

MICHAEL P. GARDNER

2009 AE Senior Thesis Presentation



Mixed-Use Project  
Eastern United States

## Thesis Overview

- Lighting Systems
  - Re-design of four spaces
- Electrical Systems
  - Circuit and Panel re-designs
- Electrical Depths
  - Bus Duct vs. Conduit & Wire
  - Transformer Comparison
- Architectural Breadth
  - Fit-out of Retail Space
- Mechanical Breadth
  - Peak Cooling Load
  - Duct Sizing

## Thesis Overview

- **Lighting Systems**
  - **Re-design of four spaces**
- Electrical Systems
  - Circuit and Panel re-designs
- **Electrical Depths**
  - **Bus Duct vs. Conduit & Wire**
  - Transformer Comparison
- **Architectural Breadth**
  - **Fit-out of Retail Space**
- Mechanical Breadth
  - Peak Cooling Load
  - Duct Sizing

## Presentation Overview

- Building Information
- Electrical Depth
  - Bus Duct vs. Conduit & Wire Study
- Lighting Depths
  - Space 1: Residential Lobby
  - Space 2: Fitness Room
  - Space 3: Outdoor Courtyard
- Architectural Breadth + Lighting Depth
  - Space 4: Retail Space
- Conclusions
- Acknowledgements

## Building Information

OWNER:  
ARCHITECT:  
GC:  
LANDSCAPE: This information  
CIVIL: withheld at Owner's  
STRUCTURAL: request  
MECH & PLUMBING:  
ELECTRICAL:  
Types of Occupancy: Residential and Commercial  
Levels Above Grade: 9 – Apartments and Office Space  
Levels Below Grade: 4 – Parking and Systems  
Estimated Cost: \$ 48 Million

## Location

Eastern United States

Metropolitan neighborhood  
with many stores and  
restaurants nearby



Building  
Information

Electrical  
Depth

Residential  
Lobby

Fitness  
Room

Outdoor  
Courtyard

Retail  
Space

## Building Information

## Slide Show Orientation

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Building  
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Electrical  
Depth

Residential  
Lobby

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Outdoor  
Courtyard

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Space



## Spaces for Redesign

Residential Lobby

Fitness Room

Outdoor Courtyard

Retail Space

## Slide Show Orientation



Building Information	Electrical Depth	Residential Lobby	Fitness Room	Outdoor Courtyard	Retail Space
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## Electrical Depth – BUS DUCT VS. CONDUIT & WIRE STUDY

**Study:** A cost comparison between the use of aluminum bus duct to aluminum wire in steel conduit.

**Methods:** Determined total length of run from Construction Documents to be 265 feet

Consulted RS Means: Electrical Cost Data for cost estimation

Adjusted for the appropriate location

**Conclusion:** Recommend bus duct to be used in this case.  
Savings of approximately \$1,520.00

Building  
Information

Electrical  
Depth

Residential  
Lobby

Fitness  
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Outdoor  
Courtyard

Retail  
Space

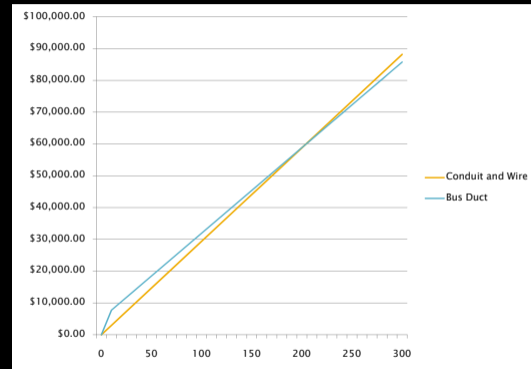
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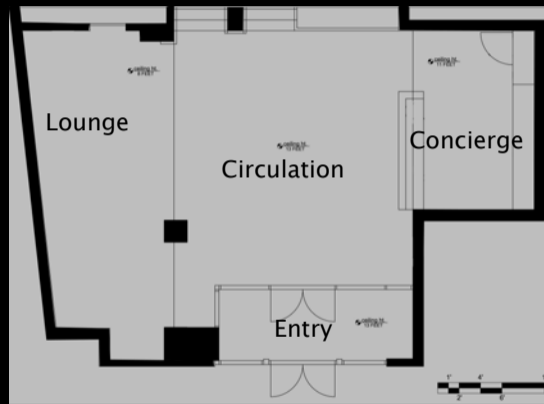
## Lighting Depth – RESIDENTIAL LOBBY

**Theme:** Luxurious and upscale environments

**Criteria:** Various IESNA Handbook criteria  
Target illuminance values  
ASHRAE 90.1 Power Allowances

**Goal:** To promote a public feel to the space.

## Lighting Depth – RESIDENTIAL LOBBY

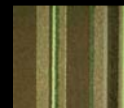


## Spatial Information

Area: Approximately 1,300 square feet

Ceiling: Heights of 8, 11, and 13 feet

Materials: Floors of carpet and limestone tile  
Walls of painted gypsum wall board and wall coverings  
Ceiling of painted gypsum wall board



Carpet



Limestone



GWB



Wall Covering

Building Information

Electrical Depth

Residential Lobby

Fitness Room

Outdoor Courtyard

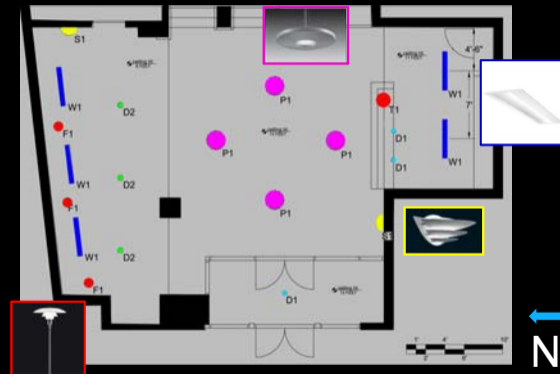
Retail Space

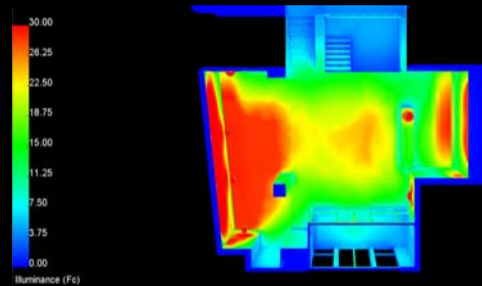
## Lighting Depth – RESIDENTIAL LOBBY

## Lighting Plan

Methods: Emphasizing peripherals  
Indirect lighting to brighten environment  
Task lighting for reading/writing  
Sconces for direction and decoration

Results: Circulation illuminance target = 10 fc  
Actual = 19.99 fc  
Lounge task illuminance target = 30 fc  
Actual = 34.91 fc





Pseudo-Color Rendering of Lobby Floor @ max 30 fc



View from Concierge Desk



View from Lounge Area

## Lighting Depth – FITNESS ROOM

**Criteria:** Illuminance value of 30 footcandles at floor  
Power density of  $0.9 \text{ W/ft}^2 = 1,676 \text{ watts}$

**Goal:** To achieve sufficient light levels for exercise.  
To maintain a clean look.  
To enhance outdoor views.

**Methods:** Recessed, diffuse lighting  
Energy efficient fluorescent sources

**Results:** Average illuminance = 29.88 fc (under 30 fc)  
Total wattage = 1,185 W – Power Density met!

## Lighting Depth – FITNESS ROOM

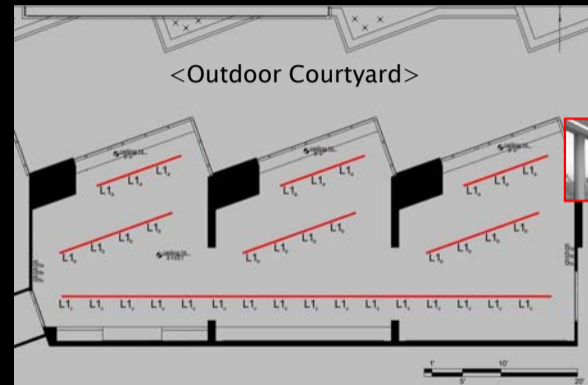
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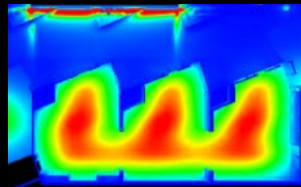
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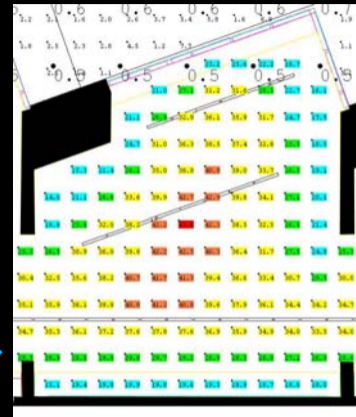


# Lighting Depth – FITNESS ROOM



Pseudo-Color of Floor @ max 40 fc

Angled array of fixtures for more uniform distribution



Highlighted calculation points

# Renderings



View looking east into Courtyard

## Lighting Depth – OUTDOOR COURTYARD

**Criteria:** Illuminance value of 3 footcandles at ground  
Power density of  $0.2 \text{ W/ft}^2 = 535 \text{ watts}$

**Goal:** To achieve sufficient light levels for navigation.  
To highlight the landscape materials.  
To illuminate walls to better views from the fitness room.

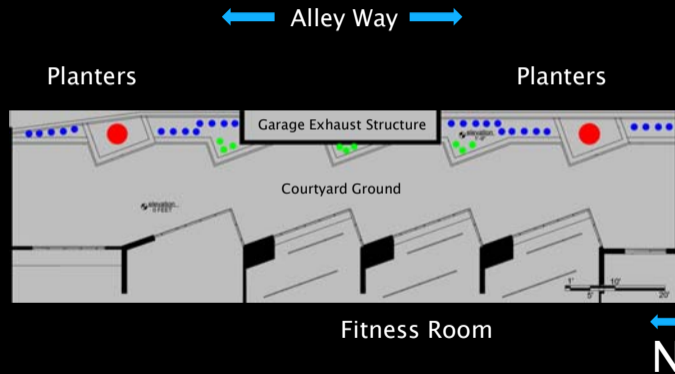
**Methods:** MR16 landscape fixtures  
LED grazing luminaires

**Results:** Average illuminance = 3.3 fc (above 3) met!  
Total wattage = 1,359 W – (over allowable) not met



# Lighting Depth – OUTDOOR COURTYARD

# Spatial Information



Area: 2,675 square feet

Space: Long, narrow space  
Fitness room curtain wall protrudes into space

Materials: Ground made of stone blocks  
Planters on eastern wall made of brick  
Japanese maple trees and bamboo landscaping



Japanese Maple



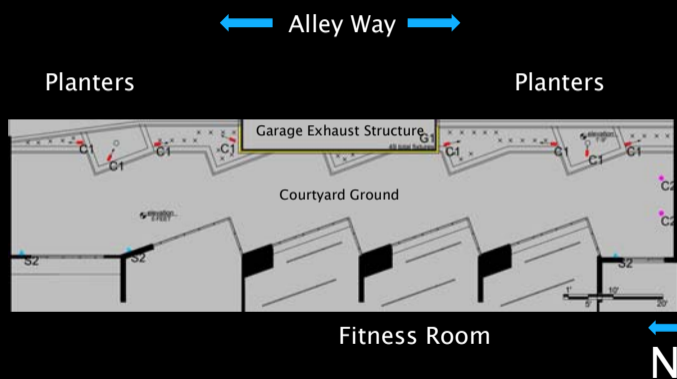
Hale Black Bamboo



Dwarf Bisset Bamboo

# Lighting Depth – OUTDOOR COURTYARD

# Lighting Design



## Luminaires



LED Graze

Purpose  
Highlighting Garage Exhaust wall  
Providing luminance through windows



MR16 Spot/Accent

Purpose  
Accenting landscape materials



CFL Sconce

Purpose  
Provide light near entries/exits



In-ground Wall Accent

Purpose  
Accent stone wall on southern side



Sectional view towards Alley



Viewing South

## Lighting Depth – OUTDOOR COURTYARD

## Renderings



Looking inside the Fitness Room



Looking outside the Fitness Room

Building Information    Electrical Depth    Residential Lobby    Fitness Room    **Outdoor Courtyard**    Retail Space

**Problem:** Retail Space requires tenant fit-out for lighting design.

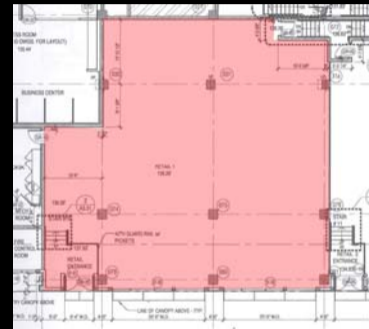
**Research:** Tenant chosen to be boutique fashion store.  
 Personal shopping experience.  
 Highlight merchandise displays.  
 Low light levels for circulation.  
 High light levels for clothing, jewelry etc.

**Solution:** Clean, elegant materials  
 Evoke contrasting warm/cool feelings

Concrete Shell

Concrete columns throughout

Total area of approximately 3,000 sf



Existing Layout



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**Solution:** Clean, elegant materials  
Evoke contrasting warm/cool feelings

- High-end fashion
- Confident
- Glamorous
- Youthful
- Energetic

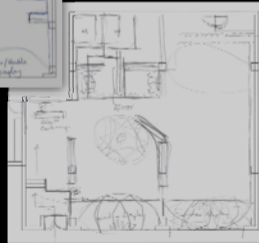


[www.dolcegabbana.com/deg/](http://www.dolcegabbana.com/deg/)



## Breakdown:

- Cash Wrap
- Fine Merchandise
- Clothing Displays
- Window Displays



Remaining space  
for storage, fitting  
rooms, restrooms  
etc.



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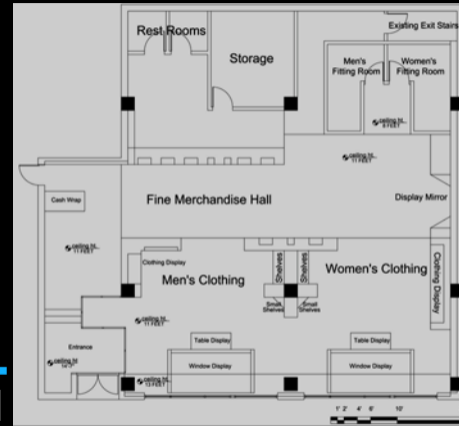
- Cash Wrap
- Fine Merchandise
- Clothing Displays
- Window Displays

Remaining space  
for storage, fitting  
rooms, restrooms  
etc.

Sales Area of  
2,120 sf

Fine Merchandise  
Hall

Displays not  
cluttered





**Criteria:** Illuminance on merchandise = 50 – 100 fc  
Illuminance for circulation = 10 fc

**Goals:** To attract the customer through the store.  
To direct attention towards merchandise displays.  
To evoke warm feeling at cash wrap.  
To evoke cool, refreshing feelings near merchandise.

**Methods:** Halogen track lighting  
Color changing accents

**Results:** Merchandise illuminance = >60 fc (within range) met!  
Circulation illuminance = >10 fc met!

## Lighting Depth – RETAIL SPACE

**Criteria:** Illuminance on merchandise = 50 – 100 fc  
Illuminance for circulation = 10 fc

**Goals:** To attract the customer through the store.  
To direct attention towards merchandise displays.  
To evoke warm feeling at cash wrap.  
To evoke cool, refreshing feelings near merchandise.

**Methods:** Halogen track lighting  
Color changing accents

**Results:** Merchandise illuminance = >60 fc (within range) met!  
Circulation illuminance = >10 fc met!

## Lighting Plan



Pinhole downlight



Track accent



Decorative downlight



CFL downlight



Window Displays



Full-height frosted glass enclosures for Power Allowance Exemption



Merchandise Displays



Focusing light on merchandise

Color-changing LEDs





Warmth: Entrance and Cash Wrap



Coolness: Merchandise Areas

# Conclusions

Designed effective lighting solutions for four spaces

Recommended an economical materials selection

Designed the layout for a boutique fashion shop

Learned the importance of designing to Power  
Density Allowances

Learned the importance of time management skills

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## Acknowledgements

Thank you to:

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Dr. Richard Mistrick

Prof. Ted Dannerth

Dr. Kevin Houser

Prof. Bob Holland

Billy Hodges

Fellow Students

My family and friends

Thank you!

Questions?