



Terminal Ave Building Addition & Stormwater Management Design

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Abstract

A chemical research facility located in Clark, NJ requires an office space expansion to accommodate growing operations. The team designed the structure, green roof, foundation, and a new stormwater management facility of the one story, 67,000 square foot building addition. The structural addition included the design of a reinforced concrete slab, steel beams, girders, and columns. A concrete slab depth of 8 inches with #6 rebar was chosen to support the roof loads. The beams were spaced 5 feet c/c with a span length of 25 feet. The girders spanned 25 feet and the column height was 10 feet. The geotechnical design was a drilled shaft to the depth of bedrock and a drilled shaft placed under every column of the addition. The axial, lateral, and moment capacity, along with reinforcement of the drilled shafts were analyzed based upon given loads by the structural team. The Green Roof design will be implemented at a depth of 8 inches and an area of 50,600 square feet on the roof of the addition. An adequate roofing system consisting of 4 roof drains will be designed to relocate the excess water from the green roof to the stormwater basin.



Design/Methods

Structural

- Reinforced concrete deck, beams, girders, and columns were designed for shear, moment, and deflection
- The structure was designed based off ASCE 7-10
- Reinforcement Bars in the concrete slab were designed
- Structure was run through Visual Analysis

Geotechnical

- Boring logs and laboratory data provided were used to determine the four soil layers.
- SHAFT v2016 was used to determine ultimate load of the drilled shaft.
- GROUP v2019 was used to analyze the lateral capacity and ultimate moment capacity of the drilled shaft.
- Drilled shaft was treated as a concrete column during design of reinforcement bars

Water Resources

- VTSPUHM was used to design required volume of basin as well as the outlet structure elevations and size
- The outlet structures were designed for the 2-, 10-, and 100-year storm events

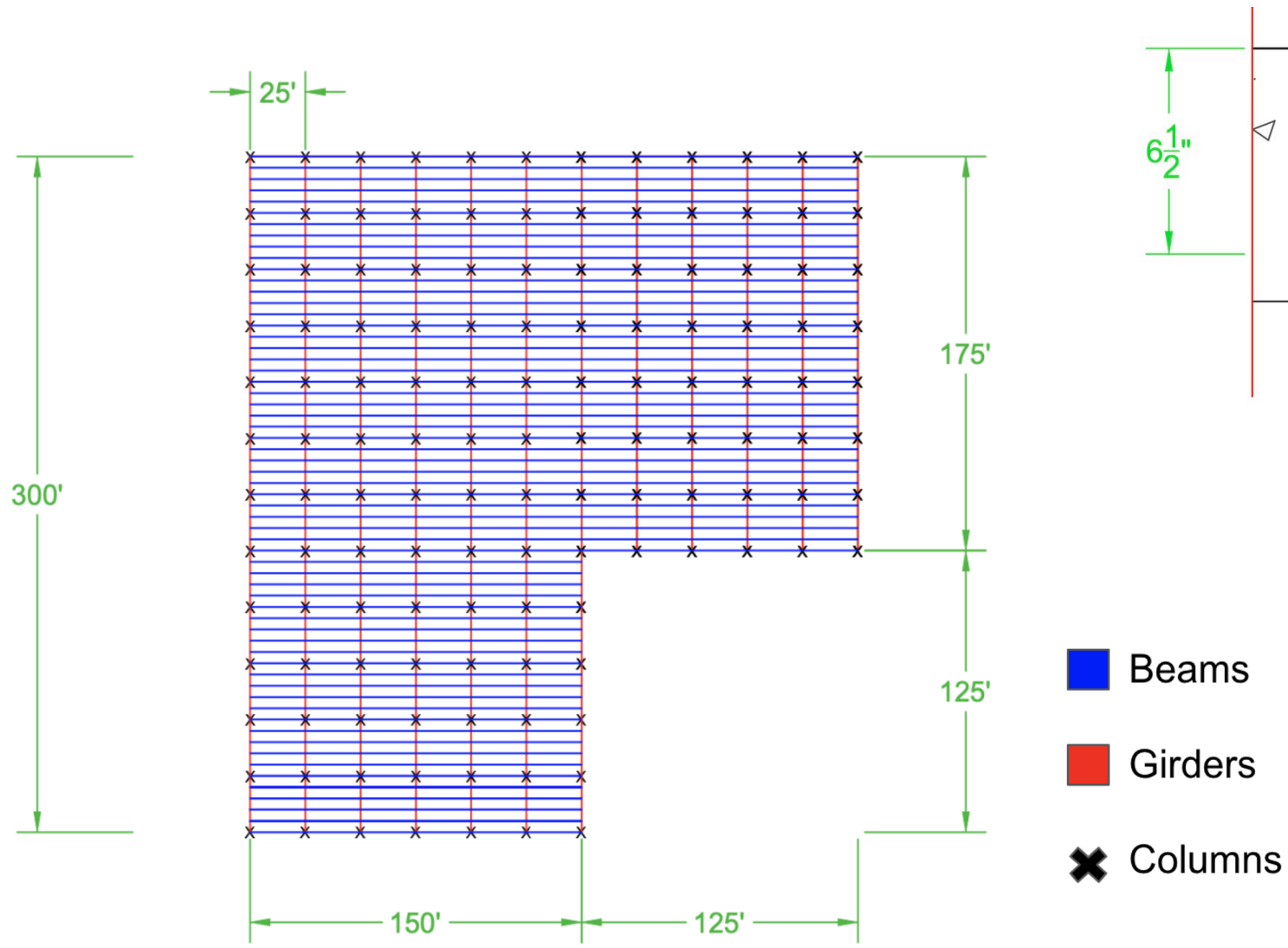


Figure 1: Structural System in AutoCAD

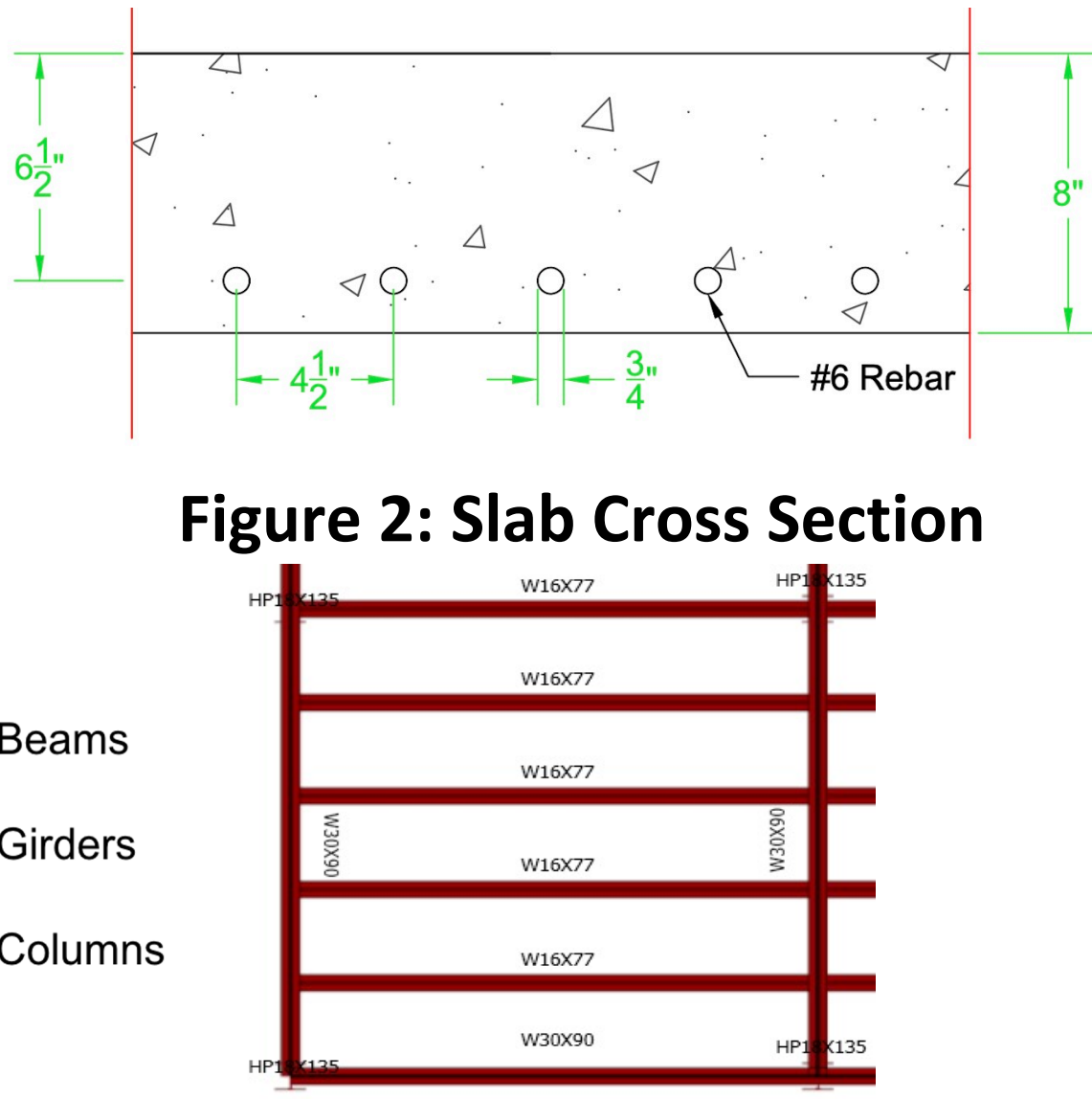


Figure 2: Slab Cross Section

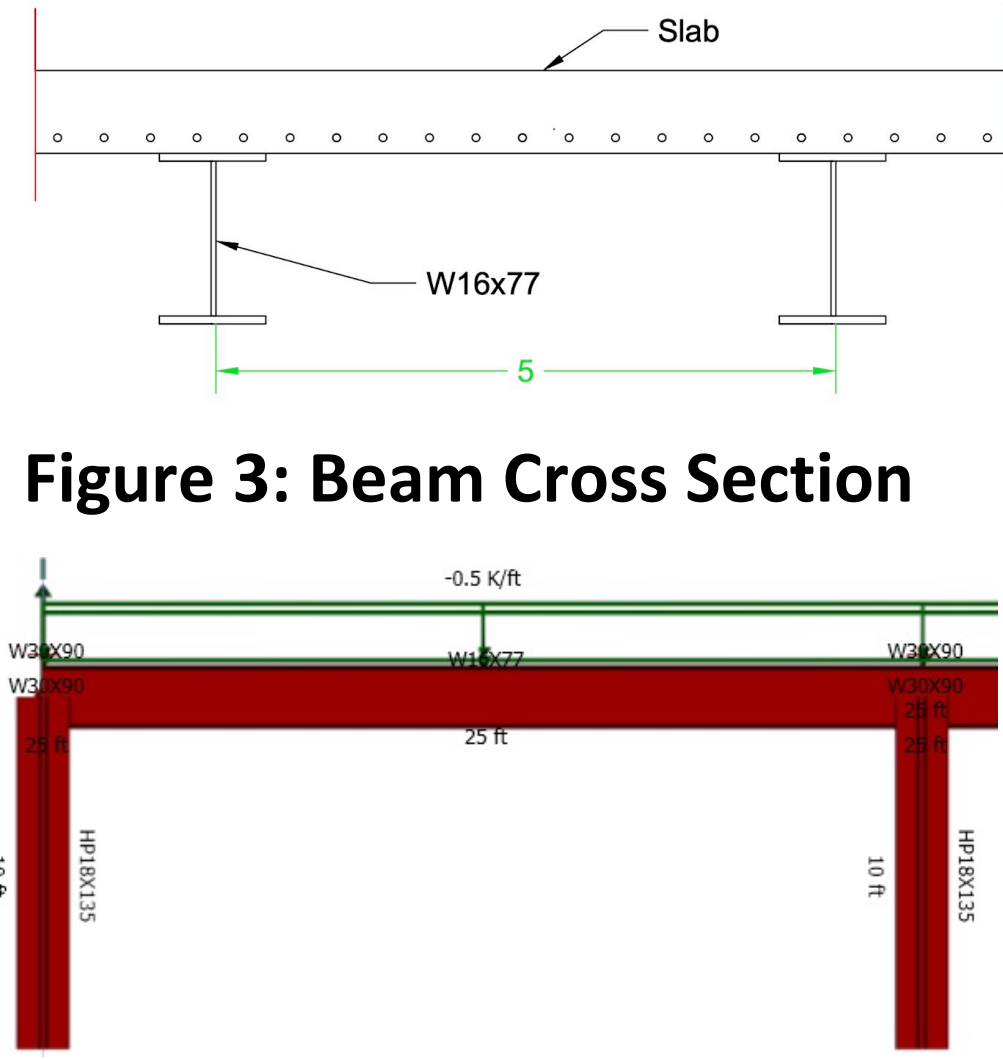


Figure 3: Beam Cross Section

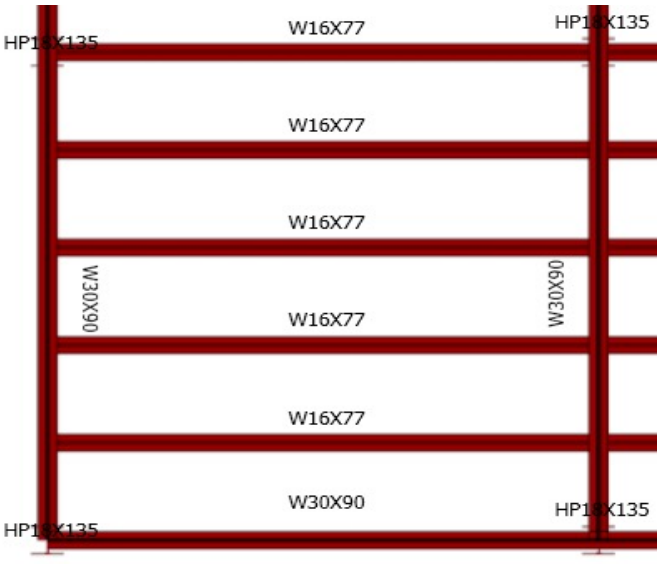


Figure 4: Steel System Plan View

Figure 5: Column Cross Section

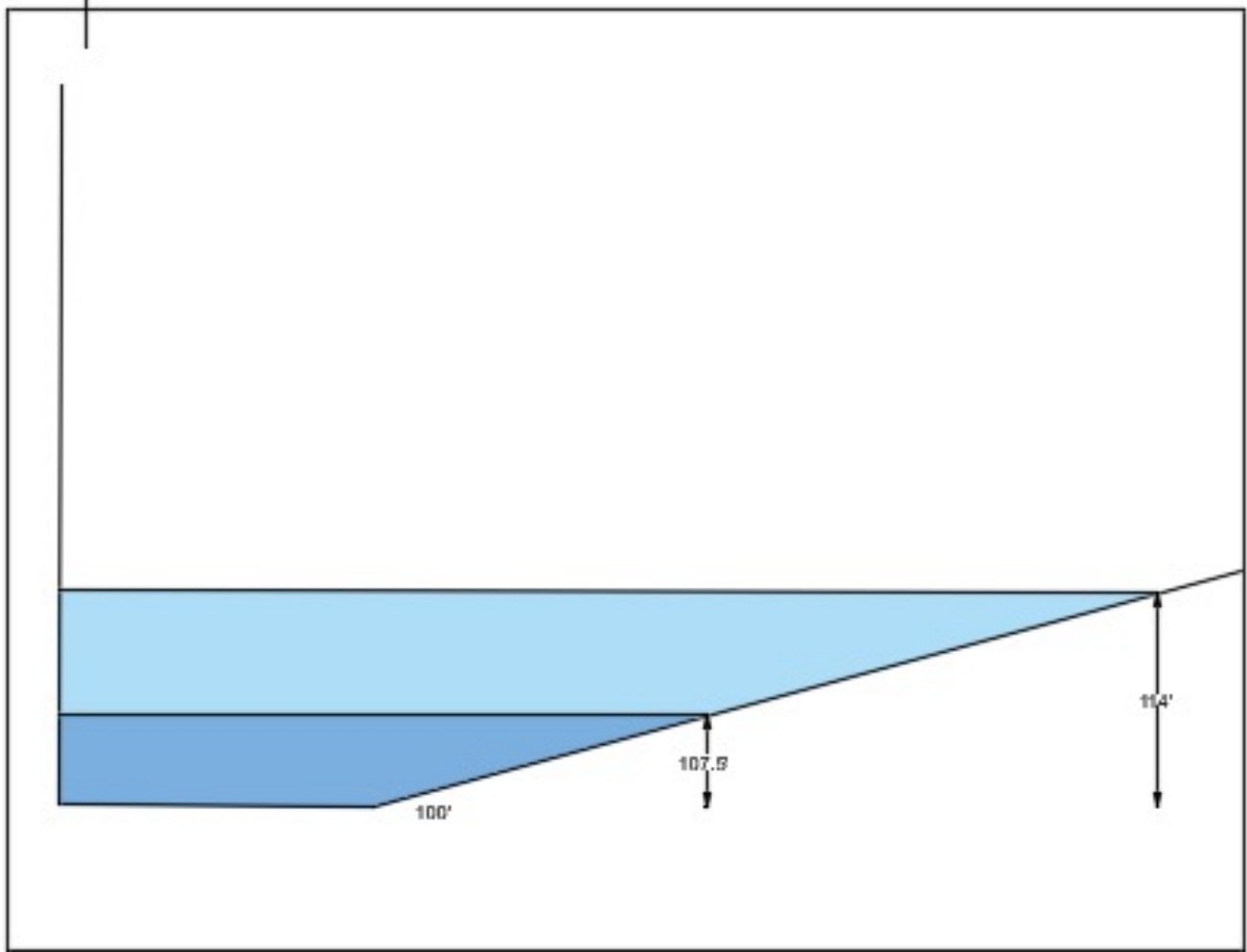


Figure 3: Outlet Structure Elevations

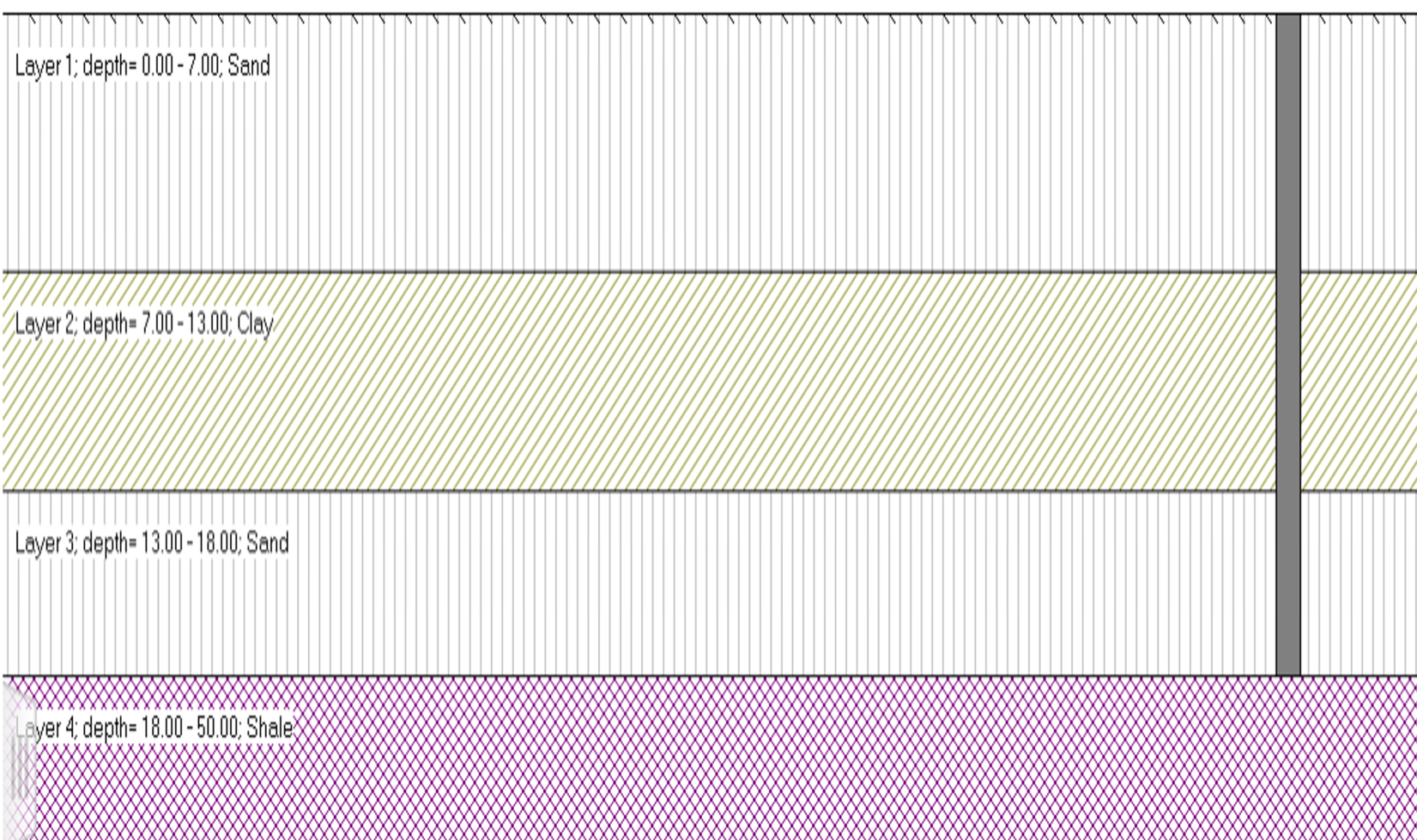


Figure 4: Reinforced Drill Shaft

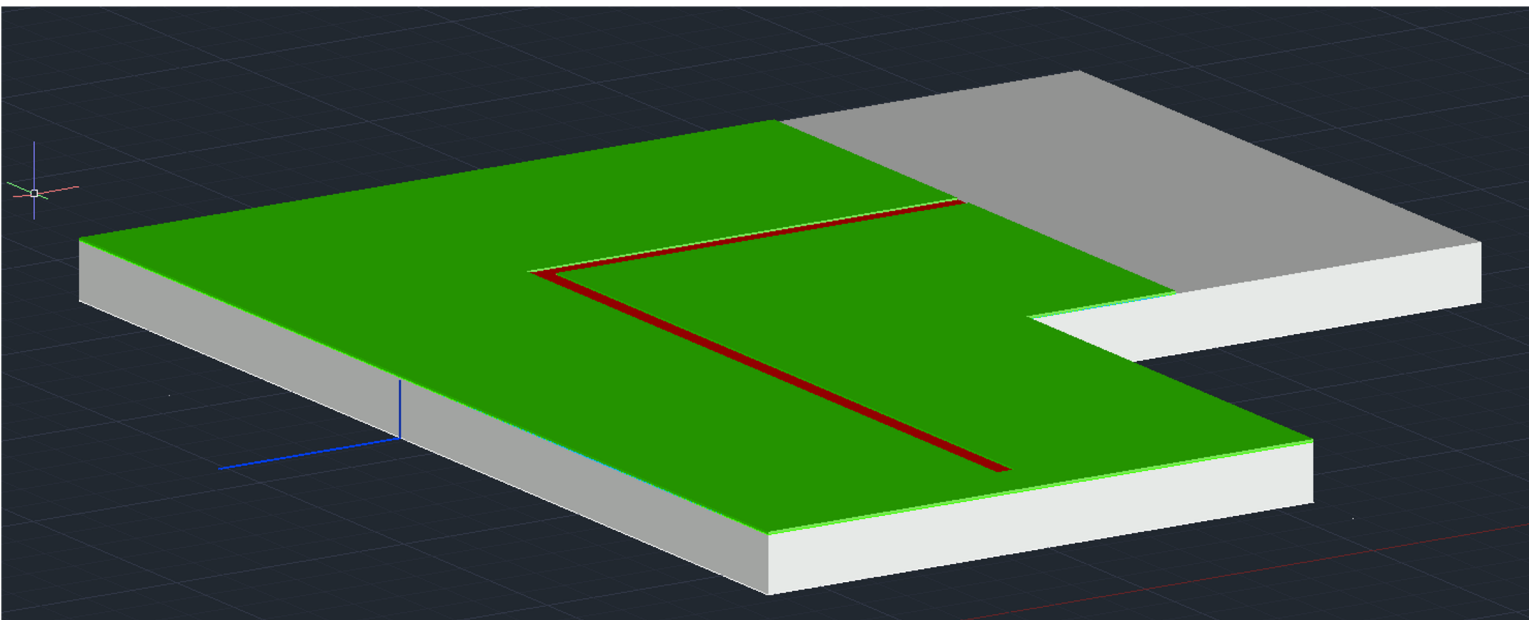


Figure 5: Green Roof AutoCAD Design

Conclusion

The proposed building structure proved adequate to handle the design loads imposed on the roof and in the Visual Analysis simulation. The shaft design proved to be able to adequately handle loads in all areas of the new proposed building addition. The Green Roof design and drain system allows for the relocation of the water from the 100-year storm to the stormwater basin.

Results

Structural

Slab	
Load Type	Load
Design Load	305 lb/ft
Design Moment	23828.13 lb*ft
Beams	
Design Moment	220.7 k*ft
Girders	
Ra and Rb	146.87
Max Moment	1101.525 k*ft
Columns	
Lc/ry	28.5
Load on Column	218.93 k
Design Moment	41.1 k*ft

Element	Material	Design
Slab	Concrete	8" thick slab with #6 rebar at 4.5" c/c
Beams	Grade 50 Steel	W16x36 at 5' spacing
Girders	Grade 50 Steel	W30x90 at 25' length
Columns	Grade 50 Steel	HP18x135 at 10' height

Geotechnical

Pile Properties	
Diameter	2 feet
Length	18
Rebar	10 #9 bars
Ultimate Axial Capacity	560 kips
Ultimate Lateral Capacity	10 kips
Ultimate Moment Capacity	42 kip * ft

Water Resources

Outlet Structure		
Structure Type	Elevation	Orifice Diameter
Circular Orifice	100 feet	.9 feet
Circular Orifice	107.5 feet	.75 feet
Rectangular Weir	114 feet	5 feet

Figure 6: 3D View of Green Roof Drainage System with Subsequent Area for the Drainage Area

References

- ASCE 7-10 Minimum Design Loads for Buildings and Other Structures (2010)
- AISC Steel Construction Manual Design Examples Version 15.1