Lighting Redesign

George Mason University
Art & Visual Technology Building

Allen Walker
Lighting/Electrical Option
Senior Thesis 2008

Advisors: Dr. Mistrick
Professor Dannerth

Presentation Outline

Building Overview

Lighting Depth

- Main Entrance Courtyard
- Painting Studio
- Entry Lobby
- Exhibit Gallery

Electrical Depth

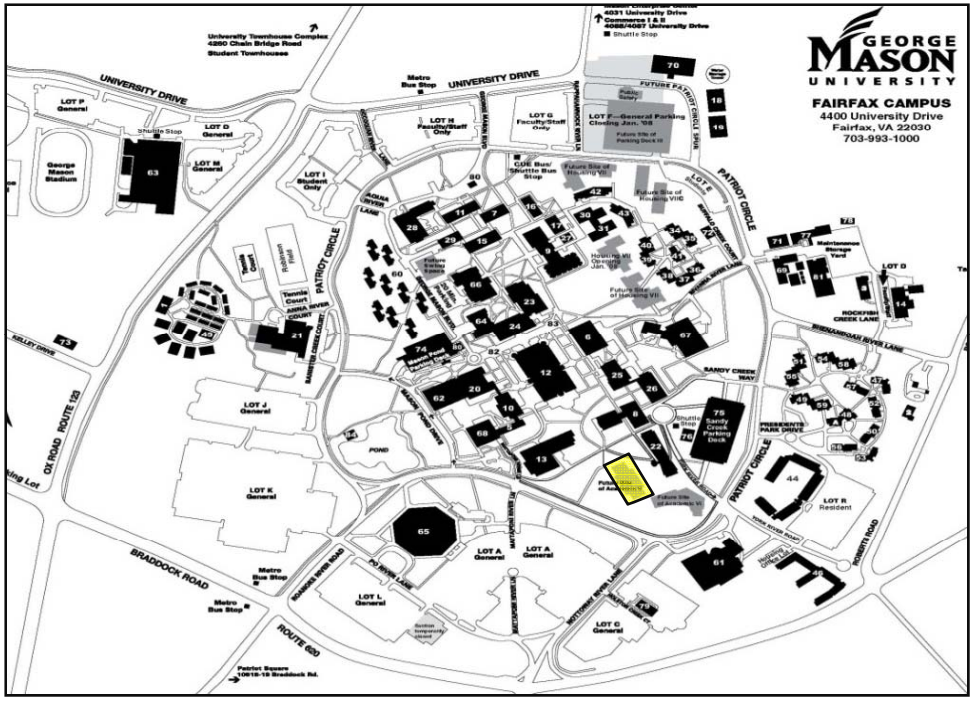
- Phot0voltaic Array
- Energy Efficient Transformers

Structural Breadth

Acoustical Breadth

Conclusions

*Topics not covered in this presentation



Building Overview

Location: Fairfax, VA

Size: 88,902 ft^2

Cost: $20.5 million

Function: To house the Art & Visual Technology department whose curriculum spans from metal working to sculpting to painting. The building will also feature an exhibit gallery to host student and professional collections and also provide space for general education

Scheduled to open in 2009

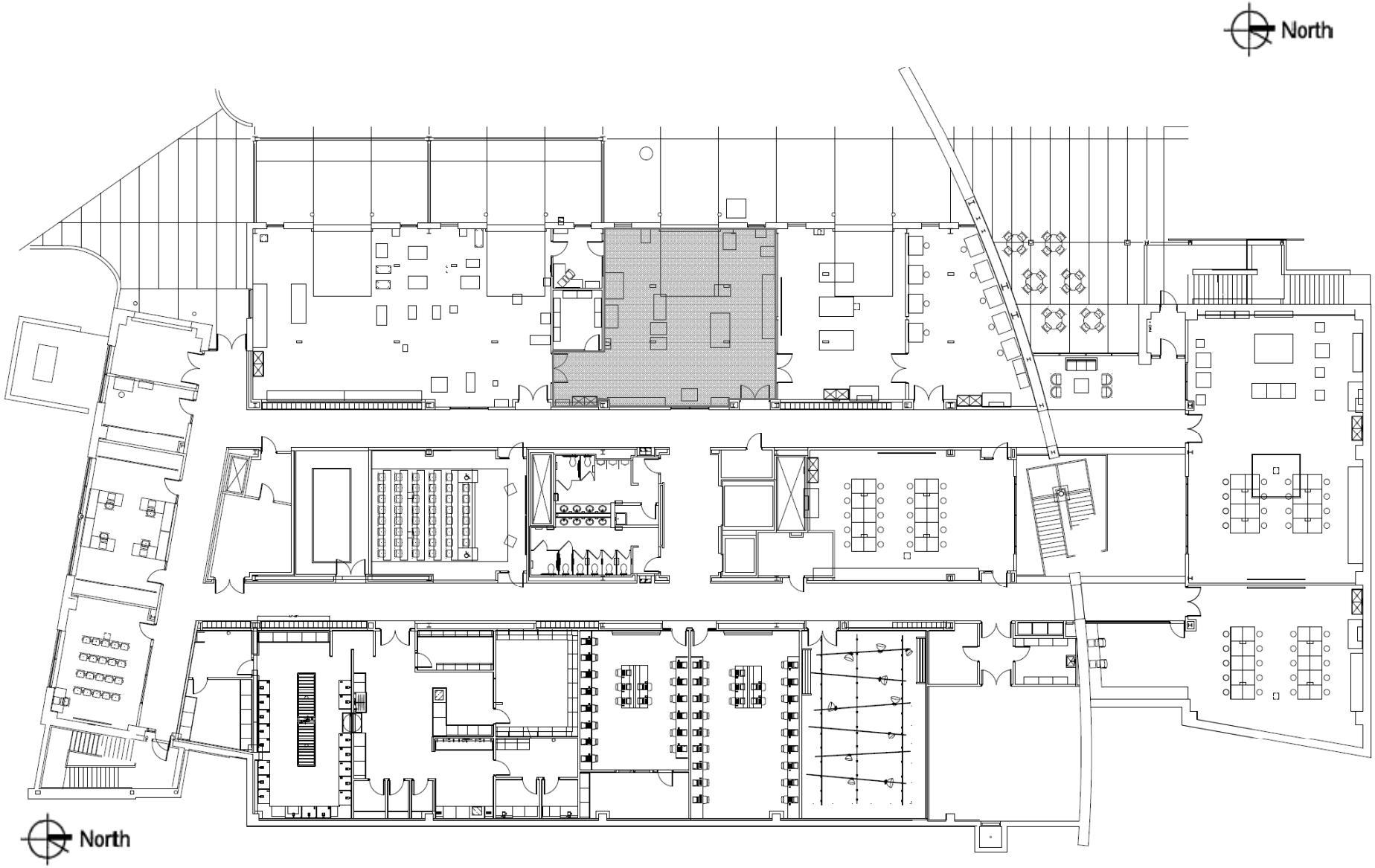
About the Art & Visual Technology Department

"The Department of Art and Visual Technology's primary purpose is to foster the conceptual and technical education of the artist in a highly professional and studio-oriented environment. Believing that the artist's success is dependent on both creative vision and technical expertise, the Department encourages excellence, critical inquiry, and experimentation."

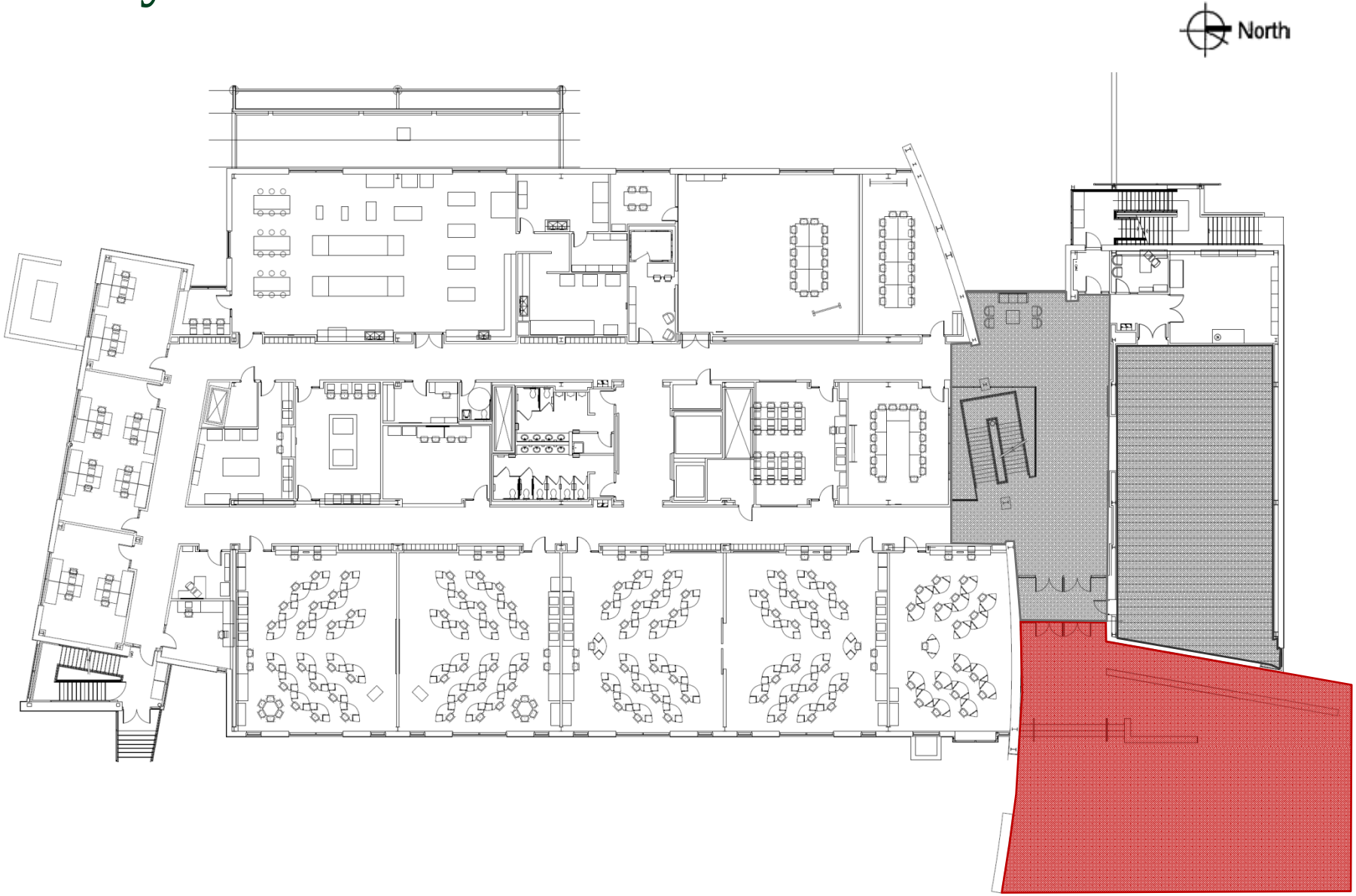
- Harold Linton, Chair
Department of Art and Visual Technology

-24 full-time & 25 part-time faculty. 550 students

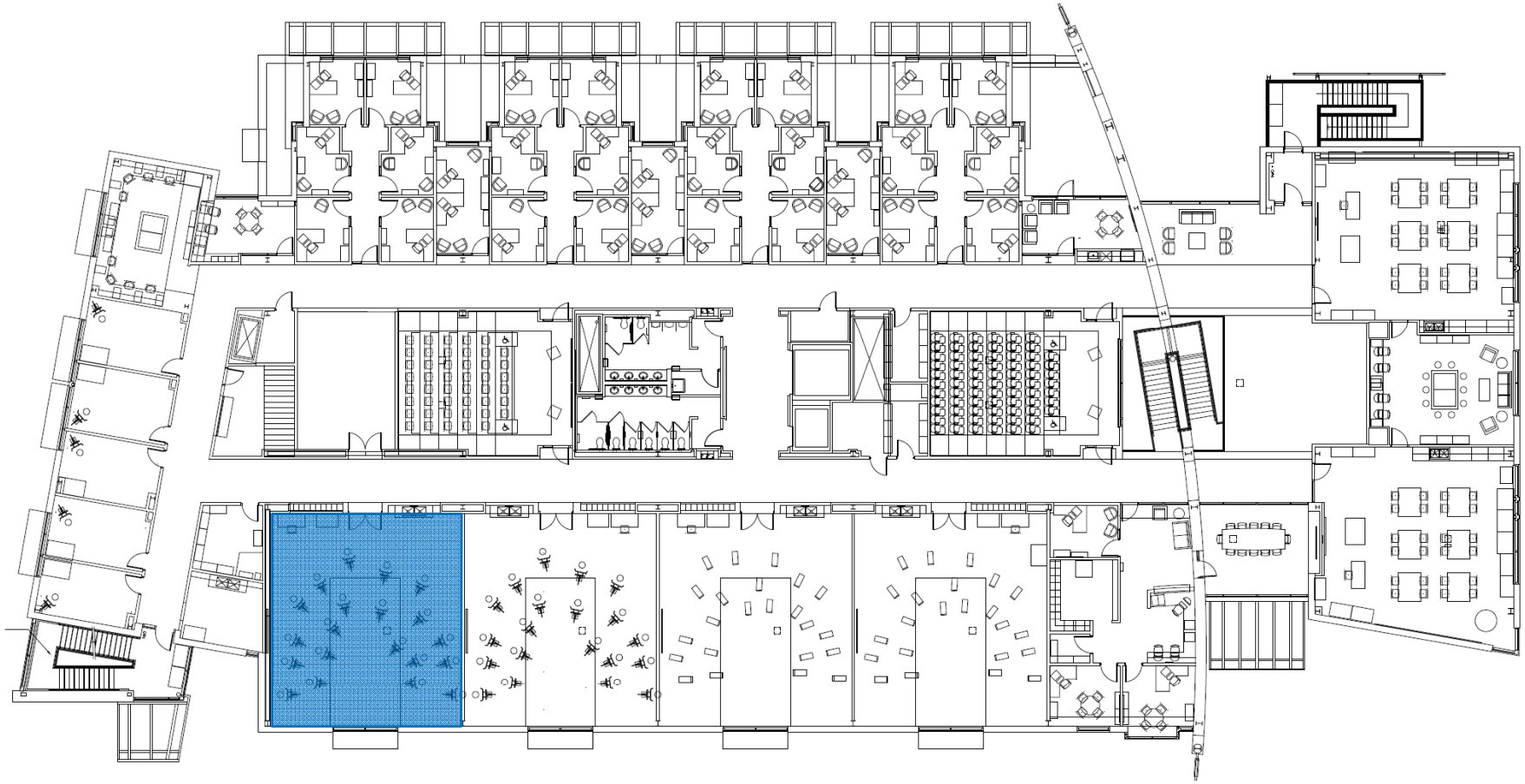
Lower Level Floor Plan



Entry Level Floor Plan



Upper Level Floor Plan



Lighting Depth

Main Entrance Courtyard

Design Goals

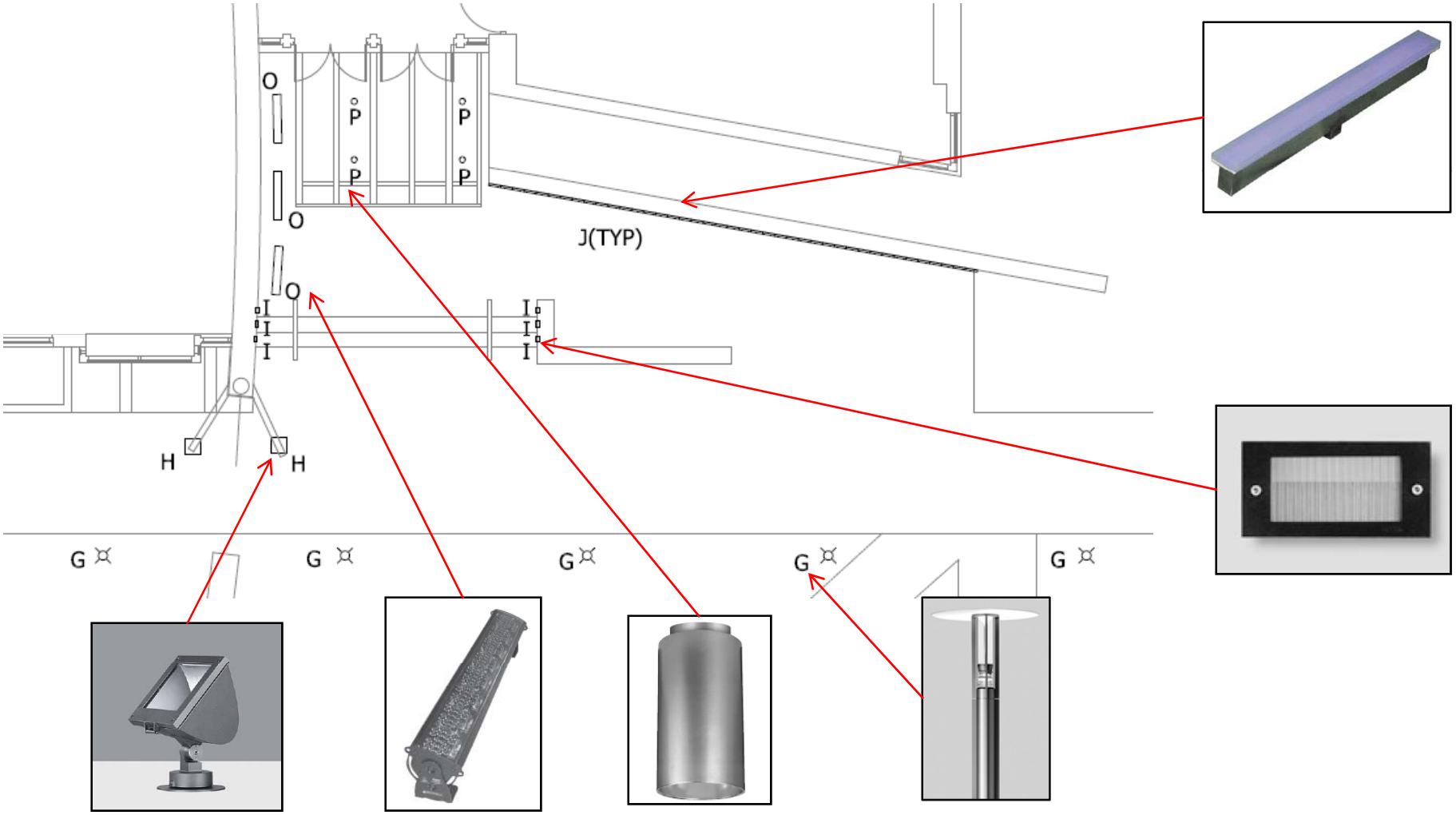
Create a sense of space and identity for the building and department

Highlight department logo on ornamental banner

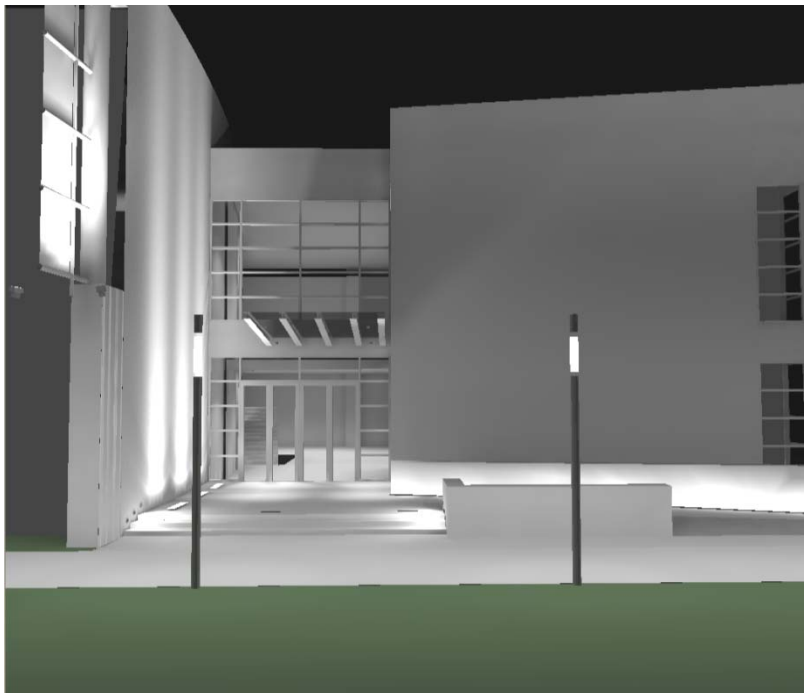
Assist in way finding

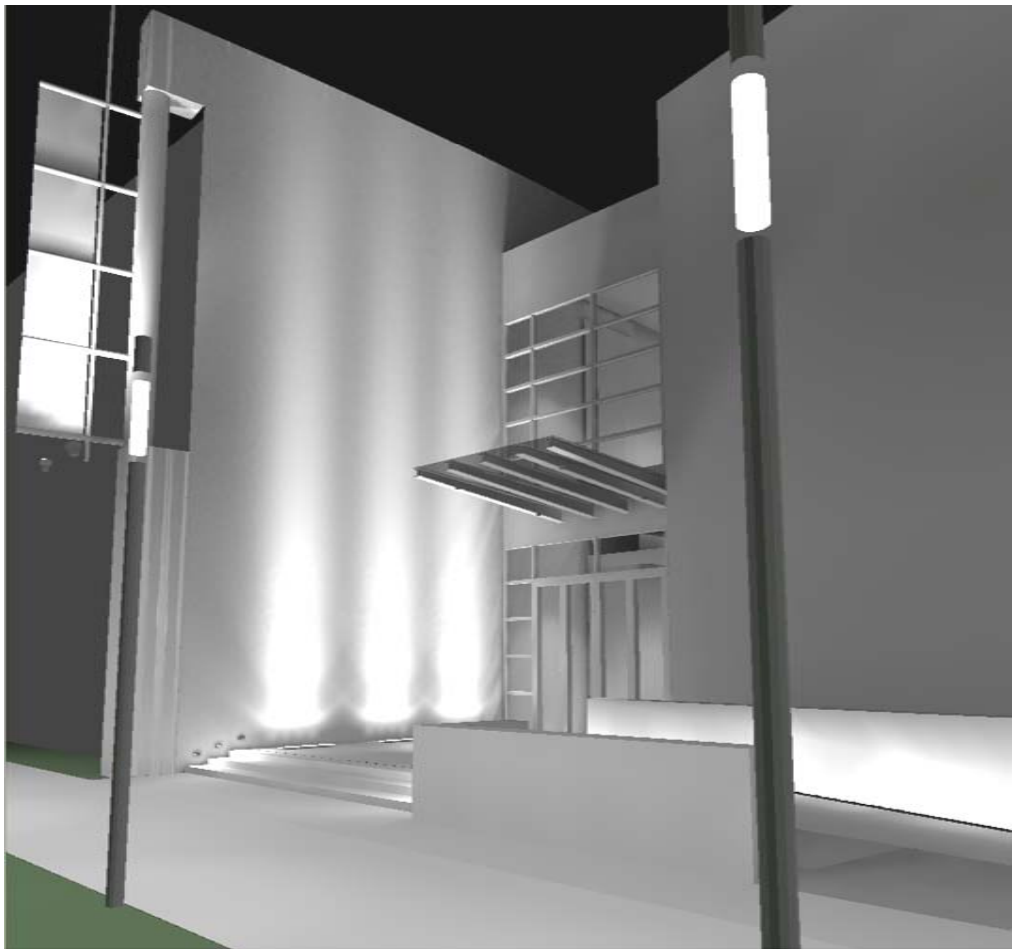
Main Entrance Courtyard

Lighting Layout

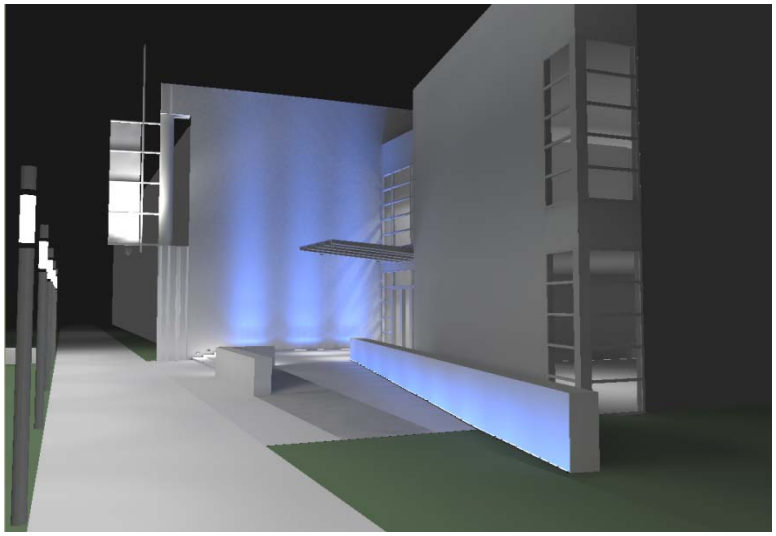


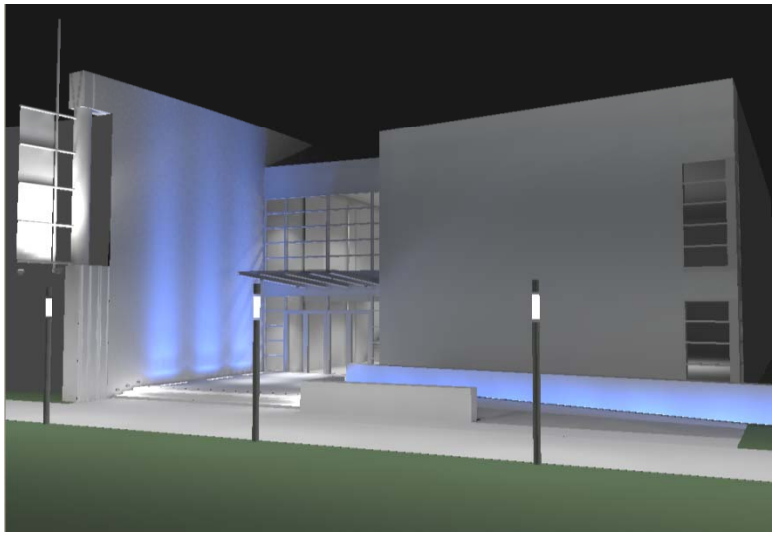
Main Entrance Courtyard

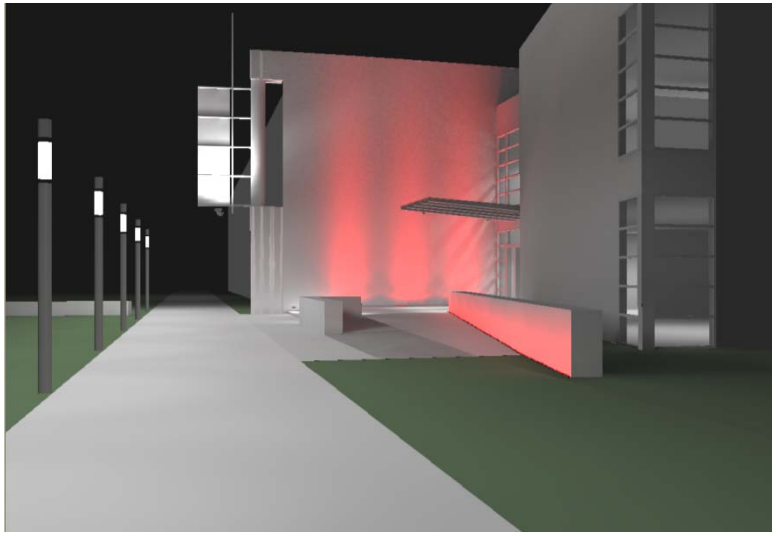




Main Entrance Courtyard







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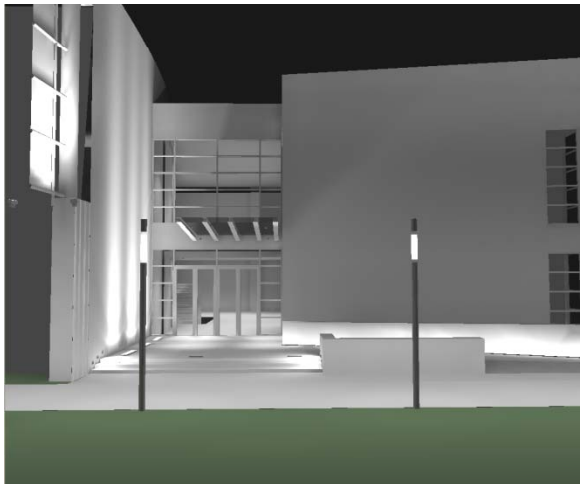
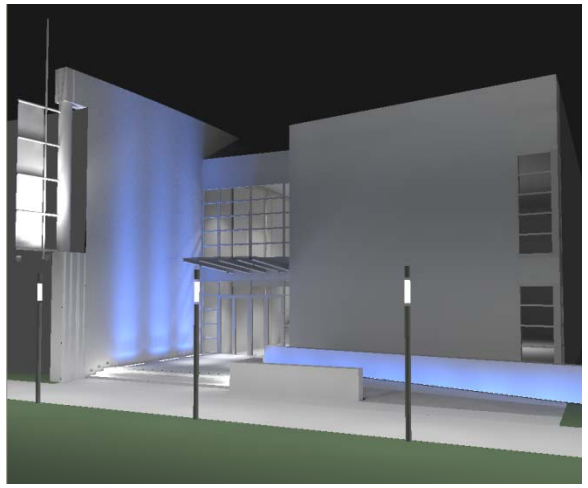
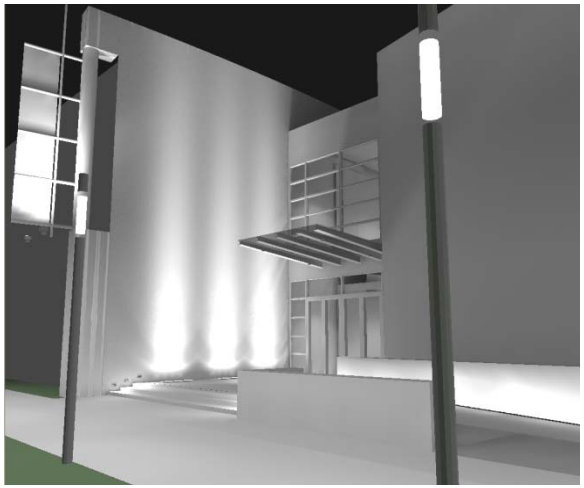
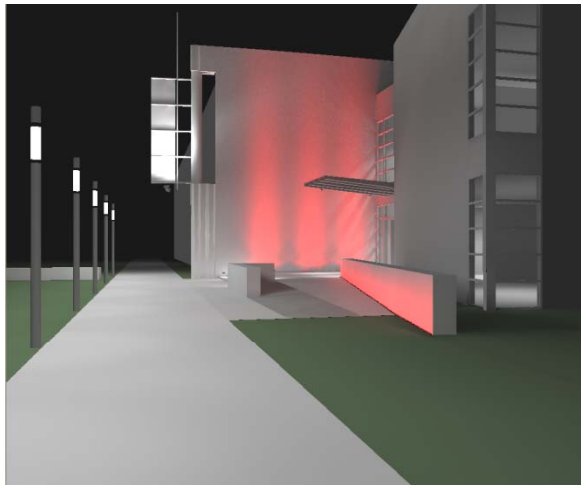
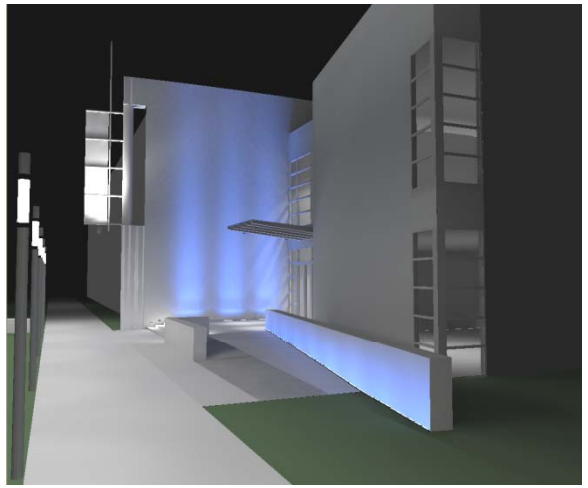


Main Entrance Courtyard

Summary

Use of LED fixtures creates a sense of place for the department and building while providing a visual cue to the entrance of the building

Illuminance levels

Pedestrian walkway

Avg. 1.7 fc (0.5 fc target)

Building Entrance

Avg. 2.9 fc (3 fc target)

ASHRAE 90.1

1866W used > 1641W allowed

Painting Studio

Design Goals

Create a flexible lighting design that integrates high quality daylight with the electric lighting

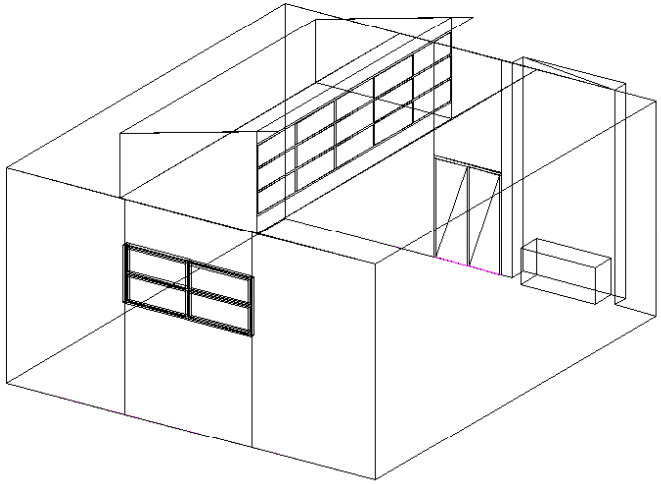
Allow the ability to give occupants of the space to create a multitude of appearances to the object being painted

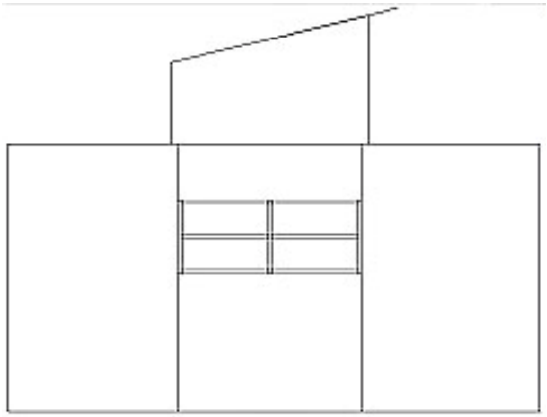
Utilize daylight to decrease the dependence on electric lighting

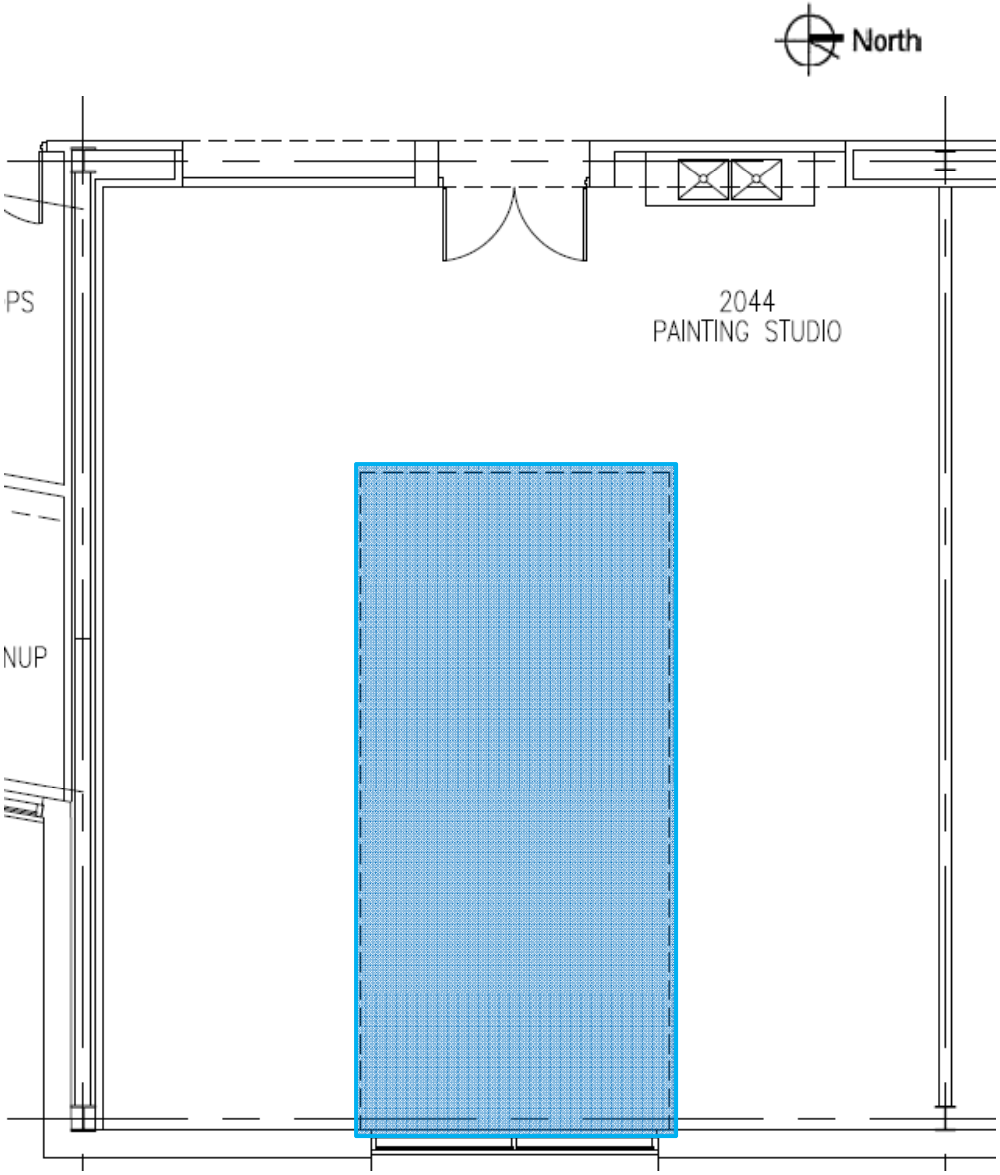
Provide high uniform light levels on the work surface (easels)

Painting Studio

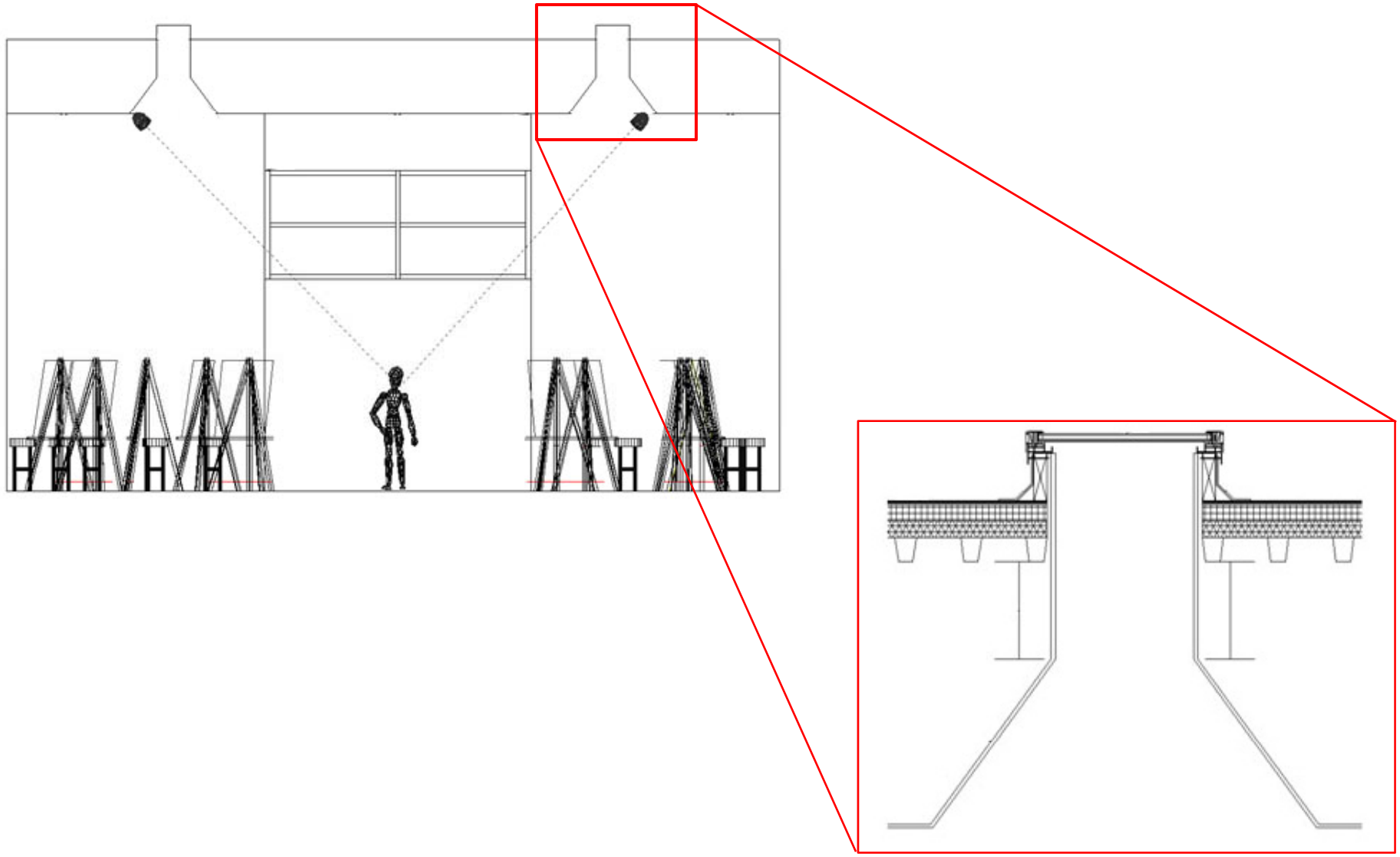
Existing Conditions





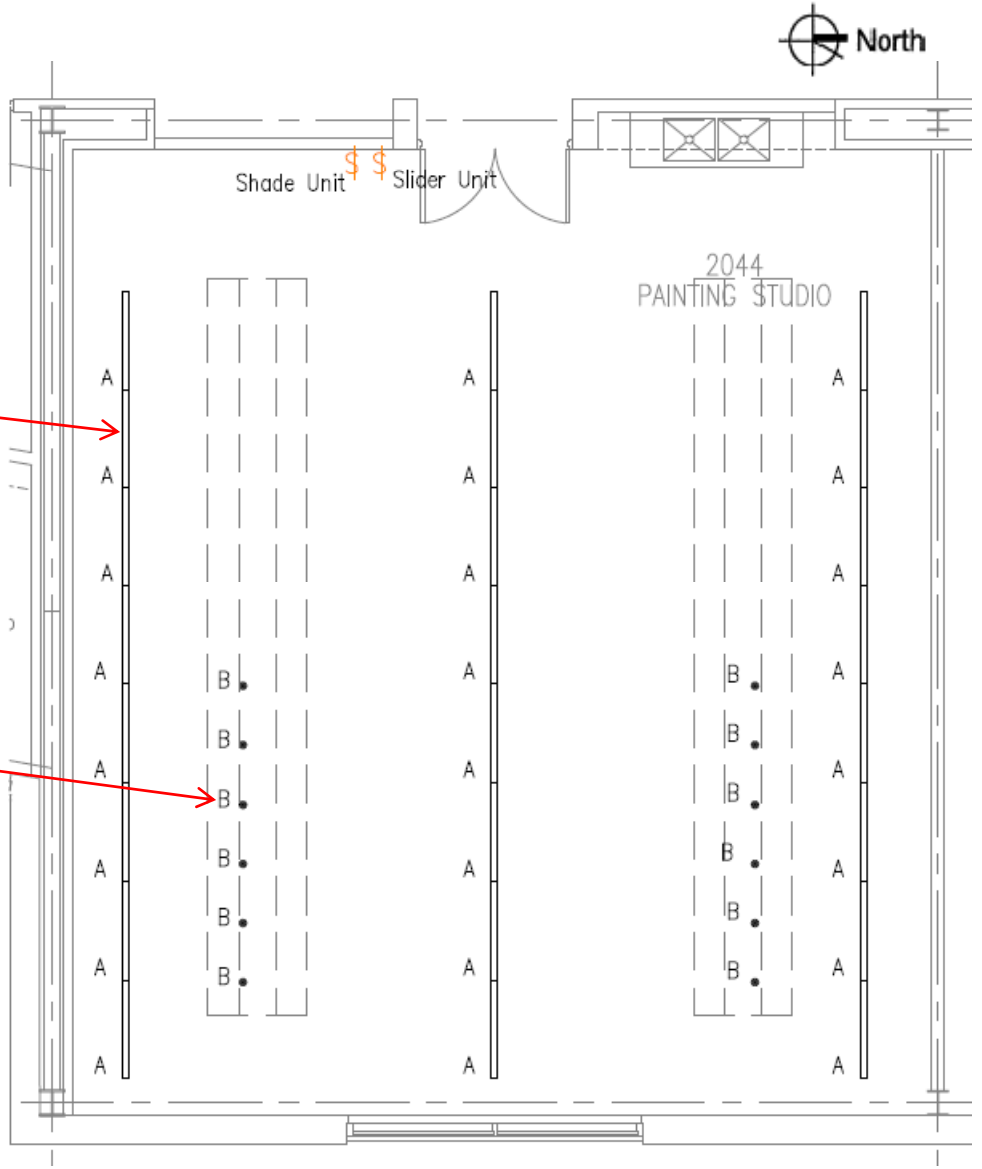


Painting Studio



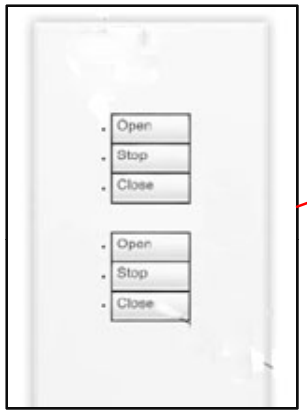
Painting Studio

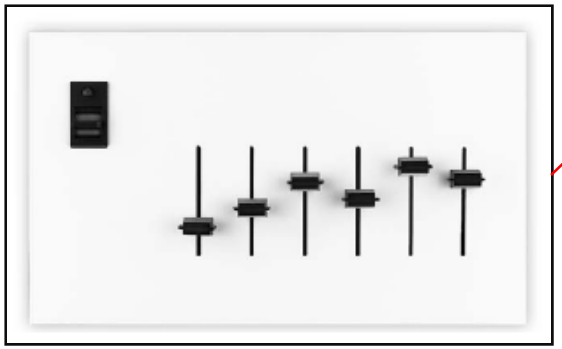
Lighting Layout



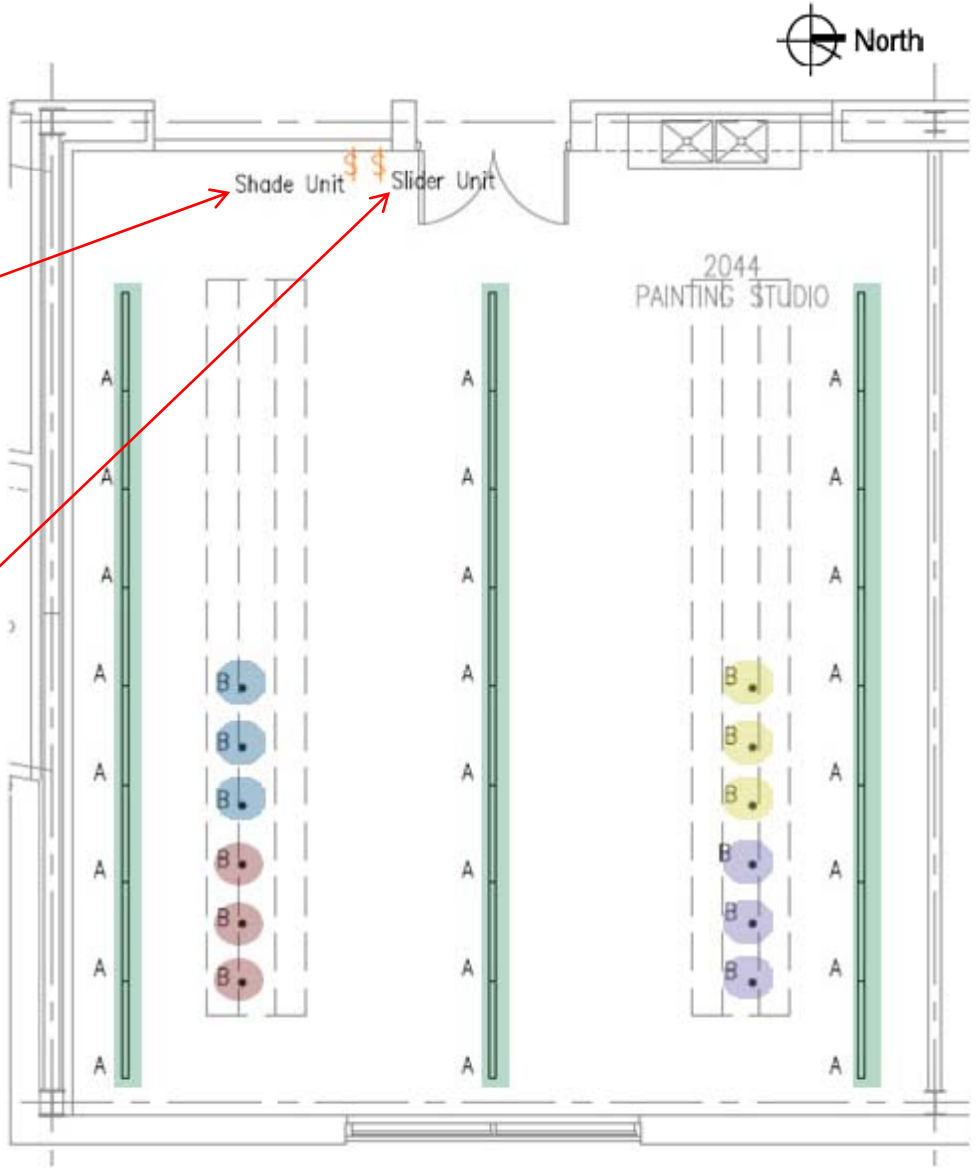
Painting Studio

Control Scheme





Zone 1
Zone 2
Zone 3
Zone 4
Zone 5



Painting Studio

Painting Studio

May 5th 11:00am

Daylight Study (SkyCalc)

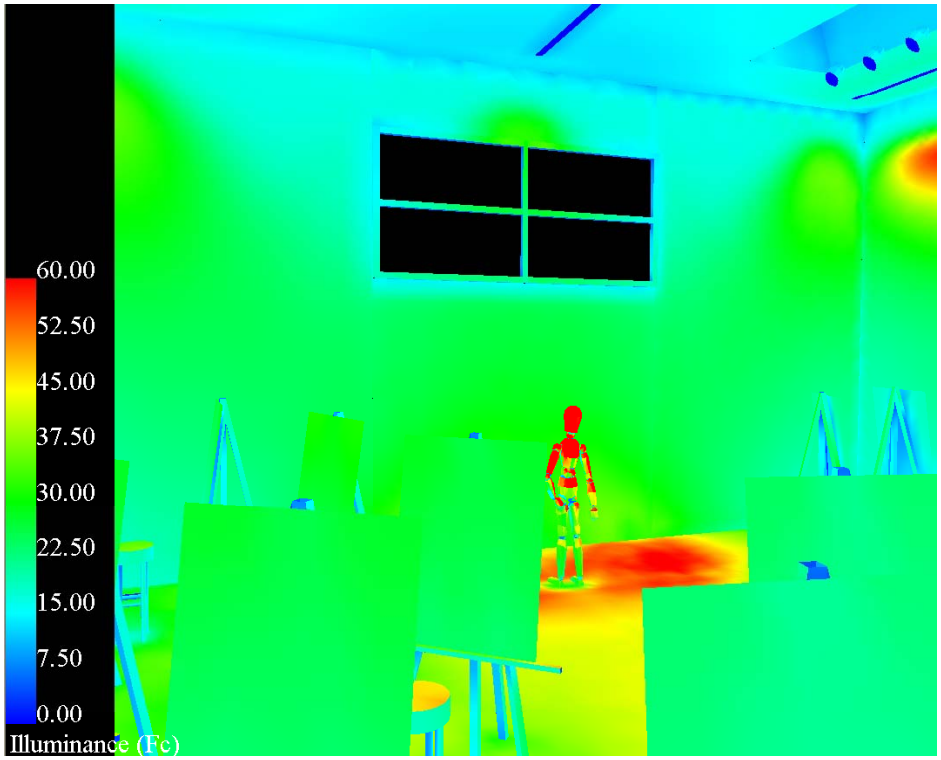
Diffuse skylight glazing assembly
- Visible Transmittance 34%
- U-Value 0.2
- SHGC 0.32

2,500 kWh/yr saved per room

10,000kWh/yr total savings

30% decrease in electric light needed

Painting Studio



Summary

High quality of daylight achieved through implementation of skylight system

Control system allows for complete control over the appearance of the space

Illuminance levels

Avg. 25-30 fc on easel (30fc target)

ASHRAE 90.1

2,088W used <2,124 W permitted

Electrical Depth

Photovoltaic Array Study

Design Goals

Establish the effectiveness of a photovoltaic array in Fairfax, VA

To determine the cost feasibility of the installation of a photovoltaic array on the roof of the A&VT building.

Photovoltaic Array Study

Design Parameters

Product analyzed
170W monocrystalline PV module

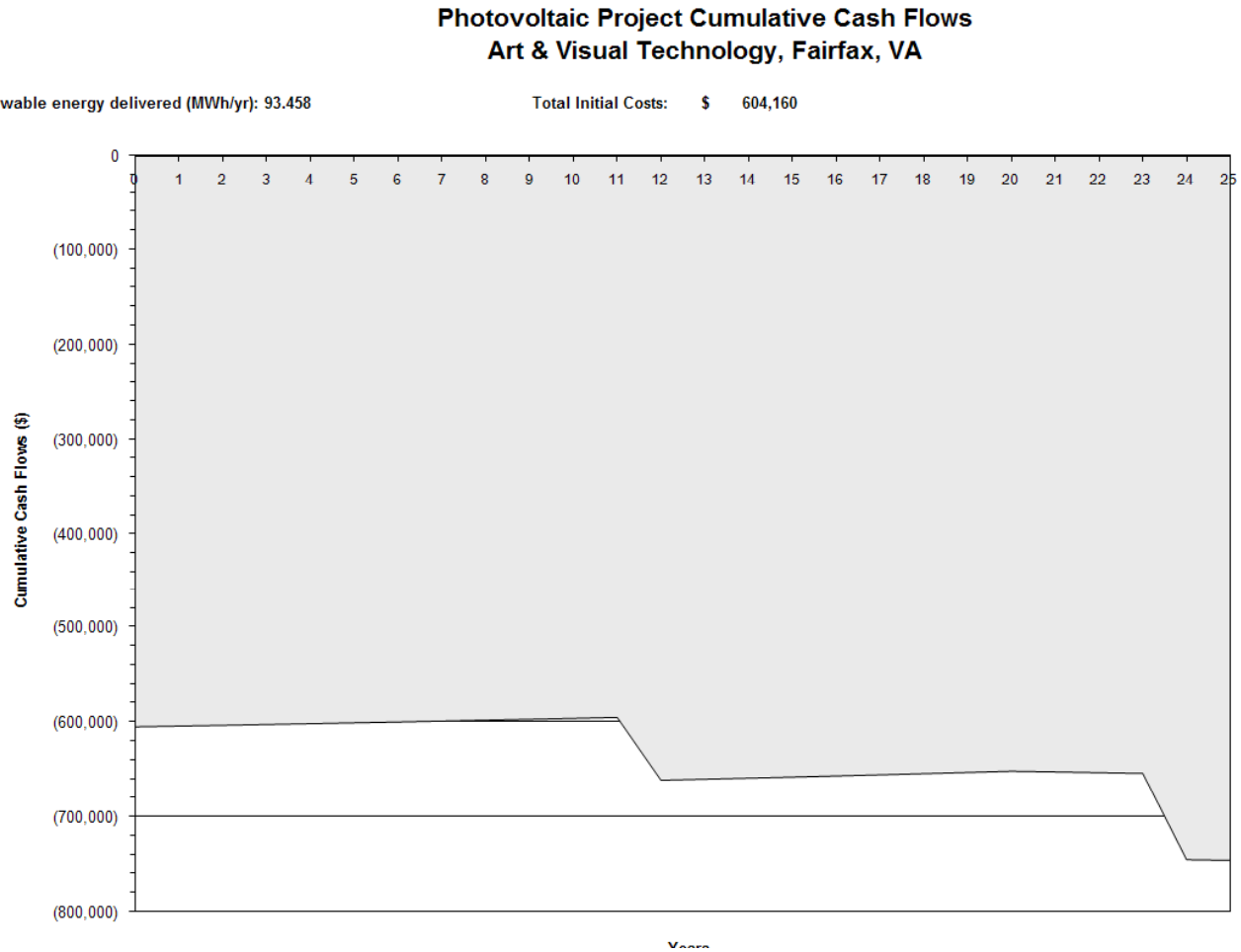
Fairfax, VA weather climate

Possible Federal & State incentives

Utility Rate: .272¢/kWh

Photovoltaic Array Study

Results (RetScreen Analysis)



Structural Breadth

Structural Breadth

Design Goals

Redesign the roof framing to support the new skylight system

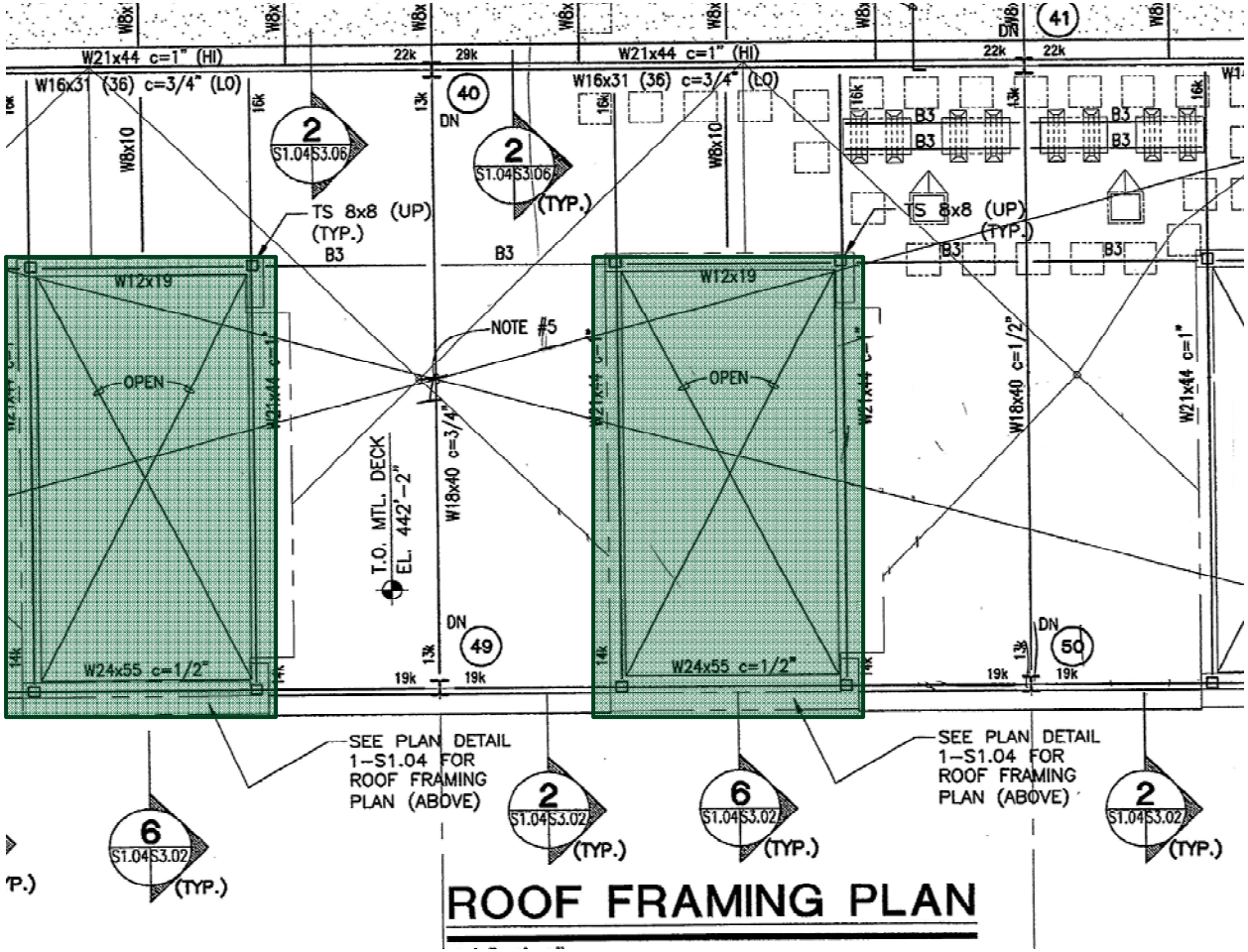
Limit any construction impacts

Reduce tonnage of steel number of connections

Structural Breadth

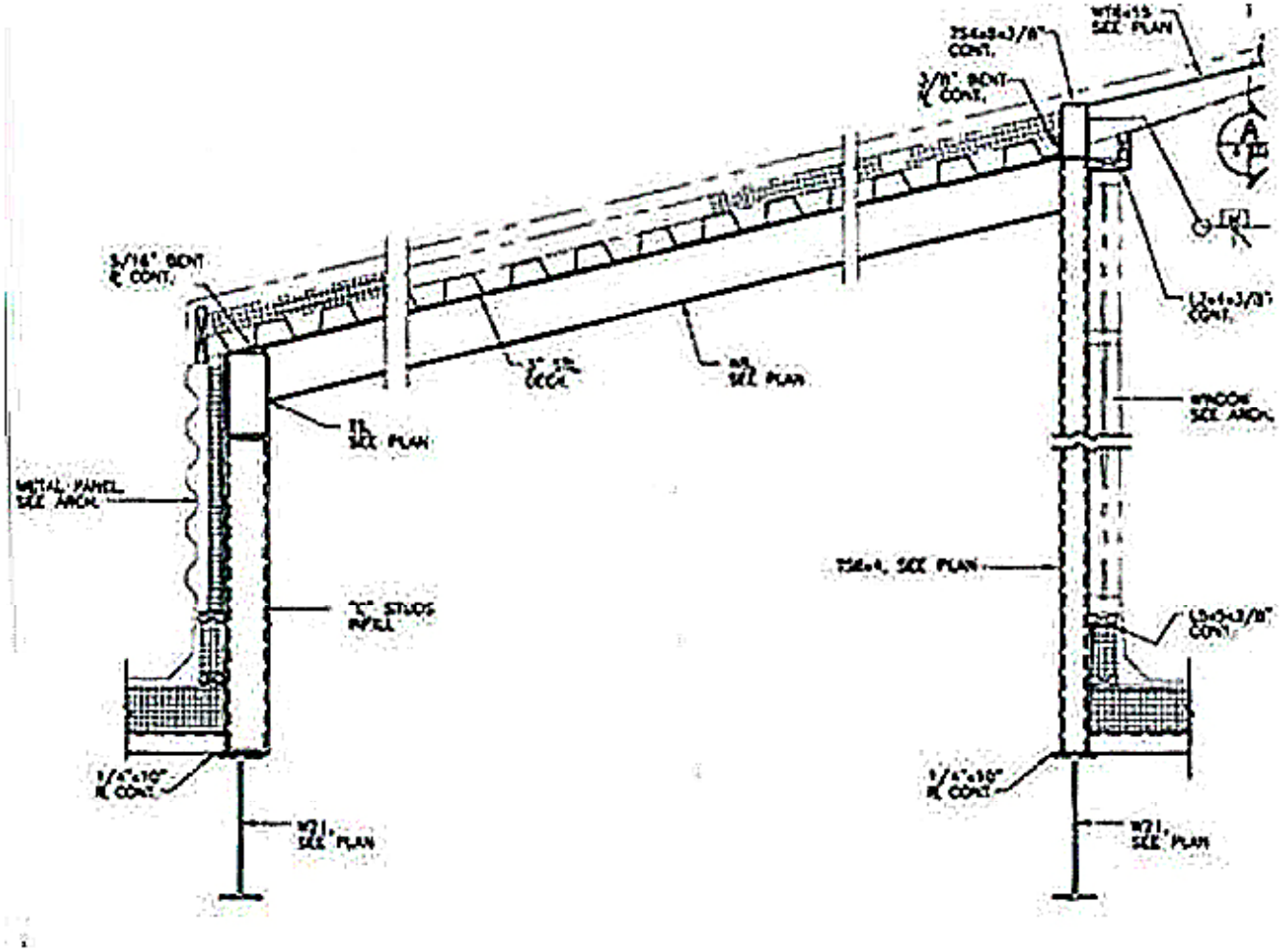
North

Existing Framing System



Structural Breadth

Existing Clerestory Section Detail

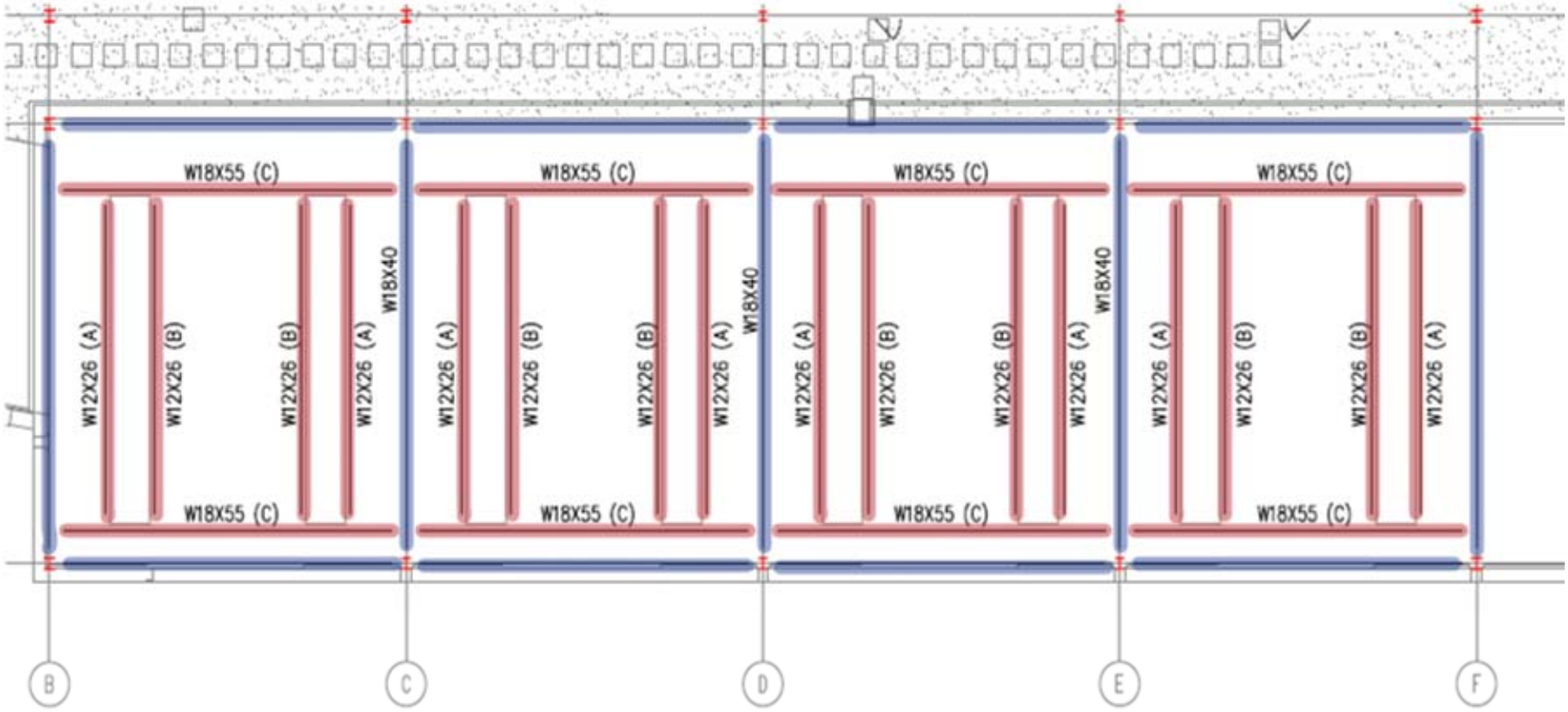


Structural Breadth

Redesigned Framing System

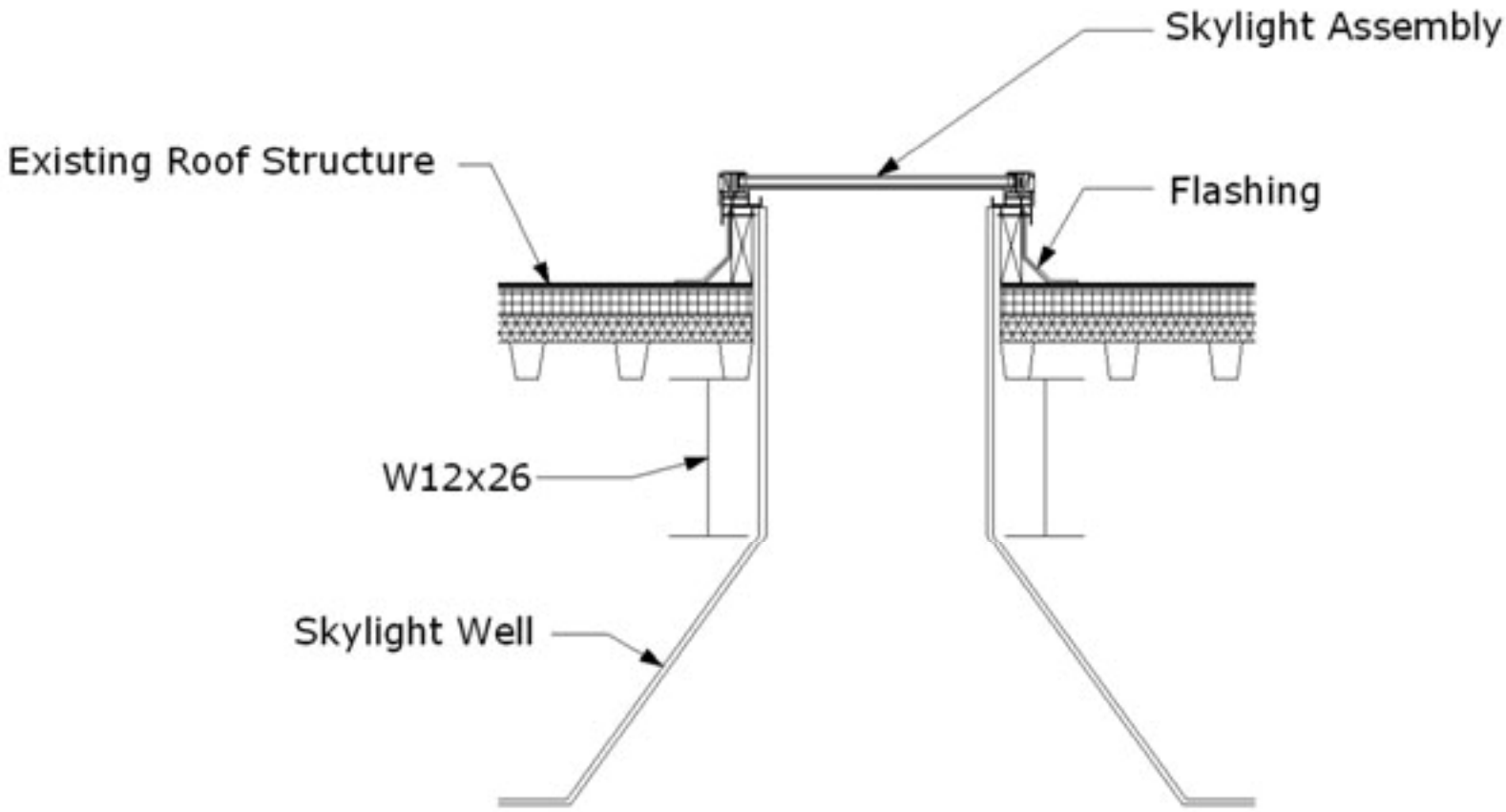
North

Existing Member
New Member



Structural Breadth

Skylight Section Detail



Structural Breadth

Steel Comparison

Existing Framing System

Member Size	Linear Feet	Weight lb/linear ft	total weight (lbs)
w12x14(B3)	71.00	14.00	994.00
w21x44	320.00	44.00	14,080.00
w12x19	64.00	19.00	1,216.00
w18x40	120.00	40.00	4,800.00
w8x15	340.00	15.00	5,100.00
TS12x6x3/8	248.00	42.70	10,589.60
L3x3x3/8	264.00	7.17	1,892.88
TS8x4x3/8	88.00	27.40	2,411.20
WT6x15	53.30	15.00	799.50
TS6x4x3/8	150.00	22.30	3,345.00
	total tons		22.61
	*Connection Tonnage		4.52
	**Price/ton		3,800.00
	total Estimated Cost		103,120.25

New Framing System

Member Size	Linear Feet	weight (lbs)/linear ft	total Weight (lbs)
w12x26	480.00	26.00	12,480.00
w18x40	320.00	48.00	15,360.00
w18x55	288.00	55.00	15,840.00
	total tonage		21.84
	*Connection Tonage (20%)		4.368
	**Price/ton		3,800.00
	total estimated cost		99,590.40

Conclusions

Lighting

Met design criteria through unique and creative solutions

Able to provide target illuminances while meeting ASHRAE power density standards

Electrical

Due to extraordinary low utility rate and a lack of federal incentives, the implementation of a photovoltaic array is not recommended.

Structural

The redesign of the roof framing system effectively accommodates the new skylight system.

A reduction in tonnage of steel and connections will lead to a cheaper and easier constructed roof.

Acknowledgements

Thank you to all of those who helped and supported me throughout the journey that has been thesis.

The entire staff of Mueller Associates in particular Adam Fry

George Mason University

Dr. Mistrick
Professor Dannerth
Professor Moses Ling

All of my AE friends especially my fellow lighting/electrical options

Ashley Bradford, Bryan Hart, Antonio Verne, Tom Yost who all provided me great advice on my structural breadth

Questions/Comments?