2010

AE 897G Updated Lighting/Electrical Proposal
Drexel University Recreation Center

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Faculty Consultants:

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executive summary

The work completed in Spring 2011 will include four lighting and four electrical depth topics, and three additional breadth topics resulting in analysis and re-design of several systems present in the Drexel Recreation Center. This does not conclude that there are actual problems with the existing designs, simply to investigate and approach alternative solutions.

The lighting depth follows the design process through schematic design, design development, and construction documentation of four spaces: the exterior courtyard, lobby, fitness center, and restaurant. The minimalist architecture exposes the core energy of the building, and the lighting design in each space will complement the architect's design goals and fulfill proposed design criteria developed throughout the Fall 2009 semester.

The electric depth will include a modification of the branch circuit distribution for each space listed above in response to the lighting redesign. A protective device coordination study will be performed along with short circuit analysis for a path originating at the utility entrance through the main switchboard to distribution panel DP-1-1, and down to panel AP-1-1. A substation upgrade will be considered, providing a new PECO ready/reserve primary service to a new Central Plant located in the basement of the New Fitness Center will be investigated, which would serve a future campus loops system. A cost comparison will be completed of an alternative solution to the existing PVC conduit distribution system located within the concrete slab of MC cable run through solid bottom cable trays on the ceiling below utilizing poke-throughs to distribute power to branch circuit loads.

An MAE focus of daylighting integration into the gymnasium using skylights and/or clerestories will in turn initiate the two out-of-option breadths of study: acoustical and structural. To incorporate daylight the dropped panel ceiling in the gymnasium will be removed, and resulting load distribution adjustments will require an analysis of the existing spacing and loading of steel truss system, as well as reverberation time calculations and consideration of echo and noise within the gymnasium.

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background

Centrally located in the heart of Drexel's Campus in Philadelphia PA, the 84,000sf University Recreation Center is a $41million state of the art addition to Drexel's existing athletic facility. Doors opened in January 2010, providing students and faculty with ID swipe card access to athletic areas including a rock climbing wall, group exercise center, and gymnasium with elevated track. The western half of the southern Market Street façade is dedicated to a restaurant and sports bar, contributing an exciting new venue to University City.

The building façade is the highlight and focal point of the Drexel Recreation Center design, reinforcing the main design goal for designer Sasaki Associates: to give the university a strong, modern presence along Market Street. A result of extensive energy studies, the strong lines and sharp angles of the glazing/aluminum panel façade create a bold presence with a modern play on transparency and concealment. Exposed concrete interiors interact with the almost floor to ceiling glazing on the southern façade to create an exposed, bright, spacious impression in interior spaces.

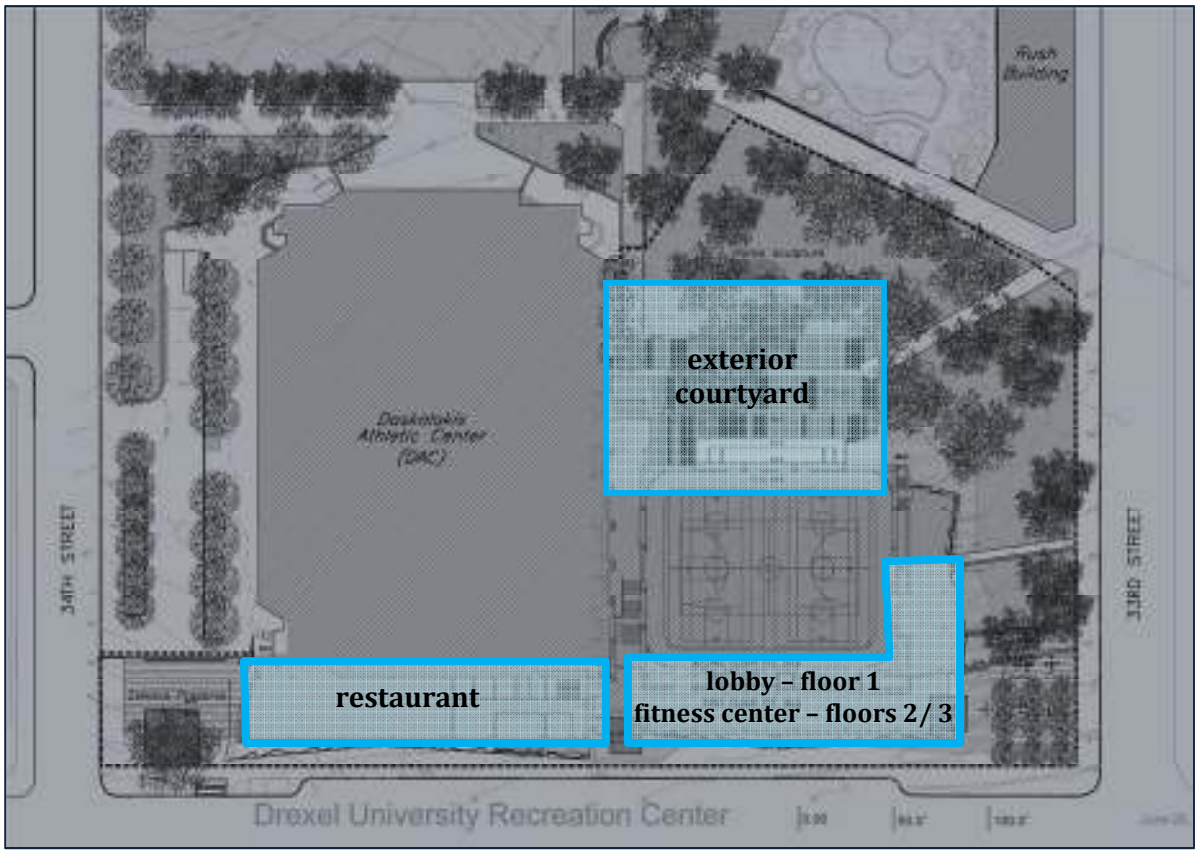

Figure 1 - Layout of Design Spaces

lighting depth

The interior of the athletic facility is almost entirely exposed by its extensive floor-to-ceiling glazing on the southern Market Street façade, making the lighting design integral in the portrayal of the architect's vision for the building. The lighting redesign will encompass four spaces: the exterior courtyard, lobby, fitness center, and restaurant. The interior spaces chosen are those that have the most influence on the façade. The lobby and restaurant stretch along the entire ground floor, while the fitness center covers more than half of the exposed area on the second and third floors.

Schematic lighting design concepts developed during fall semester will be finalized and utilized as a basis to fulfill psychological, functional, and aesthetic design criteria for each space. Each space will be fully designed with a complete set of plans and fixture schedules. Lighting design software will aid in the analysis and portrayal of final lighting designs. Knowledge acquired in AE 561 – Sceince of Light Sources will ensure that the best sources are selected for each lighting scenario.

overall design goals and concepts

Sasaki Associates took care to expose the core energy of the building. The facility is fueled by the energy of the occupants as they move within the space just as the body is fueled by core energy during a workout. The minimalist design of the architecture with its structurally exposed concrete, straight lines, clean materials, and strong angles allow the energy and active users to become the feature of the space.

Daylighting was a strong factor in the design of the façade, and will be an equally important consideration in the design of the lighting. Daylighting controls will be integrated, with daylight dimming and/or switching incorporated into each perimeter space.

The lighting throughout the Rec Center will create a bright, energetic space that interacts and responds directly to the architecture and aesthetic intent of the façade and the building within. Just as the glazing on the southern and eastern building façades demands attention in each space in the facility, the continuity of both a cool color temperature complimentary to the exposed concrete and other minimalist materials and the response to the linear façade will create cohesion when transitioning from space to space.

designer comments

Shawn Good

overall

- very nice presentation: simplistic, consistency with text, good large images
- liked plan and 3D view of space for orientation
- tying in façade/exterior with interior worked well
- presented well with proposals and liked how you incorporated and adapted presentation on the fly
- sketches black on white didn't read as well
- start with WHY you're doing it and follow with design

lobby
- linear concept: showed lines of light but not effects of it (wall and ceiling spill light)
- encourage how light interacts with space
- elevations and plans with sketches altogether for less confusion

fitness center
- good mention of daylight, visual clarity, etc.
- show north arrow to make sure people know which direction façade faces

restaurant
- included everything that privacy/relaxation Flynn mode needs

Sandra Stashik

overall
- really nice presentation, lots of sketches and breakaway images
- needed plan for orientation to location in Philadelphia
- good "core energy" image
- nice adaptation of presentation to comment from prior presentation

exterior
- owner doesn't want to hear location is unsafe, instead say "to promote safety"

lobby
- pools of light were shown conceptually
- what's on during the day? address daylight control and what luminaires would be controlled
- concepts should address daylight itself
- consider image of luminaires when they're off

fitness center
- interesting fact with treadmills and signs (liked incorporation of this with uplight)

restaurant
- needs light on tables for menus

Charles Stone

overall:
- echo Shawn's comments
- Slide 17 = best slide, very clear
- took lots of risks in presentation
- Slide 19 = least favorite, take out image on left
- go into WHY with appropriate story for lobby schematics, tied into story but WHAT IS STORY; why is concept important?
- white lines w/ black background of sketches: overwhelming but not criticism
- Slide 41 = chaotic, need to determine strong vs. weak
- owner wants details on daylight harvesting, DRC has strong case
- Restaurant: too much light going on: needs less!! Talk about dimming system
- Good adaptation to previous comments

exterior space | courtyard

The exterior courtyard space is located on the northern side of the Athletic Center addition, and is bordered on the west by the existing athletic center. Measuring 123' x 117', the courtyard covers close to 15,000sf. Providing access to both the gymnasium and the Hall of Fame entrance to the facility, the space is an important circulation space and is the first impression portrayed to visitors approaching the DAC from the north side.

The athletic center's courtyard and plaza should feel welcoming while balancing the feeling of a public space during the day and a more private, enjoyable shortcut across campus after dark. Keeping the central area dimmer and guiding the pedestrians through the space with light can transform this space from its current state as a scarcely lit, unnoticeable space to an inviting, engaging spot in which to walk. Guiding pedestrians with light is difficult because the space is used for yoga and martial arts during the day, so no luminaires can be placed within the pathway. Color appearance and color contrast are important and based on designer comments, at least one layer of exterior light will come from above in order to effectively render faces within the space to promote safety.

Ambient lighting will be provided by the core glow from the building, with backlighting on the blue façade glazing panels to emphasize the energy within. The main layer of light on the path will come from the building itself, both the stairs and from under the façade itself, reinforcing both the minimalist approach and the building energy core. A row of luminaires will provide light for the faces of those passing through, and a soft highlight on the trees and feature statue will add depth to the space. Energy efficient lighting will be used in this space, incorporating LEDs and/or fluorescent fixtures.

circulation space | lobby

The lobby and main circulation entrance is the daylight feature space of the Athletic Center. The exposed concrete and almost floor to ceiling glazing on the southern façade create an exposed, bright, spacious impression. To check into the athletic facility, visitors must use the keycard accessibility entry past the security desk on the eastern end. The entrance is also accessible from this space at the western side. This makes this corridor the most traveled space in the project. The lobby measures approximately 180' x 20' and has a ceiling height of 14'.

The lobby is the first space that a majority of the people will see, and should reflect the overall design goals of the building. The main function of the lobby is circulation, but it doubles as a student study area and longue because of its convenient operating hours and brightness throughout the day. Because of the dynamic functions of the building and the precise lines of the space, the lobby should also be visually interesting, playing with punctuations of light.

Three strong minimalist architecture concepts were chosen as design schematics for the space because of their ability to influence the energy within the space and change the way the circulation flows: the concept of linear light, circular pools of light, and the sharp lines and corners of squares. The square schematic was initially chosen for its bright, uniform result with visual interest and compliment to the architecture while encouraging directed circulation.

After receiving the designer's comments, the linear concept will be reviewed and reconsidered, as it, the initially chosen square inspired design, or aspects of each could be integrated into the final design to best fulfill the overall goals and criteria for the space. The final

selection will fully integrate daylighting using photosensors and controls, keeping important circulation points of interest highlighted including the front desk and the small café.

large workspace | fitness center

The fitness and weight lifting areas are located on the second and third floors of the DAC spanning the 140' southern façade. Sections for free weights and strength machines extend along the Eastern façade of the building. A primary focus of the facility, the floor-to-ceiling windows and 13' ceiling heights make the space an open, inviting, energizing place for cardio workouts and strength training.

The fitness area should feel spacious, and help to energize and uplift the occupants during their workouts. A bright, uniform lighting layout can help to create this impression. Peripheral emphasis and clean, uncluttered walls will add to an open space that encourages focus. To reinforce visual clarity, high illuminance levels on the ceiling and on the workplane are important. A bright open space also reinforces safety and cleanliness, which are also important within a workout facility.

This space will be a visual and literal reflection of where the energy is being produced within the space. Drexel already harnesses the kinetic energy from the cardio machines to use for an exterior sign, and the new design will incorporate this feature into the lighting. An uplight portion of the luminaires will glow a soft blue when energy is created near the luminaire, so that from the exterior the energy within the space can be visibly seen while the color rendering of the occupants will be mostly unaffected. The square energy concept from the lobby will be utilized in this space to provide visual cohesion of the building's lighting design from the exterior, and to provide the bright, uniform light levels desired in the space.

special purpose space | restaurant

The bar and restaurant is a multi-faceted space that can be a place to watch a football game or a more relaxing, intimate place to take a break and enjoy dinner and drinks with friends. The Flynn lighting mode of private and relaxing will be executed in this space. This will be enforced with a non-uniform lighting design with lower light levels immediately surrounding the guest and higher levels away from the guest, providing a sensation of watching without being watched. Perimeter focus and a highlight or focal point above the bar will be helpful in creating this impression.

The private lounge will create the impression of intimacy and exclusivity using high-end finishes and low lighting levels to enforce the mood created by having a private party behind the bar. The bar itself will use low light levels and reinforce perimeter focus by washing the walls behind the bar and having a focal luminaire above the bar to create intimacy between sports fans, so the guests feel connected to those around them and also to help encourage new relationships between those drinking at the bar. The restaurant portion of the space will create the feeling of a private dinner while still being connected to the other surrounding tables.

The architecture will be exposed by backlighting the soffits that linearly extend across the space from each column, and perimeter focus will be created with pools of light along the southern wall and a graze of the highlight feature walls on the north side. Pools of light created by accent

fixtures above each table will create an intimate experience for the guests while providing enough light above each table.

solution method

The next step of the design process involves development, analysis, and documentation of the proposed schematic lighting designs. Computer software and hand sketches will be used in the final presentation and conveyance of the completed lighting designs. Calculations will verify that all designs meet established lighting criteria including illuminance levels and power densities. Lighting plans, calculations, and renderings will be compiled for the final documentation.

tasks and tools

Schematic Lighting Design: Comments provided by the industry professionals will aid in the finalization of the lighting design. Lighting design goals and criteria will be referenced from the IESNA handbook. Deviations from recommendations in IESDNA documents will be justified and documented.

Modeling of spaces: All spaces will be accurately modeled in AutoCAD for later export into DAYSIM, AGI32 and/or 3DStudioMAX.

Design Development: All fixtures and lamps will be selected and placed in order to create schematic design concepts and fulfill design goals and criteria.

Lighting calculations: AGI32 will be used to perform calculations to ensure that adequate illuminance levels set forth by IESNA are achieved in each space. Additional analysis will ensure that ASHRAE 90.1 power densities are met in all designs.

Daylighting Considerations: Daylight controls will be selected and calibrated using DAYSIM software.

Final Renderings: Using AGI32 and/or 3DStudioMAX , final renderings visually depicting completed designs will be created.

electrical depth

The DRC's overall electrical system is a radial system with one point of 13.2 kV service entrance in the main electrical room in the basement of the Fitness Center. This service entrance is fed from existing PECO service switchgear in the Nesbit Building. The entrance is powered by a 1500kVA transformer that steps down the voltage from 13.2kV to a 480Y/277V, 3P, 4W voltage system located in a newly constructed main electrical room to feed the new addition as well as the existing substation in the DAC. A 2500A main distribution system provides power 480Y/277V power to all loads. Dry-type, step-down transformers feed 208Y/120V, 3P, 4W power to receptacles and appliance loads, while lighting panels use 277V power. For backup power to emergency branches, the DRC utilizes an indoor diesel emergency generator rated at 350kW, 480Y/277P, 3P, 4W.

branch circuit distribution

The re-design of the lighting design will necessitate new branch circuit distribution to accommodate for updated loads in four spaces in the recreation center: the exterior courtyard, the lobby, fitness center, and restaurant. Below is a brief description of the existing and proposed lighting for each space.

exterior courtyard

The exterior currently has three fixtures each grazing the statue and the tree in the courtyard. Two specification grade compact fluorescent wall-packs are located on either side of the gymnasium door for safety and there are compact fluorescent downlights under the overhang into the Hall of Fame entrance. New lighting will incorporate LEDs and/or energy efficient fluorescent exterior fixtures in bollard, landscape lighting, and steplighting applications, which will greatly increase the load to the space.

lobby

The lobby introduces the linear fixture that is prominent throughout the rest of the circulatory spaces in the facility. A majority of the lobby's lighting is provided by the direct/indirect linear lighting system that alternates lengths in order to interact with the façade. Fluorescent and/or LED fixtures will be integrated into the new design, changing the circuit distribution of the lighting based on photosensor control zones but keeping a relatively consistent overall load.

fitness center

The majority of the fitness center's task lighting is provided by a direct/indirect linear lighting system of alternating lengths in order to interact with the façade. Architectural wall

features are highlighted by recessed compact fluorescent downlights, and the space is lit primarily with daylight for a majority of the time during the day. Fluorescent and/or LED fixtures will be integrated into the new design, changing the circuit distribution of the lighting based on photosensor control zones but keeping a relatively consistent overall load.

restaurant

The restaurant lighting is almost entirely composed of metal halide and halogen track heads for the color rendering of food and people in the space. Custom fixtures adorn the bar that use standard halogen incandescent lamping. Task downlighting is provided at all service stations in addition to at both hostess stations at either entrance to the restaurant. The new design will use more energy efficient sources and eliminate all incandescent A-lamps from the fixture schedule.

protective device coordination study and short circuit analysis

A protective device coordination study will be conducted along a single path of the electrical distribution system, extending from the utility entrance through the main switchboard to distribution panel DP-1-1, and down to panel AP-1-1. The coordination of the protective devices for the redesigned system components along this path will be shown.

examine advantages of substation upgrade

The existing unit substation was installed during initial construction of the existing Daskalakis Athletic Center in the 1960s. A substation upgrade would provide a new PECO ready/reserve primary service to a new Central Plant located in the basement of the New Fitness Center will be investigated, which would serve a future campus loops system. Benefits of updating the substation include safety, selective coordination, and transformer efficiency.

branch circuit cabling comparison

An alternative solution to the existing PVC conduit distribution system located within the concrete slab would be MC cable run through solid bottom cable trays on the ceiling below utilizing poke-throughs to distribute power to branch circuit loads. A cost comparison will be executed using hand calculations and computer software, taking into account external issues including aesthetic influence on the architecture.

breadth 1 (MAE): daylighting

Gymnasiums are an ideal design space for daylight integration into the lighting system. Daylight is primarily introduced into the Drexel gymnasium by the façade glazing on the Northern wall. A redesign of the daylighting in the space will create additional energy savings by incorporating skylights and/or clerestories, resulting in an additional redesign of the photosensor system. The new photosensor placement, configuration, and controls of the existing lighting will be determined. Techniques and information from AE 565 – Daylighting will be applied to the study and analysis of the daylight in the space.

breadth 2: acoustical

Currently, the gymnasium ceiling height is 27' with a reflective, high performance acoustical ceiling. Incorporating the new daylight design requires the removal of the perforated co-polymer panels, which will alter the acoustic performance of the space. Performing calculations will ensure desirable reverberation times and echo levels will be considered and sound absorbing or reflecting materials will incorporated accordingly.

breadth 3: structural

The modification of the ceiling for daylight integration will adjust the structural loading on the steel truss system supporting the roof. Upon analysis, redesign of the truss layout, spacing, and/or structural construction will be considered in order to further facilitate daylight introduction into the space. The loading distribution due to design modifications, including possible rearranging of the will be recalculated using STAAD, and the resulting trusses will be adjusted as applicable.

Spring 2011 Lighting/Electrical Senior Thesis Schedule

Britnei Godusky | Drexel University Recreation Center | Philadelphia, PA | Faculty Advisors: Dr. Houser/Professor Dannerth

	PR #1		PR #2 Lighting 1	PR #3 Electrical 1		PR #4 Go/ No Go 1	Lighting 2	Spring Break!!	PR #5 Electrical 2	Go/ No Go 2					
1.10 - 1.16	1.17 - 1.23	1.24 - 1.30	1.31 - 2.06	2.07 - 2.13	2.14 - 2.20	2.21 - 2.27	2.28 - 3.06	3.07 - 3.13	3.14 - 3.20	3.21 - 3.27	3.28 - 4.03	4.04 - 4.10	4.11 - 4.17	4.18 - 4.24	4.25 - 5.01
Gymnasium model and daylighting calculations in AGI/Daysim			Calculate new roof loads, size trusses		Acoustic calculations and analysis						Compile all final graphics into report, powerpoint presentation	Finalize thesis presentation powerpoint Complete final documentation: due 4.07.11	Final Thesis Presentation 4.13.11 and Faculty Jury	Final CPEP Updates and Thesis Reflection	4.30.11 Senior Banquet
Finalize 3D Models, import into AGI															
		Fixture selection, lighting calulations, preliminary controls selection for daylight harvesting													
					Finalize documentation of lighting hardware										
		Protective device coordination/ branch circuit cable comparison					Renderings								
							Campus loops system and substation alternative								
									Branch circuit redistribution						

Breadth Key	
Lighting	Deadlines:
Electrical	Lighting 1: One space complete
Daylighting	Lighting 2: Second lighting space complete
Structural	Electrical 1: One depth topic complete, electrical reqs. for one lighting space
Acoustic	Electrical 2: Second depth topic complete, requirements for second lighting space