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Lighting / Electrical

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thesis proposal revision 2

Hunter' Point South Intermediate School and High School
Queens, NY

executive summary

The Hunters Point south Intermediate School and High School is a combination middle school and high school that is part of the Hunter's Point redevelopment project of lower west Queens, NY. The 5 story building is approximately 154,500 square feet, and will house roughly 1,000 students. Within, the building will contain 26 classrooms, 8 special education classrooms, several laboratories, a library, full size gymnasium, cafeteria, kitchen, and auditorium.

For the lighting portion of my thesis, a redesign of the lighting in the following spaces will be performed:

- West and South facing facades
- IS/HS Auditorium
- HS Art Room
- IS Cafeteria

The redesign of the lighting in the auditorium will necessitate a redesign of other systems in the space, which will be the basis for my breath studies. As a result of the redesign, the mechanical system in the space must be redesigned. Due to my limited knowledge on mechanical systems, I will have to work closely with mechanical students and professors to ensure that I am designing the system appropriately and accurately.

As a result of the mechanical system redesign, an acoustical analysis will be done of the space to ensure that there is no (negative) change in the acoustics of the space. This will include an analysis of the reverberation time of the space to make sure it falls in line with what is appropriate for an auditorium. Materials may be added or removed to achieve the desired reverberation time. Acoustical properties of the panels in the room may be altered as well to help achieve this reverberation time.

An MAE daylighting study will be performed in the HS Art Room to determine the feasibility of adding daylighting controls into the space. Large portions of the walls in this space are covered with glazing, and as such, there is an opportunity for significant cost savings.

All of the lighting in this building operates at 208/120V. Increasing the voltage with which the lighting operates allows us to decrease the size of the wiring which creates savings. A feasibility study and cost analysis will be the basis for my first electrical depth topic.

All of the mechanical equipment in the building is designed for a voltage of 208/120V. By adding a transformer to step the voltage up to 480/277V, the mechanical equipment could be reduced in size which will create equipment cost savings. This is the topic of my second depth topic.

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building overview

The Hunter's Point South Intermediate School & High School is a new, 5-story public school for grades 5 through 12. Located in the PS 287 Queens School District, Hunter's Point will house roughly 1,000 students. The building will contain 26 classrooms, 8 special education classrooms, several laboratories, a library, full size gymnasium, cafeteria, kitchen, auditorium, and most architecturally significant, a nearly 4000sf roof terrace.

depth proposal – lighting

overall design and concepts

It was the original design intent of the architect to combine the two individual programs (Intermediate and High school) and the students contained within these two programs. As such, it is a main goal of my lighting design to connect the **people + programs** within this building. Such a goal is achieved by my choice of spaces, which are the spaces the architect designed specifically to be connecting points of the two programs

Second, as this building is part of a redevelopment of the Hunters Point area of Queens, it is a goal to connect the **building + community**. This can be achieved by two things: designing the façade such that neighborhood residents can freely and safely navigate the base of the building, and allowing the diverse culture of NY to influence my design.

It is the last overall goal of my lighting design to connect **lighting + architecture**. Any good lighting design is reflective of the architecture of the space. My designs aim to consider not only the physical architecture, but also the main usage, and occupant makeup of each space.

exterior façade

The sides of the building considered in this redesign are those which front the east river (west) and contain the buildings main entrance (south). The main goals of the façade designs are as follows:

minimalistic: from an energy and sustainability point of view (not an aesthetic one) the design should have a minimalistic design. This is achieved not only by putting light where it is needed, but to utilize low wattage, high efficiency sources and fixtures.

high visibility from river: as this building fronts the river, it should establish itself as a landmark and way-finding point from the river. This is achieved by lighting the west façade which include an accent of one of the most interesting architectural features – the large trapezoidal, angled overhang hovering over the large roof terrace.

vandal proof design: due to the buildings' location in Queens, NY, the lighting design should consider vandals' ability to deface the lighting. To achieve this, fixtures will be placed out of reach whenever possible. Those that cannot be placed out of reach will be vandal grade and graffiti proof.

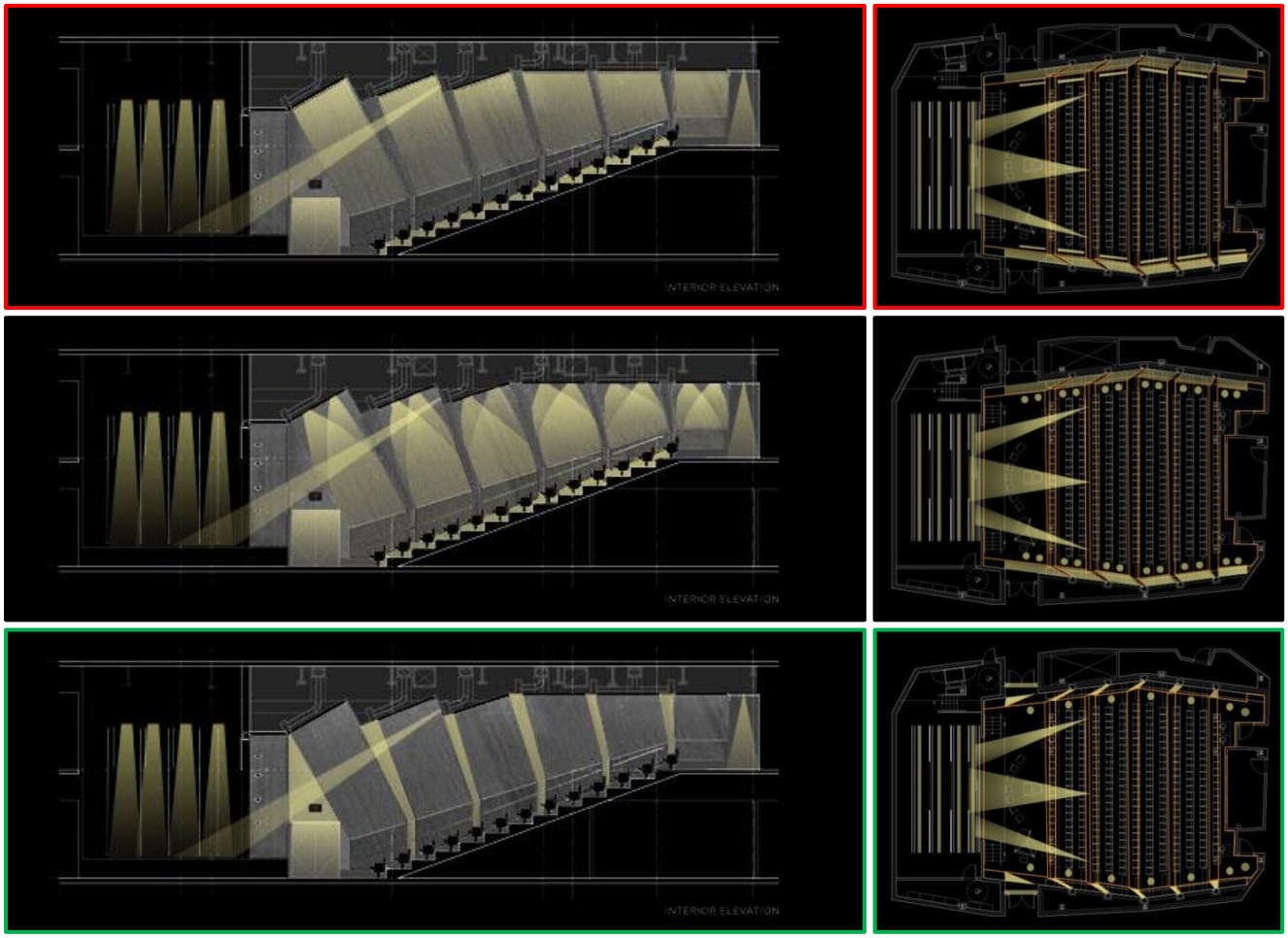
create entrance as a focal point: The entrance to the school is very small and difficult to find. It is thus the goal of the lighting to not only direct people around the building, but to then to create a focal point at the entrance to the building using a 10:1 illuminance ratio. In addition, a backlit sign of the school mascot will be placed on

the empty wall by the entrance doors. This sign will catch the eye and guide occupants to the entrance of the building.

auditorium

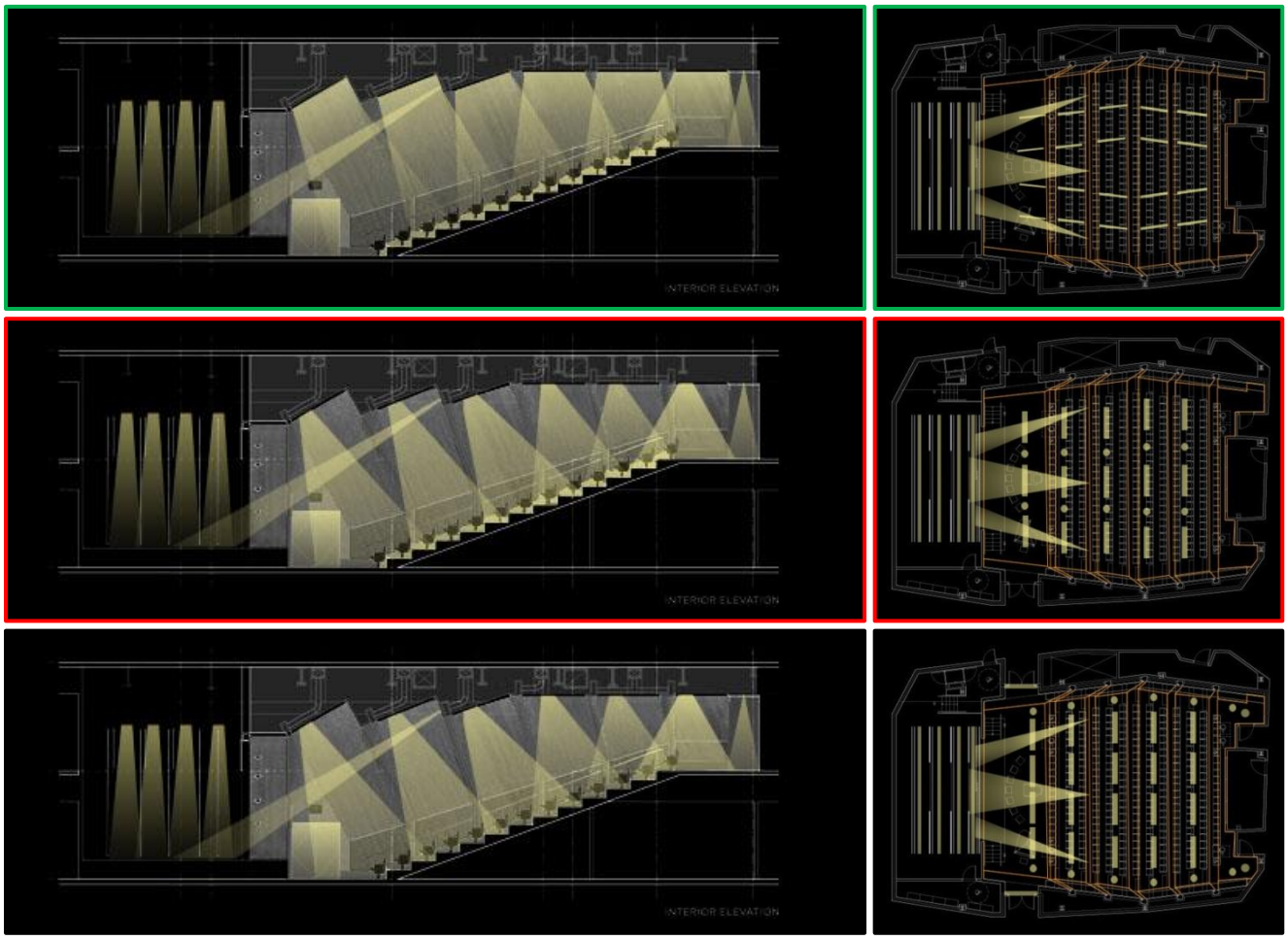
The auditorium is located in the heart of the building and connects the third and fourth floors together. The 3rd floor is dedicated entirely to classrooms and labs for the intermediate school students, while the fourth floor houses all the classrooms and labs for the high school students. As this space was designed by the architect to literally connect the two floors that house both school programs, I chose it as one of my spaces.

In the auditorium, I chose to do my three schematic designs, as well as my Flynn impression-based design. I addressed the auditorium with the goal of achieving the Flynn impression **public/private**. The need for a public scenario in the auditorium would be for when there are town meetings, or anytime there would be a large group meeting to provide information to the student body. A private scene would be needed for various events such as musical performances and talent shows. Below are my three schematic designs for the private impression:



Scene one, outlined in red, was indicated in my presentation as my preferred design. Lee Brandt, disagreeing with me, stated that her preferred design was that of scene three (outlined in green), after which she referenced me to the art works of CHIASCORO.

Below, are my three designs for the public impression:



Outlined in red is the scene that I indicated in my presentation as my preferred design. Disagreeing with me, outlined in green is the design preferred by Lee Brandt. Lee Brandt's preferred design was also my original preference but I indicated otherwise in my presentation because I thought that maybe it would infringe too much on the architecture.

high school art room

The high school art room, located on the fifth floor, is connected directly to the IS and HS cafeteria via the large outdoor room terrace. The direct connection of these spaces via the roof terrace shows the importance the architect put on connection of these spaces, and is thus why I have chosen this as one of my spaces. In addition, the HS Art room is the main space in the building where the students are able and encouraged to be creative and original. The main goals of the lighting design in this space are as follows:

promote creativity and individuality: it's very important that the art room be a place where the students can demonstrate their creativity and individuality. Their art should be a reflection of themselves – the lighting should promote this. I desire a ceiling system design such that the students have somewhat individual workstations. This will allows each student to have their own space to create original work.

decrease distraction/increase productivity: as high clarity is needed in the production of quality artwork, the lighting should not be distracting. To achieve this, the lighting should provide an illuminance level as uniform as possible, so as to reduce glare and shadows. Suggested by designers at Lutron, I will entertain the idea of giving the students control over their own lighting.

consider daylight: as two of the walls in this room are almost completely covered by windows, it is beneficial to consider daylighting from a productivity and sustainability view point. Daylight integration will be achieved by photosensor dimming of perimeter light fixtures, as well as the possible introduction of skylights.

use lighting as a tool for education: I value education very much, and as such, want to utilize this art room to not only promote lighting, but to also teach how light interacts with objects, and to understand shadows. This will be achieved by converting the rear work table in the back of the space into an adjustable exhibition space for sculpture and still-life work. The different types of fixture and sources integrated into and above this worktable will allow the instructor to teach the students about lighting, and how light interacts with objects to create shadows.

intermediate school cafeteria

The intermediate school cafeteria is attached indirectly to the HS cafeteria and HS art room via the outdoor roof terrace as indicated in the previous section. I chose this space to achieve my overall design goal of connectivity, as it was the original design goal of the architect to physically connect these spaces.

fun and creative: the main occupants of this space will be middle school students, and as such, the design should be fun and interesting to look at. It's very easy for this space to fall victim to a standard, boring lighting design, which is my goal to avoid. This will be achieved by not only integrating fun fixtures and application of color, but also with the design of the mosaic that wraps all the interior walls. As per the comments from Lutron, colored light in this space will be eliminated.

reflective of space usage: when you walk in the doors to the cafeteria, it should be immediately evident that this space is used for eating purposes. This will be achieved by using fun utensil sculptures as light fixtures.

provide illuminance suitable for eating: as the utensil sculpture will obstruct light from getting to the workplane, it is important that sufficient illuminance is provided for eating purposes. The transparency of the utensils and the density with which they are placed will be adjusted so that proper illuminance is provided.

lutron presentation – designer comments

Andrea Hartranft

Overall

- Don't tell feelings/weaknesses of design, client does not want to hear uncertainty
- Don't tell what you would have done differently

Auditorium

- Private renders space dysfunctional (misunderstanding: Andrea though my public scenario would not be combined with the private scenario)

Cafeteria
- Any white light? All color? Be clear
- Cafeteria food has a hard enough time with its appearance, colored light will make it look worse
- Need white light for food aesthetics and facial recognition

Art Room
- Consider/mention daylight – consider direct/indirect
- Uplight and not even downlight on wall will create a possible distraction that isn't visible until space is rendered in 3D

Lee Brandt

Overall
- Presentation was well Rehearsed
- Can tell your presentation was well practiced, but don't be so nervous

Façade
- Minimalistic? Be careful with semantics. Owner does not want to hear that his building is unimportant
- Slots in façade looked cool
- Wrap wall design around corner and carry it to wall
  - Make it bigger as you get to the door – go with it
- Perhaps not leave all gym lights on for exterior glow – maybe just fixtures by the windows

Auditorium
- Public scene 1 is the best (I said scene 2)
- Private scene 3 best (I said scene 1)
- Look into CHIASCORO for design idea (origami?)
- Comparisons good at the end

Cafeteria
- What was ceiling? Be clear
- Be careful with sculpture – consider the guy who would have to clean it
- Must wash the entire mosaic uniformly – then figure out what to do with tables
- "Cool kids will sit in the booths"
- Make utensils part of the mosaics?
- Make sculpture colored, and use only white light

Art Room
- Talk more about controls
- Lights over desk are confusing/distracting
- Consider access to daylight and student controllability of lighting

Brent (Lutron)

Overall
- Focus more on the feeling of the spaces
- Should be a feeling-based design, not a solution-based design

tasks and tools

For the final presentation, I will need to use certain tools and software to achieve and portray my designs. The programs and method I propose to use are outlined below.

schematic lighting design: from a conceptual viewpoint, comments provided by industry professionals will aid and influence the final design choices of my spaces. From a technical viewpoint, illuminance levels will be taken from the 10th edition of the IES Handbook.

space modeling: all spaces will be modeled in either AutoCAD or REVIT Architecture. As of now, all spaces are modeled in REVIT, with the exception of the Auditorium, which is modeled in AutoCAD. These models with then be exported to DAYSIM and 3DS.

design development: all lighting fixtures will be chosen and placed with the intent of achieving the design goals set forth in the proposed schematic designs.

lighting calculations: all lighting calculations will be performed in AGI32. However, additional calculation methods may be explored – these are 3DStudio max and the AGI plug-in for REVIT Architecture.

daylighting: all daylighting analysis will be done using DAYSIM.

final renderings: final renderings will be produced using a combination of AGI32 and 3DStduio.

depth proposal – electrical

This building utilizes a simple radial electrical distribution system. Utility power provided by ConEd electric company terminates at a transformer in an exterior, underground ConEd vault. The voltage is stepped-down to 208/120V. “Main Switchboard #1 (MS1)” is fed from the underground vault, and is the center point of the system. No additional transformers are contained in this building, and as such, the entire system operates at 208/120V.

It is from MS1 that all other loads in the building are connected. The two side-by-side electric rooms on each floor serve as the main means of routing conduit and wire. One room is dedicated to panelboards that only connect to normal power – the other contains panelboards connected to the emergency generator. Each room contains its own riser shaft for wire and conduit. This is to keep the normal power and emergency power wiring separate.

The generator, located on the roof of the building in the emergency generator room, provides power to the critical building loads in the event of a power outage. Some of these loads include: emergency/egress lighting, two (2) elevators, telecom equipment, and the fire and jockey pump which are critical to the operation of the schools sprinkler system.

This remainder of this section is dedicated to describing, in detail, the electrical depth topics to be explored in the spring semester.

depth topic one – SKM Analysis

In an attempt to learn and become familiar with the program SKM, a short-circuit current analysis will be performed on my building. The buildings existing electrical system will be modeled in the program, including accurate breaker coordination. The deliverable for this depth topic will include a comparison to see if the AIC rating of the existing electrical equipment is robust enough to handle the available short-circuit current at all locations.

depth topic two – electrical feed for rooftop mechanical equipment

It is the goal of this depth topic to analyze and redesign the method with which the rooftop mechanical equipment is fed from the main distribution panel (on the ground floor). Currently, all rooftop mechanical equipment is fed individually from the ground floor distribution panel—all with copper conductors. This depth topic will calculate the cost savings incurred from running a single feed from the ground floor—as opposed to the six that exist now—up to a rooftop transformer and distribution panel. The rooftop equipment will then be fed from this rooftop distribution panel. The transformer is included because currently, the entire electrical system operates at 208/120V, and additional savings can be generated by transforming the voltage to 480/277V—the savings resulting from the downsizing of the wire feeding the mechanical equipment.

MAE study: daylighting (AE 565)

As the HS Art Room has windows covering two walls, it will be used as the subject of my daylighting analysis. This should provide significant energy savings, but should also make the space feel more natural as it will have a significant level of daylight. The wall with the largest percentage of glazing is facing north, and as such will have a mostly diffuse daylight coming in – this will reduce glare and increase productivity. DAYSIM will be used to analyze the daylighting in this space, and aid in determining the feasibility of adding daylighting controls into the space.

breadth 1: Mechanical

Branching from the MAE study, an analysis of the load introduced into the mechanical system of the HS Art Room as a result of the daylighting will be conducted. Multiple glazing materials will be studied to see how each affects the load on the mechanical system. The overall goal of this study is to determine if the energy savings from daylighting offsets the cost of the additional load. The final deliverable for this study will be a compilation of glazing materials, and their corresponding effect on the mechanical system. Analyzing these results, one glazing material will be chosen that weighs both load and aesthetic appearance.

breadth 2: Structural

The MAE breadth will produce a yearly daylighting analysis for the HS Art Room, and breadth 1 will analyze the impact of this daylighting on the mechanical system. This breadth is dedicated to analyzing the impact of the skylights (that will be introduced in the MAE daylighting study) on the structural system of the building. The goal of this breadth is to show whether or not the steel beams need to be upsized to account for the additional load introduced via the skylighting system from the MAE daylighting study.