

# Chapel

## **Overview:**

A small chapel is located on the second floor of the Franklin Care Center. It has seating for 19 people as well as handicapped access and seating for wheelchairs. The leadership area is located in the front of the church and includes a projection screen. There is only one small window in the chapel, located behind the projection screen wall in the front. Daylighting will not have a great impact on the space; this window will only provide a nice daylighting effect from behind that wall.

## Design Criteria

### **Main Goal:**

To provide a flexible lighting system that enhances the architecture of the chapel and creates a spiritual atmosphere.

### **Very Important Design Criteria:**

#### **Congregational area**

##### ***Horizontal Illuminance:***

Horizontal illuminance of 10fc is the minimum acceptable for the congregational area. 30fc is a better illuminance level for the task of reading. A flexible system that allows the illuminance level in the congregational area to change throughout the ceremony would be ideal.

##### ***Vertical Illuminance:***

A high level of vertical illuminance is not needed in the congregational area. 3fc is adequate.

#### **Leadership area**

##### ***Appearance:***

The leadership area is the focus of the chapel. The lighting should be laid out orienting visitors towards the leadership area during services.

##### ***Color Contrast:***

Color rendering in the leadership area is important to separate the task of reading from the background. It is also important for the congregations to easily distinguish the leader from his background.

##### ***Luminance of surfaces:***

The surfaces in the leadership area should direct the congregation's attention towards that direction. While the surfaces should be uniform, they should be brighter than the other surfaces in the chapel.

**Shadows:**

Task lighting should be used to provide illuminance on the leaders reading material and eliminate shadows that may make the task of reading difficult.

**Source/task/eye geometry:**

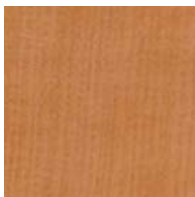
The leadership area will be the brightest area of the church, but the placement of the fixtures that the light is coming from must be carefully planned. The geometry should be used to enhance visual interest.

**ASHRAE 90.1 Power Density:** Using the space by space power density method, a worship space should have a maximum power density of 2.4 W/sqft.

## Design Concept

The main goal of this design was to enhance the architecture of the chapel and create a spiritual atmosphere. To achieve this, the side walls were moved out about six inches to make room for a cove, indirect lighting was used in the cove to uplight the wood panels on the upper part of the walls as well as the wood ceiling. Along the front wall where the window is located (behind the projection screen wall in the leadership area), a cove is also located. At night the cove light will provide a similar effect that the daylight will provide during the day, having the curved part of the ceiling glow around the leadership wall. Uplighting the wood alone does not provide adequate light levels for reading, so small downlights were provided to increase light levels when needed. Halogen lamps were placed randomly to create a starry sky effect and allow for a full range of dimming so that the light levels can be adjusted as necessary. The use of small downlight sources and indirect lighting provide a glare free environment for the elderly. In order to highlight the speaker and draw attention toward the front of the chapel halogen spots were used. Narrow spotlight distributions were chosen to avoid lighting from spilling onto the projection screen.

## Finishes



Wood panels on wall:  
Wood ceiling  
p=29%



Walls: Colonial  
White  
p=80%



Floor: White  
Marble  
p=76%

## Equipment Luminaire Schedule

Fixture Label	Description	Fixture Cat No.	Lamp #	Lamp Type	Lamp Cat. No.	CRI	CCT	Ballast Type	Ballast Cat. No.	Lamps per ballast	Fixture Quantity
F9	CFL surface mounted downlight	Lightolier 3040PB218U	2	Quad	Sylvania CFQ18W/G 24Q/830	82	3000	Dali Dimming	Sylvania QTP2x18CF/ UNV DALI	1	1
F10	Cove mounted fluorescent striplight	Prudentail PT8W-SS-STD-1T8-04-BWE-SC	1	T5	Sylvania FP28/830/E CO	82	3000	Dali Dimming	Sylvania QTP2x28T5/ UNV DALI	2	19
F11	Recessed halogen downlight	Lucifer DL1G	1	MR16	Sylvania 20MR16/T/F L40	100	3000	n/a	n/a	1	26
F12	Recessed halogen spotlight	Lucifer DL2G	1	MR16	Sylvania 20MR16/T/N SP10	100	n/a	n/a	n/a	1	1
F12a	Recessed halogen spotlight	Lucifer DL2G	1	MR16	Sylvania 50MR16/T/N SP10	100	n/a	n/a	n/a	1	1
F16	Wall mounted compact fluorescent sconce	Manning PS44-12-PLC-W	1	Quad	Sylvania CFQ13W/G 24Q/830	82	3000	Dali Dimming	Sylvania QTP1x13CF/ UNV DALI	1	4

### Visible Luminaires



F9



F11/F12/F12a



F16

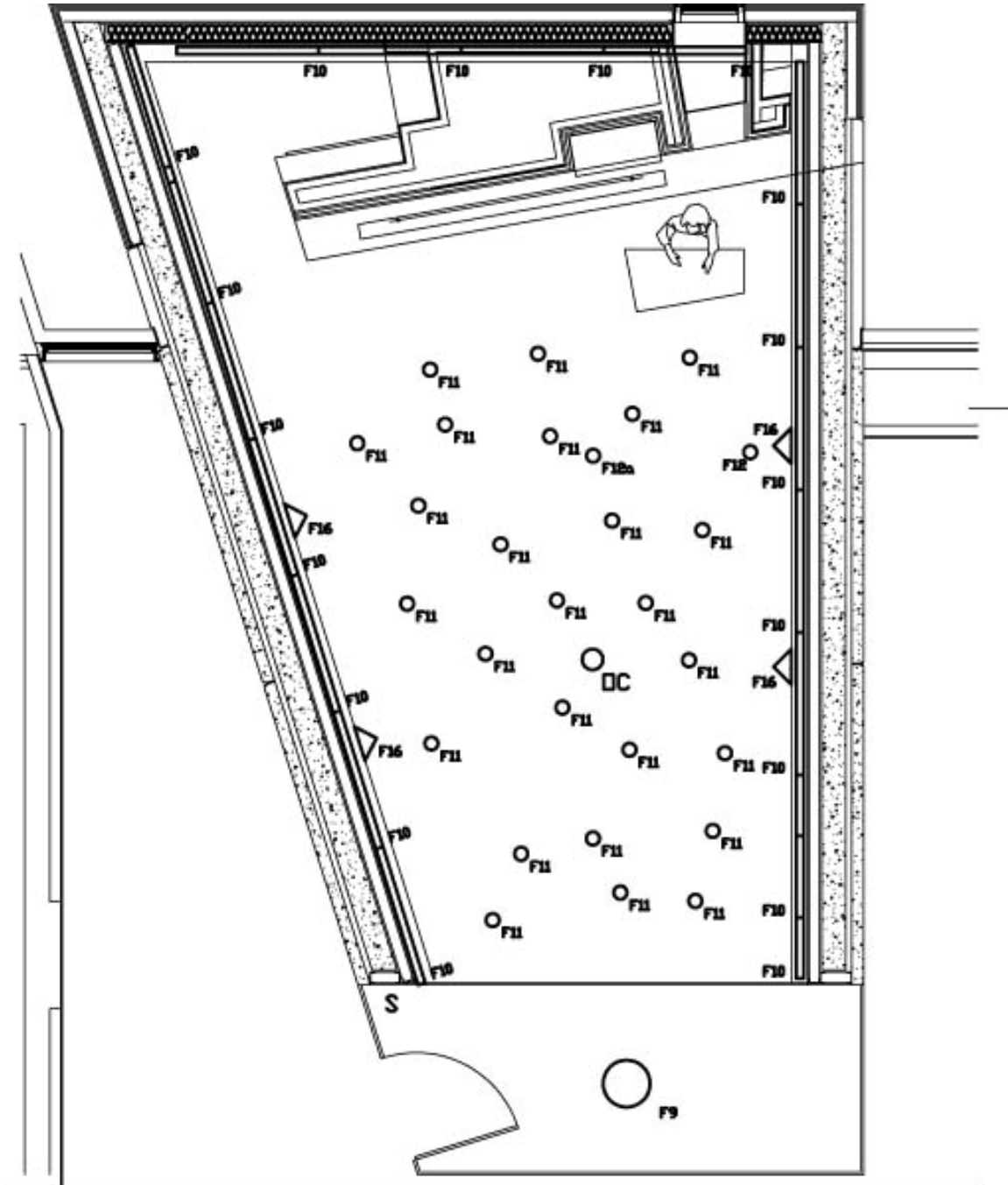
### Light Loss Factors

Luminaire Label	Maintenance Category	Cleaning Interval	Initial Lumens per Luminaire	Mean Lumens per Luminaire	LLD	LDD	RSDD	BF	Total LLF
F9	III	Very Clean - 12 months	1150	1075	0.93	0.9	0.98	1	0.82
F10	VI	Very Clean - 12 months	2900	2697	0.93	0.92	0.9	1	0.77
F11	III	Very Clean - 12 months	240	228	0.95	0.9	0.98	1	0.84
F12	III	Very Clean - 12 months	320	304	0.95	0.9	0.98	1	0.84
F12a	III	Very Clean - 12 months	900	855	0.95	0.9	0.98	1	0.84
F16	II	Very Clean - 12 months	900	774	0.86	0.98	0.98	1	0.83

### DALI Equipment

	Description	Cat. No.	Quantity
<b>Power Supply</b>	Wattstopper ezDALI Power Supply	DPS150-2	1
<b>Wall Control</b>	Wattstopper ezDALI Group and Scene Control	DLCSS4-2	1
<b>Transformer</b>	B+L Technologies DALI Star	DS98100-S	10
<b>Occupancy Sensor</b>	Wattstopper Ultrasonic Occupancy Sensor	UT-305-2	1

## Luminaire Layout



## Lighting Control

Lighting in the chapel will be dimmed and controlled using a Wattstopper ezDALI Group and Scene Controller. B+L Technologies DALI star transformers will be added to this installation, allowing DALI to control the halogen fixtures. Each transformer controls a maximum of 75W, so nine transformers will be needed to control the F11 downlights, and one will be needed to control the spotlights (F12 and F12a). The transformers will allow the halogen fixtures to be dimmed 0-100% and be controlled by the DALI group and scene controller. The compact fluorescent loads will be placed on a relay since it is unnecessary to dim these fixtures. The relay will work with the group and scene controller and switch the compact fluorescent fixtures on or off. The group element of the controller will allow each group of luminaires (up to 4 groups maximum) to be controlled and dimmed manually, and the scene selection control will allow these groups to function with the halogen loads to create 4 preset scenes. One Wattstopper ezDALI power supply is needed to provide power to the chapel.

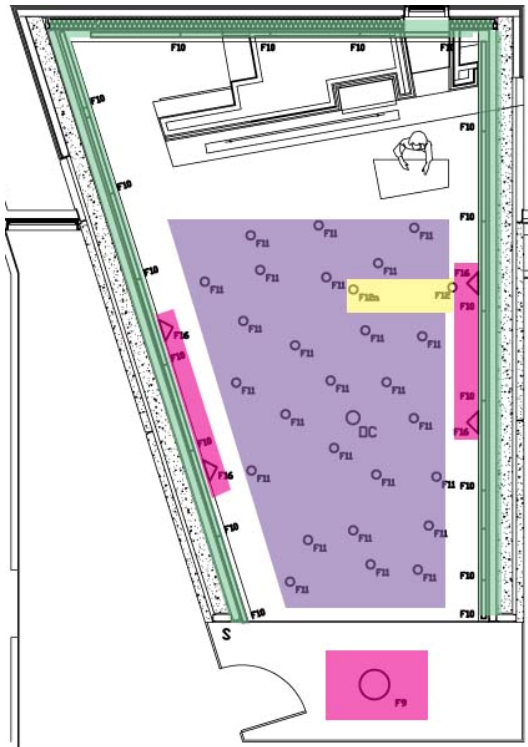
A Wattstopper ultrasonic low voltage occupancy sensor will also be installed to conserve energy by switching off all lights when the chapel is not occupied. This occupancy sensor was chosen because the chapel is a small space with a clear line of sight and the sensor is compatible with the selected power supply. The ezDALI controller will work with the occupancy sensor so that when the controller turns the lights on, the most recently used scene will be resumed. This will be especially useful during visiting hours when the chapel will be used for individual prayer. For example, during visiting hours the lighting will be set to the correct scene, if no one is present in the chapel the lighting will dim to 10% of that scene for 5 minutes. If someone enters the chapel during those 5 minutes the scene will be resumed; if not the lighting will switch off until someone enters, when the visiting hour scene will then be resumed.

## DALI Control Groups

Group 1	F10 Fluorescent Cove
Group 2	F11 Halogen downlights
Group 3	F12 and F12a spotlights
Relay Module 1	Compact Fluorescent sconces and downlight

## Scenes

	Service	Before and after service	Visiting Hours	Sermon
Group 1	100%	100%	100%	100%
Group 2	100%	35%	25%	10%
Group 3	100%	Off	Off	100%
Relay Module 1	100%	100%	100%	100%



## Circuiting

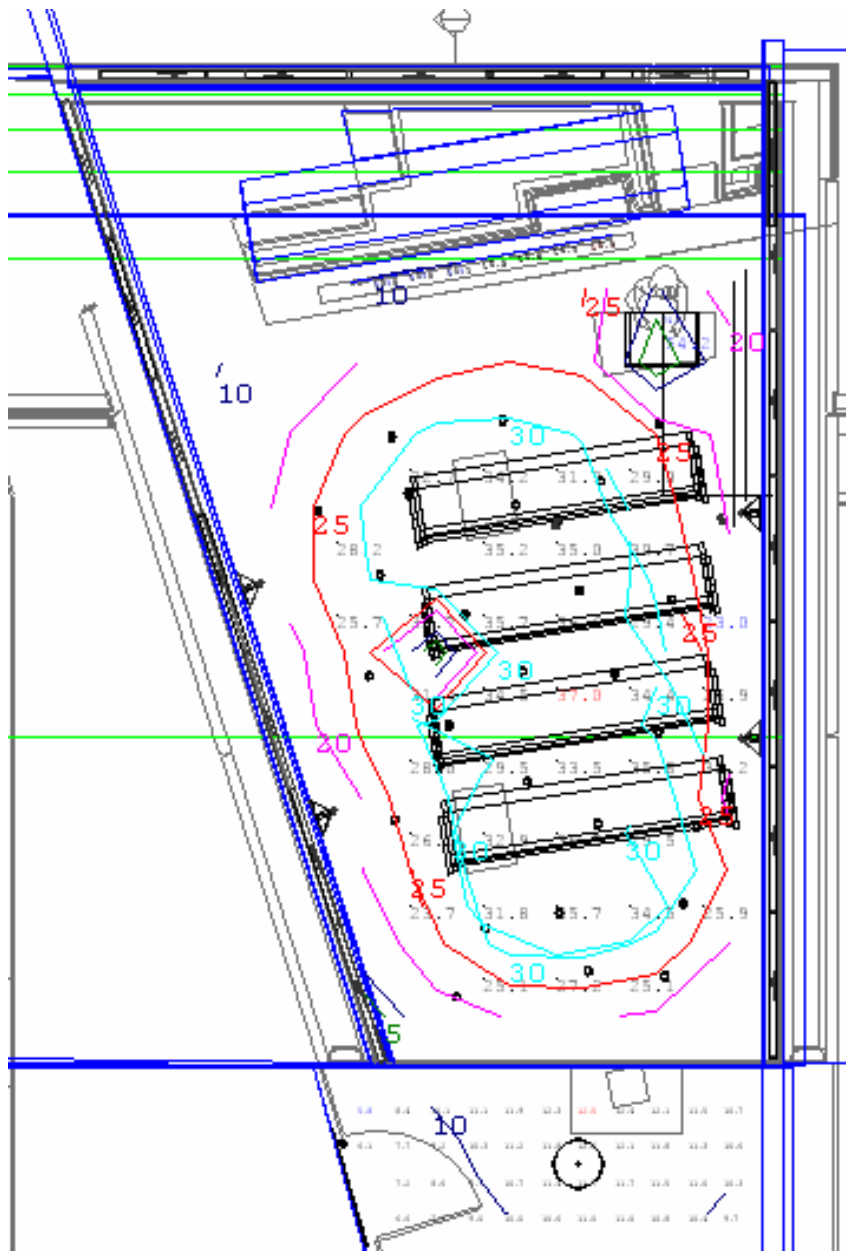
Luminaire	input watts	# used	volts	amps per ballast	total VA load
F9	40	1	277	0.33	91.41
F10	64	10	277	0.31	858.7
F11	20	26	12	1.67	520
F12	20	1	12	1.67	20
F12a	50	1	12	4.17	50
F16	16	4	277	0.18	199.44
Power supply 1	1.5	1	277	n/a	1.5
Power supply 2	1.5	1	120	n/a	1.5
Transformers		10	120	0.6	720
<b>TOTAL VA</b>					<b>2462.55</b>
Circuit	Load (VA)	Wire Size	Conduit	Breaker Size	
CH-1	1151.05	2#12 AGW, 1#12 GRD	3/4"	20A	
CH-2	1311.5	2#12 AGW, 1#12 GRD	3/4"	20A	



## Illuminance Values

### During Service Scene

During the service enough light should be provided for reading. Since this chapel will be used by the elderly, 30fc should be provided to allow for comfortable reading. Adequate lighting should also be provided on the podium for the speaker to read. The speaker should be highlighted with 50-75fc on his or her face. Light on the projection screen should be kept to a minimum to reduce glare.



Seating Area at 2.5'  
Goal: 30fc  
Avg. Achieved: 30.84fc

Entrance Area at floor  
Goal: 10fc  
Avg. Achieved: 10.29fc

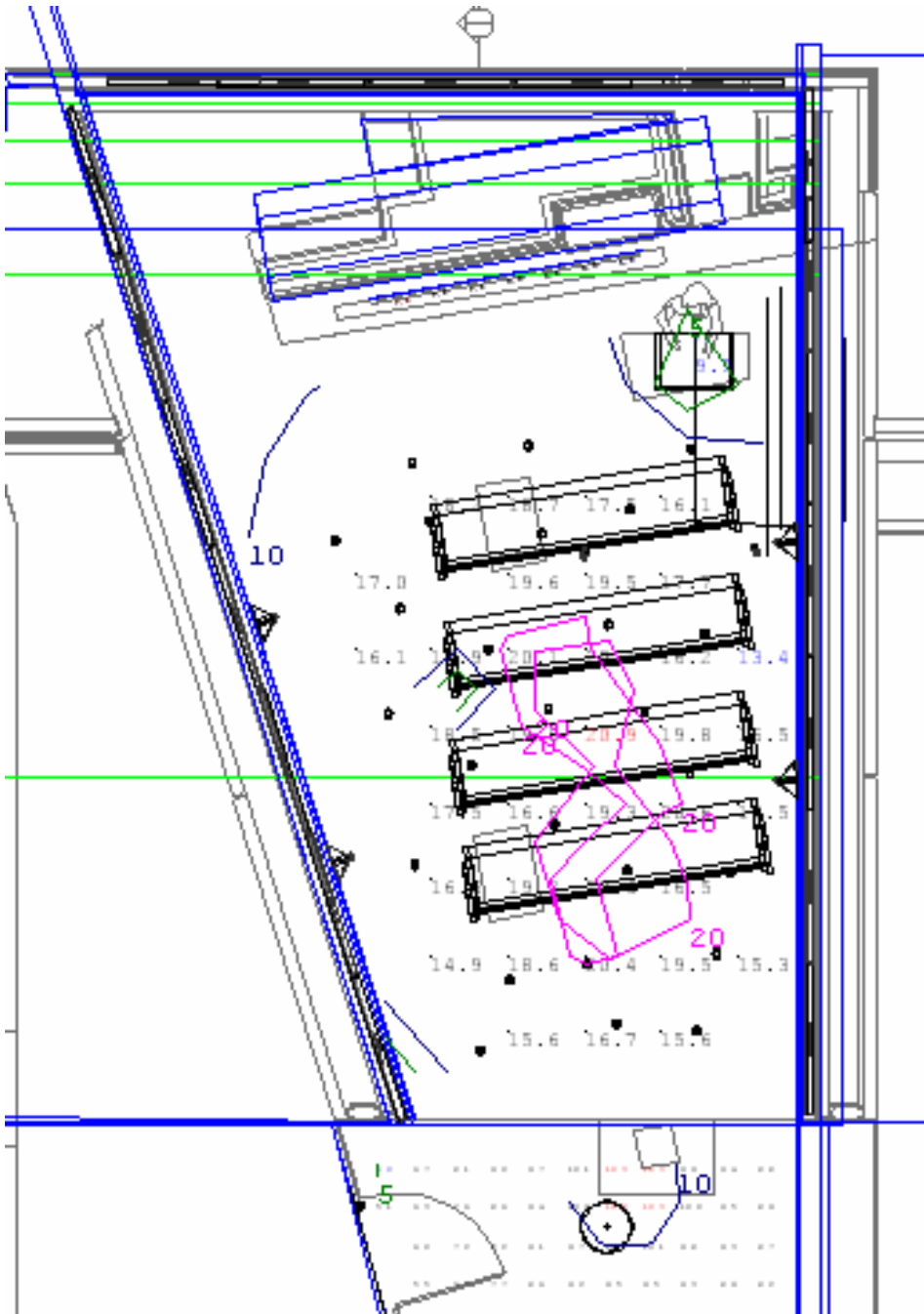
Podium at 3'  
Goal: Minimum of 30fc  
Avg. Achieved: 54.2fc

Face  
Goal: 50-75fc  
Avg. Achieved: 74fc

Projection Screen  
Goal: Minimize light  
Actual: 10fc

### Before and After Service Scene

Before and after services enough light should be provided for people to mingle and enter or exit the chapel. More lighting should be supplied than during visiting hours to signal that a service is about to start or has just ended. At least 10fc should be provided to mark the entrance and exit area. Spotlights can be turned off since the focus will not be on the front on the chapel.



Seating Area at 2.5'

Goal: 20fc

Avg. Achieved: 18fc

Entrance Area at floor

Goal: 10fc

Avg. Achieved: 8.68 fc

Podium at 3'

Goal: N/A

Avg. Achieved: 9.5c

Face

Goal: N/A

Avg. Achieved: 7.1fc

Projection Screen

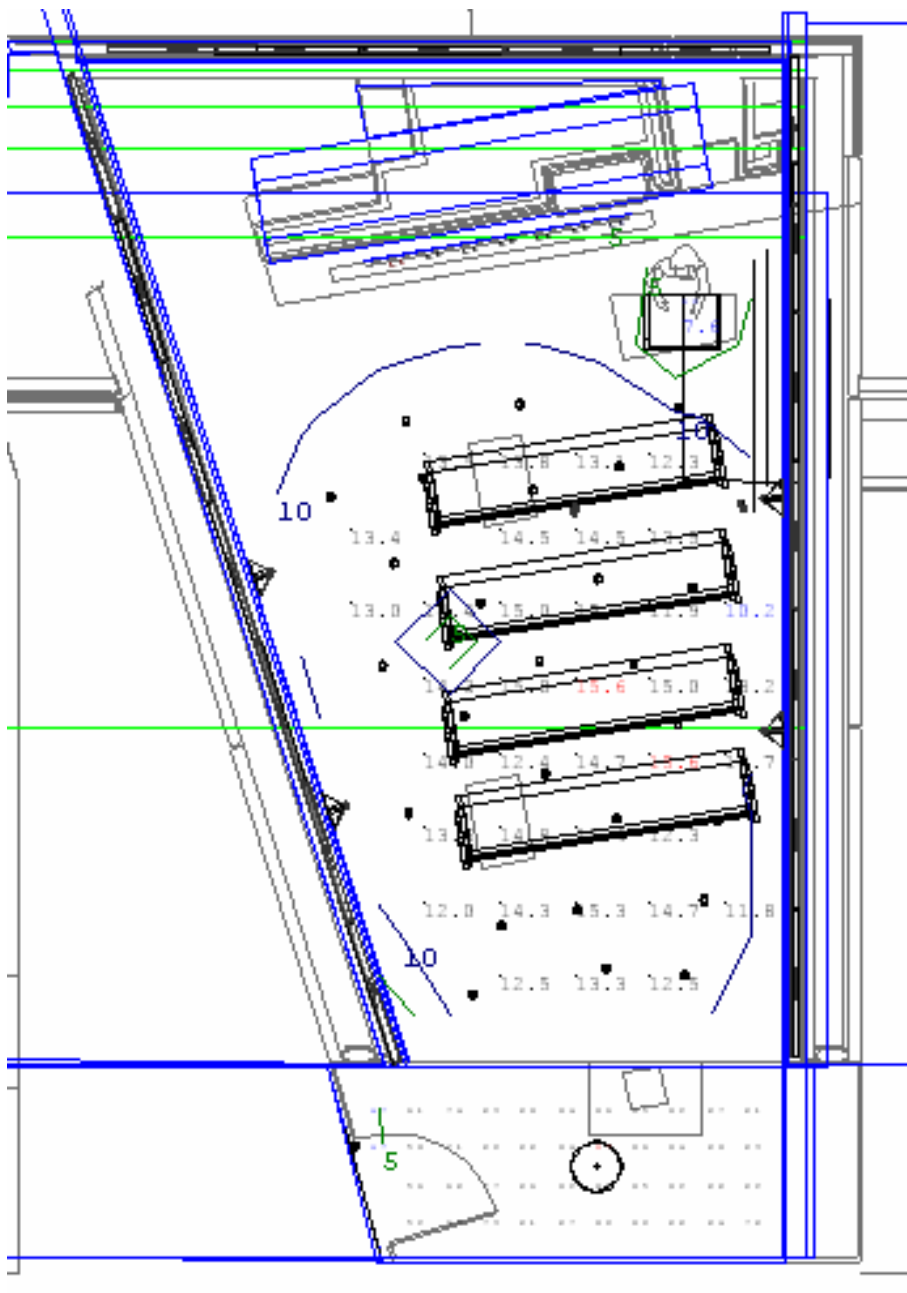
Goal: Minimize light

Actual: 6.84fc



### Visiting Hours Scene

The goal of the visiting hours scene is to provide enough light in the seating area for circulation and prayer. 15fc was the goal in the seating area because it provides more than enough light for safe circulation throughout the chapel. The entrance area goal remained at 10fc, to provide enough light to enter the chapel without creating a distraction from behind those seated in the chapel. Since there will be no speaker during visiting hours the spotlights will be off, and the illuminance values at the podium and on the face of the speaker are not applicable.



#### Seating Area at 2.5'

Goal: 15fc

Avg. Achieved: 14fc

#### Entrance Area at floor

Goal: 10fc

Avg. Achieved: 8.5fc

#### Podium at 3'

Goal: N/A

Avg. Achieved: 7.6fc

#### Face

Goal: N/A

Avg. Achieved: 6fc

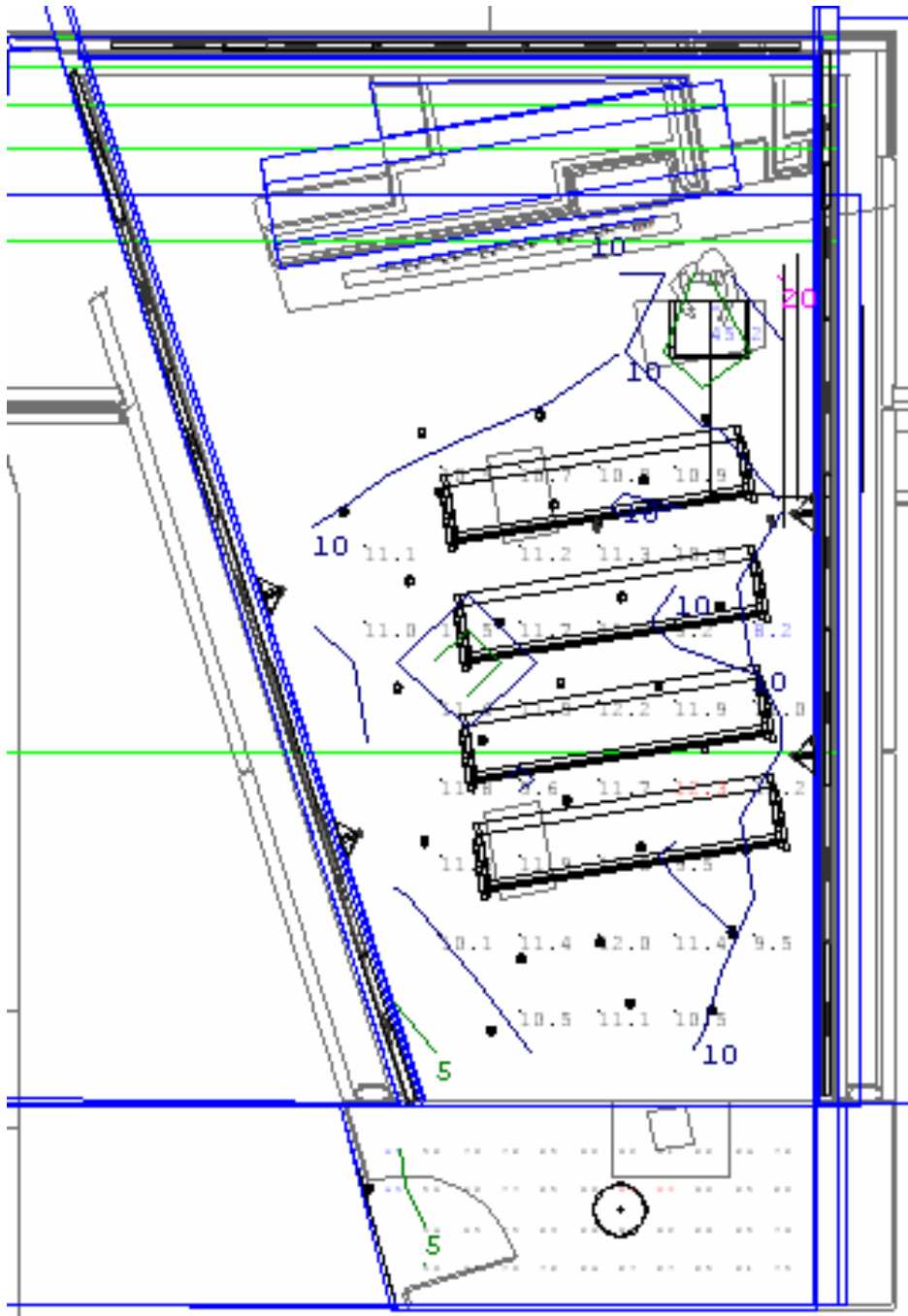
#### Projection Screen

Goal: Minimize light

Actual: 5.97fc

### Sermon Scene

During the sermon the congregation will not be reading, so lighting in the seating area can be dimmed to a minimum of 10fc. The focus will be on the speaker at the podium, so he or she should still be illuminated and the podium should be illuminated for the speaker to read.



Seating Area at 2.5'  
Goal: 10fc  
Avg. Achieved: 11.06fc

Entrance Area at floor  
Goal: 5fc  
Avg. Achieved: 7.81fc

Podium at 3'  
Goal: min 30fc  
Avg. Achieved: 45.2fc

Face  
Goal: 50-75  
Avg. Achieved: 69.5fc

Projection Screen  
Goal: Minimize light  
Actual: 7.37fc

## Power Density

Fixture Label	Description	Lamp #	Lamp Type	Ballast Type	Lamps per ballast	Fixture Quantity	Ballast Watts	power		
F9	CFL surface mounted downlight	2	Quad	Dali Dimming	2	1	40	40		
F10	Cove mounted fluorescent striplight	1	T5	Dali Dimming	2	19	64	608		
F11	Recessed halogen downlight	1	MR16	n/a	1	26	20	520		
F12	Recessed halogen spotlight	1	MR16	n/a	1	1	20	20		
F12a	Recessed halogen spotlight	1	MR16	n/a	1	1	50	50		
F16	Wall mounted compact fluorescent sconce	1	Quad	Dali Dimming	1	4	16	64		
								1302	Total Watts	
								590	sqft	
								<b>Power Density=</b>	<b>2.21 Watts per sqft</b>	

Allowable power density = 2.4 W/sqft

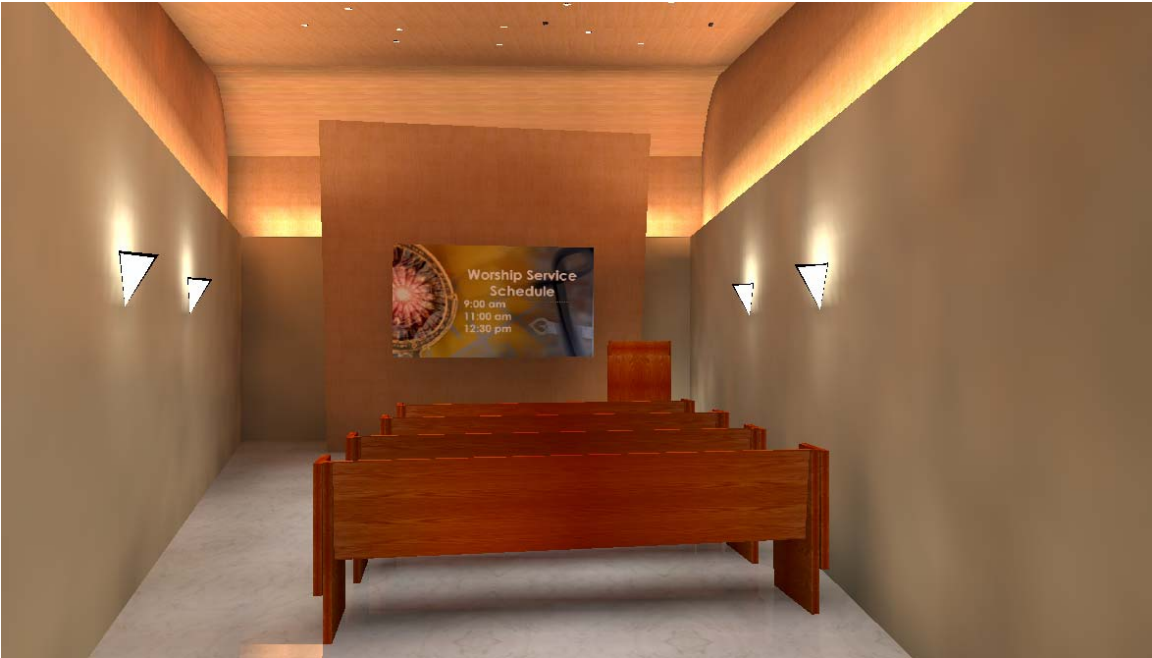
Achieved power density = 2.21 W/sqft

The achieved power density is 8.6% below ASHRAE 90.1.

# Renderings



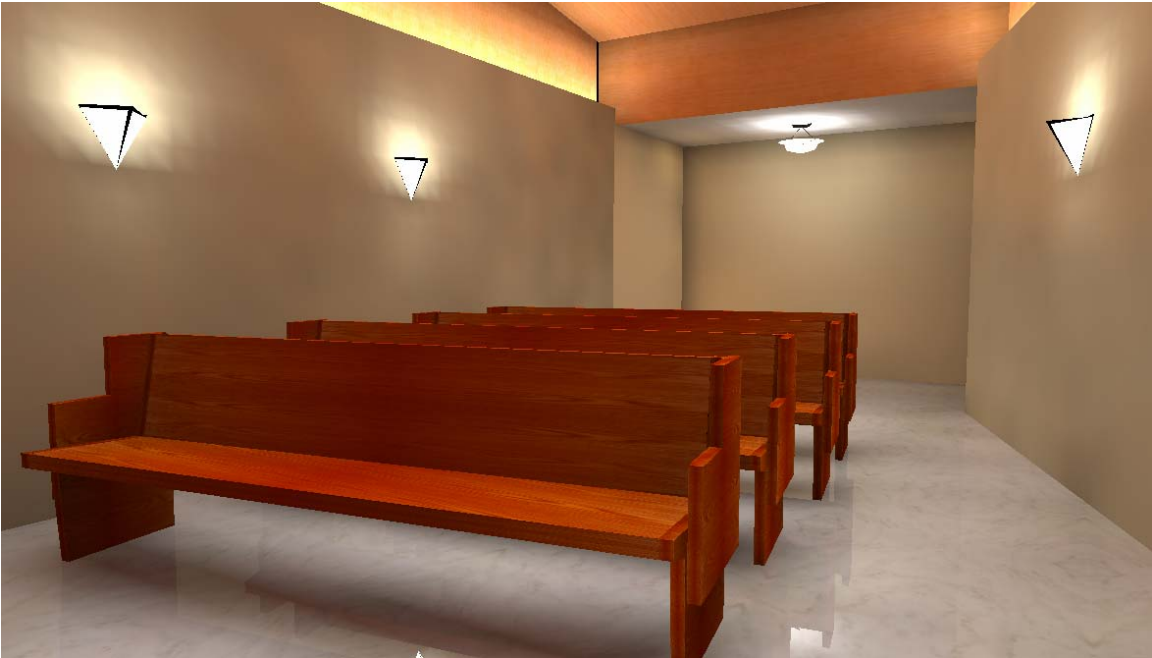
View from entrance



View from back of chapel



View from podium



View from front of chapel

## Conclusions

The architecture and shape of the chapel is enhanced while a meaningful atmosphere is created through uplighting the wood panels. Small downlights provide enough illumination for the elderly to read while keeping glare at a minimum. The random placement of the downlights prevents a structured feeling and provides continuity of a spiritual atmosphere. Spotlights are integrated with the layout for the downlights and will draw attention to the front of the chapel when switched on. Additional sparkle is provided by the decorative wall sconces along the two side walls of the chapel. Flexibility of the lighting system allows for the adjustment of illuminance levels as necessary. Scenes have been determined to supply appropriate illuminance values for the typical needs of the chapel, while the manual group control can also be used for any custom settings. An occupancy sensor integrated with the control system will help conserve energy by switching the lighting off when the chapel is not in use. In addition to the design goals being met for this space, the power density is about 8.6% below the allowable value set by ASHRAE 90.1.