Walker Jones

100 L Street NW
Washington, DC 20005

Final Proposal for Spring Thesis
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Executive Summary

This proposal serves as an outline for the research and analyses proposed for spring semester thesis. After brainstorming some initial ideas, research has been focused on a few key concepts. Initial investigations were performed to determine the feasibility of this proposal. The analysis descriptions will highlight three main topics which will be the focus of the spring semester thesis with a consistent theme of energy and the environment.

Analysis One will include a survey of teachers at LEED certified and traditional K-12 schools to determine first hand the perceived benefits of green schools. Results from this survey will be compiled and distributed locally to school boards who have not passed resolutions requiring new school construction to achieve LEED certification.

Analysis Two will use Revit and IES to calculate required loads and redesign the mechanical system. The current VAV system will be analyzed in comparison to a dedicated outdoor air chilled beam system. This will incorporate a mechanical breadth and satisfy the M.A.E. requirement.

Analysis Three will investigate an alternative façade system and the effects that it will have on the structural system. Additionally, daylighting will be investigated to improve natural light in the learning environments.

A weight matrix is provided to show how much emphasis will be placed on the core areas of research, value engineering, constructability, and schedule acceleration. A detailed explanation of the breadth studies can be found in Appendix A. The purpose of the breadth is to show proficiency in at least two option areas outside of construction. Breadths will be performed in the areas of mechanical, structural, and lighting.

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Project Background

Overview

The new Walker Jones project is a 100,000 SF DC public school, 15,400 SF community center, and 7,000 SF public library designed to replace two existing schools. Walker-Jones Elementary and Terrell Junior High School have been partially demolished to allow room for construction and will be completely demolished upon completion of the project. The new educational and community center has been designed as part of an effort to revitalize the area now known as the Northwest One neighborhood.

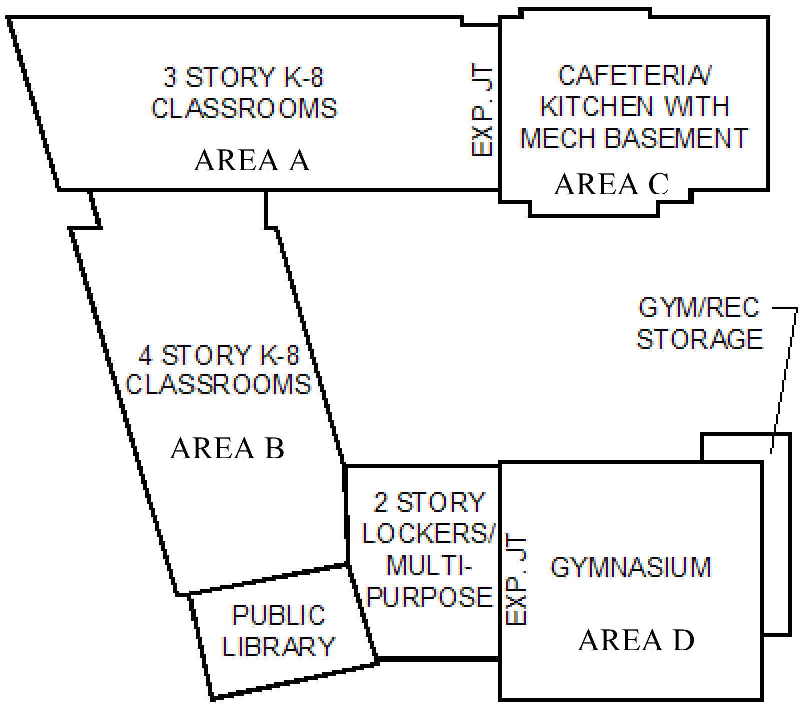

Figure 1 - Sections of the Building

The fast-paced 15 month schedule, LEED certification, and tight budget provide many coordination and logistical challenges. A negotiated GMP of $36 million was agreed on between Forrester Construction (the general contractor), and The Office of the Deputy Mayor for Planning and Economic Development (the owner). The steel structure and primarily brick façade are accented by strategically placed curtain wall and unique features such as 29,000 SF of green roof.

Figure 2 - The main entrance of Walker Jones

Building Envelope

In Areas A and B, the classroom section, the brick exterior walls will be backed up with 6" light gauge metal stud. Typical window openings on the exterior wall are "punch" windows and loose angle lintels will be provided to span the openings. In addition, brick veneer will be hung from the floor above with galvanized steel shelf angles. In Areas C and D, the exterior walls are reinforced CMU bearing walls clad with a brick veneer separated by an air space cavity. These CMU bearing walls will be used to resist wind and seismic lateral forces.

Figure 3 - The two types of bricks and the relationship between the brick facade and aluminum storefront

There are two types of face brick used; Face Brick A and Face Brick B. Face Brick A is a bronze stone color and the brick course is extended ½ inch from the face of the wall. Face Brick B is a tumbleweed color and is recessed ½ inch from the face of the wall. There are masonry wall ties at 15 inches on center and weep wholes at 24 inches on center. Cavity Drainage Material and Through Wall Flashing are located within the cavity wall near ground level and at each floor to allow moisture to escape. The aluminum storefront and glass windows found on the library, stairwells, and other accent locations have steel angles.

Mechanical System

The heating, ventilating and air conditioning system provides the facility with equipment that meets the long term energy efficiency and maintenance priorities as well as being a cost effective solution. The system provides flexibility and increased energy savings opportunities. Each air handling unit (AHU) zone is capable of an independent operating schedule. Each of the eight air handling units is responsible for an individual zone. Zones 1-8 are broken into east, west, north and south classroom blocks, cafeteria, library, gymnasium, and kitchen, respectively.

The mechanical rooms are located in Area C in a partial basement and on the third floor above the kitchen. The building's eight air handling units are located on the roof of the building. Each air handling unit will be provided with a DX cooling coil, hot water heating coil, 30% and 85% efficient filters as well as access sections for maintenance to all coils and filters. All fans will be provided with variable frequency drives (VFD's) and energy recovery wheels will be provided for AHU's 1, 2, 3, 4 and 7 to maximize energy efficiency.

The cafeteria, gymnasium and kitchen have constant air volume systems while the rest of the building has a variable air volume (VAV) system. Heating water will be generated from three (3) gas fired boilers located in the northeast mechanical room above the kitchen. Two (2) heating water pumps (primary and standby) will circulate heating water to the air handling units.

Analysis 1: The Benefits of LEED Schools

Opportunity for Improvement

The United State's Green Building Council's Leadership in Energy and Environmental Design (LEED) has become the primary accreditation system for the design and construction of green buildings. Since the conception of the USGBC in 1993, the LEED rating system has continuously evolved based on feedback from industry members. While the new LEED rating system is due out in early 2009, the current version, LEED 2.2 is widely known and highly respected. It has been commonly accepted that the benefits of LEED are lower long term costs, improved indoor air quality and higher occupant comfort. The certification system also aims to reduce pollution, waste water and ecological impact.

Although the LEED system is commonly known and respected by most, many people still seem hesitant about achieving LEED certification. Especially on publicly funded school projects, the focus is on upfront cost rather than long-term educational benefits.

Solution

This area of research would focus on the benefits of LEED certified schools and attempt to make a claim to school boards that spending a little more money upfront can lead to a much more desirable learning environment.

Analysis

Through a survey of teachers at both LEED certified and non-certified schools, the benefits of a green school will be measured. The results of these surveys will be compiled in an attempt to make a case to school boards that green schools offer immeasurable educational benefits.

Research Method

Research will be performed through review of the USGBC and current LEED for Schools requirements. Industry professionals and teachers will be consulted for their opinions on issues in green schools. A survey will then be compiled and sent to teachers at various schools. Tools will include the USGBC and LEED, industry professionals and K-12 teachers.

Sample Survey Questions

Is your school LEED certified?
If so, what has been the greatest benefit you have seen of working in a "green" school?
Have you noticed an increase in student attention spans?
Are you aware of the USGBC and the LEED certification process?
Do you incorporate environmentally friendly concepts into your lesson plans?

For Both Certified and Non-Certified Schools:
How many sick days did your students take last term?
Do you have windows in your classroom?

If so, do they provide enough natural light that on a sunny day you can leave your lights off?
Do you experience acoustical distractions in your classroom on a regular basis?
Do you have a problem with student attention spans?
Do you experience unpleasant smells in your school?

Expected Outcome

It is important that members of school boards who make important decisions about new schools understand the implications of green schools. Once the results of the survey have been compiled, results will be made available to local school boards who have not passed resolutions requiring new schools and major renovations to be LEED certified (or better). Hopefully seeing real survey results of local schools in combination with national research boasting the benefits of green schools will convince school boards that green schools are worth the small amount of extra money upfront.

Analysis 2: Mechanical Redesign Using 3D Modeling

Opportunity for Improvement

The current system requires heavy equipment on the roof which takes away from the aesthetics of the green roof. It also requires a lot of ductwork which has caused many coordination issues. Although the VAV system is fairly common and serves its purpose well, an interesting alternative to the system currently in place would be a chilled beam system. This would make for an appealing construction management analysis as far as how the system affects the cost, schedule and logistics of the project, as well as a mechanical breadth. Additionally, the use of computer modeling in mechanical design is an area worth investigating. Using a Revit model in conjunction with IES to calculate the loads will assist in the design process. Knowledge gained in AE597F – Virtual Facility Prototyping will be used for this analysis.

Solution

Although chilled beam systems have been popular in Europe for years, these systems have only begun making their way to the United States recently. The innovative HVAC technology provides a draft-free and energy-saving approach to heating and cooling.

Benefits

A chilled beam system reduces energy needed to run fans. It also requires minimal space, which leads to more shallow ceiling plenums. Additionally, such a system increases indoor air quality by eliminating the mixing of air and increases occupant comfort because it is a quieter system than VAV. Indoor air quality is especially important in a school where children are often sick and colds can be spread easily. Finally, chilled beam systems do not require large mechanical rooms or ductwork and are easier to maintain than a VAV system.

Drawbacks

Unfortunately, chilled beam systems can have a higher up front cost compared to traditional VAV systems. An important aspect of the analysis will be life cycle cost and constructability benefits. Another difficulty associated with a chilled beam system is that many MEP engineers in the United States are not familiar with this technology. With a chilled beam system, conditions must be kept within a certain range or condensation will occur.

Analysis

The analysis will include a basic redesign of the mechanical system using 3D computer modeling. Integrated Environmental Solutions (IES) will be used with Revit to calculate heating and cooling loads in the building and from there, the mechanical equipment will be sized. The design will give a general idea of the size and types of equipment necessary. Through this study, an upfront cost analysis will be performed as well as a long term estimate to determine a payback period on the system. Constructability issues such as impact on the coordination process, planning and lead times will be stressed. Indoor air quality, consistency with LEED credits, durability and long term maintenance will also be taken into account.

Research Method

To complete this analysis, a better understanding of chilled beam systems will be required. This will be done by studying literature available on this topic. To begin, using online databases such as ProQuest to obtain as much background information as possible about chilled beams will be the best approach. Once this basic knowledge has been gathered, it will be possible to speak intelligently with project teams who have worked on projects such as Constitution Center, as well as professors and mechanical engineering firms who are familiar with the system. Time will also need to be spent learning how to use IES. Other students and industry professionals will be key consultants.

A few helpful contacts have been identified already. The first contact is Bill Moyer of Davis Construction, who discussed chilled beam systems at the PACE Roundtable. Davis is currently working on Constitution Center in Washington, DC, which employs a chilled beam system. The project team on Constitution Center would be the first point of contact and a valuable source. Additionally, the mechanical engineer on Walker Jones has agreed to be of any help he can and will be a valuable contact. Additional tools will include Revit, IES, ASHRAE codes and additional industry professionals.

Expected Outcome

This analysis will be interesting from the construction management perspective as it deals with cost, schedule and constructability concerns. Although the upfront cost of a chilled beam system may be higher, determining the payback period and the effects on constructability should justify the extra money upfront. This analysis will encompass a mechanical breadth and satisfy the M.A.E. requirement.

Analysis 3: Alternative Façade Material

Opportunity for Improvement

Although the current hand-laid brick is a common façade finish, it has caused a lot of coordination and site logistics issues on Walker Jones. The exterior walls require eight steps to complete, making the masonry a logistical headache. To close in the building, the subcontractors must install studs, flashing and dens glass, then tape the joints, install rigid installation board, install the brick ties, install the brick, and finally, put the windows into place. This requires three different subcontractors to trade off using the same scaffold. The brick façade was also a primary focus of schedule acceleration planning, if it was necessary.

Solution

A hand laid brick system requires the use of a large amount of scaffolding, which can cause site congestion and coordination issues between trades. Precast systems eliminate the need for the scaffolding, mortar station and constant stockpiling of bricks. Installing standard bricks requires more people which increases safety and coordination headaches. Additionally, a precast system will cut back on cost because labor forces can be reduced. Most of the work for a precast system can be done ahead of time off site in a controlled environment, eliminating many logistical, coordination, and weather concerns.

Analysis

The main focus of the study will be on schedule acceleration and cost impacts. For a system to be considered acceptable, the quality must remain the same or better than a hand-laid system. The insulation value of the new façade system will be critical – the goal will be to achieve a higher insulation value with the new system. The analysis will include durability, aesthetics and constructability. Additionally, the structural and lighting differences will be addressed. An alternative façade system will affect the structural system, so those changes and connection details will be addressed. An effort will be made to improve daylighting in the classrooms. To do this, an analysis will be performed on the current design in comparison to the new façade design.

Research Methods

Research will begin with learning about different prefabricated wall systems. Industry professionals will be consulted for their knowledge of precast systems. The best systems will be selected and used for the analysis. Analysis will include cost, schedule, constructability and availability. Further, the structural system will be altered to accommodate the new façade system and IES will be used to run an analysis of the new daylighting conditions.

Expected Outcome

An alternative façade material should decrease initial cost and accelerate the construction schedule. It will also be beneficial by increasing the thermal value of the building envelope. Structural concerns due to different loads and connections will be addressed and an analysis on daylighting will ensure the design allows for the best learning environment for students.

Weight Matrix

The following Weight Matrix illustrates how time and effort will be distributed among the different analyses.

Weight Matrix					
Description	**Research**	**Value Engineering**	**Constructability Review**	**Schedule Reduction**	**Total**
Analysis 1: The Benefits of LEED Schools	25				25
Analysis 2: Mechanical Redesign Using 3D Modeling	5		20	10	35
Analysis 3: Alternative Façade Materials		15	10	15	40
Total	30	15	30	25	**100**

Appendix A: Breadth Studies

Breadth One: Mechanical

Using Revit and Integrated Environmental Solutions, loads will be calculated for the redesign of the mechanical system. The system will then be designed as a chilled beam system. Equipment will be sized, and a life cycle cost analysis will be performed and compared with the current VAV system. Constructability issues such as impact on the coordination process, planning and lead times will be stressed. Indoor air quality, consistency with LEED credits, durability and long term maintenance will also be taken into account.

Breadth Two: Structural

An alternative façade material will be suggested in an attempt to accelerate the schedule and lower construction costs. The structural implications of the new building envelope will be evaluated and an acceptable solution to alter the structural system and add the necessary connections will be proposed.

Breadth Three: Lighting

With the design of a new façade system, an increase in natural lighting will be a priority. IES will be used to evaluate daylighting conditions with the new façade system versus the current hand-laid brick and punch window system. Occupancy and daylighting sensors will be addressed.

Appendix B: Spring Semester Schedule

JANUARY '09

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	2	3
				GOAL FOR OVER BREAK:	1.OBTAIN REVIT MODEL AND DISCUSS SYSTEMS WITH MECHANICAL ENGINEER	2. START PRELIMINARY RESEARCH ON NEW SYSTEMS
4	5	6	7	8	9	10
INTERVIEW w/ HESS in Rockville	**INTERVIEW w/ HESS in Rockville**					
11	12	13	14	15	16	17
	CL ASSES RESUME	Conduct additional research on chilled beams, LEED and façade alternatives	Conduct additional research on chilled beams, LEED and façade alternatives	Conduct additional research on chilled beams, LEED and façade alternatives	Conduct additional research on chilled beams, LEED and façade alternatives	
18	19	20	21	22	23	24
	NO CLASS	LEARN TO USE IES	LEARN TO USE IES	BEGIN SURVEY / CONTINUE WITH IES	CONTINUE SURVEY & IES	
25	26	27	28	29	30	31
	FINALIZE SURVEY	BEGIN REVIT / IES ANALYSIS	SEND OUT SURVEY	CONTINUE REVIT / IES ANALYSIS	ORGANIZE load data and energy consumption	Review load data and energy consumption

FEBRUARY '09

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6	7
Equipment Selection	Equipment Selection	Equipment Selection	Equipment Layout and Design	Equipment Layout and Design	Equipment Layout and Design	
8	9	10	11	12	13	14
Equipment Layout and Design	Cost, Energy and Constructability Analysis	Cost, Energy and Constructability Analysis	Cost, Energy and Constructability Analysis	Cost, Energy and Constructability Analysis	Compare Cost and Constructability	
15	16	17	18	19	20	21
Compare Cost and Constructability	Compare Cost and Constructability	RESEARCH FAÇADE	COLLECT AND ANALYZE SURVEY RESULTS	COLLECT AND ANALYZE SURVEY RESULTS	COLLECT AND ANALYZE SURVEY RESULTS	COMPILE SURVEY RESULTS
22	23	24	25	26	27	28
COMPILE SURVEY RESULTS	RESEARCH FAÇADE	RESEARCH FAÇADE	DETERMINE ALTERNATE FAÇADE SYSTEM	PRICE ALTERNATE FAÇADE SYSTEM	PRICE ALTERNATE FAÇADE SYSTEM	PRICE ALTERNATE FAÇADE SYSTEM

MARCH '09

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2 DETERMINE STRUCTURAL IMPLICATIONS OF NEW FAÇADE SYSTEM	3 DETERMINE STRUCTURAL IMPLICATIONS OF NEW FAÇADE SYSTEM	4 DETERMINE STRUCTURAL IMPLICATIONS OF NEW FAÇADE SYSTEM	5 STRUCTURAL REDESIGN	6 SPRING BREAK	7 SPRING BREAK
8 SPRING BREAK	9 SPRING BREAK	10 SPRING BREAK	11 SPRING BREAK	12 SPRING BREAK	13 SPRING BREAK	14 SPRING BREAK
15 SPRING BREAK	16 ANALYZE FAÇADE REDESIGN	17 ANALYZE LIGHTING	18 ANALYZE LIGHTING	19 ANALYZE LIGHTING	20 ANALYZE LIGHTING	21 Start compiling information needed for final report
22 Compile information	23 Compile Information	24 Organize Final Report	25 Organize Final Report	26 Organize Final Report	27 Work on final report	28 Work on final report
29 Work on final report	30 Work on final report	31 Work on final report				

APRIL '09

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
			Work on final report	Work on final report	Proofread report, begin Powerpoint presentation	Proofread report, Powerpoint presentation
5	6	7	8	9	10	11
Proofread report, Power point presentation	Powerpoint presentation	Powerpoint presentation	FINAL REPORTS DUE- 5PM	Practice Presentation	Practice Presentation	Practice presentation
12	13	14	15	16	17	18
Practice Presentation	**FACULTY JURY PRESENTATIONS**	**FACULTY JURY PRESENTATIONS**	**FACULTY JURY PRESENTATIONS**	**FACULTY JURY PRESENTATIONS**	**FACULTY JURY PRESENTATIONS**	
19	20	21	22	23	24	25
26	27	28	29	30		