

Layout Design for Operations – Is it BS or Not?

By John Stewart, NMRA, Supt. Steel City Division; OPSIG, with Craig Gardner, Superintendent, BS MRR

What is model railroad “operation” all about anyway? In a word, the answer to the question is: FUN. So how do you design “fun” into a layout? If this sounds like BS to you, in this particular layout it certainly is BS!

Author Steven Covey’s phrase “Begin with the End in Mind” is often quoted. In this case, the railroad to model and the goal of the layout design were known at the beginning: model the Birmingham Southern RR (BS) and make the layout more “fun to run”.

Craig Gardner is one of those courageous model railroaders who decided to tear down a working layout and start over. Craig believed he could get more enjoyment from a new layout even though he had a variety of industries and “places”, an offsite staging yard, and a good bit of excellent scenery. He had a good fleet of DCC equipped locomotives and a fleet of cars. But he felt that there might be something he was missing. He decided he could do better and took the plunge to tear it down and start over. In short, the layout just wasn’t enough “fun to run”.

At the beginning of 2011, Craig tore down his layout and started rebuilding in June with operations in mind. Always a fan of the Birmingham Southern, which the folks in Birmingham, AL know is a small prototype packed with operating potential, Craig decided that a current version of the BS RR would be his layout theme, with a heavy dose of Norfolk Southern. In order to see how this layout concept and design evolved let’s take a look at the real Birmingham Southern RR and its namesake city’s rail history.

The Setting and Background of the Birmingham Southern RR

The City of Birmingham, AL was a land and industrial development scheme promoted to exploit the recognized but untapped mineral wealth in north central Alabama. All three mineral resources needed to make iron: iron ore, coal and limestone, are within a “rifle shot” of each other – and this situation occurs nowhere else in the world. The mineral wealth was recognized and mapped as early as the 1830’s, but the transportation of the day was completely inadequate to move bulk raw materials required for iron making in any quantity at all. Early iron makers used ox carts, baskets and barrows.

Rail transportation was the key to 19th century industrial development and Birmingham was planned at the junction of two railroads where none existed. One of these, the South and North Alabama RR was proposed to extend through the mineral region in a detailed study in 1858. The other railroad creating



Figure 1: Owner Craig Gardner checks the engine house at Birminghamport while Mark Stone reviews his train manifest for his next operating assignment. Birminghamport is a component from Craig’s former layout.



the junction would become the Alabama Great Southern, later absorbed by the Southern Ry. Locating the crossing (city) is a great (separate) story of political and financial intrigue delayed by the Civil War.

The City was founded with rail service in 1871, and the L&N soon leased the S&NA. The initial joint right of way where the two railroads ran together for a mile or so at the junction appeared on plats as “*Railroad Reservation – Reserved for Mechanical Enterprises*”. Industrial development really didn’t take off until the early 1880’s leading to Birmingham’s nickname “The Magic City”. And true to plan, there was an iron making blast furnace at each end of the “Railroad Reservation” by 1885.

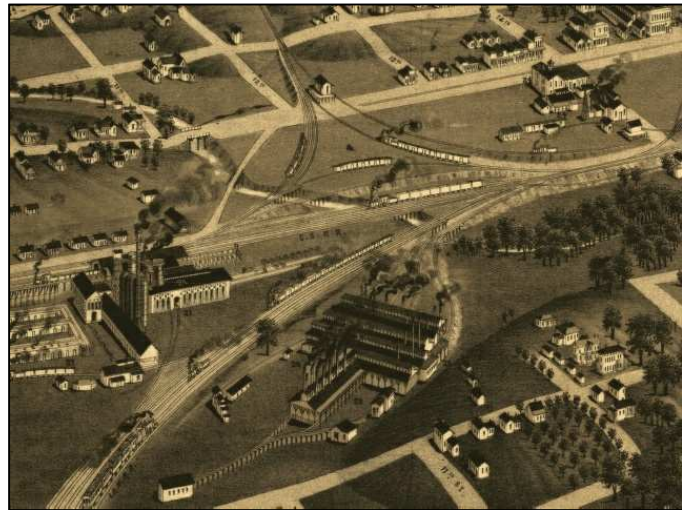


Figure 2: Alice Furnace in 1885, first customer of the Pratt Mines RR with adjacent Birmingham Rolling Mills at junction of L&N and Alabama Great Southern RR's. Pratt Mines RR comes in from top.

The future Birmingham Southern RR first appeared as the Pratt Mines RR serving the Alice Furnace Company about 1878. This humble beginning grew into an industrial railroad incorporated in 1899 by the Tennessee Coal, Iron and RR Co, a Division of US Steel (since 1907) once employing 2,500 persons in the “Transportation Department”. In the post WWI era, the BS became a common carrier, and TCI RR (now Fairfield Southern) handled “in plant” operations after an ICC rate decision about 1921, but that is another story.

In the 1920’s local industries and the Chamber of Commerce (and US Steel) wanted an inland river port to challenge the trunk line railroads’ rate structure. This led to the development of the Port of Birmingham, known locally as Birmingport about 1925. The branch rail line to the port has operated under several names over the years, but has primarily served TCI/US Steel. Birmingham Southern handled commodities at the port including taconite, coal and coke, plus an adjacent bulk asphalt facility.

In 2012 the BS RR was purchased by WATCO, but Craig decided he wanted to continue to operate his railroad on the ‘day before’ the acquisition. You may have read the very interesting article in TRAINS (April, 2013) about WATCO’s first 50 hours as the new owner of the Birmingham Southern. Check it out.

Birmingham’s rich industrial heritage includes the iron, steel and mining industries as well as many support and spin off industries. This means that although the BS RR is small (about 75 track miles) it has an interesting industrial clientele, relatively heavy tonnage and great model operating potential. These include the river port, at least one major modern coal prep/loading facility and local industrial shippers needing interchange with Class I RR’s connecting Birmingham with the rest of the country.

The BS RR has evolved into a common carrier with a small but varied set of industrial customers. Birmingham’s nine “trunk lines” have evolved into the CSX, the NS, and the BNSF. This suggested that a focus on the Birmingham Southern could also include the parallel (literally) Class I operations that make the BS such a “big-little railroad”. So the layout concept included the BS RR and the “Class I’s” together.

The layout design challenge was to weave this history and story into a reasonable representation of the Birmingham Southern and be successful in developing a new model railroad with operating “fun”.

Conceptual Design of the Layout

Birmingham and Bessemer, AL, lie in Jones Valley about 12 miles apart. On the SE side of the valley is Red Mountain, for 100 years the source of hundreds of millions of tons of red iron ore. The Warrior Coal Field extends from the NW side and is still a source of metallurgical coal exported around the world. This valley today is still home to a fully integrated US Steel mill (seamless pipe and more) plus two major ductile iron pipe plants, US Pipe and ACIPCO, as well as a number of related industries. This is where the

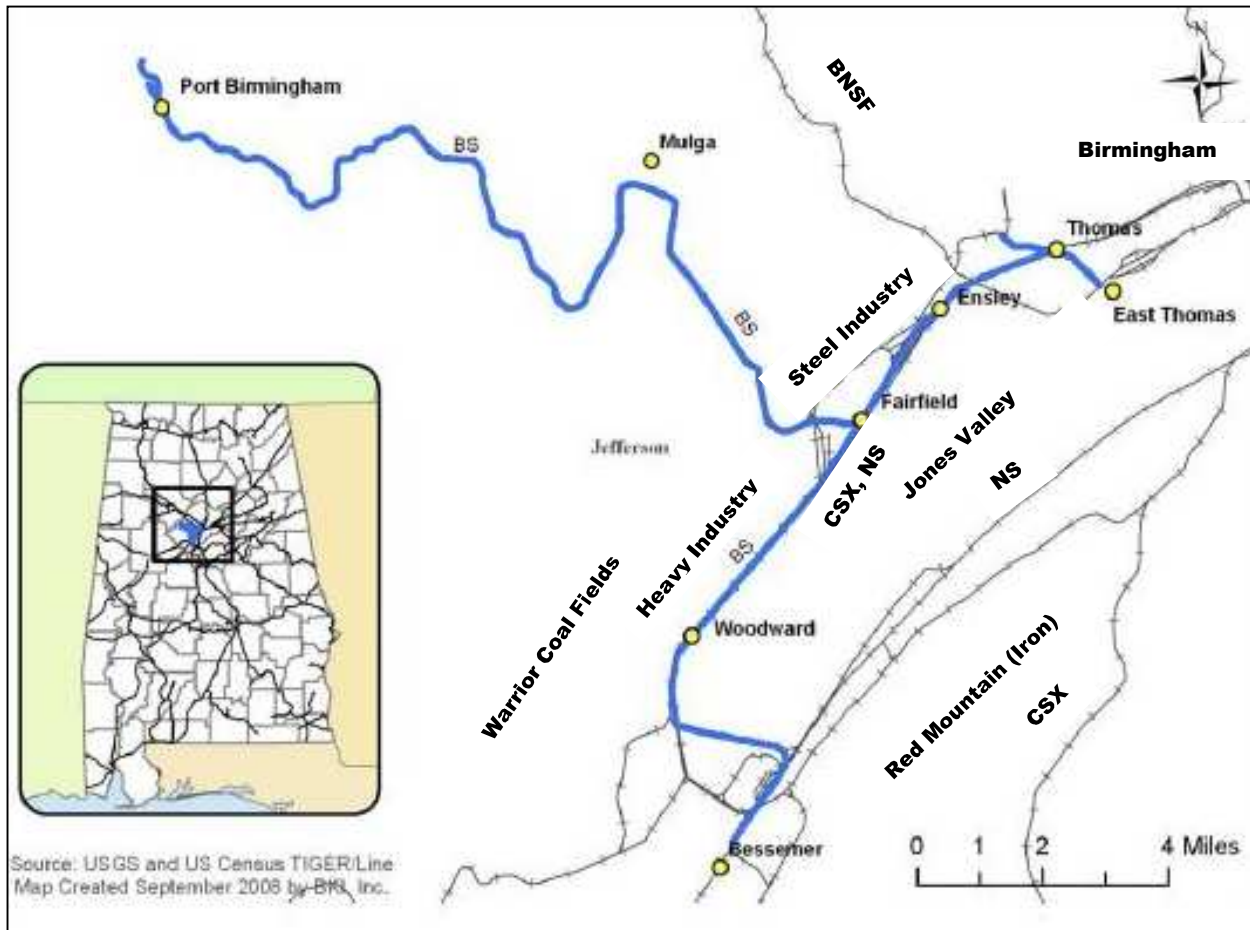


Figure 3: System map of the BS RR from the 2008 Alabama Rail Plan by ALDOT with key areas labeled.

Birmingham Southern operates. The interwoven track and operation continues based on track alignments that go back to the 1880's. The Birmingham Industrial District grew around this valley.

As might be expected, the industrial based economy of Birmingham has changed toward a service based economy, although heavy industry certainly remains. But consolidation has taken place, and the smokestack industries have changed to warehouses, assembly sites and commercial parks in many parts of the city. Birmingham is a junction of three Interstate Highways and dramatic growth of truck service.

The iron and steel industries consolidated in a corporate and geographical sense. For example, US Steel's No. 8 blast furnace (c. 1982) at Fairfield has a capacity of about 5,000 tons of iron per day which is about equal to the 9 blast furnaces it replaced at adjacent Ensley and Fairfield plants. Three merchant iron makers, Woodward, Republic and Sloss are gone. All of about 15 active iron ore mines are gone since about 1970, and dozens of coal mines in the Warrior Field are now limited to about 3 or 4 consolidated mine sites and preparation plants plus two large coke



Figure 4: "Old" Fairfield Yard and engine terminal; "new" Fairfield Yard is located nearby. These features were consolidated in the layout design to provide a central yard "home" for the BS RR.

plants. US Steel imports taconite (processed iron ore) as well as coke by rail and barge. One of our power plants burns Powder River Basin coal (BNSF); the other barged-in coal, for cleaner emissions.

The layout concept considered the Birmingham Southern track map like a letter "T" as shown above. One leg served Birmingham, one leg Oak Grove Mine (west of Bessemer) and one leg was the western corridor along Jones Valley extending toward Birmingham and the old Alice Furnace site of the 1880's. This corridor included BS, L&N, Southern and St. L&SF lines running together serving adjacent industry.

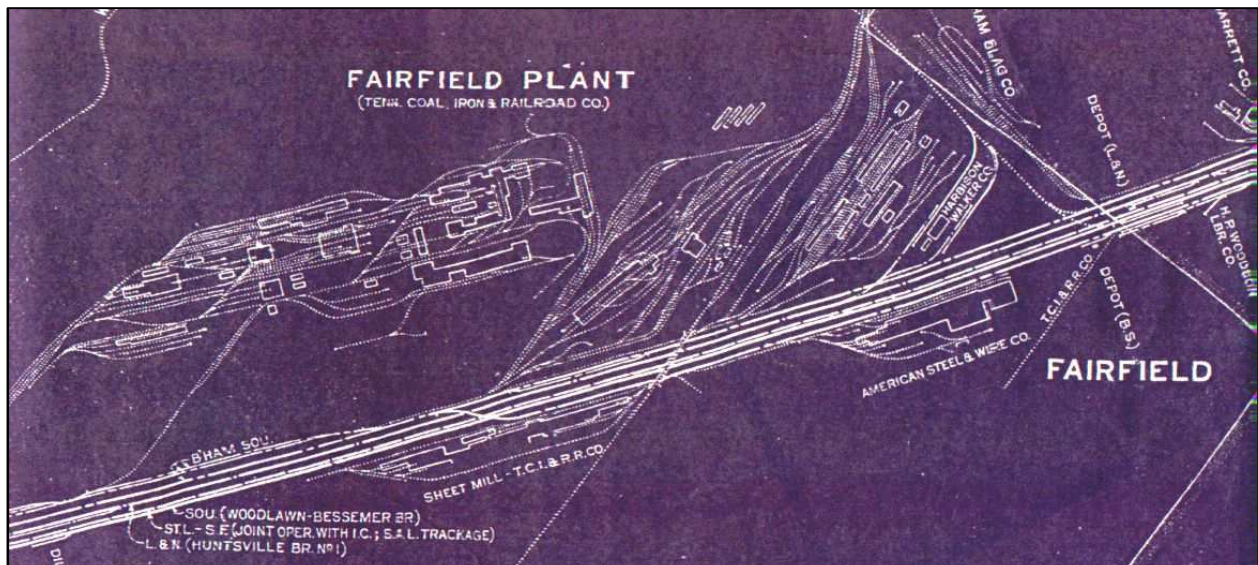


Figure 5: Fairfield Steel Plant (TCI) along the western rail corridor with BS, L&N, Southern and St. L&SF tracks shown in 1935.

Craig used old maps, BS and other websites to see how the track map had changed over the years. The former BS website listed the RR's main customers and located them on a map. Google Earth and related mapping software were used to see what these industrial facilities looked like and consideration given to which ones to include and how they would be represented. Ron Mele's wonderful book on the Birmingham Southern's First 100 Years was a great reference. Today, Ron is one of the operators!

Likewise the Class I RR's and customers were reviewed on historical mapping and current websites. The more complex trackage of the 1930's is simpler today, but insight was gained on the location of yards, crossings, "puzzle track" and customers to provide interesting ideas for the model railroad track plan.

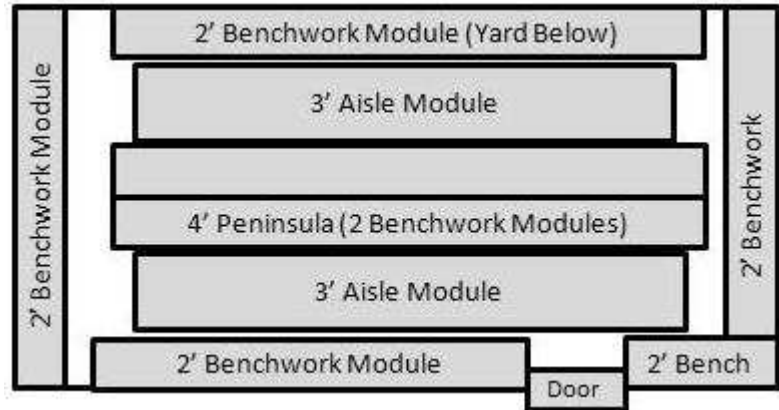
Layout Concept versus Available Space

Craig's basement layout room is slightly less than 30' x 15'. If one thinks in terms of layout depth (arm reach), curve radius and aisle width the short 15' dimension can be broken down as shown in the sketch.

Use of 15' nominal dimension

- 2 foot layout shelf
- 3 foot aisle
- 4 foot peninsula (2 @ 2 ft.)
- 3 foot aisle
- 2 foot layout shelf
- 14 foot total

This adds up to a total of 14 feet with a bit of room to use for the 5'+ turn back curve on the peninsula.



The track plan was approached first in this conceptual schematic format in two ways. First, what features were to be included and second, how to provide operational interest, particularly industrial switching? This approach led to the location of the Fairfield Yard as a center point for the model BS RR, and it led to the location of two interchange tracks with the Class I's. The idea was to include the BS main and the "Class I" main with the Class I's going to a lower level "staging" yard along the 30' wall.

We didn't want the two mainlines to appear to be continuous parallel double track. Actual crossovers were identified on old track maps and aerial views to "justify" crossovers on the layout at key locations – prototype meets operating interest. BS had access to both sides of the western corridor as TCI/USS had facilities on both sides of the corridors. BS serves other tenants that occupy these sites today.

What was (initially) considered a Class I staging yard was to be located on a lower level. The location of a helix was a significant challenge since it would tend to require a lot of real estate. Experience on the previous layout had convinced Craig that he could be happy with 30" radius curves. Thus a helix with a 5" track board would be 65" across. We thought one helix would be used to reach the lower level. But, as the concept evolved, it was determined that two helixes were better than one. Two helixes would allow Class I traffic to enter the layout from both ends. Staging was double ended, and a helix required no more room than a lower level return loop. That was the "top down" view.

Back on top, the interchange tracks wanted to be either side of Fairfield Yard. This implies the far reaching Class I's having pickups or setouts before they "head out of town" via the helixes. In turn, this implied the real-life branch lines to Oak Grove Mine and Birminghamport could be just that – BS branches beyond the helix locations at either end of the BS RR/Class I main line corridor. How could these components be located in the available space? Sketches, bull sessions and computers were used here.

Considering these layout design elements and room geometry led to the idea of 6 key spaces: 4 long shelves about 2 feet deep, two end shelves of 2' depth plus a door way as shown in the sketch above. The entry door was in one 30 foot wall about 6 feet from the corner. Initially this corner said "helix" but evolution of the plan and idea of two helixes led to one helix moving from that corner to the mid-point of the adjacent short wall. The "door corner" began to say "Oak Grove Mine" which was a stub end destination. This left the other portion of the 30 foot wall at about 21 feet. Would the salvaged Birmingham fit here?



Figure 6: Oak Grove prep plant and loader; the coal from the mine arrives by an overland conveyor several miles long.

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The Birmingham facility is a great model element and Craig had saved the port component from the previous layout. It includes the river, the long sheet pile berth, a neat old overhead crane, material storage as well as car storage and switching. Craig found that his old "port" fit into the 21' space just fine with room for a corner curve approach on the branch line. So one of the 4 "long" spaces was taken by Birmingham and Oak Grove Mine either side of the entry door at opposite ends of the entire layout. The plan was coming together! The other "long" wall would be the lower level "staging" yard.



Figure 7: River view of Birmingham during "marine recon mission" with the wonderful old 1920's era overhead crane - well worth modeling.

The peninsula seemed to want to be Fairfield Yard on one side and the rest of the western rail/industrial corridor on the other. It was decided that the peninsula was of more value with a backdrop down the middle to create more length. So the peninsula is the western corridor "folded in half". It was decided to de-emphasize the turnback curve and put something on top to hide it. So, Fairfield Yard occupied one side of the peninsula, and the other side evolved into a

switching district named for Ensley, the location of the original TCI Steel Works from 1890-1980. A large industry was selected to occupy the "air rights" over the turnback curve. And a tight Class I switching district, Avondale, fitted by the yard ladder based on several prototype businesses on the NS main.

The fourth layout area was the shelf above the lower level yard. This was determined to be a less developed area that would represent the line to Birmingham and include the former mining village of

Mulga Mines, operated by Woodward Iron Company from about 1910 to 1980. The long Birmingham Branch passes by Mulga, and this would help make Birmingham a “separate place” and a good long trip.

One of the two 15’ end spaces is rural with the Birmingham line continuing on its way to the port. One corner of this end space became the West Helix and the other corner curves to the port. The bulk asphalt terminal could fit in that curve, across Short Creek from the port, right where it ought to be!

With these items decided, the two interchange tracks fit in at Ensley and along the line to Birmingham at Mulga. They were visually separated from Fairfield Yard. The Ensley site is logically located adjacent to an industrial switching district served mostly by Birmingham Southern. The Avondale switching district would only be served by the Class I’s and is not adjacent to an interchange. The other interchange site is

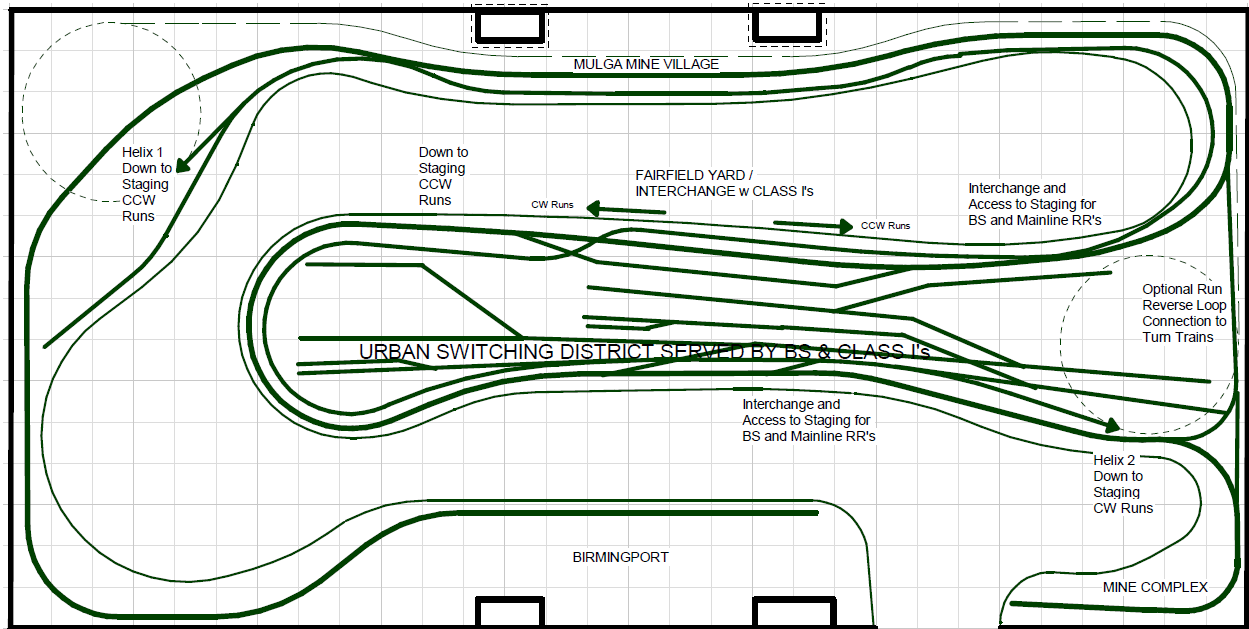


Figure 8: Conceptual layout sketch showing most of the key layout elements being worked into the space-available. The peninsula was still full width in this sketch. It was later decided to divide it with a sky board backdrop and to make it longer.

at a location where the BS is headed out of town and the Class I “comes along side” as it enters the Birmingham District at Bessemer (aka west helix). That’s the story and we’re sticking to it.

This layout concept evolved as a way to represent the key layout design elements (givens and druthers) as well as the actual schematic of the current BS RR with a certain amount of artistic license. The next step was to determine how to develop the detailed track plan of each element and tie them together. We were certainly pleased with the way things were coming together so far! We wanted to run trains!

From Concept to Final Design

Craig began to build the new layout in late May of 2011. Craig tends to be a “build the benchwork and lay the track as you go” sort of railroad tycoon. Helper John is a “design every detail and build it from the plans, using a computer aided design tool”. Fortunately the two manage to peacefully co-exist.

John likes to use 3rd PlanIt software from El Dorado, and this tool was used to work out some of the tricky geometric problems on the railroad. For example, helix placement with respect to the lower level yard was aided by using the software. This included the wye layout between Ensley and the Oak Grove Mine built over one helix. In many cases, John would develop a plan on the computer and Craig would work from an 8.5 x 11 plan solving the geometrics implied by the small plan as he went along.

Toward the end of track construction, a formal track plan was completed in the computer based on “field measurements” made on the model railroad. It seemed bass-ackwards but it got the job done.

One useful computer design exercise was the layout of the switching districts and the use of 3D capability of 3rd PlanIt software. A mix of turnouts, crossings and spurs would be moved around on the computer to obtain a trial arrangement. Then we would put some simple “box buildings” in 3D and run virtual trains around. We mixed facing and trailing point spurs for operating interest.

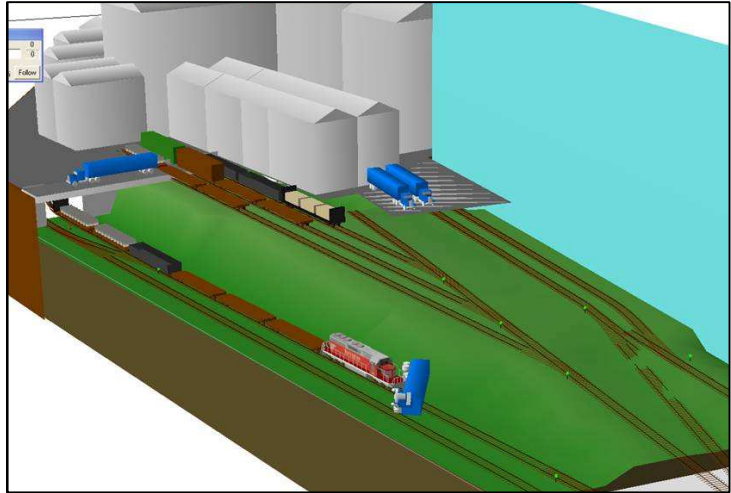


Figure 9: 3D image from 3rd PlanIt software to imagineer an industry to occupy the "air rights" over the turn back curve on the peninsula. A stray trailer truck tried to outrun a freight train in this scene.

Another use of the computer helped design the “air rights” industry above the turn back curve on the peninsula. ACIPCO’s pipe plant is up on a hill and we used that idea to create a BIG industrial

site with 5 tracks for inbound and outbound cars. Craig declared it was too big. “Pipe World” became USS Seamless Pipe Mill on the layout (scaled down) but still with 5 spur tracks. Compromise works out!

Initial Operational Concept

Before construction started Craig and John “discovered” JMRI Operations module. JMRI (Java Model RR Interface) is a robust set of computer freeware modules, developed by a group of wonderful volunteers. Most JMRI modules provide computer “interface” with the model RR. JMRI Operations module is a computer “assisted” tool that maintains the database and manipulates car movements for the railroad via paper train manifests and human train crews. Learning together, Craig and John applied JMRI Operations to both Craig’s BS RR as well as John’s steam era Birmingham District MRR. The value of working with a friend for layout design, construction, operation and maintenance cannot be over emphasized. Finding others to help on model railroad work is a benefit of NMRA Division membership.

In summary, the layout features two main lines, one for the BS and one for the “other” Class I’s along the corridor serving Birmingham and Bessemer. Today this industrial corridor includes NS, CSX and BNSF. Class I trains work from a large lower level “yard” which is double ended and accessed by helixes. There are two interchange locations with the Class I’s located on either side of Fairfield Yard which

includes an engine terminal for the BS “home”. The Class I engine terminal is located on the lower level yard within space created as the yard ladder tapers down.

The Birmingham Southern MRR initially appeared to be a point-to-point between Birminghamport and the Concord Mine with a central yard and on line industries. But it has evolved since the original concept was developed. Thinking involved to implement operations enabled the layout owner to realize a better potential than what was originally imagined. *So, it is good to design layouts with operations in mind.*



Figure 10: Jason Parham finally makes his first move as his NS switch job tackles the nefarious Avondale industrial district which includes real industries and places along the NS.

For example, originally, it was envisioned the lower level staging would enable the Class I’s to enter and leave the Birmingham Southern “stage” on the main layout level. It was anticipated that these trains would be “staged” as full trains. It was expected that the “players” would interact at the two interchange tracks. That was the plan...

In practice, however, it was found that industries on the layout, whether served by the Class I’s or the BS RR would require materials and generate products that the “visible” industries might not consume or provide. This became a real problem when loaded cars stacked up on the railroad with no industry to “eat” their loads. So, the lower level “offsite staging” morphed into a set of destinations and offsite industries such as a power plant and a steel mill simply to support operations. Instead of being staged “whole” trains are built and broken here. Plus, the BS now comes to the lower level to pick up and deliver loads to offsite industries. This can provide an additional interchange location that moves cars.

JMRI defines four categories of tracks: spurs, yards, interchange and staging. In the computer, spurs will swap loads to empties (and vice versa), yards store cars, interchange tracks swap cars between trains, and staging tracks store entire trains (and may flip loads if desired). Through the judicious selection of track types in JMRI one may achieve most any desired result as far as load changes and car movements. The software also allows the creation of non-random load schedules for industrial process requirements.

As it has turned out, the BS MRR doesn’t use any JMRI staging tracks, but does use the other three categories. In the author’s experience in model railroading, it seems interesting to have a layout with enjoyable operations and *NO* train “staging” tracks in the traditional sense of the term.

Craig’s Birmingham Southern serves a variety of industrial customers and provides interchange with the Class I carriers, particularly the NS RR. August 9, 2013 was the first formal Ops Session for Craig and his group of Steel City Division NMRA members: Bob Beaty, MMR; Mark Stone, Bill Barger, Jason Parham, John Pate, Sam Fell, and John Stewart. Would the layout design prove successful and fun? Yes it did!

Class I trains do originate in the offsite lower level yard, but now the trains are being built from offsite industries or yard tracks before entering the layout. When trains return to the lower level yard, they are broken up and the locomotives “put to bed”. Likewise, the BS RR can use the helixes and deliver to offsite industries, adding an off-layout interchange with the Class I’s to deliver and receive cars to and from the world outside of Birmingham. It could be argued that this is a form of “continuous staging” to imply trains that evolve off the layout but are changed by operations rather than “fiddling”. Fiddling after all is simply “fast” switching! The important thing is that the operations were adapted to the modeled industries, track plan and available space. Industries that didn’t fit could be accommodated and material flows of industry could be handled by the railroad.



Figure 11: Trainmaster Craig monitors Bob’s work while Mark starts assembling his train at Fairfield Yard.

JMRI car movement software is used to generate both random and planned car movements among industries and between railroads. Trains are planned with work that needs to be done, and cars may move with a purpose between industries locally or in the “wide world” beyond the layout. The former tend to be planned and the latter to be random using the same software. JMRI Operations module can accommodate a variety of planned car movements for specific material and product moves plus random car movements. JMRI software is used to bring the layout to life with train manifests and switch lists.

A planned set of trains are “built” by the computer to move cars and the train crews use the layout to do the work. Upon completion the trainmaster/dispatcher “terminates” the train in the computer. JMRI responds by “moving” the cars from the original to the current location. Then the fun continues and



Figure 12: Bill Barger works Mulga Interchange while Ron Mele’ works at Fairfield Yard. The lower level yard is visible below left.

another train rolls out of the layout’s onsite and offsite yards. Birmingham’s industries come alive and the train crews have a great time running trains with a purpose on the BS RR. Trains run while scenery “grows”.

The design and construction of an operation “planned” railroad, the learning process of implementing operations, and the creative thinking and evaluation required to design a layout for operations have made the BS RR a great layout that provides a lot of fun for the users. *No BS about that whatsoever!*

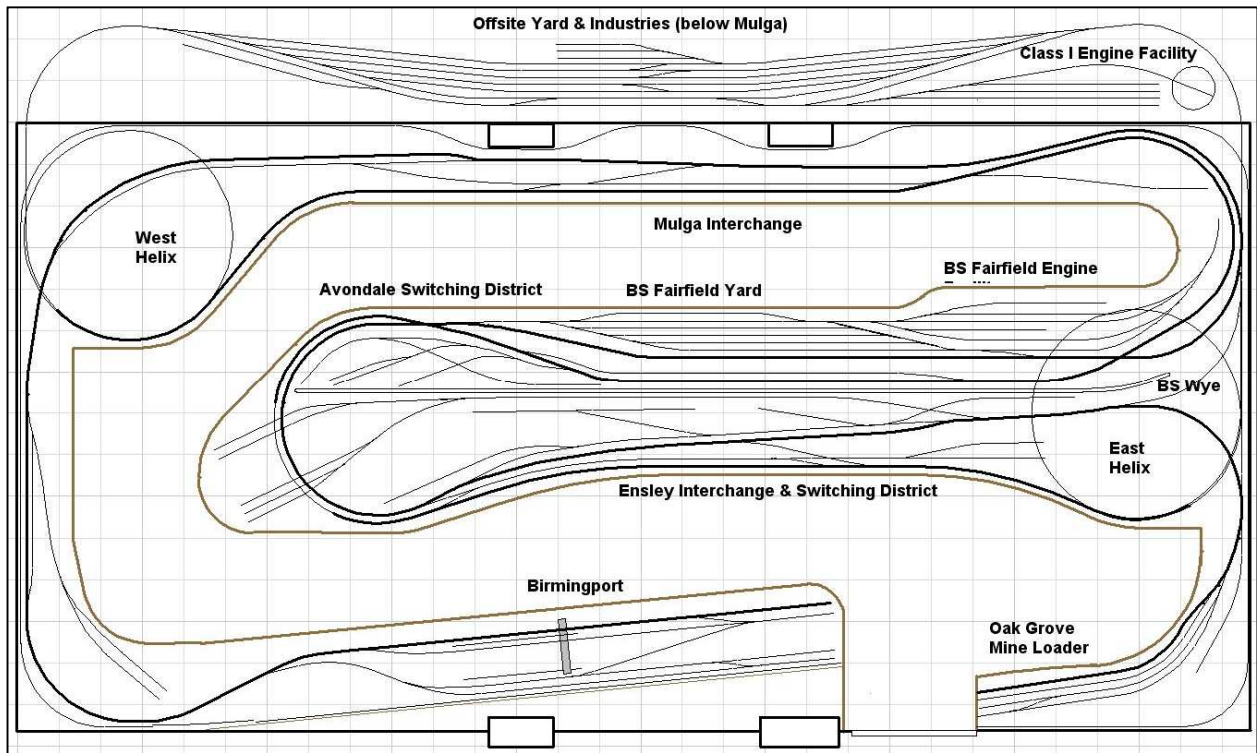


Figure 14: Final plan of the Birmingham Southern MRR with two mainlines highlighted. The offsite yard is actually beneath Mulga but “moved out” for clarity. It’s a great model railroad designed to be fully operational while scenery catches up.

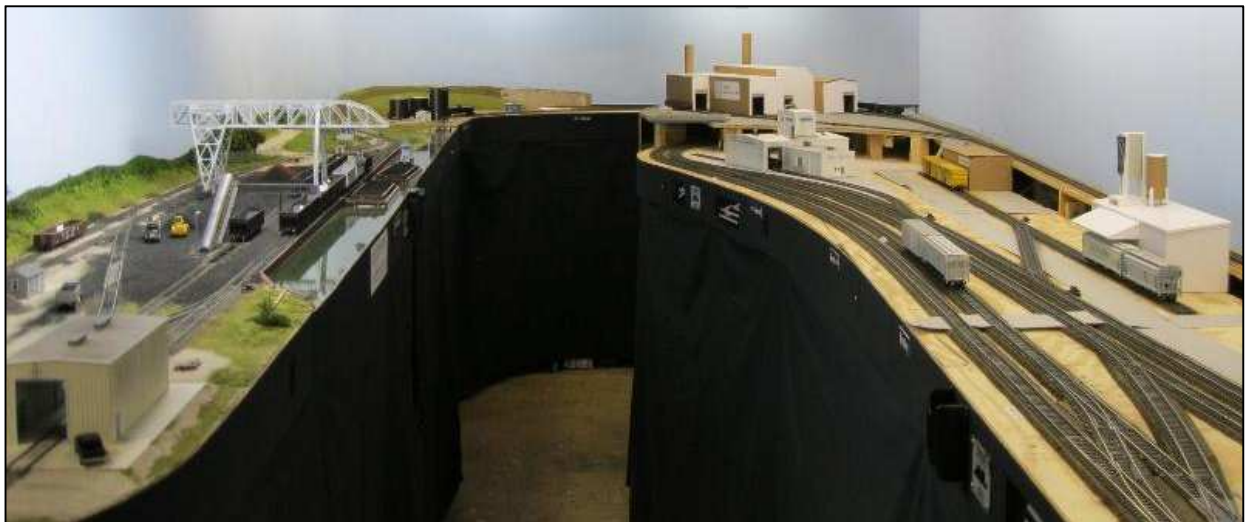


Figure 13: The salvaged Birmingport component and the new Ensley switching district and interchange on the Birmingham Southern MRR in Birmingham, AL. The entry door and Oak Grove Mine are over the camera’s left shoulder. The Oak Grove wye and the east helix are over the camera’s right shoulder.

Additional pictures this page.