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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, $\Phi Mn$: 1063 kip-ft
- Maximum Applied Loading, $Mu$, -1333 kip-ft
Moments and Forces Due to Alt. 2

- Ultimate Strength of the Critical Beam, $\Phi Mn$: 1020 kip-ft
- Maximum Applied Loading, $Mu$, -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?