Thesis Project Portfolio

Site Design for a Hotel in Pantops, Charlottesville

(Technical Report)

Analysis of Sociotechnical Failures that Lead to the Partial Collapse of Champlain Towers South

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

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Bachelor of Science, School of Engineering

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Table of Contents

Sociotechnical Synthesis: Understanding Resiliency through Design and Theory

My technical project and STS research are connected through a shared focus on the challenge of resiliency, or the ability to withstand, respond to, and recover from disruptions. However, the approaches to resiliency and its application differ between the two works. My technical project concentrates on addressing resiliency during the preconstruction phase. Here, the emphasis is on ensuring the protection of the natural environment and the robustness of the site layout as the project is being built. In contrast, my STS research explores how to maintain resiliency over the useful lifecycle of a building, as well as the consequences of its potential failure. This work delves deeper into the complex interactions between human and non-human actors, examining how the various elements of the socio-technical network influence the building's resilience throughout its operational phase. By integrating these perspectives, my work provides a comprehensive understanding of the challenges and strategies for enhancing the resilience of built environments from the preconstruction stage through a building's lifecycle.

My technical work involved developing a set of construction documents for a proposed hotel in Charlottesville, Virginia, for a private developer client. The constraints set forth by the owner included meeting 75% stormwater quality requirements onsite, meeting all stormwater quantity requirements onsite, and incorporating a 14,000-sf building on site with 80 parking spaces. Throughout the year, my project team went through multiple design iterations to determine the best site layout, building orientation, parking design, grading, stormwater management, utility design, and erosion control plans that complied with relevant county codes, state regulations, and federal environmental requirements. Key challenges included designing adequate stormwater best management practices, proper grading for accessibility, and optimizing the site layout to integrate all the design components within the constraints of the compact lot.

My STS research relies upon the framework of actor-network theory (ANT) to analyze the partial collapse of Champlain Towers South that killed ninety-eight people. ANT emphasizes the importance of not only human actors, but also non-human elements, in shaping the success or failure of technological projects and their societal impacts. My research focuses on creating an actor-network in which the developers and owners are the primary actors responsible for the network construction. My analysis aims to understand how the various human and non-human actors interacted and influenced each other within the network, and how the initial network formation and translation process broke down over time. The conclusion I reached challenges the perspective that places sole responsibility on the engineers and architects. Instead, I argue that a culmination of factors was likely the cause of the partial collapse.

Working on both projects simultaneously provided a valuable opportunity to inform one another during the academic year. The technical project's focus on the preconstruction phase allowed me to develop a practical understanding of the engineering standards that go into design. At the same time, my STS research provided insights into the broader socio-technical factors that can destabilize a structure over its lifecycle. These two projects highlighted the importance of adopting a holistic approach to resilience, one that considers not only the technical aspects but also the ongoing maintenance, environmental changes, and stakeholder interactions. Moving forward, I will apply the insights from my STS research to future technical projects, recognizing the need for a comprehensive understanding of socio-technical networks and the potential long-term implications of design decisions on a building's resilience.