Feasibility Study for a Pedestrian Tunnel Beneath Springfield Avenue at Grainger Library

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Milestone #3

CEE 190

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Introduction

Pedestrian safety is a significant concern at the University of Illinois; particularly at the crossing on Springfield Avenue between Mathews Avenue and Wright Street, a problem that has persisted since 1999 (Pona and The Langley Group, 1999). Pedestrian traffic is a hallmark of classic college campus-town areas and the university must improve safety measures to protect its students and pedestrians. Around 3000 students cross the Springfield Avenue crosswalk every day, and in one month alone, 66 students were nearly struck by a vehicle at the crossing on Springfield Avenue (Champaign County Regional Planning Committee, 2011). Previous solutions to the crosswalk problem at Springfield have included the addition of a Rectangular Rapid Flashing Beacon (RRFB), and pedestrian stop signage for increased visibility (Martin/Alexiou/Bryson P.C., 2007), as shown in Figure 1.

Figure 1: RRFB Crosswalk on Springfield Avenue (Google Maps, 2024)

While these methods improve pedestrian safety, the crossing on Springfield at Grainger Library still creates significant congestion and safety issues. Despite the addition of traffic calming measures, drivers are still impatient to let pedestrians cross; in a survey of 10 students, more than half of them noted that drivers disobeyed the installed pedestrian crossing signs (Benekohal and Mathew, 2020). During passing periods, the surge of students crossing from the engineering quad to the north quad creates traffic congestion. The congestion leads to questionable decision-making by drivers and students, compromising safety at the intersection—for example, drivers ignoring signals and failing to slow down for pedestrians in the crosswalk.

Effective solutions are needed to address these safety concerns. For instance, studies have shown that implementing raised or underground pedestrian crossings between roadways in heavily trafficked areas can significantly enhance pedestrian safety (Zhu, 2023). While a raised crosswalk would achieve the same results of ensuring pedestrians never need to step foot into the roadway as a pedestrian tunnel; it would run into issues such as meeting accessibility requirements and determining how to build a bridge over such a short span effectively. On the other hand, a tunnel connecting Grainger Library to DCL would be preferred to the raised crosswalk. The locations of each building are marked in Figure 2.

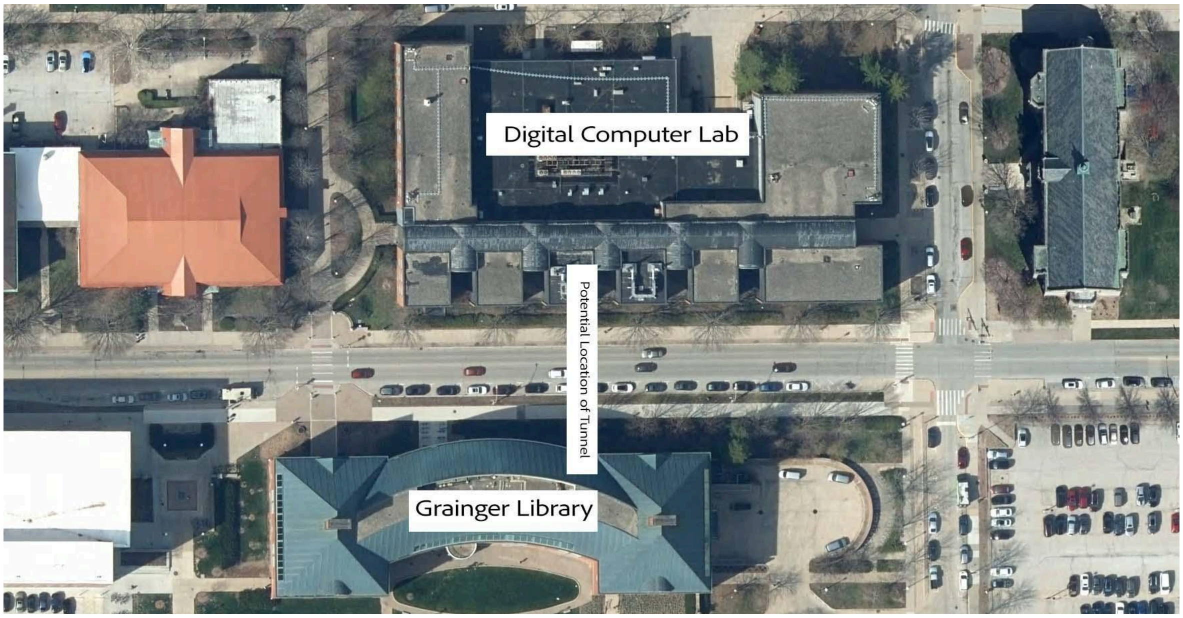

Figure 2: Locations of Grainger Library and DCL (University of Illinois F&S, unpublished imagery, 2024)

A pedestrian tunnel would provide multiple benefits, the most important being increased safety (US Federal Highway Administration, 2015). Other benefits include shelter from the cold and snow during winter and decreasing traffic delays along Springfield Avenue during peak pedestrian crossing times. As seen in Figure 3, the tunnel would allow pedestrians to cross the street without worrying about vehicular traffic. For drivers, the pedestrian tunnel would mean no more inconvenient stop-and-go traffic as cars pile up to let pedestrians cross. For those who need specific accessibility requirements, both Grainger Library and DCL have their own sets of elevators and automatic doors to help those who need them.

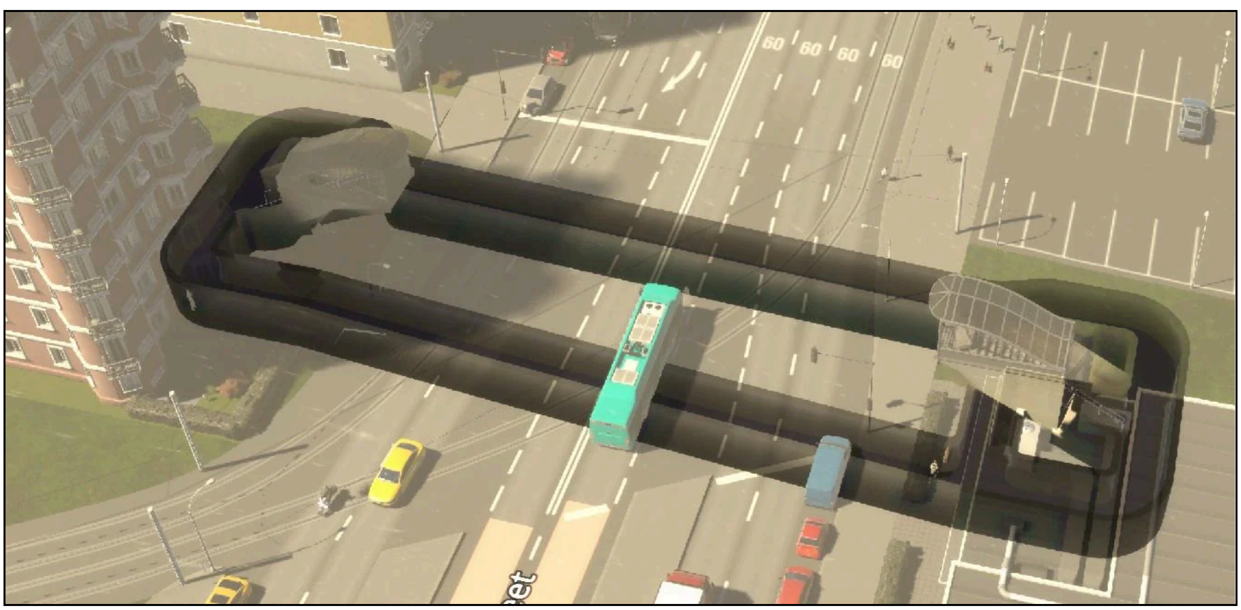

Figure 3: Pedestrian Tunnel Concept Work (Colossal, 2023)

The tunnel would face several issues that would need to be confronted before construction begins. For example, for the tunnel to be constructed, considerations such as the basement depths of both buildings would need to be carefully measured to line up and ensure the tunnel would be at an optimal alignment. Another issue would be clearing the necessary space in both buildings' basements to create the opening. Both buildings have existing structures in their basements that would need to be torn down. The basements would undergo structural checks to ensure that clearing the necessary space would not pose a structural hazard to the building. The tunnel would need to be constructed to not interfere with these utilities or would have to factor in the cost of relocating and rebuilding utilities. Therefore, a study into the feasibility of the proposed pedestrian underpass is critical to assess how to increase the safety of pedestrians.

Objectives

This feasibility study aims to determine the number of commuters impacted, and the economic and safety benefits of an underground tunnel connecting the basements of Grainger Library and the Digital Computer Laboratory (DCL). The Springfield Avenue crosswalk is a widely traveled crosswalk on campus by both pedestrians and vehicles. Vehicles constantly speed and neglect to stop for pedestrians trying to cross it. A safer alternative to cross Springfield Avenue, such as a tunnel beneath Springfield Avenue, must be explored. We will evaluate the number of pedestrians who use the crosswalk and vehicular traffic across the street, and review previous studies regarding the efficacy and feasibility of pedways. In the next 2 months, we will assess cost estimates of the overall project, and measure how many people are actively and presently affected by this project on Springfield Avenue. Finally, a report on the feasibility of the proposed project will be shown to the University of Illinois and the Illinois Department of Transportation.

Methodology

The feasibility assessment of the pedestrian tunnel involved a pedestrian safety sentiment survey, pedestrian and vehicle traffic data collection, and the financial viability assessment. The initial phases of the project included tasks we planned for a successful feasibility study; however, given time constraints, subtasks were removed to ensure the study would be completed in due time. This led to five major project tasks in the report: literature review, site assessment, stakeholder engagement and needs assessment, traffic and pedestrian data collection, and the final report.

Literature Review

A review of similar pedestrian tunnel projects was conducted to estimate construction costs and assess how public perceptions of safety influenced the development of these tunnels.

Site Assessment

We obtained a utility map of Springfield Avenue and a floor map of Grainger Library and the Digital Computer Lab around the targeted crosswalk to identify any depth discrepancies between basements and existing utilities that could pose construction challenges and determine whether utility relocation should be accounted for in the cost estimation.

Stakeholder Engagement and Needs Assessment

To evaluate the needs of pedestrians who use the targeted crosswalk, a survey was conducted via Google Forms to find out how safe pedestrians feel while using this crosswalk, and whether they would prefer a pedestrian tunnel in place of the current crosswalk.

Traffic and Pedestrian Data Collection

We used three methods to collect traffic and pedestrian data to estimate the number of people the project would impact. First, we counted pedestrians at the crosswalk during peak hours on Springfield Avenue. Second, we obtained automatically recorded pedestrian traffic data from the nearby Wright and Healy intersection through the University of Illinois Facilities and Services department. Finally, we gathered traffic data from the Illinois Department of Transportation to assess vehicle volume on Springfield Avenue.

Economic Analysis

To gather a potential cost estimate for the tunnel, we used a parameterized estimate where we looked at similar projects and considered their costs concerning labor and material costs in Illinois. We looked at a similar pedestrian tunnel implemented at another university located in New Jersey and the Midwest.

Results and Discussion

Literature Review

A review of similar projects revealed that many tunnels were constructed in areas where, before construction, the public had expressed safety concerns when crossing the road near the proposed tunnel sites. This emphasizes the importance of having favorable public opinion for such projects, as they often involve significant expenses and stakeholders aim to ensure user satisfaction and enhanced safety. This analysis helped shape the project's objectives, emphasizing the need to address safety concerns and traffic-related issues relevant to the proposed crosswalk location, as these factors are crucial in determining the feasibility of constructing a tunnel.

Site Analysis

We obtained a utility map from Facilities and Services, which is shown in Appendix A1. This map indicates that there are gas, electric, communication, sewer, and water lines beneath Springfield Avenue. Relocating these utilities during construction would result in significant costs.

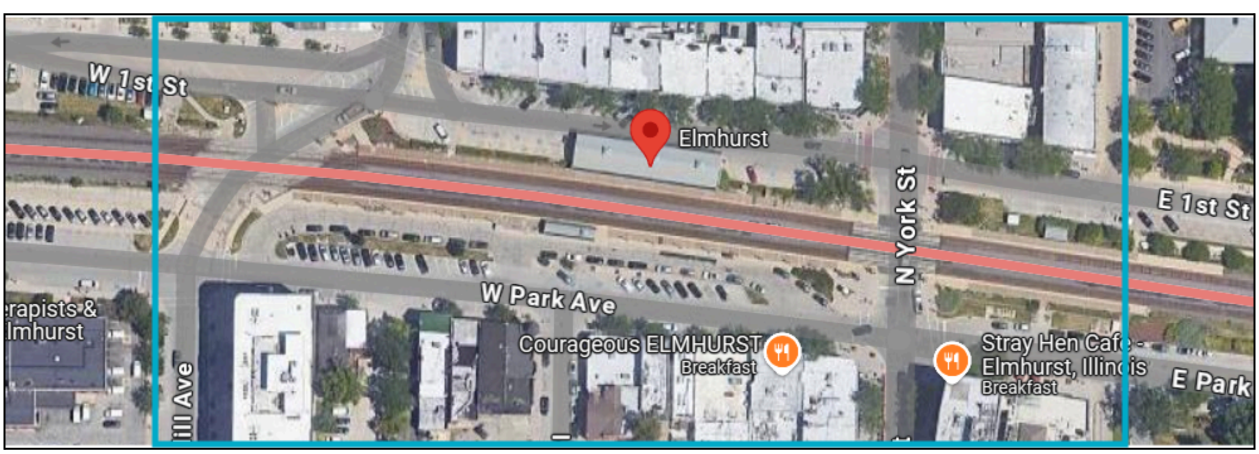

Figure 4. Elmhurst Metra Station

Traffic and Pedestrian Data Collection

We obtained data from the northernmost automatic pedestrian counter on campus, located at the intersection of Wright and Healey, to identify the best times for counting pedestrians. The hourly pedestrian count is illustrated in Figure 5. We examined the data provided by University Facilities & Services from their automatic pedestrian counters, particularly the one at Wright Street and Healey Street (see Appendix A2). Using this counter's data, we identified the busiest times at the nearby crosswalk in front of Grainger Library. Based on Figure 5, we determined that the peak pedestrian traffic occurred between 12:00 PM and 2:00 PM. The gaps in the data shown in Figure 5 can be attributed to malfunctions of the counter that resulted in missed pedestrian counts, though these did not significantly impact our analysis.

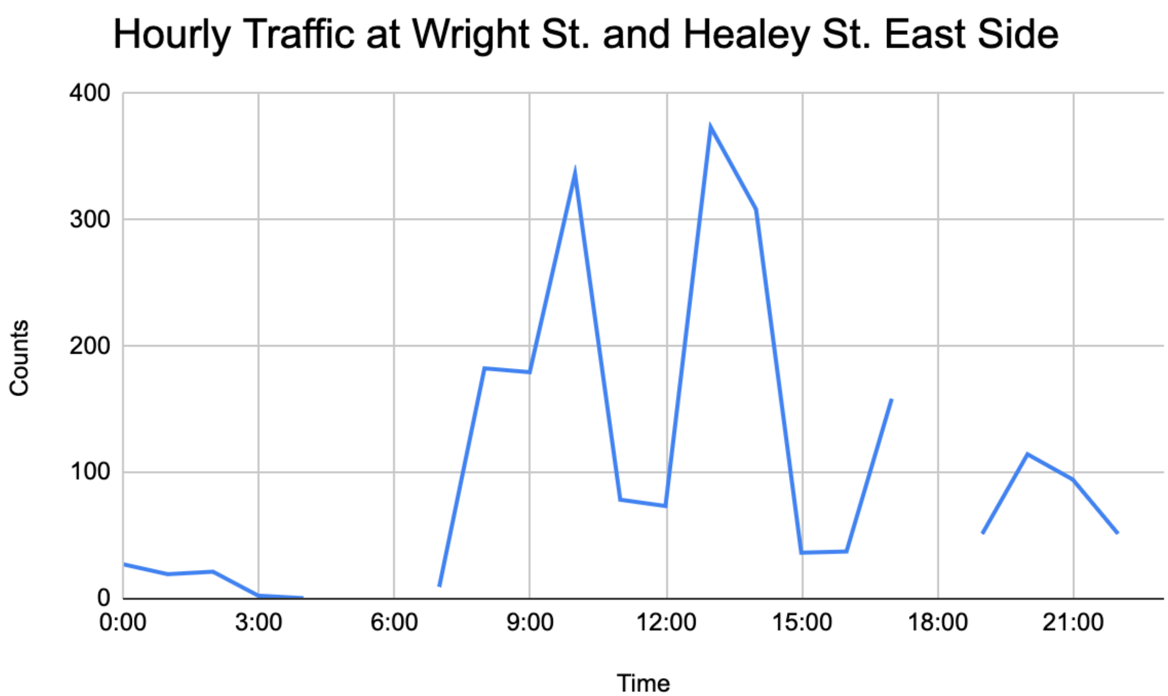

Figure 5. Hourly Traffic at the Intersection of Wright St. and Healey St. on Oct 25. (Eco-Visio, 2024)

After completing our background data collection and determining peak hours to be 12:00 to 2:00 PM, we proceeded to gather in-the-field data during peak hours. We conducted a two-hour manual count in thirty-minute intervals. The results of our manual count can be seen in Figure 6. Our findings indicate that the number of pedestrians during the busiest part of the day ranges from 200 to 300. We also observed slight peaks in the 12:30-1:00 PM and 1:30-2:00 PM intervals, coinciding with the end of classes as students and faculty travel to their destinations. These numbers suggest a significant amount of pedestrian traffic that could be redirected to an underground tunnel, alleviating congestion on the street.

We gathered vehicle traffic data from the Illinois Department of Transportation (IDOT) to determine the number of vehicles passing through this section of Springfield Avenue daily. Unfortunately, historical accident data for the crosswalk location was unavailable, which would have provided important context regarding the discrepancy between public perceptions of safety and the actual risks present, and the potential costs associated with these accidents.

We noted that the average daily pedestrian count at the Wright Street and Healey Street intersection was approximately 3,000, serving as a reference point for the number of pedestrians likely to cross at the Springfield Avenue crosswalk by Grainger Library (Eco-Visio, 2024). Finally, we examined the number of vehicles passing through this specific section of Springfield Avenue; IDOT records indicated that around 9,000 vehicles passed through daily (Illinois Department of Transportation, 2024).

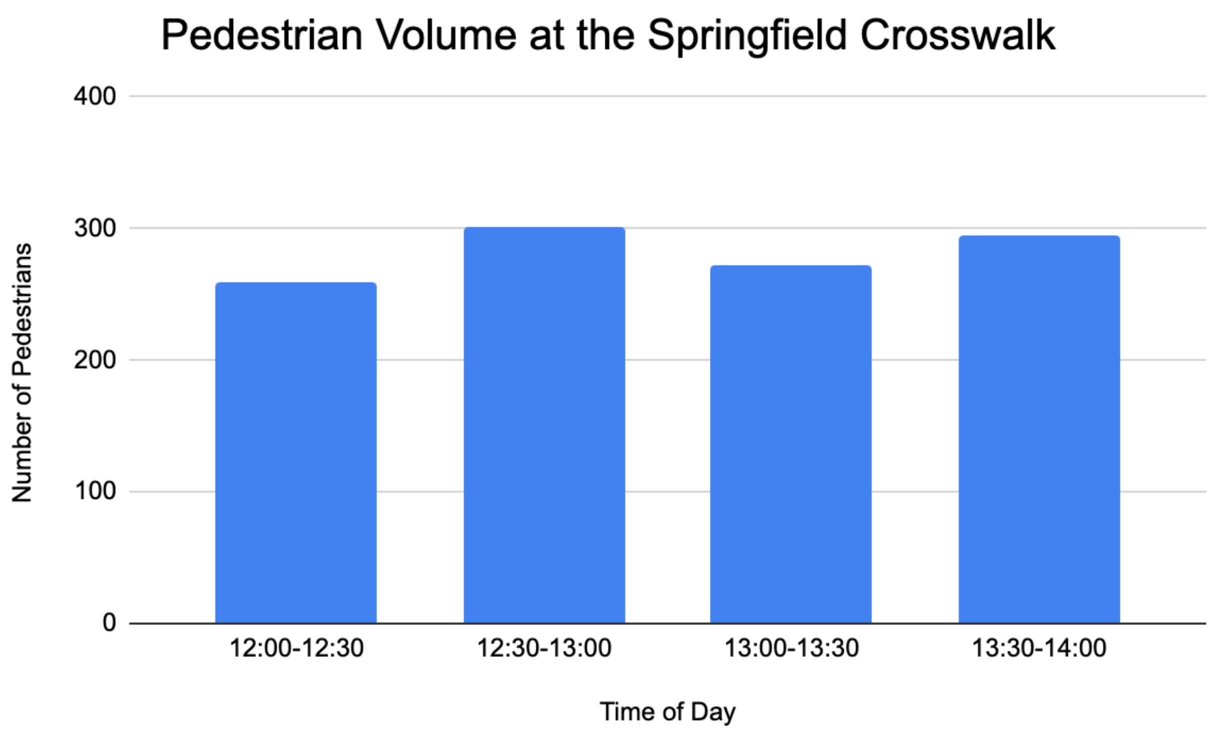

Figure 6. Pedestrian Traffic Across Springfield at Grainger Library from 12:00 to 14:00 on Oct 25. 2024

Stakeholder Engagement and Needs Assessment

The survey on driver behavior at the crosswalk provides important findings about pedestrian safety; however, findings are limited by a small sample size of 30 participants, mainly civil engineering students, indicating a need for larger studies to draw more reliable conclusions. 70% of participants observed vehicles failing to stop for pedestrians. Still, only 40% considered these incidents dangerous close calls, as shown in Figure 7.

We also asked participants to rate, on a scale of 1 to 5, how safe they felt crossing the crosswalk (Figure 8). Where 1 was unsafe and 5 was very safe, 56.7% of participants indicated a 4 or 5, meaning they felt secure with the current crosswalk design. When asked about choosing between the current crosswalk or the tunnel (Figure 9), opinions were split, with 50% favoring a tunnel over the current crosswalk, which raises concerns about convenience.

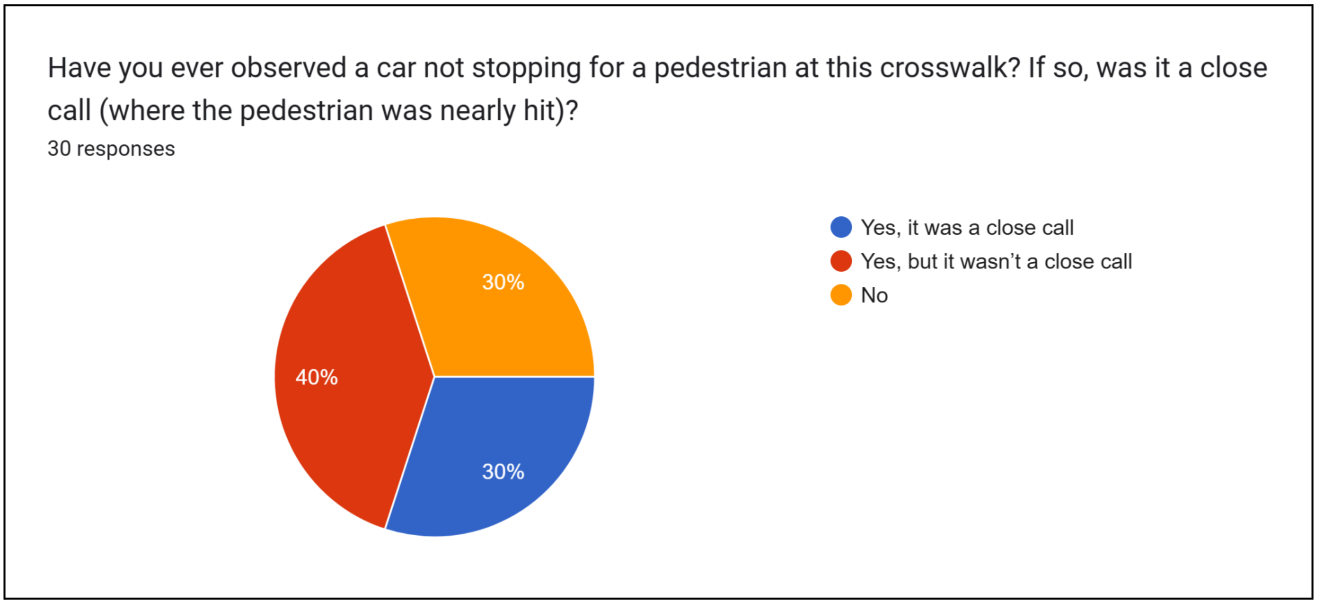

Figure 7. Survey Question 1

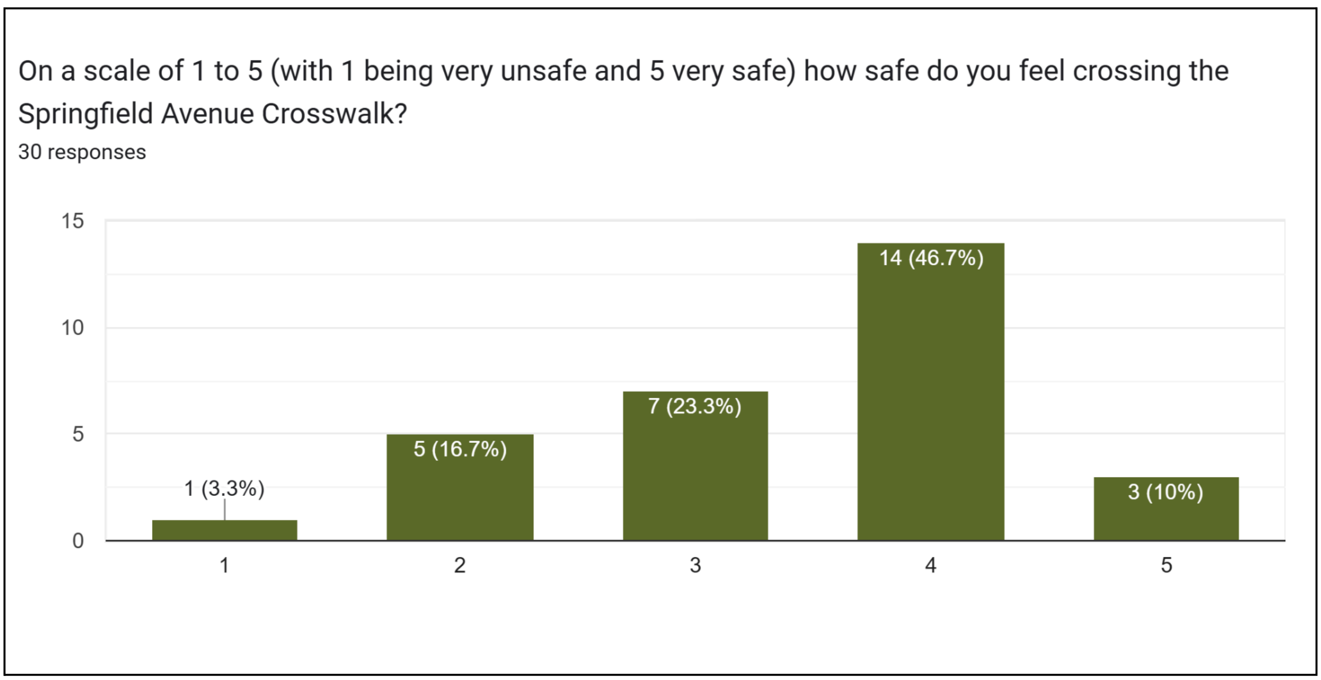

Figure 8. Survey Question 2

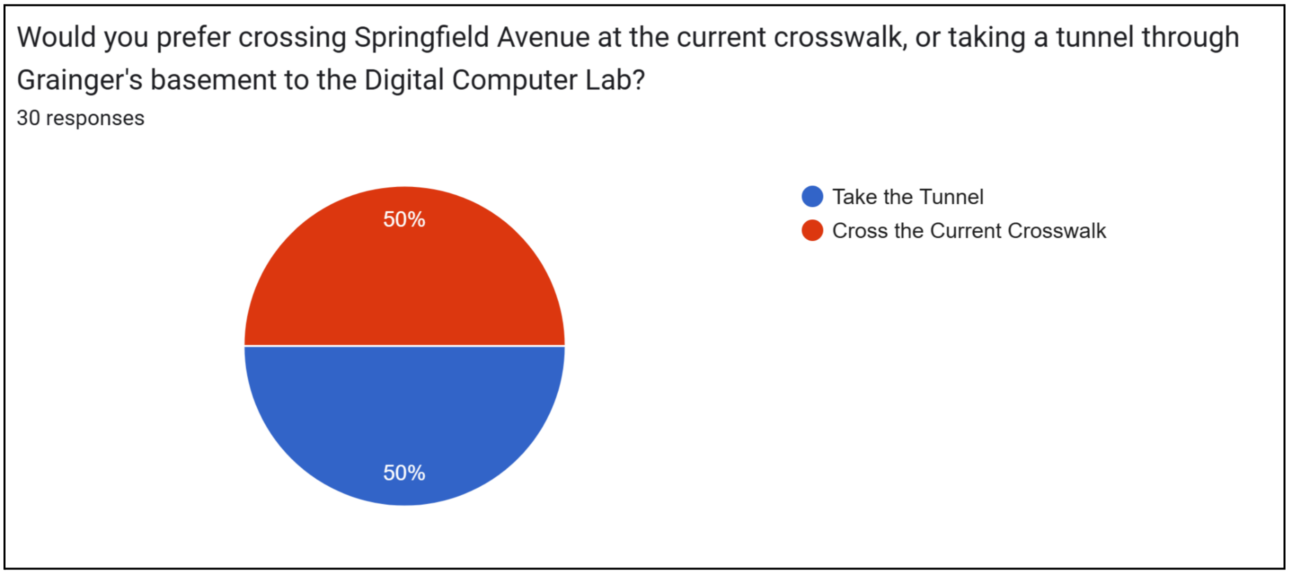

Figure 9. Survey Question 3

Economic Analysis

We used satellite imagery to calculate the estimated length of the tunnel, which came out to roughly 135 feet in length. With the length of the tunnel, we calculated an estimated cost of $4.35 million, as shown in Figure 10. To refine the estimated cost, RS Means data was used as a reference to adjust for regional cost variances. Calculations for RS Mean conversions can be found in Appendix B1. To estimate the costs associated with utility relocation (Figure 11), we referenced the utility relocation expenses from the City of Elmhurst's Metra Pedestrian Tunnel Project. While we do not have access to a utility map for Elmhurst, we selected this project as a comparison because the Metra Station is situated in an area similar to Springfield Avenue in Champaign, as shown below in Figure 4. Thus, we reasoned that gas, electricity, communication, sewer, and water lines are underground near the Metra Station. Information on how these utilities factor into the cost can be found in the Economic Analysis section of this report. Calculations for the scaled cost estimation can be found in Appendix B2. The total cost estimate, shown in Figure 12, calculated in Appendix B3, is $4,880,000.

Project	Cost (Adjusted through RS MEANS)	Project Length (ft.)	Cost Per Foot	Scaled Cost to Springfield Project Tunnel Length of 135 ft.
Pedestrian Tunnel at Monmouth University, West Long Beach, NJ	$4,741,910	75.1 ft.	$63,141.30	$8,524,075
Railroad Pedestrian Crossing at UPPR, Avon, IN	$2,038,260	130 ft.	$15,678.90	$2,116,530
Randall Road Underpass, Algonquin, IL	$2,860,000	160 ft.	$17,875	$2,413,125
			Average Cost:	$4,350,000

Figure 10. Scaled Cost Estimation Table for a Tunnel Between DCL and Grainger Library

Project	Utility Relocation Cost	Scaled Utility Relocation Cost for Springfield Avenue
City of Elmhurst Metra Station Pedestrian Underpass, Elmhurst, IL	$250,000	$530,000

Figure 11. Utility Relocation Cost Estimation

Total Cost Estimate (Average Cost + Utility Relocate)	$4,880,000

Figure 12. Total Cost Estimation

Conclusions

An underground tunnel connecting the basements of the Grainger Library and the Digital Computer Laboratory would promote safer crossings for students and pedestrians, along with additional support for unexpected weather conditions. The crosswalk across Springfield Avenue is unsafe for pedestrians due to the lack of regard drivers have, constantly ignoring traffic signals and continuing to speed through. Students, professors, and visitors are all at risk and a safer solution is necessary. Initial solutions to solve the problem included a bridge above the crosswalk, a tunnel connecting the basements of Grainger Library and the Digital Computer Laboratory, solar-powered stop signs on each side of the crosswalk, and traffic islands on nearby roads. As the bridge option would take drastically longer and have a higher cost, it differed from the solution we decided on. Both the solar-powered stop signs and traffic islands were deemed unlikely to improve the existing crosswalk to a significant degree. As a result, the tunnel solution was selected as it had the most beneficial effects. Ideally, The tunnel would create a safer alternative to walking across the crosswalk by minimizing traffic conflicts, reducing traffic congestion, and providing shelter from inclement weather. Redirecting 3,000 daily pedestrians to an underground tunnel would reduce street congestion and improve safety. However, survey results indicate a need for more enthusiasm for this solution, with only 50% of respondents expressing a willingness to use the tunnel if it were built. Additionally, most participants believe that the current crosswalk is sufficiently safe. The survey suggests that student opinions on the funding of this project are likely divided. Given this data, a pedestrian tunnel may not make a significant enough impact to justify its construction, especially since the University may be hesitant to approve a project without widespread student support. With an estimated cost of nearly $5 million, the investment does not seem justifiable considering the relatively small number of people it would affect. Therefore, the proposed project is not feasible.

Acknowledgments

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Arthur Schmidt, Department of Civil and Environmental Engineering, University of Illinois, for faculty sponsorship of the Facilities Data Security request form.

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Illinois Department of Transportation, for supplying the automatically counted vehicle data.

Beth Leitz, Records and Information Management, University of Illinois, for providing the floor plans for the Grainger Engineering Library and the Digital Computer Lab, as well as the utilities map.

The data provided by these contributors was essential to this work.

Disclaimer

This feasibility study was conducted for academic purposes only and is not intended for professional use or decision-making. The conclusions presented in this report are based on data and information available as of December 2024. Due to potential gaps in the data and sampling bias, the findings may not be fully accurate and should be verified with additional information.

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Map showing crosswalk across Springfield Avenue. 2024. Google Maps. Accessed October 7, 2024 https://www.google.com/maps/@40.1127436,-88.2271872,3a,75y,290.12h,92.95t/data=!3m7!1e1!3m5!1sR9oX-A7gH-5v2bN2vJZtwQ!2e0!6shttps:%2F%2Fstreetviewpixels-pa.googleapis.com%2Fv1%2Fthumbnail%3Fcb_client%3Dmaps_sv.tactile%26w%3D900%26h%3D600%26pitch%3D-2.9516548914496354%26panoid%3DR9oX-A7gH-5v2bN2vJZtwQ%26yaw%3D290.123492040501!7i16384!8i8192?coh=205410&entry=ttu&g_ep=EgoyMDI0MTAwOS4wIKXMDSoASAFQAw%3D%3D

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Appendix A

Appendix A contains a utility map of the area between DCL and Grainger Library to visualize issues that would arise during construction of a tunnel. Satellite imagery of the location of the Automatic Pedestrian Counter is included to understand in context where our background data was obtained. Basement plans of DCL and Grainger Library are included to also better understand the space constraints of a potential entrance to an underground pedestrian tunnel.

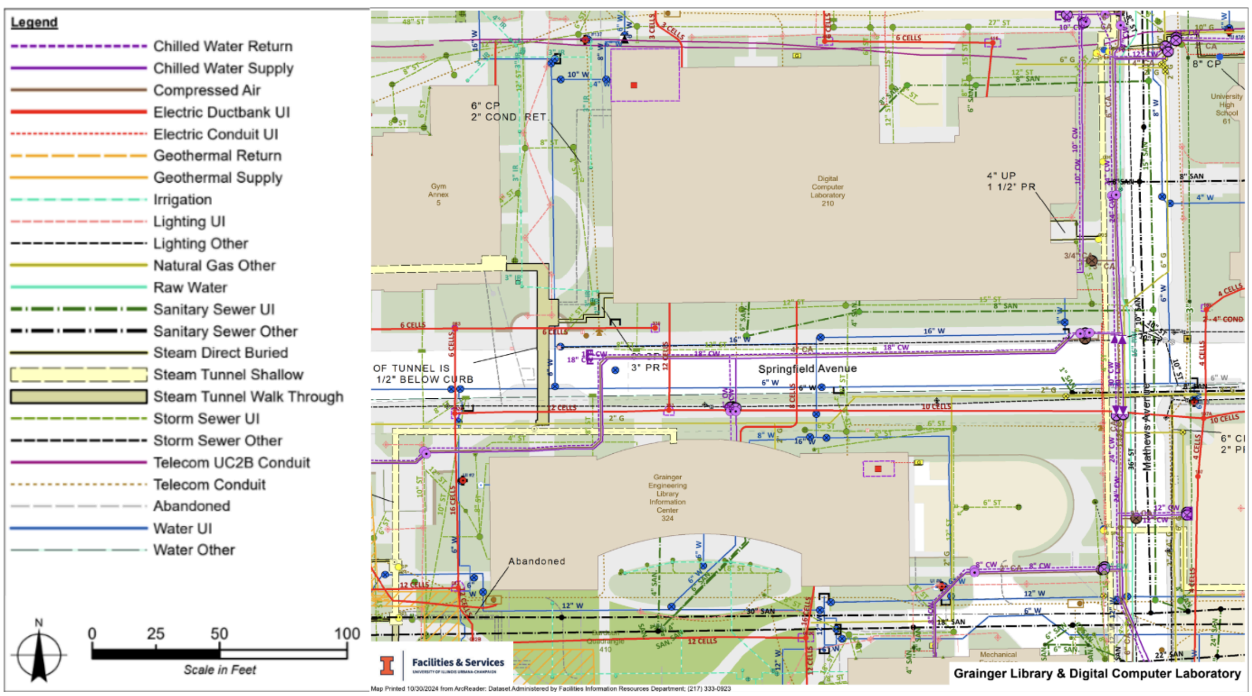

Figure A1. Map of utilities around targeted location (University of Illinois F&S, 2024)

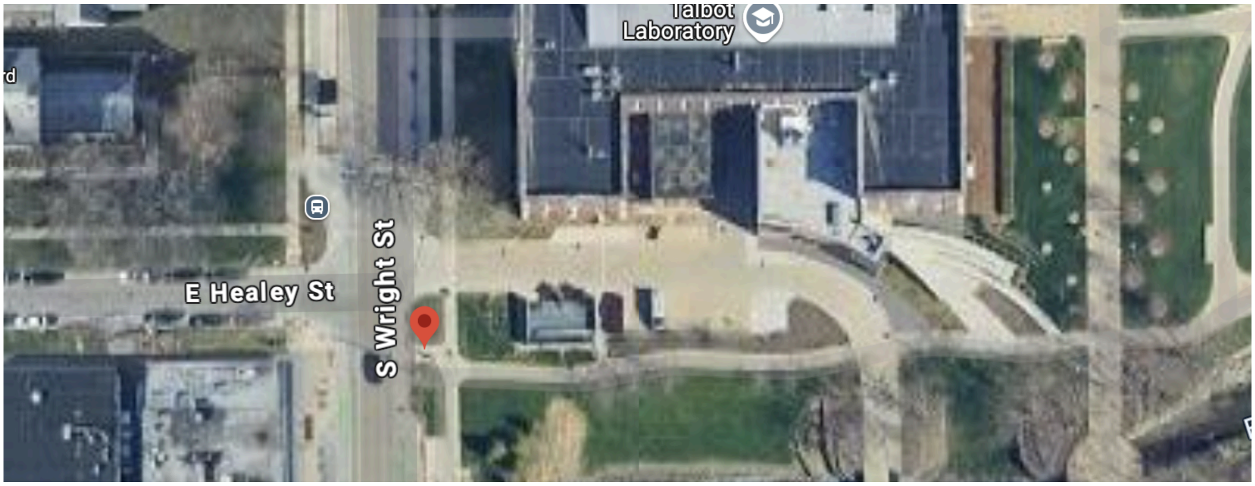

Figure A2. Location of the Automatic Pedestrian Counter at Wright and Healey St. (Google Maps, 2024)

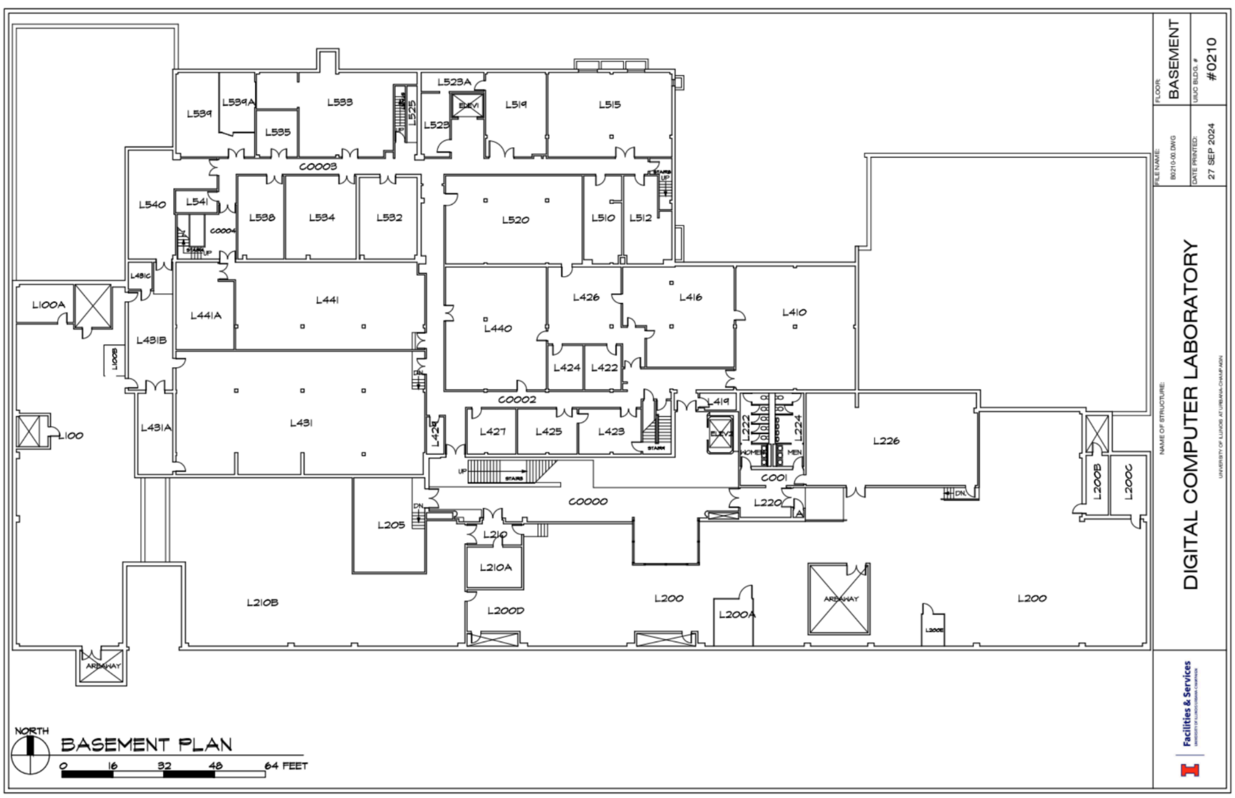

Figure A3. Basement Plan of Digital Computer Laboratory (University of Illinois F&S, 2024)

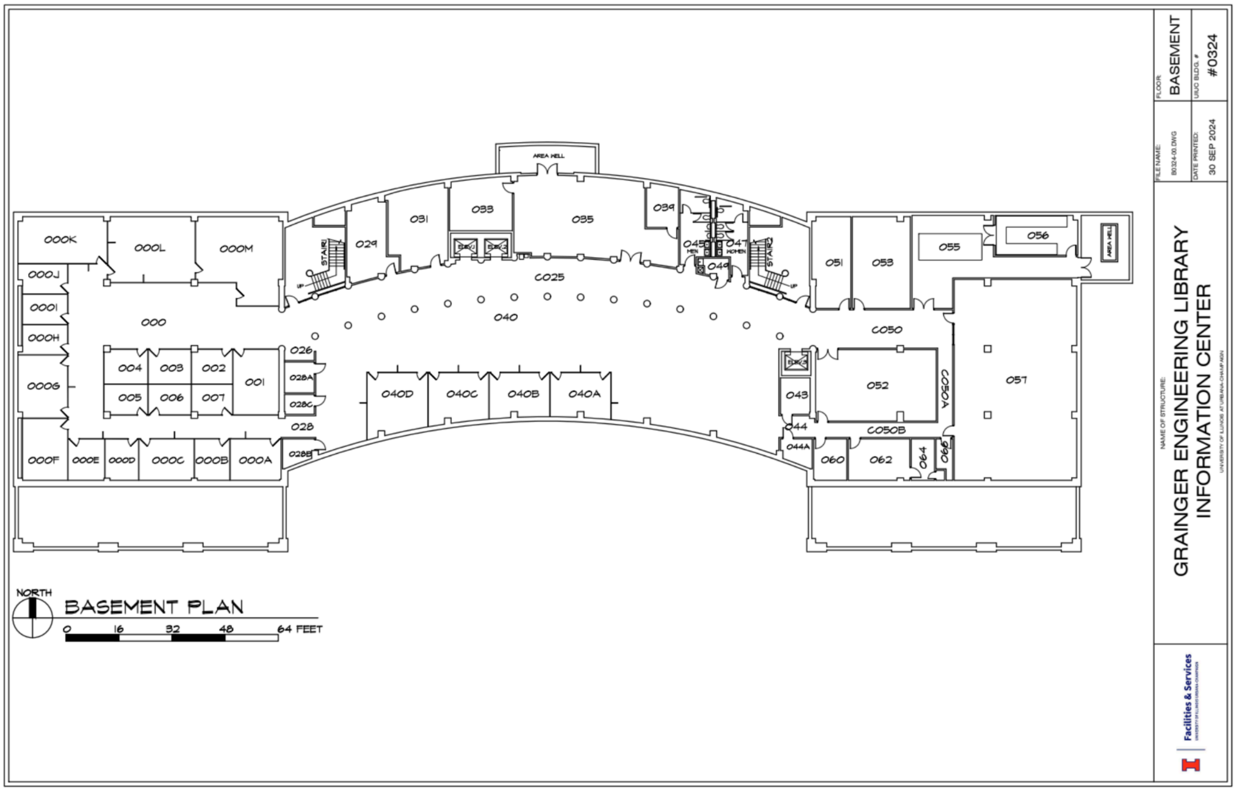

Figure A4. Basement Plan of Grainger Engineering Library (University of Illinois F&S, 2024)

Appendix B.

Appendix B contains our parametric cost estimation for both the tunnel and utilities, taking into account RS Means data for labor and material costs from the different states we looked at.

Pedestrian Tunnel at Monmouth University, West Long Beach, NJ:	{$4,750,000 * [117.2 (RS MEANS ILLINOIS)/117.4 (RS MEANS NEW JERSEY)]} / 75.1ft =$63,141.30 / ft. * 135 ft. (PROPOSED SPRINGFIELD TUNNEL LENGTH)
Railroad Pedestrian Crossing at UPPR, Avon, IN:	{$1,600,000 * [117.2 (RS MEANS ILLINOIS) /92 (RS MEANS INDIANA)]} / 130ft =$15,678.90 / ft. * 135 ft. (PROPOSED SPRINGFIELD TUNNEL LENGTH)
Randall Road Underpass, Algonquin, IL:	{$2,860,000 * [117.2 (RS MEANS ILLINOIS)/117.2 (RS MEANS ILLINOIS)]} / 160ft =$17,875 / ft. * 135 ft. (PROPOSED SPRINGFIELD TUNNEL LENGTH)
Scaled Cost For Each / 3 Projects = average cost	$4,350,000

Table B1. Parametric Cost Calculations

City of Elmhurst Metra Station Pedestrian Underpass, Elmhurst, Illinois	Utility Relocate: S 250,000.00 Length of Elmhurst Pedestrian Tunnel: 64 ft. $250,000.00/64 ft. = 3906.25 $/ft. Scaled for Springfield Avenue: Length of Springfield Tunnel: 135 ft. 3906.25 $/ft. * 135 ft. = $527,343.75

Table B2. Utilities Cost Calculation