Here we look down the Kayford branch as the stud wall to the left goes in. One of the access hatches can be seen just to the right of the blue cart. A single track line will hug each side of this pinch point, inside tunnels open to the aisle.

Note: Edited to correct 16mm fisheye lens, was 8mm lens.

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**Bob** #123 February 14, 2016, 10:35pm

We walk around to the outside of the wall that encloses the Kayford and inspect it from Glen Forge. There is another emergency exit at the apex of the “blob”. Above that David is starting to establish the spline roadbed grade from Mount Union, (beyond the right side of the wall) upgrade towards McDonald Tunnel and eventually Linnwood (past the left end of the photo.) Glen Forge is behind the camera. The track along the right wall is Bayfield.

Walking a around the corner to the right we arrive at the future site of a long bridge that brings track into Mount Union. Benchwork on the right is the double-track mainline and part of the 28 foot long International Paper plant. The lighting fixture above the bridge is still under construction.

Continuing down the aisle, then looking back, we see the town of Mount Union. I let Photoshop “de-fish” this one to create a rectilinear view. The future bridge site can just be seen to the far left. Note that the long horizontal supports will be cut shorter once David finalizes the space needed for buildings.

**Craig** #124 February 14, 2016, 10:35pm

WOW!!!

Some great progress on the layout. I can almost hear the diesels now!!

And I gotta say…Jack is absolutely amazing. Those signal bridges are jaw droppingly amazing!!!

**Bob** #125 February 14, 2016, 10:35pm

Again it has been months since the last update. 😯

The Historical Society steamed up for a test run of a newly-acquired N&W 4-8-0. It successfully negotiated all the curved turnouts at Point Vincent. Yes, the front dummy coupler is mounted backwards but that's the way it came from Sunset. It will be replaced with a Kadee (somehow!)


Meanwhile the wiring crew pulls CAT5 for the telephone system. Craig seems to be working, but Mark appears distracted and all together too comfortable!

David and Bill assemble a lighting valence for the Ohio River Bridge scene at the layout entrance from the crew lounge.

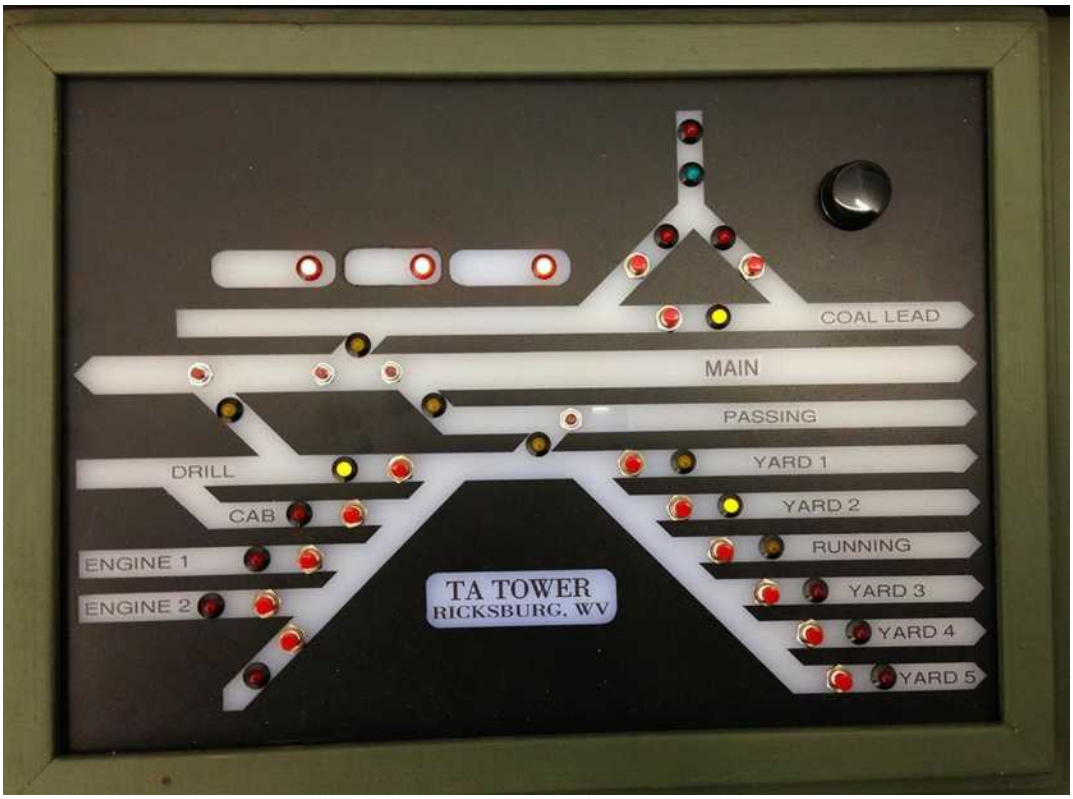
**Bob** #126 February 14, 2016, 10:35pm

Wiring is a lot more comfortable where the bench work is high. Here Mark solders DCC rail drops to a feed bus at Hawkins tipple.

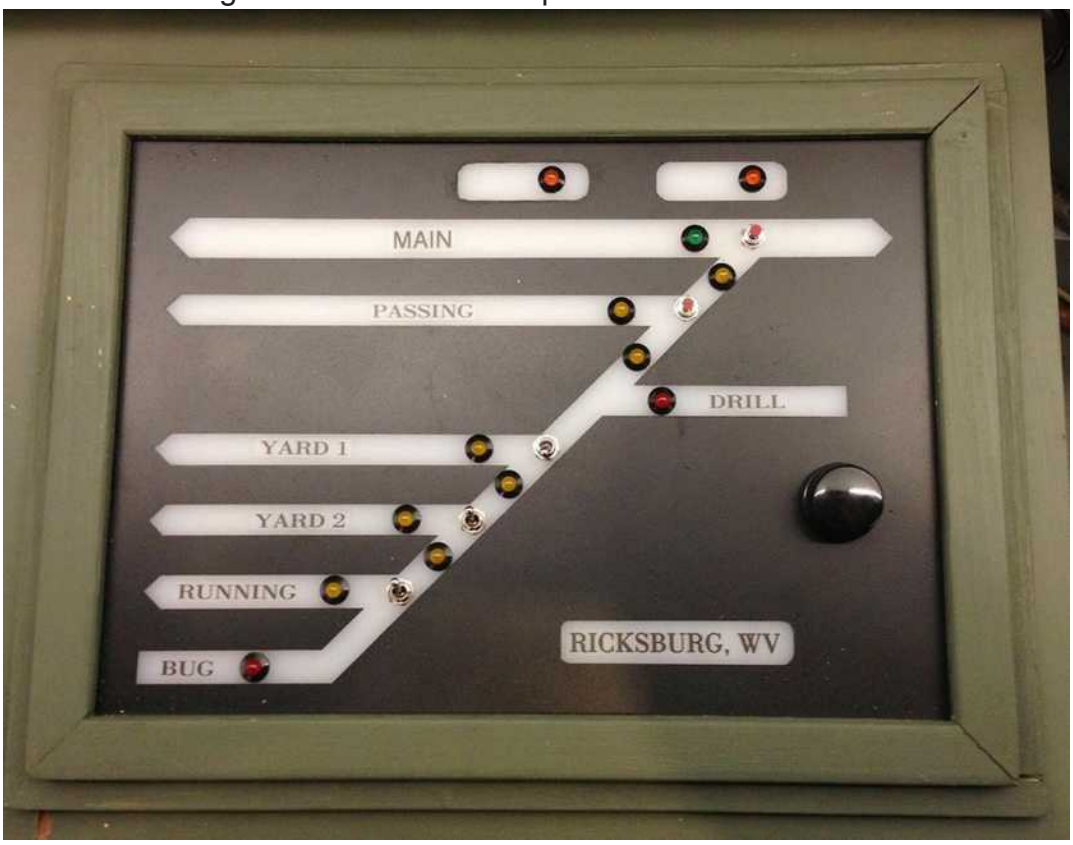
A lot of progress has been made inside the “blob” known as Kayford. This area has been a big push over the last couple months. Lighting is hung, the benchwork is in and Vince works on a crossover leading to the operating King Coal #1 loader.

**Bob** #127 February 14, 2016, 10:35pm

Bob finally got caught-up installing control panels in Ricksburg. TA Tower is the north end of Ricksburg. This route-select panel uses an Arduino mounted on a custom PC board under the layout to drive turnouts.

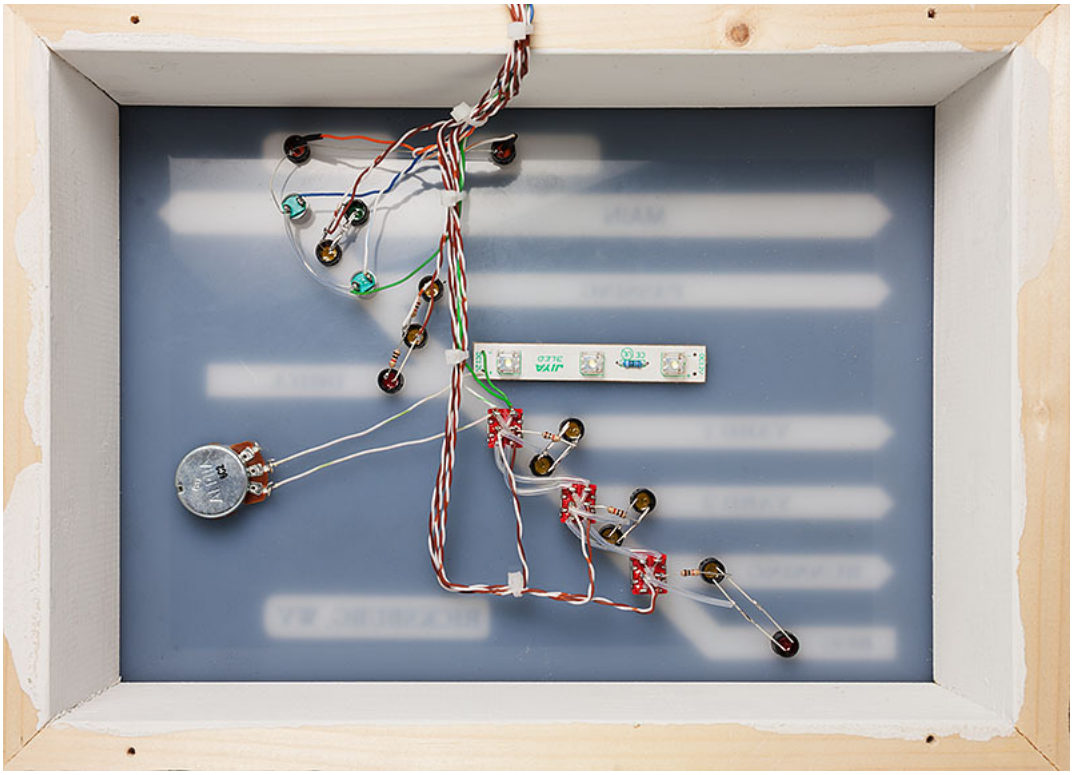



South Ricksburg controls are a lot simpler.




There is not very much inside the South Ricksburg panel. Toggle switches directly drive the Tortoise

turnout motors.



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**Bob** #128 February 14, 2016, 10:35pm

Ties and a lot of rail are down in the isolated town of Kayford.

Vince volunteered to work on the Ohio River bridge, which will span the opening to the crew lounge. He is using the OC bridge in Pittsburgh, PA for inspiration. A full-size OC bridge would not fit the space, so the model will be scaled-down.

Vince and David get a handle on the track spacing and interior width of the portal. Vince holds styrene and paper mock-ups. Eventually he will make a set of masters and cast replicas in urethane. These parts will be decorative; a pair of 1 1/2 inch square aluminum tubes will carry the live load.

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**Bob** #129 February 14, 2016, 10:35pm

Vince shows off more progress on the Ohio River Bridge mockup.

Rick's amazing A&D crane made a guest appearance. It was running in "dead rail" mode off an internal LiPo battery.


During the work session much progress was made installing fascia inside the Kayford operating aisle. This needs to be installed before the last bit of non load bearing wall can be erected. We also

installed an NCE radio receiver and repeater. The two units are about 40 feet apart and located to avoid being blocked by HVAC ducts. Quick testing suggests that radio reception should be just fine including areas that were not well covered by the old, single radio receiver.

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**Bob** #130 February 14, 2016, 10:35pm

We were recently blessed by “A Visitor from the East” (reference to the Tonight Show Starring Johnny Carson…)

Jay Barnaby, one of the original A&O 1.0 operators, arrived with a dozen or so A&O coal hoppers he re-detailed.

Here David shows Jay a few photos on his touch screen tablet/laptop.


Jay spent Saturday morning and afternoon with us at the A&O job site. We hope he can mark off time to join us for many future operating sessions. It was great to see you again, Jay!

**Bob** #131 February 14, 2016, 10:35pm

A little more progress to report. Vince brought a partial 1/2 arch mockup for the Ohio River bridge. Later he nearly finished several turnouts inside the Kayford lobe that serve the operating King Coal loader.

Meanwhile Bill and David worked to complete a major milestone—finishing the last of the partition walls that seal off the isolated Kayford branch, forming a “layout within a layout.” This occurred while Vince worked inside the Kayford. I *think* he got out OK!

The last of the sheet rock is up! Behind the left wall is the Kayford branch. The hole in the wall beyond the yellow part boxes provides an emergency exit. It will normally be closed off with something easy to remove. Track will run on a shallow shelf along both sides of this wall.

Not shown, I installed a fourth DCC power supply inside the Kayford and fixed a few short circuit issues where rail drops have already been connected. Finding shorts is fast and easy with the use of a lab power supply and a $60 Hall-effect DC current probe. I was frustrated by lots of bad crimps on the NCE DCC control bus. A cheap plastic 4P4C or “RJ22” crimp tool has been tossed and a better one ordered.

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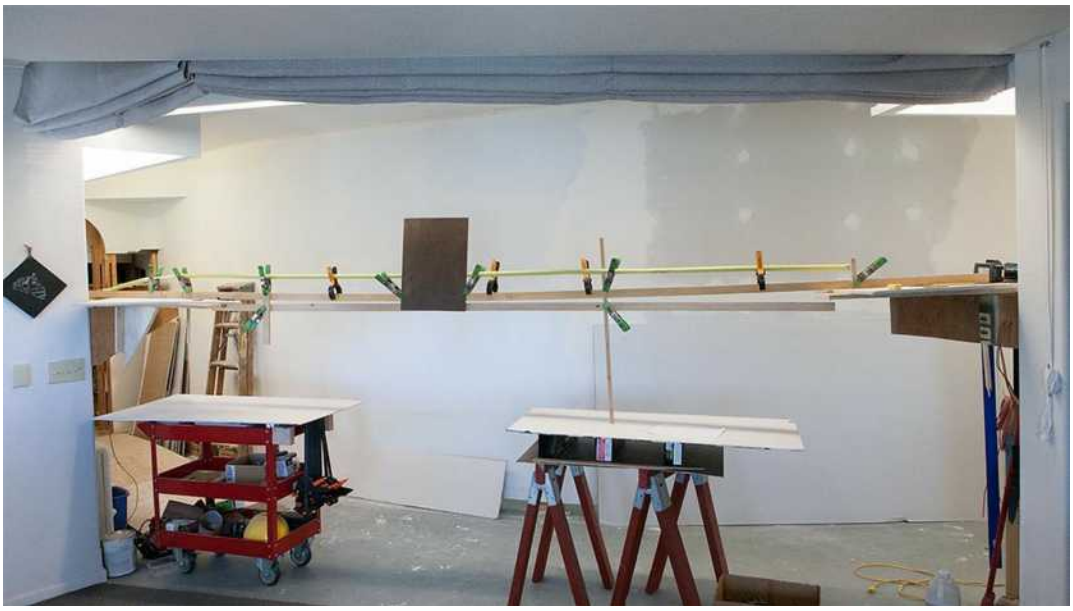
**Bob** #132 February 14, 2016, 10:35pm

Upon arriving for today’s Saturday work session, this is what I found while standing near the crew lounge entrance. David installed stand-ins to indicate the Ohio Bridge crossing/nod-under. All of this temporary construction was exciting, as we can already imagine traffic across the double-track bridge. The sheets of drywall sitting on saw horses and a cart indicate the planned water level of the Ohio River. The nod level was very easy for all 3 of us.

From the initial view there is no way for a visitor to anticipate the size and features of the rest of the layout.

A 3’ gap between sections of the Ohio River serves as the spot where “David (a/k/a Moses) parted the waters” for the operating crews and visitors to enter the layout proper. This is from my imagination, not David’s, so don’t blame him! 😃



Soon Vince arrived, and the two jumped into detailed planning that on and off lasted most of the day. Below we see David explaining the double track alignment and OS Jay, and also the spot where the B&O enters the layout.

Vince brought a mock-up in styrene and paper of a 1/2 arch section. He and David had a lot of fun visualizing the size of the arch in place, and eventually David added clamps to the spline so that we could all view the bridge while standing deep in the crew lounge. We all agreed that it should be a very spectacular view.

By the end of the day, David cut the 1 1/2 inch aluminum box sections to length that will provide all structural support for the bridge (cutting procedure not shown.)

And Happy Birthday, David!

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**Craig** #133 February 14, 2016, 10:35pm

(jaw hits floor)…

Just…plain…WOW!!

And I agree with Bob…Happy Birthday David. I hope you had a great one!!

(picking jaw up off of the floor)

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**Bob** #134 February 14, 2016, 10:35pm

As of this last weekend's progress, we see light at the end of the tunnel, and it isn't blowing a horn!

The stud walls are finished. We view the Kayford valley where David located the last Kayford spline roadbed. Behind the camera is the "blob" of Kayford, and just ahead, past the dog leg and people

tunnel to the right, resides the town of Brooks. Along the right we see the start and end of fascia. Between the two ends this entire area will be in another “people tunnel”, one fairly narrow that some may choose to navigate sideways. David plans to “daylight” the sides of these two long tunnels so operators can follow their trains and to make track cleaning a lot easier. Elevated DCC bus wires on the right will be hidden by the tunnel liner. I didn’t want us to run them through the same shelf bracket holes as a telephone wire bundles, to avoid coupling a DCC buzzing sound in the phone system.

One of three emergency exits can be seen on the right side below track level.

Vince continued to lay rails in the town of Kayford. Here we look through an equipment access porthole located on the end of the “blob.” To the left we see the base assembly for the A&O 1.0 operating Kayford coal loader. Foreground ties are the mainline and a passing siding, to be hidden behind a rising mountain. When Vince finishes, David will build in place a 3-way and a double slip switch just behind the black cardboard tray.

Bill made base cabinets for the Ohio River bridge. The top of these cabinets represent water level. There was some discussion of mounting a large A&O logo on the front of the rightmost cabinet.

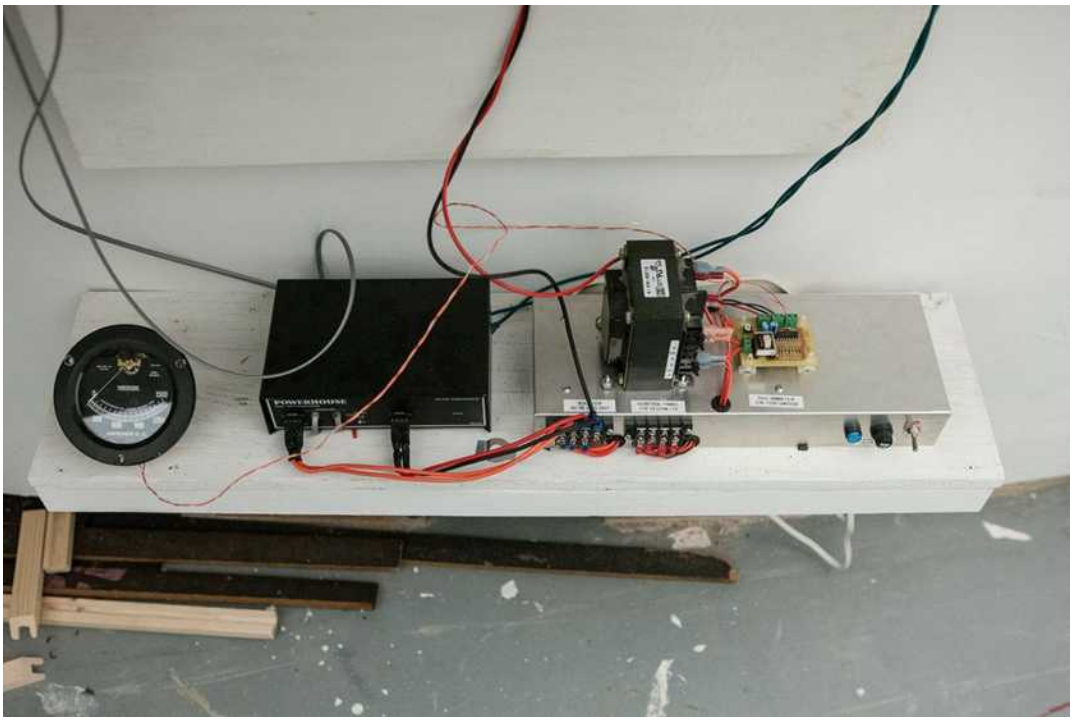
We spent quite some time staring at these cabinets. With their installation we shared a real sense of nearness to a major milestone. We also observed that a first-time visitor standing in the crew lounge will not be able to anticipate the entirety of the layout. A long walking tour through the labyrinth will be required!

Ceiling-high partition walls worked well on A&O 1.0 and made the layout feel a lot bigger, with a tremendous sense of isolation and standing in a scene. When can we start scenery, David?

**Bob** #135 February 14, 2016, 10:35pm

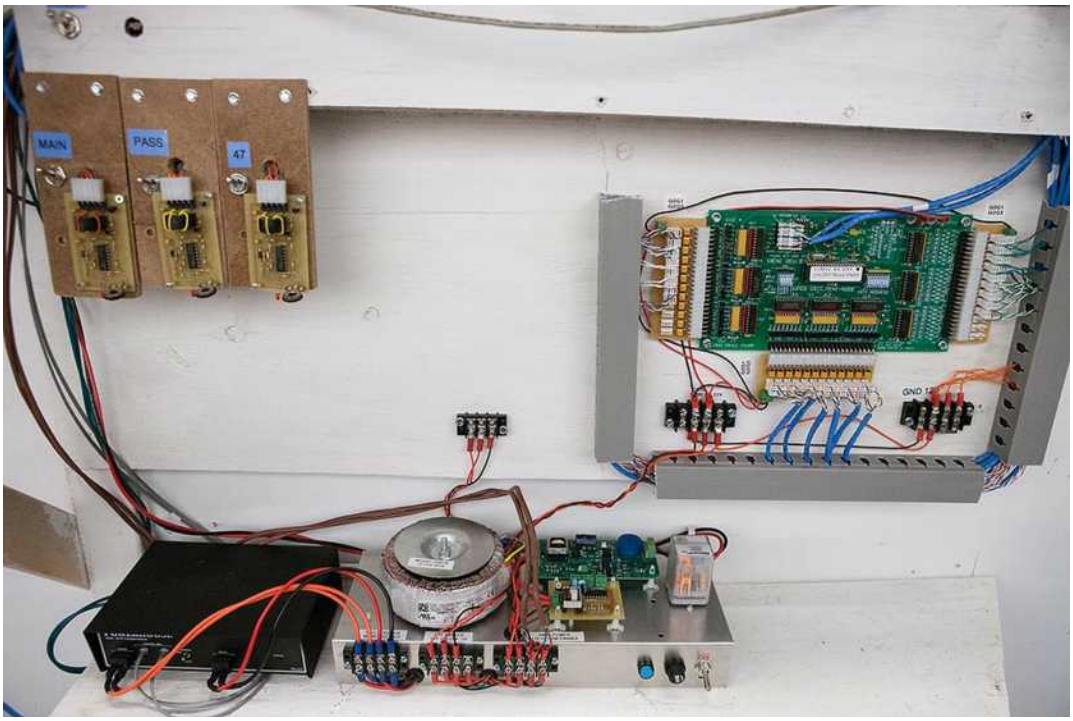
So what does the resident electrical engineer do during a work session? Much of the work may seem boring to most model railroaders, but it is a bit like putting tendons on the bones of the layout. Two DCC power district supplies were recently installed, the first one powering the Kayford valley. It is a 10 amp NCE booster, the black box to the left. The large black transformer was harvested from A&O 1.0, sold by Tony's Train Exchange (free plug!) Inside the aluminum box resides a medical-qualified 12 and 5 volt power supply to operate the control panels. To the left is a "smiley face" load meter harvested (with permission) from the control stand of Great Western GP7 #2233, which wrecked a few years ago in Kelim, CO. The meter indicates scale Amperes, 1000 Amps indicated representing 10 Amps DCC current. It will mount in the fascia to the left of this shelf.

Above and out of camera view are 4 PSX electronic DCC circuit breakers. Each operating loader has a dedicated breaker, and the mainline is split with two, to increase the chance of being within dope slap range of an operator who causes a short circuit.



The 5th of 6 DCC power supplies was installed at Mount Union. Here we only have one DCC circuit breaker, but there is also a CTC system SMINI. It powered up just fine, but full connection testing awaits. This round “toroid” transformer was found at PartsExpress. It was originally intended for use in high-quality stereo amplifiers or perhaps in a CNC (Computer Numerical Control) mill or lathe power supply. It is of extremely high quality.

The relay on the right end of the supply cuts off DC power to the CMRI SMINI boards. When power is cut off, custom A&O turnout driver boards all switch to full local control. These relays on DCC power supplies are wired in parallel, to be powered up when the CTC machine powers up. So far this design has been a huge blessing, as we can play, test and perform maintenance to our heart’s content anywhere on the layout without a working CTC system.




**Bob** #136 February 14, 2016, 10:35pm

Here are a few more photos from this month. First up: Mark finishes up lighting wiring above Jackson. No, he is not working on live wires. These are connections to feed track lights and are on a different circuit.

Levi shows his father Frank how we make resistive wheel sets. We install a 7.5K resistor on each outside axle so that we can detect a car that is part way into an OS section.

Bill roughed-in formers for the long Kayford Valley people tunnel. Tracks on both sides will run through side-daylighted tunnels so that operators can follow their trains.

**Bob** #137 February 14, 2016, 10:35pm

Bill delivered welded aluminum structural elements for the Ohio River Bridge on Saturday. He emailed two photos and gave me permission to post them.

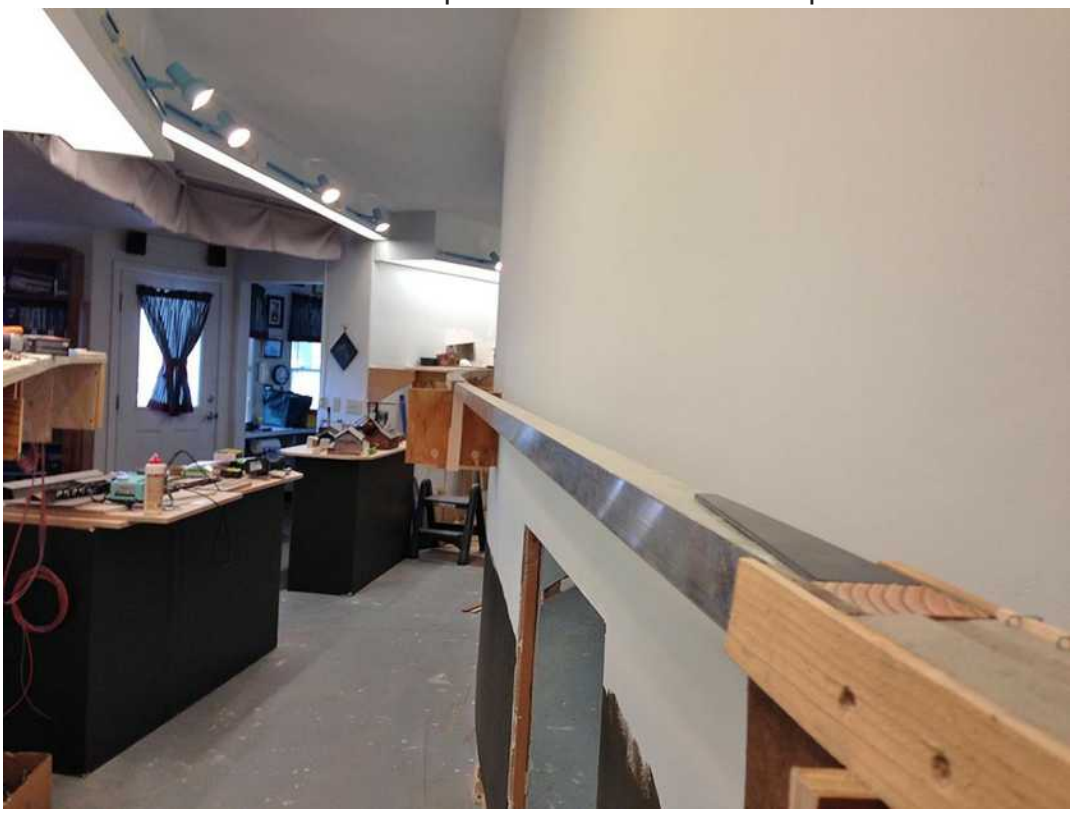
Two 1.5" square aluminum box sections will support the double track bridge.

Even *more* interesting was Bill's delivery vehicle!


**Bob** #138 February 14, 2016, 10:35pm

The aluminum structural components for the Ohio River bridge recently received a test fitting. Even though David lowered the bridge a couple inches from the original design, we had no difficulty quickly nodding under it.

Previously, David installed a cutoff piece of the box sections to serve as the structural support for a viaduct (why a duck?) above the primary Kayford branch emergency hatch. Since this photo was taken there are ties and rail atop most of the Homasote spline roadbed.



**Craig** #139 February 14, 2016, 10:35pm

Well…another session down, and another step closer to the A&O operating.

Yesterday David, Mark, myself, and Bob did a little work on the A&O. Bob and I focused on wiring (sorry no photos there) and David and Mark focused on carpet! You know that things are getting close when carpet starts to go down 🙂

**Craig** #140 February 14, 2016, 10:35pm

More construction photos from August 22nd. Things are getting close!!

**Bob** #141 February 14, 2016, 10:35pm

Fascia is now installed along the grade between Linnwood and Mount Union. A girder viaduct will wrap around the aluminum box tube installed above one of the Kayford valley emergency exits.

MP234 was a favorite railfanning spot on the last layout. It will be replicated here in grander form, along the outside of the Kayford lobe. The cutouts are emergency access hatches that will be covered by removable scenery.

Vince and David started laying rails in Linwood, home of the perpetual thunderstorm.

**Bob** #142 February 14, 2016, 10:35pm

On September 26, 2015 progress includes fascia installation in the isolated Kayford Valley. There was a need to trim existing fascia outside of the long Kayford “people tunnel” to blend into the valley.

In this spot there will be a single track truss bridge. David makes a low cut near the bottom of the steep valley.

David has a gift to visualize a scene in his head or on paper before he starts building. Once construction starts in 3D, it is time to rough-in areas on the layout to receive that vision. Here we see a sketch he made that expresses his thoughts before refining a portion of the layout between Jackson and Glenn Forge. This is a spot that will receive a concrete “tie” retaining wall.

**Bob** #143 February 14, 2016, 10:35pm

So why are these guys grinning? The structural elements of the Ohio River Bridge are now in place! The route is dead level and perfectly aligned with approaches on either side. The welded aluminum beams will be removed for painting, then they will be bolted all the way down.

Vince holds one of his urethane detail castings against the aluminum beam.

Bill (not shown) and David roughed-in the Antioch & Dover's tunnel portal at Union Gap, which will lead to a 2 track staging yard inside the Kayford lobe. Murphy helped too as the tunnel runs right through a stud inside the partition wall.


A view blocking mountain takes shape railroad north of the Ohio River Bridge and Jackson interlocking. By extending upwards to the ceiling, it prevents tracks on the opposite side of the aisle from competing with the view of locomotives grinding up this ruling grade. It will also block a bank of track lights. The Ohio River Bridge starts about 15 feet behind the camera.

The ruling grade between the far side of this mountain and the Glenn Forge people tunnel becomes a separate scene. This will make the run feel longer and produce a heightened sense of the railroad “going somewhere.”

The two upper tracks with wide tie spacing are NYC staging and will be hidden by a hillside.

**Bob** #144 February 14, 2016, 10:35pm

A giant milestone was reached on Saturday, November 7, 2015. David tightened the bolts that hold the aluminum structural members for the Ohio River bridge down for “keeps.” Barring an unforeseen reason, the big screws won’t come out again for the life of the layout. 😃

Next to David’s hands is a short stack of Vince’s reference photos of OC Bridge in Pittsburgh, used as inspiration for his build in urethane of the massive O-scale bridge’s superstructure.


The top of the aluminum box sections have been covered with a thin veneer of wood that David cut on his table saw. On these he will lay the bridge ties, tie plates and rails. Once that is finished, and pipe details are added to the side to carry DCC bus wires to the end behind the camera, trains will run across the bridge (no fear!) even though it will be a high wire act without a net. 😃

Inside are laminations of black styrene, the purpose for which should become clear as the bridge build progresses. Here we look north across the Ohio River. That's Ohio on the far side and CP Jackson in the background. Not visible: David painted the bottom of the aluminum box sections flat black. Once that was accomplished, the bridge could be permanently bolted in place.

Here’s the view across the bridge heading south. In the foreground Vince plans a pin-connected truss that connects to the main bridge over the navigable river channel.

In the background, through the arched “people tunnel” Vince builds turnouts in dimly-lit Linnwood, the last major town on the layout to be built. This is a spot formerly known as “Darwin”, a/k/a where “the sun don’t shine” because that room perpetually experiences a raging thunderstorm.

**Craig** #145 February 14, 2016, 10:35pm

Just … WOW!

I'm sitting here recalling the point when we started on the layout, thinking how far off it was to reach the bridge going in. And now…we are there!!!

I can just about imagine the trains rolling across that trestle!

Fantastic work guys.

**emdalco01** #146 February 14, 2016, 10:35pm

Craig that is going to be of the stunning scenes in model railroading today.

Regards Daryl Blake

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**Craig** #147 February 14, 2016, 10:35pm

I think you are right Daryl.

Honestly, I think what David does with his layouts is northing short of amazing and nothing that I have seen done on other layouts. The use of people tunnels really gives the operators a sense of different journeys along the way. If I had just a bit of more space on my layout, I really wanted to try to pull that off as well. That being said, I still kept a lot of things in mind based off what I have learned from David.

Can't wait for fire up the ole Soldering iron and lay some solder on the feeder drops 🙂

Until then…back to the car cards for my layout 😃 hehehehe

---

**Bob** #148 February 14, 2016, 10:35pm

Today, December 5 2015 was another landmark day on the A&O. Today Vince glued the first of his cast urethane bridge parts to the giant Ohio River bridge. 😃

Shortly after I arrived, Vince explained what he planned to do. I was in awe watching a master of urethane casting explain his art. "I'm not worthy!" 😆

Vince further showed how an upper styrene part of a floor joist would meet with a vertical member at a knee brace. The styrene part in David's hand will serve as the top member of that floor joist. These should be just visible as they are sandwiched between two ties and sit at below rail level. Normally the top of the joist I-beam would thinner horizontally but that detail won't be visible in the model.

Next Vince got serious, and pulled out the bottle of ACC glue. Hint time: when he wants to apply a very small, controlled amount of ACC along a seam, he uses a fine needle which he drags through wet glue then he transfers the glue to the joint.

Since 3 photos is the limit in the A&O forums, proceed to the next post.

---

**Bob** #149 February 14, 2016, 10:35pm

The bridge build went smoothly. Here Vince has the first two girder sections in place.

By the end of the afternoon there were four completed girders on the north end of the truss bridge section.

All I did today was install a couple more control panels, built by David, which I previously stuffed with any necessary internal parts.

I also found and fixed 3 cross-wired rail power drops between two New York Central staging tracks, the wiring mistakes most likely my own. 😊

**Craig** #150 February 14, 2016, 10:35pm

Holy…Cow. Those castings look amazing!!! Excellent work Vince.

So which panels did you install Bob? In the Kayford area?

**up148** #151 February 14, 2016, 10:35pm

The castings really have amazing detail. It just proves there are no shortcuts to excellence, as soon as you start cutting corners the quality of the end product suffers. This bridge is going to be the money shot we see in all the publications…but then again, the entire layout will be a work of art in all aspects. I'll bet you have all the major mags chomping at the bit. Nice job guys!

Butch

**David** #152 February 14, 2016, 10:35pm

Thanks for the kind comments 'yall. Vince is literally a Master at making and casting urethane parts. He won several First Place awards at NMRA nationals, including a "Best in Show". How did I get so lucky to have railroad friends like the A&O gang?! I only hope my scenery can do his bridgework justice.

And yes, I've been approached by the mags, but they'll just have to wait. I've got a railroad to build and article work takes time. I do believe there will be a photo in the soon-to-be-released 2016 MRP in an article by Jeff Kraker, however.

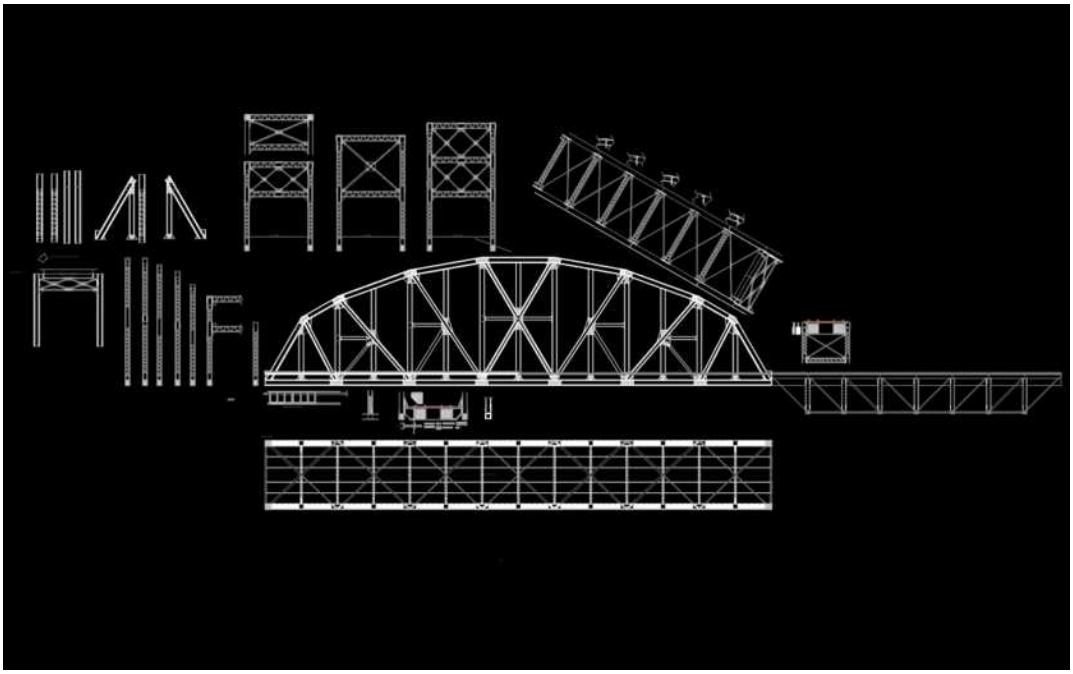
Thanks for staying tuned to this LONG journey we've been on. Eight years next month. Wow.

David

**Bob** #153 February 14, 2016, 10:35pm

Here's a peek at Vince's CAD planning drawing for the bridge. This is of course very low resolution,

but it should give a rough idea of the main span and the north-end pin-connected truss. Also keep in mind that this is a work in process.



More progress!

Edit:
For many years Vince built spectacular urethane masters of Frisco freight cars, from original Frisco

drawings, for Sunshine Models.

According to my copy of QCAD (a free open-source 2D package) the main span is 70 inches long! 😮

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**up148** #154 February 14, 2016, 10:35pm

> How did I get so lucky to have railroad friends like the A&O gang?!

Yes Sir, you have the best of the best in your group. And everyone seems to be dedicated to the same high standard in their field of expertise. I'm always amazed a the skill sets, professionalism and artistic abilities of the A&O gang. Truly an amazing group.

Butch

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**Bob** #155 February 17, 2016, 3:15am

Yikes, it has been about two months since the last update. At the moment there is little new to see.

After Christmas Mark and Craig Linn attached most of the rail drops in the last town to be wired, Linnwood. This is the "rain room" and at best lighting is dim. Craig uses a headband light to see what he's doing.


David started detailing the long Kayford people tunnel liner to give the appearance of ShotCrete. For this he attached crumpled window screen wire and coated a portion with gray tinted drywall mud. In person the mud looks very dark and realistic.

On either side of the tunnel are emergency exit crawlspaces that will be hidden by easy-to-push panic doors. At the moment they serve as quick shortcuts.

**Bob** #156 February 25, 2016, 1:25am

Another milestone! By David's measure scenery has officially begun! 😀

Of course there have been small pockets of scenery done elsewhere—Willow Creek/Taft staging, some details in Havens yard, and the long train and people tunnels in the Kayford Valley (photo just above in previous post.)

Red rosin paper on cardboard lattice went on the wall in Mount Union this last Sunday. Today I found David slinging Hydrocal plaster into rock molds.

David blends individual castings together with extra plaster that he hand carves with a chisel and hammer before it fully hardens.

Meanwhile (not shown) I wired the last of six DCC power boosters in Linnwood. Although there are still many rail drops to connect, most of the area now has power.

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**Bob** #157 April 3, 2016, 12:43am

Today Vince showed off his first assembled section for the pin-connected truss on the Ohio side of the river. The lacy detail is amazing.

**SuttonBranch** #158 April 13, 2016, 9:24pm

I have watched with anticipation and amazement as the A&O has developed. Yes David, you are blessed with a VERY talented group of craftsman. I can hardly wait to see what appears in the coming months.

David Matheny
Columbus, OH

**Bob** #159 April 21, 2016, 7:01pm

After browsing through recent A&O work session photos, I came across this one from February 2016. Bill Wood donned his hard hat to “ShotCrete” the lining of the long Kayford branch operator’s tunnel inside Cathedral Peak. The gray drywall mud turns a lighter color when dry.

This work is a *lot* safer than that done by most of my relatives and perhaps Bill’s. My uncles worked in the anthracite coal mines in northeastern PA. Even still, Bill takes no chances against a rock fall. He doesn’t want to encounter a “widowmaker” above his head!

**Bob** #160 May 22, 2016, 10:04pm

It has been a month since the last update, so here goes.

Bill Wood demonstrated proper table saw safety while using a push stick to rip narrow strips of scrap cardboard (mat board) on the table saw. The paper dust is flying, because scenery landform work has begun!

These strips were stapled and hot glued together to form landform basic shapes in River Gorge. A few clothes pins kept the strips together while the hot glue quickly cooled.

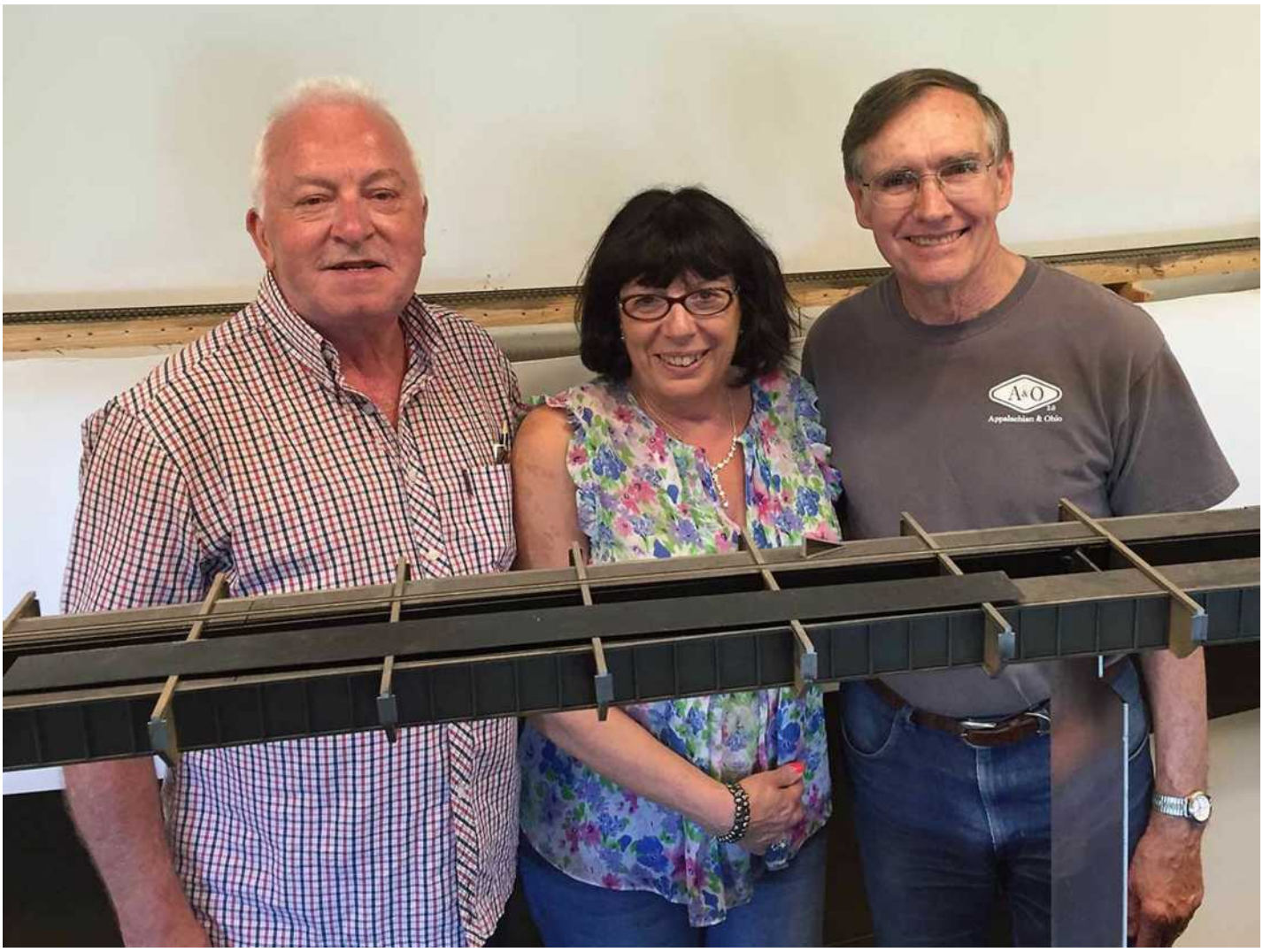
**Bob** #161 May 22, 2016, 10:13pm

Meanwhile Bob Kjelland worked underground brushing “Shotcrete” to line the long people tunnel in the Kayford valley (this day he said he was Corporal Newkirk, a character from the TV show Hogan’s Heros, who frequently was assigned to dig the tunnels.

Frequently “Newkirk” had to crawl out of the tunnel to reload his supplies.

**Bob** #162 May 22, 2016, 10:41pm

After lunch we had the *great* pleasure to host two guests who hail from “across the big pond.” James and Jackie Lucas make their home a short drive outside of Bristol, England, only about a 20 minutes from “the bridge” to Wales from the southwest corner of England. It was certainly a much longer journey across the big pond!




James, who has started a personal journey in O-scale, brought two magazine samples of UK O-scale work. The printed photos show scenes with fabulous detail, nearly impossible to distinguish from outdoors.

During James' visit to the A&O, he operated several trains, including an empty coal extra heading south from Ohio back to the coal fields of West Virginia.

Safe travels, our new friends.

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**Bob** #163 June 2, 2016, 12:58am

It would appear that serious scenery work is under way in Mount Union.

1 Like

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**jaybarnaby** #164 June 2, 2016, 2:05am

Yay!! scenery!!

Jay Barnaby
drgw5393@att.net

1 Like

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**Craig** #165 June 2, 2016, 8:04pm

Nice!!!

David…what are you using for the tree material? I usually use Candy Tuft but can't seem to find it anymore.

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**David** #166 June 3, 2016, 2:12pm

Hi guys,

The tree material is Golden Gypt wrapped in bundles and trimmed to suit. Then- sprayed green, spray adhesive, course ground foam flocked (foreground) or medium (background). When all was in place, an overspray of cheap mega-hold hairspray to minimize future "foam rain".

A new technique this time around is attaching trees and ground cover up the backdrop. Who'd a thought.

I'm still tweaking with things, so don't get too attached to it!

The first hillside landform was of foam. Didn't look good. It all came down and was replaced by cardstock weave and red rosin paper with an overlay of plastered paper towels in the future rock areas- another new technique for me.

Then the rocks were cast. Didn't like the first look so they got ripped off and went in the dumpster. Take two. Good enough.

Time to color rock. First try- too yellowish. Repaint with white drywall primer. Second try- too much of a color palette. Repaint with white drywall primer. Third try (deep breath) satisfied. I am looking to create an old, weather-worn rock face with a lot of decayed foliage wash staining the surface. I think it was the final step that got it done- a light overspray from above with flat black rattle can spray bomb followed by very light white dry brushing highlighting of sun-exposed edges.

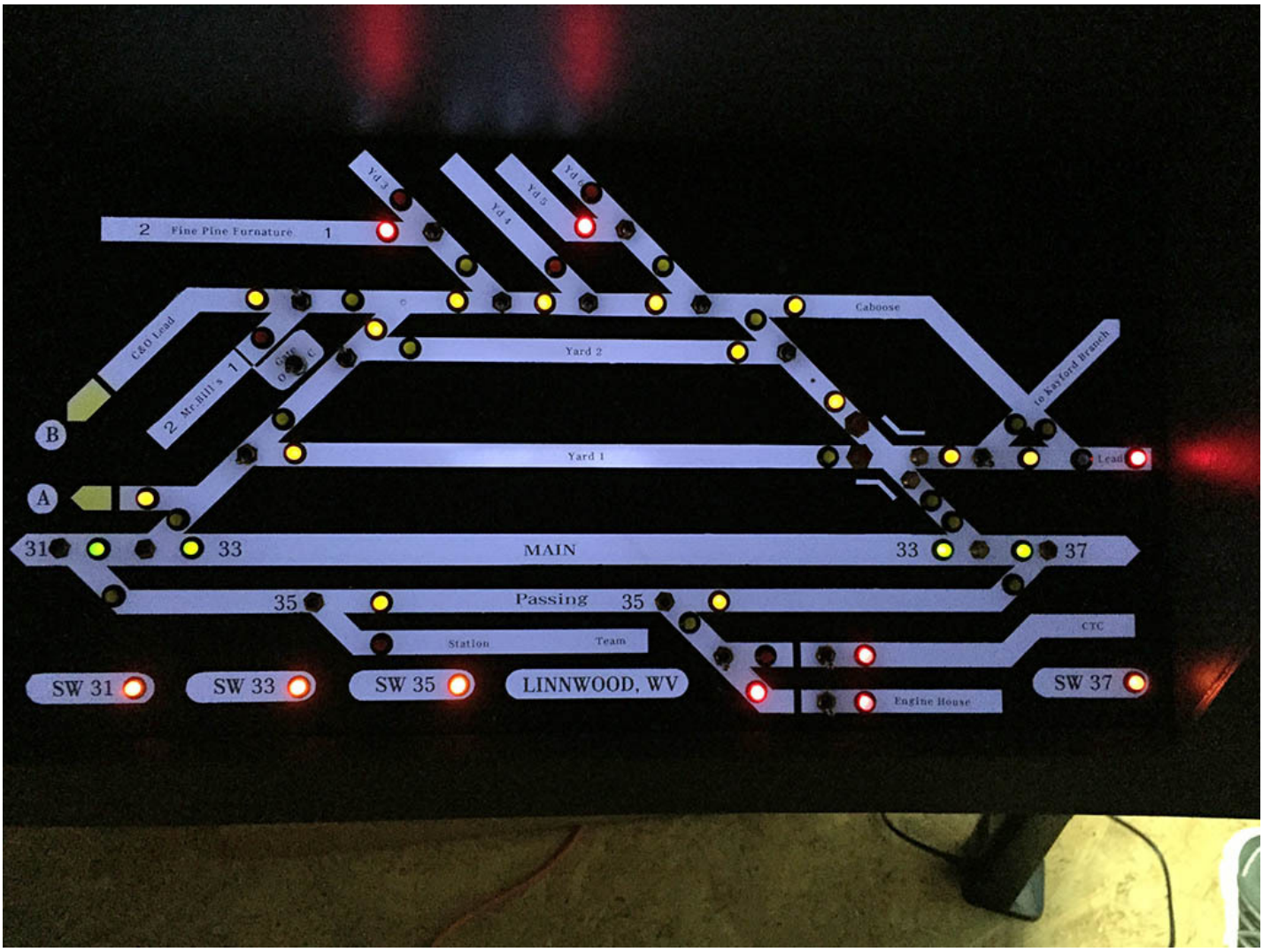
Then onto painting backdrop. Should I expect any different? Bob was there when I painted the first hillside of trees into oblivion with sky blue latex. What you see now has had some areas similarly removed. And I'm still evaluating.

New techniques from A&O 1.0 are being learned, inspired by the trip to see Mike Danneman's N scale layout. He's a professional artist, so no delusions here, but he sets a marvelous example.

**Bob** #167 August 14, 2016, 1:17pm

It has been a while since the last post. Today David and Mark laid the last rails, except for those on and immediately surrounding various bridges. Here we see them working in Mount Union.

Meanwhile the main control panel for Linnwood was installed. This one has 50 LEDs.




**IdahoCarl** #168 October 9, 2016, 7:09pm

Wow, I miss a year on the A&O and amazing things happen. We didn't make it to Longmont this year, hopefully next year. I look forward to seeing all the happenings on the A&O. Wish I lived closer. Carl

1 Like

**Bob** #169 October 30, 2016, 2:17am

Perhaps it is time to catch up on a couple of things.

Rick Bacon built quick foamcore buildings for the town of Mount Union to get a sense of scale and

proportion. That’s the A&D mainline in the foreground. This is an early photo before Rick started a lot of fine-tuning.

Recently there was a mini photo shoot for the 2017 Narrow Gauge Convention open house. Although the convention is about a year away, there was a need to submit a few photos and a brief layout description. Here are two of those photos. The first is in Mount Union.


The second is the operating Whiting Rotaside coal unloader in Glenn Forge.

**jaybarnaby** #170 November 2, 2016, 5:34pm

Would have been funny if you had re-created the shot of a hopper on the rotary with the mis-spelled hopper.

**Bob** #171 November 3, 2016, 1:40am

The thought did cross my mind…


**Jeff_Tague** #172 November 14, 2016, 7:43pm

Bob, I know it must be difficult (due to the rain!) to show track configuration in Linnwood. The control panel looks interesting, but we don't have a single photo of the rail layout. Is that a double slip at the right end of 'Yard 1'? Thanx

**Bob** #173 November 14, 2016, 8:48pm

Jeff -

The panel is easier to see if you click on the photo to enlarge it. And yes, I don't want to get my camera wet.

Anyway, the left side of the double slip, horizontal line, connects to Yard 1. The up diagonal (illuminated yellow LED) leads to Yard tracks 2-6, the C&O connection, Mr. Bill's Lumber and Hardware Emporium, and Fine Pine Furniture.

The right horizontal goes to the switch lead and switch to the Kayford, or diagonally down to controlled lock switch 33. Travel between the slip and 33 is locked out by the Dispatcher, and both the left points of the slip and 33 move in tandem (remember, it's a puzzle switch, so the points where you enter actually control where you exit.)

There is a separate control panel for the C&O, which connects with the left side of this panel. I haven't yet taken a photo of that one.

Lines on the panel have been straightened. Much of the track forms a 180 degree loop (or blob, in John Armstrong speak.)

**Bob** #174 December 4, 2016, 12:53am

It's a bridge day! David has been working hard on a scene in the isolated Kayford branch aisle. It looks great!

First photo, an Atlas truss bridge re-detailed by Rick and David spans a gorge not far from the start of the Kayford branch. Just past the bridge rails plunge into a long tunnel, as do operators. It is a "people tunnel" as well. The A&O "eats trees for breakfast" and David ran out before finishing the people portal.

David asked Craig run a first official coal train through the tunnel and across the bridge. That’s a GP35 on the head end.

**Bob** #175 December 4, 2016, 1:47am

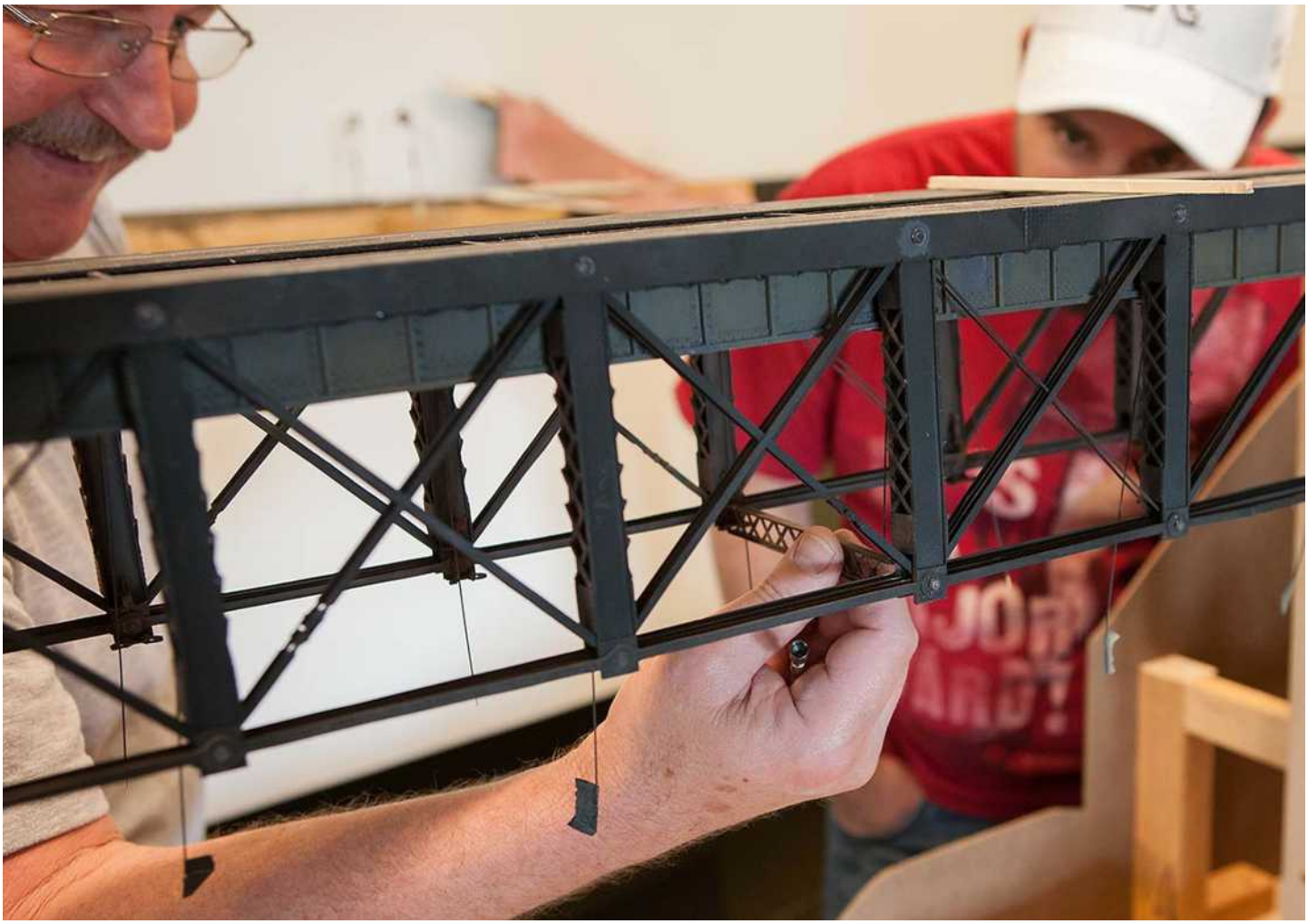
Continuing with the theme of “Bridge Day”, Vince installed finished cast urethane pieces on the Ohio River bridge pin-connected truss section. It is inspired by OC bridge in Pittsburgh, PA, only at a much more practical scale. Even still, this bridge will be about 12 feet long over the 3 spans. All this lacy detail steers the eye away from the interior structural aluminum square tubes that support the span.

First up, Vince explains how he built the sides. We previously saw parts of this construction but when it was all laid out for installation, all I can say is that once again my jaw was on the floor. As the afternoon progressed I suspect that David had to roll out the “Shop-Vac” to clean saliva off the carpet after we left.

A closer view of the North side of the bridge. Click on any photo to enlarge.

The “Urethane Maestro” goes to work installing the back side of the bridge section.

Vince’s plan is coming together! It fits!



Details! Rivets and more rivets! Turnbuckles!

After all this Vince spent some time weathering the outer sides of the pin-connected truss. Wow!

1 Like

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**Craig** #176 December 4, 2016, 2:15pm

I am still in awe over what Vince created. The level of detail is simply amazing!

---

**Bob** #177 December 4, 2016, 3:38pm

There is really not a lot to see on the electrical front. Craig and I diagnosed a couple hardware problems with SMINI control outputs. One turned out to be a hairline open on one of my home-etched PC boards. Craig also installed a control panel for D&K Dock in the Kayford aisle, off-camera to the

right in the photo of Craig and GP35 in a previous post.

I spent my remaining time going into a “programming coma” at the CTC machine. The Macbook is just for compiling and loading programs into a $20 Teensy 3.1 microcontroller mounted behind the machine.

On the model board you can see a train sitting on the North side of Ohio Bridge. For an occupancy test the train was run up the hill from the start of CTC at the left end of the panel. The radio throttle was sitting on the Dispatcher’s desktop during the entire run. And no peeking at the layout!


Rick brought over a beautifully scratch-built Texaco station for Mount Union. I’m sorry I didn’t get any photos of it to share. It will certainly be a star (pun intended) in future photos of Mount Union.

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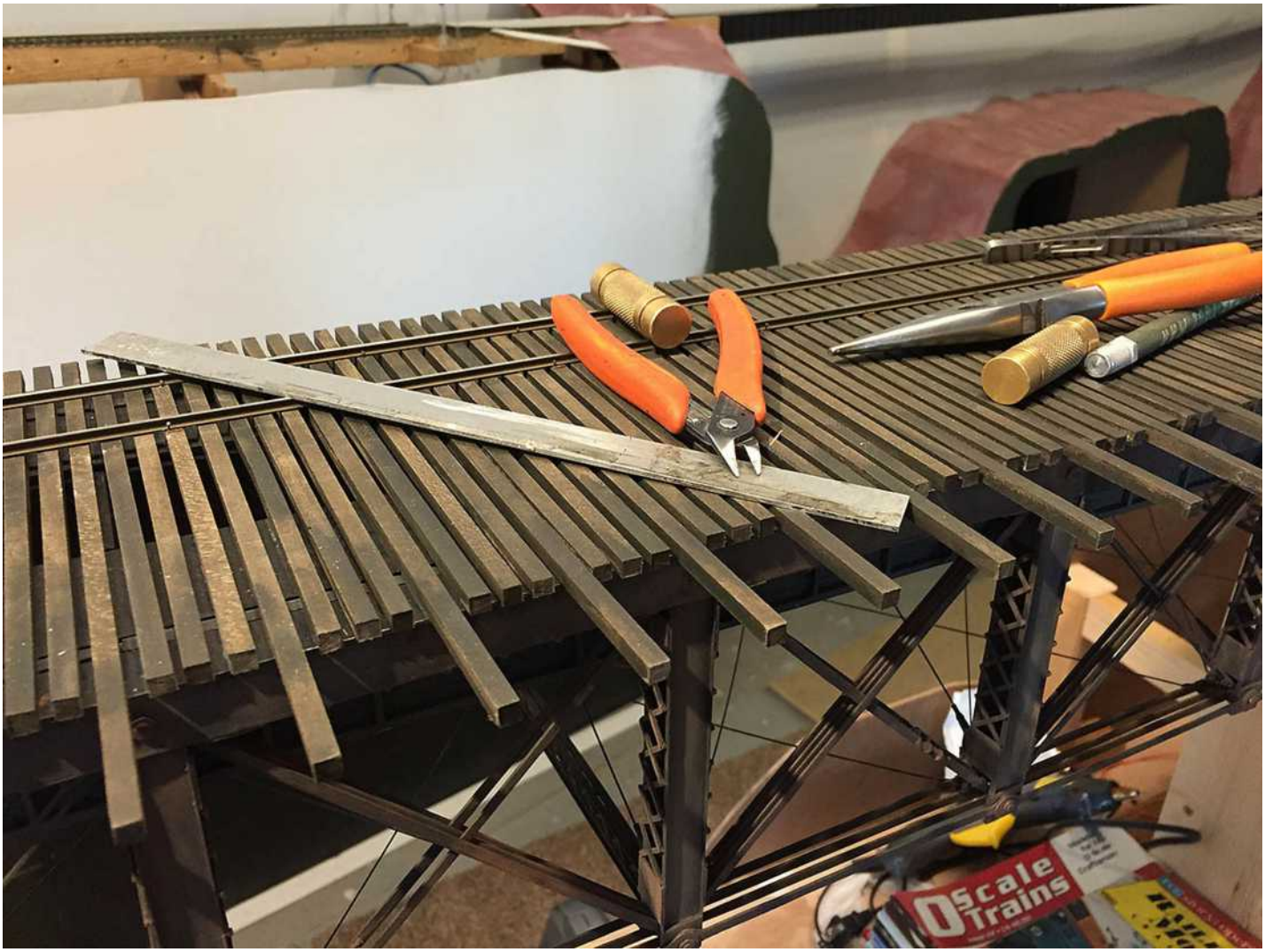
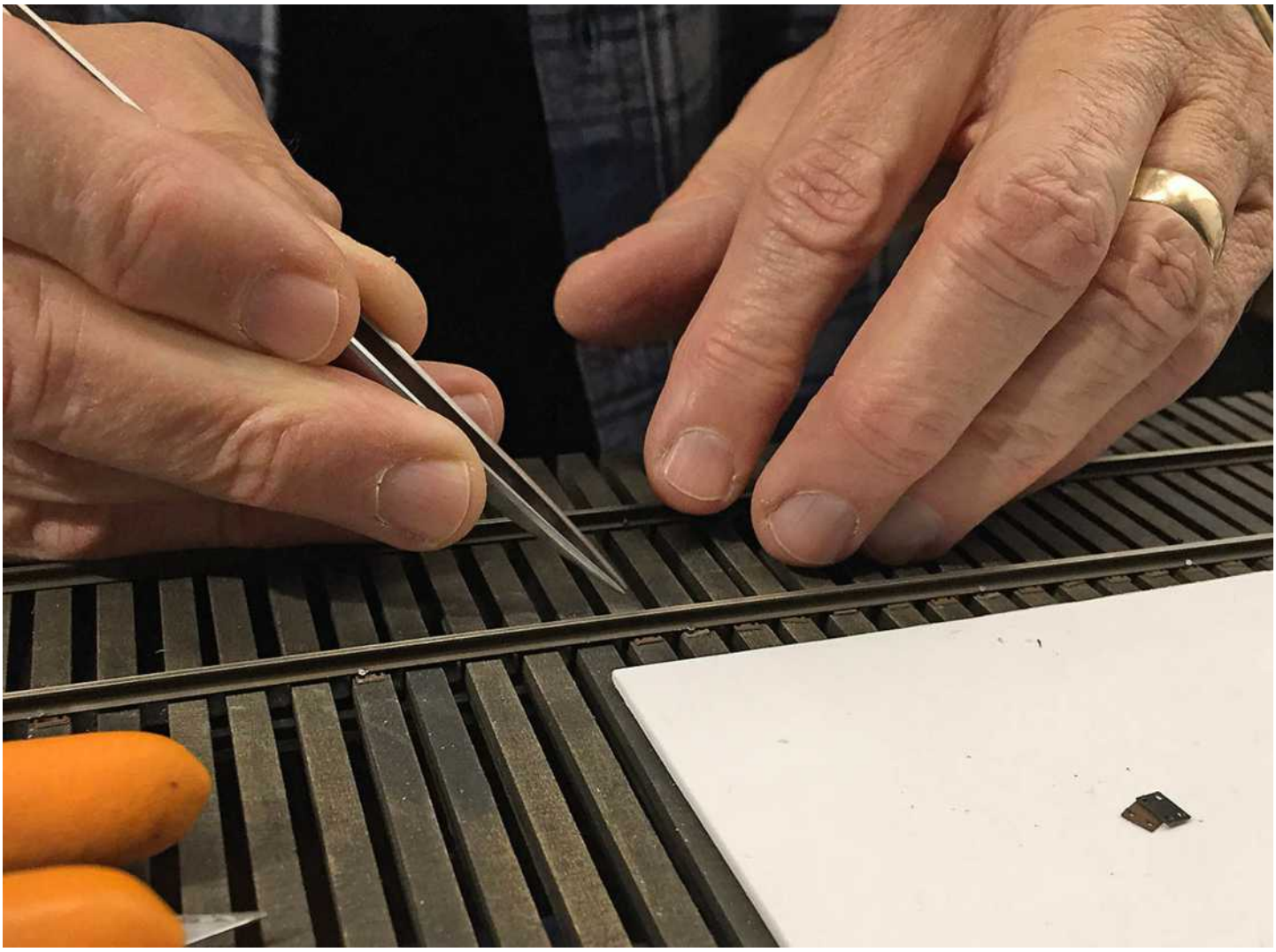
**Bob** #178 December 11, 2016, 2:41pm

**"You can tie one on!"**

David laid 530 ties across the approximately 11 foot long Ohio River Bridge spans. Ties started as 3/16" square basswood sticks (9 scale inches) cut 2 at a time to length on David's bandsaw. The long ones will support the walkway. Today I brought over 6x8 guard timbers I custom ripped on a Byrnes precision miniature table saw.




Let's see now. There are 2 spikes per tie plate, times 2 per tie, times 2 tracks, times 530 ties, well that's only 4,240 spikes! After aligning the outer then inner rails, loosely spiked, David comes back and slips tie plates under the rails and spikes them into place.



For the majority of guests the bridge will be just below eye level. That will make for some real **in-your-face** railfanning.

Here David stands on a stool and on the Ohio River (sort-of walking on water) to get a more comfortable perch while spiking the rails.

There are a few more pieces to install on the bottom of the pin-connected truss. Hopefully they will be out of the urethane oven and installed in a few days hence. David and I were again were overwhelmed by Vince's amazing craftsmanship in urethane casting, and also in planning all the parts in 3-D CAD before scratch building the masters for mold making.

I can't wait to video the first train across this span! This will also be a popular place for the dispatcher to schedule meets. To the north is the ruling grade, and the south a rather short passing siding.

David observed that when the rails are in, we can do point-to-point test ops between Ricksburg and Linnwood, with a yard on each end. Pretty soon I'll be on the hot seat to finish rebuilding a brass Overland pin-connected truss and an Atlas deck girder bridge.

**Bob** #179 December 18, 2016, 1:30am

Today Vince ran his first train across the Ohio River Bridge, still under construction. David roughed-in the south main so we can start running trains into Linnwood (entry through the black curtains closing off the people tunnel behind David.) By rough I don't imply operation, that was buttery-smooth. Rough means that not all of the spikes and tie plates are yet installed. No flex track on this layout!

At the bottom of the photo you can see a long aluminum straight edge that David uses when he wants rails dead straight and without any sideways wobble.


Vince also installed the last of his urethane cast parts below the deck of the pin connected truss section. I love the details! The diagonal "streaks" seen on the top member are actually rays of light cast by a halogen spot light located above the bridge.

Later in the afternoon Vince and I tested switch and lock control on the CTC machine. Signal logic is next on the schedule. Here we see Vince's train out of sight, running through the Bayfield crossovers and heading towards namesake Point Vincent.


**Craig** #180 December 21, 2016, 7:17pm

Now THAT is just plain awesome!!!

A big milestone for sure. Can’t wait to see a meet in this bridge.

**huib** #181 December 27, 2016, 8:53am

Hi all,

Great to see the bridge come together like this. I remember it just being an aluminum girder when I visited the A&O this summer. Keep on spiking into the new year. 😉

Best wishes for 2017 from .nl!

Grtz!

Huib

PS. I added a construction update of my own lay-out over Christmas. **If you're bored, have look**.

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**Craig** #182 December 26, 2016, 10:03pm

Huib,

Great progress as well!! I love the figure of yourself as well. Great addition to a layout.

---

**ErikLindgren** #183 January 11, 2017, 8:41pm

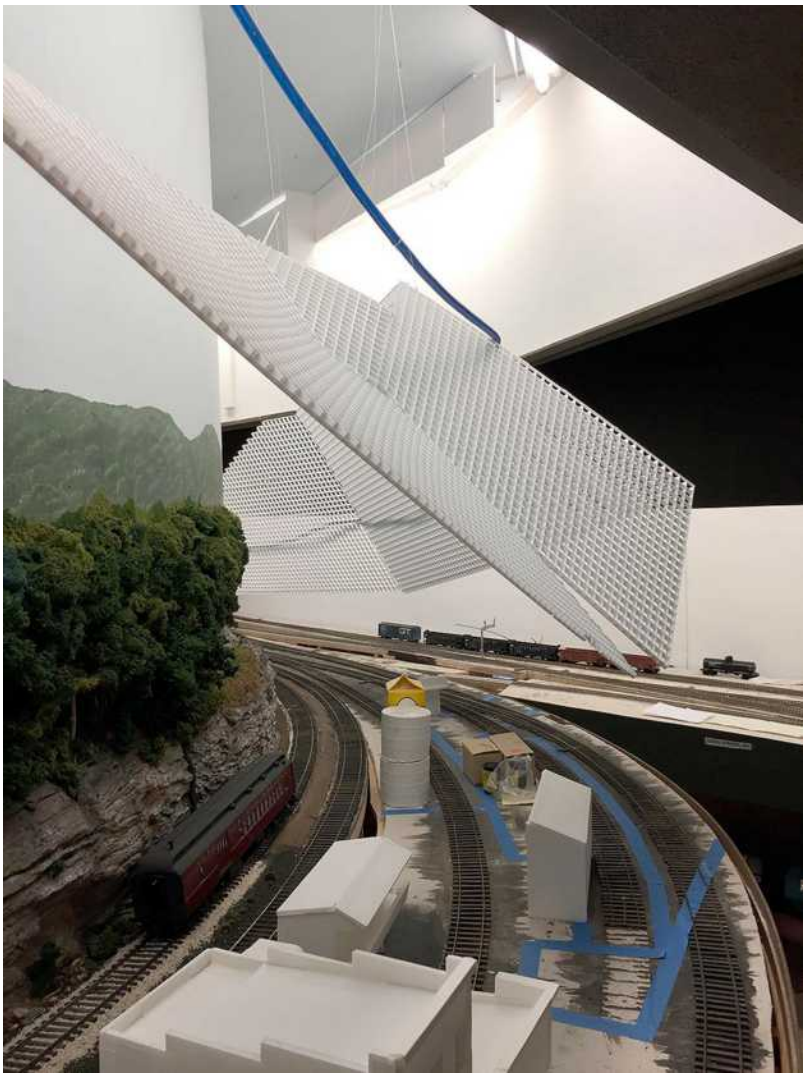
Stunning work fine gentleman thank you for sharing

**Bob** #184 February 19, 2017, 1:34am

Again it has been a while since the last construction update. This morning Vince test fitted parts for the main span of the Ohio River bridge. Prior to this David spent *many* hours installing tie plates, guard timbers and J bolts across the double track deck.


A view from the other side.


Chicken little came running around the corner proclaiming that “The sky is falling!” Inspection revealed that a few of the lighting valence diffusion panels were literally “hanging by a thread.” Oops!
😮



In the afternoon Vince installed trucks and couplers while David sanded lettering off cars prior to painting for the A&O. Meanwhile I fixed a few signal system issues identified earlier today.

**ErikLindgren** #185 February 19, 2017, 10:08pm

Incredible! So marvelous Vince just beautiful!

**Jeff_Tague** #186 February 20, 2017, 7:38am

Good Grief! Don’t leave us hanging! WHY is the sky falling? Is it because there was a passenger car on the main? And are you sure that that bridge is BIG enough?

Jeff, the 'ol mechanic

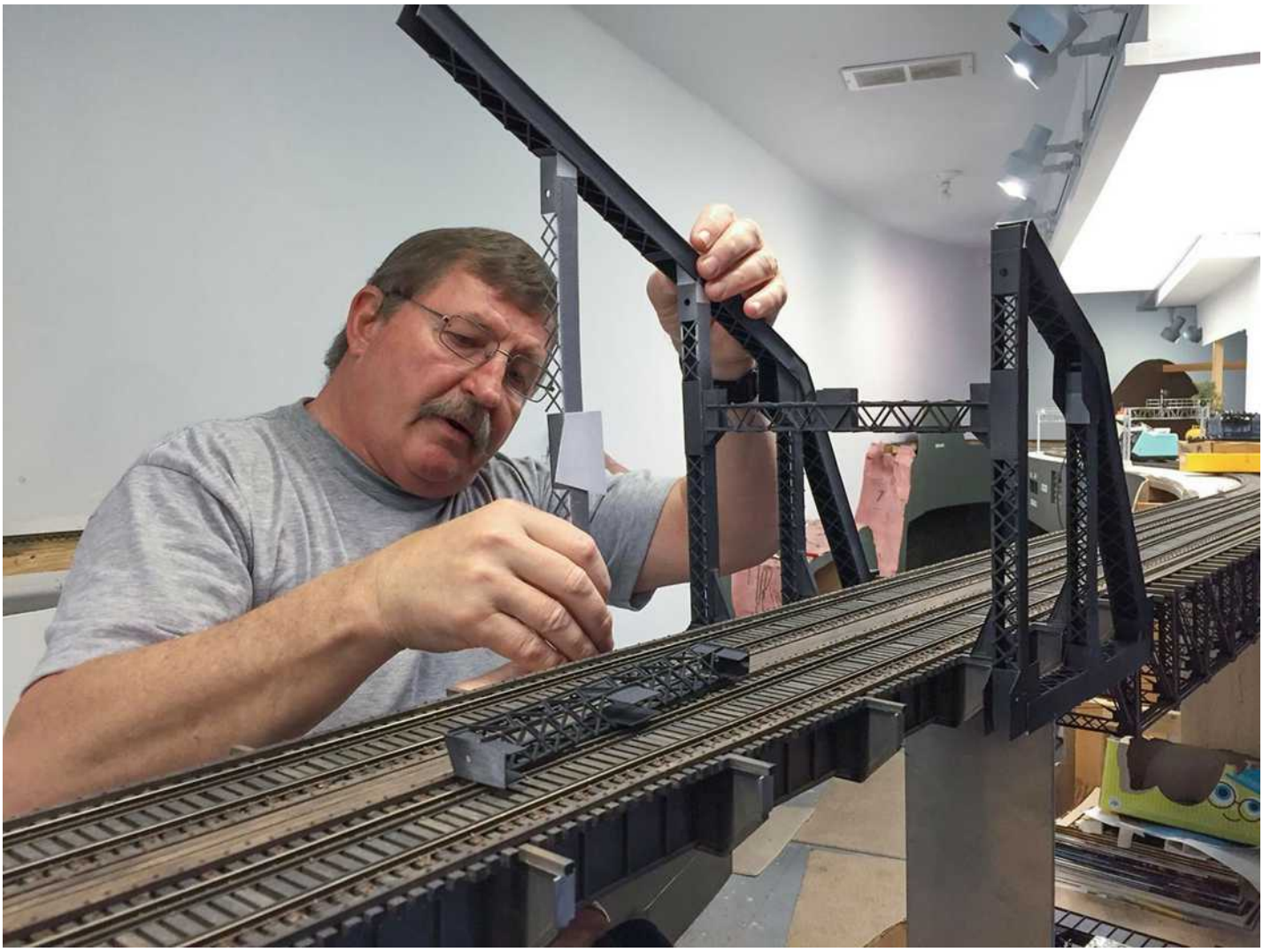
**David** #187 February 23, 2017, 8:55pm

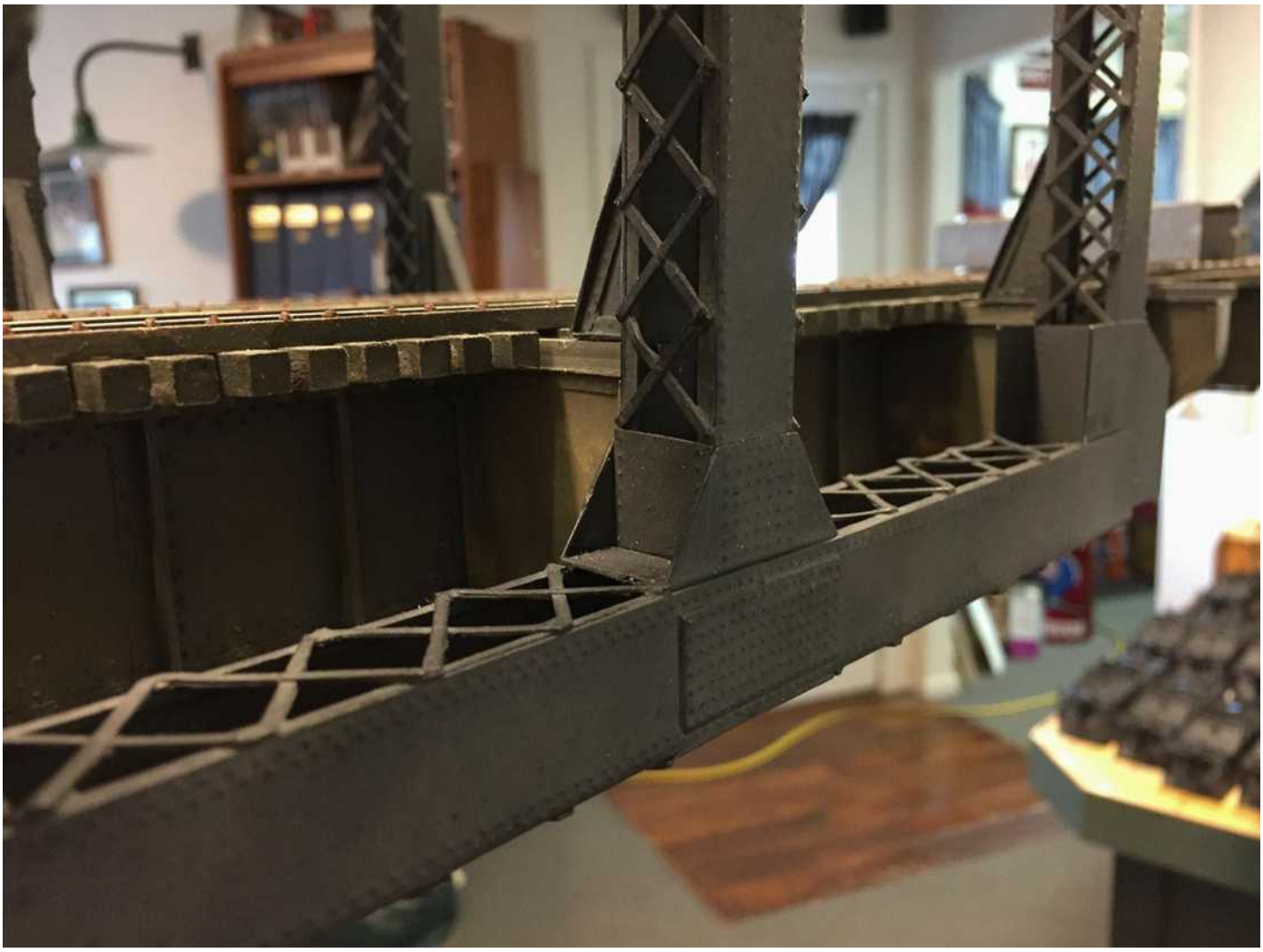
The grills were tied with thread to the ceiling, but also some, stupidly, to the nearby blue rope light that provides our night lighting. I guess it added just enough weight that over time one of the ceiling rope clips let go and like dominos, they all let go, dropping the rope light and the light grills. Uff. I will be a trick to reassemble.

BTW- Glad you are able to get back onto the site, Jeff.

**Bob** #188 April 1, 2017, 11:37pm

Today we had another fairly quiet work session after a hiatus. The highlight was seeing Vince's latest urethane castings being test fitted for the main span of the Ohio River bridge. This one will be a monster, and there are tons of rivet details.





1 Like

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**ErikLindgren** #189 April 2, 2017, 8:32pm

Just beautiful Vince! Keep up the good work.

My progress on my pin connected Truss. LOVE it guys.

**Bob** #190 April 6, 2017, 10:44pm

John Johnson did a great job building the new deck!

1 Like

**Bob** #191 April 6, 2017, 11:08pm

David pulled out the aluminum structural beam for the Twin Creek Viaduct and subsequently laid ties, rail with full tie plates, J bolts and guard timber NBWs. I could easily be wrong, but I think it is around 12 feet long. I'll give an update once it goes back in place.

In the short term there will probably be temporary supports to limit bridge beam deflection when loaded with ~30 pounds of Alcos and loaded coal hoppers. In the long term David plans to build 3 brass structural support towers driven to bedrock (structural wood).

On Wednesday David *got on a roll* (of paper towels and Hydrocal) to advance scenery underneath the Viaduct. I was alerted to this while working on CTC machine programming to add support for traffic levers when I heard David yell "**This isn't good!**" Then he proclaimed a new push to get the mainline finished.

*Why a duck? Why a no chicken?*—Chico Marx in the movie Coconuts.

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**Craig** #192 April 9, 2017, 5:51pm

I must say David…you are keeping your hands much cleaner than I when doing the same thing.

Heheheh. I feel like I wear the hydrocal mixture.

Are you using any baking powder to retard the mixture a bit? I can't believe it too me this long to use that. Makes working hydrocal a dream!!!

1 Like

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**David** #193 April 9, 2017, 7:05pm

Craig-

Baking powder? Those would be some hard biscuits.

I have no knowledge of this. Please enlighten us.

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**ErikLindgren** #195 April 10, 2017, 8:39pm

Cool stuff David! Keep em coming ! ❤️:heart::heart_eyes:

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**Bob** #196 June 23, 2017, 3:25am

It has been a while, so here are a few updates, starting with a video of Vince running a train during an open house. If you are curious, Vince is momentarily distracted by a couple of David's grandchildren zooming by. They enjoy running around the aisles of the layout for hide-and-seek.

**https://photos.smugmug.com/Trains/Model/PandD-F3s/i-rQqcTSZ/0/5dad44ee/1280/IMG_3823-1280.mp4**

Most recent work has been scenery. Rick stopped by to start installing streets in Mount Union. The A&D will "street run" along the edge of the layout.

Vince continues casting urethane parts for the Ohio River bridge main span. Here he does a test fit.


Scenery is going in so that the remaining 4 mainline bridges can be installed.

Not shown, Bill Kepner joined Saturday's work crew and made trees. Meanwhile, Vince added lead weights to more of the A&O coal hopper fleet and I installed detection resistors to 108 Intermountain wheel sets.

1 Like

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**Bob** #197 June 18, 2017, 9:27pm

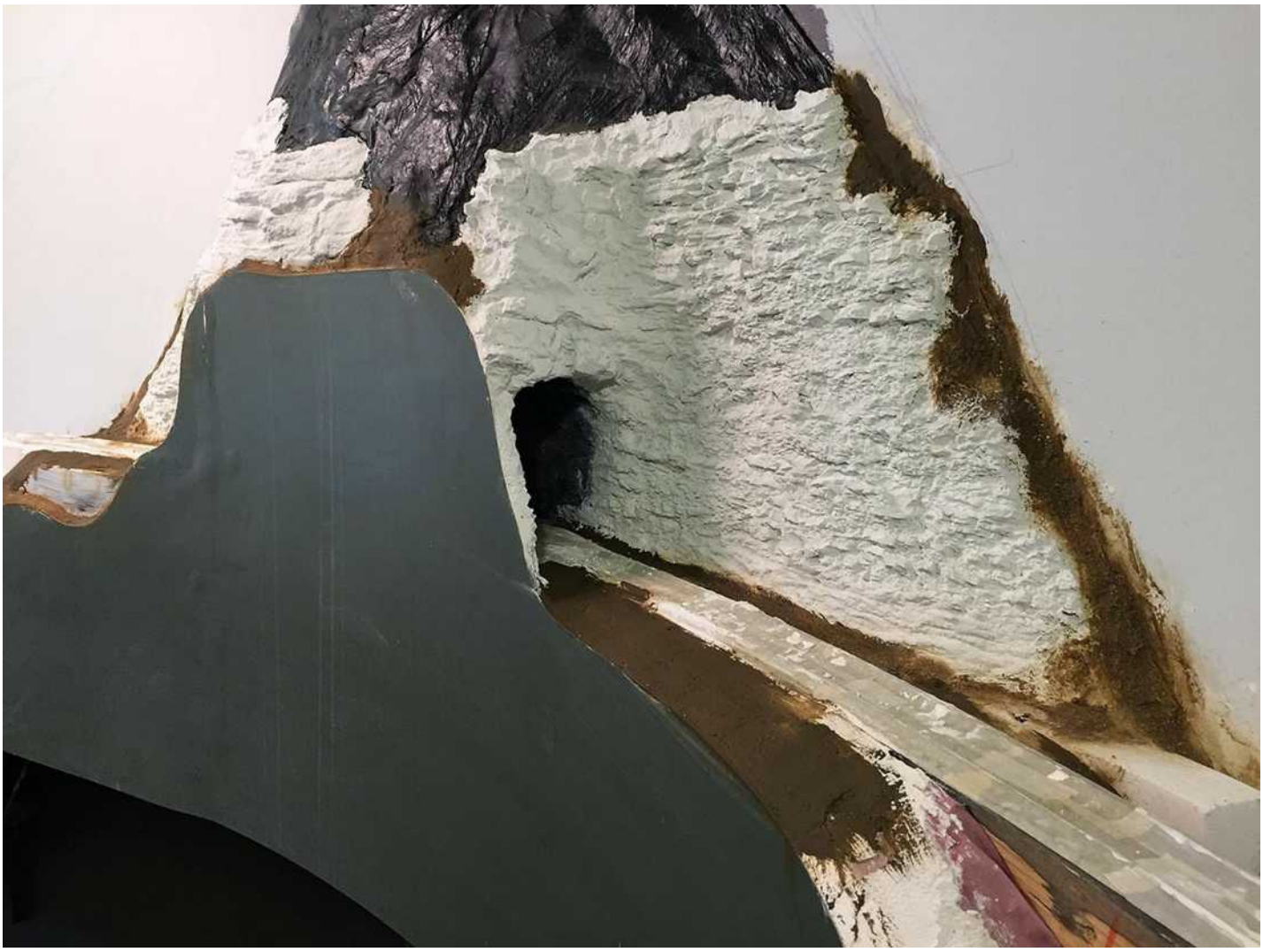
Here are a few more photos from the last month or so as I dig through my photo archive.

David cuts scrap pieces of picture framing mat board into strips on the table saw. A local frame shop saves their scrap pieces for David. Here Bill installs them using scissors and a hot glue gun. The lattice will be covered with glue-soaked red rosin paper, available at any big box home store. Over that David drapes paper towels soaked in Hydrocal. Such construction can be seen just to the right of Bill. Finally David will cast Hydrocal rocks in-place at appropriate locations of the hillside.

An abutment goes in at the north end of Twin Creek Viaduct. The black paint helps disguise the shallow space behind a row of trees. The concrete retaining wall inset into the hillside makes room for an intermediate signal and its shanty.

At the south end of Twin Creeks viaduct David works freshly-moulded Hydrocal rocks.

Here are cast-in-place Hydrocal rocks and a partial bridge abutment at far right to “Trussel trestle”, so named to honor David’s friend Dave Trussell, founder of the *fabulous* Colorado Model Railroad Museum in Greeley. **http://www.cmrm.org**



By the way, A&O David scratch built the #12 switches at the CMRM. He is a very humble man who doesn't brag, so I'll do that for him.

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**IdahoCarl** #198 June 18, 2017, 9:57pm

What wonderful work. We were over in April for a funeral. I was hoping to come at the end of July for the UP Convention or in Aug for the Narrow Guage, however the funeral ruined those plans. I hope to see you guys next summer. Look forward to that and future photos of your progress. Carl Sorensen, Payette, Idaho

1 Like

**ErikLindgren** #199 June 18, 2017, 11:10pm

Absolutely fantastic!!

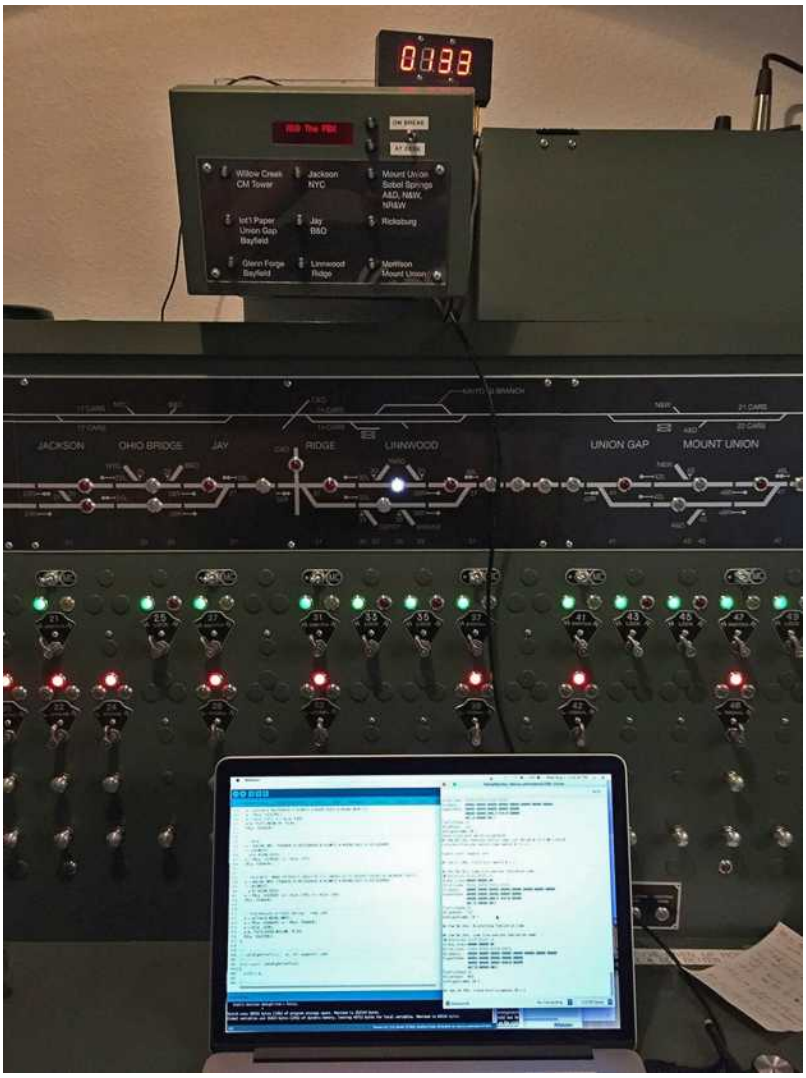
**Bob** #200 August 3, 2017, 1:54am

A big “must work faster” push continues to get the full mainline operational prior to a 2017 Narrow Gauge Convention open house. There once were five missing bridges but now there are only three.

David has nearly finished this scene and installed the bridge to allow operation from Linnwood (through the photo left black curtains, a/k/a the “rain room,” down to Union Gap. This is an Atlas bridge, re-detailed by Rick and David. The scene is at eyeball height for *“in your face”* railfanning. Although the star of the crew lounge view will be Vince’s massive urethane Ohio River Bridge, this will be a close second.

While exiting the far tunnel, the engineer running these F3s engaged full dynamic brakes for a slow and controlled descent to Union Gap. This is the first coal train to cross the bridge and descend to Union Gap.


Many signal heads previously removed for scenery work, including 3 intermediate pairs, were re-installed this week. I was able to test and fix a few minor issues in the CTC software during quiet times this afternoon.




Two of the three missing bridges are mine, and I'm trying my best to fire ahead of the gun. I'll mention details in another post.

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**Bob** #201 August 3, 2017, 11:36am

David runs the first coal train across the St. George River bridge.

**https://photos.smugmug.com/Trains/Model/Appalachian-Ohio-20/i-hG6WQ5d/0/f6a74ae5/1920/NewBridge-1920.mp4**

1 Like

**IdahoCarl** #202 August 5, 2017, 12:02am

WOW! I am even more envious of you guys now, if that is even possible. Thanks for posting, please, keep up the great work

1 Like

**Bob** #203 August 6, 2017, 3:51pm

Vince test fits more parts of the massive Ohio River bridge. Here we see the full height of the center section. The next top chord will be level.

1 Like

**ErikLindgren** #204 August 6, 2017, 9:18pm

Passenger? Wow ! That's fantastic. Like the Pin Connected Bridge Bob looks great. Vince your project is looking beautiful as expected!!

**Bob** #205 August 13, 2017, 1:12am

Must build faster! David built up a rosin paper cliff that may look nearly vertical, but worked very well on the 1.0 layout. To his right is the Joel Beach scene.


The drop cloth protects an Atlas deck plate truss bridge that I rebuilt. Today I laid the last of the J-bolt NBW castings and NBWs on the guard timbers. David did the hard part of laying rails on a curve through that bridge with full tie plates.

**Bob** #206 August 20, 2017, 4:11pm

The push is on to get the full mainline operational for an open house during the Narrow Gauge Convention.

Although unfinished, the Atlas double-track bridge over Union Gap has been temporarily installed. The A&D mainline to staging will have to wait for now.

**https://photos.smugmug.com/Trains/Model/Appalachian-Ohio-20/i-gBBJLbb/0/cfa45d30/1280/UNION%20GAP-1280.mp4**

The Overland pin-connected truss is seated in place. There are 8 spikes/tie, Grandt Line tie plates, and a full complement of J-bolts and guard timber NBWs. For now it has light weathering. Additional rusting with chalks is anticipated.

The last spike goes in! For now, anyway… The mainline is now operational.

Katie takes the first full mainline run while David and grandson Christopher watch.

Finally, the first train over the last two bridges to be installed.

**Bob** #207 August 20, 2017, 6:58pm

David brought out the Golden Spike memorial and set it between bridges in the A&O 2.0 River Gorge scene. Katie noticed it and took a quick look before her train arrived. This was a momentous occasion even though there is still some A&D rail to lay. We agreed that the official Golden Spike celebration should wait until the A&D is complete.

Will scenery work suddenly come to a halt and operations take precedence? Or will the double track bridge at Union Gap come back out for completion of that scene? Who knows!

I vote for both.

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**Bob** #208 August 20, 2017, 7:08pm

The “victory lap” was almost complete as Katie’s train runs through Jackson and heads for the Ohio River bridge to West Virginia.

**Craig** #209 August 20, 2017, 10:52pm

Wooooooohooooooo!!! Congrats guys!!!

This is awesome!!!

**Jeff_Tague** #210 August 21, 2017, 6:11am

How does the Twin Creeks area look now with the viaduct in place. (even though temporary)

**Bob** #211 September 3, 2017, 2:16am

Jeff -

In the business of preparations for a visit from Tony K and a layout tour for the 37th National Narrow Gauge Convention, I couldn't get back to you with a photo. Here is how it looked during today's tour. The MRL caboose paint will be stripped in the future for A&O livery; it was a relatively inexpensive item that David procured years ago.

The span is structurally sound, with the substructure a 1.5" aluminum box tube. It doesn't need additional reinforcement, but will sag just a bit with a heavy train. David plans two brass towers in the approximate areas outlined by the wood forms. For the upper part of the scenic landform "hump" he plans a campground with obligatory Arduino-powered nighttime campfire(s).


**David** #212 September 3, 2017, 4:36am

Thanks for the picture help, Bob.

For what it's worth, there will actually be 4 towers supporting the bridge. I made the two wood squares the size of the actual tower footprints so that I could plan the campground sites accordingly, since two of the towers fall within the Twin Creek State Campground.

The other two towers are 1) on the near rock face/hillside, and 2) in the far river bed. The locations are of course determined by the joints in the bridge girder, with the tower spans being shorter than the spans between the towers.

Sometimes, steel trestles have smaller-depth girders over the towers than between the spans. I would like to have done this for visual variety, but with the core of the bridge being the 1.5" aluminum tube requiring the full-depth girder, that couldn't be done. No big deal. It's still prototypical.

The campground "hump", forming the two rivers, is where emergency exit from the adjacent Kayford Branch aisle reside. It would have been more dramatic to have the viaduct span the distance at full depth, but realities required yet another compromise.

I had so hoped that I could get this scene done by the Open House. Sigh. I'll just have to pull a few spikes when the time comes so I can remove the bridge to paint the background. After having such fun running the trains this week, it will be worth the inconvenience.

And, it will be fun to compare this picture with a completed scene when the time comes.

David

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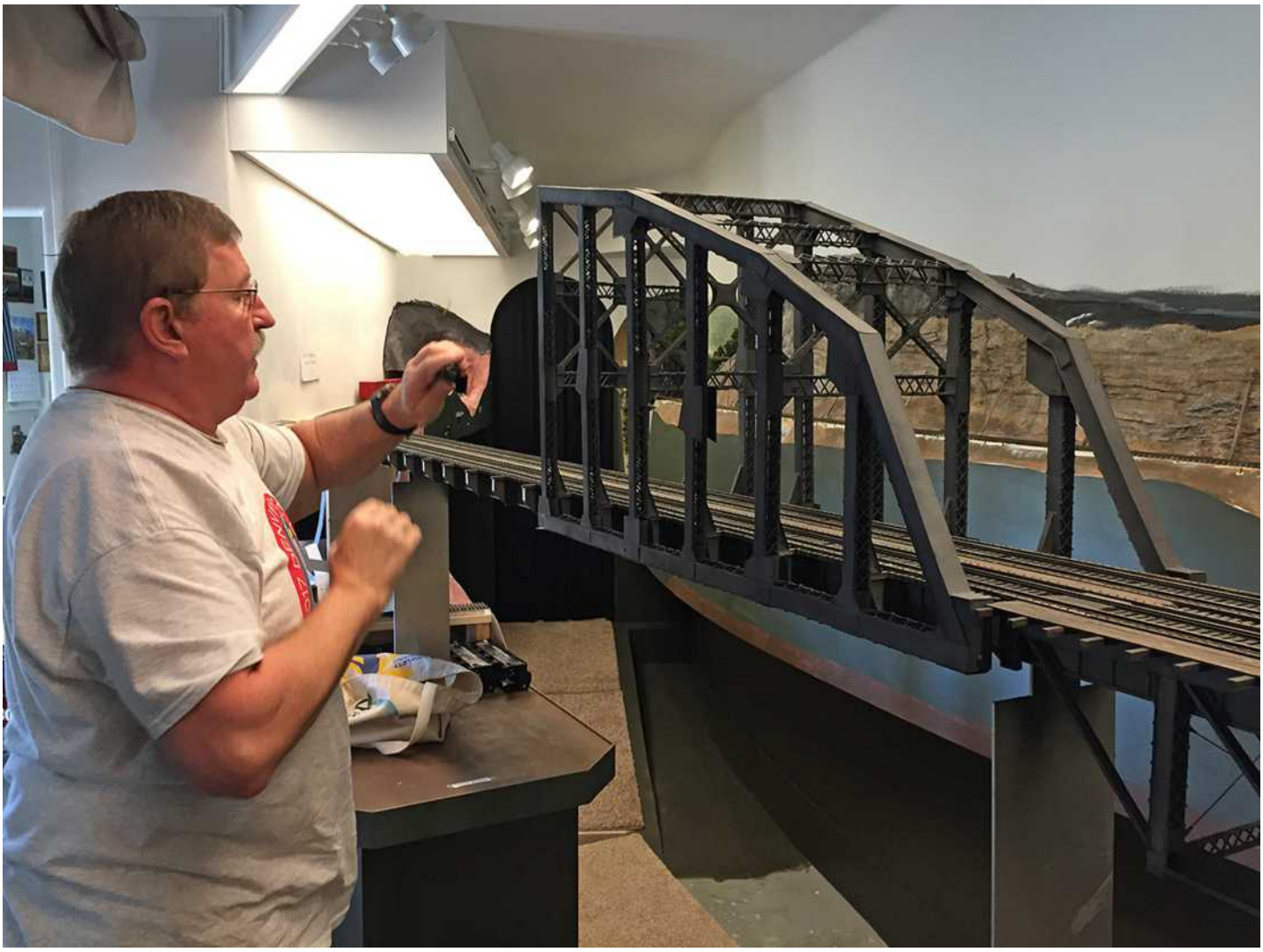
**Bob** #213 November 24, 2017, 5:50pm

We took a long break from layout work after the open house. Vince was still busy making urethane molds and casting bridge parts. Here are two views from Nov 18, 2017. I can only imagine how sweet it will look when finished.



**Mock1A** #214 November 28, 2017, 1:11am

“That’s no moon…that’s a space station!”- Seriously though, VERY impressive. I would very much like to see how you created the blanks of the laced beams and casted the forms.

**ErikLindgren** #215 February 25, 2018, 4:50am

For sure! Magnificence Vince pure awesomeness.

**Bob** #216 April 16, 2018, 5:06pm

A lot of life has gotten in the way of progress reports. David has been busy stripping and painting hundreds more cars, and I need to get to printing the decals. I sure hope I don't run out of white ribbon.

Vince is back in the saddle casting more parts for the Ohio River bridge. It has now reached the half-way point, although many new castings remain to be added to the first half. Hopefully these photos help with the relative size of the bridge to a train.


BAY STATE MILLING CO.


**Bob** #217 October 13, 2018, 7:36pm

I can't believe that the last construction post was back in April 2018, fully 6 months ago! Where has the summer gone?

Actually, a lot of hard work transpired that isn't very visible, along with vacation time for most.

First up, Vince made a lot of progress on the Ohio River bridge. Now it is so long that it requires 4 hands to test-fit into place, and it is about to become so long that it needs a custom transport sled for Vince to move it in his car.

Meanwhile, David has been busy weathering rolling stock for their “graduation photos” and making up car cards. Since the A&O has a hump yard with operating retarders, the hump operator will need to know how each car rolls. An “A” marked in grease pencil indicates that the car, if not retarded, will roll almost all the way to the end of the bowl. A “D” means that the car, despite best efforts, stops near the front of the bowl. For the most part, poor rollers are Atlas cars with rotating roller bearing journals.

Waybills are inserted into the vee-notch at the bottom of the card.


Free-spirit cars that roll *too* freely receive 0.005 or 0.008 phosphor-bronze wipers attached to the truck bolster that rub against the axles.

Yesterday as I walked around the A&O, there were cars with waybills all over the place!

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**Bob** #218 October 13, 2018, 7:45pm

Yesterday there was an evening reunion of 3 old A&O 1.0 crew members. Rick Bacon arrived first with a still-under-construction city block for Mount Union.


A few minutes later Jay Barnaby arrived, visiting from his home in Wichita where he works as a Yardmaster for the UP. Here he inspects Rick’s amazing build-out at Mount Union.

I thoroughly enjoyed the evening with David, Rick and Jay. It was like old times, starting at 7PM and working (or just talking) until nearly midnight.

Thanks, Jay, for stopping by to visit!

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**jaybarnaby** #219 October 15, 2018, 12:21pm

Hadn't noticed that you had taken a picture, but I am not at all surprised. It was good to see you all and was n enjoyable evening.

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**Bob** #220 September 2, 2019, 9:18pm

It has been quiet here, so I'll toss a photo into the mix. The Maestro of Urethane Vince works on the Ohio River bridge. Here he is actually "harvesting" a back brace so he can copy how he built it with a bunch of newly-cast parts.

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**Bob** #221 October 24, 2019, 8:01pm

Vince was at it again adding more castings to the Ohio River bridge just prior to Saturday's open house.

David has been busy with scenery along the long super elevated grade up from Union Gap to Linnwood. For most adults this track is truly “in your face” that presents the mass of O-scale modeling up-close and personal.

The ballast is limestone Vince, David and I sifted from piles at the Springfield Underground (with permission, of course.) Just a reminder that you can click on most recent photos to see an enlarged version. To enlarge older photos, right click on them and open them in a new window or browser tab.

We spent quite a bit of time running a coal train through the almost-complete scene. His work is particularly impressive with room light set for night ops and locomotive headlights that actually cast bright beams. Details of the high-intensity headlights at:

**Link to Bob's Smugmug site**

On many Overland brass engines I need to open the back of the headlight castings with a small dental burr and a "screaming banshee hand mill." Looks like I need to add the air hoses on that C425 grinding upgrade in run 8. "It's always something!"