Louis at the 14th

Senior Thesis Proposal

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Table of Contents

Executive Summary

Louis at the 14th is a commercial building project located in Washington, D.C. owned by JBG Companies and currently being managed by Balfour Beatty Construction. It is a nine-story residential building with 268 luxury apartments, retail spaces on the street-level, and a below-grade parking garage. It will replace existing two-story buildings and parking lots on the property. The building is pursing a LEED Silver certification and is scheduled to be complete in early 2014.

This document proposes areas of analysis and research pertaining to the construction of this building to be credited for the senior thesis spring semester. Each proposed analysis contains unique aspects of the project that offer opportunities to adjust the project schedule, project budget, building performance, and the constructability of the design. Two additional breadths relating to the structural and mechanical designs are included, as well.

Since the original underground parking garage occupies only a portion of the building footprint, the first proposed analysis involves the extension of this underground parking area into the entirety of the building footprint, demanding a larger but willower area of excavation. To compliment this change, a structural breadth will be performed to redesign the building foundation in order to best accommodate this change.

The second analysis will be research on a critical industry issue involving prevention through design, specifically applicable to the excavation phases of buildings where a large portion of jobsite incidents occur. The research will aim to finding ways of changing design documents, specifications, and means and methods of excavation to make safer work environments.

The next analysis will apply the research of the previous analysis to devising a site-specific safety plan for the excavation phase of the foundation previously redesigned in Analysis #1. OSHA regulations, public safety, site constraints, and risks associated with the equipment and ongoing operations will be the main concerns when considering the direction of the safety plan.

Analysis #4 involves the installation of a geothermal well system to serve the mechanical needs of the ground-level retail spaces, which will create potential schedule and budget impacts, and also a constructability study in coordination with the current AGM pile foundation. A mechanical breadth will be performed in order to efficiently size the geothermal loops and sufficiently serve the mechanical needs of the building.

Included in the appendix is a proposed schedule of the spring semester describing how this proposal will be approached and delivered in a timely manner. A weighting breakdown is also included in an effort to predetermine how much work each area of analysis will require and thus how each should be graded.

At the conclusion of each analysis at the end of the semester, recommendations will be made based on the findings of each analysis and whether or not each would be a necessary or favorable option.

Analysis #1

Problem:
The existing design of the building includes a below-grade parking garage consisting of three levels located at the southern half of the building footprint only. The parking garage was not extended to the rest of the building footprint to the north because building codes encouraging public transportation would only allow so many parking spaces to be utilized.

Background:
The excavation performed for the originally designed parking garage required a temporary dewatering system designed based on geotechnical reports, but several complications occurred as a result and caused notable delays on the project.

It was determined by geotechnical reports and cost analyses that the soil on the second level of the underground parking garage was very weak and would require a thick mat foundation if it was to be the lowest level. If the garage were designed to be one floor deeper, spread footings would be more appropriate.

Therefore, with the additional concern of underpinning existing historic structures adjacent to the north footprint, the garage was moved to the south footprint only where the spread footings were be utilized.

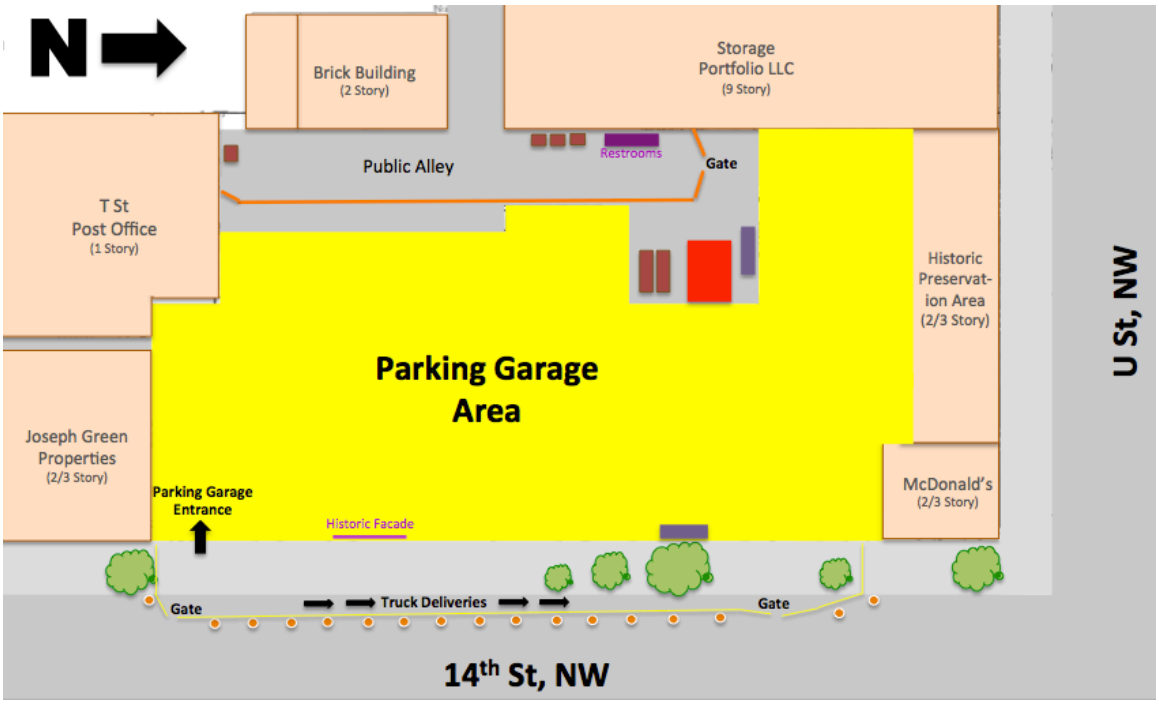
Potential Solution:
I propose to extend this parking garage back to the northern end of the building footprint as originally intended with the knowledge of the dewatering complications that the change introduced. This change will demand more square footage of excavation area, but will be less cubic yardage of excavated soil since it is to be significantly willower than the existing 3-level parking garage design. The shallower excavation may result in fewer dewatering issues, a more conservative project schedule, and possibly a cheaper result, as well. These geotechnical details and constraints will be further researched to determine if this is a viable solution.

Methodology:
Once the foundation system is redesigned, the additional material and labor impacts associated with the concrete parking garage extension will be implemented in the project budget, as well as its impact to the critical path schedule.

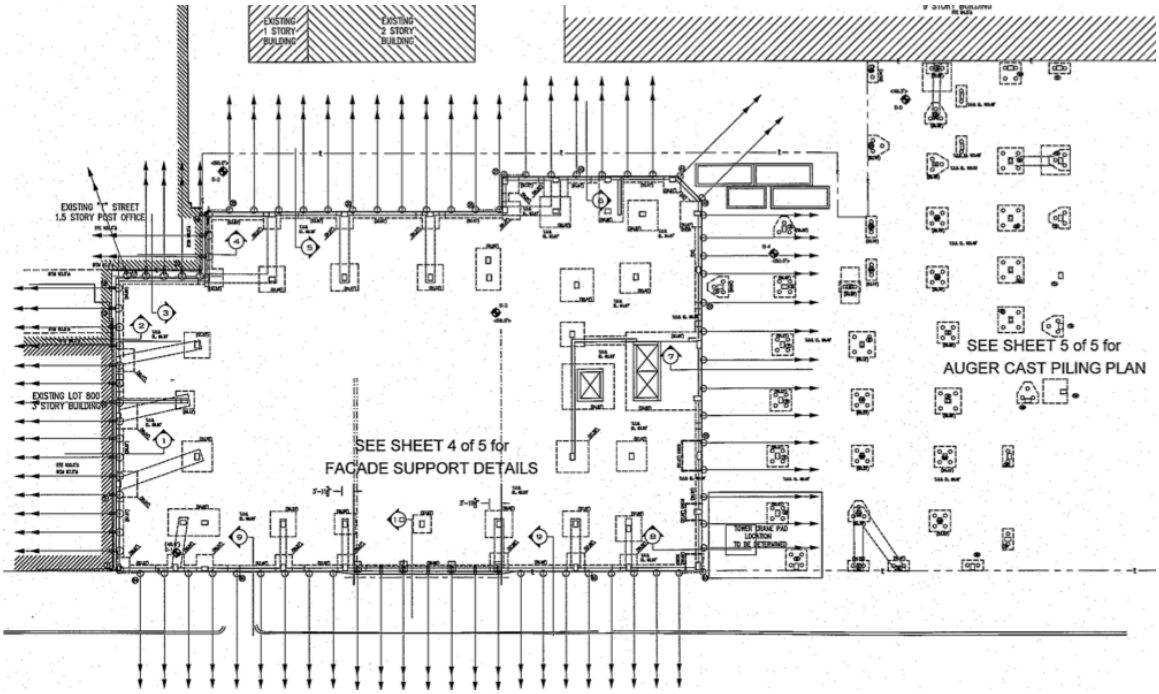
Constructability issues and constraints concerning adjacent historic buildings shown below will be considered, as well, since their foundations form the property boundary on that northern footprint.

Expected Outcome:
The goal of this analysis is to determine if this different design would be more beneficial to the success of the project than the actual design used. Depending on the findings of the associated structural breadth, it is possible that the proposed

change will be cheaper and faster to build given the knowledge of the problems that were encountered with the actual design.



^Pictured above is a site plan showing the area available for the proposed parking garage extension and the neighboring buildings that may cause restraints on the design.



^Pictured above is the foundation plan depicting the existing design featuring AGM Piles on the north footprint and a soldier pile & tieback system on the south footprint.

*__***Structural Breadth:***__

Problem:
Since the original parking garage sits on spread footings three stories below the northern foundation micropiles, it introduces the risk of differential settlement between these two adjoining foundation types.

Background:
The existing foundation design where the proposed parking garage extension is to be located consists of auger pressure grouted piles (shown below).
According to geotechnical reports, the soil where the proposed extension is to be built is very weak and would require a 4-5' thick mat foundation instead of spread footings. There was also concern about the underpinning of adjacent historic structures and the risk associated with their condition.

Potential Solution:
It is proposed to redesign the whole foundation as one structural unit that will allow for the extension of the parking garage and a shallower excavation, maintaining the same square footage of parking as originally intended.

The proposed foundation redesign will adjoin the northern and southern foundation in a way that mitigates the risk of differential settlement and future complication.

Methodology:
The most appropriate foundation type for both parts of the footprint will be chosen based on geotechnical details and building loads. Methods of soil strengthening Basic critical dimensions and specifications of the proposed structural elements will be determined for this conceptual redesign, while keeping in mind the next analysis implementing prevention in design practices.

Expected Outcome:
It is likely that a mat foundation will be used in some form as the original design previously intended; however, soil strengthening techniques may prove to be beneficial with the foundation changes.

***Analysis #2* (Critical Industry Issue)**

^Pictured above is the actual excavation of the southern building foundation, compliments of Balfour Beatty Construction.

Problem:
Prevention through design is commonly neglected during building excavations, which is a phase of construction where a large portion of accidents and injuries occur on the jobsite.

Potential Solution:
Foundation designs as well as excavations means & methods may allow for more opportunity to incorporate safer work environments and safer approaches to different types of excavations. Design documents and specifications may be altered different ways to avoid such accidents.

Methodology:
As a critical industry issue, prevention in design opportunities will be thoroughly researched specifically pertaining to building excavations and foundation designs. The primary goal of this investigation will be to determine how design documents of foundations can be changed to make a safer environment during excavation.

In order to more effectively determine what entails a safer foundation design, excavation means and methods will be researched along with the risks and hazards involved with each. Foundation types, depths, soil types, excavation support, and site area constraints will specifically be researched to reveal where the most risks are and how they can be mitigated.

This research will be applied to the featured Louis at the 14th project and any major risks as such will be identified and addressed in Analysis #3.

Expected Outcome:
This research shall pinpoint the most dangerous aspects and hazards of excavations and will likely lead to alternative options that can be used in order to avoid these dangers. These safer alternatives or preferred findings will be based on both the design of foundation systems as well as the means and methods that should be specified or forbidden to use by contractors in certain cases. Recommendations will be made regarding design documents and specifications based on the findings of this research so as to provide a safer work environment during the excavation phases of construction projects.

Analysis #3

Problem: The proposed building is located on a congested project site with sizeable adjacent buildings and general public bordering the property and the excavation. Prevention through design is typically not considered for excavations

Background: The project means of delivery is design-bid-build, therefore it can be assumed that prevention through design was not utilized on the project, especially not for the excavation since most of the risk associated is assumed by the contractor, not the designers.

Public safety was a primary concern throughout all phases of the project because the property is bordered by 14th street, which has high vehicle and pedestrian traffic that is required to remain open throughout the majority of construction. Adjacent building up to seven stories tall border the north and south ends of the proposed building and will also remain occupied throughout construction.

Potential Solution: Utilizing the findings of Analysis #2 and considering the foundation redesign of Analysis #1, a site specific safety plan will be developed in an effort to harmonize with public safety, the foundation redesign, and the primary risks and hazards involved with the excavation required for the work.

Methodology:
All research from Analysis #2 that pertains to the Louis at the 14th project will be selected and applied to the specific needs of this particular excavation. The same concept will be used from Analysis #1 in order to identify the constraints appropriate for the excavation of the redesigned foundation system.

In addition, all hazards, risks, and appropriate precautions associated with the excavation equipment, excavation support, removal of spoils, adjacent buildings, site access, and other elements will be sufficiently identified.

Public safety will be a concern throughout this analysis since the property is quite congested and exposed to the public. Therefore, specific precautions will be recommended for nearby pedestrian & traffic control.

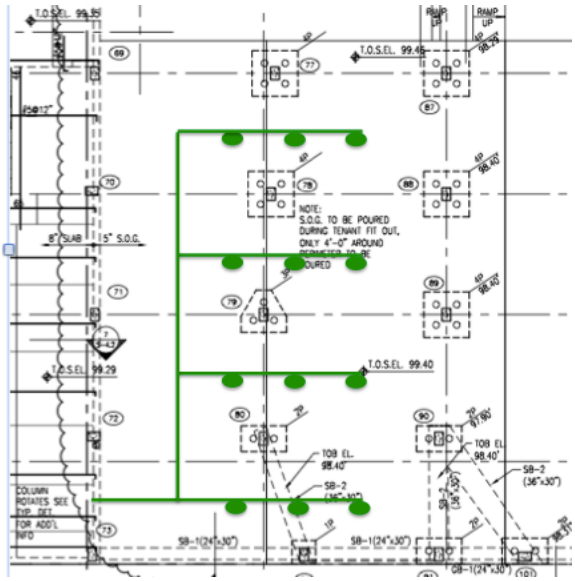
Expected Outcome:
The goal of this analysis is to minimize the risks and hazards and provide a safe work environment for the building excavation of Louis at the 14th. Any additional costs or savings associated with this safety plan that may arise, along with schedule impacts and safety statistics, will be calculated to potentially provide more incentive for the owner or project team to invest in such proposed safety practices.

Analysis #4

Problem:
The ground floor retail spaces are served by HVAC units separate from that of the above residential units. Also, with the parking garage being built on the south end of the building footprint, this leaves underground space unutilized at the northern footprint.

Background:
The original design of the building's water-to-air mechanical system includes the traditional chiller, boiler, and cooling tower combination separately serving the ground floor retail spaces and the above luxury units.

The soil on the northern end of the building footprint is likely too weak for economical below grade foundation work, but it may be suitable for other purposes that can enhance the building design.



^Above is a depiction describing the manner in which the geothermal wells will be organized relative to the foundation structure, in this case the existing AGM piles.

Potential Solution:
The installation of a geothermal loop system beneath the northern foundation will serve the mechanical needs of only the ground level retail spaces.

Methodology:
It was determined that the likelihood of having enough space available to install a sufficiently-sized geothermal loop to serve the whole building would be very low and possibly create too many constructability issues with the foundation design. Therefore this idea was refocused on the ground-level spaces only that have a completely separate mechanical system from the residential units above.

The underground loops will be installed underneath the northern section of the building footprint where the originally designed parking garage excavation would not interfere. The parking garage expansion and foundation redesign will not be used in this analysis to provide the owner with an additional option to further utilize the northern building footprint unoccupied by the parking garage.

The duration of activity required to install the geothermal wells will be determined after the system is designed in the mechanical breadth being described next. Because the drilling of the AGM piles for the northern foundation contains very similar preparation and activity as the drilling of the geothermal wells, both may be

done simultaneously and thus likely cutting down on additional equipment costs. Material and labor costs will be analyzed in detail, as well as the potential amount of energy savings and payback period that the new system will offer the owner.

Expected Outcome: The geothermal wells will eliminate the need for other HVAC equipment originally intended to serve the spaces, it will provide extra savings on energy costs for the tenants, and it will make the building more sustainable possibly gaining extra LEED points.

It is expected that the geothermal well system will take slightly longer to install and be more expensive upfront but provide a payback period to be more beneficial to the owner.

****Mechanical Breadth:***

As previously described, the geothermal well system will be sufficiently sized and designed to meet the mechanical load demands of the ground level retail spaces. The current mechanical design will be analyzed as necessary to accurately determine which other mechanical components will need to be adjusted or eliminated in order to accommodate the proposed geothermal well system.

All equipment that will be replaced by the geothermal system will be identified and their mechanical loads accounted for by the new design. The loop dimensions and technical requirements of the actual underground geothermal loop will be calculated, as well. This design will be used in the previously mentioned analysis for the constructability of the geothermal system concerning the existing foundation system.

Appendix

Proposed Senior Thesis Progress Schedule

Spring Semester 2014

	Jan 27-31	Feb 3-7	Feb 10-14	Feb 17-21	Feb 24-28	Mar 3-7	Mar 10-14	Mar 17-21	Mar 24-28	Mar 31-4	9-Apr	14-Apr
Conceptual Redesign		Conceptual Redesign										
Basic Sizing Calculations		Basic Sizing Calculations										
Schedule Impact			Schedule Impact									
Budget Impact				Budget Impact								
Research Prevention in Design			Research Prevention in Design									
Safety Plan					Safety Plan							
Calculate Mech. Loads.						Calculate Mech. Loads.						
Size Loop System						Size Loop System						
Constructability w/ foundation								Constructability w/ foundation				
Budget Impact									Budget Impact			
Schedule Impact										Schedule Impact		
Proposal Revision	Proposal Revision											
Spring Break							Spring Break					
Final Report Subimssion											Final Report Subimssion	
Faculty Jury Presentation												Faculty Jury Presentation

Overall Breakdown

Analyisis Topics	*Grade Portion*
Depth #1: Parking Garage Extension	30%
Structural Breadth: Foundation Concept Redesign	
Depth #2: Prevention through Design Research	20%
Depth #3: Site Specific Safety Plan	20%
Depth #4: Geothermal Loop Addition	30%
Mechanical Breadth: Geothermal Well Design	