

Walter Nichols
Hawthorn Building
Altoona, PA



Executive Summary

This report is an analysis of the existing lighting conditions for the Computer Labs, Pechter Family Music Room, Lecture Hall/Video Conferencing Room, and Main Corridor of the Hawthorn Building at Penn State Altoona's campus. I started my analysis by using the IES Handbook for general design criteria, and then ran calculations with AGI32 Lighting Calculation computer software. Power density calculations were also taken into consideration and compared to ASHRAE Standard 90.1.

Each area of my analysis had different issues that needed to be researched and addressed. For example, one of the main focuses in the computer lab area was that there couldn't be much glare, but in the video conference area facial rendering was very important. Every area of the building is controlled with dimmable lighting systems, as well as "scene selection" capabilities. Each room has around 6 scenes to choose from, and this allows for the teachers and students to use the lighting system that best suits their needs.

Through my analysis, I got a good idea of what I liked about each room, and what I didn't, and also built an idea on what I might do in the future when I redesign the spaces. I also have a feel for what is needed in each space, and possibly what can be taken away to save energy.

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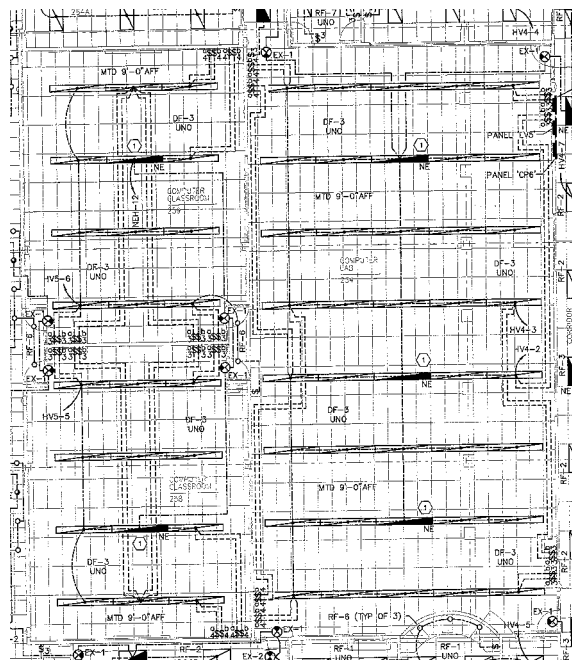
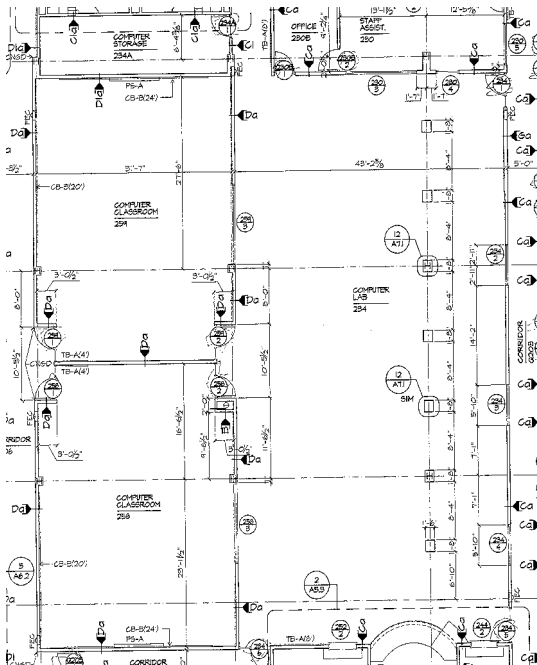
Computer Labs and Computer Classrooms

Computer Lab

Furniture:

- 40x 6' desks that sit 2 computers each
- 2x 3' diameter round tables
- 88x office style chairs with wheels

Floor Plan and Lighting Plan:



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Computer Labs and Computer Classrooms

Finishes:

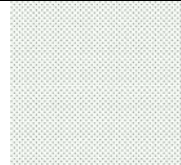
South, East, and West Walls:

	Paint Finish Color: Cream Reflectance: 75%
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North Wall:

	Paint Finish Color: Dark Cream/Golden Brown Reflectance: 50%
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Ceiling:

	Acoustic Panel Color: White Reflectance: 86%
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Floor:

	Carpet Finish Color: Brown Reflectance: 26%
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Computer Labs and Computer Classrooms

Existing Lighting:

Type	Description	Lamps	Voltage	Wattage	Ballast	Quantity
DF-3	Architectural direct/indirect	(6) F32T8/ADV835/ALTO	277	192	Dimming	59

Light Losses:

Type	Ballast Factor	Cleaning Interval	Maintenance Category	LLD	RSD	LDD	Total Losses
DF-3	*0.9	12 months	Type II	0.93	0.92	0.89	.685

*Note: Ballast factor assumed

Existing Power Density:

59 fixtures x 6 lamps/fixture x 32 watts/lamp = 11328 Watts

Lighting Controls:

This room is equipped with a Lehigh Electric dimming system with multiple scene selections. In this room, there are 3 zones programmed: the front 1/3 of the lighting, the middle 1/3 of the lighting, and the rear 1/3 of the lighting. Between these 3 zones, there are also scene selections that combine the zones in different ways. The system also allows for automatic timed off, so the lighting system will turn itself off when it gets to a certain point in the day. The control station for this system is located on the wall behind the help desk. Also included in this dimming system, 1 additional scene is included that acts as a backup in case of main power outage. The scene has all of the emergency lighting on it, and is controlled by a separate power source than the rest of the system.

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Computer Labs and Computer Classrooms

Task Descriptions:

This room is used as the main computer lab for the building. Tasks include: typing word documents, surfing the internet, playing computer games, and using web cams for communication purposes. There is no artwork in this room and there are also no presentations, so vertical light levels are not as important at horizontal levels.

Design Criteria:

System Controls:

This room is equipped with a dimming system for the lighting, as well as multiple scene selections. These can be used to adjust how much light is being provided on the work plane, as well as which lights it is coming from. These both allow for energy savings since not all the lights need to be on at maximum output all the time.

Daylight Integration:

This room uses no natural day lighting. It is located in the middle of the 2nd floor, so there are no windows near it to allow for a day lighting solution.

Appearance of Space and Luminaires:

I feel the appearance of this room is pretty important. The room is pretty large, so by using indirect lighting, it gives the room the feeling of being large and welcoming, instead of large and intimidating. Indirect lighting also minimizes the glare on the monitor screens.

Surface Characteristics:

Besides the dark cream color north wall, the entire room is a standard plain white color and doesn't really need anything extra or special to make important features stand out. There are a few columns in the space that could be lit specially, but it isn't necessary in my opinion. The dark cream wall in the front is primarily there to guide you to the help desk, as well as be a place to hand flyers on a bulletin board. A wall wash or spot lighting system might be appropriate for this.

Glare:

Glare is an important issue for this space. The indirect lighting system that is used gets rid of almost of the possibility for glare. Lighting controls gives a 2nd means of protection against this. As stated in the day lighting section, there is no day lighting in this space, so that won't cause unwanted glare either.

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Computer Labs and Computer Classrooms

Accent Issues:

The dark cream colored bulletin board area will need accent lighting to make the flyers on it stand out more than the surroundings. There is no artwork that needs accented in the space.

Unwanted Shadows:

The columns in the space could cause unwanted shadows, but the lighting system is pretty uniform and prevents most of this from happening.

IES Criteria:

Horizontal:

Reading VDT screen: 10 FC

Reading paper/taking notes w/ #2 pencil: 40 FC

Keyboard reading: 30 FC

Vertical:

Educational: 5 FC

Power Density Criteria:

ASHRAE 90.1 Allowed: $1.5\text{w}/\text{ft}^2 \times 3608 \text{ft}^2 = 5412 \text{watts}$

Special Allowances: $1.0\text{w}/\text{ft}^2$ for accent lighting

Existing Power Density:

$59 \text{ fixtures} \times 6 \text{ lamps/fixture} \times 32 \text{ watts/lamp} = 11328 \text{ Watts}$

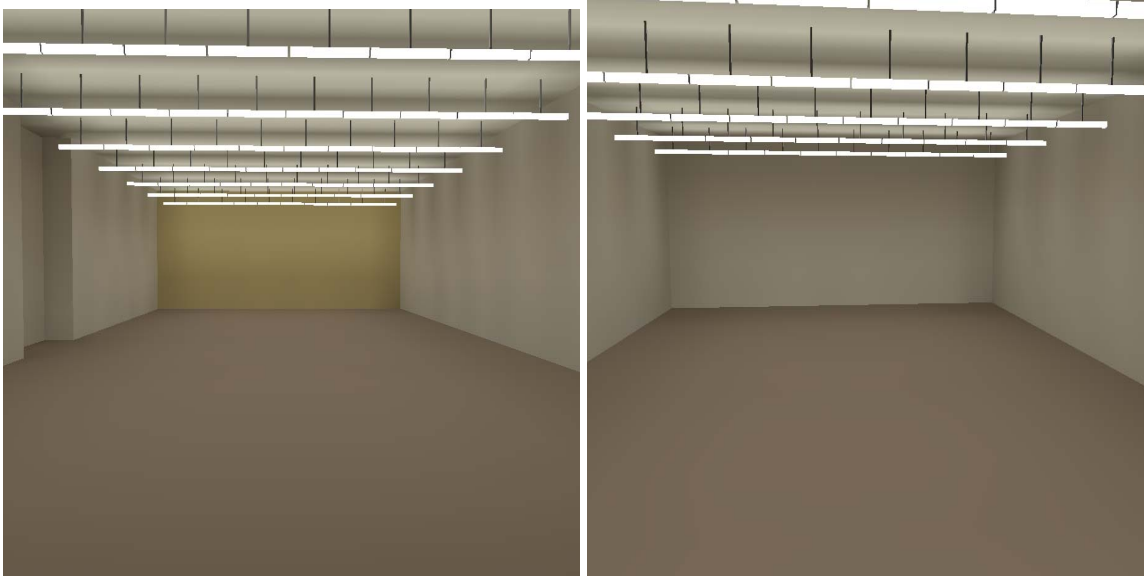
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Computer Labs and Computer Classrooms

Calculations and Evaluation of Existing Conditions:

Renderings:

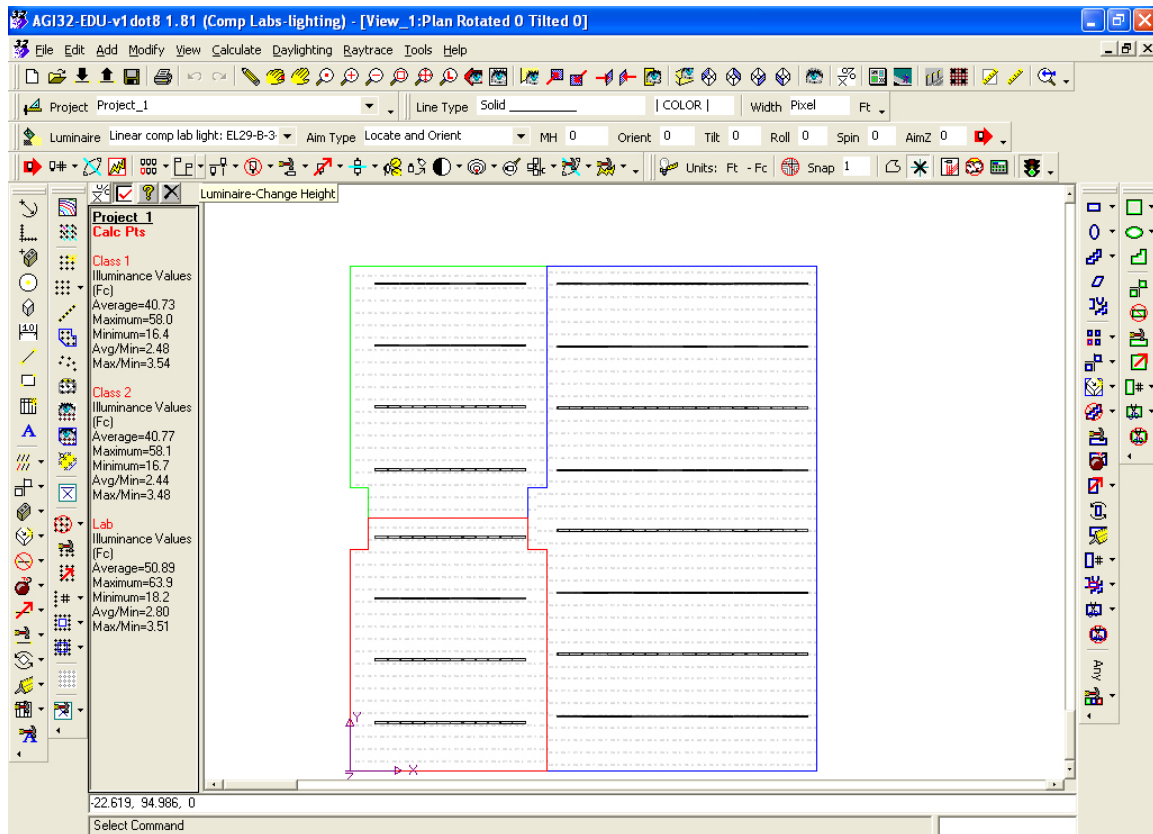


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Computer Labs and Computer Classrooms

Final Evaluation of Existing Conditions:



After observation and calculations, I feel that the main computer lab area is meeting the right lighting levels. IES criteria asks that 40 FC are provided on the work plane for #2 pencil tasks, and after calculations, I found that there is 51 FC on the work plane. This value is more than what is needed, but my model is also very basic and doesn't include any of the objects that would lower the lighting levels. However, this space exceeds the power density requirements of ASHRAE 90.1 by close to 2 times that allowed.

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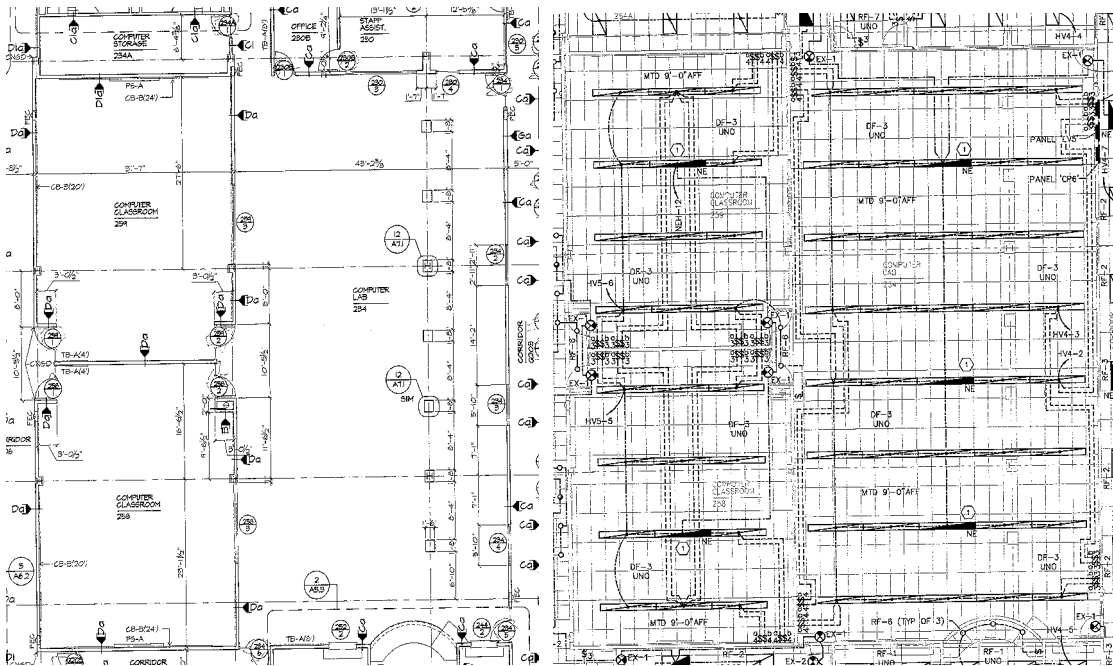
Computer Labs and Computer Classrooms

Computer Classrooms

Furniture:

- 20x 6' desks that sit 2 computers each per classroom
- 1x 5' Podium per classroom
- 41x office style chairs with wheels per classroom

Floor Plan and Lighting Plan:



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Computer Labs and Computer Classrooms

Finishes:

All Walls:

	Paint Finish Color: Cream Reflectance: 75%
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Ceiling:

	Acoustic Panel Color: White Reflectance: 86%
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Floor:

	Carpet Finish Color: Brown Reflectance: 26%
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Computer Labs and Computer Classrooms

Existing Lighting:

Type	Description	Lamps	Voltage	Wattage	Ballast	Quantity
DF-3	Architectural direct/indirect	(6) F32T8/ADV835/ALTO	277	192	Dimming	**24

Light Losses:

Type	Ballast Factor	Cleaning Interval	Maintenance Category	LLD	RSD	LDD	Total Losses
DF-3	*0.9	12 months	Type II	0.93	0.92	0.89	.685

*Note: Ballast factor assumed

**Note: Includes both classroom spaces

Existing Power Density:

24 fixtures x 6 lamps/fixture x 32 watts/lamp = 4608 Watts

Lighting Controls:

These rooms are equipped with a Lehigh Electric dimming system with multiple scene selections. In this room, there are 2 zones programmed: left side of the room lighting and right side of the room lighting. Between these 2 zones, there are also scene selections that combine the zones in different ways. The system also allows for automatic timed off, so the lighting system will turn itself off when it gets to a certain point in the day. The control station for these systems are located on the wall inside the classroom door. Also included in this dimming system, 1 additional scene is included that acts as a backup in case of main power outage. The scene has all of the emergency lighting on it, and is controlled by a separate power source than the rest of the system.

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Computer Labs and Computer Classrooms

Task Descriptions:

This room is used as a classroom primarily and a computer lab when no class is scheduled to be in the room at that time. Tasks include: typing word documents, surfing the internet, playing computer games, and using web cams for communication purposes, note taking (paper and with a computer), computer programming, and viewing slides from an overhead projector. There is no artwork in these rooms.

Design Criteria:

System Controls:

This room is equipped with a dimming system for the lighting, as well as multiple scene selections. These can be used to adjust how much light is being provided on the work plane, as well as which lights it is coming from. These both allow for energy savings since not all the lights need to be on at maximum output all the time.

Daylight Integration:

This room uses no natural day lighting. It is located in the middle of the 2nd floor, so there are no windows near it to allow for a day lighting solution.

Appearance of Space and Luminaires:

I don't feel the appearance of this room is as important as the larger lab. The room is fairly small and comfortable to begin with. By using indirect lighting, it gives the room the feeling of being welcoming, as well as minimizes the glare on the monitor screens.

Surface Characteristics:

The entire room is a standard plain white color and doesn't really have anything extra or special features. There is a large projector screen in the front of the room as well as white board, however. The large projection screen doesn't need anything additional done to it for viewing purposes, but the white board would be best utilized with a wall wash or spot light system.

Glare:

Glare is an important issue for this space. The indirect lighting system that is used gets rid of almost of the possibility for glare. Lighting controls gives a 2nd means of protection against this. As stated in the day lighting section, there is no day lighting in this space, so that won't cause unwanted glare either.

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Computer Labs and Computer Classrooms

Accent Issues:

The white board area will need accent lighting to make it stand out more than the surroundings, especially when the light is at a lower level. There is no artwork that needs accented in the space.

Unwanted Shadows:

The only shadows in this space are under the desks.

IES Criteria:

Horizontal:

Reading VDT screen: 10 FC

Reading paper/taking notes w/ #2 pencil: 40 FC

Keyboard reading: 30 FC

Vertical:

Educational/lecture: 10 FC

Power Density Criteria:

ASHRAE 90.1 Allowed: $1.5\text{w}/\text{ft}^2 \times 3608 \text{ ft}^2 = 1968$ watts per classroom

Special Allowances: $1.0\text{w}/\text{ft}^2$ for accent lighting

Existing Power Density:

$24 \text{ fixtures} \times 6 \text{ lamps/fixture} \times 32 \text{ watts/lamp} = 4608 \text{ Watts}$ (2304 per classroom)

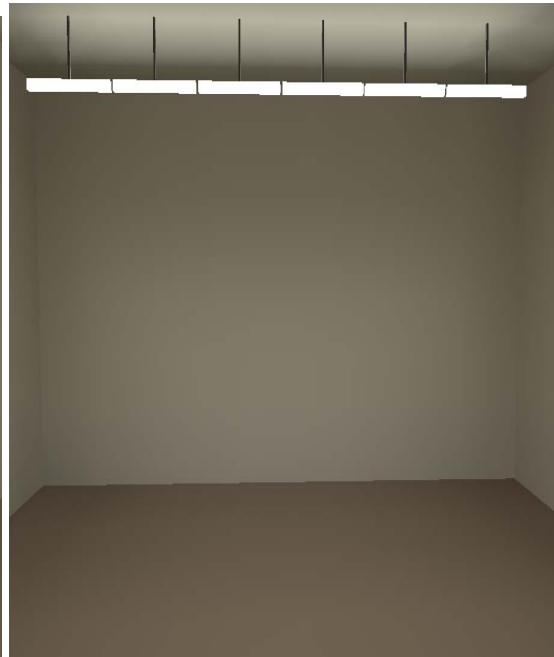
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Computer Labs and Computer Classrooms

Calculations and Evaluation of Existing Conditions:

Renderings:

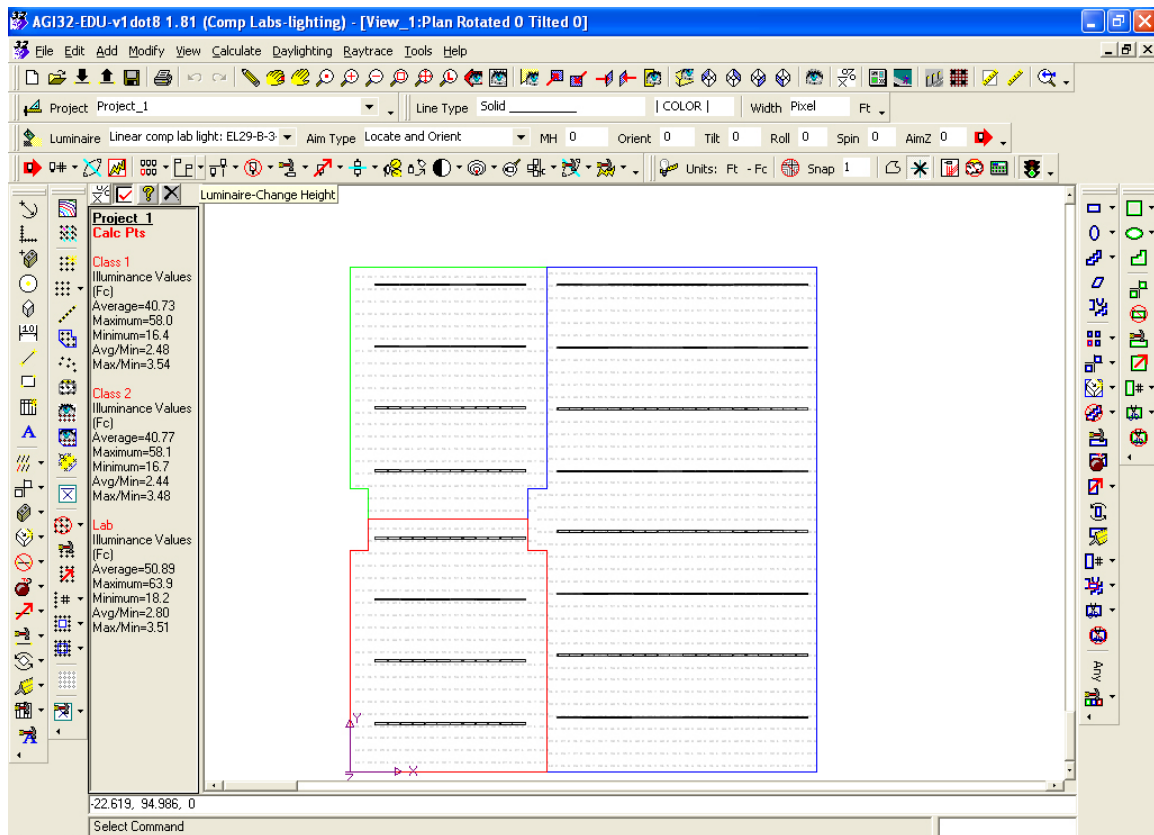


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Computer Labs and Computer Classrooms

Final Evaluation of Existing Conditions:



After observation and calculations, I feel that the classroom spaces are meeting the right lighting levels. IES criteria asks that 40 FC are provided on the work plane for #2 pencil tasks (highest visual demand), and after calculations, I found that there is 41 FC on the work plane. This value is right about where it should be. This space also exceeds the allowed power density, but not nearly as much as the main lab area.

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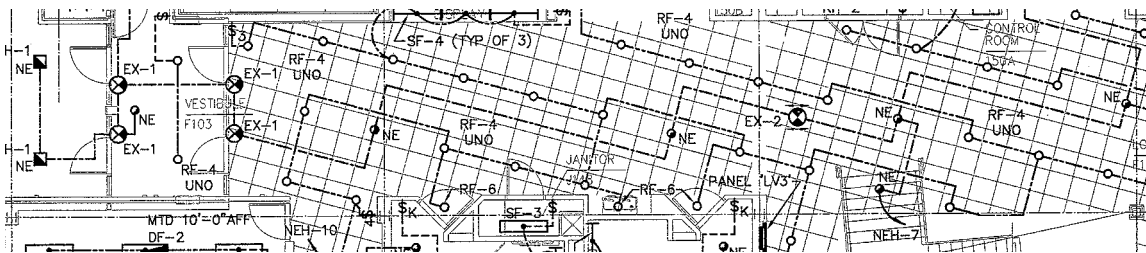
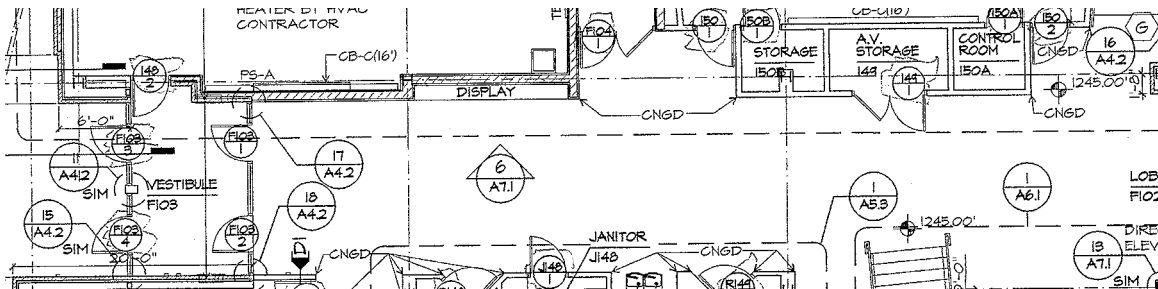
Main Corridor

Main Corridor

Furniture:

- 4x Lounge Chairs
- 2x Lounge Couches
- 3x Small Wooden Coffee Tables

Floor Plan and Lighting Plan:



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Main Corridor

Finishes:

All Walls:

	Paint Finish Color: Cream Reflectance: 75%
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Ceiling:

	Acoustic Panel Color: White Reflectance: 86%
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Floor:

	3 Color Tile Finish Colors: Brown, Green, and Amber Reflectance: 30% (tiles are slightly glossy)
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Main Corridor

Existing Lighting:

Type	Description	Lamp	Voltage	Wattage	Ballast	Quantity
RF-4	6" Open downlight	(1) PL-T32W835/4P/ALTO	277	32	Dimming	32
RF-6	4" Open downlight	(1) PL-C18W/835/ALTO	277	18	Dimming	3
EX-1	Double sided LED exist sign	NA	277	0.91	NA	3

Light Losses:

Type	Ballast Factor	Cleaning Interval	Maintenance Category	LLD	RSD	LDD	Total Losses
RF-4	*0.90	12 Months	Type IV	0.85	0.97	0.98	0.727
RF-6	*0.90	12 Months	Type IV	0.85	0.97	0.98	0.727

*Note: Ballast factor assumed

Existing Power Density:

32 lamps x 32 watts/lamp + 3 lamps x 18 watts + 3 lamps x 0.91 watts = 1080.73 Watts

Lighting Controls:

This area is equipped with a Lehigh Electric dimming system with multiple scene selections. There were 2 zones programmed into the system: the 4" down lights and the 6" down lights. There are also possibilities for scene controls, but none are used in this space currently. The system also allows for automatic timed dimming, so the lighting system will dim itself during the day and raise the light levels later when the additional light is needed. The control station for this system is located on the wall near the entrance door. The building's main backup generator, not the dimming system, controls emergency lighting in this area.

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Main Corridor

Task Descriptions:

The main corridor is used mainly to walk between classes as well as in and out of the building. Up the stairs, there is a small study lounge area. Tasks here include: doing homework, socializing, studying, and reading the newspaper.

Design Criteria:

System Controls:

The main corridor uses a dimming system for the lighting, allowing the lighting to be adjusted depending on time of day. This also allows for energy savings during times where maximum output isn't needed.

Daylight Integration:

The main entrance to this building is connected to the main hallway, so there is some daylight that comes in through the doorways. There is also day lighting upstairs in the student lounge area. The lounge is in front of 3 double heighted windows that provide a decent amount of day lighting in the lounge area as well as out to the stairs that are close by.

Appearance of Space and Luminaires:

I feel the appearance of this area is important. This is where you get your first impression of the building, almost like a lobby area. This should draw people into the building from the outside, as well as make them feel comfortable when they get inside. This is currently done using down lights, daylight, and wall washers. The down light and wall washers in this space however, are too close to the walls, and produce overly intense and uneven scallops.

Surface Characteristics:

The corridor has standard, white walls on both sides, and the doors are made of a lighter colored wood. The main architectural feature to this space in my opinion, is the intricate floor tiling pattern, and how the space opens up dramatically when you begin to go up the stairs. The wall washers and down lights do a good job of making the floor tiles to stand out and draw your attention, as well as make the stairs visible and inviting. There is also day light spill light from the lounge windows that make the stairs even more of a focal point, and create somewhat of an atrium space at the stairs.

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Main Corridor

Glare:

Glare is somewhat of an important issue for this space, mainly in the lounge area. The lounge area gets a lot of daylight without any blinds or curtains to block it. This produces a lot of glare in the lounge when the sun is bright. Blinds or curtains for the windows would eliminate some of this glare, but I think that a light shelf and/or indoor plants and foliage would also help to correct this issue.



Accent Issues:

All of the walls in this space have a wall wash to accent them. There is also a bulletin board at the end of the corridor that is being wall washed. Each classroom entrance has a down light above it to provide additional light for the classroom.

Unwanted Shadows:

There are very little to no shadows in this area. Shadows aren't a very important concern for this space. The lounge couches cause shadows, but these shadows don't do anything to cause concern.

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Main Corridor

IES Criteria:

Horizontal:

Simple visual tasks (walking): 10 FC

Vertical:

Simple Orientation: 5 FC

Power Density Criteria:

ASHRAE 90.1 Allowed: $1.0\text{w}/\text{ft}^2 \times 640\text{ ft}^2 = 640\text{ watts}$

Special Allowances: $1.0\text{w}/\text{ft}^2$ for accent lighting

Existing Power Density:

$32\text{ lamps} \times 32\text{ watts/lamp} + 3\text{ lamps} \times 18\text{ watts} + 3\text{ lamps} \times 0.91\text{ watts} = 1080.73\text{ Watts}$

Special allowances allow for an additional 640 watts, which would then make the Main Corridor meet ASHRAE 90.1 criteria.

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Main Corridor

Calculations and Evaluation of Existing Conditions:

Renderings:

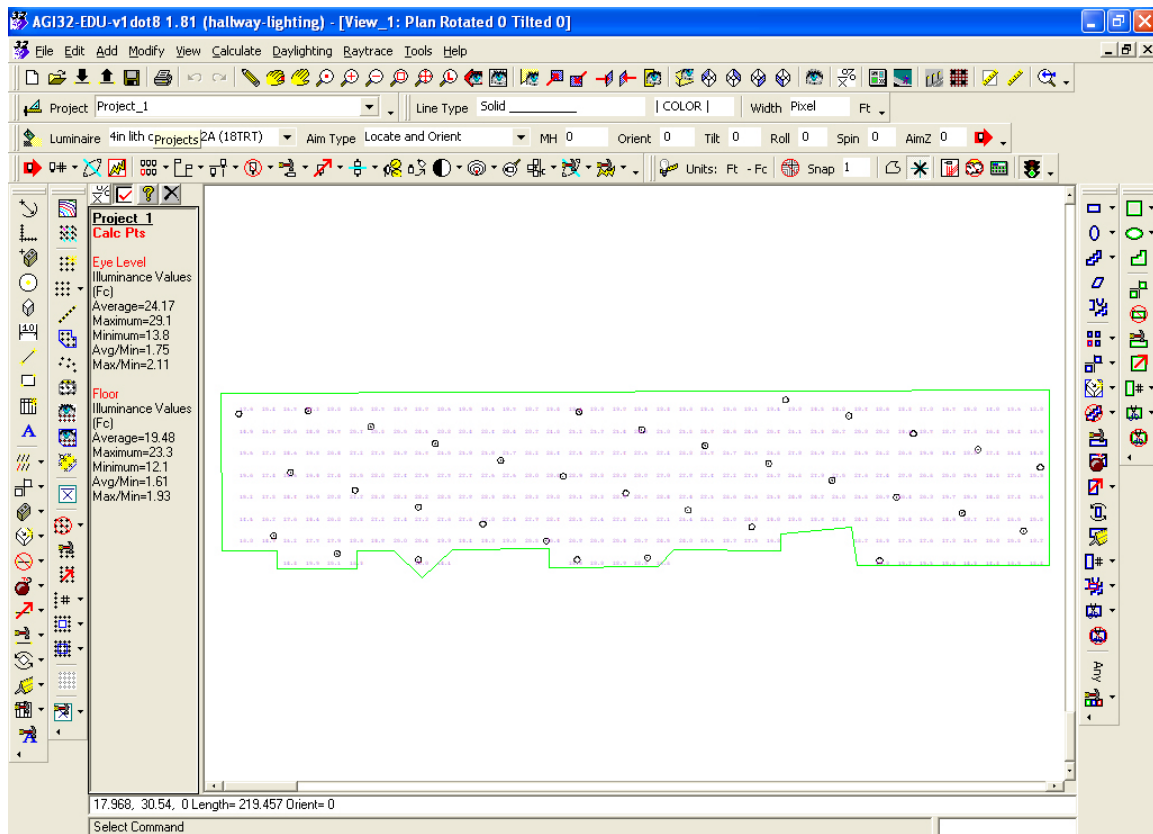


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Main Corridor

Final Evaluation of Existing Conditions:



I was somewhat surprised at the lighting levels that down lights alone were able to produce. IES criteria states that there should be 5 FC on the floor, and 10 FC vertical, and this lighting layout far exceeds this. However, this space exceeds the power density requirements of ASHRAE 90.1 unless you use the additional 1.0 watts/ft² for accent lighting, but this is a bit of a stretch. The down lights in this space aren't really for accenting purposes, so it might be advantageous to remove some of these down lights to lower the power density of the space.

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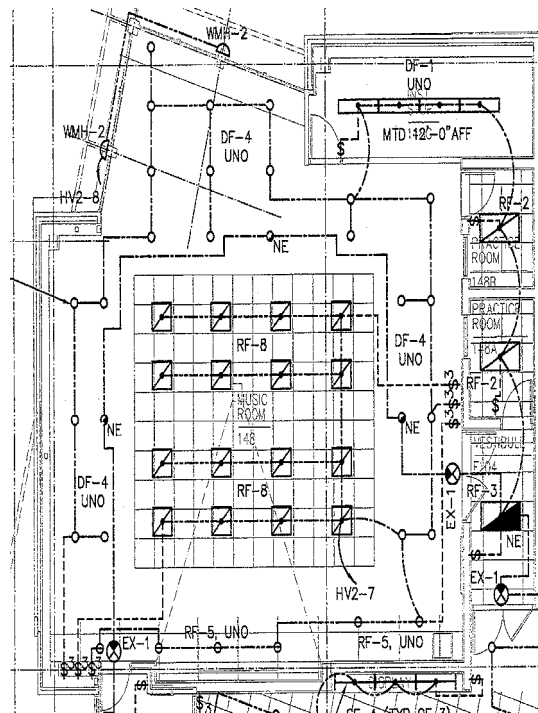
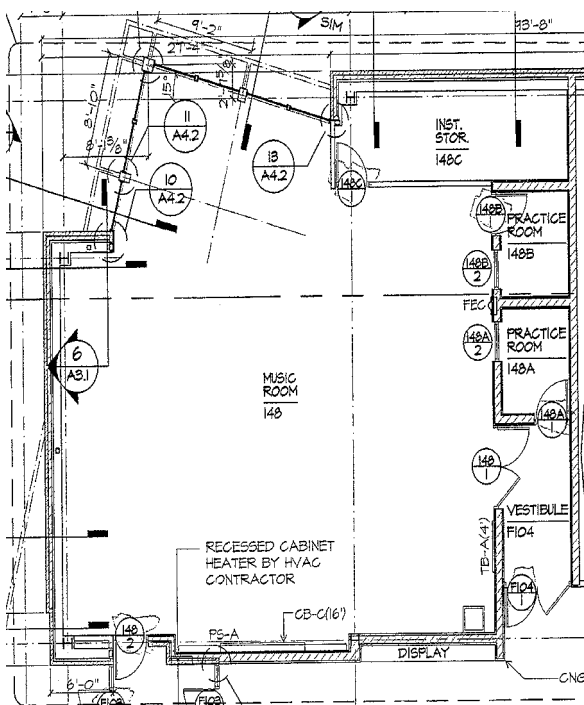
Pechter Family Music Room

Pechter Family Music Room

Furniture:

- 15x 6' 2 person tables
- 40x Metal Folding Chairs
- 30x Black Music Stands
- 1x 5' Podium
- 1x Full Size Piano

Floor Plan and Lighting Plan:




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Pechter Family Music Room

Finishes:

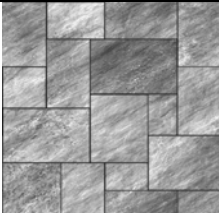
All Walls:

	<p>Acoustical Cloth Tile Finish Color: Cream/Brown Reflectance: 45%</p>
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Ceiling:

	<p>Acoustic Triangulated Panel Color: White Reflectance: 86%</p>
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Floor:

	<p>Marble Tile Finish Colors: Grey Reflectance: 30% (tiles are slightly glossy)</p>
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Pechter Family Music Room

Existing Lighting:

Type	Description	Lamp	Voltage	Wattage	Ballast	Quantity
RF-8	3 lamp, 9 cell parabolic	(3) FB40/35U/6 /ALTO	277	120	Dimming	16
RF-5	6" open wall wash	(1) PL- T32W835/4 P/ALTO	277	32	Dimming	5
DF-4	8" down light pendant cylinders	(1) PL- C26W/835/ ALTO	277	26	Dimming	21
RF-2	2 lamp prismatic	(2) F32T8/TL83 5/ALTO	277	64	Electric	2
RF-3	3 lamp prismatic	(3) F32T8/TL83 5/ALTO	277	96	Electric	1

Light Losses:

Type	Ballast Factor	Cleaning Interval	Maintenance Category	LLD	RSD	LDD	Total Losses
RF-8	*0.90	12 Months	Type IV	0.85	0.97	0.98	0.727
RF-5	*0.90	12 Months	Type IV	0.85	0.97	0.98	0.727
DF-4	*0.90	12 Months	Type IV	0.85	0.97	0.98	0.727
RF-2	*0.90	12 Months	Type IV	0.85	0.97	0.98	0.727
RF-3	*0.90	12 Months	Type IV	0.85	0.97	0.98	0.727

*Note: Ballast factor assumed

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Pechter Family Music Room

Existing Power Density:

16 fixtures x 3 lamps/fixture x 40 watts/lamp = 1920 watts

6 fixtures x 1 lamps/fixture x 32 watts/lamp = 192 watts

20 fixtures x 1 lamps/fixture x 26 watts/lamp = 520 watts

2 fixtures x 2 lamps/fixture x 32 watts/lamp = 128 watts

1 fixtures x 3 lamps/fixture x 32 watts/lamp = 96 watts

Total = 1920 + 46 + 624 = 2856 watts

Lighting Controls:

This room is equipped with a Lehigh Electric dimming system with multiple scene selections. In this room, there were 3 zones programmed into the system: the 9 cell parabolics, the wall washers, and the down lights. Between these 3 zones, there are 6 different scenes programmed into the system, including all off. The system also allows for automatic timed off, so the lighting system will turn itself off when it gets to a certain point in the day. The control station for this system is located on the front wall near the entrance door. Also included in this dimming system, 1 additional scene is included that acts as a backup in case of main power outage. The scene has all of the emergency lighting on it, and is controlled by a separate power source than the rest of the system. The 2 practice rooms are switched separately, and are not on the dimming system.

Task Descriptions:

Tasks inside the Pechter Family Music Room include: taking notes on music scores, reading music scores, and following tempos from the band director by watching his hand or tempo stick movements.

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Pechter Family Music Room

Design Criteria:

System Controls:

This room is equipped with a dimming system for the lighting, as well as multiple scene selections. These can be used to adjust how much light is being provided on the work plane, as well as which lights it is coming from. These both allow for energy savings since not all the lights need to be on at maximum output all the time. There is also lighting in the back of the room via cylindrical suspended pendants that has its own switching so it can act independently of the rest of the room.

Daylight Integration:

The rear of the Pechter Family Music Room utilizes 6 large, double heighted windows for day lighting purposes. These windows allow sunlight to come into the full size piano area, as well as the rest of the room due to the double heighted windows. Because the walls and ceiling are covered with acoustic panels, the sun light plays a significant role in provided adequate light levels for this space.

Appearance of Space and Luminaires:

Generally speaking, people involved in the arts, music, and theater (students and teachers alike) major tend to have a finer appreciation for artistic and aesthetic thing. Because of this, I feel that the appearance of this room is very important. I think this room should be lit in a way that isn't standard. The cylindrical suspended pendants are a nice approach to this. The daylight also gives this room a nice, welcoming feel to it.

Surface Characteristics:

The Pechter Family Music Room has interesting surface characteristics to it. Because it is a band and music room, the walls and ceiling are covered with acoustic panels, and these panels tend to lower the light levels because it breaks up the consistency and texture of the walls and ceiling. Higher amounts of light are needed in this space to achieve the same lighting levels that the other spaces can achieve with less light. Because of this, I feel the surface characteristics of this room are very important.

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Pechter Family Music Room

Glare:

Glare is somewhat of an important issue for this space. It is important that there is no glare on the musical scores when students are trying to read and play music. It is also important that when the conductor is conducting a song, that everyone in the band can follow his tempo and body movements without having any glare to interfere with them. In the rear of the space, there is a lot of sunlight that comes through the large windows. This might cause some unwanted glare, so blinds might be a possible solution if this problem does exist.

Accent Issues:

All of the walls in this space have acoustical panels on them, so there is little need for accent lighting the walls. In the front of the room however, there is a staffed (musical lines) blackboard. I would advise using a wall wash or spot lighting for additional light on this board.

Unwanted Shadows:

In this space, shadows need to be taken into consideration. When students are reading sheet music, shadows could produce a problem if they appeared on the music. The recessed lighting as well as the suspended cylinders and day lighting prevent this from occurring though.

IES Criteria:

Horizontal:

Note taking: 30 FC

General Art Room Requirements: 30 FC

Reading 10 pt. Font: 50 FC

Vertical:

Reading off of a blackboard: 50 FC

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Pechter Family Music Room

Power Density Criteria:

ASHRAE 90.1 Allowed: $1.5\text{w}/\text{ft}^2 \times 2124 \text{ ft}^2 = 3186 \text{ watts}$

Special Allowances: $1.0\text{w}/\text{ft}^2$ for accent lighting

Existing Power Density:

16 fixtures x 3 lamps/fixture x 40 watts/lamp = 1920 watts

6 fixtures x 1 lamps/fixture x 32 watts/lamp = 192 watts

20 fixtures x 1 lamps/fixture x 26 watts/lamp = 520 watts

2 fixtures x 2 lamps/fixture x 32 watts/lamp = 128 watts

1 fixtures x 3 lamps/fixture x 32 watts/lamp = 96 watts

Total = $1920 + 46 + 624 = 2856 \text{ watt}$

This space is under the allowed maximum power density, and is most likely sharing its leftover power allowances with one of the over designed spaces. The wall washers in this space can also be treated as accent lighting, and can be used under the extra $1.0\text{w}/\text{ft}^2$ for accent lighting special allowances.

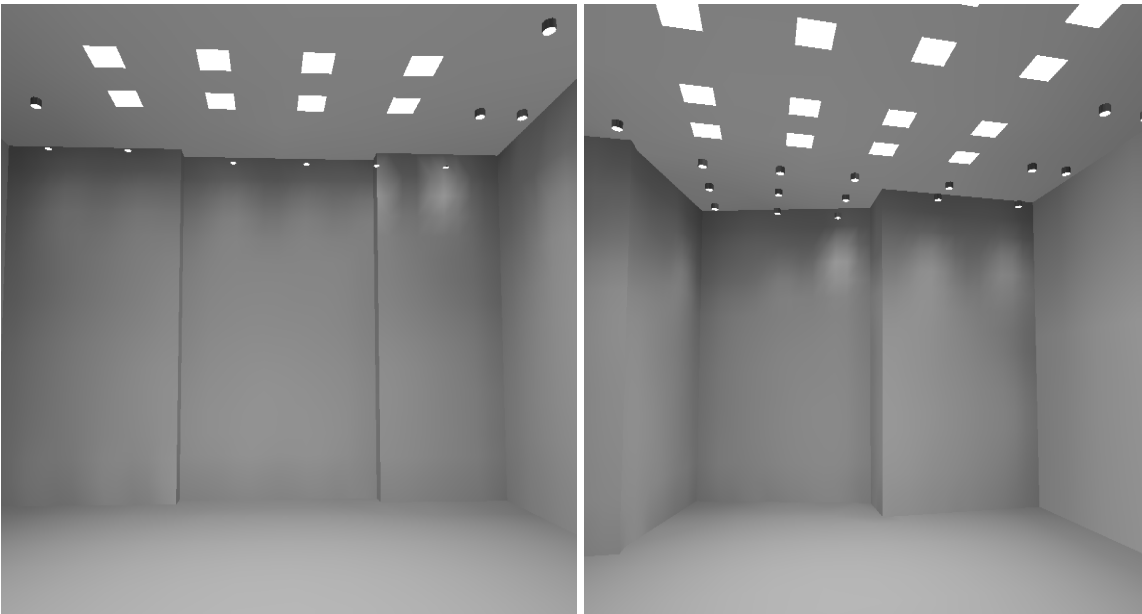
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Pechter Family Music Room

Calculations and Evaluation of Existing Conditions:

Renderings:

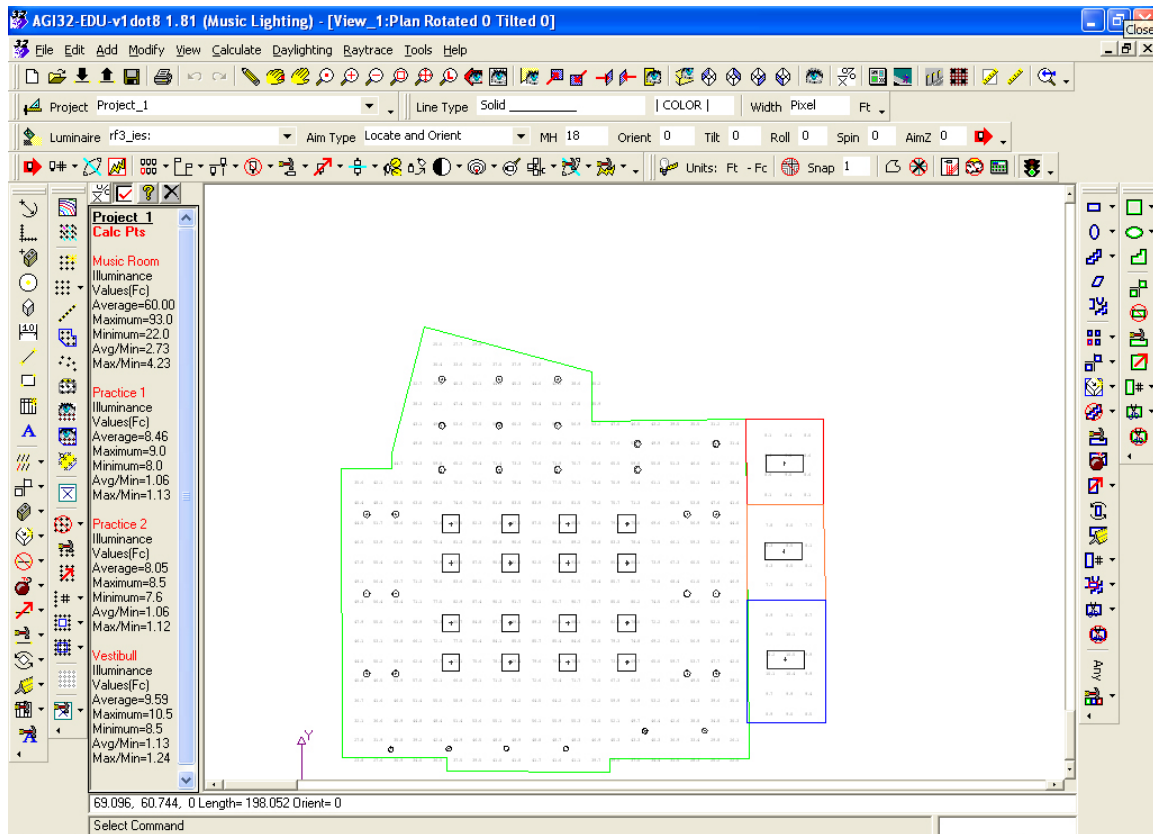


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Pechter Family Music Room

Final Evaluation of Existing Conditions:



After observation and calculations, I feel that the music room is provided enough light for the tasks being done there. After checking the IES Handbook, I decided that the design should achieve 50 FC. I chose 50 FCs because one of the tasks in the space would be reading sheet music from around 2 feet away. For 10 point font, IES requires 50 FCs. After running the calculations, I found that the room is getting around 60 FCs on the work plane, which is slightly higher than needed. This space (including practice rooms) is also under the ASHRA 90.1 power density requirements. The practice rooms that flank the main music room however, do not meet the needed lighting levels. The levels there are around 8 FCs, and I feel that they should be in the 20's to 30's. Students are still reading sheet music in there as well, but they more room to get closer to read the music, so I don't think 50 FCs is needed here.

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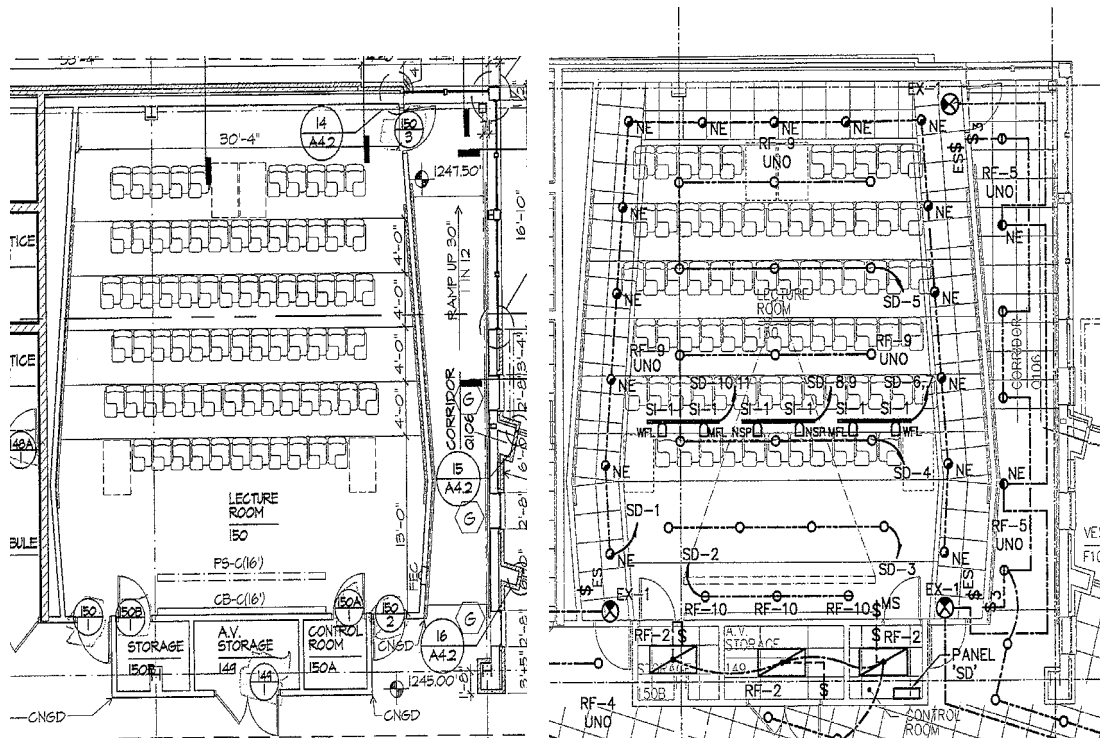
Lecture Hall/Video Conference Room

Lecture Hall/Video Conference Room

Furniture:

- 75x auditorium style seats with built in folding desk tops
- 1x 5' podium

Floor Plan and Lighting Plan:



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Lecture Hall/Video Conference Room

Finishes:

All Walls:

	Acoustical Cloth Tile Finish Color: Dark Gold/Brown Reflectance: 50%
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Ceiling:

	Acoustic Panel Color: White Reflectance: 86%
---	---

Floor:

	Carpet Finish Color: Brown Reflectance: 26%
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Lecture Hall/Video Conference Room

Existing Lighting:

Type	Description	*Lamps	Voltage	Wattage	Ballast	Quantity
RF-10	6" open wall wash	(1) PL-T32W835/4P/ALTO	277	32	Dimmable	9
RF-9	8" down light	(2) PL-T42W835/4P/ALTO	277	84	Dimmable	27
SI-1	Track mounted incandescent	(1) 300PAR56Q/NSP	120	300	NA	8

*All lamps taken from Philips Lighting

Light Losses:

Type	Ballast Factor	Cleaning Interval	Maintenance Category	LLD	RSD	LDD	Total Losses
RF-10	*0.9	12 months	Type IV	0.85	0.97	0.98	0.727
RF-9	*0.9	12 months	Type IV	0.85	0.97	0.98	0.727
SI-1	1.0	12 months	Type IV	0.95	0.97	0.89	0.82

Existing Power Density:

*Note: Ballast factor assumed

9 fixtures x 32 watts/fixture = 288 watts

27 fixtures x 42 watts/lamp x 2 lamps/fixture = 2268 watts

8 fixtures x 300 watts/fixture = 2400 watts

Total= 4956 watts

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Lecture Hall/Video Conference Room

Lighting Controls:

This room is equipped with a Lehigh Electric dimming system with multiple scene selections. In this room, there were 3 zones programmed into the system: the track-mounted fixtures, the wall washers, and the down lights. Between these 3 zones, there are 6 different scenes programmed into the system, including all off. The system also allows for automatic timed off, so the lighting system will turn itself off when it gets to a certain point in the day. The control station for this system is located on the wall closest to the entrance door. Also included in this dimming system, 1 additional scene is included that acts as a backup in case of main power outage. The scene has all of the emergency lighting on it, and is controlled by a separate power source than the rest of the system.

Task Descriptions:

The lecture hall space has a variety of tasks that take place inside it. It is used primarily as a classroom, so general tasks include: note taking, reading off of a blackboard, reading notes off of a projector, and reading books and notes from the student's desks. This room also serves as a video conferencing room too. Some classes are offered over the internet, teachers can teach via webcam to the students across the internet. Because of this, additional care needs to be taken so the internet students can read from the board as well as take notes from their computers.

Design Criteria:

System Controls:

This room is equipped with a dimming system for the lighting, as well as multiple scene selections. These can be used to adjust how much light is being provided on the work plane, as well as which lights it is coming from. These both allow for energy savings since not all the lights need to be on at maximum output all the time. The track mounted spot lights in this space are included in this system as well.

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Lecture Hall/Video Conference Room

Daylight Integration:

The lecture hall/video conferencing room has no direct daylight coming into it. There is a very small possibility that some day light spill light from the hall could come in through the window on the entrance door, but daylight was not integrated into the design of this room directly.

Appearance of Space and Luminaires:

I feel that the appearance of this space is important. This is the largest classroom in the Hawthorn Building, and can also be used for auditorium style presentations to larger groups of people. Because of this, the room should have a welcoming feel as well as a feel that keeps people interested. The lighting scene selections can be used for this purpose. There is one issue with the existing conditions in this room that I personally don't like. In the front of the room, the track mounted spot lights are a much warmer color light than the rest of the room. From the student's perspective, this difference in CCT can barely be noticed, but from the teacher's perspective, when they look to the back of the classroom from the front, the two different CCTs create a distracting combination.

Surface Characteristics:

The Pechter Family Music Room has interesting surface characteristics to it. Because it is a band and music room, the walls and ceiling are covered with acoustic panels, and these panels tend to lower the light levels because they break up the consistency and texture of the walls and ceiling. Higher amounts of light are needed in this space to achieve the same lighting levels that other spaces can achieve with less light. Because of this, I feel the surface characteristics of this room are very important.

Glare:

Glare is a very important issue in this space. Since this is a large classroom space, glare on the blackboard or projector screen could cause students sitting near the rear of the room to have problems seeing and reading properly. Also, since this room is used for video conferencing, unwanted glare could cause problems for the webcam, making learning for internet students difficult. This could be glare on the board, the webcam lens, or the teacher's face.

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Lecture Hall/Video Conference Room

Accent Issues:

All of the walls in this space have acoustical panels on them, so there is no artwork or bulletin boards that need accented. However, in the front of the room, I would advise using a wall wash or spot system to accent the blackboard. The existing lighting condition is a track mounted spotlight solution that also doubles as a spotlight for the teacher in video conferencing scenarios.

Unwanted Shadows:

In this space, shadows are an important consideration to take into account. Unwanted shadows could produce reading difficulties for students in the back of the room if the shadow is on the front blackboard. The seating in this space is a raked auditorium style seating, so there is also the possibility that a taller person sitting behind someone could cast a shadow onto the front person's desk. Facial shadows also need to be taken into consideration for video conferencing reasons. Unwanted facial shadows, shadows that are too strong, etc, could cause learning issues for students taking the class via internet.

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Lecture Hall/Video Conference Room

IES Criteria:

Horizontal:

Note taking: 30 FC

Reading 10 VDT screens: 3 FC

Vertical:

Reading off of a blackboard: 50 FC

Facial Rendering: 50 FC

Special Conditions:

Background to Speaker: 3:1 ratio

Power Density Criteria:

ASHRAE 90.1 Allowed: $1.5\text{w}/\text{ft}^2 \times 1330\text{ ft}^2 = 1995\text{ watts}$

Special Allowances: $1.0\text{w}/\text{ft}^2$ for accent lighting

Existing Power Density:

9 fixtures x 32 watts/fixture = 288 watts

27 fixtures x 42 watts/lamp x 2 lamps/fixture = 2268 watts

8 fixtures x 300 watts/fixture = 2400 watts

Total= 4956 watts

This space is providing appropriate levels of light, but is over the allowed power density. Even using the special allowances for accent lighting, the space is still over the allowed power density by about 750 watts.

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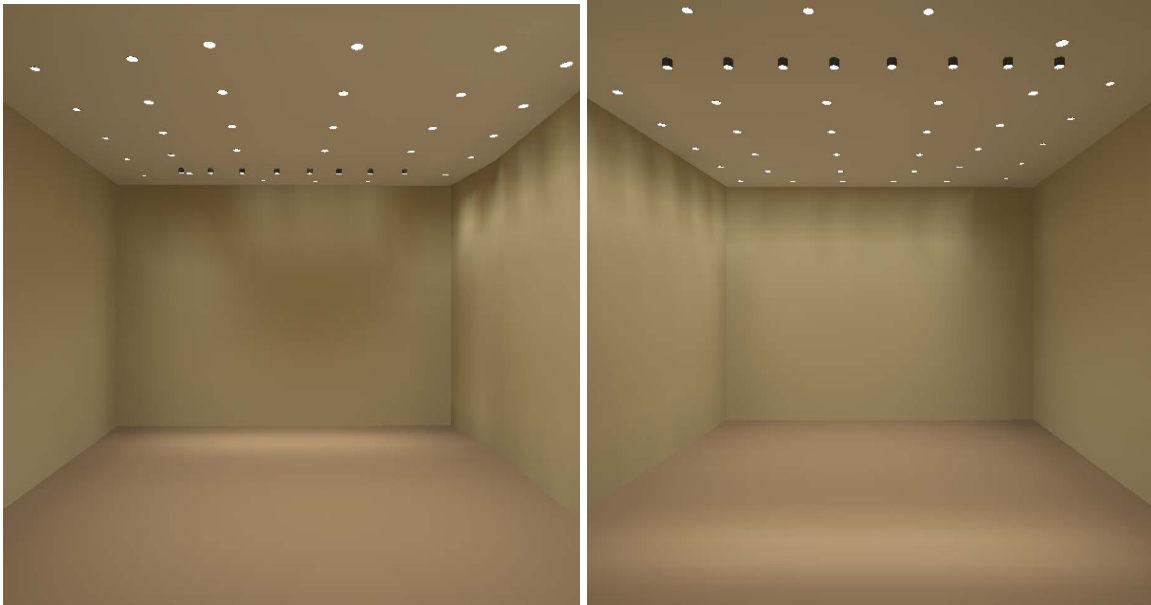


Lecture Hall/Video Conference Room

Calculations and Evaluation of Existing Conditions:

***Rendering:**

*Note: The exact .IES file for the track-mounted spotlights couldn't be found. For rendering purposes, an ERCO equivalent spot light .IES was used.

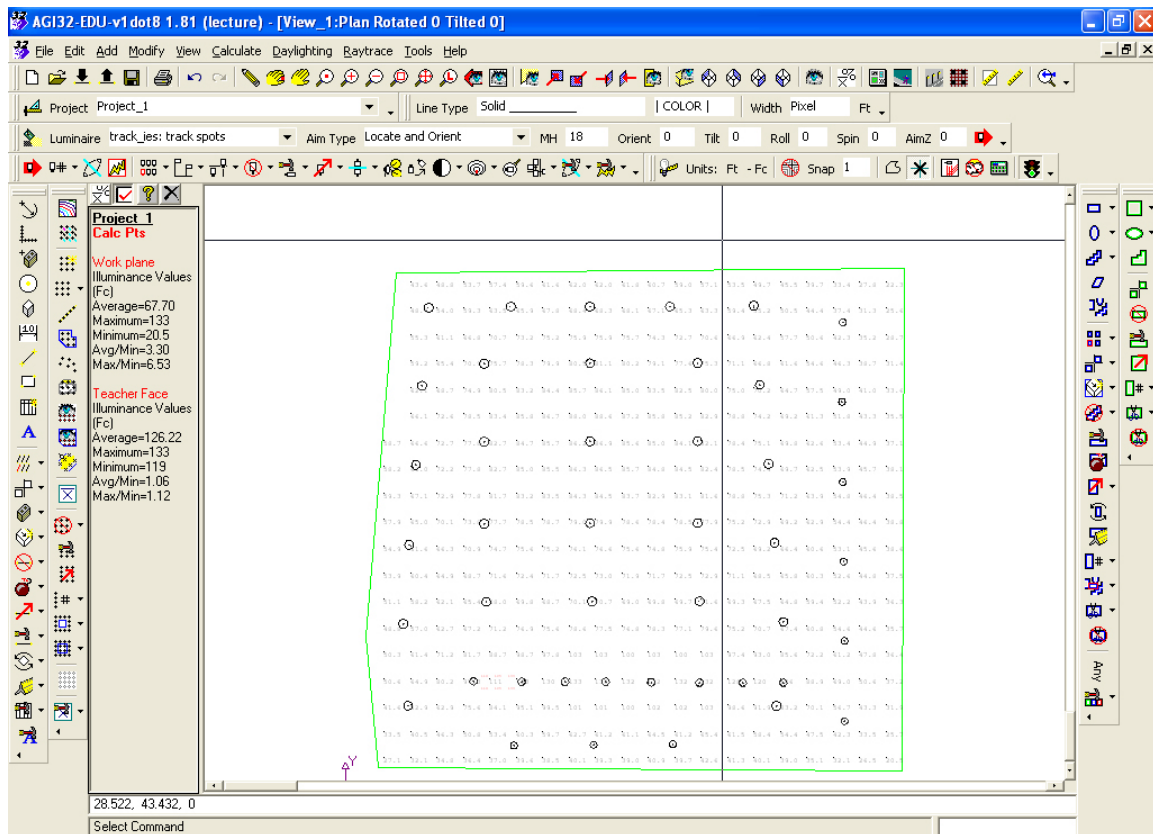


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Lecture Hall/Video Conference Room

Final Evaluation of Existing Conditions:



After observation and calculations, I feel that the lecture hall space/video conferencing room meets the lighting requirements very well. IES criteria requires that 40 FC are provided on the work plane for #2 pencil tasks (highest visual demand), and after calculations, I found that there is 67 FC on the work plane. This value is a little higher than needed, but given the size of the room, I feel students in the rear of the room reading off the board and taking notes justify this extra light. When the teacher has the track-mounted spotlights on them, there is around 126 FCs on them at 5' vertical. While this light is coming from multiple directions (the spots are aimed), this still might cause problems for a camera due to hot spots. This space also exceeds the allowed power density. Taking out 1 or 2 of the track-mounted spots, and possibly going to a lower wattage down light would correct this problem I think.