Model Railroad Engineer Civil

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NMRA Model Railroad Engineer Civil AP
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INTRODUCTION

The Norfolk Southern Connector (NSC) is a free lanced model railroad that I have constructed. I will use the electrical components of this model railroad to satisfy the requirements of the NMRA Model Railroad Engineer- Civil AP requirements. The document I have prepared is intended to provide a summary of how the AP requirements are met on my model railroad.

Requirement #1- Prepare one original scale drawing of a model railroad track plan, identifying overall size, scale, track elevations, curve radii, and turnout sizes.

A scaled 1" = 1'- 0" track plan of my HO scaled Norfolk Southern Connector has been prepared and has been submitted with this document. The overall physical size of the NSC is approximately 15' by 20' and the track is level except for a differential in elevation that takes place at Furnace Mountain where a 2% incline was engineered to allow sufficient clearance of an obstruction west of that location at Hot Springs. Figure 1 shows this incline which changes the distance from the floor to top of track elevation from 40 inches on the east side of Furnace Mountain to 42 inches on the west side of Furnace Mountain.

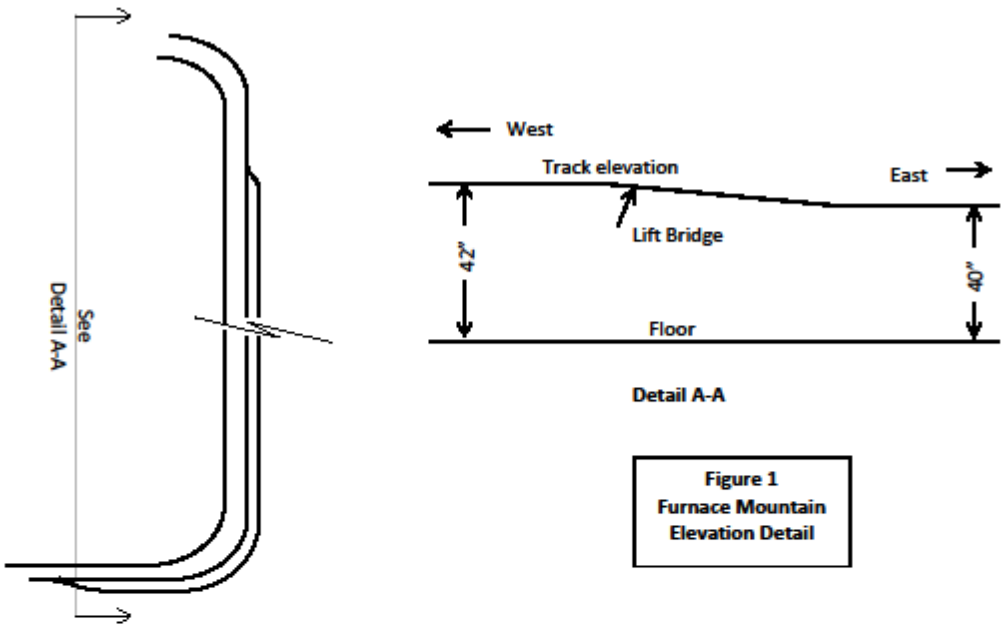


Figure 1
Furnace Mountain
Elevation Detail

Curve radii on the layout are 18", 22", 24", 28", and 30" dependent upon location and are shown on the scaled drawing. The track turnouts are Atlas #4 with the following exceptions; one Atlas #6, one Shinohara 36/38 curved turnout, two Atlas wye turnouts, and one Peco three way turnout.

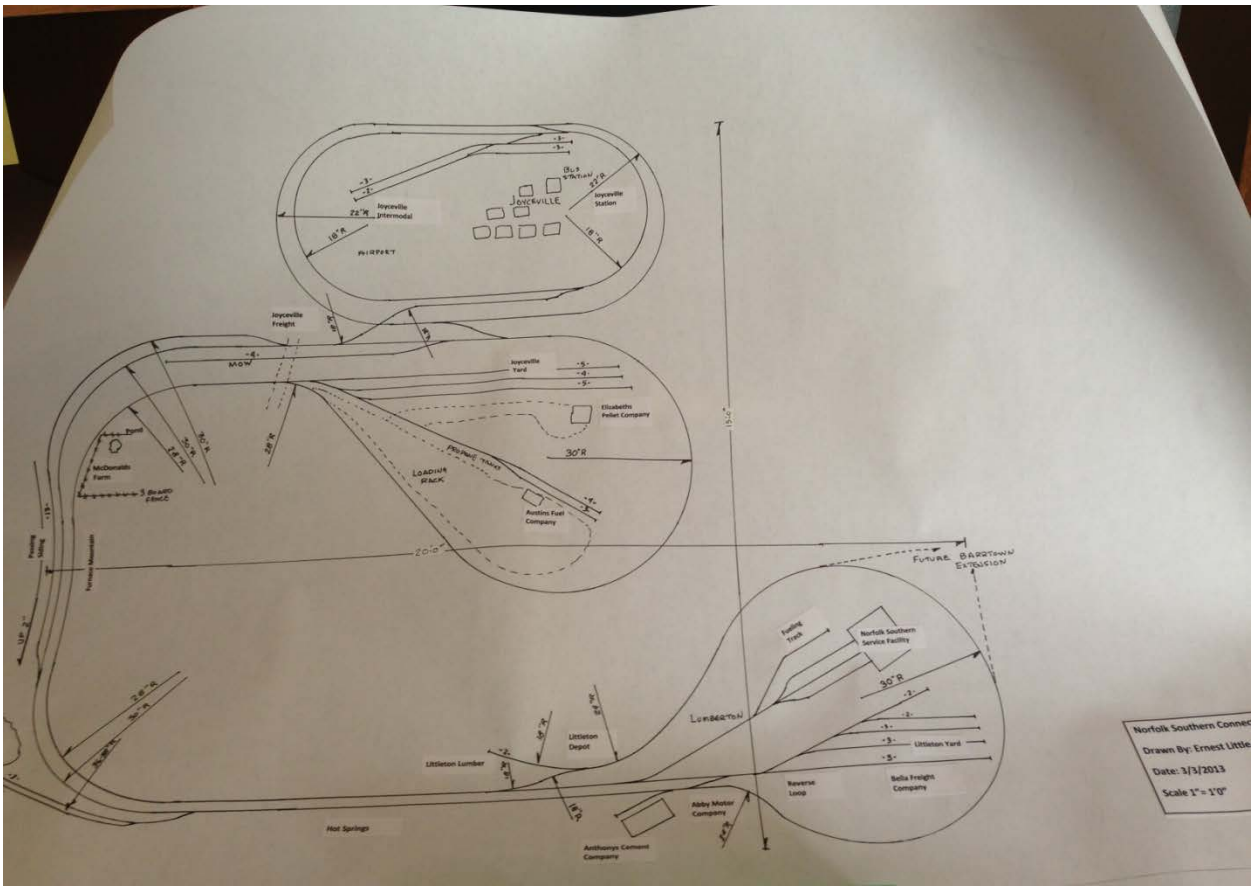


Figure 2- Scale drawing of Norfolk Southern Connector

Tables 1 and 2 provide information regarding the facilities on the NSC for handling of freight and passengers as well as locomotives and railroad cars. Table 3 provides the car storage capacity for the spurs and yards on the NSC. As the NSC is a connector type railroad and not a large railroad it has a combined locomotive/rail car service/maintenance facility in Littleton.

Table 1
Freight and passenger terminal facilities

Facility	Goods received	Goods provided
Joyceville Station	Passengers	Passengers
Littleton Depot	Passengers	Passengers
Joyceville	Intermodal	Intermodal
Elizabeth Pellet Company	Raw Plastic and wood	Plastic and wood pellets, finished plastic goods
Austin Fuel Company	Propane, gasoline, and diesel fuels, motor oils	Empty rail cars, fuels to local consumers
Littleton Lumber	Lumber and building materials	Empty rail cars, lumber and building materials to local consumers
Alexandra Power and Light	Coal	Empty rail cars and electricity to local community
Fubar Quarry	Empty rail cars	Rock, gravel, and similar building materials
Abby Motor Company	Electrical parts	Electrical Motors, generators, etc.
Anthony's Cement Company	Cement, gravel, sand	Concrete and similar goods
Bellas Freight Company	Freight goods	Empty cars and transferred freight goods
Joyceville Freight	Freight goods	Empty cars and transferred freight goods

Table 2
Motive Power and rail car repair and service facilities

NSC Engine/Car Service Facility	Locomotives and rail cars in need of repairs or service	Repaired locomotives and rail cars
	Storage of locomotive power	

Table 3
Storage Capacity of Yards and Spurs

Spur or Yard	Storage Capacity (40' cars)
Litttleton Yard	
Track 1	5
Track 2	3
Track 3	3
Track 4	3
Track 5	2
Anthony's Cement Company Spur	3
Littleton Lumber Spur	2
Alexandra Power and Light Spur	3
Fubar Quarry Spur	3

Table 3 (Continued) Storage Capacity of Yards and Spurs	
Spur or Yard	**Storage Capacity (40' cars)**
Passing Siding	13
MOW siding	4
Joyceville Yard	
Track 1	5
Track 2	4
Elizabeth Pellet Company Spur	5
Austin Fuel Company Spur	
Track 1	4
Track 2	3
Joyceville Intermodal Yard	
Track 1	3
Track 2	2
Track 3	3
Track 4	3

A mainline passing siding is located at Furnace Mountain which is located between Littleton and Joyceville. This passing siding allows for trains of lengths up to the equivalent of 13 cars going either direction to pass one another by one taking the siding.

The NSC railroad has more than four switching locations besides the two large yards designated as Littleton Yard and Joyceville Yard which are provided on each end of the layout. These facilities provide for storage and switching of in excess of 9 railroad cars at each yard. Additional switching can be performed at the Alexandra Power and Light, Littleton MOW siding, Littleton Lumber, Joyceville Intermodal, and the spur that serves the Austin Fuel Company and Elizabeth's Pellet Companies.

The NSC railroad has a reversing loop located at the Littleton Yard consisting of an isolated track area that has the ability to have the DCC polarity reversed manually by use of a DPDT switch. This loop was reviewed and approved as part of the successful NMRA electrical AP done more than a year ago. Actions are currently underway to make this an automatic reversing loop in the near future.

The layout was wired with two power districts powered by a Digitrax DCS100 Command Station which permits the operation of two or more trains on the main line. Electrical operation of the railroad and Dispatcher operations were described and evaluated during prior AP's resulting in the award of AP-Electrical and Dispatch certificates. The design of the railroad allows for multiple through train operations on a schedule and local train operations between the various switching locations.

Figure 2 illustrates typical construction of railbed as described in the Norfolk Southern Railroad Construction Standards manual. Typical ballast and drainage ditch depth are reflected in the figure. HO equivalent dimensions were used in the construction of the layout. This was used in the area of the mainline near McDonald's farm. The water drained from the right-of-way has been diverted to the pond on the farm. A similar feature has been constructed on the Civil AP demonstration board which also includes drainage basins to drain the area between the two parallel sections of track that connect underground to the discharge leading to a pond.

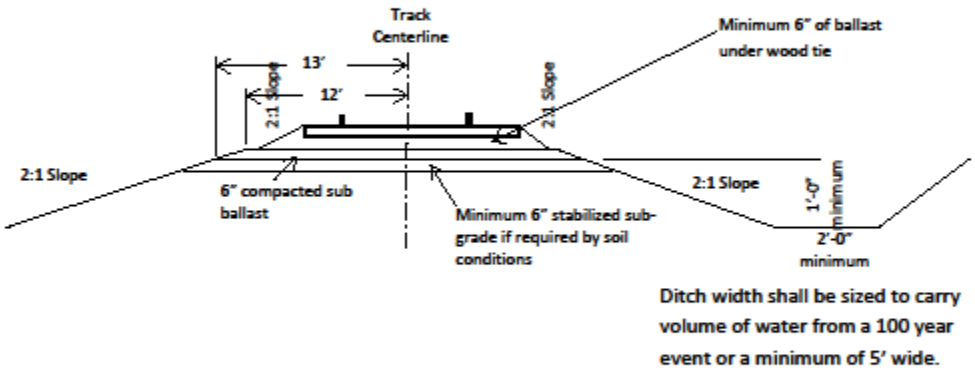


Figure 3
Rail bed cross section

A tour of the Norfolk Southern Connector Railroad

Our tour of the NSC starts at the Littleton yard on the west end of the layout. To leave the Littleton yard we take the north Littleton yard entrance crossover to enter the mainline. We are heading eastbound and immediately pass the Anthony Cement Company on the left side of the mainline. This facility produces bulk cement for use in the building industry and ships product in covered hopper cars. Just past the Anthony cement company is the Littleton interlock building on the right that controls the access to the Littleton Lumber spur and the south entrance to the Littleton yard. Passing the Littleton crossover are now crossing over a lift out bridge at Hot Springs. This bridge is only open when the facility needs to take a shipment of wood pellets to keep the fire that keeps Hot Springs (a pellet stove) going. After Hot Springs we pass the spur to the Alexandra Power and Light and Fubar Quarry facilities. Alexandra Power and light takes deliveries of coal to produce electric power to the region. The Fubar Quarry provides stone, sand, and gravel products to facilities along the mainline and also in other regions of the United States through an agreement with other railroads. The quarry is new to the area and is still in the process of establishing its infrastructure which will include several conveyors and loading facilities in the future. We begin a down grade movement that starts at the spur and ends on the east side of Furnace Mountain. This grade change was needed to allow the railroad bed to have a safe clearance from the heat at Hot Springs. Furnace Mountain features a lift out bridge to allow pedestrian traffic to get past the layout, and a passing siding, where trains up to thirteen cars in length can pass each other. At the east end of the bridge is McDonald's farm on the right. This farm has existed for a long time and produces farm goods that are taken to Joyceville by truck and then placed on the railroad at Joyceville Station. The farm has a small pond on it that serves as a watering hole for the livestock and also as a receiving facility for water runoff from the NSC drainage ditch on the mainline adjacent to the farm. The NSC takes pride in its commitment to the Green movement and has taken appropriate actions to protect the sensitive environment. Now entering the Barrtown/Joyceville area we encounter two communities that have grown in size to the point that it is difficult to distinguish one from the other. Joyceville has a downtown area that is undergoing redevelopment and significant investment was made into having the NSC serve the downtown area. The crossover that we are passing leads to downtown Joyceville which has a major intermodal facility on its south side. Joyceville is a transportation hub possessing a bus station and airport offering alternative transportation means to the residents of the city. Regular shuttles run between Joyceville Station and the bus station to provide commuters a link to rail service. Arriving in Barrtown we pass a siding on mainline which is used for MOW equipment storage and to deliver and receive goods from the mercantile area located in Barrtown at Joyceville Station. Joyceville Station is proposed to be part of a commuter rail system that will serve Littleton, Joyceville, and Barrtown in the future. The crossover we now see allows rail traffic to return to the mainline from downtown Joyceville. Just past the crossover we see the entrance to the Joyceville Yard and the Austin Fuel and Elizabeth Pellet Company spur. The Joyceville Yard provides room for storage and classification of railroad traffic on its three tracks. Austin Fuel Company is a major distributer of petroleum and propane related products to the area and takes bulk shipments of petroleum and propane related products. The Elizabeth Pellet Company is a

manufacturer of plastic materials and a user of the raw products needed to make plastic. Leaving Barrtown we are traveling westbound toward Furnace Mountain and beyond. As we do so we encounter the sights we have previously seen until, including the Furnace Mountain grade, crossing the Furnace Mountain bridge and past Hot Springs. Just past Hot Springs we take the crossing at the Littleton crossover and see the Littleton Lumber spur on our left. Littleton Lumber is a supplier of building products for the community and sends and receives bulk shipment of lumber and similar products. Passing Littleton Lumber westbound we next see the entry to the Littleton Yard and NSC Service and Maintenance spur track. The Littleton yard is provides access to the Bellas Freight and Storage, and the storage and classification of railroad traffic at the utilizing the yard's five tracks. The NSC service and maintenance spur allows access a three track yard that can be used for storage of motive power and or cars needing service or repair. The engine facility located here is full service for locomotives. Continuing westward on the mainline from the entrance to the Littleton yard/NSC service and maintenance spur we proceed to pass the rear of the NSC maintenance facility and pass Abby's Motor Company. Abby's Motor Company is a manufacturer of internal combustion engines and electric motors. It is a user of parts associated with engine manufacturing. We are now back to where we started our tour. It should be noted that by using the north and south entrances to the Littleton yard there is an ability to turn motive power around on the mainline using a short run on the main between the two entrances.

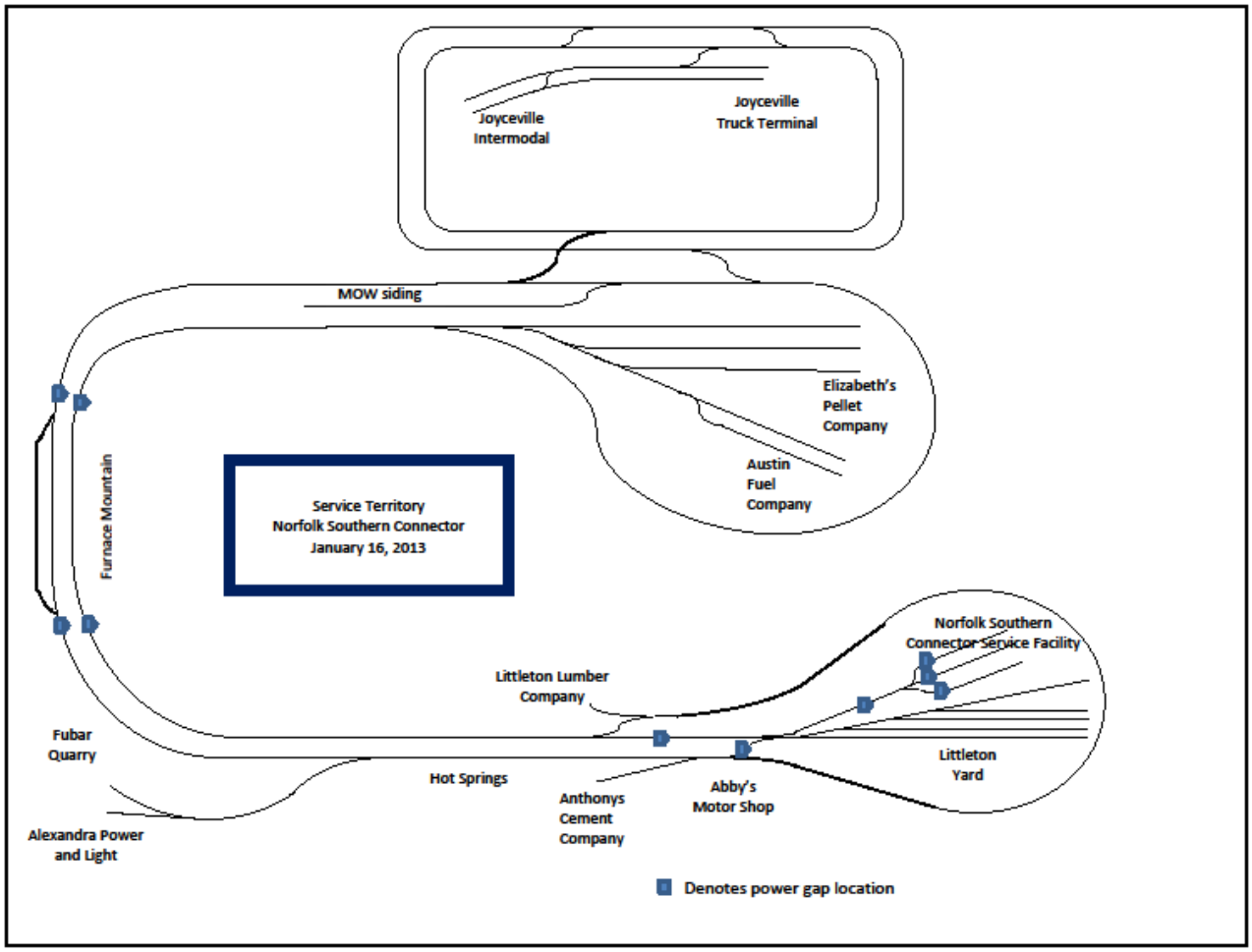


Figure 3
Norfolk Southern Connector Service Territory

Requirement #2- Construct and demonstrate the satisfactory operation of a completed section of the model railroad and track work described in requirement 1. Containing at least 50 linear feet in HO scale with appropriate ballast, drainage facilities, and roadbed profile, which may contain spurs, yards, etc.

The six features I am providing to meet the AP requirements are as follows:

1. **Passing Siding**

A passing siding has been constructed at Furnace Mountain and is of sufficient size that trains up to a length of 13 rail cars can enter the siding from either end and be clear of the mainline.

2. **Spurs**

There are several spurs on the NSC mainline. One provides to Austin Fuel and Elizabeth's Pellet Company and runs off of the number 1 track off of the track ladder in the Joyceville yard. Another provides service to the Alexandra Power and Light and Fubar quarry facilities. A third spur provides service to the Littleton Lumber facility. A fourth spur provides access to the NSC locomotive and car service facility in Littleton.

3. **Crossover**

There are four crossover locations on the NSC involving the mainline. The first is the north entrance to the Littleton yard. A second is on the main line going west from Hot Springs and can serve as a reversing loop which was described elsewhere in this document. There are two crossovers in downtown Joyceville near the Joyceville intermodal yard. The remaining crossovers are located on the mainline near Barrtown which allow access and return from downtown Joyceville. These crossovers were constructed using two #4 Atlas turnouts. The turnouts are left or right handed depending upon the location of the turnout on the layout.

4. **Reversing Loop**

There is a reversing loop at the NSC service facility which permits locomotive power to be turned when needed.

5. **Simple ladders**

Simple ladders were used in the construction of the Littleton and Joyceville Yards using Atlas #4 left hand in the Joyceville yard or right hand switches in the Littleton yard.

6. **Grade level differential**

The topography of the NSC is flat except a *grade elevation* differential, as described in item 1, which was constructed at Furnace Mountain.

Requirement #3- Construct for merit judging, scratch build scale models of three items and demonstrate their satisfactory operation.

The three items selected to meet this requirement are construction of a turnout, crossover, and 90° crossing. These items were demonstrated on a 16 inch by 6 foot layout board separate from the NSC layout for demonstration and judging purposes.

The crossover, consisting of two number 10 right hand turnouts, the number 10 right hand turnout and the 90° crossing were scratch built constructed using Micro Engineering Code 83 non-weathered rail, pc board, wooden railroad ties, #10 turnout assembly fixture (part AF-HO-T-10-ME83) and 90° crossing assembly fixture (part AF-HO-X-90-ME83), and stock aid and point form tools from Fast Tracks. Long

wooden railroad ties were scratch built from basswood, and add on detail parts secured from Proto: 87 stores. All of the scratch built items were built after a review of videos of each step provided by Fast Tracks in DVD format. The following is the sequence of steps taken to construct one of the turnouts:

Construction process for the turnouts and 90° crossing

I placed the #10 turnout assembly fixture on my work desk under good lighting to allow me to have a good work space to build the turnout. I then cleaned the fixture to assure that all of the slots where I needed to insert pc ties and rail were clean and free from debris to assure that the components would be in the correct location when I inserted them.

I then cut two lengths of rail for guard rails and bent them as specified in the Fast Track instructions. I then set them into the appropriate slots in the assembly fixture to assure they were properly shaped and then set them to the side and proceeded to cut two lengths of rail to make the frog. Each of the rails for the frog needed to be filed on one end to permit them, when placed up against each other, to come to a point. The filing was completed using the Fast Track point form tool which the rail was inserted into to secure and a sharp file used to file the rail to the correct shape. When filing it was important to stay level to the tool and file along to tool to shape the rail into the correct configuration.

I then took the two lengths of rail and placed them in the appropriate rail slots on the fixture. I had to adjust the position of the two lengths to assure that they were coming together in the correct fashion. After getting the lengths into the correct position I applied a small amount of non-corrosive flux to the inner surface of points on what was going to be the frog. Heat was applied using a variable temperature soldering pencil to the inner sides of the lengths and solder was introduced to the area and allowed to flow and fill the area between the two lengths. With the heat source removed the two lengths were kept in position until the solder had hardened sufficiently to allow the frog to be removed from the assembly fixture. I cleaned the top side of the frog of flux and used a file to remove any solder that may have gotten on the top surface of the rail. The frog was then set to the side and preparation for the insertion of the pc ties into the assembly fixture took place.

I then turned to positioning the pc ties into their slots on the assembly fixture. The ties I used had been stamped to be made and I chose to use the better side as the track side of the tie and placed it on the top when the tie was inserted into the slot on the assembly fixture. Some of the ties needed to be cut to length which I did with my rail cutters and also an isolation cut, where I cut through the conductive surface only with a small triangular file, to isolate to provide the necessary electrical isolation of the tie when after it was soldered to the rail. The length of the pc ties and location of the isolation cuts were shown on the Fast Track template that I had downloaded and printed from the Fast Track DVD. At this point I tested for necessary isolation by using a test light and lightly filed the end that I had cut to remove any burrs that may have existed. I then inserted the pc ties into the appropriate slots on the fixture assuring they fit snug and all the way into the fixture so that the tie was below the level where the bottom of the rail would be. It was important for me to pay close attention to positioning of one of the ties as I was going to construct a solid rather that a hinged switch point turnout.

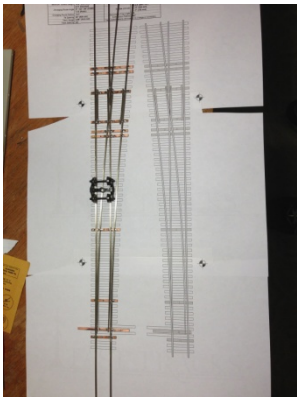
The next step was to create the straight stock rail where I took a length of rail and cut it to a length about five ties past the throw bar along the straight rail on the turnout. I inserted the rail into the appropriate slot and marked two points on the stock rail. The first was where the end of the switch point met the straight stock rail and the second was where the switch point diverted away from the straight stock rail. To clarify I used a marker to mark where I would need to remove material from the stock rail to allow the switch point to engage the stock rail for a smooth transition when set to divert from the main. I then took the straight stock rail and inserted it into the Fast Track stock aid tool and after assuring the rail was properly placed secured the rail into the tool and proceeded to remove the needed material from the straight stock rail with a file. It was important for me to file up the stock aid tool and not the opposite direction to prevent file chatter and distortion of the stock rail. After filing the material away the straight stock rail was removed from the stock aid tool and laid into the appropriate slot on the assembly fixture in the proper position. I placed flux on the straight stock rail where it touched the pc tie (the tie designated as the s tie) and soldered the two parts together using a small amount of solder and soldering pencil. After it cooled and I

assured it was in proper position I proceeded to flux and solder the straight stock rail to the remaining pc ties where soldering would not interfere with the installation of other track later in the assembly.

I then took another piece of rail of a length approximately the same as the straight stock rail to create the curved stock rail. I needed to remove the base of the curved stock rail so it would properly engage the straight stock rail. I did so in the same manner as before using the stock aid tool and file. When completed I filed the inside of the curved stock rail at the filed end in a fashion to create a curved top of rail where the curved and straight stock rails intersected. I then created a slight bend in the rail section and placed the curved stock rail into the assembly fixture, positioned it in the proper location, and proceeded to flux and solder the rail onto the s pc tie. After this cooled I proceeded to flux and solder the curved stock rail to the other pc ties where soldering would not interfere with the installation of other track later in the assembly.

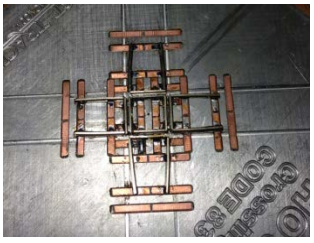
The next step was to prepare and install the solid switch points. Taking a section of rail approximately 1 inch longer than necessary to go between the throw bar and the end of the wing rail I filed one end using the point form tool to create the point. I then took the section and placed it in the appropriate slot on the assembly fixture and determined where it would have to be bent and marked the location. Taking the rail section out of the assembly fixture I then took a pair of track cutters and made a small incision into the outside of the rail base. This was done to allow a small kink to be formed in the rail which I made. The section was then placed back in the assembly fixture to assure the bend as of proper angle and the section was cut to length using rail cutters. The rail section was then fluxed and soldered as with the other track sections.

The curved or diverging switch points were next and were constructed of a section of rail with points created with the Fast Track point tool. It needed to have a curve matching the curve needed to fit into the assembly fixture placed into it. The rail section was then fluxed and soldered as with the other track sections. It was also fluxed and soldered to the throw bar paying attention to not soldering it to the straight stock rail by the insertion of a piece of paper between the switch point and the stock rail.



Turnout Test Run with truck

At this point I installed the guard rails by placing them into the appropriate slots in the assembly fixture and fluxing and soldering them. After this the frog points were installed by placing them in the assembly fixture and moving them forward, toward the throw bar until they were in compliance with NMRA clearance requirements. A NMRA clearance gauge was used to check the clearance and I found that the frog points were almost all the way forward they could go when in proper position. I also took a set of wheels on a truck and ran them through the area to confirm sufficient clearance was present. After making sure the clearance was proper and the wheel set ran through without difficulty the frog points were fluxed and soldered in place. The next step was to use a track saw to create isolation gaps on both sides of the frog to make it electrically isolated to prevent a short in the electrical system. This completed the construction of the turnout and I then removed the turnout from the assembly fixture and inspected it for poor solder connections, dirt, or other debris. I cleaned the assembly with a brass wire brush and wiped it down with alcohol to clean it and set it aside. This process was followed three times to allow me to have a cross over and a turnout for judging.



90° crossing during construction

A similar process took place for the 90° crossing. To demonstrate the operation of these items I decided to make a demonstration board separate from my layout. The following is how the demonstration board was constructed and how the four items were incorporated into it.

Construction of the Civil AP demonstration board

The first step in creating the demonstration board was to locate the centerlines of the two parallel tracks and the locations of the crossover, turnout, and crossing. After conducting some research it was determined that the parallel tracks would be established with 2 ½" separating the adjacent rails. The locations of these items were drawn on the mounting board surface to permit carpenters wood glue to be applied to the board over the track centerline.

Centerlines drawn on board

Sections of Midwest N scale cork were separated along the cork's beveled edge and one width was affixed to the board, mounted with the wide portion of the cork up with on the opposite cork pressed into the distributed glue. The center line of the width cork was over the center line of the track and the cork was aligned to the drawn centerline with a metal yardstick to assure the rail bed would be true and straight. After the first with of cork was mounted an additional width of cork was glued to the board, in the same fashion, on each side of the first section except these cork widths were mounted with the wide side down. After all three widths of cork were in place a wall paper roller was used to press the cork sections into the glue and assure a good adhesion of the glue to the cork and wooden board. The glue was allowed to cure overnight before any additional work was done. N scale roadbed was chosen to be used for the demonstration board because it was felt it was more to prototypical profile than HO scale cork. Thus it took three widths of the cork to provide the approximate same with as two widths of HO scale cork.

The next day the cork that had been applied to the demonstration board was sanded with 200 grit sandpaper. The purpose of this step was to assure that the track bed was smooth and level. Any depressed areas were filled with drywall compound which after it had cured was again sanded with 300 grit sandpaper. The sloped areas of the cork to either side of the track line were also sanded to make a rounded profile in appearance. The entire demonstration board and all of the cork was then spray painted a primer grey to provide a base color for future application of scenic materials and not have a cork or wood texture to have to be seen. The paint was permitted to cure overnight prior to work being done to lay ties.

Next, the track centerlines were re-established on the painted surface of the cork and preparation to place the wooden railroad ties took place. The wooden railroad ties used were of two types, one type was secured from Fast Tracks. The second type was made from ⅛" x ¼" x 36" basswood secured from a local craft store. These ties were needed to provide a longer wooden tie to go under more than one width of train track in the cross over and turnout areas. To create the longer tie a construction process was developed that would create ties of proper width, height, and length. To determine the length of the ties needed measurements were taken for each tie from the appropriate location on the paper template for the turnout that had been downloaded and printed from a Fast Tracks® DVD. Using a HO scaled ruler a length of 27 HO scaled feet was established for many of these ties. The basswood material was cut to the appropriate length using a Northwest chopper tool.

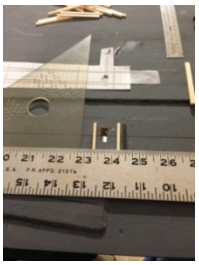
Cutting to length

The jig

Cutting to width

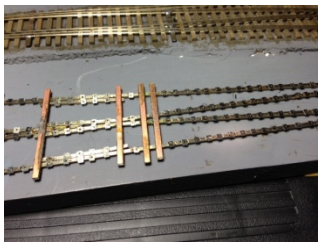
Next the cut material was cut to width by pushing the tie material through a jig made by using a ½" piece of 3/8" square Evergreen plastic material that had a small Exacto® knife blade inserted through it at the appropriate dimension for the width of the tie.

The next step was to cut the tie to depth by positioning the tie against the top guide of the Northwest Chopper and positioning it between two of the ties from Fast Tracks®. The Fast Track® ties were being used to establish the proper depth of the tie under construction. Using a flat Exacto® knife blade material was removed from the basswood tie until it was the same depth as the Fast Track® ties to either side of it. This completed the process and after a light sanding with 300 grit sandpaper the tie was ready for use.



Now that both regular and lone rail road ties were available the task to putting the ties on the rail road bed was started. The process was started on the ties on the mainline track that would result in connection of the crossover with the 90° crossing. Utilizing the Fast Track® paper template the two turnouts were located on the roadbed to create the crossover. The lone turnout was also located on the roadbed on the parallel track. This process was needed to determine where the holes for the Tortise® motor connector wires would need to be drilled through the demonstration board to permit the Tortise® motors to operate the throw bars. A metal yardstick was laid parallel to the rail bed with one edge of it in line where the end of the ties would be and attached to the demonstration board using two large wood clamps. This assured that the ties were in alignment along the track line. Next, one of the printed turnout templates, with the railroad tie positions on it, was aligned with the pc ties on the turnouts. This established the position of the railroad ties to be installed and kept the proper tie spacing relative to the pc ties on the constructed turnouts. The process of laying the ties on the rail bed was started and consisted of positioning a 45-45-90 square against the metal yardstick and putting one edge of in line with a tie position on the printed template. A small amount of Plibond® adhesive was applied to the bottom of a tie and using needle nose pliers the tie was placed on the cork pressing it in place. This process was repeated for the remainder of the ties. After completing a number of ties a check was made to assure that the placement of the ties was correct and that they were in good contact with the cork. After all of the ties were in place the adhesive was allowed to cure overnight and then a check was made of the ties for any imperfections in height by taking a metal ruler and spanning it across the ties. Any high points were identified and sanded with 300 grit sandpaper to bring them to proper height. A dry fit of the turnouts on the ties that had been placed was performed verification that everything was in alignment a small paint brush was used to paint the railroad ties with Floqil® railroad tie brown. This completed installation of the rail road ties and now the process moved on to getting the rail prepared to be mounted onto the installed rail road ties.

The necessary detail parts for the track and turnouts were secured from the Proto:87 store and each part was identified and the location where it would need to be applied to provide an accurate look of the crossover, turnout, 90° crossing, and hand laid track. The first step was to take Isopropyl Alcohol applied to a small applicator and clean the rail to remove any oils or other debris that would interfere with the adhesion of the detail parts to the rail. The turnouts were positioned on the appropriate ties where it was designed to go to permit accurate determination where the tie plates needed to be applied to establish proper spacing along the line of the track.



The appropriate locations for the tie plates were marked on the underside of the turnouts and rail then using a paper template secured from the Proto:87 website I took the necessary detail parts and using a small amount of Pliobond® was placed on a toothpick and application of the adhesive to the rail took place. The detail part was mounted using a small pair of tweezers. It was necessary to hold the part in place for a few seconds while the adhesive set up to allow the process move on to the next part. Every five to ten tie plates the turnout or rail was placed on the mounted rail road ties to assure the tie plates were mounted in the proper location. This process was done until the all of the tie plates were in place. Electrical feed wires were attached to the turnouts, 90 degree crossing, and track where necessary to solding #22 feeder wires to the underside of the track and drilling a hole for each feed wire in the demonstration board to allow the feeder wire to go through the demonstration board. The completed turnouts and track pieces

were then glued to the railroad ties using Plibond® adhesive. All of the rail and detail parts, were necessary, were then painted with a mixture of Floquil® rust and railroad tie brown paints and water using a small brush.

The track was cleaned using Isopropyl Alcohol and a bright boy then a check for properly electric isolation using a test light was performed. After assuring that proper electric isolation was in place power was applied to the track using a Digitrax® DB150 Command Station and a PS515 Power Supply to apply power to the track. A DCC locomotive was placed on the track and using a Digitrax® 400R throttle the locomotive across all of the turnouts, crossover, and 90° crossing from every possible approach direction. A short was found in one of the turnouts that was determined to be caused by lack of isolation on a PC tie, inside the isolated area of track, between the two rails that was found and corrected. After which the locomotive was able to run through the demonstration board track without incident.

Detail Parts-


Additional detail parts secured from a local supplier consisting of Details West® switch motor and tie mount (SM-903), switch heater with blower, propane tank and air duct (SH924),hot box detector (HD-900), one and four door electric relay cabinets (EC-901 and EC-904) were constructed and mounted in the appropriate locations on the demonstration board.

A two light rail road lighting tower was constructed from various plastic parts. The lighting tower utilizes two 5 mm Minatronics yeloglo white (475-1251010)LEDs as lamps in the lights and girder parts from Central Valley Model Works (1902-5) to construct the tower. The tower was mounted to the demonstration board in the vicinity of the crossover.



A Tichy Train Group milepost marker (#8184) was mounted along the mainline near the 90 degree crossing intersection. A wood bridge ditch crossing scratch built from basswood was mounted over the ditch near the pond. Impact protection was placed around the three propane tanks and wood bridge entrances using Evergreen 1/16th inch rod (#217).

Requirement #4- Achieve a Merit Award by accumulating at least 87.5 points in requirement 3 above.

See AP Civil scoring sheet provided in Appendix A.

Requirement #5- Submit a Statement of Qualification which includes the following:

Track Plan from requirement 1

A scaled track plan has been prepared and is being submitted. The scale of the track plan is 1” = 1’. The plan contains the required information to meet this requirement.

Description of track work features, methods of construction, and identification of commercial components used in requirement 3.

The NSC is currently a one tier train layout that is contained in one room. Plans are being developed to make it a two tier layout by creation of a second deck and utilization of a Digitrax® DB150 command station. For the requirements of section 4, the track work features, methods of their construction, and a summary list of the commercial components are provided as follows:

Track work features-

- All turnouts, crossings, crossovers, and the three-way turnout were commercial components. There are not any hand-laid tracks used on the NSC layout.
- LH and RH #4 turnouts were installed throughout the layout. There is also a LH #6 turnout.
- A curved switch made by Shinohara was used on the spur to the power plant to accommodate the switch in the space available.
- A three-way turnout was used on the spur to the Engine Servicing facility to allow the use of all three bays of the facility from one track.
- Rerailers were used in several locations in the layout to minimize the number of locomotives derailing when negotiating the layout.
- Wiring and installation instructions provided by manufacturers of the commercial components used on the layout were followed to make them ready for operation.
- Bumping posts were installed at the end of all sidings and staging tracks.
- Commercial turnout motors were installed on many of the turnouts located on the layout and are controlled through the use of hand built switch panels that are equipped with visual indicators to provide the status of the switch at a glance. DPDT switches were utilized as the control for the turnout motor. The commercial turnout motors were installed underneath of the switches except in one instance where it was installed on the top of the layout and contained within a building.
- There are ground turnout throws located on a few of the switches.
- Programming of DCC locomotives is done with a programming track connected to a Digitrax DCS100 Command Station.
- Schematic diagrams have been provided for the items I chose to demonstrate for requirements 2 and 3.
- The entire layout is controlled by use of a Digitrax DCS 100 Command station, a loconet system, and Digitrax Cab throttles all of which are capable of tethered operation and some of which are capable of radio and Infra-red control.
- No decoders are in use on turnout motors on the NSC layout.

Methods of Construction-

- Several methods were used for the construction of the track which involved many techniques which are summarized below:
- Normal track construction practices were followed for laying track on the NSC including the installation of commercial turnouts, crossings, crossovers, and a three way turnout.
- The layout support consists of L girder design topped with 5/8” plywood and ½” homosote on much of the layout.
- Cork roadbed was installed on top of the homosote or plywood to provide support for the track.
- Track nails were used to secure the track to the roadbed.
- Flex track was used on much of the layout and where flex track was not used single sections of curved and straight track were utilized. All connections between track sections were made with appropriate rail joiners. After using the rail joiners the track was soldered together to provide a

strong method of continuity for electrical current. The only exception to using conductive rail joiners and soldering was where a section of track required isolation when a non-conductive rail joiner was used and feeders were wired to the affected track section.

- None of the switches installed had feeders connected to them.
- Track power from the RRamp meter to the main line track is provided by using #12 conductor wires. The power supply providing the track power has constructed from parts secured from a train dealership following the instructions provided with the kit. The kit provided the enclosure, SPST switch, step down transformer, 8 amp circuit breaker, and power cord.
- The DC power buss providing power to the Tortoise motors consists of a two conductor #16 wires. A commercial power supply made by Radio Shack was used to provide the 12v DC power.
- Red/green bipolar LED were installed to provide a visual indication of the alignment of the switches having Tortoise motors attached to them. As the motors have sufficient resistance the need for 470 ohm resisters was resolved and the LEDs will not burn out due to exposure to higher voltages.
- All wiring associated with the Tortoise motors was soldered and connectors were used to provide connection between the wiring and the motors themselves.
- Switch panels were constructed of 1/8" plexiglass with the appropriate holes drilled into them to accommodate the installation of DPDT or SPST switches and LEDs.
- A strip electrical multi-plug was utilized to control power to the layout electrical components.
- A programming track was installed using the appropriate power connections to the Digitrax DCS100.
- A Digitrax UR-91 was installed at a midpoint to the layout to permit the use of radio Cab controls.

Commercial Components used on the layout-

The following list of commercial components was used for the construction of the layout:

Structures-

Walthers Cornerstone buildings-
- Diesel fueling facility
- Railroad shop
- Medusa Cement Company
- Northern Power and Light
- Merchants Row II
- Western Avenue Fire Station
- Merchants Row III
- Plastic Pellet transfer tanks
- Propane tanks
- Yard Office
- Transfer Company
- Bus station
- Fuel tanks

Model Power-
- Old storage shed
- Building under demolition
- Built up structure- lumber yard
- Horse stable

Bachman-
- Savings and Loan
- Office Building

Pikestuff-
- Truck terminal
- V&K Plastics

Other Pikestuff building kits which were of used for components of scratch built structures.

Lifelike-

Woodlawn Police Station
Fire Station #46
Kentucky Fried Chicken
Seven Eleven
Union 76

Turnouts-

Atlas LH and RH #6
Peco triple turnout
Shihahara curved #6
Circuitron Tortoise motors
Atlas Snap Switch controllers
Caboose Industries manual ground throws
Atlas Code 100 Nickel silver flex track
Atlas Code 100 Nickel silver straight and 15" and 18" radius curves
Radio Shack multi-voltage power supply
Minatronics DPDT and SPST switches
Minatronics 3mm bi-polar LEDs
#12 stranded copper wire
#16 stranded copper wire
Multiwire #22 loconet cable with connectors. The Loconet cables were home made and installed on the layout.

Controls-

Digitrax DCS100 Command Station
Digitrax DB150 Command Station
Digitrax UP-5, UR-91, and UP-5 Loconet interface panels
Digitrax DT400R, DR300R, and UT4 cab throttles
Springhaven Shops layout power transformer kit.
Digitrax PS515 Power Supply

Civil AP demonstration board materials

Details West

SM903 Switch Motor and tie mount
HD900 Hot Box detector
SH-924 Switch heater with blower, propane tank and air duct
EC-901 Electric relay cabinet 1 door type
EC-904 Electric relay cabinet 4 door type

Tichy Train Group

#8184 Milepost markers

FastTracks

AF-HO-T-10-ME83- HO Scale, #10 Turnout Assembly Fixture for Micro Engineering 83 Rail
AF-HO-X-90-ME83 HO scale 90 degree Crossing Assembly Fixture for Micro Engineering 83 Rail
PF-10-M #10 Point Form filing jig for frog and switch points
SA-M StockAid Stock Rail filing tool for Micro Engineering 83 Rail
CopperHead HO Scale PC Board Turnout Ties - 1/32
17-083 Micro Engineering 36" Micro Engineering Code 83 non-weathered rail

CircuitTron

800-6000 Tortoise Slow Motion Switch Machine

Micratronics

475-1251010 Minatronics yeloglo white LEDS- 5mm

Central Valley Model Works

1902-5 Bridge Girder Assortment

Evergreen

#217 plastic rod assortment

Verification of Merit Award

Witness certification showing each of the above models meets all applicable NMRA standards