

INTRODUCTION

Carmeuse has many different plants around the world. The Carmeuse Buffington Operations is the focus of this project and is a lime manufacturing plant located off North Clark Road in Gary, Indiana. Carmeuse Buffington Operations has three access roads into the facility. Carmeuse Buffington Operations asked Applegate Engineering to provide the preliminary designs for overlays of the existing asphalt pavements, a new road construction for the crushed stone road, and a pavilion structure. Carmeuse would like the two roads with existing pavement repaved because some areas have cracking and rutting. The unpaved road has numerous ruts in it. They would also like a pavilion structure for their employees to use on breaks.

FIELD WORK

A topographic survey of the site was performed in September 2020. Applegate Engineering used GPS surveying equipment to collect GPS data points. An existing site plan was developed from this survey. The points were also used to complete a comprehensive drainage analysis. The site is mostly flat with about a 4 ft elevation change from the south end to the north end of the site. The north end of the site had an average elevation of 588 and the south end of the site had an average elevation of 593. The geotechnical field work at the site was performed using a hand auger. The hand auger collected soil samples up to 18 inches deep at three different locations. These samples were then taken to the lab to be tested. The soil on the site is Silty Sand.

STORMWATER ANALYSIS

We recommend maintaining the existing grade for the new overlay on Carmeuse Lane and the widened section on the Employee Dr. The runoff from these areas will basically be the same as before construction. Currently, N. Clark Rd. has a width ranging from 24-50 feet, and with the recommended full reconstruction, the width will only be a uniform 24 feet. Therefore, there will be a decreased amount of impervious surface area on the site. All runoff will run into existing swales on each side of each road and eventually infiltrate the soil.

ROAD DESIGN

For this project there were three different road sections. All three roads were designed based off the Indiana Department of Transportation (INDOT) standards. All three roads were analyzed using the 1993 AASHTO Method and the current MEPD method. The 1993 method was used to find the amount of ESALs and the structural numbers for each roadway. Then the MEPD software was used to determine how much damage each road would exhibit for a certain period of time without failing. The first road was an employee drive that has recently been repaved. It is currently not at a uniform width and varies from 13 feet to 21 feet. Applegate Engineering recommends that we widen the road to a uniform width of 21 feet. INDOT minimum standards were used for the pavement section design. This included 1.5 inches of surface asphalt, 2.5 inches of HMA intermediate, and 6 inches of an aggregate base.

ROAD DESIGN

The second road was North Clark Road. This road is currently has a crushed stone surface, and contains rutting and potholes. It ranges from 24 feet to 50 feet. Applegate Engineering recommends a total reconstruction. The new road would be a uniform 24 feet wide. INDOT minimum standards were also used for the pavement design section. This included 1.5 inches of surface asphalt, 2.5 inches of HMA Base, and 6 inches of an aggregate base. The third road section was Carmeuse Lane. It currently has issues such as alligator cracking. It also ranged from 20 to 24 feet. Applegate Engineering recommends keeping the width the same. We also recommend doing an overlay section for this using HMA. The calculations required at least an inch of HMA overlay, but INDOT standards said to use a minimum of 1.5 inches.

PAVILION DESIGN

For the proposed pavilion, three alternatives were considered. The first design is a Lawn Master 12' x 12' pavilion that has a material cost of \$3000 and could seat 9. The second alternative that was considered was a Sunjoy 13' x 15' pavilion that had a material cost of \$2000 and could seat 13. The third and chosen alternative was a Yardistry 12' x 16' pavilion that had a material cost of \$3000 and could seat 18 people. This was chosen for its cost, maximum capacity, and versatile design. This design has a typical roof member size of 1.5" x 3" and a column size of 4" x 6", and is shown in the figure below.

The structure was then analyzed according to the International Building Code as well as the National Design Specification for Wood Construction. The structure was analyzed using the computer program Visual Analysis. The structure was found to meet all structural requirements. The maximum moment in the structure was found to be 9,441 lb-in while the maximum allowable moment was 30,439 lb-in. The maximum allowable deflection was found to be 0.38 inches, but the maximum deflection found in the structure was .32 in the roof rafter. The maximum shear stress was also found in the lowest roof rafter and was 260 lb, while the maximum allowable shear stress was 577 lb.

The concrete slab beneath the pavilion will be 12' x 16' x 4" with a 4" gravel subgrade. The columns will be supported with a minimum 12" x 12" x 12" foundation on each corner. These are the minimum designs and will more than adequately be able to handle the 559 lb pavilion loads.

