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 perform a basic redesign of 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 daylighting to improve natural light in the learning environments. Analyses will be performed to determine the best way to reduce energy consumption and improve the classroom atmosphere through natural lighting.

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 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.

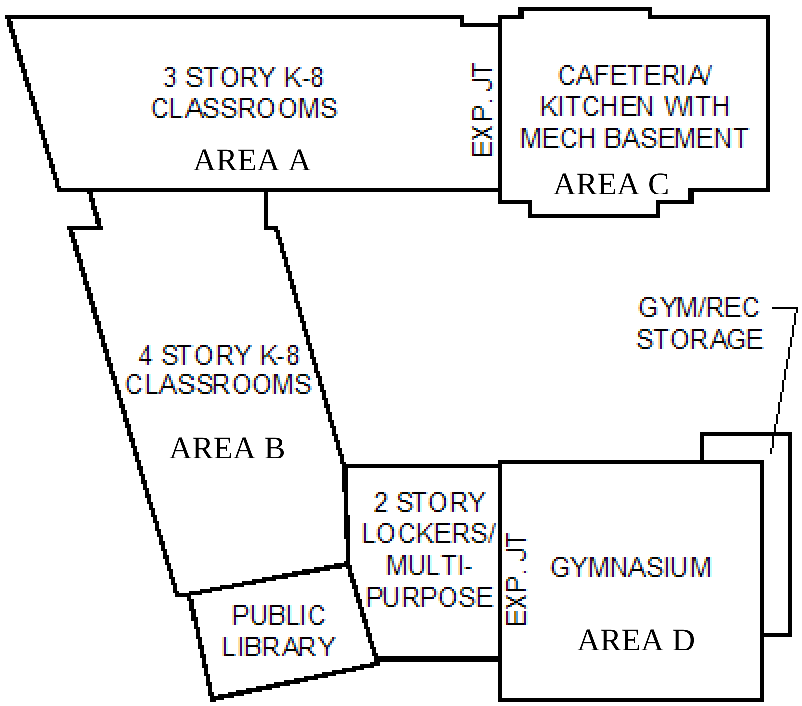

Figure 1 - Sections of the Building

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 will 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 green schools 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: Daylighting in Classrooms

Opportunity for Improvement

Daylighting in classroom settings provides undeniable benefits to students. According to preliminary LEED checklists, the Walker Jones team anticipates achieving LEED Credit EQ 6.1: Controllability of Systems, Lighting by implementing occupancy sensors in all classroom spaces. Additionally, the team decided not to go for Credit EQ 8.1: Daylight & Views, Daylighting. This means that the students are not getting enough natural light in the classrooms to maximize learning benefits.

Solution

In a K-8 setting, occupancy sensors may not be the best way of monitoring lighting control. Since the same teacher is in the room all day, one individual is responsible to turn out the lights when no one is in the classroom. For the daylight credit, the current typical classroom layout will be evaluated to determine if natural lighting is sufficient. If it is not, an alternative layout will be tested. Through the use of computer simulation with AGi32, it will be attempted to achieve a minimum daylight illumination level of 25 footcandles.

Analysis

Different types of dimming ballasts and on/off switches will be analyzed to determine the best way to control lighting in the classroom spaces. In combination with this research, through the use of computer simulation with AGi32, it will be attempted to achieve a minimum daylight illumination level of 25 footcandles.

Research Methods

Research will begin by learning about different lighting control systems. After consulting lighting faculty members and industry professionals, a type of dimming ballast or on/off switch will be selected. AGi32 will then be used to determine how useful this lighting control system is. Different layouts will be analyzed to maximize daylighting in a typical classroom space.

Expected Outcome

If the current classroom layout does not provide sufficient daylighting, a new layout will maximize natural light in the classrooms. Because occupancy sensors will be removed and an alternative sensor will be installed, there should be minimal cost or schedule impacts. The relocation of windows should not impact the mechanical system as changes will be small. In the long run, the owner should save money on electric expenses and the students will have a more ideal learning environment.

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	20	5			25
Analysis 2: Mechanical Redesign Using 3D Modeling	5		20	10	35
Analysis 3: Daylighting in Classrooms	5	20	10	5	40
Total	30	25	30	15	**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: Lighting

Analyses will be performed to determine the best way to reduce energy consumption and improve the classroom atmosphere through natural lighting. Daylighting calculations will be run on the current classroom layout, and the layout will be reconfigured if the daylighting is inadequate. Dimming ballasts and on/off switches will be considered. In addition, the cost and schedule changes will be examined.

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 and LEED	Conduct additional research on chilled beams and LEED	Conduct additional research on chilled beams and LEED	Conduct additional research on chilled beams and LEED	
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	CONTINUE REVIT / IES ANALYSIS	CONTINUE REVIT / IES ANALYSIS	Contact Schools For Survey	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	SEND OUT SURVEY	Equipment Selection	Equipment Selection	
8	9	10	11	12	13	14
	Cost, Energy and Constructability Analysis	Cost, Energy and Constructability Analysis	Cost, Energy and Constructability Analysis	Cost, Energy and Constructability Analysis	Compare Cost and Constructability	Compare Cost and Constructability
15	16	17	18	19	20	21
RESEARCH DAYLIGHTING	RESEARCH DAYLIGHTING	RESEARCH DAYLIGHTING	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	LEARN AGi32	LEARN AGi32	DO LIGHTING ANALYSIS	DO LIGHTING ANALYSIS	DO LIGHTING ANALYSIS	DO LIGHTING ANALYSIS

MARCH '09

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