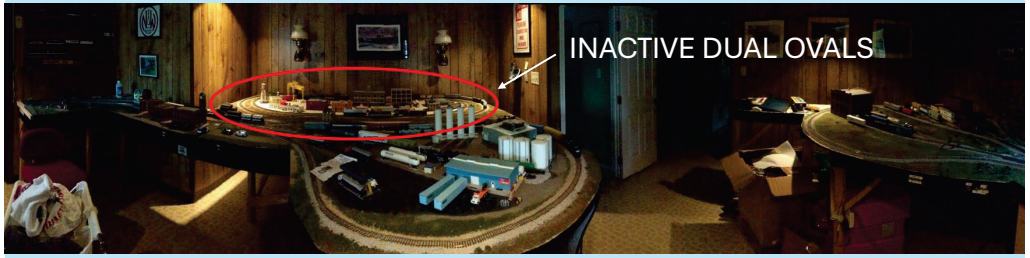
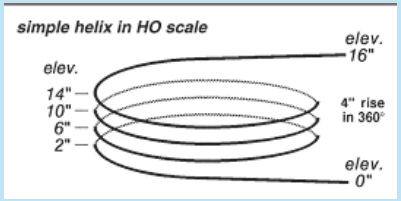
The layout, originally being a 4’ by 8’ double oval with a crossover between the ovals, had undergone an expansion to 12’ by 20’ over the years resulting in the original ovals not being used as part of the main line very often.



Helix Construction



Ernie Little, MMR 647
Superintendent, Potomac Division
October 17, 2025

The desire to create a second level for the layout caused research to take place. I knew that I wanted a sixteen-inch difference in levels but was not sure how to accomplish the two levels together.

From the research I found I had three choices-

A. Move the trains manually by picking them up and placing them on the second level.
B. Create a run long enough to accommodate the height differential.
C. Build a HELIX.

August 2020 – With the onset of the Covid 19 restrictions, I had a lot of time on my hands and decided to add a second level to my NORFOLK SOUTHERN CONNECTOR HO scale model railroad.

Building a HELIX

This was a viable option, and I went back to the internet and did more research on building a helix.

I found a website – http://www.trainweb.org/s-trains/helix/percent_grade.htm that had a track rise and helix calculator, and other information on how to build a helix.

Manual movement

Move the trains manually by picking them up and placing them on the second level.

Not prototypical and this would be a poor choice and have a significant impact on set up time if I was to move onto operations sessions on my railroad.

Considerations for a HELIX

How much space do you have for the HELIX ?

What scale are you working in ?

Do you want single or multiple tracks ?

What radius can your equipment handle ?

Length of trains?

What grade % do you want ?

What materials do you want to use ?

Creating a Run

The desirable maximum incline on a railroad is a maximum 2% grade.

This would be a rise of 2” in 100” and to get a 16” rise it would require 800” of track run, (a run of 66’ 8”). My layout room is 12’ by 20’ which would allow a maximum 64’ run around the perimeter of the room before the track would be over itself.

This was not doable due to doors/windows/other obstructions on the perimeter walls.

Considerations

Do you want single or multiple tracks ?

Multiple tracks will require a wider roadbed to accommodate the tracks. You will need space between the tracks to allow equipment movement in opposite direction if you have multiple tracks. This will affect the width of the HEXLIX rings.

What radius can your equipment handle ?

The minimum radius for the centerline of the track in the helix is dependent upon the equipment you will be running.

Length of trains ?

Considerations

How much space do you have ?

The HELIX will take up space and the larger the track radius you use the larger the HELIX will be. Thus, the space is dependent upon the scale you are working in and the number of tracks you want.

What scale are you working in ?

The larger the scale the larger the HELIX will be in size, width of rings needed, and the height you will need between the tiers.

Considerations

What train clearance do you need between the levels?

You need the height of your tallest equipment plus a little more to allow for expansion/contraction and other factors.

How will you separate the levels?

Threaded rod

Wood blocking

Considerations

What grade % do you want ?

Do you want a Saluda grade (7%) or something more reasonable, like a maximum of 2% which would be more prototypical.

What materials do you want to use ?

There are several materials that you could use, such as wood, mdb, or other materials.

The How

Using Microsoft Excel, I created an elevation chart that would allow me to measure the change in height at any point on the helix.

Zero being the beginning and 16 being the topmost elevation above the base.

Considerations – Height Separation

sing Atlas Code 100 flex track

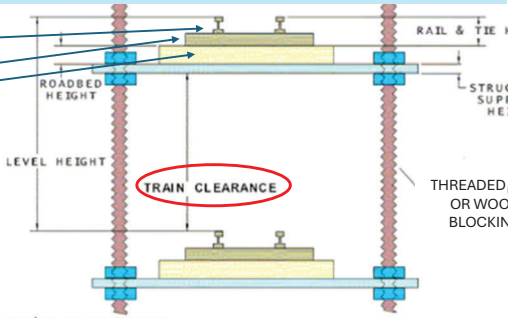
sing Mid west HO cork roadbed

sing ½" plywood as structural support

ere width of the roadbed is 4"

ere are 6 segments per level

so consider superelevation on the curve



s in decimal (ie. .25 instead of 1/4) and stay with the same units, like inches or centimeters.

0.125"

ance 2.75"

us 26"

rade Percent Grade = 2.27%"

Road Bed 0.25"

Structural Support 0.5""

The Elevation chart

Track Helix Height based on 2.27% grade

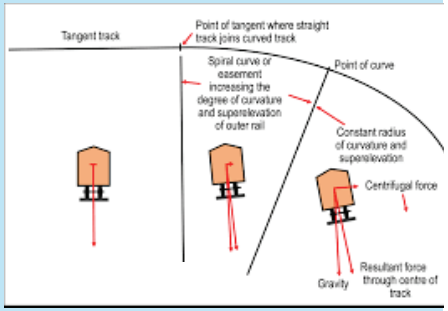
	In	Track	Out	"	In	Track	Out	"	In	Track	Out	"	In	Track	Out	"	In	Track	Out	"	In	Track	Out	"	In	Track	Out	"	In	Track	Out	"	In	Track
0				88.00	1.98	2.00	2.02	178.00	4.02	4.04	4.06	266.00	6.02	6.04	6.06	354.00	8.02	8.04	8.06	442.00	10.01	10.03	10.05	530.00	12.01	12.03	12.05	618.00	14.01	14.03	1
0	0.03	0.05	0.07	90.00	2.02	2.04	2.06	180.00	4.07	4.09	4.11	268.00	6.06	6.08	6.10	356.00	8.06	8.08	8.10	444.00	10.06	10.08	10.10	532.00	12.06	12.08	12.10	620.00	14.05	14.07	1
0	0.07	0.09	0.11	92.00	2.07	2.09	2.11	182.00	4.11	4.13	4.15	270.00	6.11	6.13	6.15	358.00	8.11	8.13	8.15	446.00	10.10	10.12	10.14	534.00	12.10	12.12	12.14	622.00	14.10	14.12	1
0	0.12	0.14	0.16	94.00	2.11	2.13	2.15	184.00	4.16	4.18	4.20	272.00	6.15	6.17	6.19	360.00	8.15	8.17	8.19	448.00	10.15	10.17	10.19	536.00	12.15	12.17	12.19	624.00	14.14	14.16	1
0	0.16	0.18	0.20	96.00	2.16	2.18	2.20	186.00	4.20	4.22	4.24	274.00	6.20	6.22	6.24	362.00	8.20	8.22	8.24	450.00	10.20	10.22	10.24	538.00	12.19	12.21	12.23	626.00	14.19	14.21	1
0	0.21	0.23	0.25	98.00	2.20	2.22	2.24	188.00	4.25	4.27	4.29	276.00	6.25	6.27	6.29	364.00	8.24	8.26	8.28	452.00	10.24	10.26	10.28	540.00	12.24	12.26	12.28	628.00	14.24	14.26	1
0	0.25	0.27	0.29	100.00	2.25	2.27	2.29	190.00	4.29	4.31	4.33	278.00	6.29	6.31	6.33	366.00	8.29	8.31	8.33	454.00	10.29	10.31	10.33	542.00	12.28	12.30	12.32	630.00	14.28	14.30	1
0	0.30	0.32	0.34	102.00	2.30	2.32	2.34	192.00	4.34	4.36	4.38	280.00	6.34	6.36	6.38	368.00	8.33	8.35	8.37	456.00	10.33	10.35	10.37	544.00	12.33	12.35	12.37	632.00	14.33	14.35	1
0	0.34	0.36	0.38	104.00	2.34	2.36	2.38	194.00	4.38	4.40	4.42	282.00	6.38	6.40	6.42	370.00	8.38	8.40	8.42	458.00	10.38	10.40	10.42	546.00	12.37	12.39	12.41	634.00	14.37	14.39	1
0	0.39	0.41	0.43	106.00	2.39	2.41	2.43	196.00	4.43	4.45	4.47	284.00	6.43	6.45	6.47	372.00	8.42	8.44	8.46	460.00	10.42	10.44	10.46	548.00	12.42	12.44	12.46	636.00	14.42	14.44	1
0	0.43	0.45	0.47	108.00	2.43	2.45	2.47	198.00	4.47	4.49	4.51	286.00	6.47	6.49	6.51	374.00	8.47	8.49	8.51	462.00	10.47	10.49	10.51	550.00	12.47	12.49	12.51	638.00	14.46	14.48	1
0	0.48	0.50	0.52	110.00	2.48	2.50	2.52	200.00	4.52	4.54	4.56	288.00	6.52	6.54	6.56	376.00	8.52	8.54	8.56	464.00	10.51	10.53	10.55	552.00	12.51	12.53	12.55	640.00	14.51	14.53	1
0	0.52	0.54	0.56	112.00	2.52	2.54	2.56	202.00	4.57	4.59	4.61	290.00	6.56	6.58	6.60	378.00	8.56	8.58	8.60	466.00	10.56	10.58	10.60	554.00	12.56	12.58	12.60	642.00	14.55	14.57	1
0	0.57	0.59	0.61	114.00	2.57	2.59	2.61	204.00	4.61	4.63	4.65	292.00	6.61	6.63	6.65	380.00	8.61	8.63	8.65	468.00	10.60	10.62	10.64	556.00	12.60	12.62	12.64	644.00	14.60	14.62	1
0	0.62	0.64	0.66	116.00	2.61	2.63	2.65	206.00	4.66	4.68	4.70	294.00	6.65	6.67	6.69	382.00	8.65	8.67	8.69	470.00	10.65	10.67	10.69	558.00	12.65	12.67	12.69	646.00	14.64	14.66	1
0	0.66	0.68	0.70	118.00	2.66	2.68	2.70	208.00	4.70	4.72	4.74	296.00	6.70	6.72	6.74	384.00	8.70	8.72	8.74	472.00	10.69	10.71	10.73	560.00	12.69	12.71	12.73	648.00	14.69	14.71	1
0	0.71	0.73	0.75	120.00	2.70	2.72	2.74	210.00	4.75	4.77	4.79	298.00	6.74	6.76	6.78	386.00	8.74	8.76	8.78	474.00	10.74	10.76	10.78	562.00	12.74	12.76	12.78	650.00	14.74	14.76	1
0	0.75	0.77	0.79	122.00	2.75	2.77	2.79	212.00	4.79	4.81	4.83	300.00	6.79	6.81	6.83	388.00	8.79	8.81	8.83	476.00	10.79	10.81	10.83	564.00	12.78	12.80	12.82	652.00	14.78	14.80	1
0	0.80	0.82	0.84	124.00	2.79	2.81	2.83	214.00	4.84	4.86	4.88	302.00	6.84	6.86	6.88	390.00	8.83	8.85	8.87	478.00	10.83	10.85	10.87	566.00	12.83	12.85	12.87	654.00	14.83	14.85	1
0	0.84	0.86	0.88	126.00	2.84	2.86	2.88	216.00	4.88	4.90	4.92	304.00	6.88	6.90	6.92	392.00	8.88	8.90	8.92	480.00	10.88	10.90	10.92	568.00	12.87	12.89	12.91	656.00	14.87	14.89	1
0	0.89	0.91	0.93	128.00	2.89	2.91	2.93	218.00	4.93	4.95	4.97	306.00	6.93	6.95	6.97	394.00	8.92	8.94	8.96	482.00	10.92	10.94	10.96	570.00	12.92	12.94	12.96	658.00	14.92	14.94	1
0	0.93	0.95	0.97	130.00	2.93	2.95	2.97	220.00	4.97	4.99	5.01	308.00	6.97	6.99	7.01	396.00	8.97	8.99	9.01	484.00	10.97	10.99	11.01	572.00	12.96	12.98	13.00	660.00	14.96	14.98	1
0	0.98	1.00	1.02	132.00	2.98	3.00	3.02	222.00	5.02	5.04	5.06	310.00	7.02	7.04	7.06	398.00	9.01	9.03	9.05	486.00	11.01	11.03	11.05	574.00	13.01	13.03	13.05	662.00	15.01	15.03	1
0	1.02	1.04	1.06	134.00	3.02	3.04	3.06	224.00	5.06	5.08	5.10	312.00	7.06	7.08	7.10	400.00	9.06	9.08	9.10	488.00	11.06	11.08	11.10	576.00	13.06	13.08	13.10	664.00	15.05	15.07	1
0	1.07	1.09	1.11	136.00	3.07	3.09	3.11	226.00	5.11	5.13	5.15	314.00	7.11	7.13	7.15	402.00	9.11	9.13	9.15	490.00	11.10	11.12	11.14	578.00	13.10	13.12	13.14	666.00	15.10	15.12	1
0	1.12	1.14	1.16	138.00	3.11	3.13	3.15	228.00	5.16	5.18	5.20	316.00	7.15	7.17	7.19	404.00	9.15	9.17	9.19	492.00	11.15	11.17	11.19	580.00	13.15	13.17	13.19	668.00	15.14	15.16	1
0	1.16	1.18	1.20	140.00	3.16	3.18	3.20	230.00	5.20	5.22	5.24	318.00	7.20	7.22	7.24	406.00	9.20	9.22	9.24	494.00	11.19	11.21	11.23	582.00	13.19	13.21	13.23	670.00	15.19	15.21	1
0	1.21	1.23	1.25	142.00	3.20	3.22	3.24	232.00	5.25	5.27	5.29	320.00	7.24	7.26	7.28	408.00	9.24	9.26	9.28	496.00	11.24	11.26	11.28	584.00	13.24	13.26	13.28	672.00	15.23	15.25	1
0	1.25	1.27	1.29	144.00	3.25	3.27	3.29	234.00	5.29	5.31	5.33	322.00	7.29	7.31	7.33	410.00	9.29	9.31	9.33	498.00	11.28	11.30	11.32	586.00	13.28	13.30	13.32	674.00	15.28	15.30	1
0	1.30	1.32	1.34	146.00	3.29	3.31	3.33	236.00	5.34	5.36	5.38	324.00	7.33	7.35	7.37	412.00	9.33	9.35	9.37	500.00	11.33	11.35	11.37	588.00	13.33	13.35	13.37	676.00	15.33	15.35	1
0	1.34	1.36	1.38	148.00	3.34	3.36	3.38	238.00	5.38	5.40	5.42	326.00	7.38	7.40	7.42	414.00	9.38	9.40	9.42	502.00	11.38	11.40	11.42	590.00	13.37	13.39	13.41	678.00	15.37	15.39	1
0	1.39	1.41	1.43	150.00	3.39	3.41	3.43	240.00	5.43	5.45	5.47	328.00	7.43	7.45	7.47	416.00	9.42	9.44	9.46	504.00	11.42	11.44	11.46	592.00	13.42	13.44	13.46	680.00	15.42	15.44	1

Considerations – Superelevation

Superelevation is used by prototypical railroads to assist in keeping the train on the track in curves.

In model railroads superelevation can be modeled but there is a need to consider not overdoing it so that it will not cause long trains in a helix to overturn toward the inside of the helix.

A little superelevation is ok but don't over do it. This is not the Daytona 500!



Construction – First Step

A portion of the outside oval was left to provide a marker for the start of the helix run. The is the “base” elevation of the helix.

A hole was cut into the existing layout to allow access to the center of the new helix. “Things” do happen, and you need a plan “A” to be able to access the inside of the helix.

The Elevation chart

		Track Heli	
"	In	Track	Out
0.00			
2.00	0.03	0.05	0.07
4.00	0.07	0.09	0.11
6.00	0.12	0.14	0.16
8.00	0.16	0.18	0.20
10.00	0.21	0.23	0.25
12.00	0.25	0.27	0.29
14.00	0.30	0.32	0.34
16.00	0.34	0.36	0.38
18.00	0.39	0.41	0.43
20.00	0.43	0.45	0.47
22.00	0.48	0.50	0.52
24.00	0.52	0.54	0.56
26.00	0.57	0.59	0.61
28.00	0.62	0.64	0.66

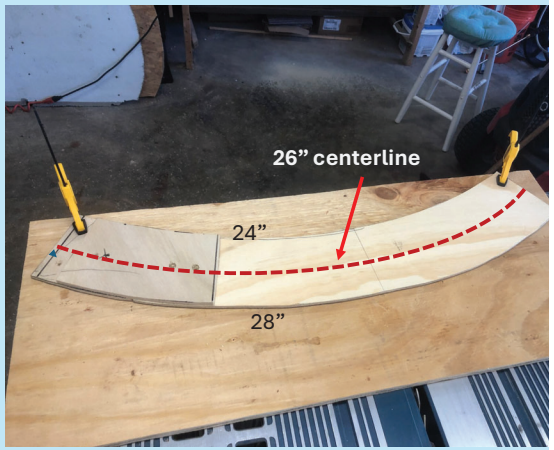
Construction – Second Step
Making of the helix segments

e helix design called for six segments create each level.

e segments were to be 4” in width to ow the needed horizontal clearance a single track.

egment template was made using a ’ centerline which created an inner ius of 24” and outer radius of 28”.

e template was traced onto a sheet of plywood then the segment was cut with a band saw.



The Beginning
Urban Renewal

Construction

At this point the transition has been completed, and a “wye” has been created to allow trains to approach of leave the helix and to either direction on the lower level.

Construction – Third Step
Creating the transition from flat to 2.27% grade

The transition from flat starting point to the 2.27% grade was constructed. The transition is necessary to permit the trains to begin/end the slope of necessary to make the climb to the second level and not have issues with couplers becoming disengaged and other operational issues.

The track work is following the path of the original layout outer oval.

The slope level is used to check for proper grade.

Construction

1” x 3” wood blocking

The transition leg is been completed, using wood blocks for level separation, and work the actual helix has begun. Note that on th level the wood blocks are installed perpendicular to the track, are of different height, and the top is beveled to the “grade to allow the track bed to be solid against th blocking for connection purposes.

Remember that once the base level is completed the blocking will be of the same height. You DO NOT keep adding slope to t layout as the track is now maintaining the separation between the rings.

IF YOU KEEP adding slope you are making big mistake, and the result will not be what correct AND you will end up with a tremendous grade percentage greater than that of the Saluda Grade.

Construction
Assuring proper grade.

Here is a close-up view of the slope level that was used to set the proper roadbed slope.

The vertical dimension from the Excel spreadsheet was also used to assure that the trackwork was of the proper slope.

Construction

After considering the options, it was determined that light was an important to the layout so you could see it! Thus, **STOP** going vertical and level out.

This is the transition point from the helix to the second level.

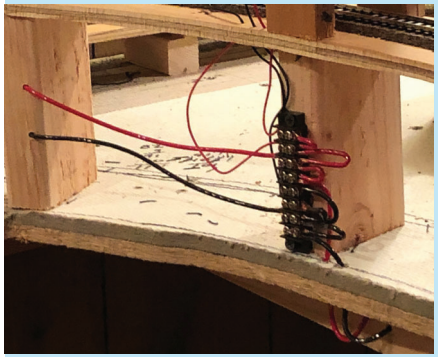
Construction

h the six segments of the first ring installed and vertical spacing cks in place the blocks will now be installed on the sides parallel to track and will no longer need the grade bevel.

track is installed, as construction progresses, as there will not be ficient room to install it later. The segments are joined over the od blocks for support.

w is a good time to check the clearance between the rings to assure is "good"! Remember, measure twice to keep from having to go ck and "fix" it later.

Construction



Time to get track power arranged to power the HELIX.

A track wiring buss connection block was installed with connection to all levels of the helix to assure there as a good source of power for the locomotives.

The buss is connected to the power district of the layout that connects to the HELIX.

Construction

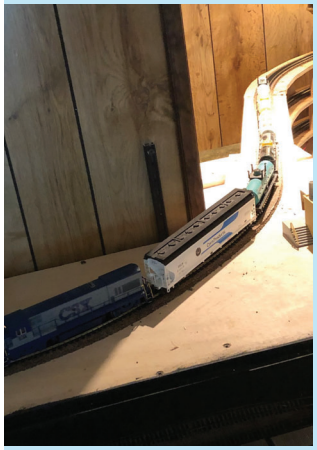
Everything was going great, according to Hoyle, when I got to this point and encountered a **BIG** issue . The track work was going to **intersect** with the existing light fixture! Whoops! How did that happen?

The darned light was going to interfere with the final level, and the engineering department was going to have work out a FIX for it, either remove the light OR stop going vertical.

Finishing the Helix

1” x 2” wood supports were installed on the outside of the helix to support 1/8” Masonite material. I painted a background on the Masonite and added scenery to the front consisting of a town square and park.

Testing of the HELIX



A test run with one of the possible combinations of locomotive and consist was done to make sure all was good, and it was.

By design trains on the layout are a maximum of 5 cars in length. This is due to the limited length of sidings on the layout.

Due to the helix radius the trains will be limited to two axle locomotives. Three axle could run on it, but I am limiting it to two axle for locomotive safety.

Finishing the Helix

This is the upper-level entrance/exit from the helix. I didn’t like the light in the tunnel and a sight line that allowed the helix to be visible, so I installed a shield made of cardboard and painted it black. (right photo)

Construction Complete

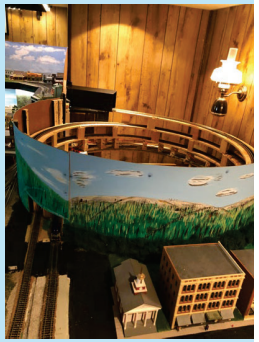
The helix is installed and now what to do so no one can see as it not the best scenery for a train layout.

You don’t see to many prototypical helixes on real railroads!

The Finished Helix

The left photo shows the start, and the right photo shows the finished product from an upper view.

You can see the view block for the upper helix entrance/exit point that makes it more difficult to see the helix at eye level through the portal tunnel there.



Finishing the Helix

didn't like look of the exposed tortoise motor at the interlock on the first level. So, I kit bashed tower building to hide the motor.

Finishing the Helix