

Green Roof Feasibility Study Presentation

College of Engineering



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SIoux CITY ROOFTOP GARDEN

Emily Hannan, Phillip Gregory, Jacob Preuschl



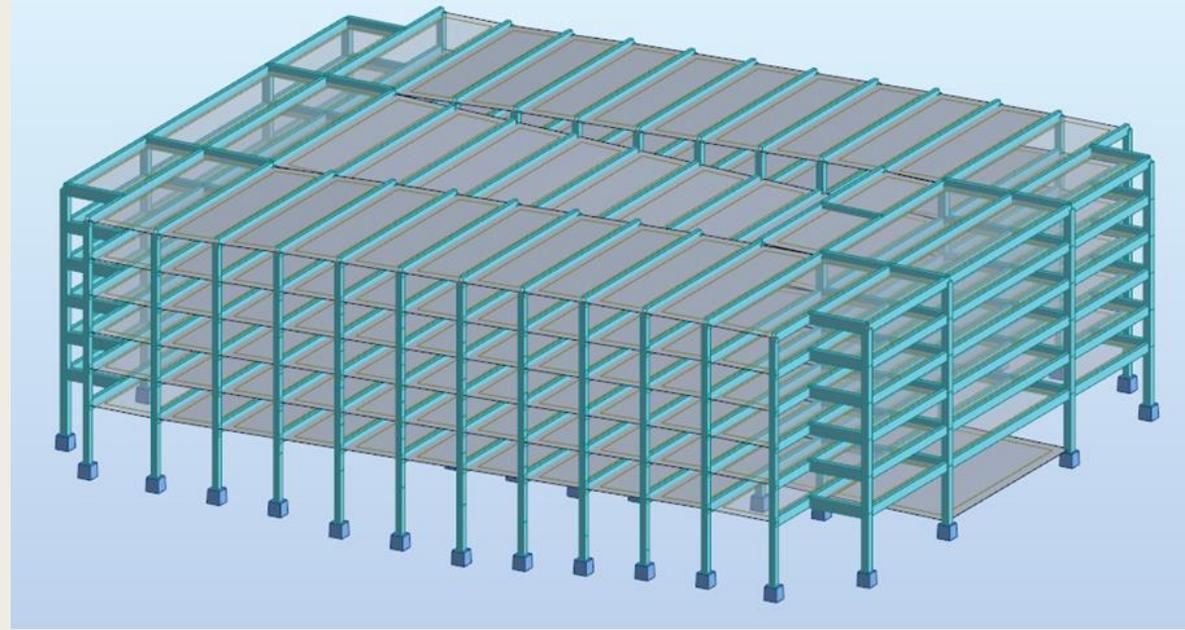
Background

- Sioux City Green Initiative Project
- Discovery Parking Garage
 - *Identified by client, Site visit, condition report*
- Design Question: Can the Discovery Parking Structure safely handle the structural demands of a green roof?



Approach

- Model and Design started consecutively
- Loadings calculated/Applied to the Robot Model
- Critical Components Identified
- Strength Capacity Calculations
- Structural Modification
- Existing Garage cannot feasibly handle a rooftop garden
- Alternative 1 as a design for a future rooftop garden



Constraints and Challenges

- Limit Cost
- Weight of Garden
- Limited Space based on footprint of the garage
- Time
- Finding Suitable and Accepted Design Standards
- Narrow Urban Roadways Downtown
- Low Clearance (10 ft)



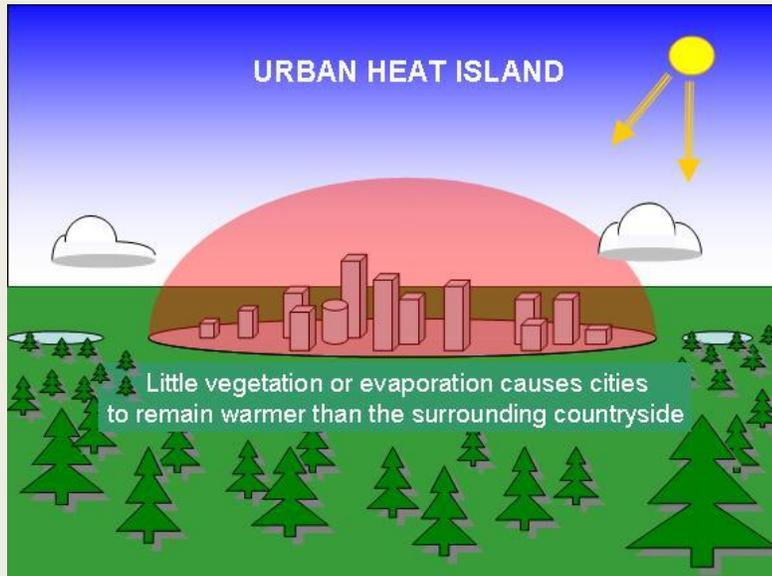
Societal Impacts

Negative

- Inconvenience of Construction
- Decrease in potential City revenue

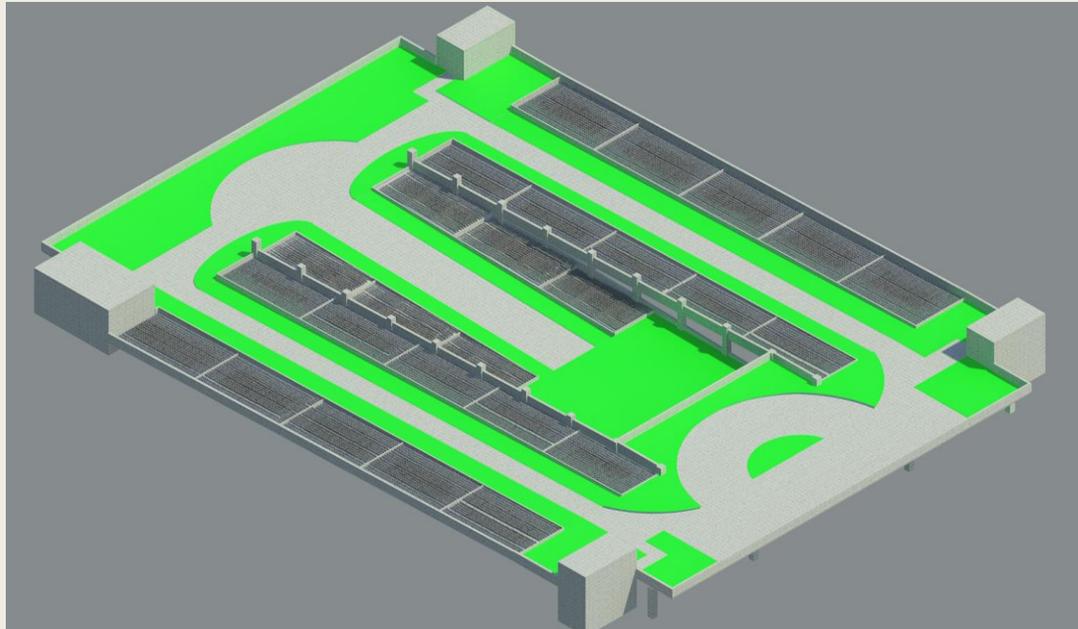
Positive

- Increased Community Green Space
- Involvement of Local Businesses
- Increased foot traffic through nearby restaurants
- Cooling Urban Heat Island
- Clean Runoff
- Drainage Control

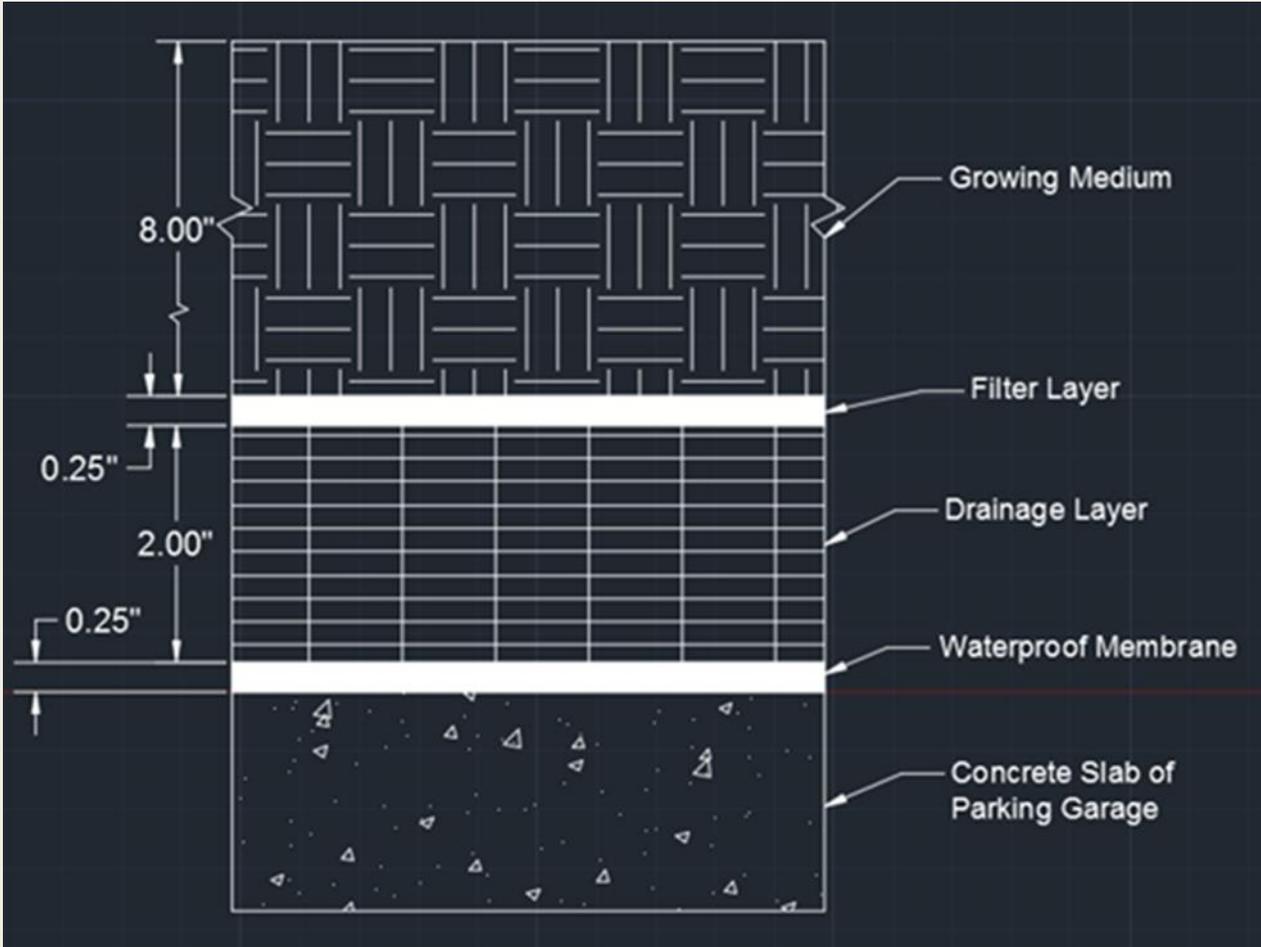


Alternative Solution Option 1

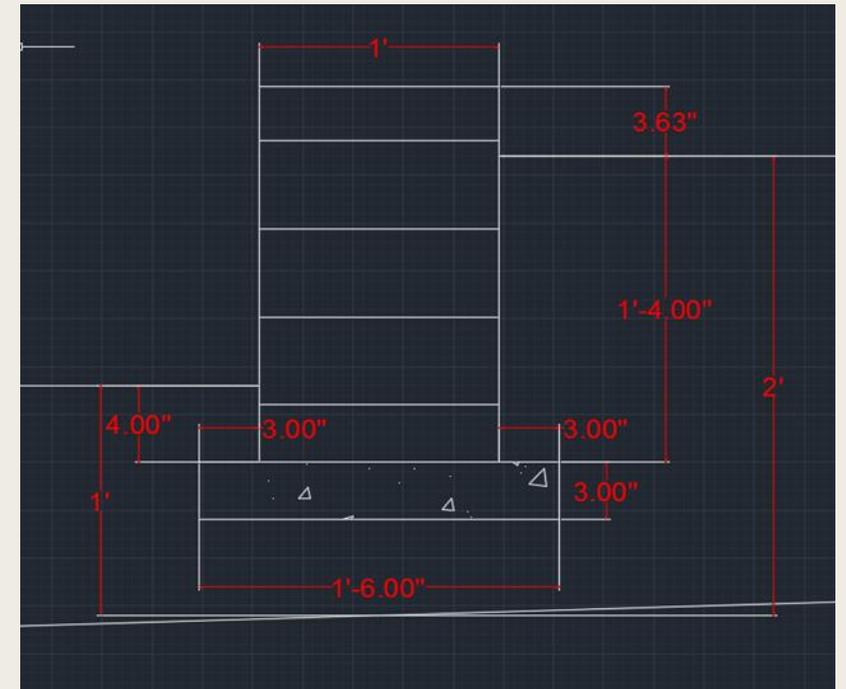
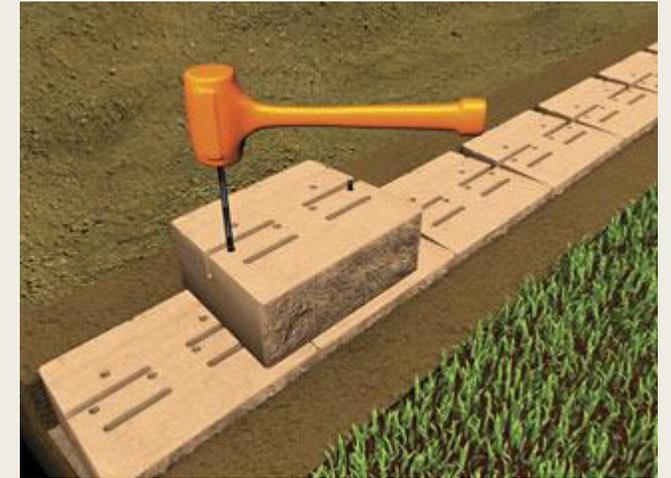
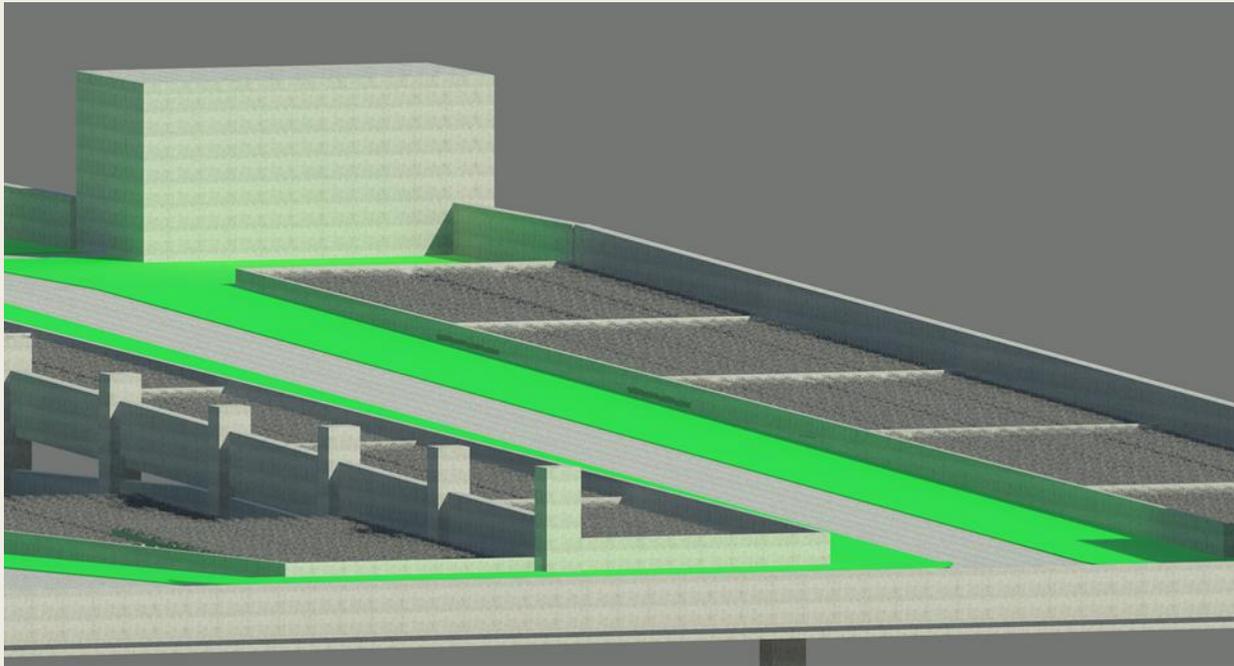
- Full Garden Design
- Components
 - *Terraces*
 - *Multipurpose Area*
 - *Opportunity for local art*



Garden System

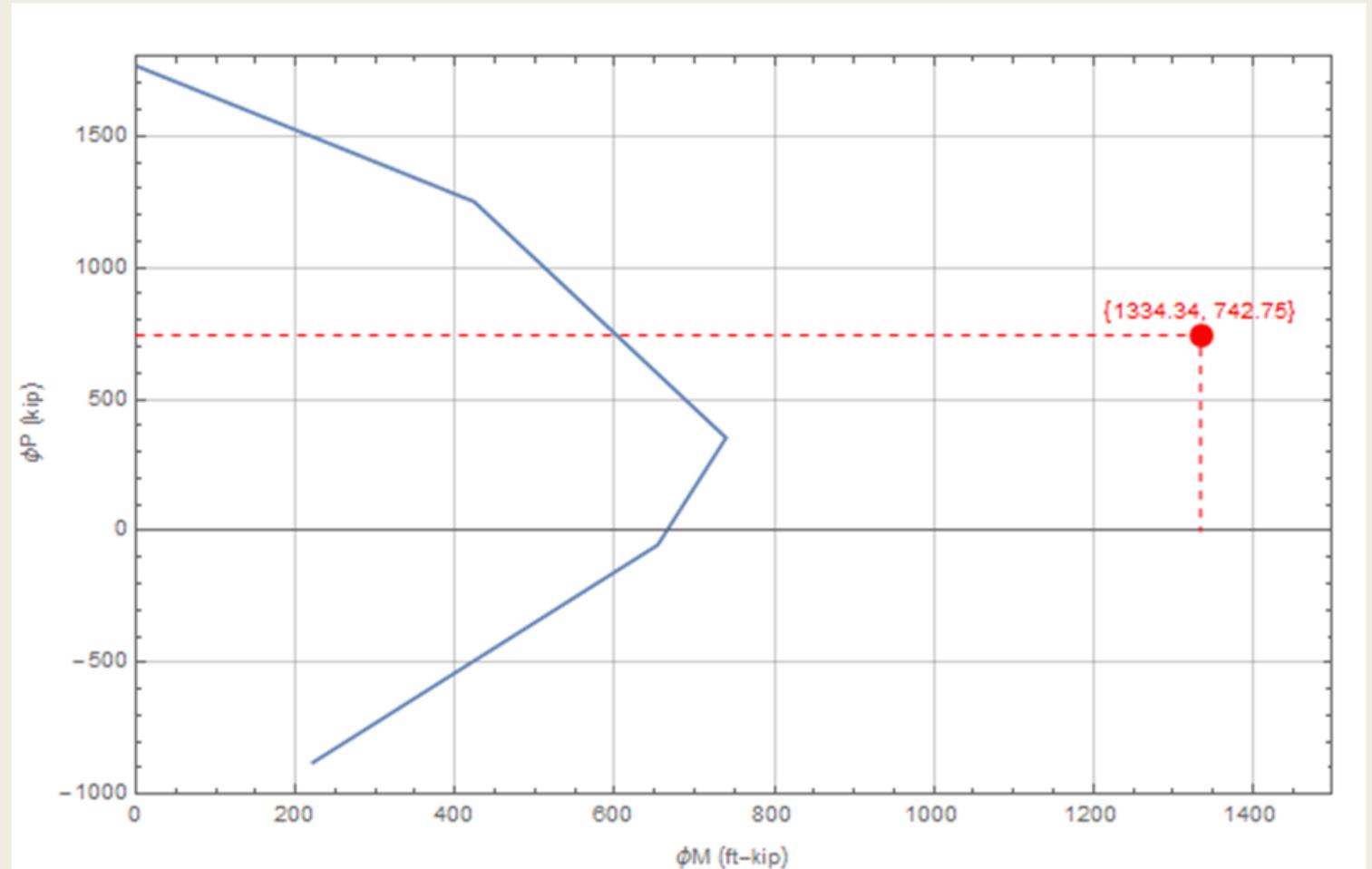


Retaining Walls



Moments and Forces Due to Alt. 1

- Critical Exterior Column
- 5 Point Interaction Diagram
- Safety Envelope



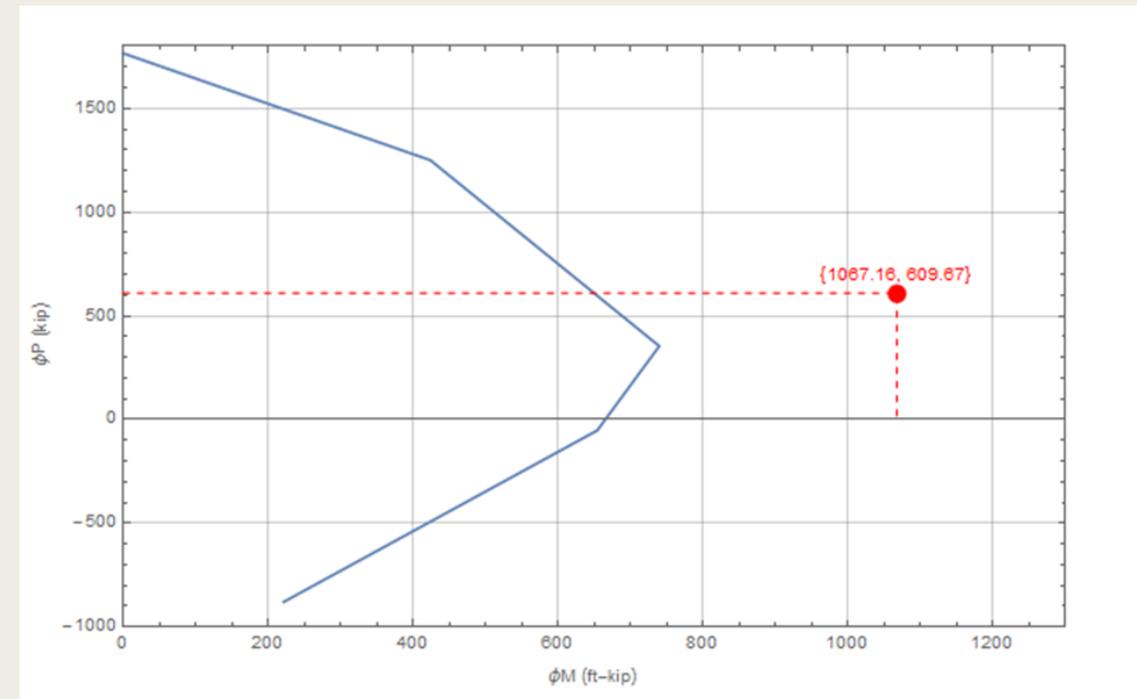
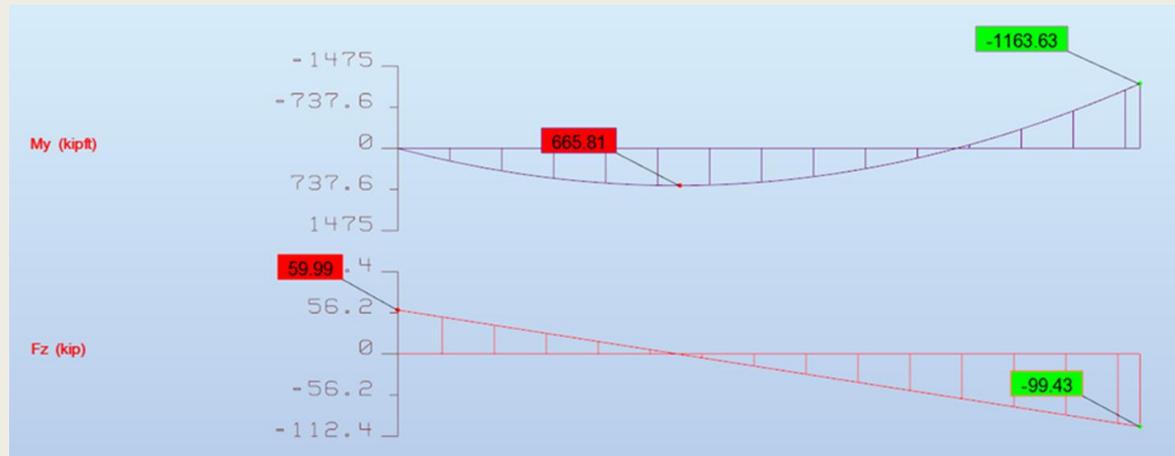
Moments and Forces Due to Alt. 1

- ACI (313-56) Ultimate Strength Method Design
- Ultimate Strength of the Critical Beam, ΦM_n : 1063 kip-ft
- Maximum Applied Loading, M_u , -1333 kip-ft



Moments and Forces Due to Alt. 2

- Ultimate Strength of the Critical Beam, ΦM_n : 1020 kip-ft
- Maximum Applied Loading, M_u , -1163 kip-ft



Structural Modification

- Carbon Fiber Reinforcement
- Concrete Jacketing
- Feasibility of Structural Modification



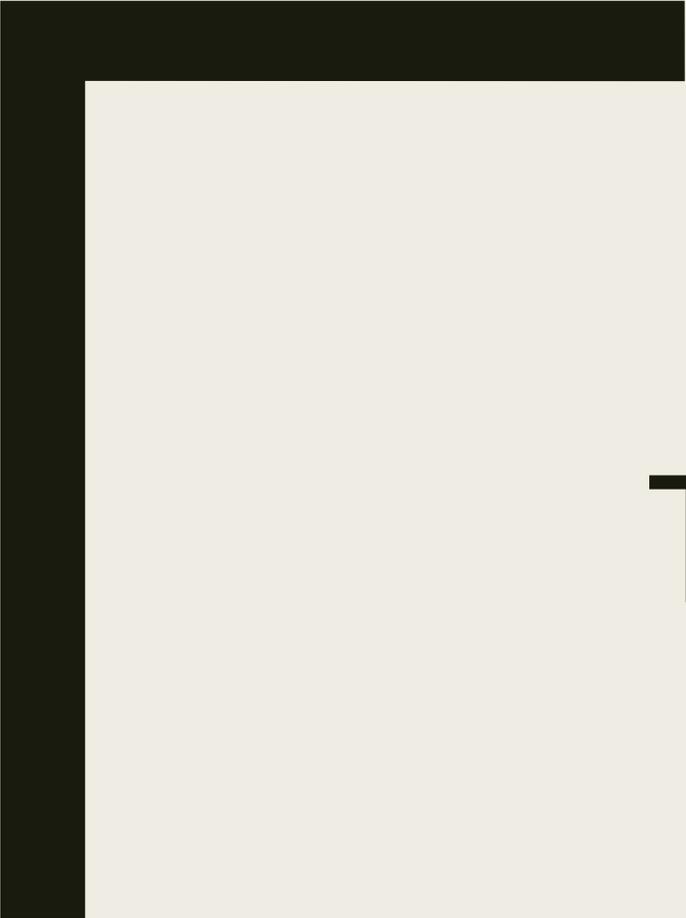
Cost and Construction Estimates

- Materials Cost: \$362,000
- Labor Cost: \$90,000
- Total Cost with 15% Contingency: \$520,000



In Conclusion

- Objective: Can the Discovery parking garage handle the weight of a rooftop garden?
- Outcome: No, it cannot and structural modification is not feasible.
- For the future: Our garden design would make a great addition to a future structure if that structure is designed with the loadings of the garden in mind.



THANK YOU

ANY QUESTIONS?

