Overview of Modular Model Railroading

Fall-Winter 2014-2015
Dick Schwanke and Harford Modular Group
Harford Community College

Background on Course Organizer

- Returned to hobby in mid-1990s after 20 year hiatus / sabbatical
- Just an average modeler, but learning / wanting to be master
- Member of Western Maryland Railway Historic Society
- Joined WMRHS (DCC powered) modular group in 1999
- Founding member of the Harford Modular Group in 2003

What Is a Module?

- Table type structure
- Designed to be portable
- Built to interface with other modules
- Is not a piece of a sectional layout (although looks nearly identical)
Advantages of Modular Layout

- Single module uses limited space
- Combines to create a large layout
- Reasonably transportable
- No expansion limit
- Small size = reasonable cost

Advantages of Modular Layout

- Size allows ability to (95%) finish
- Creative modeling challenge
- Detailing to n\textsuperscript{th} degree possible
- Easily stored when not in use
- Group assistance and support

Disadvantages of Modular Layout

- Typically not much operating time
- Vehicle capacity hassles
- Transport damages need repair
- (Reality) Not every module matches
Construction Standards

- National Model Railroad Association
  - Standards
  - Recommended Practices
  - HO draws most from N-Trak experiences
- Assorted Modular Groups
  - Varying purposes means different construction standards
  - NMRA “backwards compatible” style
  - FREMO style

NMRA Construction Specs

- Module Standards
  - MS-1.0 Standard Gauges
  - MS-1.1 Narrow Gauge
  - MS-1.2 Traction/Overhead
  - MS-1.3 Electrical, All Scales
- Module Recommended Practices
  - MRP-1.0 Standard Gauges
  - MRP-1.1 Narrow Gauge
  - MRP-1.2 Traction/Overhead
  - MRP-1.3 Electrical, All Scales
  - MRP-1.4 Transition Module, All Scales

Variations in Construction

- Purpose of Modular Group
  - Running Long Trains
  - Historical or Geographic Accuracy
  - As a show for children
  - Modeling of diverse interests
  - Model Railroad is (supposed to be) fun
- Age of modular group compared to age of NMRA standards and recommended practices
- Backwards compatibility to NMRA
### Some Typical Rail Numbers

<table>
<thead>
<tr>
<th>Specification</th>
<th>Scale</th>
<th>N</th>
<th>HO</th>
<th>O</th>
<th>Hi-Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top of Rail to Ground</td>
<td>40&quot;</td>
<td>40&quot;</td>
<td>40&quot;</td>
<td>40&quot;</td>
<td></td>
</tr>
<tr>
<td>Track Setback from edge</td>
<td>2&quot;/4.5&quot;</td>
<td>2.0&quot;</td>
<td>5.0&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track Setback off front</td>
<td>4/5.5/7&quot;</td>
<td>6/10&quot;</td>
<td>4/7.5&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centerlines of track</td>
<td>1.5&quot;</td>
<td>2.0&quot;</td>
<td>4.0&quot;</td>
<td>3.5&quot;</td>
<td></td>
</tr>
<tr>
<td>Minimum Track Code</td>
<td>80</td>
<td>100</td>
<td>148</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

### What is a “Harford County Modular Model Railroad Module?”

- Mainline tracks in HO scale (87.1:1)
- Able to be transported
- Built to interface with other Harford Modular Group modules - at least at all ends of a multi-piece set
- Module owner is a participant in Harford Modular Group activities

### Compare Harford & NMRA HO Scale Rail Distances

<table>
<thead>
<tr>
<th>Specification</th>
<th>Scale</th>
<th>HMG-HO</th>
<th>NMRA-HO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top of Rail to Ground</td>
<td>40&quot;</td>
<td>40&quot;</td>
<td></td>
</tr>
<tr>
<td>Track Setback from edge</td>
<td>3.0&quot;</td>
<td></td>
<td>4.5&quot;</td>
</tr>
<tr>
<td>Mainline Track Setback off front</td>
<td>5/7&quot;</td>
<td>5/7/9&quot;</td>
<td></td>
</tr>
<tr>
<td>Siding Tracks Setback off front</td>
<td>3/9&quot;</td>
<td>no spec</td>
<td></td>
</tr>
<tr>
<td>Centerlines of track (straights)</td>
<td>2.0&quot;</td>
<td>2.0&quot;</td>
<td></td>
</tr>
<tr>
<td>Minimum Track Code</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Demonstration: Construction

- Benchwork Construction
  - Framing
  - Leg attachments
  - Top of module / subroadbed options
- Electrical Connections
  - Through tracks power (14 V-DCC)
  - House power (110 VAC)
  - Accessory power (18 VAC or 12 VDC)
  - Throttle network

Demonstration: Transport & Show

- Transport
  - Racks
  - Covered boxes
- Showtime
  - Set-up: unpack, legs up, frames aligned, connections made, tested
  - Operate model trains
  - Take-down: Set-up reversed

Additional Data / Handouts

- Introduction to module standards (reprinted with NMRA permission)
- List of module organizations
- Sample specification / data sheets from local H.A.R.M.
- Purpose for this session (the means for the class)
- Objectives for past session (the end results of previous class)
Overview of future sessions

- Benchwork
- Electrical
- Scenery
- Transport and Show

Week 1: Benchwork Construction

- Module Frame
- Tabletop of module
- Legs
- Subroadbed
- Roadbed and track

Week 2: Electrical Construction

- Digital Command Control (DCC) primer on operations
- Track power bus and feeder wiring (14 V-DCC)
- House power (110 VAC)
- Accessory power (18 VAC / 12 VDC)
- DCC throttle network
Week 3: Scenery Construction
- Scenery base in place
- Begin finish scenery
- Planning for scenery detailing

Week 4: Transport and Show
- Transport options
- Set-up steps
- Showtime operations
- Actual test running in class
- Take-down steps

Week 5: Making It More Complete
- Transport preparation
- Finish preliminary scenery
- Begin detailing
Summary of course overview

- What is a module?
- Advantages and disadvantages
- Standards and specifications
- Demonstrations
- Outline of weeks 1 to 5

Week 1: Benchwork Construction

- Frame Construction
- Tabletop of module
- Legs
- Subroadbed
- Roadbed and Track

Frame Construction 1

- Cut 1” * 4” dimensional lumber for 48” * 24” frame
  - Two at 48” (front and back)
  - Two at 22.5” (for sides of 24” total use 22.5 = 24 - 2*3/4” thickness of 1” board)
- Cut center cross brace from 1” * 2” at 22.5” long
- Drill two 3/32” pilot holes 3/8” in from ends of 48” pieces for screws
Frame Construction 2

- Glue and square frame
- Hold with eight #8 * 1 5/8 screws
- Mark 24” center for cross brace

Frame Construction 3

- Drill pilot holes so brace sits even with top edge
- Glue and square brace
- Hold with four #8 * 1 5/8” screws

Tabletop for module 1

- Cut 3/8” plywood top to 48” * 24”
- Square then glue to top of 1” * 4” frame
- Drill 3/32” pilot holes around edge
  - Space about every 6”
  - Go thru plywood into frame 1/2”
- Hold top to frame with #6 * 3/4” screws (or staples)
Tabletop for module 2

- **Mark cutting lines for leg braces**
  - Two braces each at 10” wide
  - Left side / outer leg at 22.5” long
  - Right side / inner leg at 19.5”
  - 4” set in from back edge of top
  - 1” set in from left and right edges
  - Double check - should have 3.5” center strip remaining

Tabletop for module 3

- **Drill 5/8” pilot hole at each of eight brace corners**
- **Use jigsaw to cut out leg braces**
- **Set aside braces until legs are prepared**

Leg Attachment
Leg Attachments

- Attachment options **not allowed here**
  - Slide into box frame
  - Telescoping PVC pipes
  - No legs (just set on tables or floor)
- Will use folding wood legs with height adjusters
  - One fixed & one removable bolt per leg
  - Legs stay attached to finished module
  - Use plywood cross brace for each end

Leg Construction 1

- Cut legs from 2” * 2” dimensional lumber
  - Four legs each at 32” long
  - Two spacers each at 3 1/2” long
- Install height adjuster
  - Drill hole 1/4” * 5” long into leg’s length
  - Put in insert nut with 6 mm allen wrench
  - Screw in 1/4” * 4” Eye bolt with nut

Leg Construction 2

- Prepare spacer block
  - Parallel and flush to end opposite of adjuster bolt
  - Glue and C-clamp together (if screwed, do at 1 1/4” down)
**Leg Attachment**

![Diagram of Leg Attachment](image)

**Leg Construction 3**

- **Drill attaching holes (at end opposite of adjuster bolt)**
  - Attach (C-clamp) drilling template
  - Drill attaching bolt holes at 1/2” and 2 1/2” from end
  - For two legs with spacer blocks, drill through spacer also

**Leg Construction 4**

- **Attach leg braces (previously cut from tabletop 3/8” plywood)**
  - Shorter brace (19.5” long) goes on two legs with spacer blocks
  - Bottom edge of brace at 10” from bottom of leg
  - Glue and square, double check square
  - Drill three 3/32” pilot holes for each leg
  - Go thru plywood into leg 1/2”
  - Hold brace to leg with #6 * 3/4” screws
Leg Construction 5

- Mark inside of frame for leg attachment holes
  - In from side at 4” for center of legs
  - Top of leg to clear tabletop by 1/2”
  - Holes at 1” at 2.5” down from top
- Drill 1/4” leg attachment holes
  - May wish to C-clamp the template onto the leg for a square hole
  - Drill first hole, bolt together, use leg to verify markings

Leg Construction 6

- Bolt on legs
  - 1/4 \* 2.5” bolt for outer legs
  - 1/4 \* 4.5” bolt for inner legs with spacer blocks
  - First attach with two washers and standard nut on four lower holes
  - Adjust upper hole size/spacing if needed
  - Attach with two washers and wing nut on four upper holes

Leg Construction 7

- Secure legs for transit
  - Fold legs by removing upper bolts
  - C-Clamp legs in folded position
  - About 6” from bottom of leg, drill thru legs and frame
  - Test fit 4.5” bolts, one per leg
  - Bolts will keep legs from unfolding
Leg Construction

- Secure legs for transit
  - About 6” from top of inside legs, drill hole
  - Test fit 2.5” bolts, one per leg
  - Bolts go here for transit
- In transit
  - Legs folded and secure
  - Loose parts secured

Subroadbed preparation

- Make decision about number of tracks / rough out scenery
  - Track in cut / valley
  - Zero elevation
  - Bridge (over lower scenery)
- Mark then cut 3/8” plywood for subroadbed (48” * 4” typical)
- Using 1x4 and 1x2 * 4” lumber, Glue & screw into two L girders

Risers and Legs
Attach subroadbed 1

- Attach subroadbed 1” x 2” brace
  - 2” side is vertical
  - 1” side is centered front to back for the number of tracks to be used
  - Use wood glue and screws
- Glue and screw assembly to risers
  - Make notch in risers for brace
  - Screws must be flush or below surface for smooth roadbed

Attach subroadbed 2

- Attach risers to tabletop
  - Square (measure twice) but do not glue
  - Drill two 3/32” pilot holes for each riser
  - Hold risers to tabletop with #8 * 1 5/8” screws

Subroadbed and Scenery Profile
Skyboard

- Allow for 14” above top of railhead (~20 to 23” total height)
- Cut 1/8” masonite to 48” length
- File / smooth edges
- Test fit to frame using #6 * 3/4 screws (no glue)
- Do not attach (permanently) to frame (yet? / ever?)

Paint

- Frame primed then topcoat in green
- Rear of skyboard primed then topcoat in green
- Front of skyboard primed in white
- Final paint of skyboard front for sky and scenery match (on week 3)

Roadbed and Track 1

- Lay roadbed
  - Using cork or equivalent
  - Go full 48” of subroadbed
  - Bevel back edges at joint with adjacent modules
Roadbed and Track 2

- Prepare track
  - Straight-aways: use 3" fixed straights on each end of 36" flextrack
- Turnouts
  - None on first module
  - inspect for all "DCC friendly" connections
- If weathering rails, paint now
- If painting ties, do now

Summary - benchwork

- Frame Construction
- Tabletop of module
- Legs
- Subroadbed
- Roadbed and Track

Other Notes About Week 1

Presentation on Benchwork

1
2
3
4
5
Week 2: Electrical Construction

- Digital Command Control primer
- Track power bus wiring (14 V-DCC)
- Track power feed lines (bus to rails)
- House power (110 VAC)
- Accessory power (18 VAC / 12 VDC)
- Digital Command Control (DCC)
  Throttle network

Digital Command Control primer

- 90% of this DCC section has moved to 8 week basic course
- What is DCC?
  - A control system
  - Using digital data packets to communicate commands
  - To decoders that control the model railroad

DCC Components used in a Modular Display

- Power Supply (transformer)
  - one for each command station and
  - one for each booster
- Command Station (computer brain)
  - only one for entire layout
  - ops switch set others to slave boosters
- Booster (merge power & commands)
  - one per block, # set by current draw
DCC Components used in a Modular Display (continued)

- Throttle (for engines & accessories)
  - one per active operator plus
  - one dedicated to command station
- Decoder (translator of commands)
  - one for every locomotive
  - some accessories may have one

Additional DCC Considerations

- Block wiring for
  - Reversing sections (wyes and loops)
  - Short circuit protection and/or power distribution
  - Detection & signaling systems (within individual module only?)
  - Independent operations
- Programming track available

Week 2: Electrical Construction

- DCC Primer - just finished
- Track power bus wiring (14 V-DCC)
- Track power feed lines (bus to rails)
- House power (110 VAC)
- Accessory power (18 VAC / 12 VDC)
- Digital Command Control (DCC) Throttle network
Track power bus wiring
connectors (14 V-DDC)

- Wires
  - DCC short detection requires low resistance wiring
  - Use larger diameter wire for lower resistance
  - 14 gauge in 10 colors - see spec sheet

- Cinch Jones Connectors
  - Two prong polarized is NMRA standard
  - Narrow blade on inner rail / prime color
  - Note: are not using N-Trak approved alternative of Anderson Pole Connectors

Cut six to 10 bus wires
- For one foot leads use six foot lengths
- Minimum for two mainlines
- Optional for all for 10 wires

Mount terminal strip (barrier block)
- On 1” * 2” cross brace is good location
- Use #6 * 3/4” wood screws
- Allow 3.5” inside of front edge for clearance of folding legs

Cut bus wires in “middle” for terminal strip location

Solder connectors on wires
- C-J connectors to ends - bus wires to adjacent modules
- Ring terminals in middle - bus wires to terminal strip
Finish track preparation

- Straight-aways: solder 3” fixed straights on each end of 36” flextrack
- Turnouts: if used, solder in all “DCC friendly” connections
- Turnout joints
  - Solder all track joints
  - Add in additional straight sections
  - Mark for insulating gaps (do not cut until after ballasting)

Track power feed lines

- Cut 18 gauge wire to sufficient length to reach cross brace
- Solder wires to every rail for every “electrical block” on module
- Drill 3/32” holes in subroadbed, roadbed, & tabletop to run track feeds
- Attach track feeds to terminal strip (see spec sheet for correct positions)

Lay track

- Minimum trackwork
  - Two mainlines at 5” and 7” centerlines
  - Keep straight and level
- Follow track construction specifications for all dimensions
- Nail down track enough to secure
- Ballast with appropriate color
House power (110 VAC)

- Plan for 10 amp minimum rating
- All pieces with UL listing
- Attaching powerstrip
  - Sufficient cord to reach next module
  - Clearance for folding legs

House power (110 VAC)

- Use of on-module transformers
  - 9-12 VDC for slow motion turnout motors
  - 18 VAC for dual solenoid turnout machines
  - 1.5 to 12 VDC for accessories
    - On module lights, animation, etc.
    - Off module flood lights

Accessory power (18 VAC / 12 VDC)

- Typical powerpack supplies 18 VAC
- NTrak uses 12 VDC on C-J connector
- Use 14 gauge stranded wire (in white and green)
- Cut wires in middle for terminal strip
- Solder connectors on wires
  - Two prong automotive style connectors
  - Ring terminals in middle
Digital Command Control (DCC)

Throttle network

- Have 6 position / 6 wire connection wiring through all modules
- Option of throttle panel (UP-5 etc.)
  - front mounted in frame
  - rear mounted in frame or skyboard
- Connection to two rails for LED
- Option of connection of 12 VDC for throttle battery “stay alive” feature
**Summary - Electrical**

- Digital Command Control primer
- Track power bus wiring connectors (14 V-DCC)
- Track power feed lines
- House power (110 VAC)
- Accessory power (18 VAC / 12 VDC)
- Digital Command Control (DCC) Throttle network

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**Other Notes About Week 2**

Presentation on Electrical

- 1
- 2
- 3
- 4
- 5

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**Weeks 3 & 5: Scenery Construction**

- Scenery base
- Finish scenery
- Scene detailing
Scenery Construction

- Decide on area and profile to model, then photograph and sketch
- Virtually any profile acceptable for module use
  - Level - have more tracks or industries
  - High front and back - a cut or tunnel
  - Low front - bridge or embankment
- Make provisions to match adjacent module’s profile

Scenery Base

- Options available
  - High density foam
  - Riser, wire mesh, and plaster
  - Plaster cloth and hydrocal
- Scenery and module transportability
  - Durability
  - Weight

Finish scenery

- Paint and turf
  - Paint all of base in light brown / dirt
  - Get all of foam (base) covered first
- Finish ballasting track (touch-ups)
- Add Plaster rock moldings (if desired)
Finish scenery

- Paint skyboard
  - Mark horizon and put on hills/trees/etc.
  - Bluer sky to top, whiter at horizon
- Trees and details
  - Never enough trees
  - Never too much detail
- Add detail to limit of public's view
- Consider transport/set-up/take-down damage risks

Scenery Construction

- Decide on area and scenic profile
- Build base
- Build finish
- Add details
- Expect to do continual maintenance

Other Notes About Week 3

Presentation on Scenery
Week 4: Transport and Show

Transport options
Set-up steps
Showtime operations
Take-down steps

Transport Options

To hold the modules
- Racks
- Covered boxes
- Inverted and attached modules

To carry the modules
- Car, van, truck and/or SUV
- Trailers
- Rental trucks

Set-up steps

Unpacking
- Out of racks/crates and legs up
- Place in approximate position

Module alignment and clamping
- Clamp area at (-7,-7) of a 1.5” square
- C-clamp from underneath while top is aligned
- Set top of rails at 40”
Set-up steps

- Tracks' connections
  - Six inch tracks with undercut
  - Verify track joints are even
  - Reset heights with level from corner #1
  - Begin cleaning track
- Electrical connections
  - Track, accessory, throttle, house power
  - Verify all plugs and colors
  - Connect command station & booster(s)

Pre-operations testing

- All boosters slaved to command station
- Connect 110 VAC and circuit check
- Track cleared of all material and tools
- Turn on DCC
- Run test locomotive

Showtime operations

- First know “philosophy” of group
  - Running Long Trains
  - Historical or Geographic Accuracy
  - As a show for children
  - Modeling of diverse interests
  - Model Railroad is (supposed to be) fun
Showtime operations
- Schedule of operators
- DCC address assignments
- Rolling stock inspected
- Dispatcher determines what trains and animations are to be operated

Note: above may be done pre-show

Showtime operations
- Operator communications
- Train lengths
- Speed limits
- Switching
- Bi-directional running

Note: the above are preset, but with ongoing adjustments during shows

Take-down steps
- Know show promoter’s “rules”
- Remove rolling stock & motive power
- Take down & pack group equipment
- Work only on your module(s) or under direct supervision of owner
  - Remove track connectors (may be specific pieces to save)
  - Remove separately packed structures
**Take-down steps**
- Disconnect all wiring under modules
- Separate modules
- Fold / remove legs
- Crate / rack / pack

Warning: large amount of damage can be done rapidly in these steps.

**Take-down steps**
- All people stay until everything is in the vehicles
- Quick group meeting
  - Good and bad points of show
  - Work to be done before next show
  - Reminder of upcoming events

**Upcoming Schedule**
- 1. HCC Summer Session – Building a Modular Railroad in January 2015
- 2. Great Scale Model Train Show Timonium, (joint display?), April 2015
- 3. HCC Summer Session – Building a Modular RR, w/ June 2014 set-up?
- 4. Greenberg Show, Timonium, MD (joint with MARRS?), August 2015
- 5. HCC Open House September 2015
Other Notes About Week 4

Presentation on Transport & Show

- 1
- 2
- 3
- 4
- 5

Week 5 Notes

- All module work time, no lecture time
- Bring materials so that module may be safely transported home