since the roadbed piece will see some weight on it for both trains and scenery, a stiffener should be added below the roadbed piece to keep the roadbed piece from drooping or bowing. This stiffener should be made from a 1 x 2 x 48” piece of wood. The narrow dimension (1”) is what will sit up against the roadbed, so it will look like a ‘fat T’ if viewed from one end of the module. The stiffener will need to be cut to 36” so it fits between the two cross braces, and will be centered with the roadbed. It is recommended to attach the stiffener to the roadbed provisionally and then set onto the module frame to make sure everything fits as it should, and the roadbed is centered and goes right to the end plates. Before attaching the roadbed to the module it is recommended that the next step, the wiring, be completed. It’s a lot easier to get the wiring installed before the roadbed gets attached.

**Wiring**

As the spec mentions, there are a total of eight conductors in the wiring harness. This is also a departure from the old specification. In addition to having independent ground wires for accessory power and track power, we’ve added two wires that will allow us to execute a block control system, which protects trains from rear-end collisions. The wiring harness, and how each wire will be used in every module, is outlined below:

Pin Color Bus Purpose

1+ red Outside Track Power MUST be connected to outside track pukos

1– black Track Ground MUST be connected to both track grounds

2+ orange Inside Track Power MUST be connected to inside track pukos

2– green Catenary Power MUST be connected to catenary on both tracks

3+ purple Inside Track Feedback DO NOT USE

3– blue Outside Track Feedback DO NOT USE

4+ yellow Accessory Power Use as needed for powering lights and accessories

4– brown Accessory Ground Use as needed for powering lights and accessories

There will also be a 110VAC extension cord with drops that runs around the layout. This can be used as well for powering things like transformers or non-standard accessories. You can also run your accessories or lights from an independent transformer if you prefer. This reduces load on the accessory bus transformer, and also makes troubleshooting a little easier if there is an accessory short. Our only ask is that you keep the wiring simple, and have only 2 or 3 wires extend to the transformer as needed (just accessory power, just track power for a separate loop of track, or both). Make sure the wires are long enough to reach the transformer in case it has to be set on the floor below the module, and have some way of storing the wires so they don’t hang down during transport.

On each cross brace, a 1” diameter circular hole should be cut into the cross brace near the middle of the module but on the operator side of center. The Neutrik chassis connectors will need to be mounted facing downwards in these holes. The wires attach to the connectors using pins, so the easiest way to install the harness is to cut all the wires to the same length, about 48”, and crimp the pins onto the ends of the wires. Then attach all the wires to one connector. Run the other end of the wires up through one hole, screw in the attached connector on that side from below, screw in the connector on the other side from below, and then connect the wires to that other connector.

Now comes the ‘cool’ part. Take a handful of the Scotchlok suitcase connectors and about a foot of wiring for the wires that you’ll be connecting on your module. This will be either four or six wires, depending on whether you plan to use accessory power from the accessory bus or not. Insert one end of the wires into the suitcase connector and clamp the connector onto the equivalent bus wires. Voila! You’re done! No soldering, no wire stripping, nothing.

At this point it makes sense to test your wiring harness. Use a voltmeter or simply wire up a model train light across each line in the harness one at a time. Remember to check for continuity between both ends of the wiring harness at the connector as well as any wires connected via the suitcase connectors.

Now you’re ready to install the roadbed with its stiffener. Before doing so, figure out how you’ll attach the bus wires so they don’t hang down. The side of the stiffener makes a great mounting point, and any larger cup hooks will do the trick of securing the wires. We recommend the cup hooks with latches (also known as safety cup hooks) so the wires don’t work their way off. Space the hooks so they don’t interfere with the suitcase connectors, and install the roadbed. Secure the wires into the cup hooks and you’re ready to begin installing track, catenary, and scenery!

**Scenery, Track and Catenary**

Now that the basic module is prepared, it’s time to add scenery. By now you should have a very good idea where your scenic elements go. It is recommended that you complete the scenery work prior to laying track or adding catenary, but for the sake of this guide, let’s fast-forward to the point where your newspaper/chicken wire or plaster cloth / flyscreen scenery is completed, and you’re ready to begin painting. The spec calls out a paint color that provides some continuity from module-to-module. Often at train shows we can see layouts where the ground color changes (sometimes drastically) when one module ends and the next one begins. The ETEGL specified ground and grass color is only required at the ends of the modules to avoid this issue, so feel free to gradually transition to a different color for the interior of your module(s).

There is one exception, however, and that is the track roadbed. The roadbed under the track should be painted end-to-end in the spec color. This color lends itself well to the color of the ballast and helps ‘hide’ any bare spots that could appear unrealistic. And speaking of ballast, now would be a good time to ballast the roadbed. Note that we are ballasting the roadbed, and not the track. Marklin C-track already has imitation ballast, so the only ballasting we have to do is the ground around the track. There are several ways of painting and ballasting the roadbed, but we’ll focus on two of the most simple, both of which use the paint as an adhesive for the ballast.

In the first method, the track is not placed on the module yet. Instead, a fairly thick coat of paint is applied across the length of the roadbed. The ballast is then liberally sprinkled onto the wet paint until it is completely covered, and extending about a half inch to an inch on both sides of where the track will be, and in between the tracks. Some pressure onto the ballast with your hand while the paint is wet will help push the ballast into the wet paint and will reveal any bare spots at the same time. When the paint dries, the excess ballast can be vacuumed up (be sure to save this, since it can be reused). What you’ll have as a result is a smooth ballasted surface ready for the track to be laid upon.

The second method is very similar, but the track gets installed first. Then, instead of painting the whole surface, only the areas next to and between all tracks gets painted and ballasted. This allows some paint and ballast to work up the side of the C-track, resulting in a much more natural transition from roadbed to track.

There are advantages and disadvantages to either method. Although the second method tends to have a more realistic appearance, once that paint dries those tracks are solidly attached to the roadbed, and any electrical gremlins or issues that require track removal will completely undo the appearance and will require starting over, since ballast on both sides of the tracks will likely be ripped up, along with the track itself, if the track ever needs to be removed.

The catenary specification is designed to not only make it simple to string catenary along a straight-through module with standard Marklin pieces, but also to allow catenary to be added to sidings and additional tracks. Basically, the first and last mast should be 71mm from each module end. For straight-through tracks, this results in needing three 70360 catenary wires between them, and two additional masts on each main line. The placement of the first and last mast is the equivalent distance of a piece of Marklin 24071 track from the edge. Since Marklin catenary is designed to ‘split’ at a mast when a switch is present, it allows the module builder to put switches very close to the ends of the modules and still be able to add catenary to the diverging track. Then, if the main line continues straight through, the standard catenary spec can still be followed without requiring complicated adjustable pieces or additional masts. It’s important that the catenary wire is taut, but not so taut that it pulls the next mast in one direction or the other.

One item worth noting: If you plan to have signals that control train movement on your module(s), you will need to insulate the catenary wires as well as the track, since trains do run off catenary using a separate (analog) transformer. There are resources online to show you how to do this, or reach out to your fellow ETEGLers for assistance.

**Other Module Considerations**

As you go about the process of developing and constructing your module, here are some things to consider:

* The theme of the layout is European. Although you may have a Tyco ranch house from your childhood that would fit nicely onto your module, it isn’t really European and doesn’t belong. If you need European inspiration, watch some Youtube videos on Europe (the drone footage ones are super fun and helpful) or go online and visit the websites of manufacturers like Kibri, Noch and Faller.
* There is a direct correlation between the cost and realism of most trees and other scenic elements. Yes, you can get a bag of fifty trees for $20 on eBay, but these ‘trees’ are usually very unrealistic. Consider spending a little more and getting better quality. Distributors like Scenic Express have a very good selection and decent pricing.
* Nothing grabs the public’s attention more than an HO-scale photographer’s flashbulb going off, fire engines with flashing lights, or crossing gates that really close when a train passes them. Make sure that your module incorporates some attention-grabbing action scenes. There are several manufacturers like Viessmann that have kits that add movement to your module, including moving garage doors, moving chimney sweeps, fountains that look like they are running, etc.
* Even subtle mini-scenes are attention-getters, and go a long way towards putting smiles on faces. Manufacturers like Noch and Preiser offer mini-scenes that may not have movement or flashiness, but are fun for visitors to the layout to discover. From mountain climbers on a rock cliff to construction workers putting up a building, be sure to add views of daily life, both serious and whimsical, to your module. A small investment in a scene can make a big impression.
* Don’t skimp on figures! If you are modeling a train station platform, make sure you have people waiting for a train or the bus. Small details like luggage and baggage carts complete these scenes and add ‘life’ to the layout.
* Although our venues are usually well-lit, consider adding lighting to your module where appropriate. Street lights and park lights, or lighting in pedestrian tunnels, add a level of realism to modules, and really stand out when lighting conditions are less than ideal.