Lightweight Module Construction

Clinic for Calgary Model Trainmen

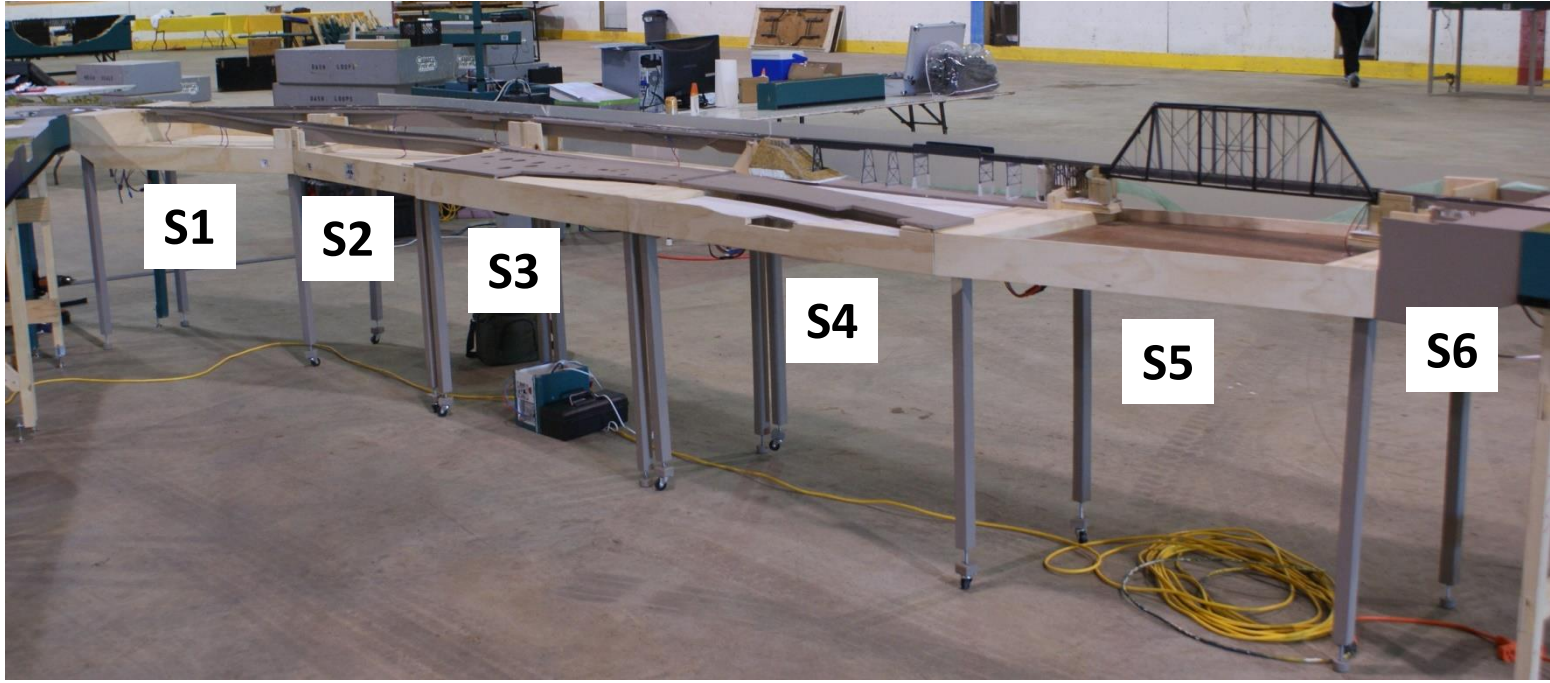
Ironside 13 Jan 2016

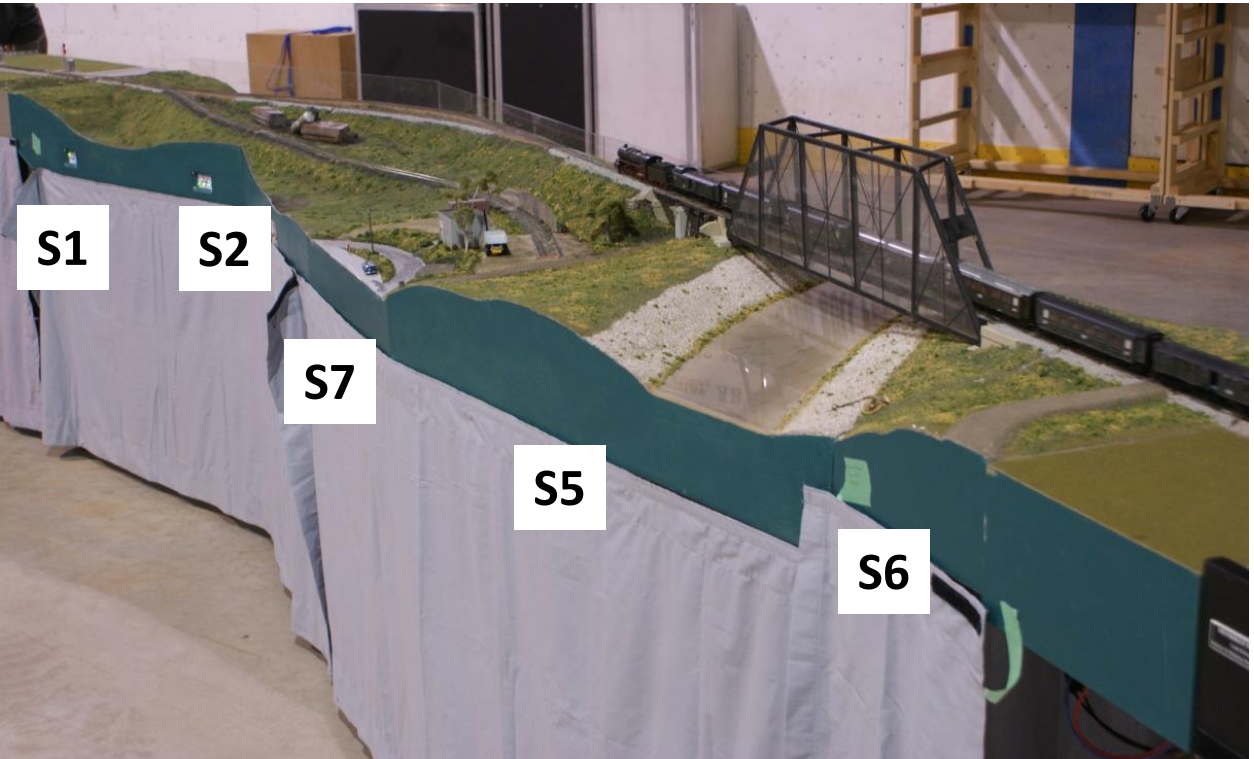
Learn by Doing

Then do it again

(or learn by someone else doing)

Ogden Road





Full Config 21’
(earlier in life)
full Timesaver

Small Config 15’
(later in life)
S7 (2’) sub for S3/S4
Timesaver (8’)

S7 Old

J Ironside
and Son
Equipment Sales
(Section 7)

Can be used in place of
Ogden Industrial
(Timesaver) S3/S4 for
smaller footprint

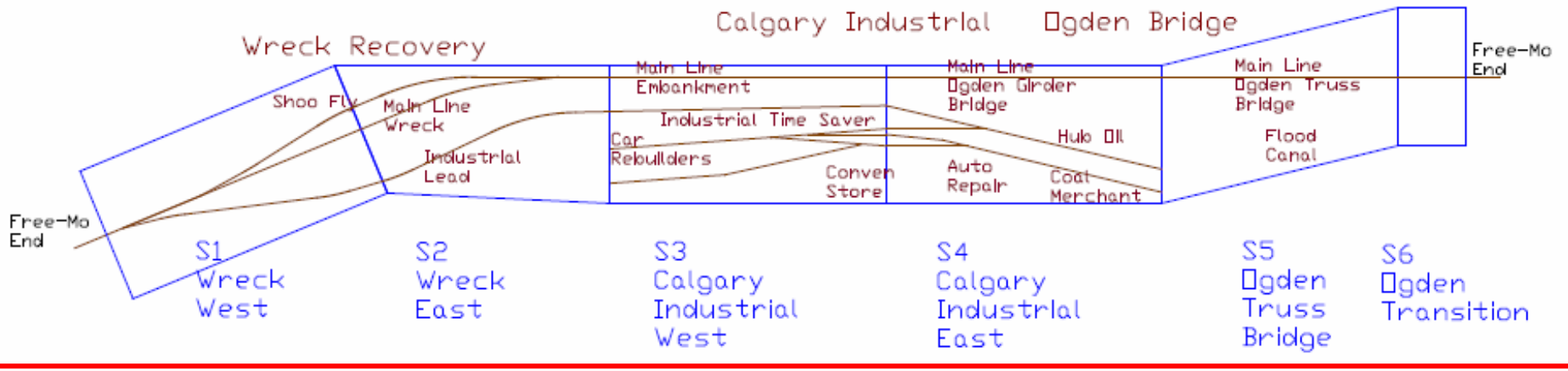
Why rebuild?

- Ogden Road Statistics:
  - 21 feet long
  - 6 sections
  - Five inter-section joints
- Uppers
  - CNR Ogden Road bridge prototype
  - Timesaver switching
  - Grade changes
  - Curved module
  - Transport sections 2’ x 4’ x 1’ max – fit module on/ in RAV4
  - Protected in transit and during initial setup
- Downers
  - Multiple alignments, not reliable. Previous alignment approaches inadequate
  - Time-consuming setup
  - Heavy – for one person carry up basement steps in coffin
  - Track too close to side
  - Steep grade to lower level
  - Awkward fit in basement

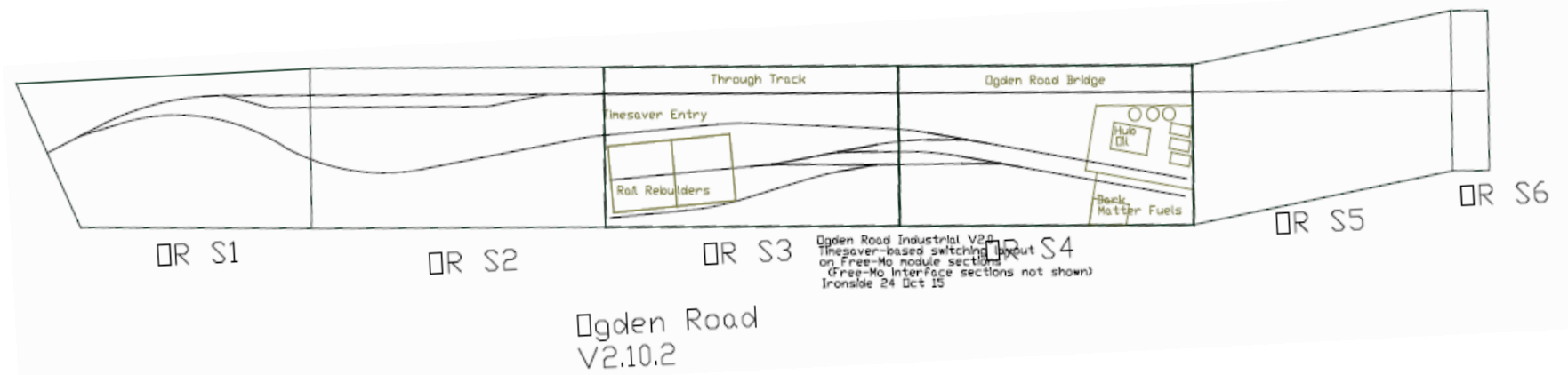
These issues caused development to stall for about two years

Rebuild

Old

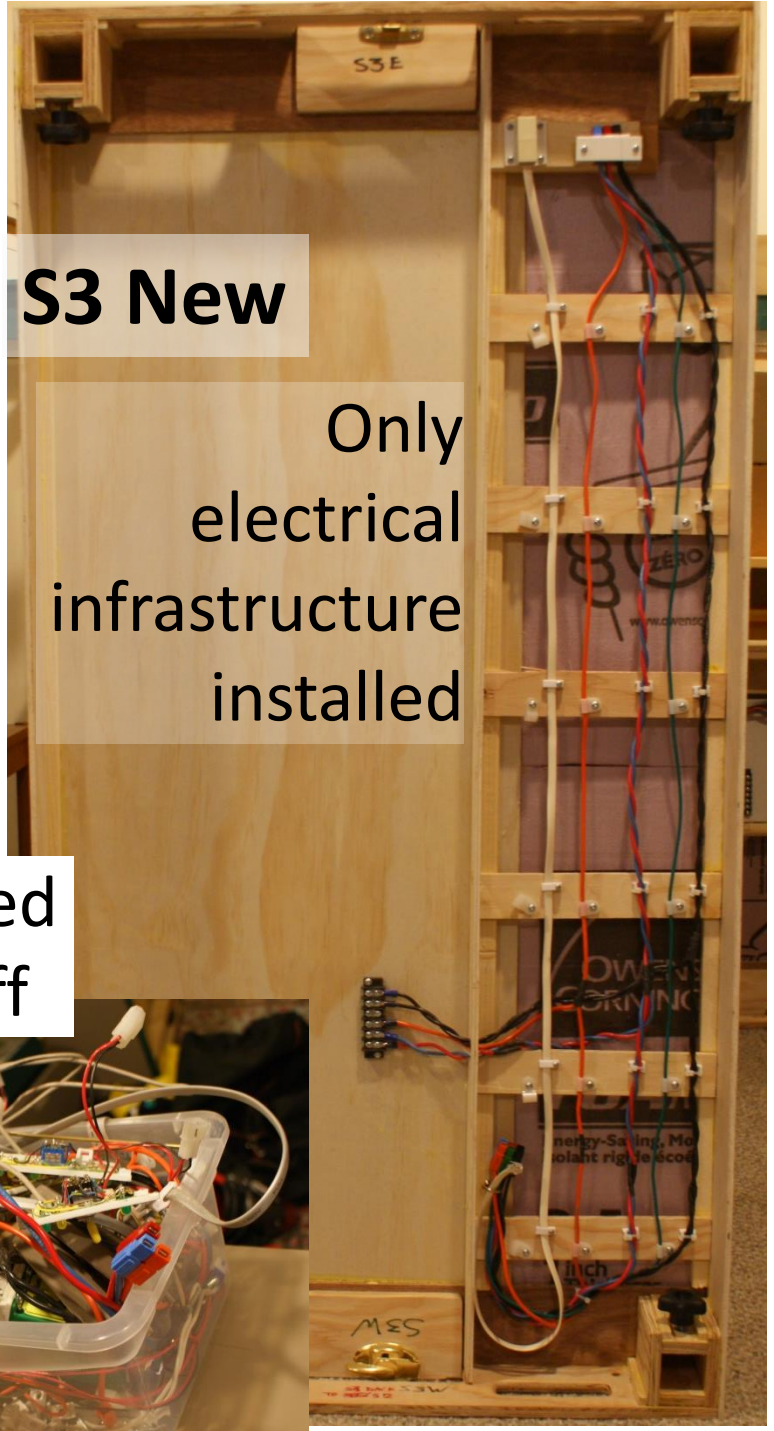


New



Overview

Objective	Approaches
Lightweight, portable	• Light Materials – thinner ply, foam top with plywood beam sub-roadbed • Strength through structure • Flexible vs stiff **Improved** • Handholds including in coffins
Easy section setup – no tools except socket driver for coffin removal (Free-mo ends standard clamps/ fitter rails)	• Butt joint tracks **Improved** • Dowel alignment • Sprung cam latch connection • Knob-clamped legs • Electrical pigtail one end only
Protection in transit and setup	• Legs installed prior to coffin removal • End plates protect track butt joints and scenery **Preserved** • Coffin protects scenery



Harvested old stuff

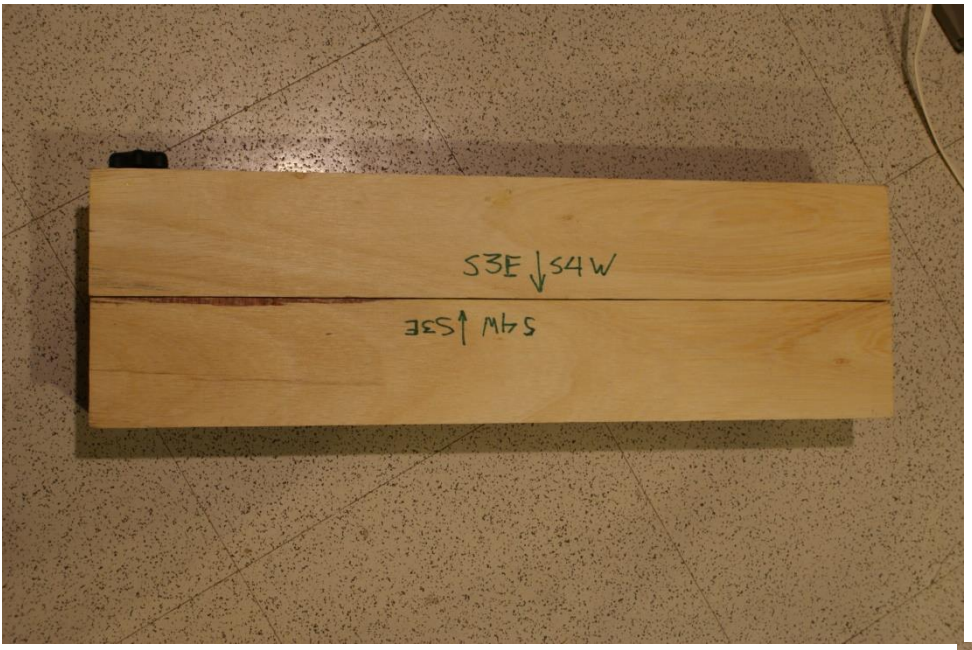

S5 Old
after
harvest


S5 New, only
infrastructure
installed
DOW
ROSPAN™

Build (1)

Sequence of assembly makes the difference in construction difficulty

- Ends built first in matching pairs
  - Cut and route end plates for handholds and latches
  - Drill end plate pairs together and install alignment dowels (mark pairs!)
  - Assemble end plate to top, leg pockets, and latch base plate
  - Install cam latches for sections



Top View of section end assemblies – Sections Joined

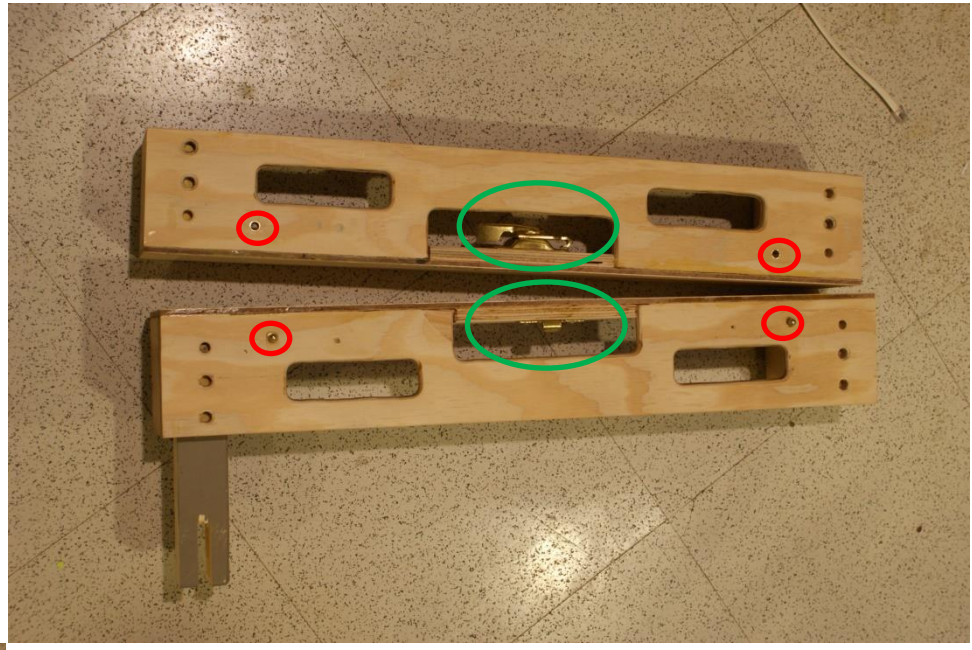
End structures are assembled first, then sides are added on assembly fixture which holds everything square

Bottom View – Sections Joined

End assemblies are constructed as matching ends with all glued joints
End plates are ½” ply routed and drilled on a template
Tops are ¼” ply
Leg pockets are ½” ply
Knob is leg securing clamp – one of four knobs installed

Outside End View – Sections Separated, shown top to top

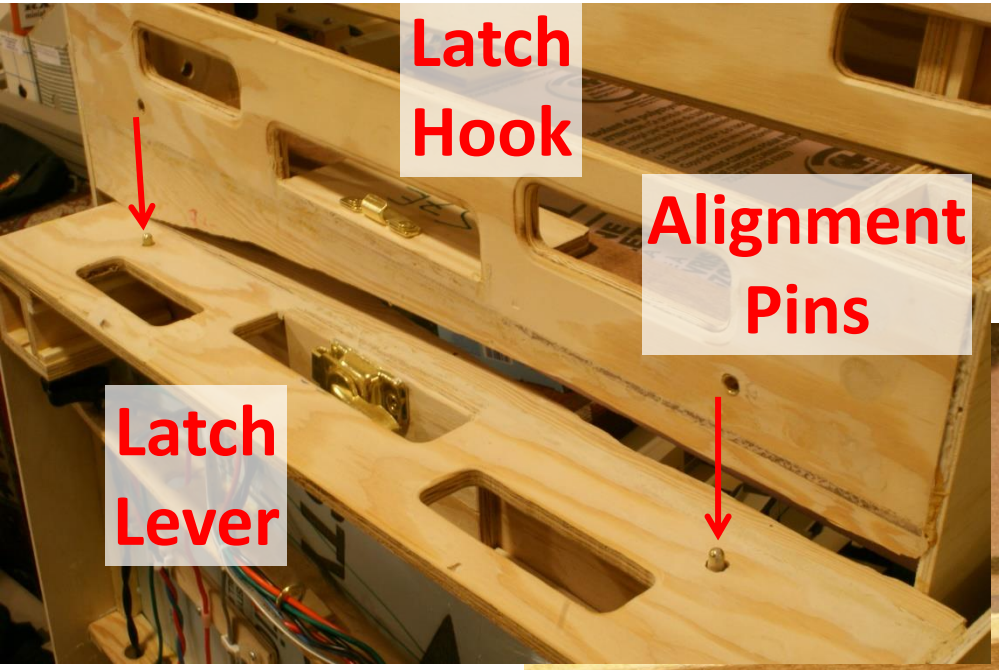
Centre slot for catch [LV: Sprung Draw Catches] circled in green
Dowels [LV: Table-Leaf Alignment Pins] circled in red
Side horizontal slots are handholds
Three smaller edge holes for coffin securing (since changed)



Inside End View – Sections Separated, shown bottom to bottom

Leg (short sample) secured by clamp
Clamp is knob with ¼-20 x 1” bolt [LV: Wing & Bar Knobs (¼-20 Thread)]
and threaded hole in leg pocket (red circles) is insert nut [LV: ½”, ¼-20 Quick-Connect Flanged Insert Nuts]

Pins/ Cam Latch Joining Sections



Build (2)

- Assemble Module/ Section
  - Attach sides using assembly fixture
  - End profiles shaped as a pair (trio)
  - Install end profiles
  - Use one section as jig for next

Adding sides on assembly fixture with previous section as jig

Assembly fixture allows precise leveling and provides clamping surfaces

Build (3)

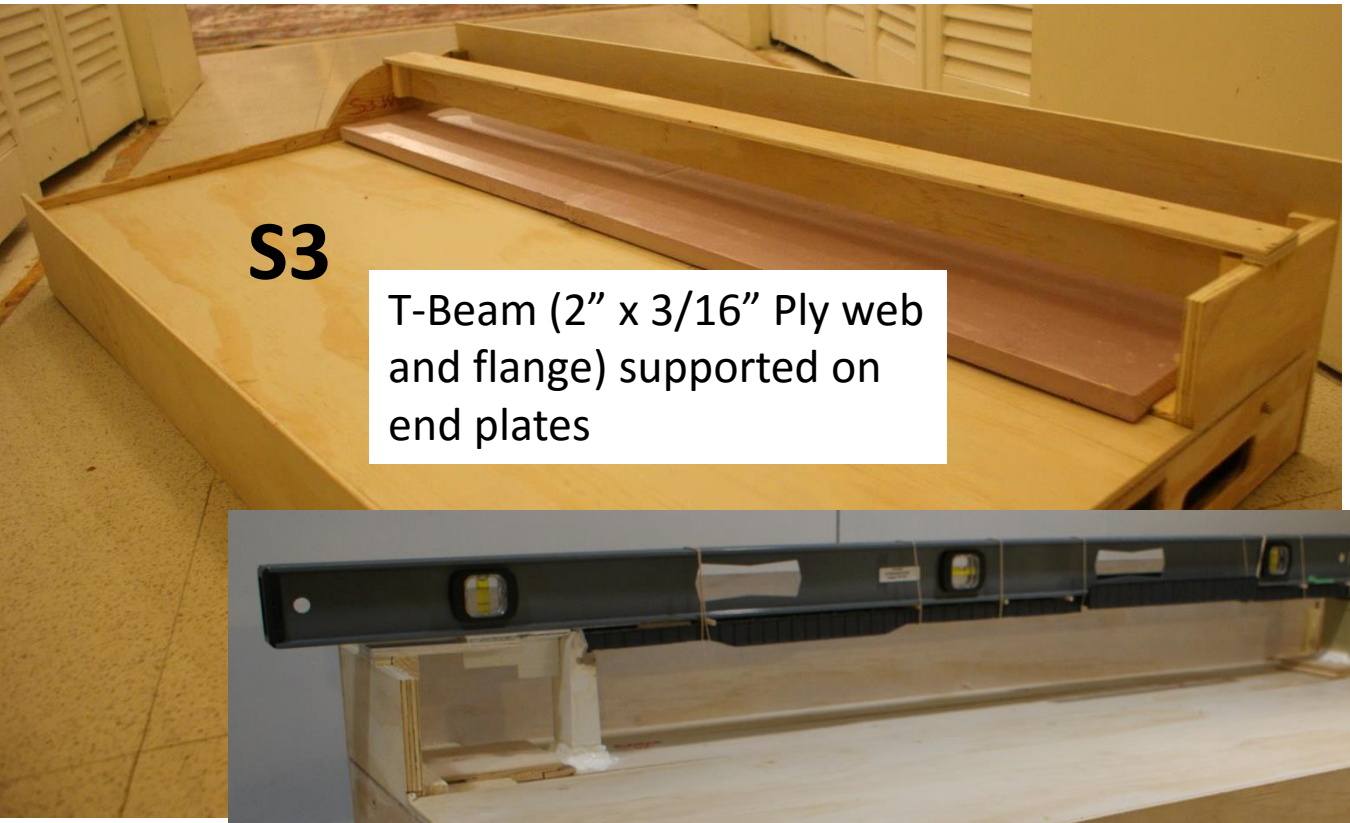
- Install Electrical Infrastructure

- Add sub-roadbed and track
  - Set up section pairs, attached and level
  - Add sub-roadbed
  - Note use of lightweight beam structure – sound isolation
  - Add roadbed
  - Install track across joints
  - Use PC ties to ensure robustness
  - Cut track and PC ties
  - File chamfers on rails

- Electrical
  - Install feeders and other electrical elements

- Scenery
  - Add scenery and cut fascia profiles

Sub-Roadbed



S3

T-Beam (2” x 3/16” Ply web and flange) supported on end plates

Every section is different!!!

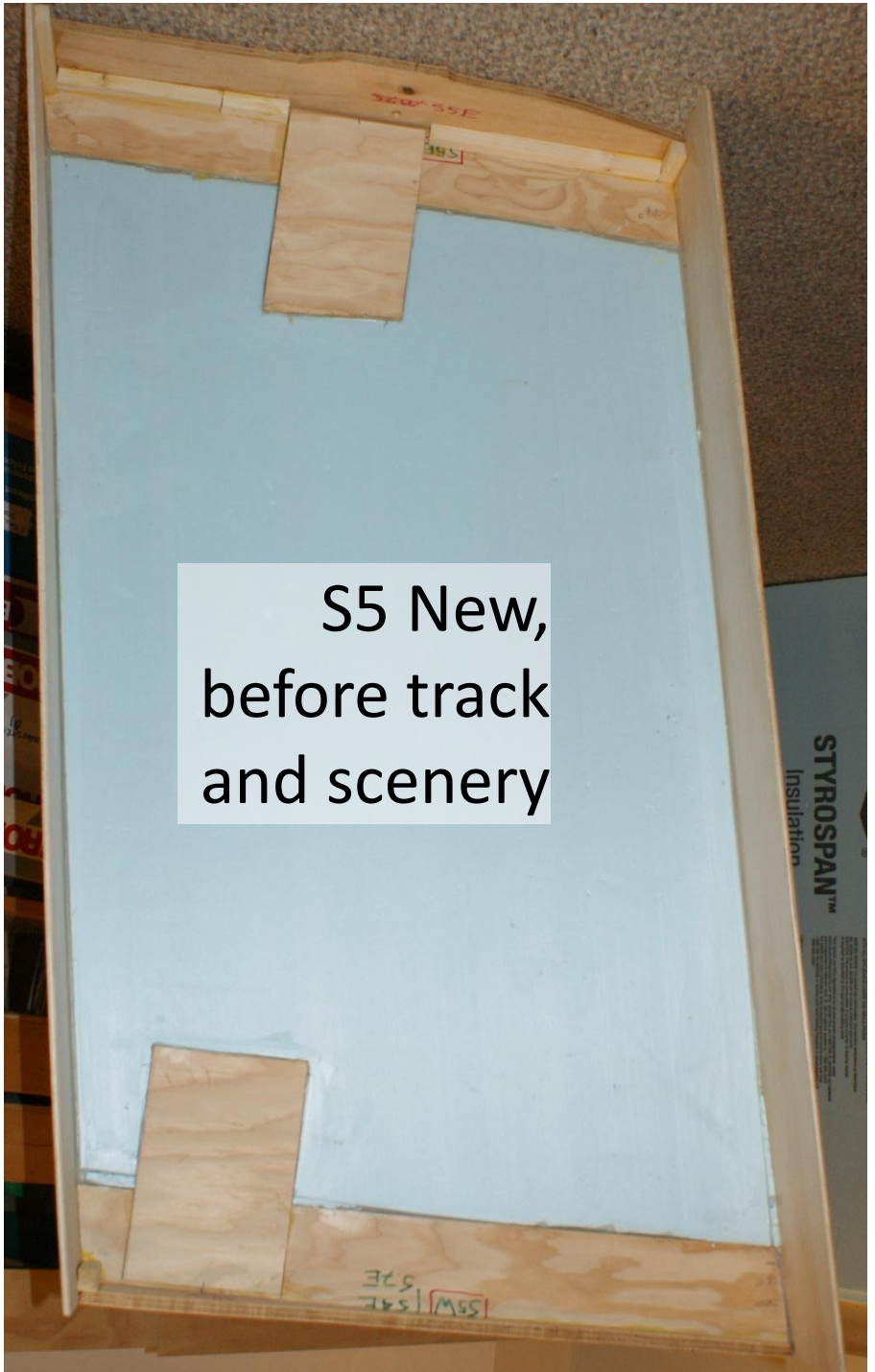
(but end structures may be the same)

S5

S4

Bridge abutments and piers supported on removable 3 1/2” x 3/16” Ply strip made rigid by aluminium channel on bottom, supported on end plates

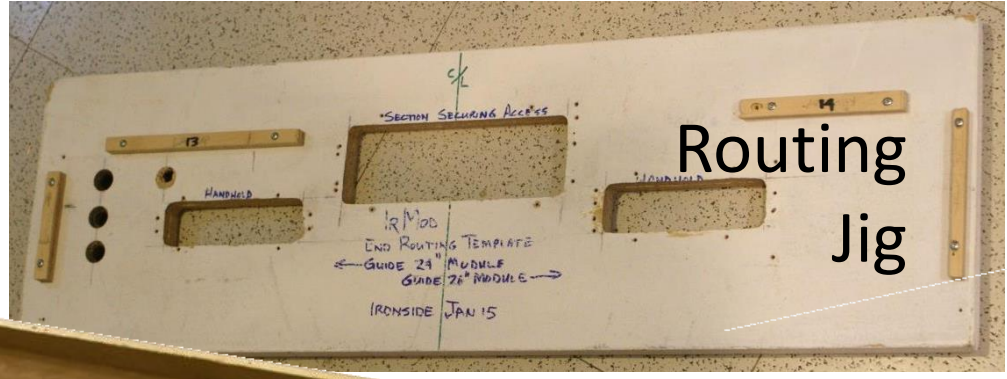

S5 Old


S5 New,
before track
and scenery
STYROSPAN™
Insulation

Access to proper tools required

- Regular Tools
  - Table saw
  - Cross compound or chop saw
  - Drill press
  - Router with top/ bottom guided bits
  - Clamps (lots of them)
  - Squares/ Right Angle clamping fixtures
- Special Tools
  - Routing jig (for end handholds and latch holes)
  - Drilling jigs (for dowels, end plates, and coffins)
  - Assembly fixture (for ensuring flatness and perpendicular surfaces when gluing)

Special Tools



Assembly
Fixture
(Unpacked)

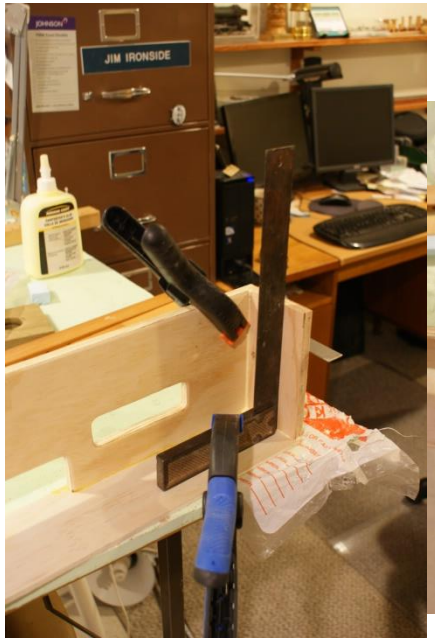
(Packed)

Assembly

Clamp and wait

then

Clamp and wait



Coffin

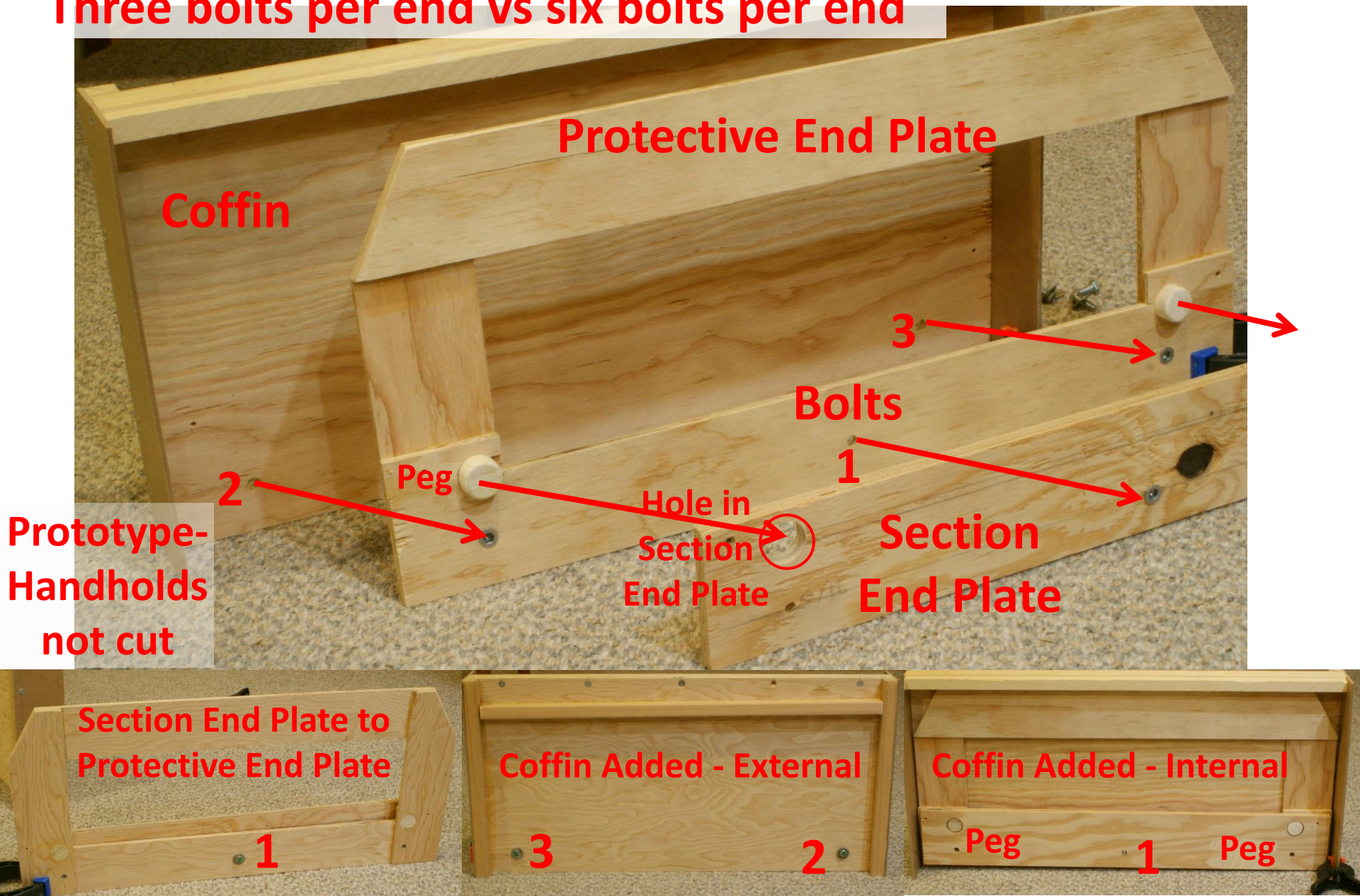
Ten minutes later

Assembled

As flatpack

Modified End Plate/ Coffin Attachment

Three bolts per end vs six bolts per end



Weight Comparison

- Old section measured weight
  - S1 (4 feet): TBD
  - S2 (4 feet): 13100g
  - S3 (4 feet): 14100g
  - S4 (4 feet): 17415g
  - S5 (4 feet): 12700g
  - S6 (1 foot): 4855g
  - S7 (2 feet): 8600g
- Predicted weight /% Reduction
  - 6100g/ TBD
  - 7300g/ **-44%**
  - 7000g/ **-50%**
  - 8200g/ **-53%**
  - 6500g/ **-49%**
  - 3300g/ **-17%**
  - 5000g/ **-42%**

Predicted weight based on measurement of unfinished section, and addition of same weight for electrical as in old section, plus ~500g per foot for scenery.

Weight reduction does not include legs or coffin

Material Densities

Material	Size	Weight Grams	Unit
Pine/ Fir Strip	¼” Sq	1	in
Pine/ Fir Strip	½” Sq	4	in
Pine/ Fir Strip	¾” Sq	9	in
Pine/ Fir Strip	¾” x 1.5”	18	in
Pine/ Fir Strip	¾” x 2.5”	29	in
Pine/ Fir Strip	¾” x 3.5"	36	in
Pine/ Fir Strip	1.5" Sq	10	in
Ply Fir	1/2"	5	in2
Ply Birch	3/4"	7.5	in2
Ply Fir	1/4"	2.5	in2
Ply Pine	3/16"	2	in2
Foam Expanded	1/2"	0.22	in2
Foam Expanded	1"	0.43	in2
Foam Expanded	1.5"	0.65	in2
Foam Expanded	2"	0.87	in2

Examples so far

- Mike Walker
  - Two section, 8’ Free-mo module with 15 degree angled ends
- Mark Wittrup
  - Two section, 12’ Free-mo module with 10 degree angled ends
- Ironside
  - Five baseboard sections built, one angled, no track yet
  - To go, both Free-mo end sections, one angled

Alternative Light Weight Approaches

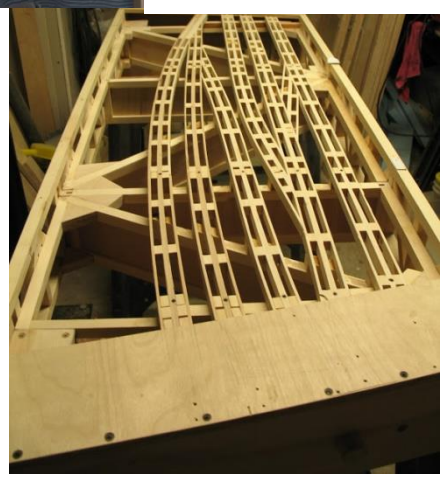
Waffle

Very strong, rigid

More complex

The Sipping & Switching Society of N.C

Frank Wilhem Palouse



FoamTop

Light

Durability question remains

Conclusions

- Lightweight but robust modules possible
- Use structure, not mass, for strength
- Approach neither trivial nor fast
- **Major benefits:**
  - **Alignment (but does not require lightweight structure)**
  - **Portability/ ease of setup**
- **Unverified factors**
  - **Long term stability**
  - **Noise isolation**

Finger Poking Time

- Section 5 Old Design
  - Ogden Road Truss Bridge Mock-up
  - Offset angle to move track from near edge (2 ½”) to centre
  - Electrical already harvested
- Section 5 New Design
  - Same footprint/ purpose as old design
  - Offset angle to move track from near edge (4”) to centre
  - Electrical infrastructure installed
- Section 7 New Design
  - Optional substitute section (2’) for S3/S4 Timesaver (8’)
  - Electrical infrastructure installed
  - Joins to S5 West new design
- Section 6 (Free-mo; end sections only)
  - Joins to S5 East new design
  - Short (1’) section

Presentation slides will be made available on

www.**calgarymodelrailway**.ca/