COVID Coaster

Elyse Nardozza, Yariel Levin, Nick Marcelli, Yamir Levin; Advisor: Dr. Nabil Al-Omaishi, Dr. Manish Paliwal[1]

[1]Department of Civil Engineering, [2]Department of Mechanical Engineering, The College of New Jersey, Ewing, NJ

Abstract

The COVID Coaster is a 16-foot-high, 4191-foot-long coaster that features 108 supports and spans through the campus of The College of New Jersey located in Ewing, New Jersey. The design and construction planning of this roller coaster will provide students at the College with a new and alternative method of transportation around campus. This project focuses on the structural and kinematic components of the coaster and was designed in accordance with AASHTO and ASTM Specifications. The coaster will feature a rail track which was designed using W14X48 columns, W14x48 beams and W10x45 girders. The track will have three launching mechanisms at each platform.. The car was designed in accordance with CDC social distancing guidelines. It will weigh 2500lbs, have an axle distance of 7.79 feet and dimensions of 10'x5'x3'. The ride will feature 8 carts which would accommodate 3 riders per cart bringing the maximum capacity of the ride to 24 riders. The total construction costs of the project will be $7,200,000 while the total engineering cost will be $32,200.

Design/Methods

Site Planning

- Used topographic map to determine placement and height of each support
- Determined the placement of all three platforms
- The rail track was placed in order to avoid existing traffic patterns.
- The clearance height of the coaster was determined to be 16 ft in accordance with AASHTO *(Articles 2.2 to 2.6)*.

Structural

- Beams Girders and Columns were designed for moment and deflection using *Visual Analysis*
- The rail track for the coaster was designed to support the cart loading, be within the allowable deflection and minimize material costs.
- The three platforms were designed using loading conditions outlined in ASCE 7-10: Minimum Design Loads for Buildings and Other Structures for walkways and elevated platforms.
- The welded and bolted connections for the rail track & platforms were designed to withstand the live loads of the cart while also the dead load of the rail track. The welded connections for the rail track were designed to withstand the loading outlined in ASCE 7-10, while also withstanding the loading of the grating and the self weight of the steel

Mechanical

- ANSYS Workbench static-structural analysis was performed on each of the three different materials to analyze structural stability and deflection of cart
- Wind Loading Analysis of cart was completed on solid works for an optimal design
- Stratasys Dimension Printer was used to print FDM prototype of model
- 3 Person Wishbone Design
- Steel Body
- Plexiglass Barriers
- Plastic Seats
- Polyurethane Tri-Dimensional Wheel Interface
- Classic Train connection
- Electromagnetic Launch Track
- Magnetic V- Shape Braking System
- Additional PID Control System

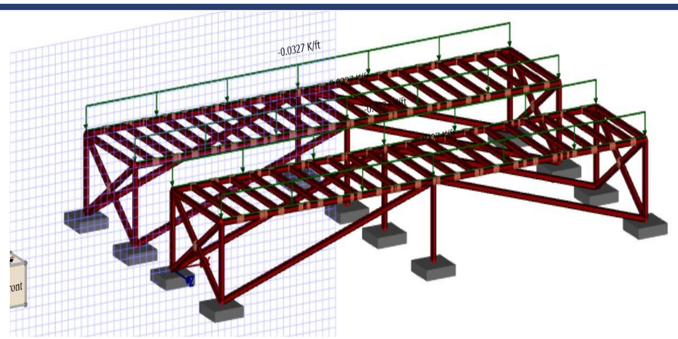

Figure 1: Full Platform

Figure 2: Site Plan

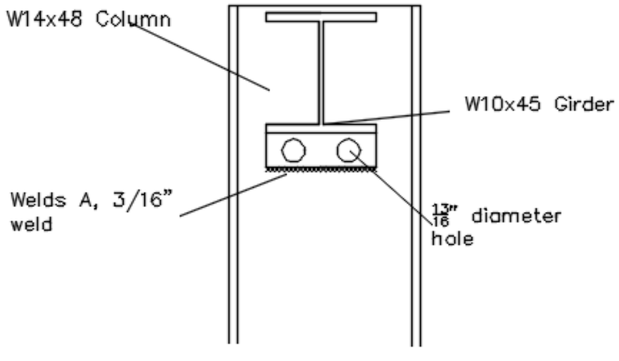

Figure 3: Girder to Column Connection

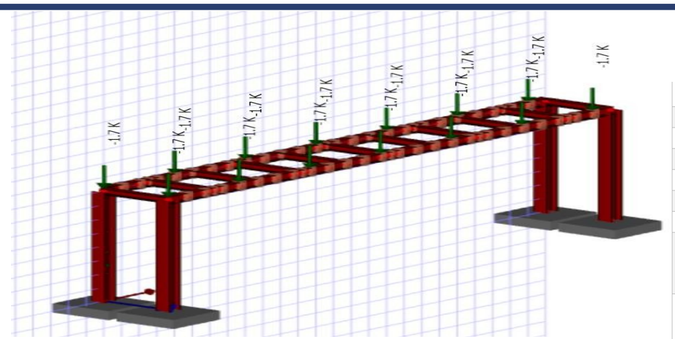

Figure 4: Rail track Model

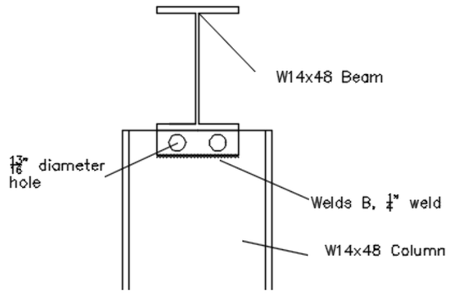

Figure 5: Beam to Column Connection (

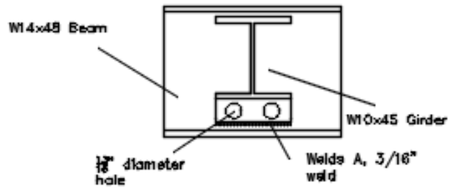

Figure 6: Beam to Girder Connection

Figure 7: 3D Car Prototype

Results

Rail track	
Beam	W14x48
Column	W14x48
Girder	W10x45
Beam Capacity	294k
Column Capacity	294k
Girder Capacity	206 k
Welded Connections	Column to Beam: Welds B, 1/4 " weld, 123k capacity Beam to Girder: Welds A 3/16 " weld, 105k capacity Column to Girder: Welds A 3/16 " weld, 105k capacity
Bolted Connections	Column to Beam: 2 holes, 3/4-inch bolts, 8-inch angle Beam to Girder: 2 holes, 3/4-inch bolts, 8-inch angle Column to Girder:2 holes, 3/4-inch bolts, 8-inch angle
Deflection	-0.69206

Platform	
Steel Shape	HSS 14x14x.875
Welded Connections	3/8" Fillet Weld
Deflection	-1.4378
Steel Grating	14 gauge galvanized 2- Diamond Pluck 4-3/4" width, 6'0" span
Hardware	Saddle Grip Assembly
Staircase	Standard 16 ft Staircase (5 Total)

Site Planning	
# of Supports	108
Distance	4191'
Clearance Height	16'

Conclusion

The coaster was placed in order to minimize traffic alterations. The clearance height of the coaster was determined to be 16 feet in accordance with AASHTO (Articles 2.2 to 2.6). The rail track was designed using the loading conditions of the cart & passengers in accordance with ASTM F2291and was designed to be within the allowable deflection. The platform was designed using loading conditions ASCE 7-10. The car was designed to be aerodynamic, ergonomic and sustainable as well as structurally adequate for all factored loads. The launching mechanism was designed to be integrated into the rail track design was also providing a safe method of take off.

References

I.AASHTO Provisional Standards. Washington, D.C: American Association of State Highway and Transportation Officials, 1995. Print.

II.ASTM F2291-20, Standard Practice for Design of Amusement Rides and Devices, ASTM International, West Conshohocken, PA, 2020, DOI: 10.1520/F2291-20

III.Joe PasterisJoe Pasteris REI. In 2003, et al. "How Much Should Your Pack Weigh?" *REI Co-Op Journal*, 12 Apr. 2019, www.rei.com/blog/camp/how-much-should-your-pack-weigh

IV. "Coasters-101: Wheel Design." *Coaster101*, 8 Aug. 2020, www.coaster101.com/2011/10/24/coasters-101-wheel-design

V. "Master's Thesis: Design of Roller Coasters"