ArcelorMittal’s facility in Steelton, PA produces high volumes of rail for the North American railroad industry. The storage of these products presents a safety issue. In the lag time between production and shipment of the rails, the material is stored in piles with a wooden separator between each layer of rail. The wooden separators are subject to the load of rails along with the environment, causing them to weather and degrade over time. The degradation of the separators presents a potential risk of the pile destabilizing into the walkways of the facility, affecting the safety of the employees.

Our team was tasked with designing a solution to this problem while meeting additional needs. The most important of which included safety, portability, and assembly. Resulting from concept generation and selection, two main ideas were produced. The first of which is called Stack Stabilizers. This design would replace the wooden separators currently used between each row of rail. The material would consist of non-degradable high-density polyethylene. A wedge connection would be used on the outer sides to add lateral stability to the pile as each new row is added. The other idea was called Inserted Bin Pole. This design resembled the Bin Pole concept already used at the facility, but with an added portability option. A hook design would be added so that each pole could be transported by the overhead crane and moved to another location. The pole would just be slide or inserted into ground sleeves that hold the pole for upright use.

It was decided to continue with the Inserted Bin Pole design due to feasibility and ease of integration. Since structures like this already exist at the facility, very little processes have to be updated with additional advantages to the company. It was also determined that these poles could be made from recycled rail material lying in the yard. This rail can be melted and re-rolled into desired square blooms, using manufacturing processes right at the facility. To make the hook structure, bar stock would be placed horizontally through the top of the pole with a steel cable attaching to the extending ends via a spliced connection. The sides of the cable would be tack welded to the pole to stay upright during operation. The sleeves would be made from welded sheet metal placed in the ground once the holes were dug. A hinged capped would be applied as an extra safety precaution when the bin is not in use.

Structural analysis was conducted on the pole to validate its strength against a possible impact from the overhead crane carrying a full load. This would represent a catastrophic event that would greatly damage the poles. In our approach, using an energy relationship, we could test the poles until failure and back calculate a safe crane operating speed. In addition, the steel cable used for the hook, produced a factory of safety of 15 based on the manufacturer load rating and estimated weight of the poles. Both analyses produced encouraging results.

In the end a 5” x 5” cross sectional pole was chosen with recommended crane velocity of 144 fpm. Once incorporating all the in-house manufacturing, material, and labor costs this design has an estimated cost of $754 per bin. The team believes that the proposed design satisfies all of the customer needs and is a valid solution to ArcelorMittal’s safety concerns.