TECHNICAL ASSIGNMENT 3

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THE URBN CENTER & URBN CENTER ANNEX

PHILADELPHIA, PA

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EXECUTIVE SUMMARY

This technical assignment gives a LEED strategy to obtain LEED certification of the URBN Center project. The report provides an analysis by category and explanation of the methods to achieve LEED points based on the 2009 LEED guide for new construction and major renovation. The proposed strategy suggests pursuing **62** LEED points as an effort to achieve LEED gold certification.

The report also summarizes an interview with Mr. Adam Rockmacher (project manager on the URBN Center) which discussed the schedule acceleration methods and concerns for the URBN Center as well as implemented value engineering methods in the project. Such value engineering methods include:

1. Alternatives for exposed conduit
2. Curtain wall system supports
3. Chilled beams.

The technical assignment also summarizes the events during the 21st annual PACE Roundtable. This event gave students an opportunity to discuss current industry issues with building industry professionals. Industry issues that are summarized in this report include supply chain and modularization.

Finally, the report summarizes possible analytical research options based on the issues faced on the URBN Center project. Since the biggest challenge of the URBN Center project team was to complete the project scope on such short period of time, analytical construction research regarding prefabrication of curtain walls is proposed as an effort to reduce construction time. Other research areas proposed relating to the curtain wall include an architecture breadth to redesign the exterior façade. Since the exterior façade will be modified, research opportunities regarding energy usage and structural supports for the new curtain walls are also proposed. As for the second construction analysis option, SIP scheduling is proposed as an effort to reduce production time and increase productivity on site.

Sincerely,

_____

Ghaith Yacoub

LEED EVALUATION

For cost reasons, the owner of the URBN Center project did not pursue LEED certification. However, it could be argued that LEED certification would be beneficial to the owner in the long run. This section will include a proposed LEED evaluation and analysis of the appropriateness of LEED for this project.

There are many advantages of pursuing LEED certification for the URBN Center mainly due to the type of building the project encompass. Since the building will host architecture students, it is important for this project to be LEED certified because it will give students a sustainable space to work and help the owner in the following ways:

Figure 1: USGBC Logo, property of the USGBC.

1. A LEED certified building will attract future quality architecture students to the Drexel architecture program because LEED is rapidly becoming a common desirable design feature in the building industry.

2. Working in a LEED certified environment could be used as an educational tool for the architecture students by giving them examples of LEED building feature and help them understand sustainable design

3. A LEED certified building will give a healthier environment for all the students occupying the building and working in a healthier environment is statistically proven to improve productivity of the occupants.

4. Finally, the LEED features will reduce energy cost for the owner in the future by having a more efficient energy usage, waste water management, indoor air quality…etc.

To conduct the LEED evaluation, the "LEED 2009 for new construction and major renovations" project checklist was filled. Existing design features and additional design alterations are proposed in order to achieve an appropriate LEED certification with a total of 62 points, which would make the URBN center qualified for a "LEED Gold Certification. The LEED score card is included in APPENDIX A.

Scorecard Breakdown

The following section will include an analysis of the LEED score card by category and how the points will be achieved in order to deem the URBN center to be gold certified. Table 1 shows the overall point breakdown by category. As a reference, the LEED 2009 for new construction and major renovation rating system guide was used to gain better understanding of the LEED point breakdown and to determine whether each point is appropriate for this specific project.

Table 1: Proposed LEED Points Breakdown By Category.

Proposed LEED Points Breakdown (By Category)			
Category	Pursued	Maybe	No
Sustainable Site	14	4	8
Water Efficiency	4	2	4
Energy & Atmosphere	12	13	10
Materials & Resources	9	1	4
Indoor Environmental Quality	13	-	2
Innovation and Design Process	6	-	-
Regional Priority Credits	4	-	-
Total	**62**	**20**	**28**

Sustainable Site:

Many of the pursued points in this section are due to existing conditions of the project site. For example, the project location is within 285 ft. of the Philadelphia Subway station on 34th St. and there are 2 bus stops within 0.25 miles of the project location which qualifies the site for 6 possible points. Also, Existing trees and plants on the site qualifies the site for 1 point for the "heat island effect" section. As for alterations to the project site, some points can be easily attained by adding bike racks in the parking lot and giving a few parking spots to cars that use alternative fuel energy. Also, adding an appropriate shading system to the windows in the URBN Center should be pursued to minimize light pollution emitted by the building since the building has many windows and curtain walls. However, there are 8 points that did not fit the site of the URBN Center which deemed them inappropriate for the project and therefore were not pursued. For example, having minimum parking spots as specified by the zoning requirement does not qualify for the existing parking lot which goes beyond the minimum parking limit.

Water Efficiency:

Four points are proposed to be pursued in this section. These points can be achieved mainly by using appropriate plumbing equipment and fixtures such as urinal and water closets that would meet the appropriate requirements specified by the USGBC. However, four points are not pursued for water efficient landscaping due to the lack of landscaping included on the site.

Energy and Atmosphere:

Out of the 12 points pursued in this section, 10 come from proposing to improve the energy usage by 26% which leads to 10 points as designated by USGBC for renovated projects. This is very important and although might be costly to do, it will reduce the energy cost for the owner in the future. Additional points could be attained from starting commissioning very early for the project which requires some alterations to the existing contract for the project. Also, 2 additional points could be attained if the owner agrees to change the energy provider to a green power provider.

Materials and Resources:

9 points are pursued in this section. 2 points can be achieved from maintaining 75% of the exterior walls, floors, and roof which is true to the existing building renovation. Also, 1 point can be attained from the existing building since the design maintains more than 50% of the interior elements. Additional points are proposed by recycling construction waste management, buying recycled contents, and regional contents (within 500 miles of the project location). As for points that should not be pursued, they include material reuse which is inappropriate to the desired new design features. Also, use of certified wood is not pursued since wood is not used for structural elements in the building.

Indoor Environmental Quality:

This section is very important because it improves the environment for the students and creates a better work space for them. Therefore, 13 points should be pursued out of the possible 15 points. Points can be achieved from increasing ventilation, monitoring oudoor air delivery, developing indoor air quality plan during the construction, using low emitting materials, and adding lighting and thermal controls. Also, some points can be achieved from the existing daylight lighting implemented in the design by having the skylight on the roof and curtain walls on two sides of the building. 2 points are should not pursued in this section. These points are from constructing an indoor air quality plan before occupancy which can be difficult to achieve since there is very little time between completed construction and building occupancy. Also, using low emitting materials (composite wood and agrifiber product) is not pursued since this type of wood is not used on the project.

Innovation and Design process/Regional Priority

There are 10 points in these two sections and all 10 points should be pursued by showing innovation in achieving the LEED points and not by just simply following LEED minimum requirements, by having a LEED accredited principle on the project, and by focusing on the regional Philadelphia area as identified by the USGBC regional council.

Summary:

Although the URBN Center project did not pursue LEED certification, the analysis above shows it is possible to achieve LEED gold certification for the URBN Center project. This certification will not only help the owner by having a sustainable and efficient building, but also by attracting world class students to the Drexel architecture program.

PROJECT MANAGER INTERVIEW

Schedule acceleration scenarios

The critical path of the URBN Center's schedule is mainly concentrated around activities in the core of the building where the building was demolished. Therefore, the critical path includes the demolition of each floor and the center of the roof. Other construction activities on these floors depend on completion of the demolition which is why it was important to remain on schedule for the demolition and minimize the duration of the demolition of the center of the building. Another main item of the critical path was the mezzanine structure. Constructing the mezzanine structure and the added levels to the existing structure was crucial to be done in a timely manner in order to allow for activities that follow to be completed on time.

This being said, the biggest risk of completing the project on time was to keep the demolition duration to a minimum. The demolition included cutting the center portion of the building to allow for the construction of the roof skylight and the mezzanine structure and some general demolition (MEP…etc.). The original demolition package of the project consisted of two phases:

1. Demolition of the Center of the building
2. General Demolition

Original contractual agreement was for the General contractor to only have to perform the general demolition of the project. However, due to time delays the general contractor had to start project with phase 1 of the demolition not being completed by the owner. Therefore, Turner had to perform both phases of the demolition instead of just the second phase.

Throughout the first phase of demolition, the original plan was to demolish the structure starting from the roof down to the ground floor. However, the structural engineer on the project opposed this idea and proposed a different shoring plan. This problem was solved by partially tearing down the structure and keeping certain beams that were supposed to be demolished in place. These beams were kept in place during the construction of the mezzanine floor above and demolished after completing the construction of the mezzanine floor. These changes led to time delays which led to accelerating construction activities related to the demolition, mezzanine structure, glazing, MEP portion of the building.

This acceleration of the schedule was done partially by working overtime/working two shifts, and by implementing prefabrication into the project. Working overtime is a costly method to reduce the project time due to the added labor cost but necessary at times. Miscellaneous metals were prefabricated off site to reduce the time of installation on the project. This method reduces labor cost on site by reducing the instillation time on site.

Value engineering topics

As an effort to maintain the project cost within the owner's budget, there were three main value engineering implementation into the URBN Center. These topics are as follows:

4. Alternatives for exposed conduit
5. Curtain wall system supports
6. Chilled beams.

These topics are explored in more details below.

Alternatives for exposed conduits:

The project team decided to implement the use of Metal Clad Cable with cable trays instead of exposed conduits which were used as the wiring method of the existing structure. The advantage of using a cable tray instead of an exposed conduit comes from faster installation time. Cable trays are quicker to install which leads to savings from labor. Also, when using the MC Cable on the cable tray, the time used to pulling the wires in conduits is completely eliminated adding to the time saving advantage of using the MC Cable. By doing so, the project team was meeting the owner's request to reduce the cost of the project and remaining within budget.

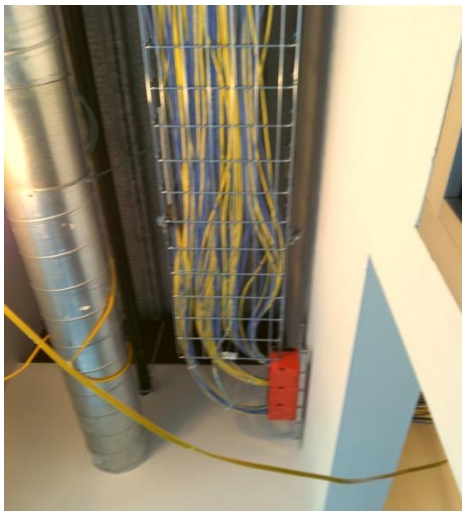

Figure 2: MC Cable on a Cable tray in the URBN Center. Photo property of Drexel Univ.

Curtain Wall system Supports:

Another value engineering effort was pursued through changing the supports of the curtain wall system from point supports to conventional curtain wall supports.

Chilled Beams:

The most difficult value engineering decision for the project team was whether to use chilled beams or not. The uncertainty was mainly because chilled beams remain a relatively new type of mechanical unit which made it difficult for the project team to distinguish the long term effect of using this type of system. The chilled beam units are also more expensive than typical fan cooling units. Another reason for uncertainty to use this type of system because it would be the first of its kind on any of the owner's buildings. However, chilled beams ended up being used on the project after further research due to their long term advantages.

The main advantage of using a chilled beam system comes from the savings due to low operational cost. The chilled beam works as a radiator which is chilled by recirculated water[1]. The warm air rises to the chilled beam and once it is cooled, the air falls back to the floor allowing for the cycle to start again[1]. This way of operation reduces the need for ductwork[1]. Also, a chilled beam system operates very quietly which makes it a perfect system for buildings that has auditoriums and classrooms such as the URBN Center. Therefore, the project moved forward with the use of chilled beams in the URBN Center even with the expensive purchase cost of the chilled beams because in the long run this system will benefit the owner from low operation cost, and a better working environment for the students. There are no value engineering efforts that the project team considered without implementing them on the project.

Figure 3: Chilled Beam in the URBN Center. Photo property of Drexel University.

1: http://www.buildings.com/ArticleDetails/tabid/3334/ArticleID/6087/Default.aspx

CRITICAL INDUSTRY ISSUES

The 21st annual PACE Roundtable was a great opportunity to network with the various professionals from the building industry and to learn about some of the current issues in today's industry. Two topics that were discussed that day were supply chain, and modularization.

The first break-out session revolved around supply chain. Supply chain is the process of material deliveries to the site and installing them properly on site. This issue is important because it creates challenges that relate to communication among the project team and vendors of various products used during the construction of the building. Members of this break-out session discussed whether the project team should buy materials when it is needed or to store the materials. This issue was determined to be better to figure out when the material is needed and buy it at a time that will allow the material to be on site when it is needed. This will eliminate spending the owner's money on unnecessary storage space. The discussion also explored the use of technology in chain supply to improve the process of delivering materials to site. Some of these technologies include the use of bar codes that are tagged on materials which are being delivered to the project. This technology allows for easy tracking of where the material is and when it will be available on site. Also, information about the materials could be attached to the 3D model allowing for the project teams to know which members are prefabricated and when will the material arrive to site. As for the vendors, it has been fairly easy to get them involved in the use of technologies such as bar codes for major materials like steel members or precast concrete.

Thesis research topics on the URBN Center regarding supply chain include finding a unique product on the project such as the chilled beams and tracking its source or its delivery method to figure out an efficient way to speed up the delivery process of this material. Another possible research topic is to come up with a material handling plan that can potentially improve the sequencing of the project. This would be a good topic for the URBN Center because of the site logistics of the project which is located in a busy city area which can have an effect on delivery timing. Resources needed to conduct this research can be obtained from the project manager and by tracking vendors who provided the materials for the URBN Center.

The second break-out session revolved around modularization. Modularization is gaining popularity in the construction industry because it allows for saving labor time and increasing productivity on repetitive construction activities. Members discussed the improvement of modularization in recent years. These improvements include the introduction of multi-trade modularization such as drywall and plumbing specialty contractors. The impact of prefabricating such items lead to better quality, fast

installation, and safe work environment since the product is being prefabricated off site in a controlled environment.

However, modularization requires a lot of planning in order to be a successful process. The keys to success for modularization include early involvement from all parties, designing for modular (instead of modularizing the design), and considerations for cost and transportation. Sections of the building that are good for modularization include but not limited to the following: formwork, curtain walls, bathrooms, headwork, casework, and brick panels.

Thesis research topics that could be explored regarding modularization include exploring the process to prefabricating bigger sections of the building (i.e: curtain wall) or designing a preconstruction process for modularization some sections of the URBN Center (considering cost, time, parties involved…etc.). Contacts necessary to conduct this research include the project manager of the URBN Center and various members from the design and engineering team since modularization requires communication from all parties involved in the design/construction process.

Overall, The Roundtable was a great experience for networking with industry professionals and Penn State graduates. It was also a good way to see where the department of Architectural Engineering is heading and the results of recent research conducted by the department.

Note: Roundtable questionnaire is included in APPENDIX B.

TECHNICAL ANALYSIS OPTIONS

Construction Analysis option#1: Prefabricated curtain wall system

The biggest constructability issue for the URBN Center was the rigid project schedule. Therefore, an effort to save time during construction is worth exploring. To do so, a construction analysis of prefabricating the newly introduced curtain walls to the URBN Center design is proposed. Prefabricating the curtain wall system will allow for possible time saving due to shorter installation time and possible labor cost savings. The analysis will focus on the following aspects:

- Developing a coordination plan between design and construction team early on in the design process.
- Research available vendors
- Analyze delivery methods and durations of prefabricated system with a comparison to the existing delivery plan utilized on the project.
- Explore storage options for the prefabricated system on site.
- Develop instillation plan—crane usage, required labor…etc.
- Comprehensive cost and schedule comparison of the prefabricated curtain wall system and the existing system.

Architecture analysis option: Redesign of exterior façade

Based on the proposed prefabricated curtain wall research, architectural research can be done on the exterior façade of the URBN Center. Redesigning the exterior façade, specifically the curtain walls can be beneficial to better suite a prefabricated curtain wall system. Proposed design options include the following:

- Modifying the locations and size of the curtain walls located on the north and east facades
- Adding a curtain wall on the west façade
- Assuming that the south façade cannot be modified due to historical preservations, no alterations will occur to the existing design.
- Explore alternative glazing options

Structural analysis option: Structural support for Prefabricated Curtain Wall System

Due to the proposed architectural redesign of the exterior façade, a structural research can be conducted on the required structural support of the prefabricated curtain wall system. Also, analyzing the structural modification that is necessary due to the redesigned exterior façade. This analysis will be conducted as follow:

Mechanical Analysis Option: Energy use based on the new exterior façade

The redesigned exterior façade will also open the opportunity to study the changes in energy usage based on the new curtain walls. Since the building's façade will be modified and the curtain walls will be alternated as well as possibly having new glazing type, a comparison energy usage between the new system and the existing system can be conducted. This comparison will determine whether the new curtain wall system will be beneficial to the owner as and whether it will save the owner money based on energy usage.

Construction Analysis Option#2: utilization of SIP Scheduling

Another construction analysis to explore regarding the schedule of the URBN Center is the use of SIP scheduling. Short interval scheduling is a good area to explore as an effort to improve productivity and accelerate the schedule of the project as much as possible. This research can be conducted by doing the following:

- Identifying areas in the building where SIPs can be used
  - Based on similar activities
  - Similar spaces (offices, classrooms, etc.)
- Developing a 4D model with the proposed sequence of these spaces
- Comparing the durations and cost of labor between the new sequence and the existing durations based on the project schedule

Resources required:

The following resources will be utilized in order to conduct the analysis topics described above:

- Penn State AE Faculty
- URBN Center Project Manager
- URBN Center Design/Engineering team
- Curtain wall vendors

APPENDIX A

LEED SCORE CARD

LEED 2009 for New Construction and Major Renovations

Project Checklist

The URBN Center

Y	?	N			
14	4	8	**Sustainable Sites**	Possible Points:	**26**
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
3	2		Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
6			Credit 4.1	Alternative Transportation—Public Transportation Access	6
1			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
	1	2	Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
		2	Credit 4.4	Alternative Transportation—Parking Capacity	2
		1	Credit 5.1	Site Development—Protect or Restore Habitat	1
		1	Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
		1	Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
	1		Credit 7.2	Heat Island Effect—Roof	1
1			Credit 8	Light Pollution Reduction	1

Y	?	N			
4	2	4	**Water Efficiency**	Possible Points:	**10**
Y			Prereq 1	Water Use Reduction—20% Reduction	
		4	Credit 1	Water Efficient Landscaping	2 to 4
2			Credit 2	Innovative Wastewater Technologies	2
2	2		Credit 3	Water Use Reduction	2 to 4

Y	?	N			
12	13	10	**Energy and Atmosphere**	Possible Points:	**35**
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
10	9		Credit 1	Optimize Energy Performance	1 to 19
		7	Credit 2	On-Site Renewable Energy	1 to 7
2			Credit 3	Enhanced Commissioning	2
	2		Credit 4	Enhanced Refrigerant Management	2
		3	Credit 5	Measurement and Verification	3
	2		Credit 6	Green Power	2

Y	?	N			
9	1	4	**Materials and Resources**	Possible Points:	**14**
Y			Prereq 1	Storage and Collection of Recyclables	
2		1	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
1			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
		2	Credit 3	Materials Reuse	1 to 2

Y	?	N			
			Materials and Resources, Continued		
1	1		Credit 4	Recycled Content	1 to 2
2			Credit 5	Regional Materials	1 to 2
1			Credit 6	Rapidly Renewable Materials	1
		1	Credit 7	Certified Wood	1

Y	?	N			
13		2	**Indoor Environmental Quality**	Possible Points:	**15**
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1			Credit 1	Outdoor Air Delivery Monitoring	1
1			Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
		1	Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
		1	Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
1			Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
1			Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
1			Credit 7.2	Thermal Comfort—Verification	1
1			Credit 8.1	Daylight and Views—Daylight	1
1			Credit 8.2	Daylight and Views—Views	1

Y	?	N			
6			**Innovation and Design Process**	Possible Points:	**6**
1			Credit 1.1	Innovation in Design: Specific Title	1
1			Credit 1.2	Innovation in Design: Specific Title	1
1			Credit 1.3	Innovation in Design: Specific Title	1
1			Credit 1.4	Innovation in Design: Specific Title	1
1			Credit 1.5	Innovation in Design: Specific Title	1
1			Credit 2	LEED Accredited Professional	1

Y	?	N			
4			**Regional Priority Credits**	Possible Points:	**4**
1			Credit 1.1	Regional Priority: Specific Credit	1
1			Credit 1.2	Regional Priority: Specific Credit	1
1			Credit 1.3	Regional Priority: Specific Credit	1
1			Credit 1.4	Regional Priority: Specific Credit	1

Y	?	N			
62	20	28	**Total**	Possible Points:	**110**

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

APPENDIX B
PACE ROUNDTABLE QUESTIONNARE

Student Name Ghaith Yacoub

Session #1

Topic: Supply Chain: Integrating Strategies & technologies.

Research Ideas:

(1) Prefabrication options to reduce time / labor

(2) Develop Better Material Delivery Plan to site

Session #2

Topic: Modularization

Research Ideas:

(1) Designing a Pre construction process for modularization
- cost & Parties involved.

(2) Developing a training Program of how to introduce workers to Prefab. process.

Student

Industry Panel: Differentiation in a Down Economy

Research Ideas:

(1) how multidicipline teams benefit from working together.

(2) [redacted] time management between students w/ different majors.

Student Form

Pg. 1

Industry Member Discussion

Key Feedback:

Which research topic is most relevant to industry? What is the scope of the topic?

Modularization

Suggested Resources:

What industry contacts are needed? Is the information available?

- Jeffrey S. Angstadt & other contacts available as needed.

→ Foreman
Program & Construction Managers.

Student Form

Pg. 2