Hawthorn Building

Penn State Altoona Campus

Altoona, PA

Walter Nichols

Lighting/Electrical Option

Faculty Advisor: Dr. Richard Mistrick

The Hawthorn Building

Building Overview

- **Location:** Altoona, PA
- **Owner:** Penn State University
- **Architect:** WTW Architects of Pittsburgh, PA
- **Engineers:** H.F. Lenz Co. of Johnstown. PA
- **General Contractor/CM:** Lawruk Builders, Inc. of Altoona, PA
- **Size:** 58,800 sq.ft.
- **Project Start:** November 28th, 2003
- **Completion:** January 1st 2004
- **Final Cost:** $6.5 million

The Hawthorn Building
Presentation Outline

- **Lighting Depth**
  - –Pechter Family Music Room
  - – Computer Classroom
- **Mechanical Breadth**
  - - Acoustical study in the Pechter Family Music Room
- **Construction Management Breadth**
  - – Energy efficient lamp analysis and energy savings
- **Acknowledgements**

Topics to be excluded:

Lighting Depth: Auditorium Classroom
Lighting Depth: Main Corridor
Electrical Depth

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Lighting Depth: Pechter Family Music Room

Architectural Characteristics

-10' Ceiling above main practice are suspended from the above 15' ceiling

-2 large windows in the rear of the class provide some daylighting

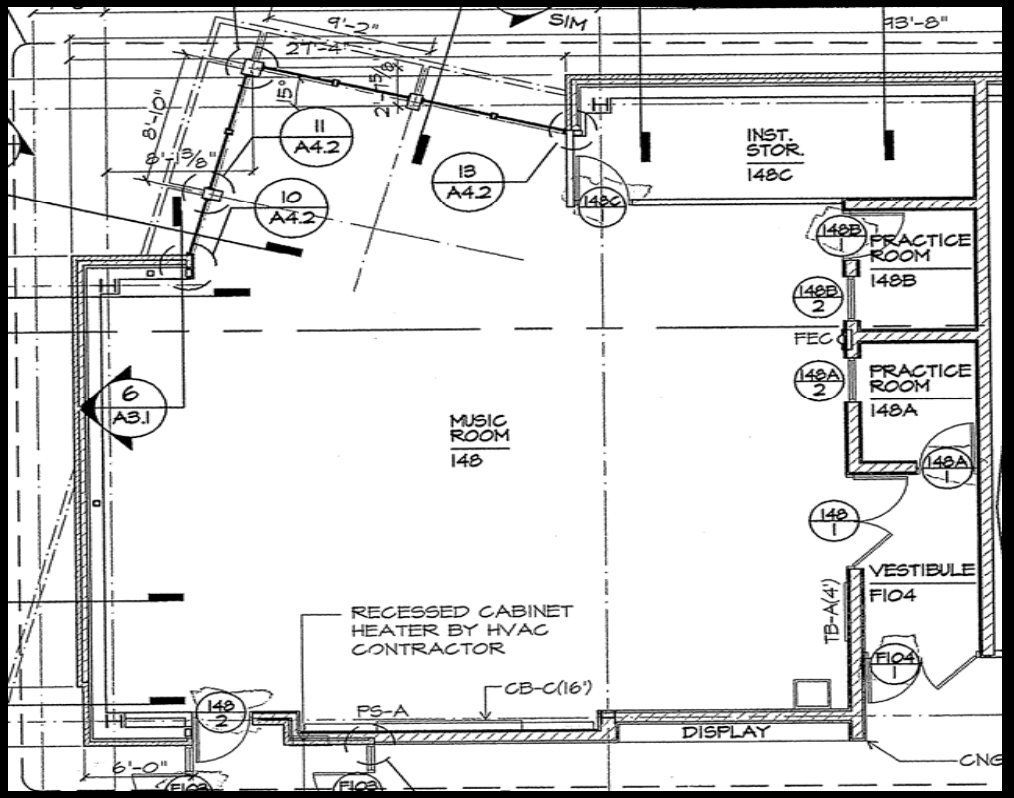
-Acoustical panels on walls as well as acoustical pyramids on 10' ceiling

Design Goals

-Aesthetically pleasing

-50 fc on music stands

-Maintain adequate acoustics for a music room



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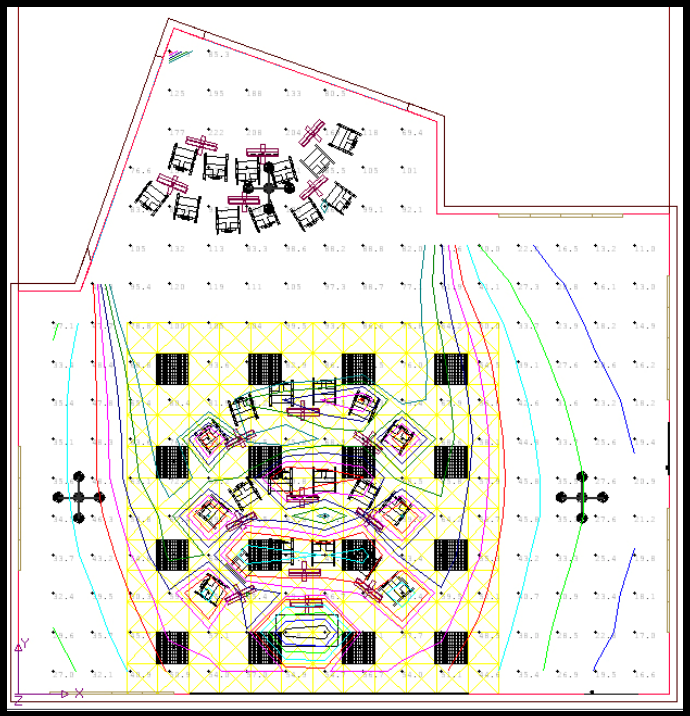
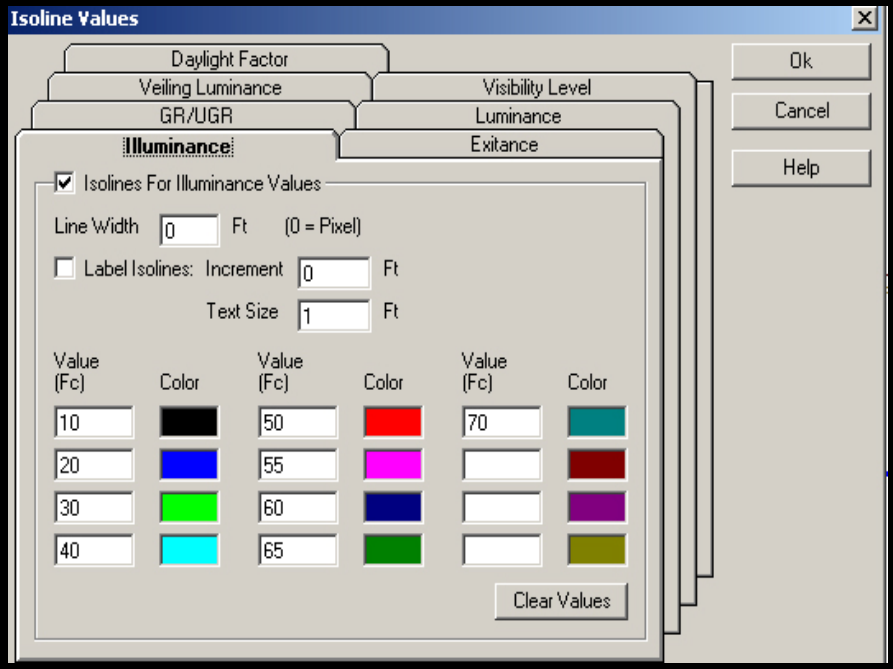
Lighting Depth: Pechter Family Music Room





Type	Description	Lamps	Voltage	Wattage	Ballast	Quantity
B1	2'x2' recessed indirect	(2) 21w T5	277	48	Electric	16
B2	Cloud Pendant	(5) 60w Halogen Quartz	120	300	NA	3

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Lighting Depth: Pechter Family Music Room

Fixtures

Cloud pendant with 5x halogen quartz lamps

2x2 recessed indirect with T5 lamp

Power Density Calculation:

16 2x2 fixtures * 48 watts/fixture = 768 watts @ 277v
3 pendant fixtures * 300 watts/fixture = 900 watts @120v
Power density = 1686 watts / 2250 ft^2 = 0.75 watts/ft^2
Target power density = 1.4-1.6 watts/ft^2
Power density is ok.

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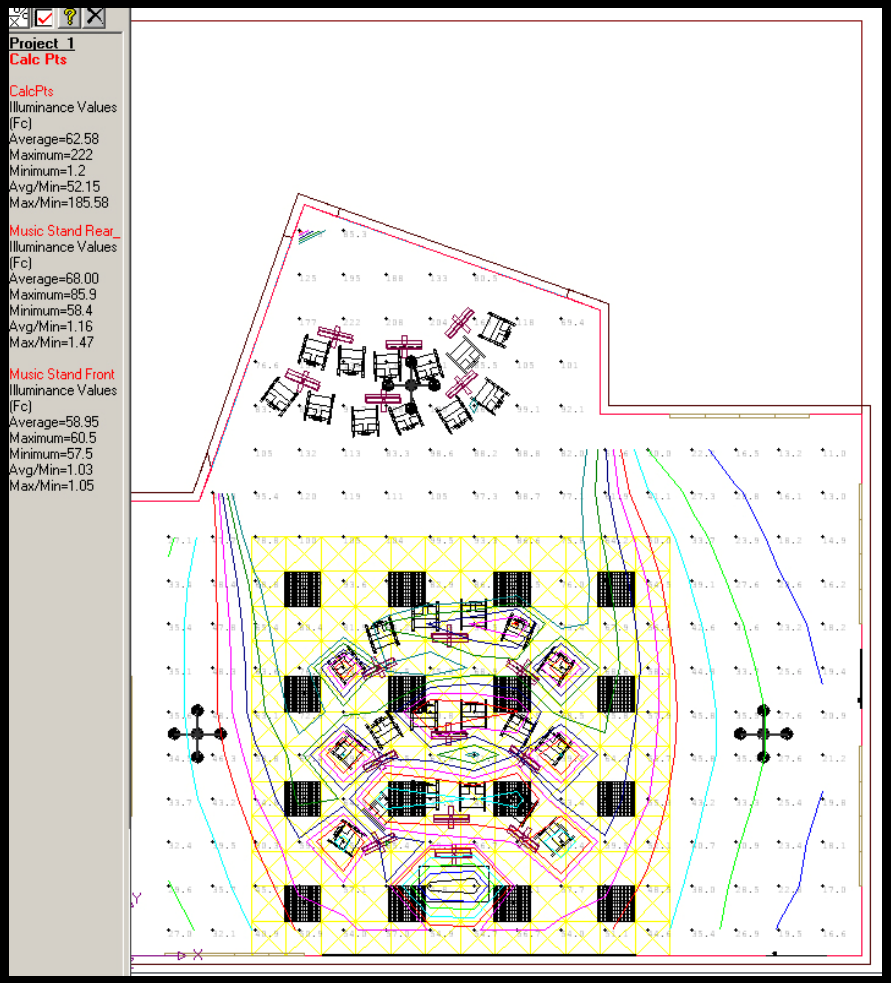
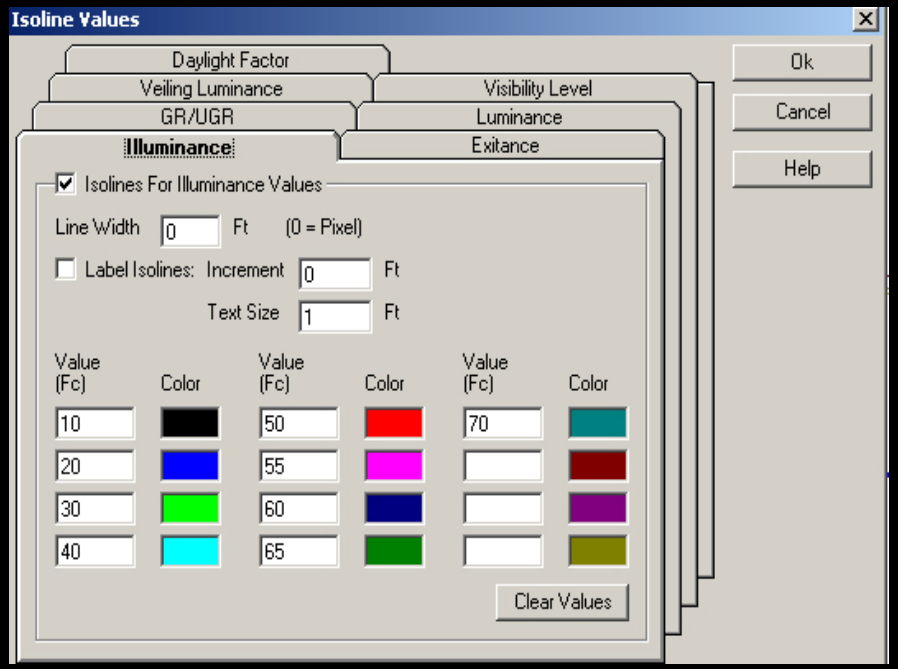
Lighting Depth: Pechter Family Music Room

Lighting Calculation Results (done with AGI32)





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Lighting Depth: Pechter Family Music Room

Final Solution

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- **Lighting Depth**
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Lighting Depth: Computer Classroom

Architectural Characteristics

-15' Ceiling

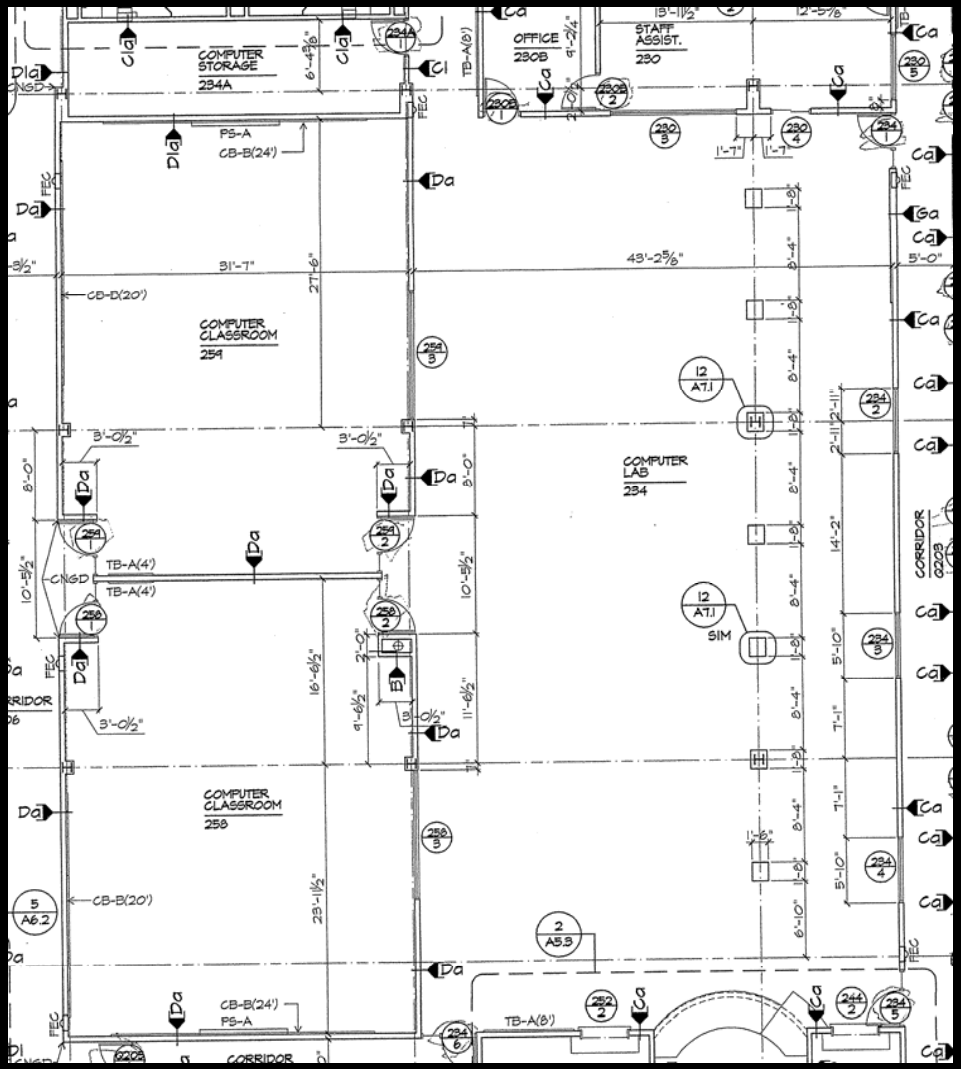
-Laptop computers built into the desks

Design Goals

-Provide 30fc on workplane

-Avoid direct and indirect glare

-Provide dimming controls to allow different lighting levels for different activities and users



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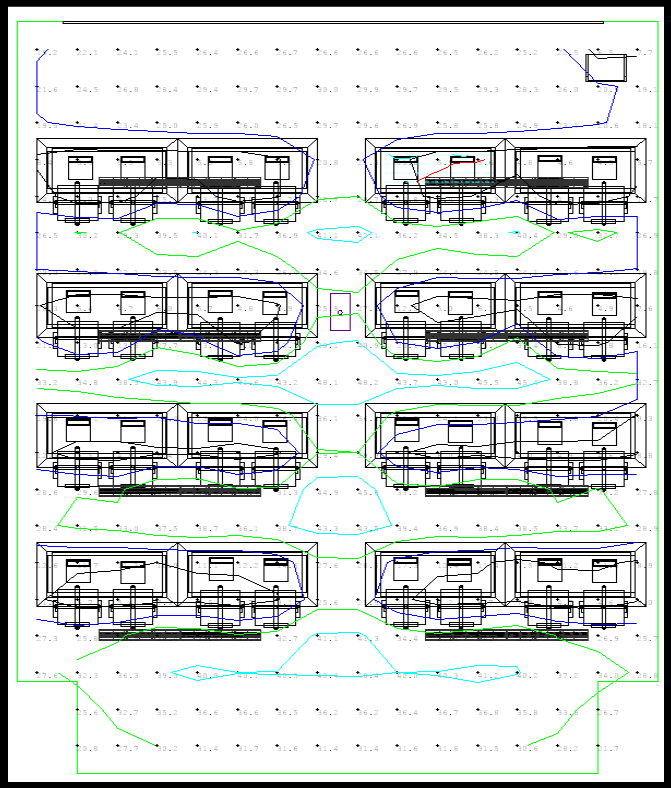
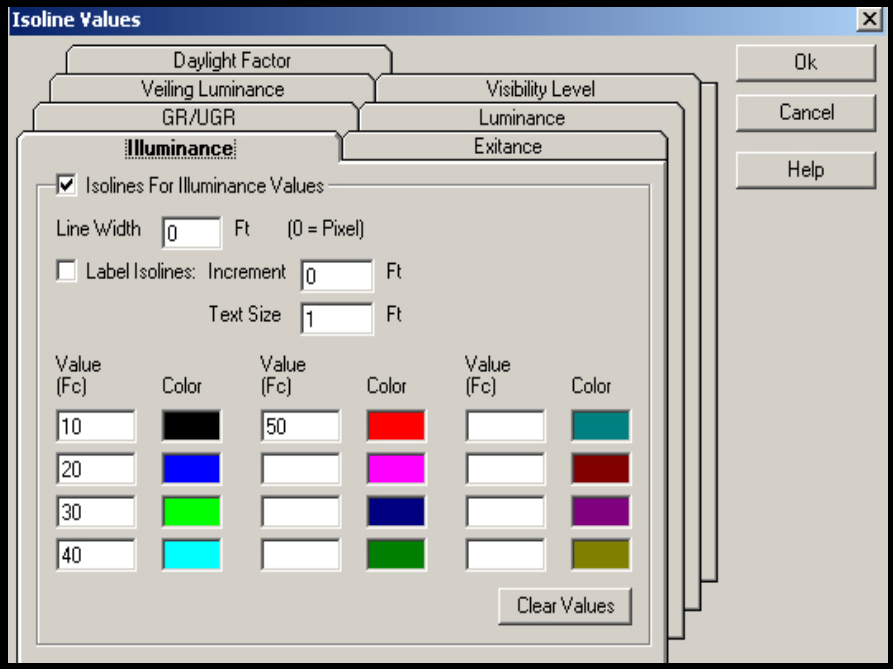
Lighting Depth: Computer Classroom





Type	Description	Lamps	Voltage	Wattage	Ballast	Quantity
D1	Indirect/direct pendant	(2) 54w T5HO	277	118	Dimming	16

The Hawthorn Building

Lighting Depth: Computer Classroom

Fixtures

Indirect suspended pendant with T5HO lamps

Power Density Calculation:

16 indirect * 118 watts/fixture = 1888 watts @ 277v
Power density = 1888 watts / 1280 ft^2 = 1.48 watts/ft^2
Target power density = 1.4-1.6 watts/ft^2
Power density is ok.

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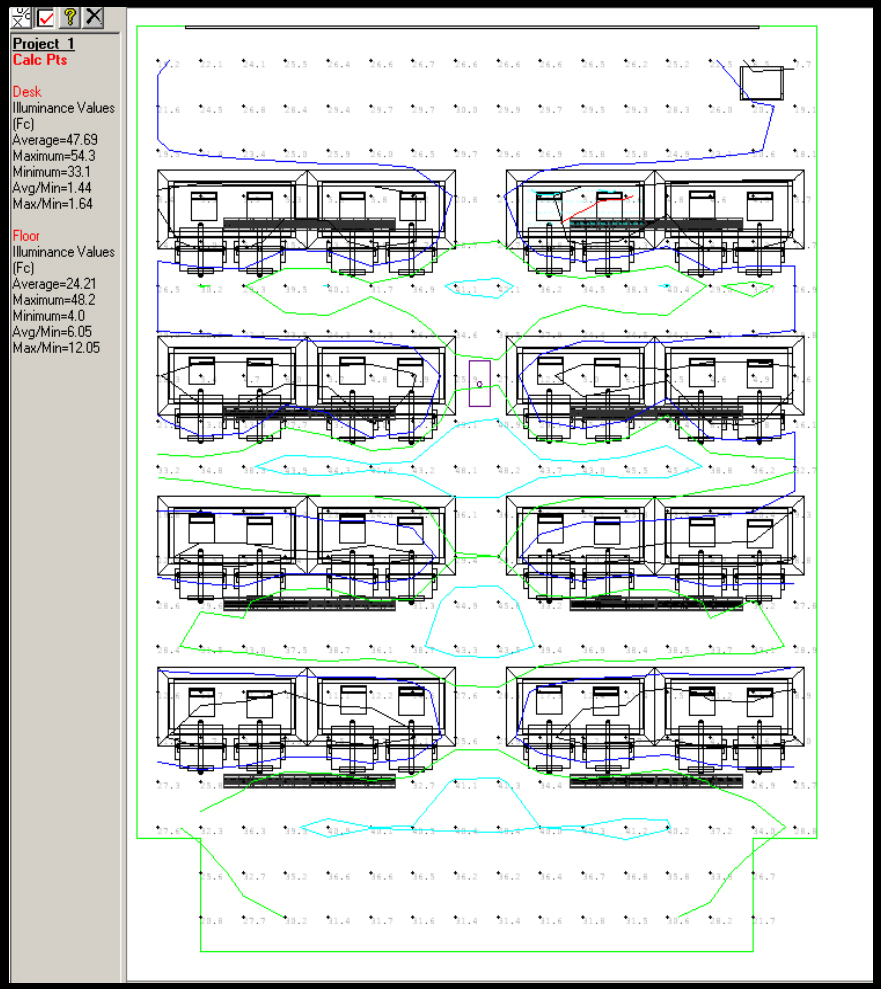
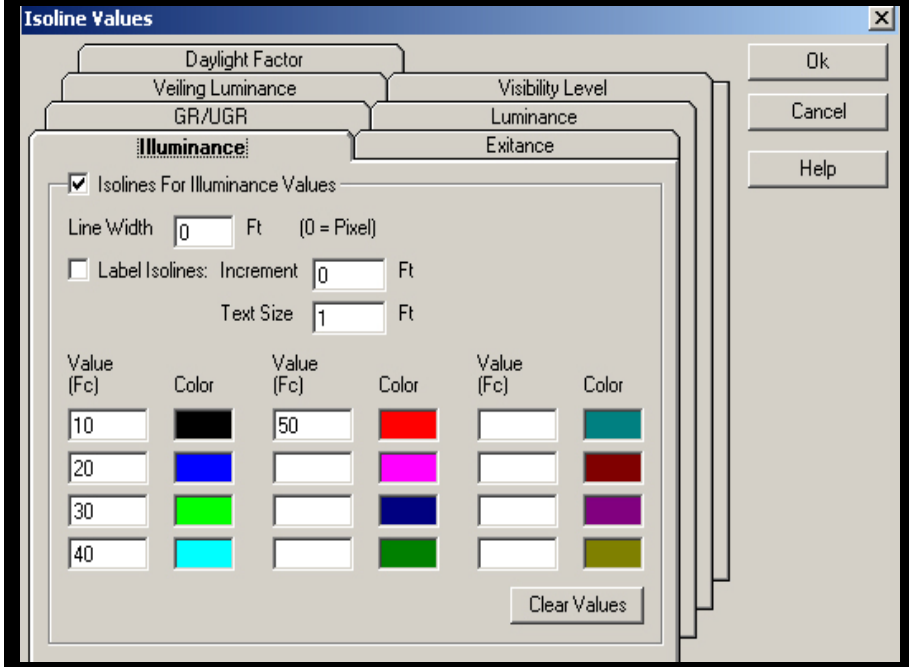
Lighting Depth: Computer Classroom

Lighting Calculation Results (done with AGI32)





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Lighting Depth: Computer Classroom

Final Solution

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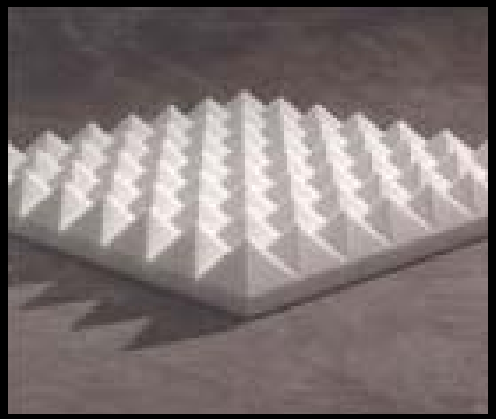
Mechanical Breadth: Acoustical Study

10' Ceiling Pyramid:



FOAM STOP: Sound Absorption / Noise Reduction per ASTM C423-90a							
	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	NRC
2"	0.07	0.25	0.6	0.94	0.97	1.08	0.7
3"	0.18	0.44	0.96	1.14	1.18	1.19	0.95
4"	0.16	0.62	1.1	1.2	1.21	1.22	1.05

Wall Panels:

SOUND ABSORPTION DATA (NRC VALUES)							
	OCTAVE BAND FREQUENCIES (Hz)						
Product	125	250	500	1000	2000	4000	NRC
2" thick	0.05	0.31	0.81	1.01	0.99	0.95	0.8

The Hawthorn Building

Mechanical Breadth: Acoustical Study

Results:

	A	B	C	D	E	F	G	H	I
1	**Walter Nichols**	**Music Room T60 Calcs**							
2									
3				125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
4	Surface	Material	Area (ft^2)	α	α	α	α	α	α
5	10' Ceiling Below	Foam Pyramid 2" thick	512	0.07	0.25	0.6	0.94	0.97	1.08
6	Walls	Gypsum board -1 layer @ 5/8"	1742	0.55	0.14	0.08	0.04	0.12	0.11
7		Painted Foam Panels 2" think	160	0.05	0.31	0.81	1.01	0.99	0.95
8	Windows	Heavy Glass	300	0.18	0.06	0.04	0.03	0.02	0.02
9	Doors	Steel Doors	48	0.05	0.1	0.1	0.1	0.07	0.02
10	Floor	Glazed Tile	1441	0.01	0.01	0.01	0.01	0.02	0.02
11	15' Ceiling	Plaster on Lath	1441	0.14	0.1	0.06	0.05	0.04	0.03
12									
13				125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
14	Surface	Material	Area (ft^2)	Sα	Sα	Sα	Sα	Sα	Sα
15	10' Ceiling Below	Foam Pyramid 2" thick	512	35.84	128	307.2	481.28	496.64	552.96
16	Walls	Gypsum board -1 layer @ 5/8"	1742	958.1	243.88	139.36	69.68	209.04	191.62
17		Painted Foam Panels 2" think	160	8	49.6	129.6	161.6	158.4	152
18	Windows	Heavy Glass	300	54	18	12	9	6	6
19	Doors	Steel Doors	48	2.4	4.8	4.8	4.8	3.36	0.96
20	Floor	Glazed Tile	1441	14.41	14.41	14.41	14.41	28.82	28.82
21	15' Ceiling	Plaster on Lath	1441	201.74	144.1	86.46	72.05	57.64	43.23
22									
23			ΣSα =	1274.49	602.79	693.83	812.82	959.9	975.59
24									
25		Volume (ft^3) =	21615						
26									
27			T60=	0.847986	1.79291	1.55766	1.32963	1.1259	1.107791
28			Ave. T60=	1.293646					

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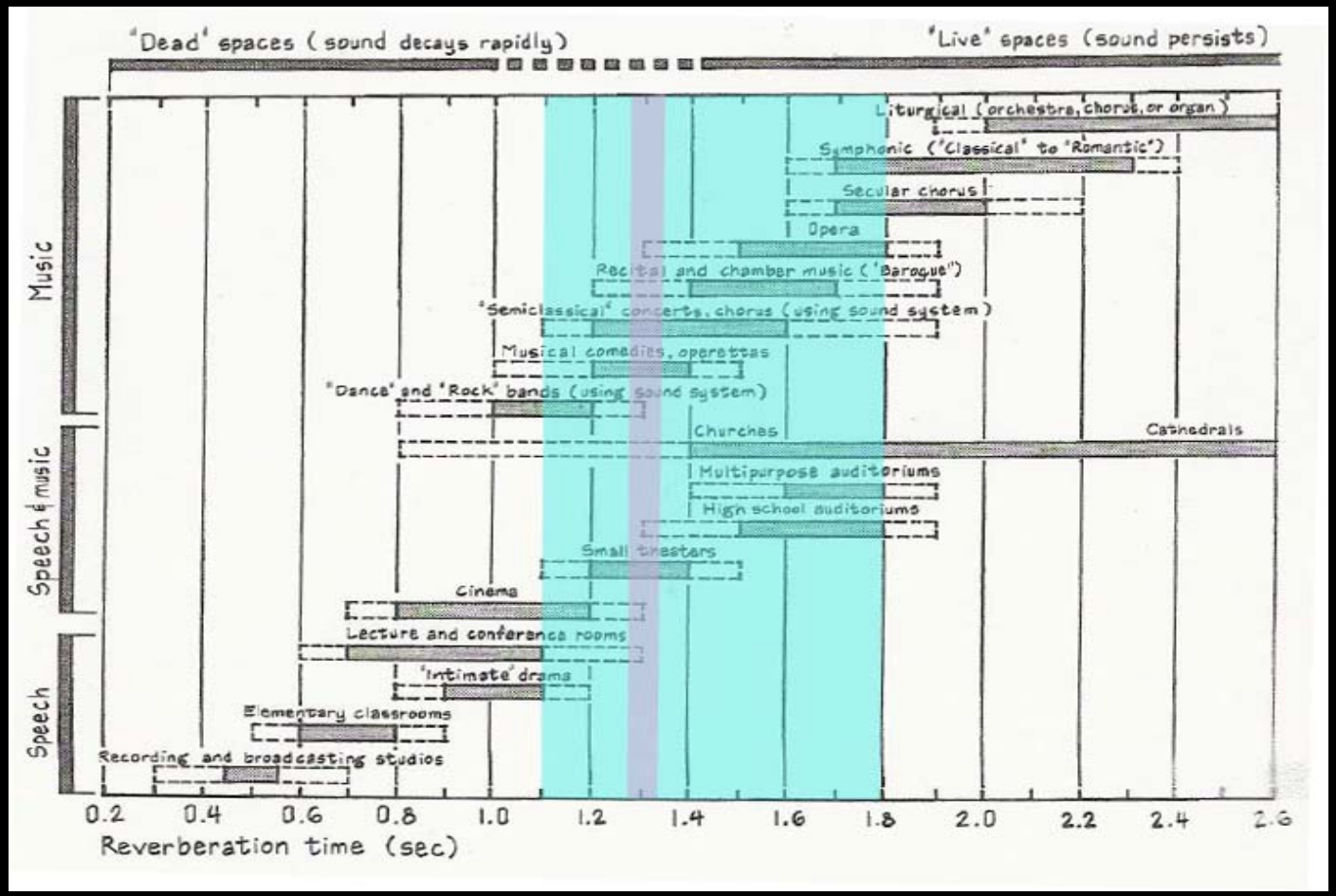
Mechanical Breadth: Acoustical Study

Target vs. Results:



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Construction Management: Economical Lamp Study

	A	B	C	D	E	F
1	**Lamp Comparison**		**Note: All lamps from Philips Lighting unless noted otherwise in lamp description**	**Note: All ballasts taken from Advance Transformer**		
2						
3	**Space**	**Fixture**	**Lamp Description**	**Design Lumens**	**Watts (w/o ballast)**	**Watts (w/ ballast)**
4	Computer Class	Indirect/direct	(1) 54w T5HO	4740	54	62
5		Indirect/direct	(2) 28w T5	5500	56	63
6	Corridor	Wall mount	(1) 28w T5	2750	28	33
7		Wall mount	(1) 34w Cold Cathode (by American Cathode)	2836	34	34
8	Corridor	Downlight	(1) 18w CFT	1100	18	20
9		Downlight	(1) 75w Incan.	1030	75	75
10	Music Room	2x2 indirect	(2) 21w T5	4000	42	48
11		2x2 indirect	(1) 39w T5HO	3320	39	40
12	Music Room	Cloud Pendant	(5) 60w Halogen Quartz	4600	300	300
13		Cloud Pendant	(5) 50w Incan.	4125	250	250
14	Lecture Hall	2x4 Troffer	(2) 32W T8	5420	64	79
15		2x4 Troffer	(2) 32w T8 Ultramax (by GE)	5170	56	71
16		2x4 Troffer	(2) 32w T8 Alto energy advantage (by Philips)	5500	60	75
17	Lecture Hall	Wallwasher	(1) 54w T5HO	4740	54	62
18		Wallwasher	(2) 42w CFT	5440	84	91
19	Lecture Hall	Spot	(1) 150w Incan.	2850	150	150
20		Spot	(1) 120w Par38	1200	120	120
21						
22	**Space**	**Fixture**	**Lamp Type**	**Watts Saved per lum.**	**# of Lums.**	**Total Watts Saved**
23	Computer Class	Indirect/direct	(1) 54w T5HO	1	16	16
24		Indirect/direct	(2) 28w T5			
25	Corridor	Wall mount	(1) 28w T5	1	27	27
26		Wall mount	(1) 34w Cold Cathode			
27	Corridor	Downlight	(1) 18w CFT	55	18	990
28		Downlight	(1) 75w Incan.			
29	Music Room	2x2 indirect	(2) 21w T5			
30		2x2 indirect	(1) 39w T5HO	8	16	128
31	Music Room	Cloud Pendant	(5) 60w Halogen Quartz			
32		Cloud Pendant	(5) 50w Incan.	50	3	150
33	Lecture Hall	2x4 Troffer	(2) 32W T8			
34		2x4 Troffer	(2) 32w T8 Ultramax (by GE)	8	16	128
35		2x4 Troffer	(2) 32w T8 Alto energy advantage (by Philips)			
36	Lecture Hall	Wallwasher	(1) 54w T5HO	29	13	377
37		Wallwasher	(2) 42w CFT			
38	Lecture Hall	Spot	(1) 150w Incan.			
39		Spot	(1) 120w Par38	30	2	60
40					**Total Kwatts =**	**1.876**
41						
42			**Building use in hours/year =**	**2376**	**(KW*hours)/year =**	**4457.376**
43			**Building rate plan = $0.06/kwh**			
44			**Total savings/year =**	**267.44256**		

Acknowledgements

Professionals
- WTW Architects of Pittsburgh, PA
- H.F. Lenz Co. of Johnstown. PA
- Rich Wareham at OPP Altoona

Faculty
- Prof. Mistrick
- Prof. Moeck
- Prof. Parfitt
- Prof. Burroughs

Peers
- Family
- Friends
- All AE's, especially the L/E option AEs

Questions?

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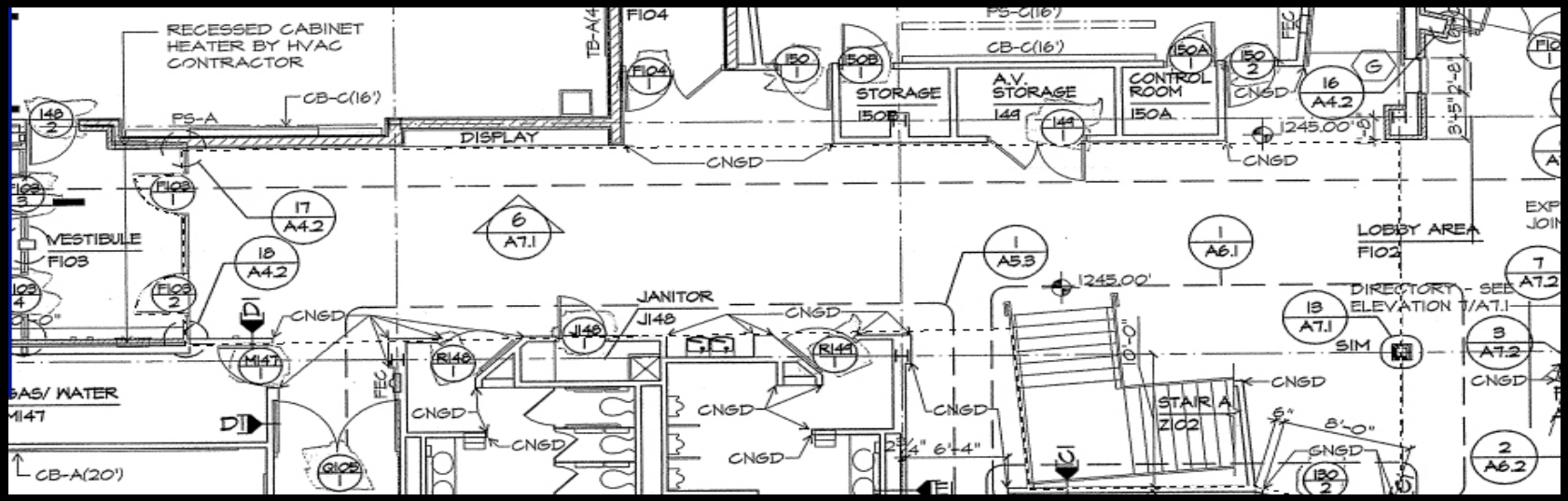
Lighting Depth: Main Corridor

Architectural Characteristics

- 10' Ceilings
- Double heighted ceiling at stairs
- Small day lighting contribution on stairs from lounge windows
- Elaborate tile pattern on floor

Design Goals

- Light ceiling and walls to make space seem larger and inviting
- Provide easy facial recognition
- Accent the floor tile patterns



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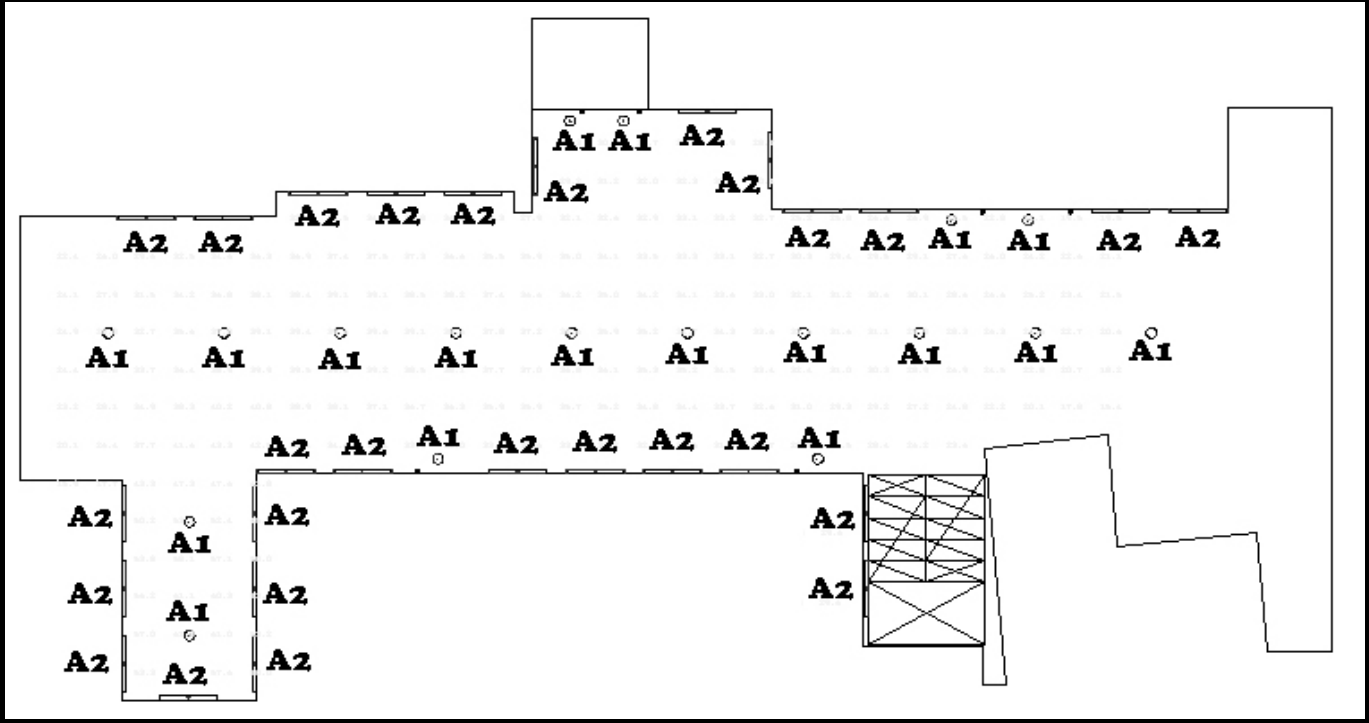
Lighting Depth: Main Corridor

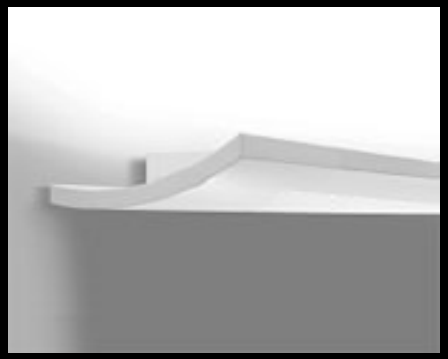


Type	Description	Lamps	Voltage	Wattage	Ballast	Quantity
A1	Downlight	(1) 18w CFT	277	20	Electric	18
A2	Wall mounted fixture	(1) 28w T5	277	33	Electric	27

The Hawthorn Building
Lighting Depth: Main Corridor

Fixtures

6" open downlight with CFT triple tube



Perforated wall mount with 4' T5 lamp

Power Density Calculation:

27 wall mount fixtures * 33 watts/fixture = 891 watts @ 277v
18 downlight fixtures * 20 watts/fixture = 360 watts @ 277v
Power density = 2050 watts / 1400 ft^2 = 1.46 watts/ft^2
Target power density = 0.5-1.6 watts/ft^2
Power density is ok.

The Hawthorn Building
Lighting Depth: Main Corridor

Lighting Calculation Results (done with AGI32)

At 0' (floor)

Calc Points - Floor
Illuminance Values (Fc)
Average=32.46
Maximum=58.3
Minimum=13.7
Avg/Min=2.37
Max/Min=4.26

At 5.5' (face)

CalcPts - Face
Illuminance Values (Fc)
Average=32.93
Maximum=96.5
Minimum=0.6
Avg/Min=54.88
Max/Min=160.83

At 10' (ceiling)

CalcPts - Ceiling
Illuminance Values (Fc)
Average=40.40
Maximum=960
Minimum=0.3
Avg/Min=134.67
Max/Min=3201