Technical Report #1 - Massachusetts Public Library

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Lighting Systems Existing Conditions and Design Criteria Report

AE Senior Thesis Project

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Appendices:

Can be view upon Request

Lighting Existing Conditions and Design Criteria Report

Executive Summary

This technical report contains the existing lighting conditions and design criteria for the Massachusetts Public Library. Within this report is a full description of all the existing lightings systems and major lighting hardware. The focus of the report encompasses the redesign of four spaces; a large work space, a circulation area, a special purpose room and an exterior space. In an appendix, drawings (plans and sections) of the select spaces are included. A list of all appropriate design considerations is provided for all spaces being evaluated. The criteria presents a lighting concept and theme which will be further developed within technical report number three. Evaluations and critiques of some of the exiting lighting conditions include AGI 32 rendered models and calculations. These computer models were simplified to approximate the system's performance.

General Building Description

The Massachusetts Public Library was originally opened in 1889. In 1982, the building was listed as an important landmark on the National Register of Historic Places. Today it is being renovated as a state-of-art public library facility. An additional 70,000 square foot expansion is being added to a renovated existing historic library space of 35,000 square feet. The extensive use of a state-of-the-art curtain wall façade in the new design maximizes views of the library's park setting, celebrates the library's openness and accessibility, and provides abundance of daylight. Including on the top floor of the new library addition is a children's wing, featuring a tree-like ceiling that connects the space to the canopy of park trees outdoors. Separate craft and story rooms are also provided. A young adult area, with media stations and informal seating, is deliberately placed in the old building to bring new vitality to all parts of the project. New below grade parking for 70 cars allows for the park above to be restored and provides an open green space for the community and adjacent School. In addition, a new 230-seat underground auditorium and a number of smaller conference/ meeting rooms will provide opportunities for the library to greatly expand is programming for the public.

The building's existing lighting systems compliment and accentuate the style of architecture in the two buildings. The interior of the library is lit with a comprehensive lighting system utilizing well over 60 different 277V or 120V fixtures that include fluorescent, metal halide, LED and incandescent lamping. Daylighting and occupancy controls in conjunction with a Lutron dimming system allow for event lighting while also contributing to energy savings. Capacity for theatre lighting is also built into the large meeting room in the basement of the Addition. At night the building truly "glows". The addition interior vertical surfaces are washed with light which is visible from the building's exterior at night.

Four Proposed Spaces –

2nd Floor Stacks l Seating- Large Work Space

1st Floor Lobby l Hall- Circulation Space

Basement Meeting Room- Special Purpose Room

Library Park – Exterior Space

I. Meeting Room l Special Purpose Space

Dimensions

Length- 44'-0"
Width- 67'-6"
Height- 19'-0"
Total Area- 2970 sf

Description

The large meeting room can accommodate up to 230 guests in auditorium seats. This portion of the library's renovation has greatly expanded its program for the public. The large auditorium is split into three sections; the first consists of a wooden stage, and the remaining sections include rows of seating. The first group of seats is located on a 1:15 carpeted slope in the front of the room between two perimeter walkway aisles. Four of these seats are removable for wheelchair space and additional wheelchair space is located in the last row. To the right of the seating section is a ramp with a 1:12 slope. A stainless steel railing splits the third portion of the room from the first by means of a stainless steel railing, which guards an aisle walkway. Two aisles divide this third group of seating and each row climbs in elevation. Located on the front wall of the room is a large motorized projector screen. The projector is recessed into a wooden panel at the rear of the space. Two angled lecterns are located on both sides of the projection screen. These lecterns sit on a 4 1/2" elevated wooden stage platform. In addition to the level changing floor, the room is unique due to its undulating wood wall panels. Another fascinating architectural detail is the sloped maple veneer ceiling. (Refer to Materials Schedule- Appendix- page. 1, 2 Room Floor Plans/Sections- Appendix- pg. 17-20)

Activities l Tasks

As the space consists of auditorium seating, the room is for presentations and guest speakers. Speakers may choose to give presentations that require the lecterns or visual assistance of a projection screen. Supplementary to projection presentation viewing, the task will mostly consist of speaking, reading, and writing. The room may also occasionally be for film viewing.

IESNA Design Criteria

Auditorium (Social Activity- Normal gathering (without projection))

Very Important Criteria:
System control and Flexibility
Horizontal Illuminance- Category D- 30 fc
Important Criteria:
Color Appearance (and color contrast)
Daylighting Integration and Contrast
Modeling of Faces or Objects
Somewhat Important Criteria:
Appearance of Space and Luminaires
Direct Glare
Flicker (and Strobe)
Luminance of Room Surfaces

Appropriate Design Considerations

- **Aesthetic Criteria:**
  Because the space is for meetings, speeches and presentations by the public, the **appearance of space and luminaires** is important. The auditorium seating should have diffuse, uniform, comfortable illumination. The luminaires style should match the sophisticated feel of architecture within the room.

- **Psychological Aspects:**
  Since the meeting room is a multipurpose space with numerous visual tasks the most essential impression is **visual clarity. High uniform light levels**, which are particularly beneficial for discussions, can enhance the impression of visual clarity. The lighting should be mostly **overhead (direct) lighting** with some **peripheral emphasis**. Emphasis of the **architectural details** can create visual interest**.** In particular, grazing the distinctive undulating perimeter with light to highlight their distinctive shape can facilitate visual stimulation.

- **Illuminance Criteria:**
  There should be a **minimum horizontal illuminance of between 10-20 fc** for the auditorium seating and a higher **horizontal illuminance value** of around **30 fc** for **visual tasks** such as reading and writing.
  Speakers located at the podiums should have a **vertical illuminance** of at least **20 fc.** The podium lighting should be on a different control setting for stage usage. Architectural presets can allow for the seating area to be dimmed and the stage to be highlighted during non-active discussions and monologues.

- **Glare Criteria:**

During open discussions between speakers and the audience, lighting must **glare free and support dialog.** Glare occurs when one part o the visual scene is much brighter than the remainder. It can impair vision, cause discomfort and reduce task performance. **Uniform ambient light** can aid in the avoidance of glare. **Overhead lighting** with some **peripheral wall emphasis** can achieve ambient illuminance**.** The **source, task, eye geometry** must be considered for the podium speaker. **Facial modeling** for all auditorium occupants should include a **vertical illumination** of at least **5 fc** during discussions.

- **Control Criteria:**
  Due to the multi-functionality of the room, there must be **multiple scene settings** for the controls. The room should have a **dimmer control** to transition between speaking and video projection. Controls should include **easy switching** which librarians or patrons can utilize. This space should have **occupancy sensors** to shut down lights when the room is vacant to conserve energy.

- **Appearance Criteria:**
  Chandeliers / suspended luminaires must be placed in locations that do not interfere with the rear projection. During a projection, the **vertical illuminance** on the screen should not exceed **5 fc. Downlighting** is one of the most effective methods for this purpose. Screen luminance with picture running is between 3-20 cd/m^2. It is necessary to eliminate any stray light on the screen.

- **Luminance Ratios:**
  For the duration of projection, the aisle luminaires should have **low light levels** and preserve a **uniform luminance** in the aisle for easy egress.

- **Light Quality and Color Appearance:**
  IESNA lists color appearance as important. As most of the interior consists of a dark wood, the lamps should render a **warmer CRI and CCT.** Lamps should have a CCT of around 3000K and a **high CRI (close to 100).**

- **Maintenance Issues:**
  The selection of dimmable lamps for the multiple lighting modes in the space is mandatory. Lamps must also be **distinguishable** for the ease of replacement (no lamps of the same size and shape should share two different wattages etc.). Luminaires out of reach of ladder assistance must maintain a higher life expectancy.

- **Power Density:**
  The **power density** for a Conference/Meeting Space is **1.3 W/ft^2.**

Evaluation and Critique (*of existing Lighting*)-

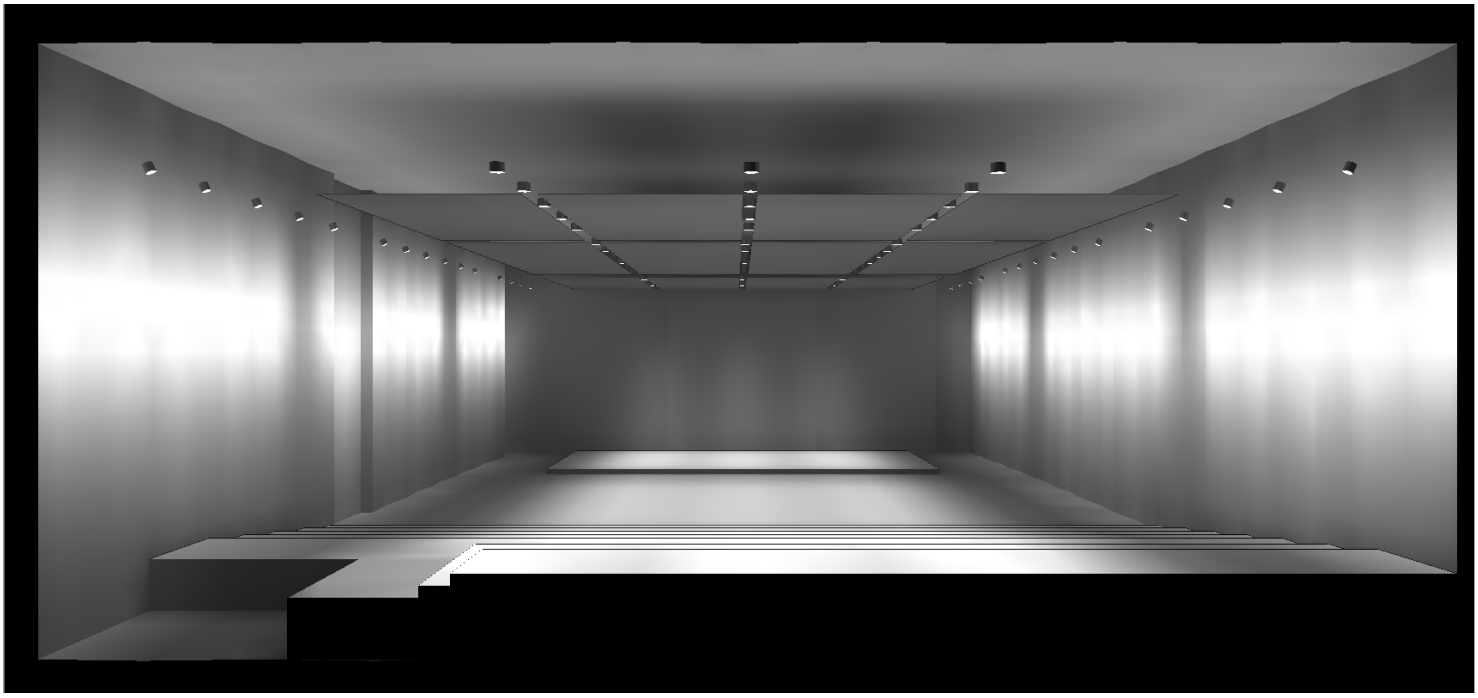
Light Loss Factors	F44	F45
Maintenance Category	IV	IV
Degree of Dirt Condition	Very Clean	Very Clean
Months	12	12
LDD	**0.88**	**0.88**
Intial lumens	2070	2070
Mean lumens (assumed)	1950	1950
LLD	**0.94**	**0.94**
BF	**1.00**	**1.00**

Power Density:

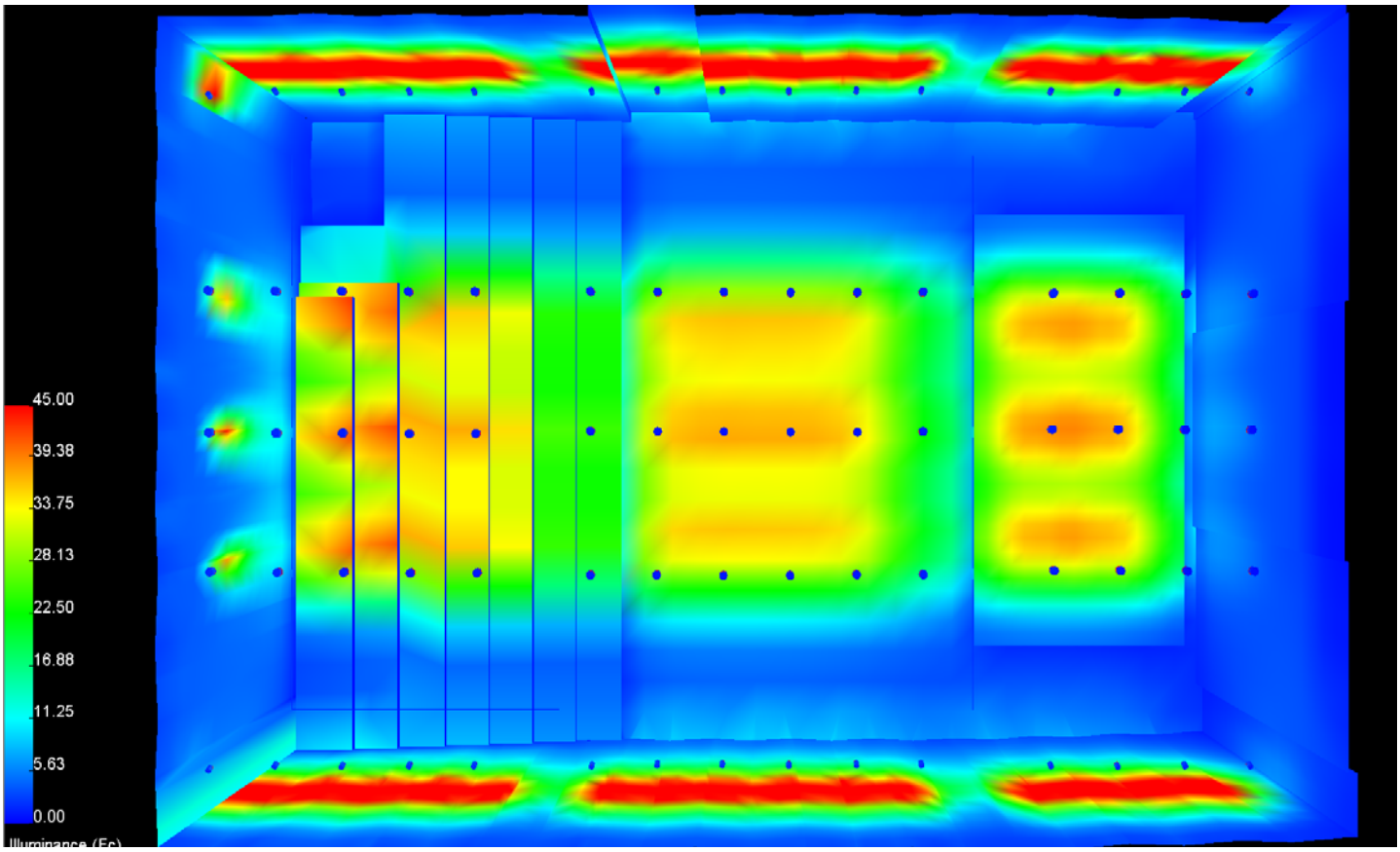
45 lamps x 100 W = 4,500 Watts

30 lamps x 100 W = 3,000 Watts

7,500 Watts/ 2970 sf = **2.53 w/sf**



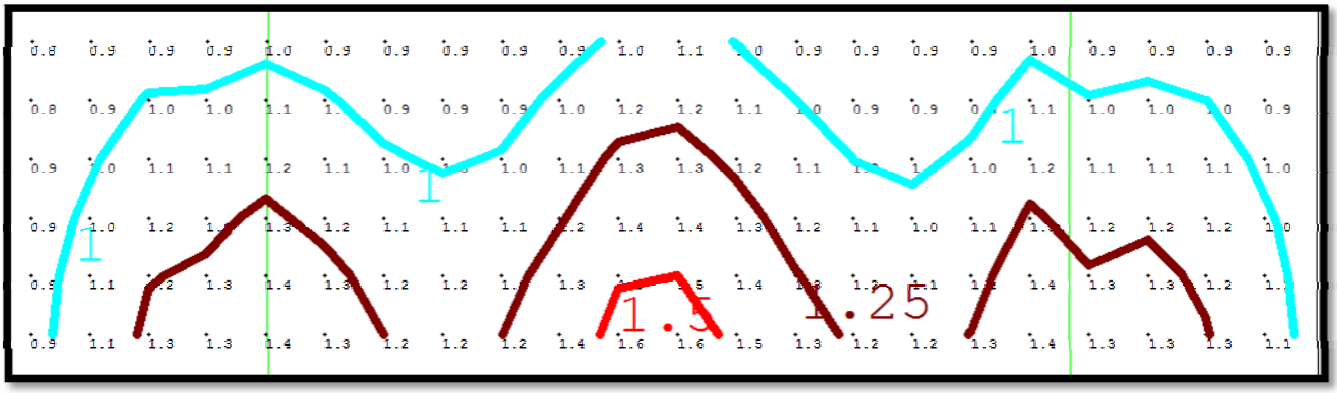
Room Luminance Rendering



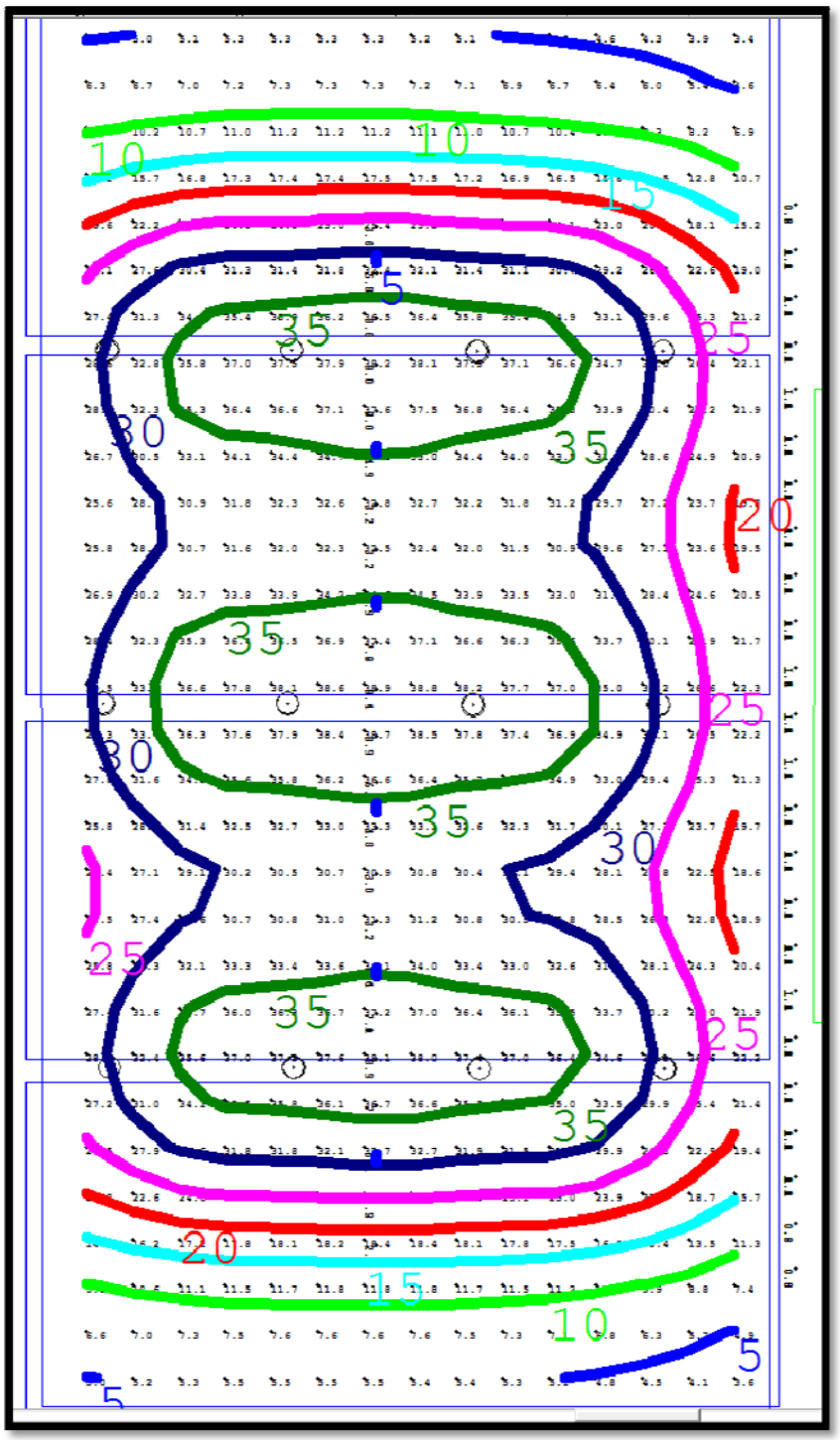
Room Illuminance Pseudo Color Rendering

Illuminance Values

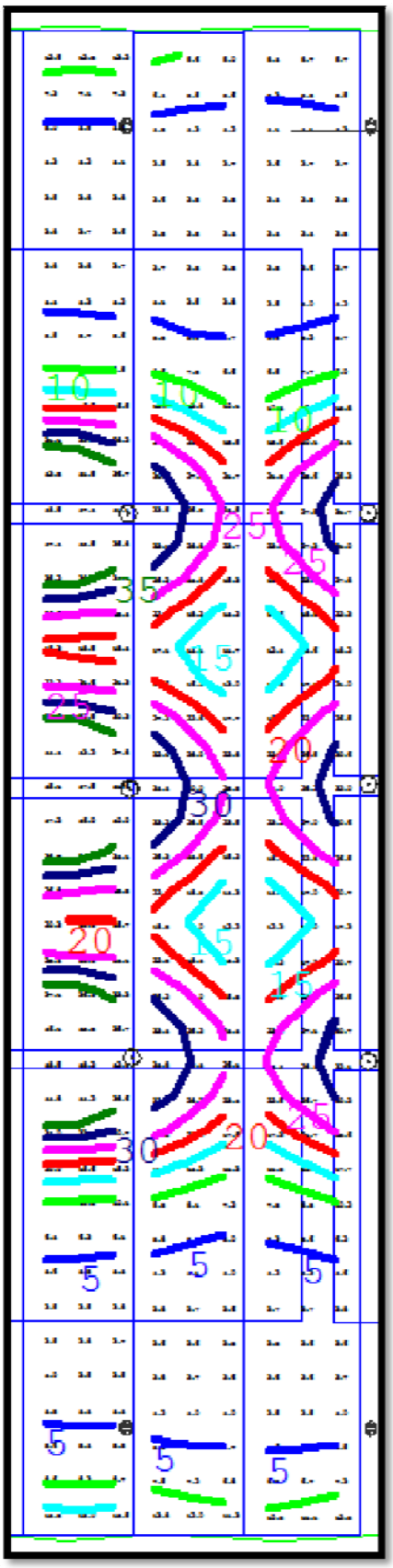
Label	CalcType	Average	Maximum	Minimum	Max/Min
Stage Floor	Horiztontal Illuminance Floor Height	25.13 fc	38.9 fc	3.4 fc	11.44 fc
Podium On Stage	Vertical Illuminance (4.5'-7.5' AFF)	1.09 fc	1.6 fc	0.8 fc	2.00 fc
Projection Screen	Vertical Illuminance - Front Wall Screen	5.66 fc	9.4 fc	2.3 fc	4.09 fc
Auditorium Seats Back row #1	Horiztonal Illuminance-Seating 2' aboves 1st row height	14.24 fc	32.1 fc	3.4 fc	9.44 fc
Auditorium Seats Back row #2	Horiztonal Illuminance-Seating 2' above 2nd row height	14.74 fc	34.8 fc	3.4 fc	10.24
Auditorium Seats Backroom #3	Horiztonal Illuminance-Seating 2' above 3rd row height	20.96 fc	49.1 fc	3.4 fc	13.64



Vertical Illuminance on Screen



Horizontal Illuminance Over the Stage



Horizontal Illuminance over Seating Area/Aisles

Critique

The impression of the space is visual clarity with the convention of overhead (direct) lighting and slight peripheral wall emphasis. Wall washers illuminate the undulating walls and the evenly spaced overhead down lights light the seating area. However, the illuminance levels do no not comply with the design criteria. Lighting around the perimeter seating is not uniform over the task plane. Overhead lighting in the center of the space offers sufficient illuminance values for discussion, but not for tasks such as reading and writing. There is a lack of vertical illuminance for facial modeling in the current design. Controls include time clocks as well as local and master switches, which are suitable for the meeting space. No luminaires obstruct the projection path from the rear projector to the projection screen. Aisles currently lack in horizontal illuminance values and do not provide uniformity for easy of egress. The current design includes two luminaires with the same type of lamp for the ease of maintenance. The CRI and CCT of these lamps do compliment the interior colors and materials well.

II. Stacks & Seating l Large Work Space

Dimensions
Length- 175'-0"
Width- 41'-0"
Seating Area: Height- 12'-6"
Stacks: Height- 11'-6"
Total Area- 6344 sf

Description

As an occupant climbs to the second floor they are welcomed by a warm flood of daylight and a large open floor plan. Past a circulation area, similar to that of the first floor, is a very sizeable stacks area in combination with a seating zone. After selecting a book in the stacks a patron can find seating neighboring an extensive state-of-the-art curtain wall facade. This facade has operable concealed vent type factory-glazed awning windows and cantilevered glass sun-shading visors which provide the library with an abundance of daylight year round. In addition to this, people may admire optimal views of the library's park. The ceiling in this seating region reflects light into the stacks due to the perforated acoustical aluminum specular ceiling panels. All furniture, including the stacks, are evenly spaced throughout and run perpendicular to the windows. The tall ceiling over the seating area is reduced by a foot over the stacks and the ceiling alters to acoustical wood ceiling panels. The very few walls of the space are gypsum wall board and painted white. In addition to seating for reading, there is a cluster of desks sandwiched between the stacks which include 16 computers. (Refer to Materials Schedule- Appendix - pg. 1, 2 and Room Floor Plans/Sections - Appendix- pg. 8, 10-15)

Activities l Tasks

All typical libraries maintain this type of space in which patrons can acquire books in the stacks and read in the seating area. The large work space will mainly be utilized for occupants to do research on the computers or study at desks.

Existing Lighting Hardware- (Refer to Lighting Hardware Schedule- Appendix- pg. 5 and electrical plan pg. 24)

IESNA Design Criteria

Libraries (Reading Stacks- Seating near stack area)

Very Important Criteria:
Direct Glare
Source, Task, Eye Geometry
Horizontal Illuminance- Category D- 30 fc
Important Criteria:
Appearance of Spaces and Luminaires
Color Appearance (and color contrast)
Light Distribution on Surfaces
Light Distribution on Task Plane (uniformity)
Somewhat Important Criteria:
Modeling of Faces of Objects

Libraries (Book stacks)

Very Important Criteria:
Vertical Illuminance- Category D- 30 fc
Important Criteria:
Color Appearance and color contrast)
Direct Glare
Somewhat Important Criteria:
Appearance of Space and Luminaires
Light Distribution on Surfaces
Light Distribution on Task Plane (uniformity)

Appropriate Design Considerations

- **Aesthetic Criteria:**
  Because the space is for the public, the **appearance of space and luminaires** is important. The space maintains a very linear and **uniform** architectural pattern. The furniture is **rectangular, linear** and **evenly spaced** in layout; the luminaires should mimic the same type of geometry and spacing.

- **Appearance Criteria:**
  The architectural plan of the entire building is very **open** and connected to the outdoors. The lighting in the stacks/seating should sustain this feeling and illuminate the space with **ambient light.** Each room appears to flow to the next area and the lighting **should not segregate spaces** harshly. The luminaires should run **continuously** complimentary to the architectural flow.

- **Psychological Aspects:**

The open floor plan in this area suggests the impression of **spaciousness.** To implement this psychological effect, the lighting should be **uniform** with an emphasis on **peripheral (wall) lighting.** To create spaciousness, a **moderate amount** of **general ambient light** should be produced. Within this impression, **warm colors advance**, and cool colors recede. The perimeter of the room should generally be **bright** and **free from clutter.**

- **Light Quality and Color Appearance:**
  Also listed in IESNA, was the importance of **color appearance.** The color of the seating area and book shelves should appear warm and inviting. As most of the interior is wood, the lamps should render a **warmer CRI and CCT**. The lamps should be around **3000 K** CCT with a **high CRI (close to 100).** The CCT of daylight is much higher than this CCT, however the human eye can more easily adapt to daylighting than electric lighting.

- **Controls Criteria:**
  Since the curtain wall facade provides the library with an abundance of daylight year round, **daylighting sensors** should be installed. It is important to integrate natural light and create a balance of electric lighting. Also, because public libraries are typically open no later than 8 pm, **time clocks** must be utilized within this facility. It is very important to have lights turned off in all vacant spaces. Controls should be located in an area librarians can easily access, and the public cannot tamper with.

- **Glare Criteria:**
  IESNA lists **direct glare** as a very important issue with work tasks such as reading and writing. Glare occurs when one part of the visual scene is much brighter than the remainder. It can impair vision, cause discomfort and reduce task performance. Therefore, **source, task, eye geometry** must be considered for both horizontal desk tasks and vertical computer tasks, due to direct glare and **veiling reflection.**

- **Luminance Ratios:**
  As the two major tasks in this area will be paper tasks and VDT usage, there should be a maximum **luminance ratio of 3:1** for task to near surround. High background luminance can be beneficial. For VDTs, the screen should not be oriented towards windows. The orientation of a **screen perpendicular to the window** will limit both **reflected glare** and **veiling reflections.**

- **Illuminance/Luminance Criteria:**
  For tasks such as reading and writing, the **average maintained illuminance levels** should not exceed **50 fc** on the **horizontal work plane.** As IESNA stated, the horizontal illuminance should be around **30 fc** and **uniformly** light the work plane. The **luminance ratio** between a task and the adjacent surround should be no greater than **3:1**. The **luminance ratio** between a task and a remote dark surface should be no greater than 10:1.

- **Quality of Lighting:**
  The wooden furniture and flooring in the space should have a matte property to reduce the **reflected glare.** Luminaires should be positioned to reduce **human shadows** over the work

plane. More importantly, luminaires must be strategically placed over the **bookshelves** to **minimize shadows.** Placing multiple sources over the work plane, to create an abundance of ambient light will reduce shadowing over the desk. Similarly, creating **adequate ambient lighting** in the stacks area will diminish shelving shadows. Positioning luminaires parallel to shelving,, in aisles, can assist with this. Also, situating shelving perpendicular to the windows will reduce shadows created by daylighting. **Vertical illuminance** on book shelves is very critical in the space. The library will be explored by all age ranges, and it is important for titles and code numbers to be easily read. Not only is vertical illuminance important, but maintaining **uniform luminance** on the books is crucial. A uniform vertical luminance can be maintained through highlighting shelves with the assistance of ample ambient light.

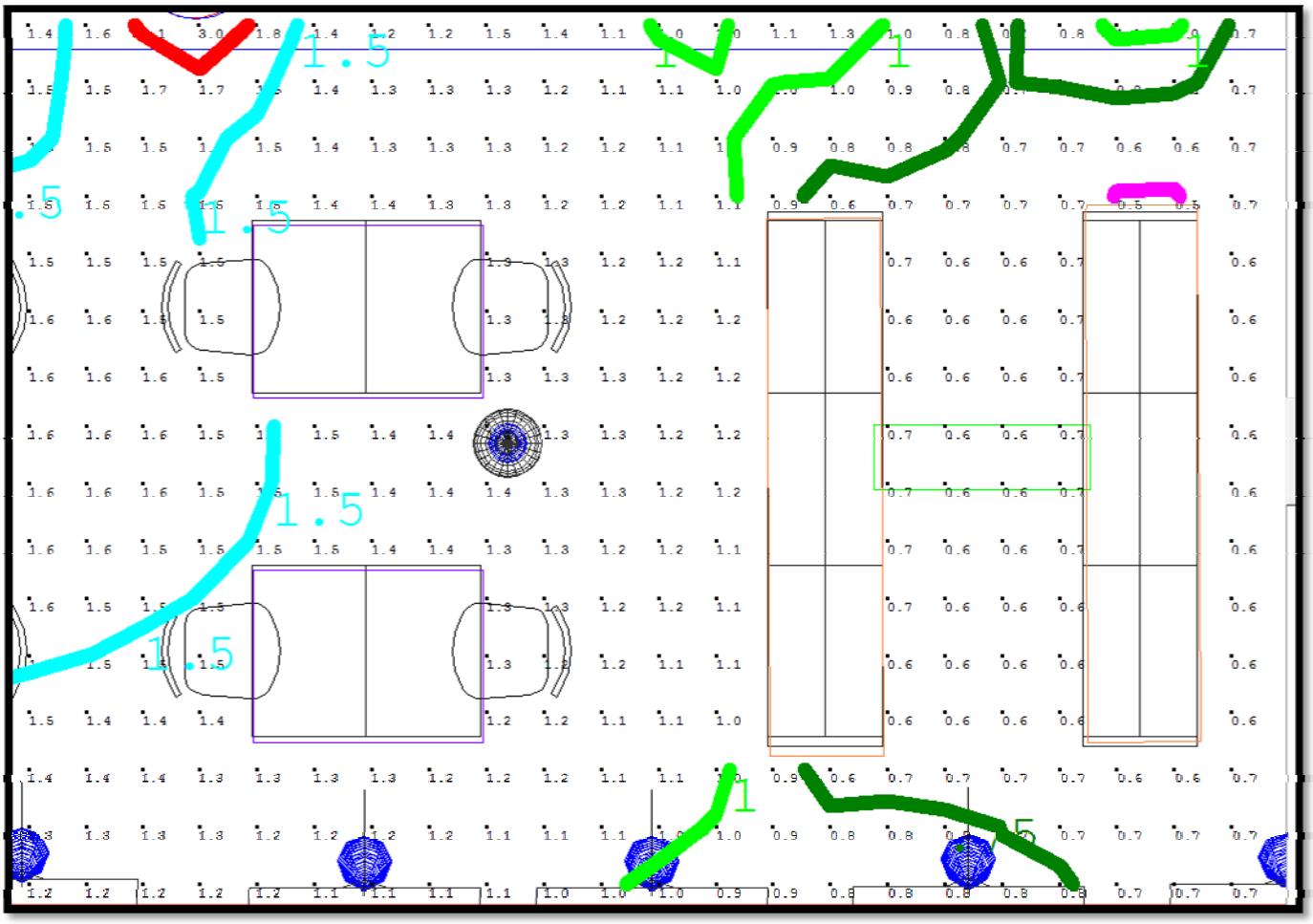
- **Aesthetic Night Light:**
  To create an appealing view at night, the building facade should "glow" from within. Because the geometry of the facade is very linear and uniform, the glow should accentuate the buildings' linear lines. The glow can be created by illuminating structure of the facade from within. Washing the interior visible vertical surfaces such as the shelves or interior walls create an exterior night glow.

- **Maintenance Issues:**
  Lamps for this room must maintain a good CRI and CCT. Lamps which are dimmable must be considered for daylighting integration. Lamps must be **distinguishable** for the ease of replacement (no lamps of the same size and shape should share two different wattages etc.). Luminaires out of reach of ladder assistance must maintain a higher life expectancy.

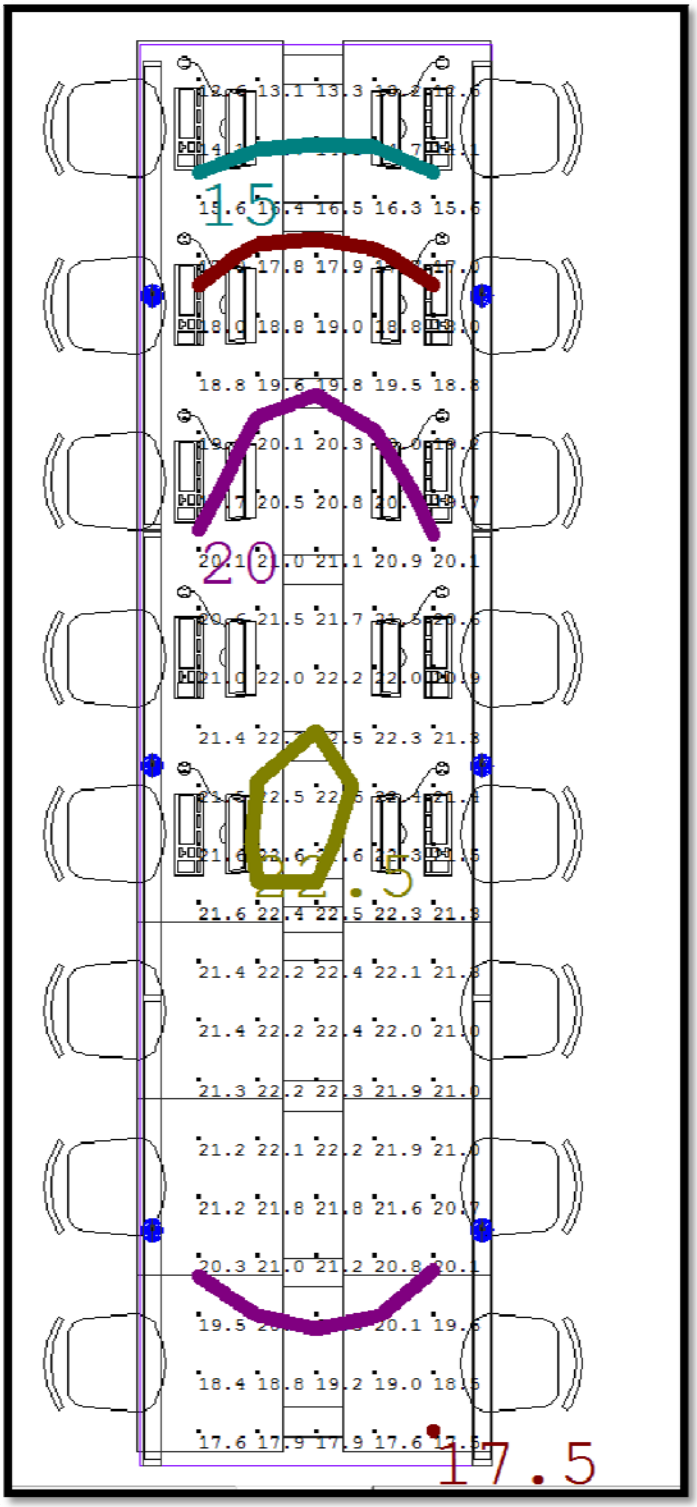
- **Power Density:**
  According to ASHRAE 90.1, the power density for the library stacks area is **1.7 W/ft^2**, and **1.2 W/ft^2** for the reading area.

Evaluation and Critique (*of existing Lighting*)-

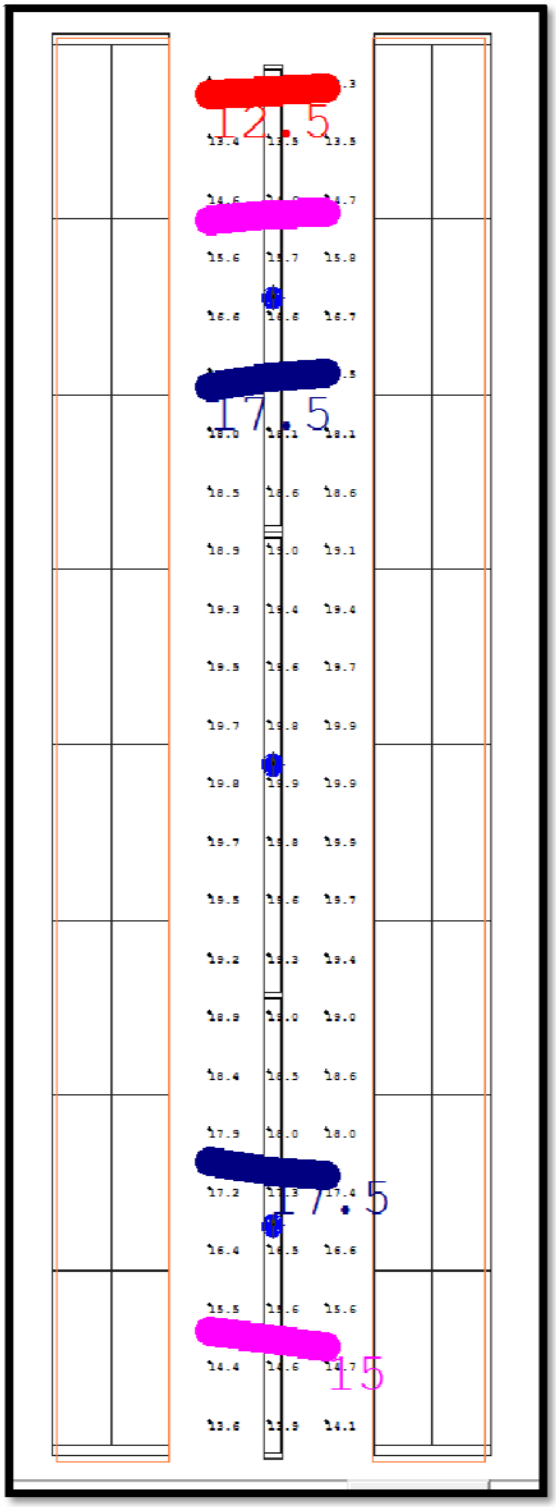
Light Loss Factors	L1	L3	L4	L34
Maintenance Category	V	V	VI	V
Degree of Dirt Condition	Very Clean	Very Clean	Very Clean	Very Clean
Months	12	12	12	12
LDD	**0.87**	**0.87**	**0.86**	**0.87**
Intial lumens	4450	5200	4450	2328
Mean lumens	4138	3400	4138	2002
LLD	**0.93**	**0.65**	**0.93**	**0.86**
BF	**1.00**	**0.88**	**0.88**	**0.88**



Horiztonal Illuminance-
Between Small Stacks and Seating

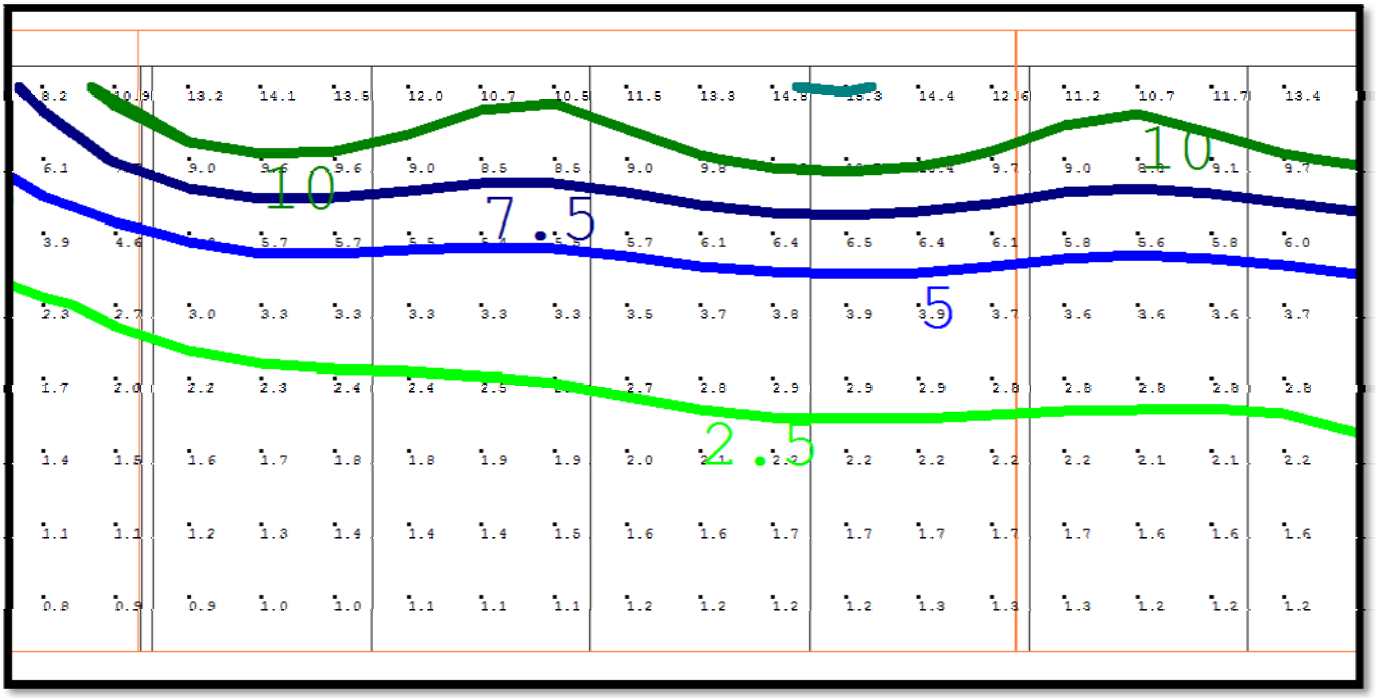


Horizontal Illuminance Over Desks



Horizontal Illuminance Between Stacks

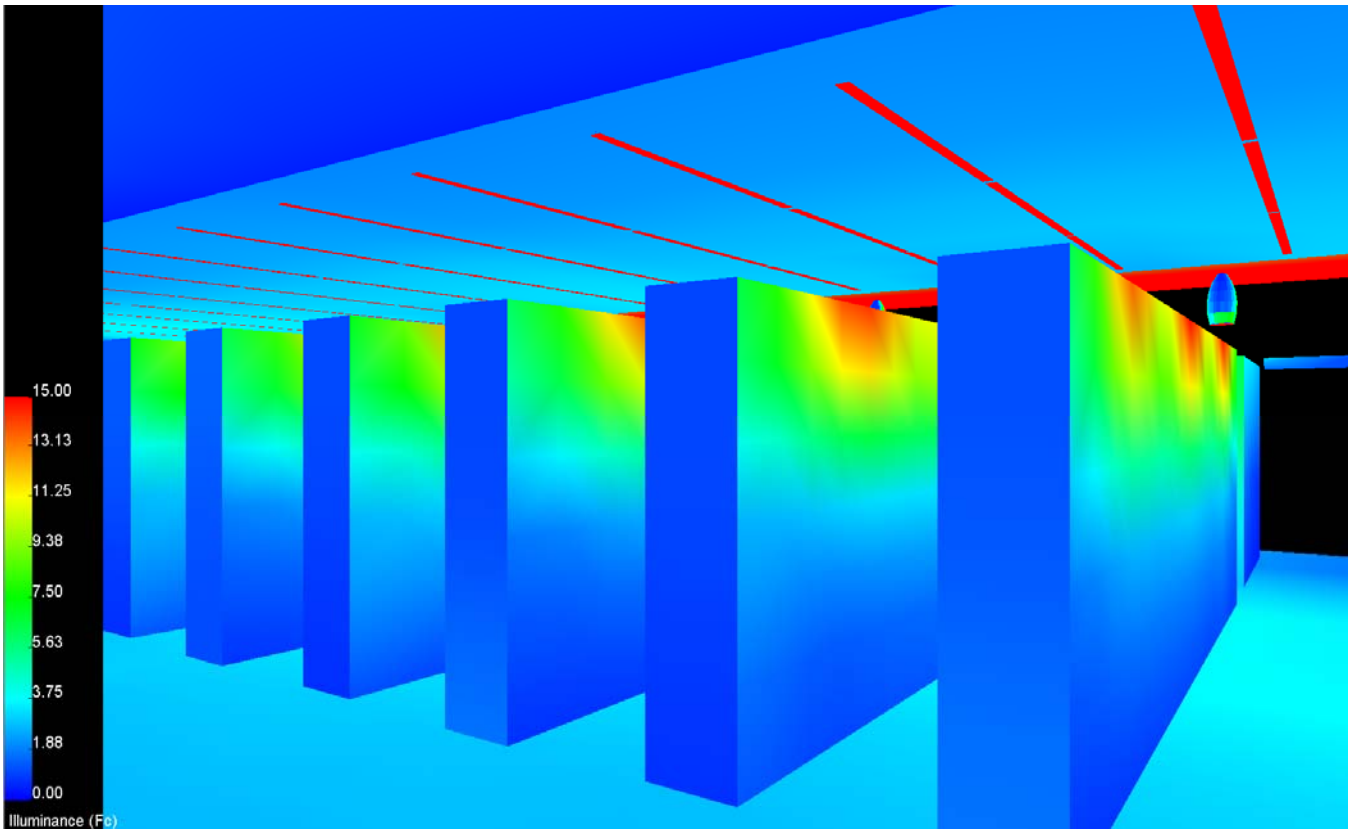
Vertical Illuminance on Bookshelf



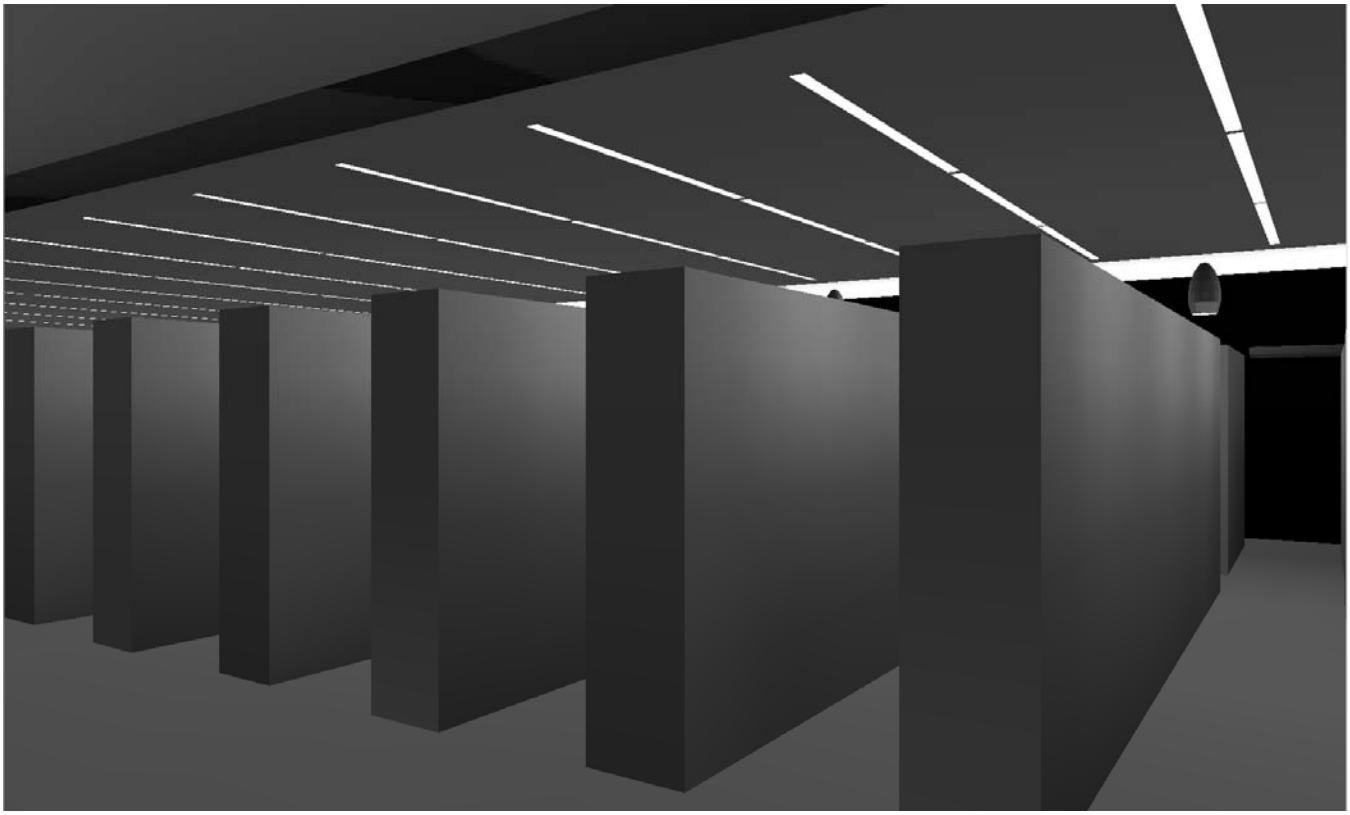
Illuminance Values

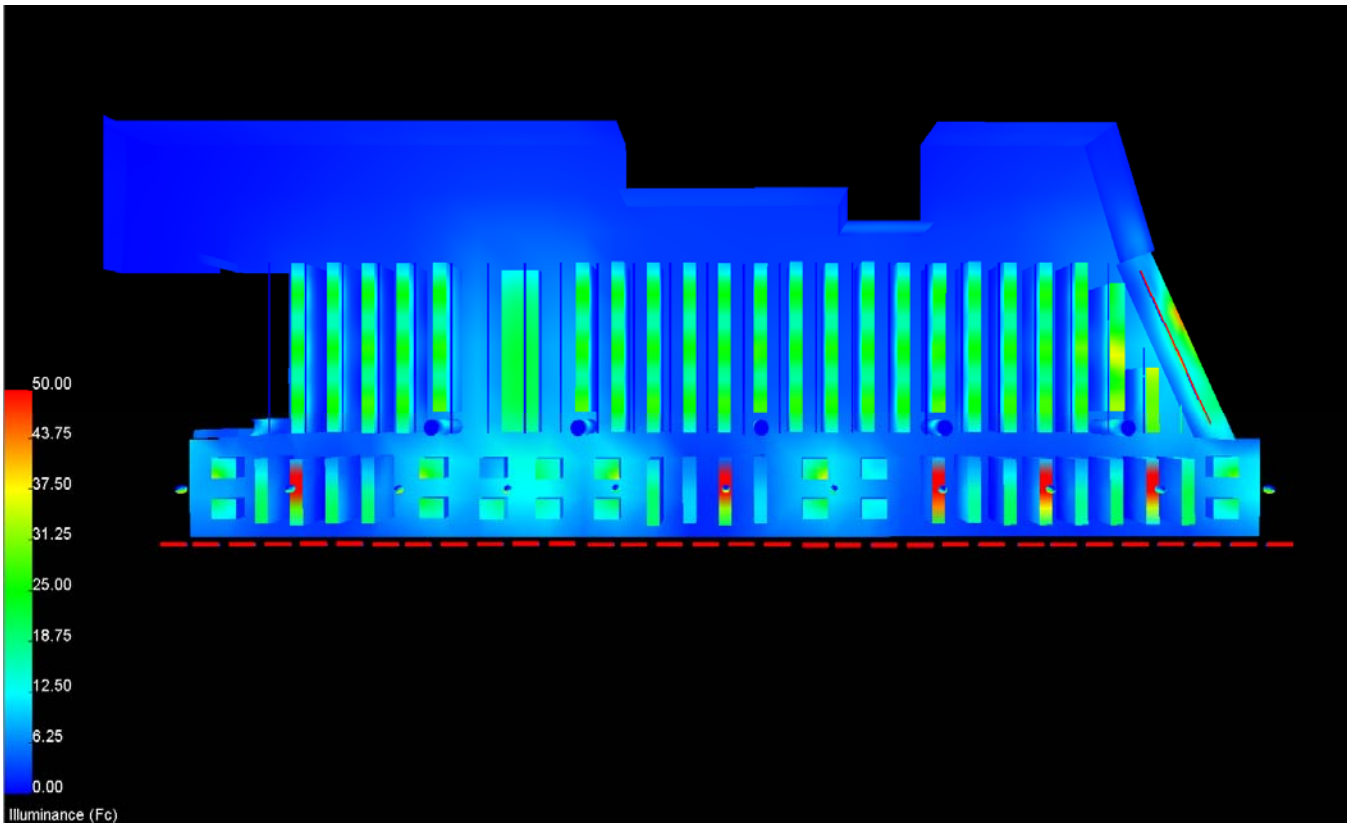
Label	CalcType	Average	Maximum	Minimum	Max/Min
Book Shelving	Vertical Illumiance (From floor to 8' AFF)	4.69 fc	15.3 fc	0.7 fc	21.86 fc
Desk Task Plane (Near window facade)	Horizontal Illuminance (2.5' AFF)	20.00 fc	29.1 fc	15.1 fc	1.32 fc
Aisle Floor	Horizontal Illuminance - Floor	5.97 fc	7.3 fc	3.9 fc	1.87 fc
Computer Seating Area (Middle of Stacks)	Horiztonal Illuminance (2.5' AFF)	19.84 fc	22.6 fc	12.6 fc	1.79 fc
Seating Area Floor (Near window facade)	Horizontal Illuminance- Floor	6.48 fc	13.4 fc	2.2 fc	6.09 fc

Stacks Illuminance Psuedo Color Rendering

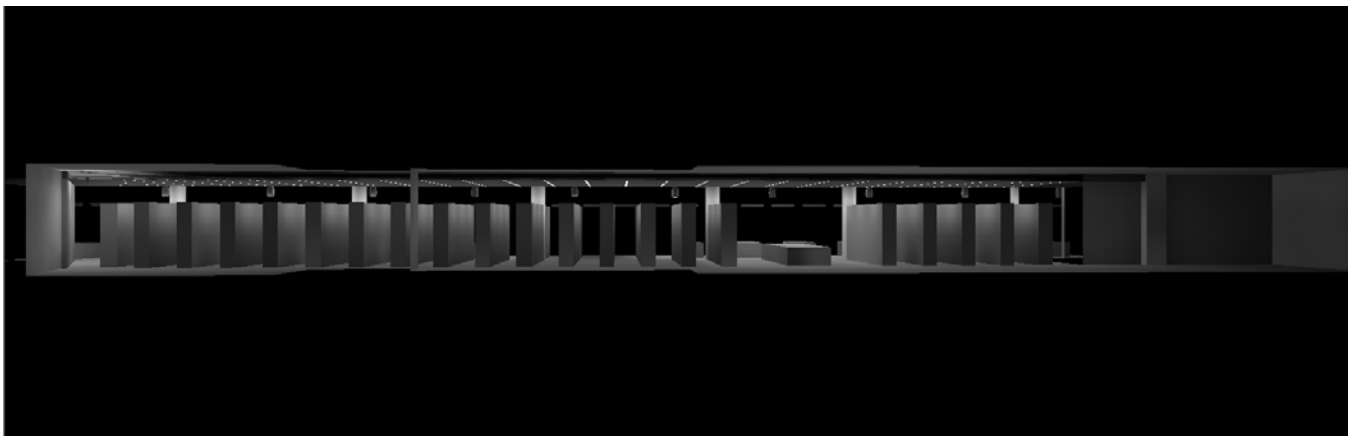


Stacks Luminance Rendering





Room Illuminance Psuedo Rendering



Room Luminance Rendering

Power Density:

F1- 80 lamps x54 W = 4,320 W
F32- 32 W x 0.88 BF x 6 lamps = 169 W
F3- 7 lamps x 70 W x 0.88 BF = 431 W
F4 – 20 lamps x 54 W x 2 x 0.88 BF= 1901 W
6820 W/ 6344 sf = 1.08 W/sf

Critique

There is a deep consideration for the architectural pattern in the existing lighting design. The luminaires simulate the rectangular, linear and evenly spaced furniture in the layout. The sleek thin modern feel of the luminaires are harmonious throughout the stacks area. The impression of spaciousness is emphasized. However, the illuminance levels do not appear to comply with the criteria. It seems that the illuminance levels on the shelving units are not uniform and appear inadequate. The luminaires do run perpendicular to the windows and are well positioned. The bookshelves have a vertical illuminance of 4.96 fc and a horizontal illuminance is 5.97 fc on the floor. The lighting layout is not continuous in the transition from stacks to seating. Over the seating area there are pendants and over the stacks are recessed rectangular luminaires. All of the fixtures preserve a sleek, sophisticated, modern, appearance but do not sustain the same geometrical properties. The pendants also do not provide acceptable vertical illuminance for the nearby stacks and the horizontal illuminance over the desks does not suffice either. Controls are appropriate for the spaces including time clocks and local and master switches. However, the room lacks daylight sensors. Peripheral lighting around the room and spill light from adjacent spaces emphasize the impression of spaciousness in this elongated room. The up lights, in combination with wall washers, highlight the structure and walls to create an aesthetically pleasing exterior night view. Two of the luminaires have the same type of lamp for easier maintenance. The CRI and CCT for these lamps compliment the interior colors and materials.

III. Entry Lobby- 1st Floor Corridor l Circulation Space

Dimensions
Length- 156'
Width- 58'
Total Area- 4,032 sf
Height in hall-15'
Entry lobby- 14'-0"

Description

As an occupant follows the quartzite pavers into the entry lobby they are greeted by the librarians. To the left is the charging desk area where librarians have several computers on a long natural finish maple wood desktop. For personal convenience, at the center of the desk, is a lowered self check-out desk. Behind this small standing area is an interior glass wall system and dropped ceiling. Mimicking this counter space, on the right, are the returns desks with rubber flooring. This space is very similar in layout but slightly larger with shelving behind the counter. The ceiling over this area consists of wood ceiling panels. If a patron continues walking into the space and is unsure where to go, directly in front is an information desk, similar to the desks of the entry lobby. A librarian at this desk can guide the guest both to the left and up the stairs to a sky walk bridge via the elevators or the center staircase to the left. This floating staircase feels translucent as it is shielded by transparent glass panels. If a patron is hungry they may choose to travel further to the left down the corridor into the cafe seating. Flanking both sides of the corridor are rooms filled with stacks and desks. The corridor has a playful feeling with vibrant red aluminum ceiling panels. Complimenting this vibe in the tall, open space are lounge seats that are randomly positioned in the center of the circulation zone. These modern seats are creative irregular trapezoidal shapes. (Refer to Materials Schedule- Appendix- pg. 1,2 and Room Floor Plans/ Sections- Appendix- pg. 9, 10-14, 16)

Existing Lighting Hardware- (refer to Lighting Hardware Schedule- Appendix- pg. 3, 4 and Electrical Plan pg. 23)

IESNA Design Criteria

Hotel Lobby (Reading and Work Areas - Reading Areas in Entry Lobby)

Important Criteria:
- Appearance of Space and Luminaires
- Color Appearance (and color contrast)
- Direct Glare
- Light Distribution on Surfaces
- Light Distribution on Task Plane (Uniformity)
- Luminance of Room Surfaces
- Reflected Glare

Somewhat Important Criteria:
- Flicker (and Strobe)
- Shadows
- Source, Task, Eye Geometry
- **Vertical Illuminance- Category D- 30 fc**

Hotel Lobby (Reading/Desk Work - Charging Desk and Returning Desk)

Important Criteria:
- Direct Glare
- Light Distribution on Task Plane (uniformity)
- Reflected Glare
- Source, Task, Eye Geometry

Somewhat Important:
- Color Appearance (and Color Contrast)

Hotel Lobby (Corridors, Elevators, Stairs)

Important Criteria:
- Daylighting Integration and Control
- Light Distribution on Surfaces
- Luminance of Room Surfaces

Somewhat Important Criteria:
- Color Appearance (and Color Contrast)
- Direct Glare
- Light Distribution on Task Plane (Uniformity)
- Modeling of Faces or Objects
- Reflected Glare
- **Horizontal Illuminance- Category B- 5 fc**

Specific Visual Task (Dining-Cafe)

Very Important Criteria:

Color Appearance (and Color Contrast)
Direct Glare
Modeling of Faces or Objects
Horizontal Illuminance- Category B- 5 fc

Somewhat Important Criteria:

Appearance of Space and Luminaires
Daylighting Integration and Control
Light Distribution on Surfaces
Light Distribution on Task Plane (uniformity)
Luminance of Room Surfaces
Point(s) of Interest
Reflected Glare
Source, Task, Eye Geometry
Sparkle/Desirable Reflected Highlights
Surface Characteristics
System Control and Flexibility

Appropriate Design Considerations

- **Psychological Aspects:**
  Because this space is adjacent to the main entrance, the **appearance of space and luminaires** is very important as it is viewed by all public occupants. The circulation space should appear **welcoming and interesting.** The entrance lobby is similar to that of a book cover; it should attract attention so the read desires to continue reading. For this reason, the impression created for this space intriguing. The addition is an enormous difference in comparison to the historic building and the lobby should emphasize the contrast. The entry lobby should appear **modern** and perhaps slight "**visual clutter**" is advantageous. **Sparkle/glitter** complimented by the use of **warm colors** are also valuable in the corridor. All luminaires should retain a **modern shape** and **style** to compliment the architecture.

- **Aesthetic Criteria:**
  Decorative lighting or **"sparkle"** could be considered within this area. The architecture tends to lend itself to a modern **young vibrant feel** which could be complimented with decorative lighting of that style. The red ceiling and trapezoidal chairs draw attention. The unique pendants/chandeliers could compliment the usage of other distinctive elements. The tall ceiling in the hall allows for pendants to hang in this area.

- **Appearance Criteria:**
  Due to the variety of ceilings and flooring in this space, different lighting schemes should be used to **compliment** each of these materials. Even though a variety of lighting schemes should be used from space-to-space, they must also be a **similar style** and **cohesive** in the open lay-out.

- **Luminance Ratios:**
  While remaining **unique**, the lighting throughout the circulation space should be **way-finding.** The areas in which guests can find guidance must be well illuminated. For this reason, the help desks must be differentiated from the surrounding. A help desk must be **highlighted for attention** with a luminance ratio of around 5:1. Lighting the horizontal surfaces and shelving around the desk areas will assist with the contrast. Grazing the front surface of the desks or illuminating any signs will assist with this as well.
  The overhead lighting in the corridor should possess a lower luminance to create a higher contrast for way-finding. For this reason, the perimeter of the hall space should provide **peripheral lighting** with either **wall washing** or **spill light** from the adjacent spaces.

- **Accent Lighting:**
  As the space should provide **circulatory flow,** the elevator and stairwell should be well illuminated. The elevator should either be lit with **accent lighting** or **wall sconces.** Stairwell door signs should be easily read and **highlighted.** The main stair case in the obtains a translucent feeling and is mostly surrounded by glass. To highlight this staircase and provide **safety lights** for visitors, down lights should be installed. Some down lights could be recessed into portions of the ceiling above the staircase. If down lights do not illuminate the entire stair case then handrail lights could also be considered.

- **Quality of Lighting:**
  Glare occurs when one part of the visual scene is much brighter than the remainder. It can impair vision, cause discomfort and reduce task performance. **Source, task, eye geometry** must be considered for both horizontal desk tasks and vertical computer tasks. Reflections can be avoided by aiming luminaires away from specular surfaces such as the interior glass wall or ceiling in the evening. There should be a **luminance ratio of 3:1** to near surround for paper tasks and VDT usage. High background luminance can be beneficial. For VDTs, the screen should not be oriented towards the windows. The orientation of a screen perpendicular to the glass entrance will limit both **reflected glare** and **veiling reflections.**

- **Luminance Ratios:**
  As IESNA stated, the horizontal illuminance should be around **30 fc** and **uniformly** light the work plane. The **luminance ratio** between a task and the remote dark surface should be no greater than **5:1.**

- **Controls:**
  Simple switching should be considered for ease of usage by librarians. A **time clock** should be used to shut off all luminaires at night. The main entrance lobby lights should be on a different schedule so the **entry can "glow"** from an exterior night view. **Master switches** for the library circulation space should be located either behind the reception desk or check-out counter to avoid public tampering.

- **Emergency Lighting:**
  Emergency lights must be installed to guide occupants to all exists quickly and safely. The entry lobby and stairwells must have safety lights which guide occupants to exits.

- **Light Quality and Color Appearance:**
  Also listed by IESNA, is the importance of **color appearance.** As most of the interior consists of wood, the luminaires should have a warmer **CRI and CCT.**

- **Illuminance Criteria:**
  Similar to the shelving in the 2nd floor stacks the shelving behind the charging and return desk must have a vertical illuminance of 30 fc. Luminaires must be strategically positioned over bookshelves to minimize shadows. Creating a large quantity of ambient lighting in the shelving area will diminish shelving shadows. It is important for the titles and code numbers to be easily read on books.

- **Aesthetic Night Light:**
  To create an appealing view a night, the building facade should "glow" from within. Because the geometry of the facade is very linear and uniform the **glow** should enhance the buildings linearity. The main entry is the only part of the circulation space which should have lighting at night. A few lobby luminaires should be on a different schedule for night usage. A night glow can be created by illuminating the steel structure of the main entrance vestibule from within. The illumination of the entrance should be similar to that of the entire facade so the building appears uniform.

- **Power Density:**
  The power density for a lobby is **1.3 W/ft^2** + and extra **1.0 W/ft^2** for decorative lighting.

Evaluation and Critique (of existing light)- refer to appendix pg. 23

Critique

There is a variety of luminaires in the existing lighting plan which corresponds with the variety of materials within the space. Different task areas retain different lighting layouts. Deep consideration was give to choosing luminaires which fit a modern, unique style contradictory to the historical section of the existing library. A choice of pendants in the entry way immediately creates a statement which differentiates the addition from the historical building. There may be a lack of vertical illuminance for the bookshelves. Calculations were not conducted for this space however the bookshelves and luminaires are similar to those of the 2nd floor stacks area. If the 2nd floor stacks on retain a vertical illuminance average of 4.96 fc, then it is presumed that the 1st floor bookshelves do not possess sufficient illumination. The lighting layout is continuous throughout the hallway down to the cafe area. Over the seating area there are pendant fixtures which preserve a sleek, sophisticated, modern appearance. Supplemental perimeter lighting from the wall washers enhance the impression of spaciousness in the corridor. The luminaires are controlled by time clocks and local and master switches. Emergency lights are located around the entry lobby and hall space and are well planned out. For easier maintenance, the same luminaires are chosen to be on multiple floors throughout the building. The lamp CRI and CCT choices match the interior colors and material well.

IV. Library Park l Exterior Space

Description

There are multiple types of trees within the library's park. There are many deciduous and evergreen trees within the existing soil. The park area consists of exiting beech trees and willows. As the building is an addition, the front entrance to the library originally was covered by trees. Now, a large walkway divides the park and aligns the building with the main street to allow for easier public access. (Refer to site plan- Appendix pg. 21)

Existing Lighting Hardware- **(**Refer to Lighting Hardware Schedule- Appendix- pg. 7 and electrical plan pg. 23)

Activities l Tasks

At the front of the library is the main entrance to the building. The only task involved is walking to and from library.

IESNA Design Criteria

Outdoor Locations- Gardens (Paths, away from building- Entrance Walkway)

Very Important Criteria:
- Direct Glare
- Light Distribution on Surfaces
- Point(s) of interest
- Source, Task, Eye Geometry
- Surface Characteristics
- **Vertical Illuminance- 3 lux**

Important Criteria:
- Appearance of Space and Luminaires
- Color Appearance (and color contrast)
- Light Pollution, Trespass
- Modeling of Faces and Objects
- Peripheral Detection
- Reflected Glare
- Shadows

Somewhat Important Criteria:
- Sparkle/Desirable Reflect Highlights
- **Horizontal Illuminance- 10 lux**

Outdoor Locations- Gardens (Trees or shrubbery- Park Trees)

Very Important Criteria:
- Appearance of Space and Luminaires
- Color Appearance (and color contrast)
- Direct Glare
- Light Distribution on Surfaces
- Modeling of Faces and Objects
- Point(s) of Interest
- Shadows
- Surface Characteristics
- **Vertical Illuminance- Category A- 3 fc**
- **Horizontal Illuminance- Category A- 3 fc**

Important Criteria:
- Sparkle Desirable Reflected Highlights
- Reflected Glare

Somewhat Important Criteria:
- Light Pollution, Trespass

Appropriate Design Considerations

- **Light Pollution/Trespass:**
  Outdoor lighting in a medium district brightness area is **Category E3.** This means that the **urban sky glow** should be a maximum ULR of **5%.** Lighting should be placed at angles which do not impede or spill onto surrounding properties. No sources should face upwards.

- **Light Quality and Color Appearance:**
  Entrance pathway lighting should **deter criminal activity, enable people and their intent to be recognized.** The pathway lighting should also provide **decent color rendering** with a higher CRI to distinguish people.

- **Appearance Criteria:**
  Park lighting should be **harmonious with surroundings** (including sidewalk lighting and adjacent buildings of the area) Lighting should present the library well, and be aesthetically pleasing.

- **Maintenance Issues:**
  Due to the location, the outdoor lamps should have very little maintenance issues. The major considerations for outdoor fixtures are **weather, corrosion resistance, vandalism, glare, light pollution, and aesthetics reflection.** Lamps should maintain good color properties as well.

- **Illuminance Criteria:**
  The park lighting should meet a maximum **vertical illuminance of 3 fc and horizontal illuminance of 3 fc.** The pathway should have a horizontal illuminance of 10 lux and a vertical illuminance of 3 lux.

- **Appearance Criteria:**
  The park trees should be illuminated in a manner which is complimentary to their shape. Leaves of fuller tress should be highlighted and rendered at night, while minimizing urban sky glow.

- **Controls:**
  Luminaires should be on a **time clock** and only set to be utilized during the night.

- **Power Density:**
  The power density for the main entries to buildings is **30 W/linear foot** of door widths.

Evaluation and Critique (of existing light)- refer to appendix pg. 25, 21

Critique

Because the front of the building is all glass, lighting the building from the outside is not logical. Instead, the exiting design allows the interior to "glow" from within. Pole-mounted metal halides are located on the exterior pathway to only the main entrance. The lighting layout on the pathway currently appears non-uniform. Luminaires are positioned on both sides of the entrance path with uneven spacing. Although calculations have not been done, it visually appears to lack horizontal illuminance on some places along the pathway. Metal halide lamps with good color rendering were utilized which is beneficial for the park space. The lamps should provide adequate rendering of pedestrians. The luminaires reduce light trespass on adjacent properties with their positioning in the center of the property. The full cut-off shields reduce urban sky glow. The exterior lighting appears to be for utilitarian purposes, rather than aesthetics. The interior luminaires create the aesthetic night view, by producing a glow from within. All exterior luminaires are coordinated with photocell/time clock operation which is logical for the location.