

Fall 2021

Structural Engineering Project



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Acknowledgments

I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this report. Special thank is due to Dr Jazaei whose help, and stimulating suggestions helped me in writing this report.

Executive Summary

The client has plan to utilize the space above the second floor of his hometown house in Cartagena, Colombia. The Project will construct a 3rd floor structure with Rooftop Deck, Wooden Pratt Pavilion and on the same floor but opposite side a playing room with a bathroom, small bedroom and a living. The construction is planned to use Steel, Wood, and Concrete Material.

As with any construction project, there are risks on the design, so it was recommended to build steel columns, beams and girder on the second floor of the house to support the new construction and make it safe structurally.

The overall recommendation is that this would be an exciting and attractive project with minimal risk. It is sustainable and economical for the design and client.

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Introduction

This structural engineering report has been completed for a proposed 3rd floor rooftop deck and guest room to be constructed in Cartagena, Colombia. A total area of 351 square feet with a wooded pavilion will be developed. Also, a foundation support consisting of steel beams, columns and girder on the floor below the new guest room will be constructed and will cover an area of 156 square feet.

Structural and cost analyses are included in this report. The purpose of the structure analyses is to provide information and recommendations relative to structure stability and deflections.

Site Investigation



Figure 1 Zoom in site location (El Campestre)

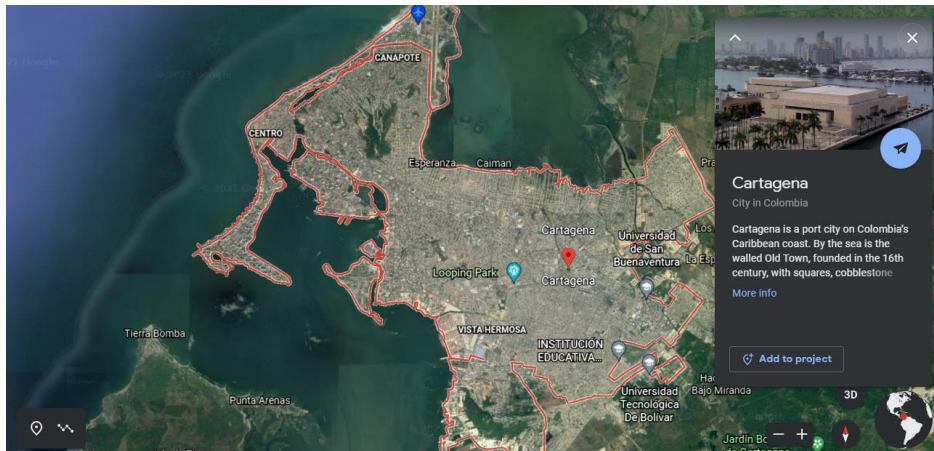


Figure 2 Zoom out Site Location (Cartagena, Colombia)

Based on the site investigation from the customer and the Colombian state and facilities department, as shown above the site is in the tropical, near the ocean, neighbor's house is next to each other. After looking at it from google earth, the roads are very narrow. This may cause problems to delivery of the material. No snow load, or earthquake loads are needed to be considered for the structural analysis.

Proposed Design

A rooftop deck is proposed with space for a wooden Pratt pavilion 10' x13'x 19', a facing south twenty-one (21) square feet space for a garden and 14 square feet space for a BBQ. The Rooftop deck design makes the space a quick and easy access from the second floor. It will be a fun and shady area for the hot weather conditions of the site.

The guest room will have a small bedroom, a full bathroom, playing room and two total windows, one facing south and the other facing north. As geometry and orientation are crucial, this design will provide a south- east side to capture most of the light in the morning to wake up and a cool and shady afternoon to take a nap and enjoy the sunset.

The proposed foundation on the second floor will be made of steel beams and columns. There are six columns welded to the beams. As the choose material are the strongest and durable, the building should have no problem lasting a long lifespan.

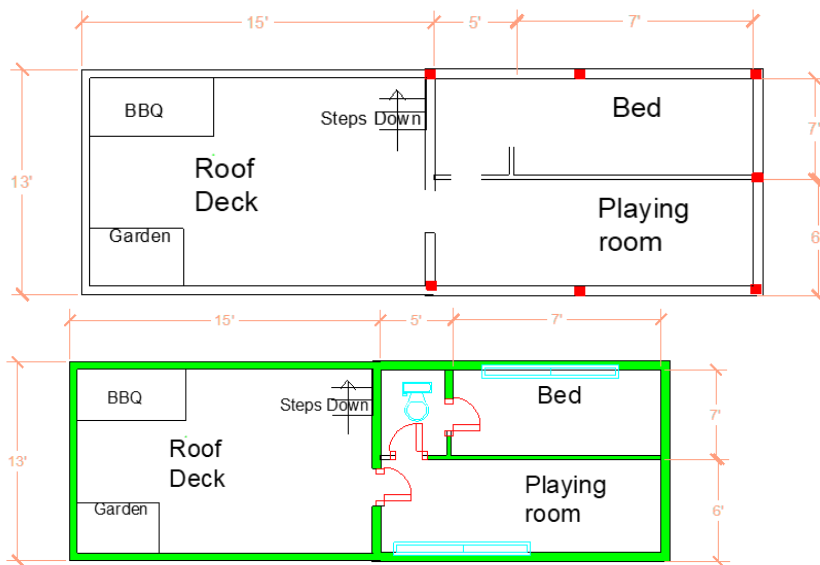


Figure 3 Column floor plan

Figure 4 General Floor plan

Structural Analysis

Design and Structural Analysis

Wooded Pratt Pavilion. Material Pressure Treated Pine (2X4X16) Load Self weight and 10 lbs./ft

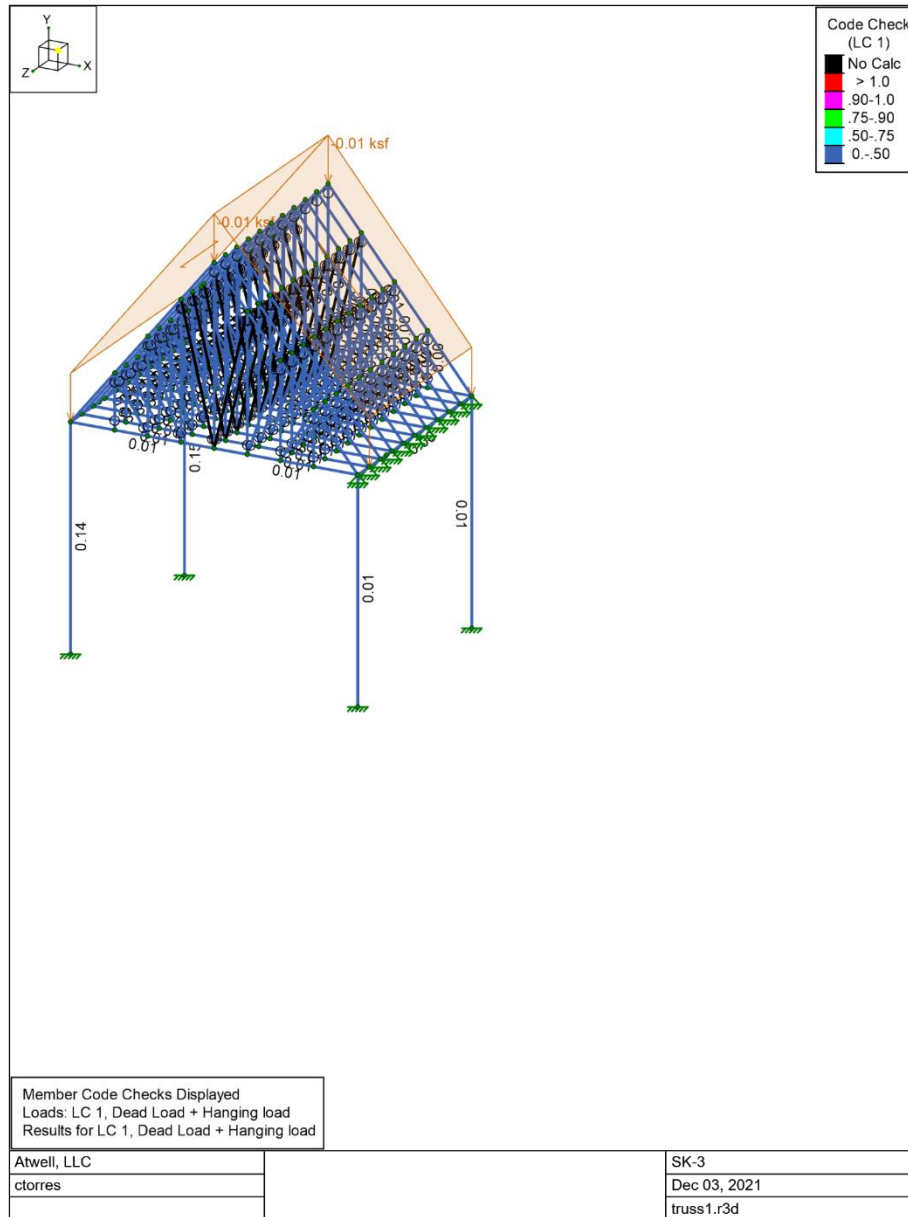


Figure 5 Code Check Pavilion Display plus load.

Guest room frame 12' x 13"

Material 4000 PSI NW concrete. Six columns, five beams and four girders. Loads 100 lbs./ft downward

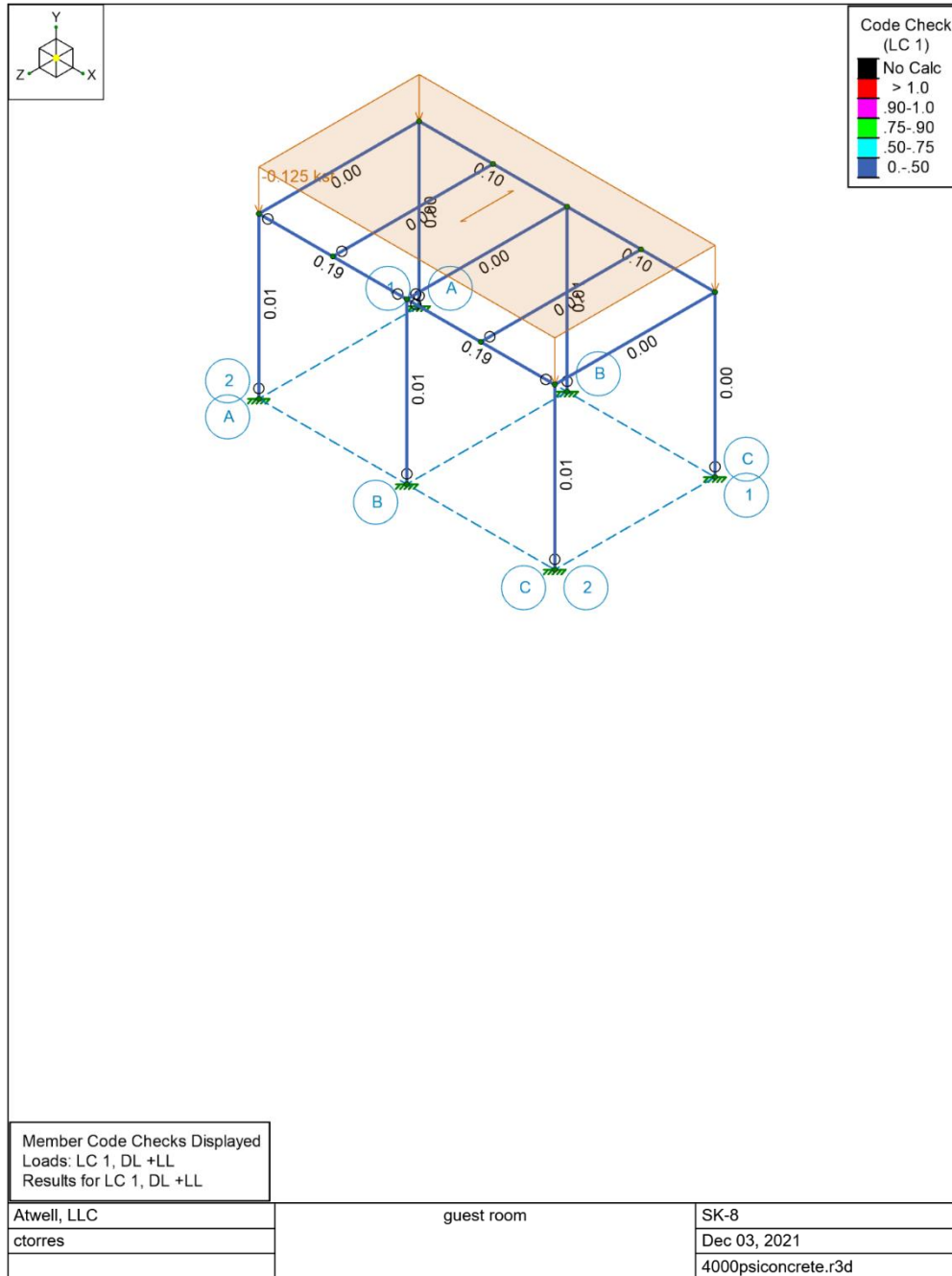


Figure 6 Guest Room Code check display plus loads

Steel Foundation 12 X 3

Material Hot Rolled Steel (double angle and WF shape). Six columns, five beams and four girders. Loads: 8in thick NW concrete slab. Weight of the Pavilion. 40 lbs./ft residential.

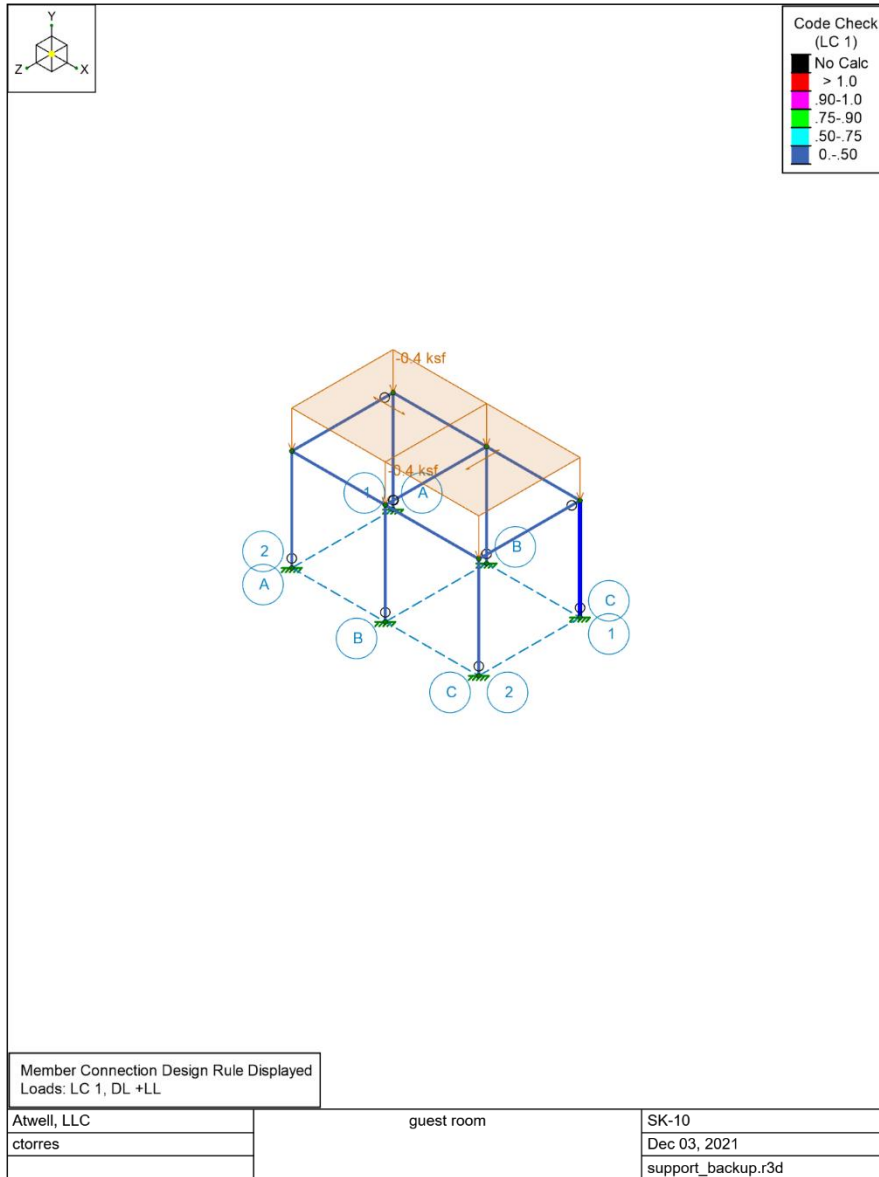


Figure 7 Foundation Code check plus loads

Steel Foundation Deflection

The steel foundation design shows a stable and solid structure on every member.

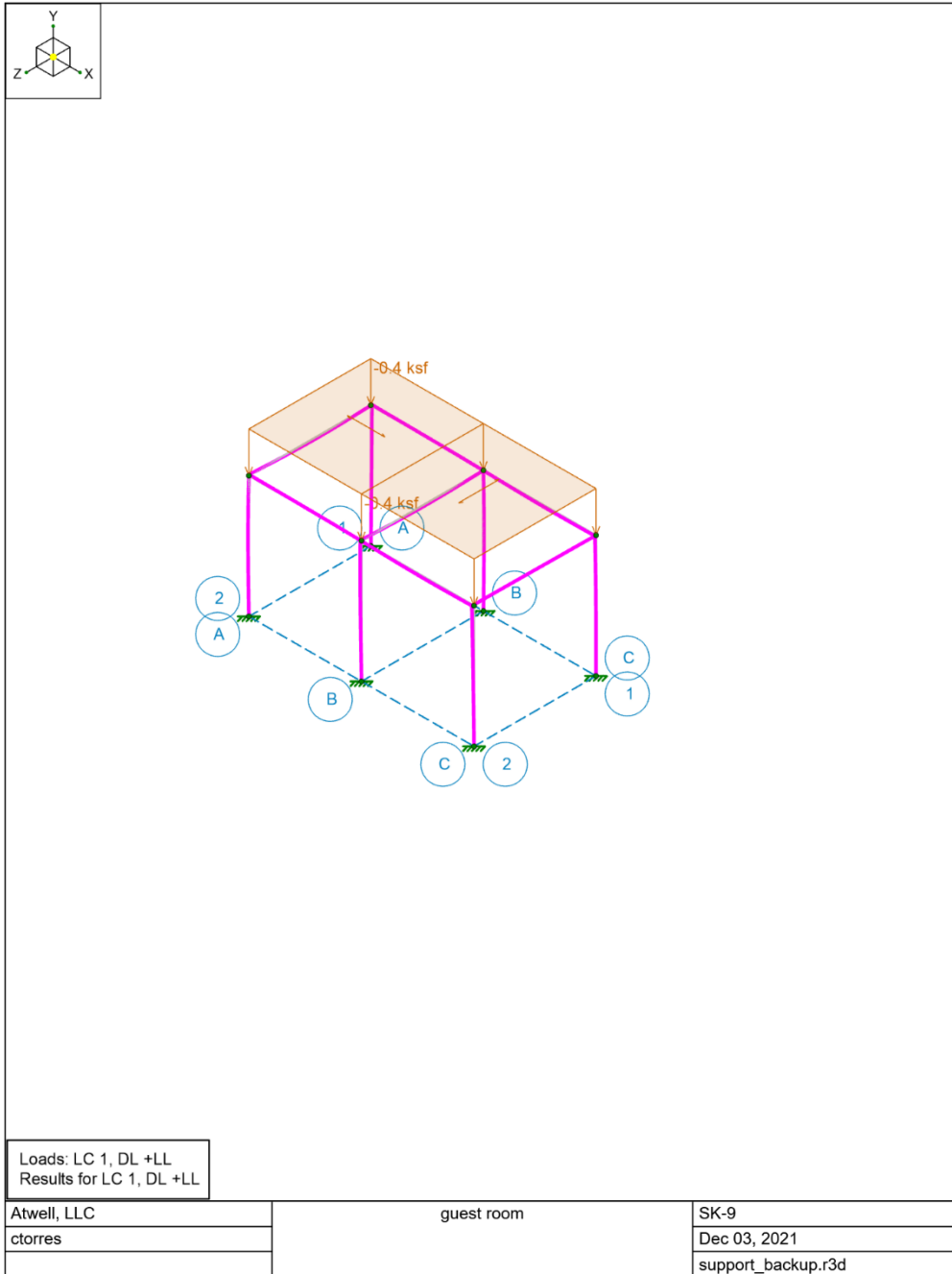
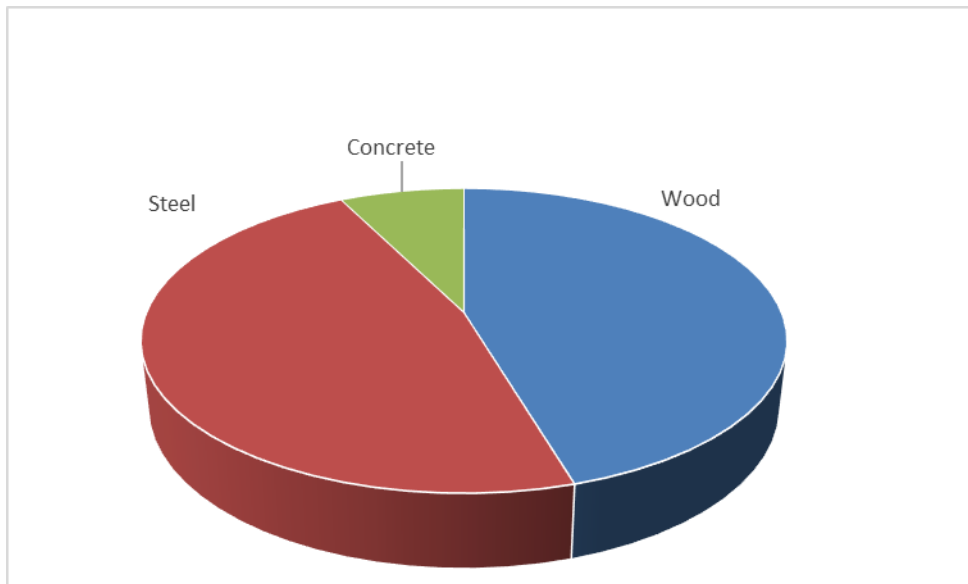


Figure 8 Foundation deflection

Cost Analysis

Material	Quantity	Cost Per Unit
Hot Roll Steel	28,000 lbs	\$11,200
Pressure Treated Pine	1035 ft	\$11,644
4000 PSI NW concrete	10.5 cu yard	\$1,837
	Total (\$)	\$24,681

Table 1 Material Cost Analysis



Conclusion

In any construction project, initial investigations are crucial such as site's topography, site conditions and existing utilities. In this project, I have learned how to research a site's conditions by examining old site civil engineering plans. Also, During the design process, I developed some skills to use the RISA software for structural analysis and AUTOCAD for floor plans.

I was able to apply the knowledge acquired in class on a real project and understood the importance of details and little details on a civil engineer design. "You can't build a great building on a weak foundation; you must have a solid foundation if you are going to have a strong superstructure.

An overall conclusion about the project itself, there was not deflection noticed on any structures. The cost of the project itself is high if those prices are to be paid in Colombian Pesos, the project is feasible, and the utilization of the space above the second floor of the house was a good idea.