

KAISER PERMANENTE
MEDICAL OFFICE BUILDING
at Tysons Corner
McLean, Virginia



Brooke Helgesen
Advisor: Dr. Chimay Anumba
Construction Management

PRESENTATION OUTLINE

- Project Background
- Analysis 1-IPD
 - Coffe Design Overview
 - IPD Case Study
 - Cost/ Schedule Impact
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

KAISER PERMANENTE MEDICAL OFFICE BUILDING at Tysons Corner McLean, Virginia



Brooke Helgesen
Advisor: Dr. Chimay Anumba
Construction Management

KAISER PERMANENTE MOB at TYSONS CORNER

McLean, VA

Brooke Helgesen Construction Management

Project Background

KAISER PERMANENTE MOB at TYSONS CORNER

McLean, VA

Brooke Helgesen Construction Management

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

LOCATION:

8008 West Park Drive McLean , VA

COST:

\$44,078,649

CONSTRUCTION DATES:

March 16, 2011- May 8, 2012

SIZE:

241,175 SF

FUNCTION:

Short term care Medical Office Building:

SCOPE OF WORK:

Renovation & Construction of Mechanical Tower Addition



Integrated Project Delivery

- Presentation Outline:
- Project Background
 - Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
 - Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
 - Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
 - Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
 - Final Conclusions
 - Acknowledgements

IPD vs. DESIGN-BID-BUILD

GOAL: To research and compare the costs and risks of IPD versus Design Bid Build specifically for the coffer design issue on the Kaiser Permanente Project.

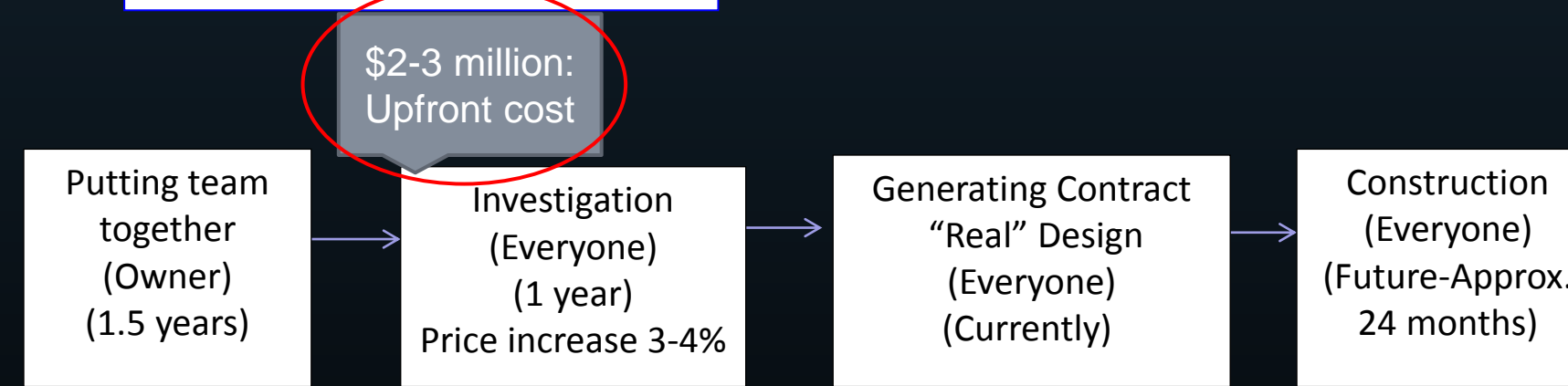
Design Bid Build	IPD
Delegated risk	Shared risk
Uncertainties not foreseeable	Uncertainties more predictable
Hidden costs: increased claims/ disputes, change orders, reputation, etc.	Upfront Cost: Adequate planning minimizes change orders, disputes, etc.
Limits cooperation, coordination, innovation	Promotes teamwork and more ideas
Contract documents are known from the beginning although not always accurate.	Lack of contract documents that spell out in detail what happens in failed events
Everyone has their own risk/ goals.	Built on trust/ must have good team

Case Study: The House of Temple of Scottish Rite

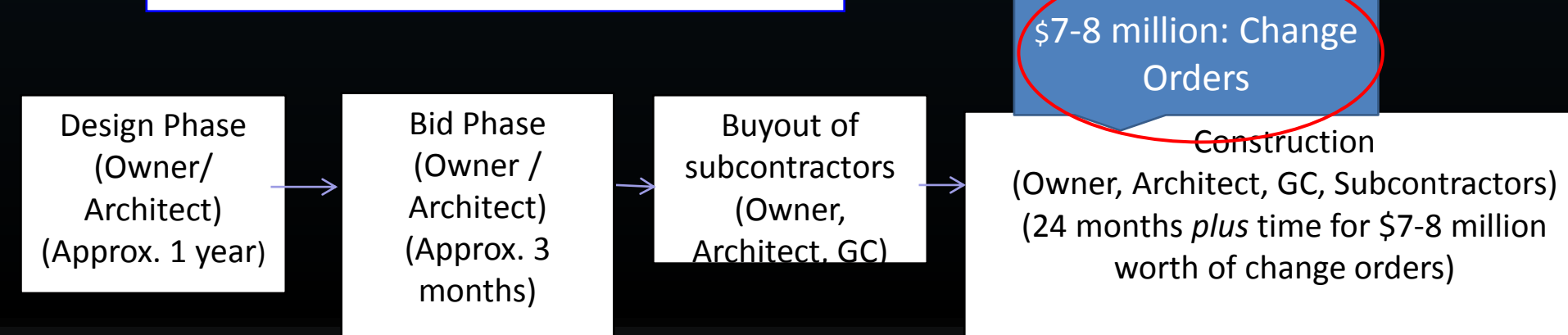
Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

The House of Temple Project: IPD



The House of Temple Project: Design-Bid-Build (Hypothetical)



LESSONS LEARNED about IPD:

- Save money & time
- More enjoyable atmosphere
- Promotes innovation and ideas!

How could this help Kaiser Permanente Project?...

Coffer Design Overview

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

ISSUE: Fire Rating the Waffle Slab Coeffers

COST IMPACT:

- Lost labor hours
- Extra materials
- Removal/ re-installation
- Repeat inspections

Total: \$250,000

SCHEDULE IMPACT:

- Delayed: track installation, MEP overhead, interior wall framing
- Coffer production dropped:

25 coffers per day per man to
16 /day/ man

Total: 5 Month Process



Conclusions

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

IPD could have helped to:

- Better understand severity of coffer design issue
- Integrate project team early on to increase communication
- Allocate accurate amount of money for coffer activity

- Early detection of coffer design issue using IPD could have saved a:
5 month & \$250,000 process

Curtain Wall Façade Re-design

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

PROBLEM IDENTIFICATION

- Unforeseen water infiltration from cracks in existing 1980's precast panels & leaks in existing glazing.



SOLUTION

- Removal of existing precast panels and glazing
- Installation of Curtain Wall System for:
 - Improved water protection
 - Increased day-lighting
 - Updated aesthetic appeal

Curtain Wall Façade Re-design

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

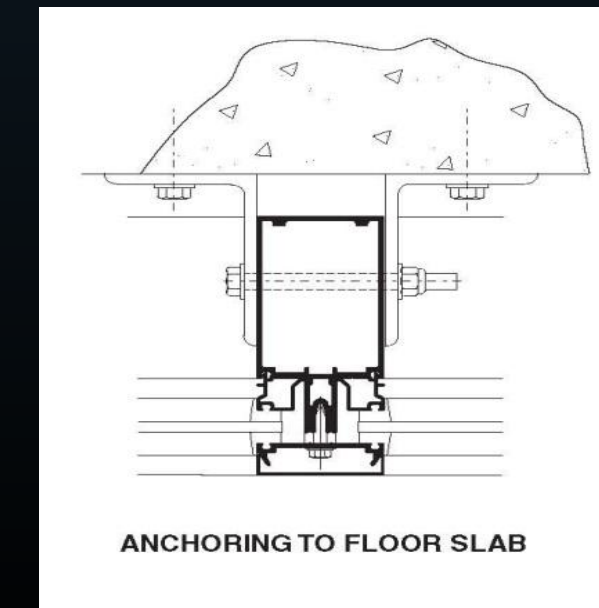


SYSTEM DESIGN

- Kawneer I600 System I Curtain Wall

INSTALLATION

- Crane & swing stage at every floor
- Anchor to concrete slab at each level



CURTAIN WALL COVERAGE:

West & East Facades: 11,584 SF
About 27% of Building Surface Area

North & South Facades: 22,708 SF
About 53% of Building Surface Area

Total: 34,292 SF
About 81.3% Building Surface Area

KAISER PERMANENTE MOB at TYSONS CORNER

McLean, VA

Brooke Helgesen Construction Management

Architectural Elevations

KAISER PERMANENTE MOB at TYSONS CORNER

McLean, VA

Brooke Helgesen Construction Management

Presentation Outline:

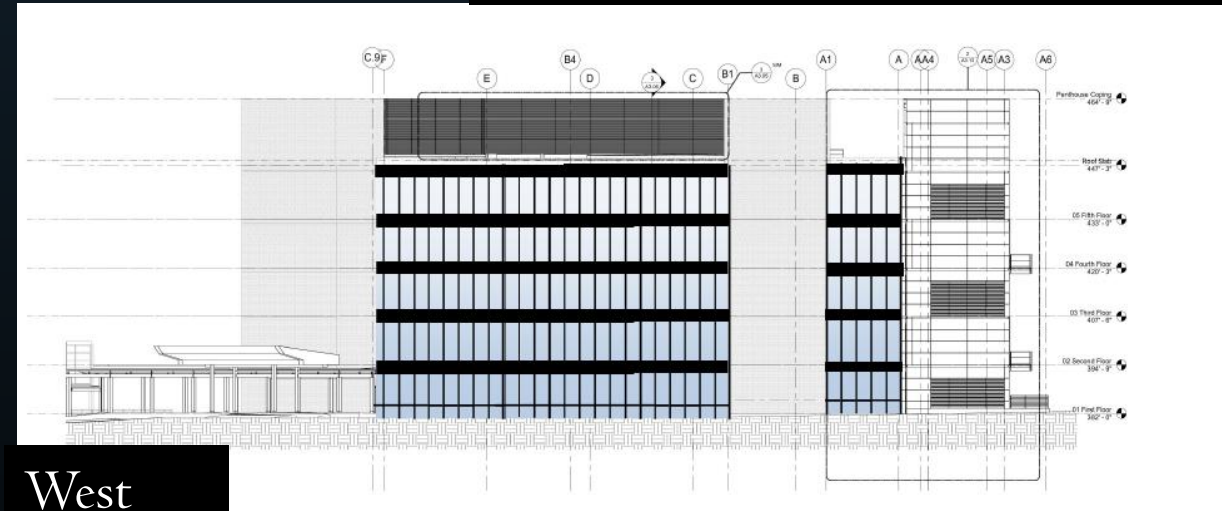
- Project Background
 - IPD Case Study
 - Coffey Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements



PREVIOUS WESTERN FACADE

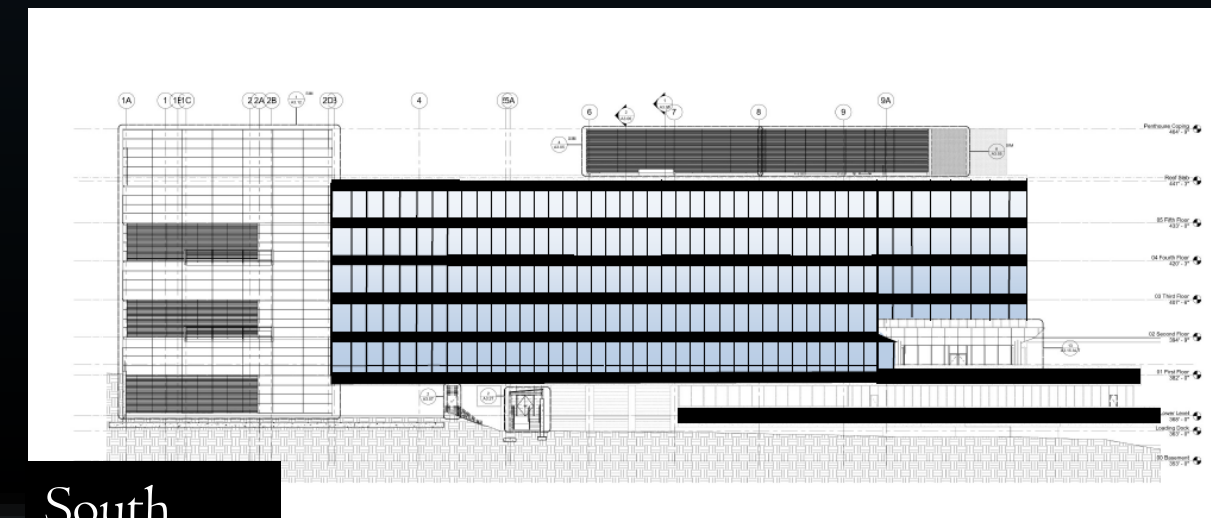


PROPOSED CURTAIN WALL ELEVATIONS

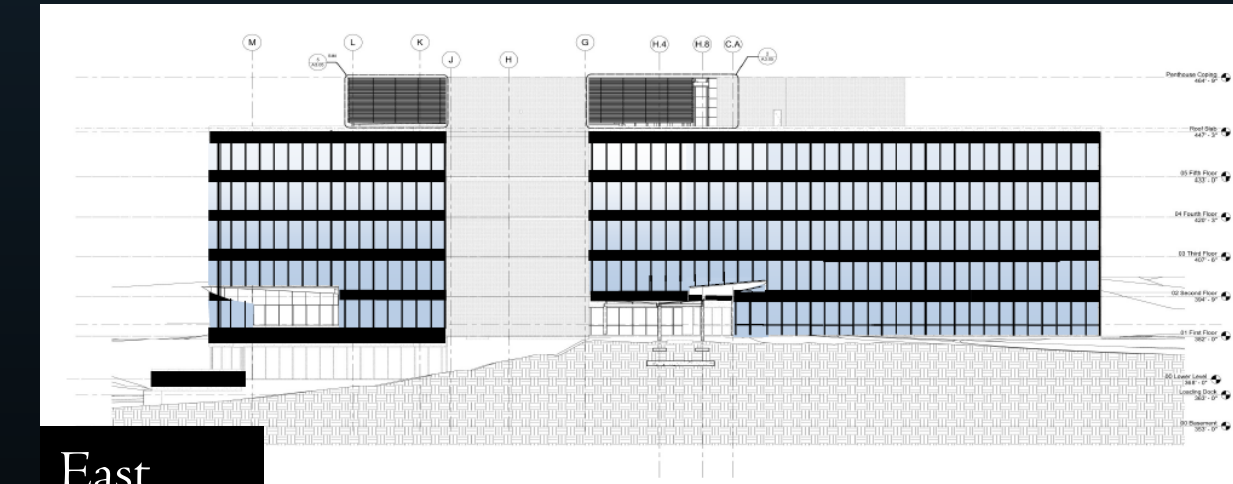


West

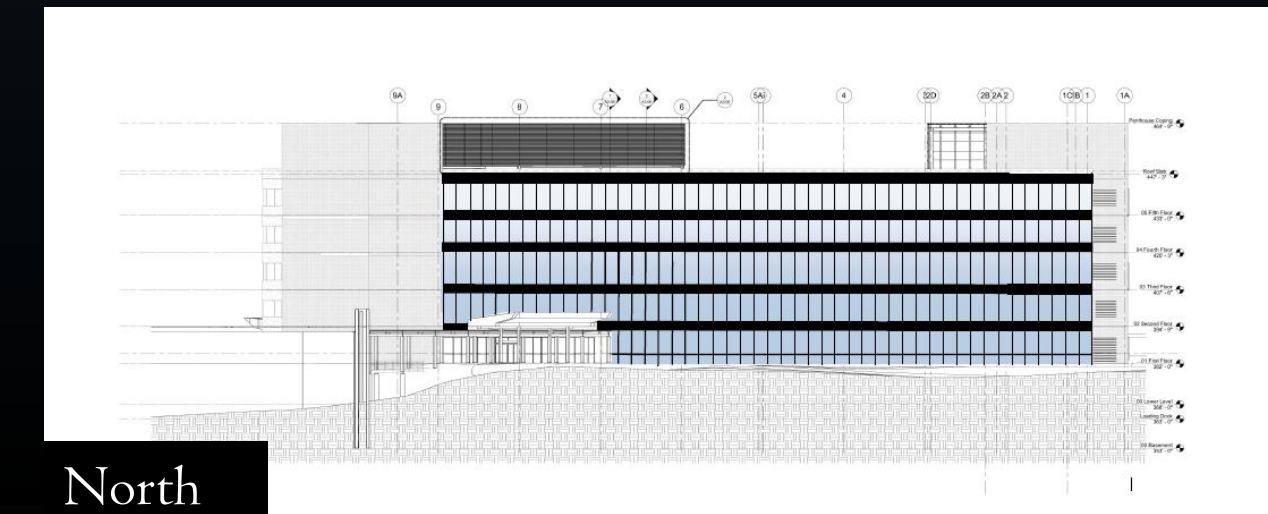
30% Increase
of Exterior
Glass



South



East



North

Curtain Wall Façade Re-design

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

COST IMPACT

Curtain Wall 1600 System

Total=\$2,440,980

Comparison to Precast Injections/Glazing Replacement:

Total=\$2,038,860

\$402,120
cost
difference

SCHEDULE IMPACT

Shop drawings: 8 weeks

Fabrication: 8-10 weeks

Removal: 120 days

Replacement/Installation: 140 days



September 6, 2010- April 4 2011

7 Month duration before project construction begins

7 Month
Duration.
No
Significant
Impact

Conclusions

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

CONCLUSIONS FOUND FOR CURTAIN WALL

- 30% Increase of glass & day-lighting
- \$402,120 cost increase
- No schedule impact
- Updated & improved aesthetic appeal
- Increased water infiltration protection



LED Temporary Lighting

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

PROBLEM IDENTIFICATION

- Lack of sustainable features
- High energy demand of the building systems
- Increased cost associated with maintenance of temporary lighting during construction

SOLUTION

- Switch all temporary lighting from Fluorescent to energy saving LED's
- Analyze power consumption, cost savings, and feasibility of this change

LED FLEX SLS Components

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements



POWER SUPPLY

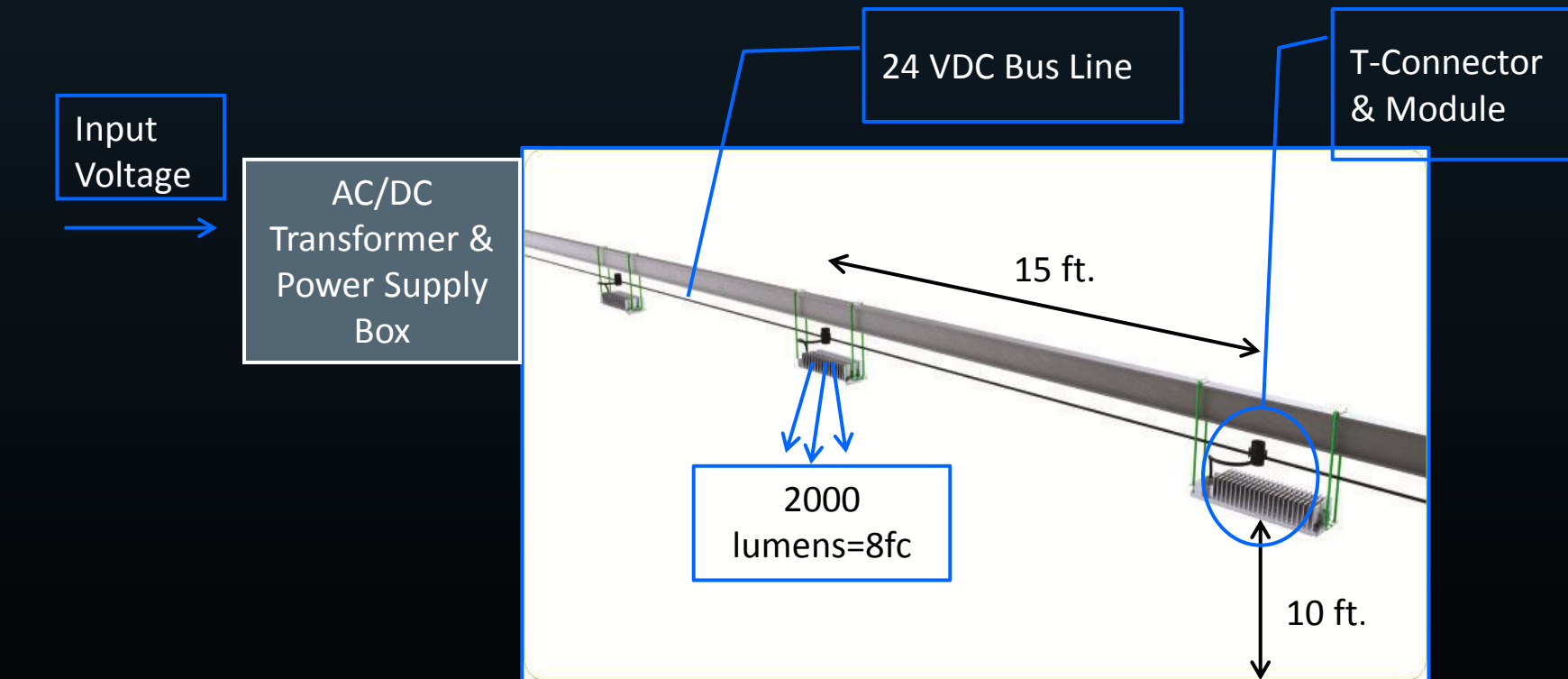
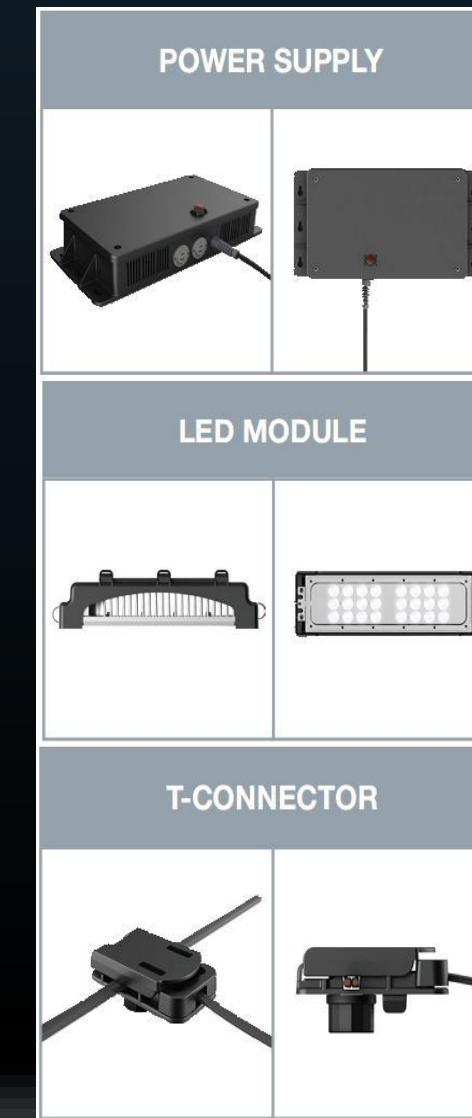
- 450W transformer.
- 110-265VAC input
- Outputs 24VDC
- Can utilize 2 simultaneous bus lines

LED MODULE

- 2000 “focused” lumens
- 8 fc @ 15 ft. spacing on center. 10 ft. mounting height.
- Lumen Maintenance: 70% at 50,000 hours

T-CONNECTOR & 24VDC BUS LINE

- Easy and quick-to-install T-Splice
- I25’ length I2 gauge wire standard

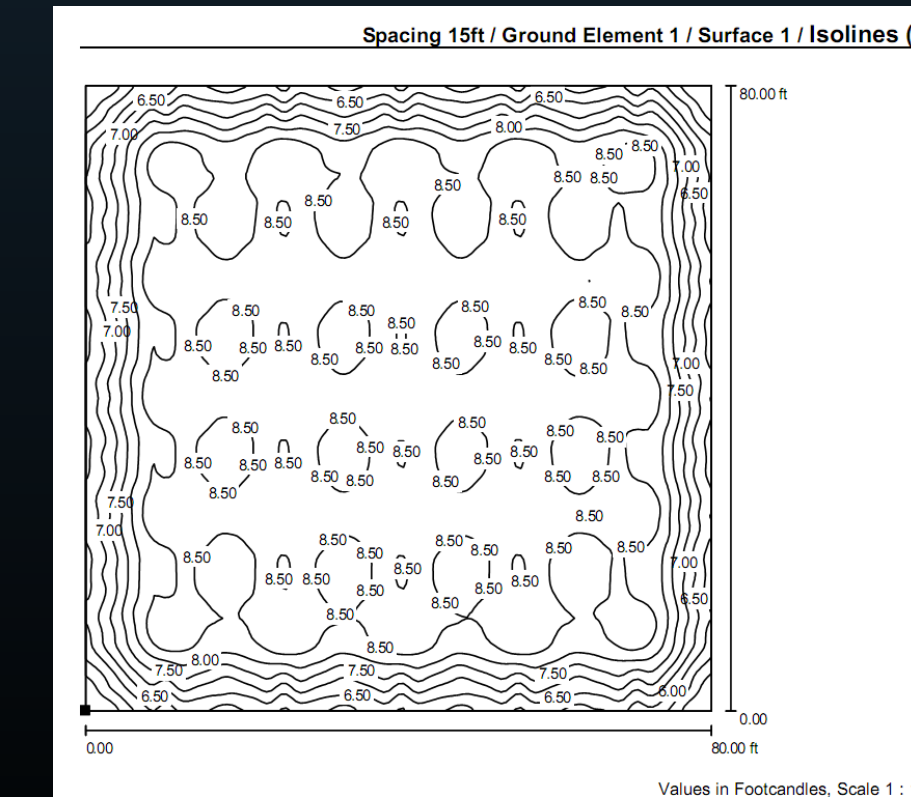


LED Temporary Lighting

Presentation Outline:

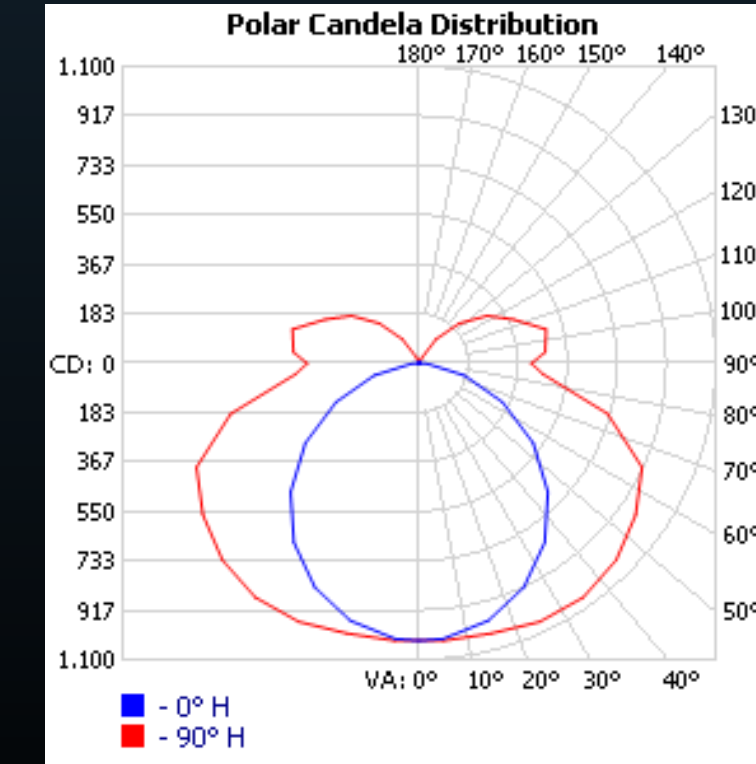
- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

	LED	Incandescent	Metal Halide	Fluorescent
Durability	Solid State circuitry, not affected by vibration and impact. No filament, no glass to break	Easily damaged by vibration or impact causing failure	Easily damaged by vibration or impact causing failure	Easily damaged by vibration or impact causing failure
Lifetime	Minimum 50,000 hours at 70% lumen maintenance	50% failure rate at 2,000 hours for typical 75 Watt bulb	10,000-15,000 hours is common	Typically 24,000 hours
Efficacy	Emit 100 lm/W	Emit 15 lm/W.	Emit 65+ lm/W range.	Emit 48+ lm/W range.



Photometric Graph- LED Flex SLS System

100 Degree Spread

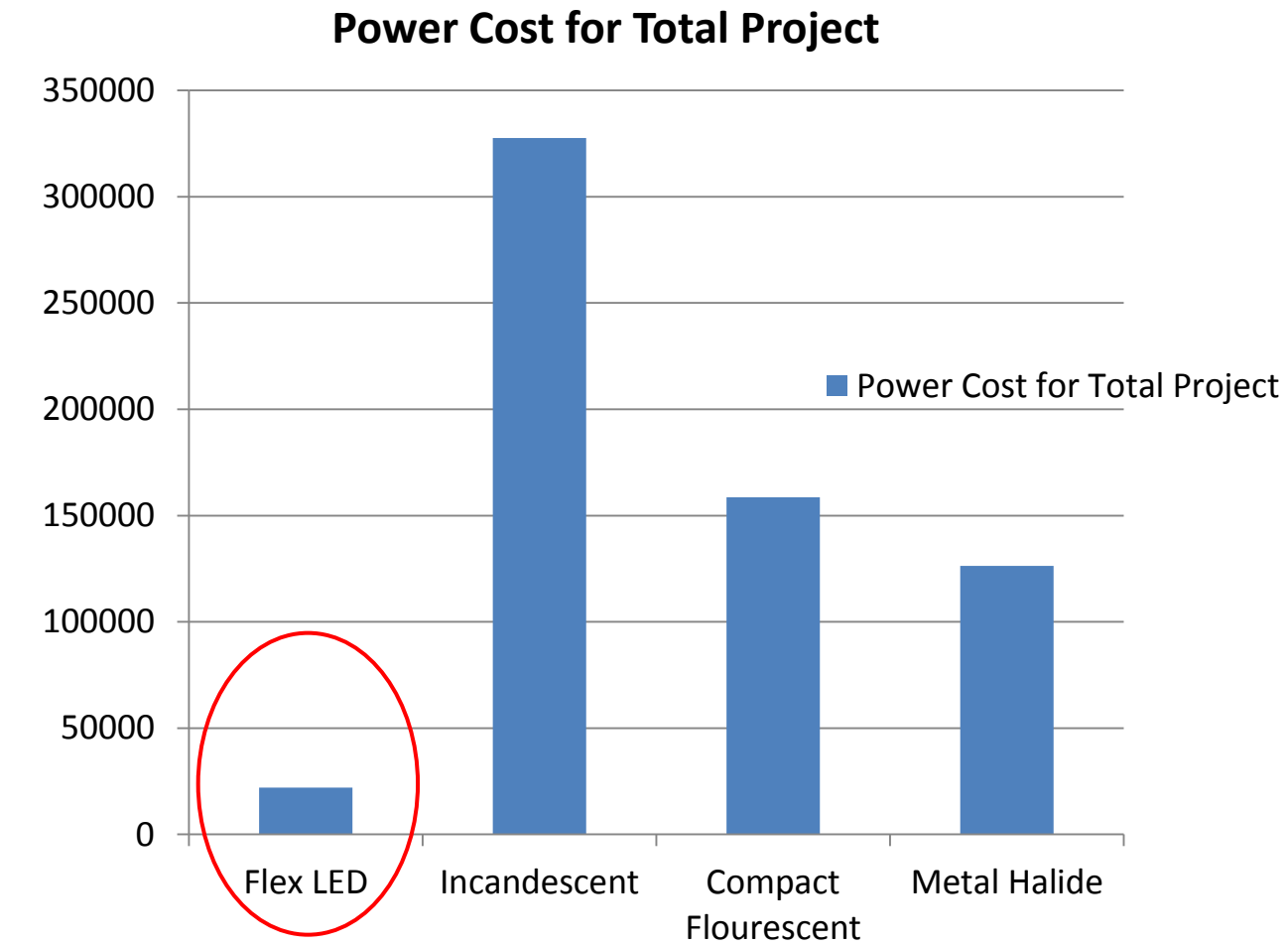


Photometric Graph-F32T8 Fluorescent, 2 lamps, 2900 lumens/lamp

360 Degree Spread

LED Temporary Lighting

POWER CONSUMPTION



	Flex LED	Incandescent	Metal Halide	Compact Fl.
Power Consumption	16,764 W	246,580 W	119,340 W	104,800 W

- Electricity cost of \$.14/kWh
- Project Duration=13 months

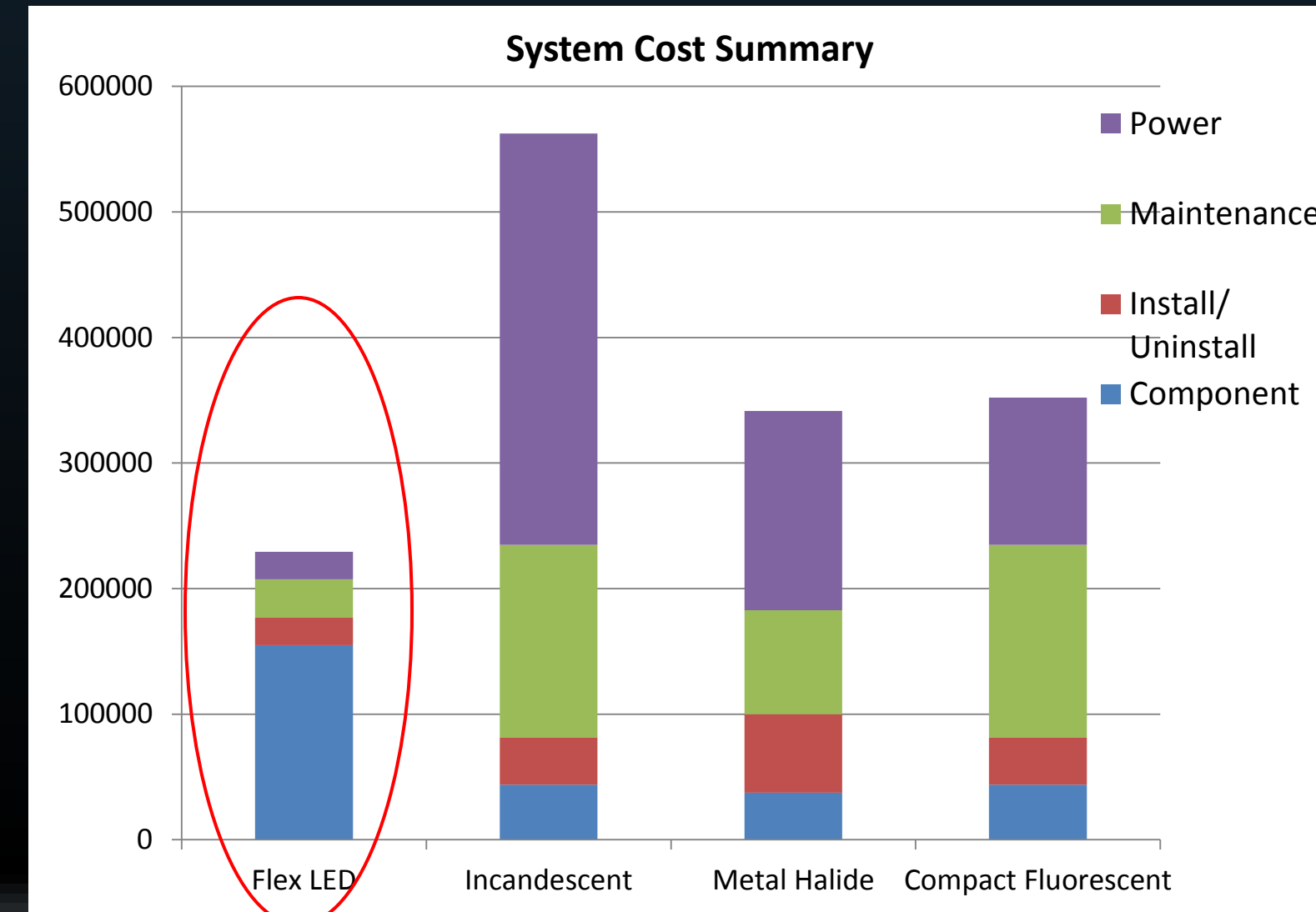
Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

LED Temporary Lighting

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements



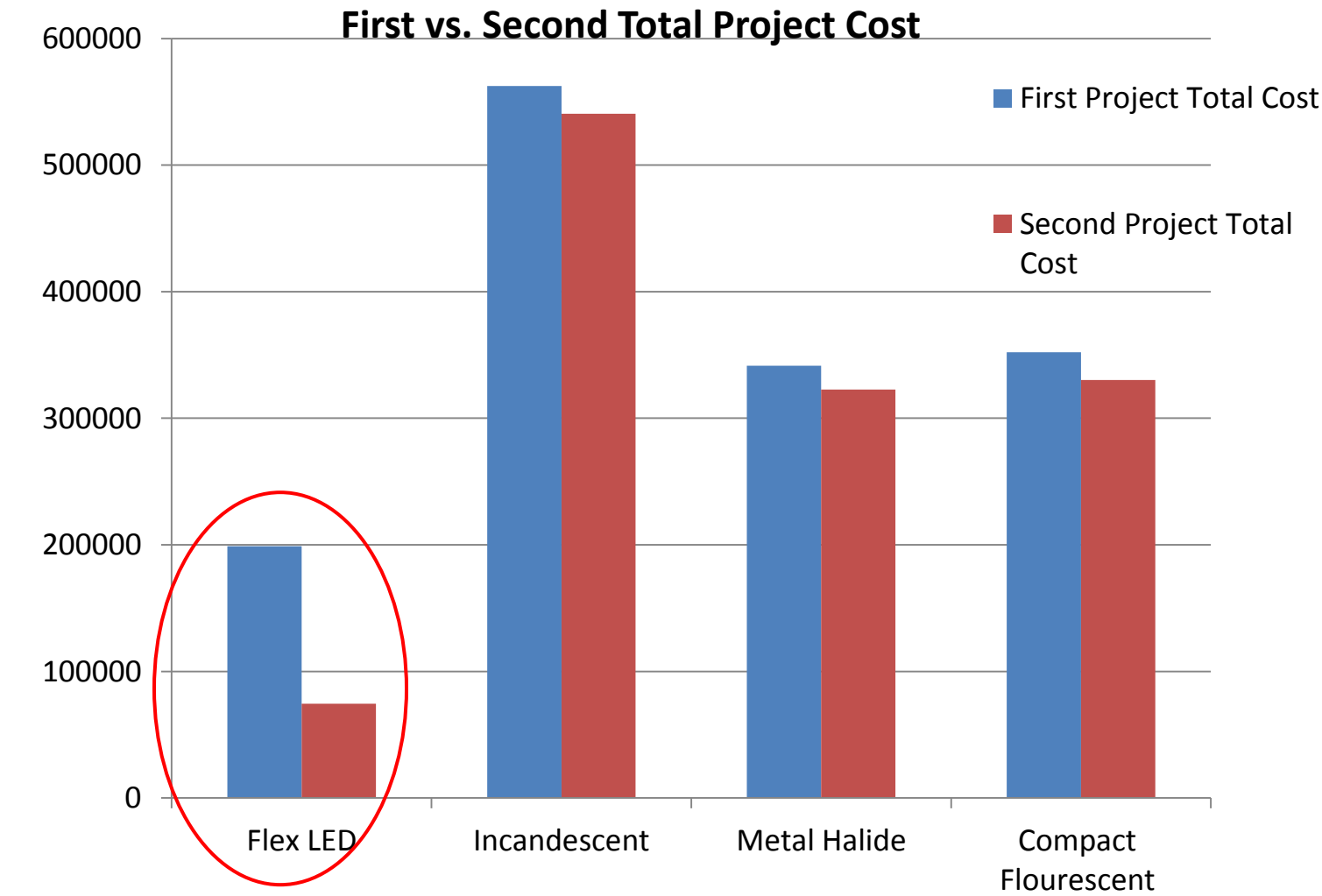
COST COMPONENTS CONSIDERED:

Breakdown of Total Cost per system (13 month duration)				
Total Cost Breakdown	Flex LED	Incandescent	Metal Halide	Compact Fluorescent
Component	155,034	43,750	37,500	43,750
Install/uninstall	21,829	37,500	62,500	37,500
Maintenance	30,469	153,563	82,875	120,335
Power	21,968	327,600	158,545	126,329
Total	198,832	562,413	341,420	325,314

LED Temporary Lighting

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements



- Largest first to second project cost difference

Lighting/ Electrical Breadth

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffered Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

GOAL:

Analyze further benefits of LED FLEX SLS System over Fluorescent lighting with a lighting layout and power plan for the Kaiser Tysons Project.



LED Layout



Fluorescent Layout

KAISER PERMANENTE MOB at TYSONS CORNER

McLean, VA

Brooke Helgesen Construction Management

Lighting/ Electrical Breadth

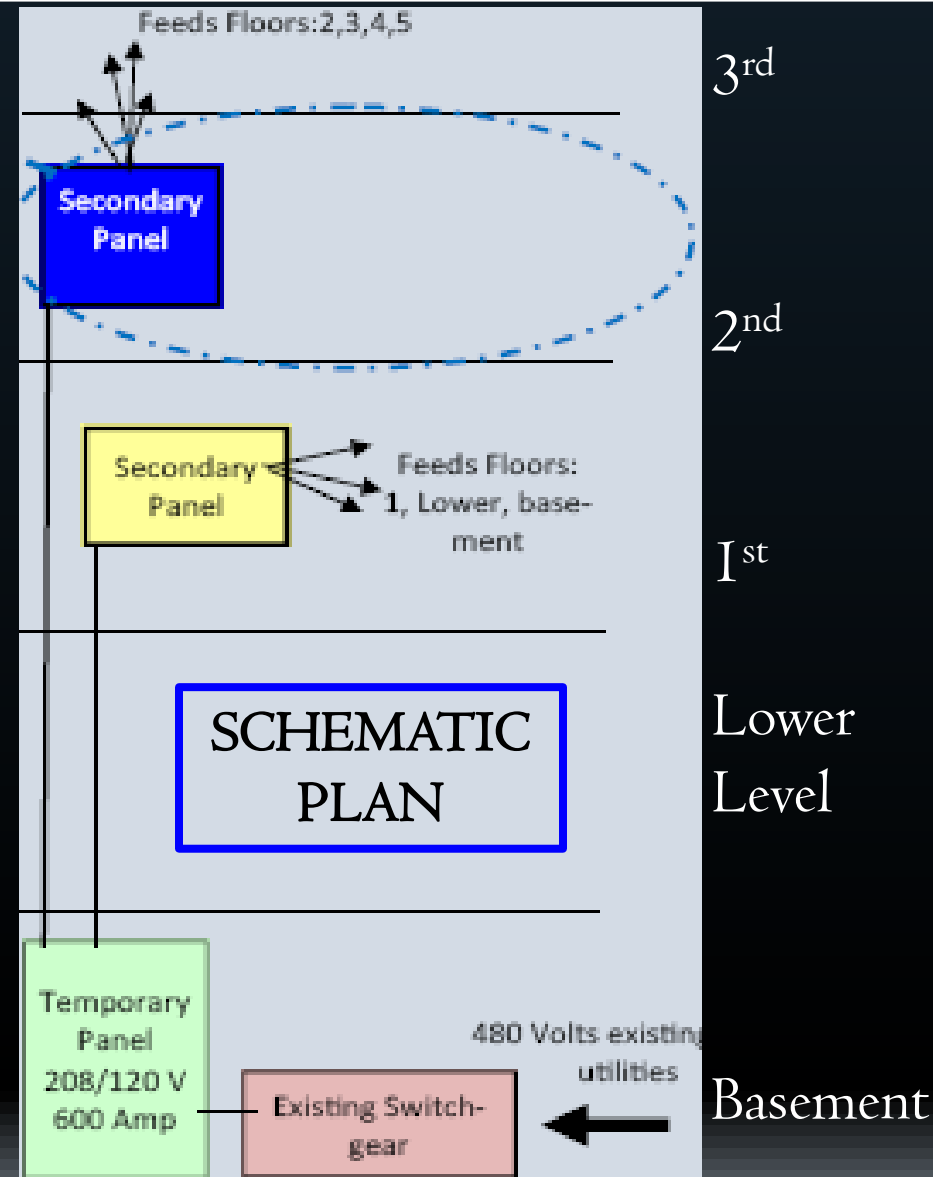
KAISER PERMANENTE MOB at TYSONS CORNER

McLean, VA

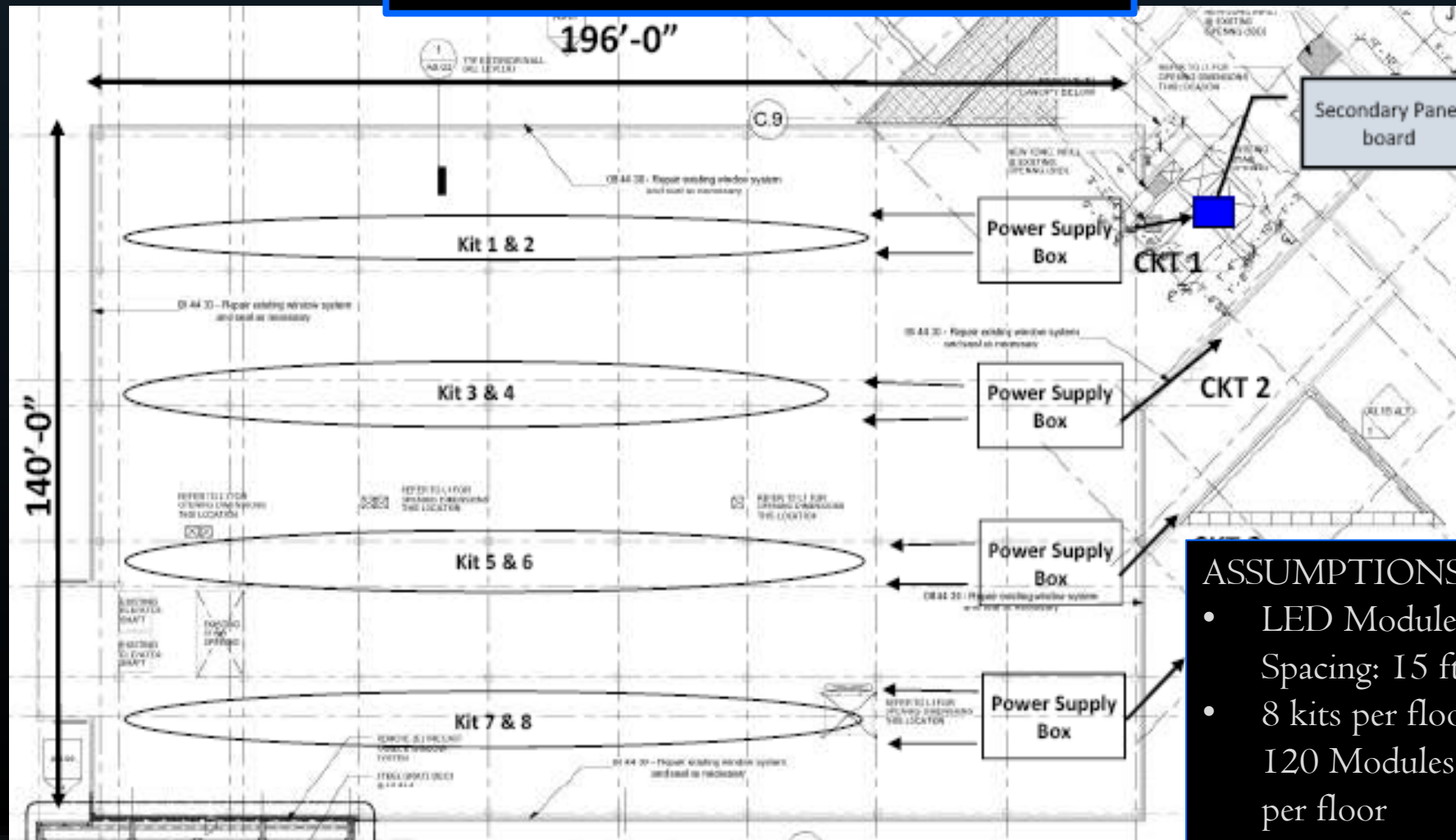
Brooke Helgesen Construction Management

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

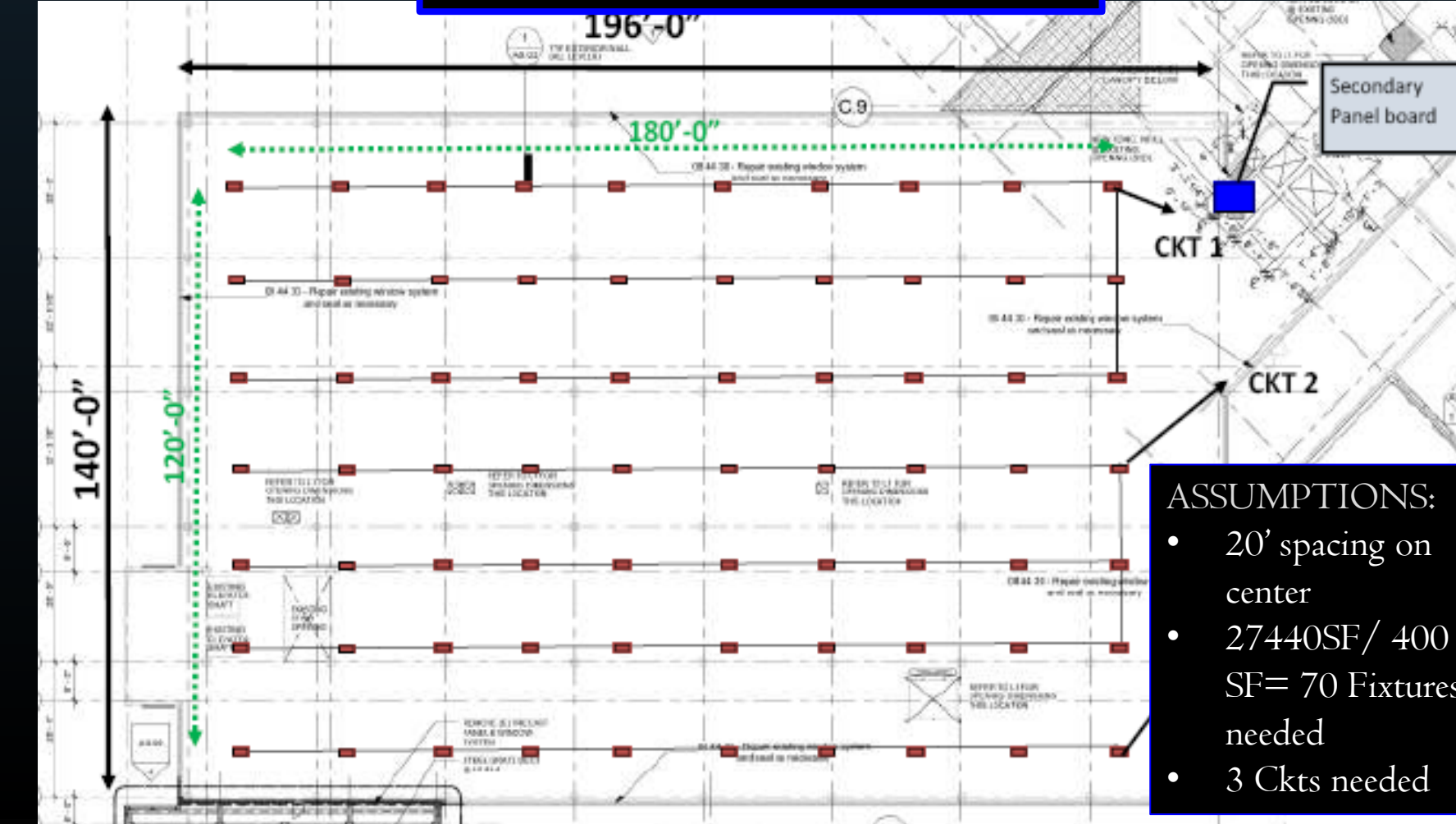


LED FLEX Power Plan



- ASSUMPTIONS:**
- LED Module Spacing: 15 ft
 - 8 kits per floor = 120 Modules per floor

Fluorescent Power Plan



- ASSUMPTIONS:**
- 20' spacing on center
 - 27440SF / 400 SF = 70 Fixtures needed
 - 3 Ckts needed

LED Temporary Lighting

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

Lighting/ Electrical Breadth Results:

Cost savings of \$12,600

From reduction in wiring needed

CONCLUSIONS

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

✓ Cost:

- Reduces labor and maintenance costs
- Power savings cost for whomever is paying electric
- Reduces layout cost

✓ Safety

✓ Sustainability

It is recommended to use the
FLEX SLS LED System

Green Roof Terraces

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

GOAL:

Utilize the 3 exterior terraces as Green Roof space to add value for the owner and benefit patients.



EXPECTED BENEFITS:

- Provide patient views/access to nature to promote healing
- Add value and sustainable features to the design of the building
- Further promote Kaiser Permanente as an innovative healthcare facility

Research: Health Benefits

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

Results of Green Roof Health Benefit Research

- Quicker patient recovery process
- Patients needed less medication
- Less unfavorable assessments
- Reduces transmission of sound by about 40 decibels
- Reduces stress for patients, staff, and families.
- Increases productivity of workforce
- Increases job satisfaction of workforce
- Decreases employee sick days



St Elizabeth Hospital in Appleton, Wisconsin

Green Roof Terraces

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

LIVE ROOF SYSTEM: MODULARIZED LITE ROOF

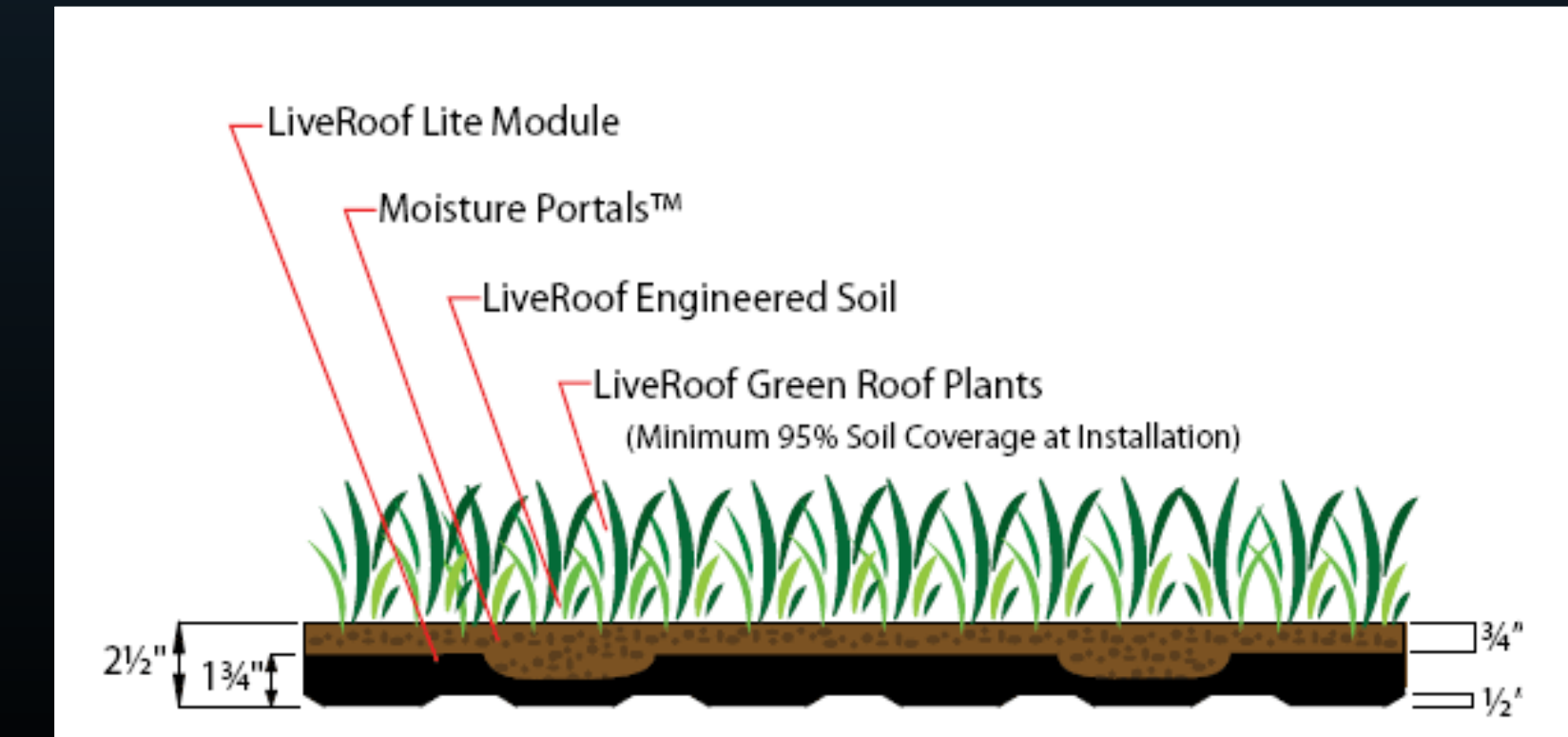
Dead Load (Concrete Slab) = 150 psf

Live Load for Assembly Areas (Non Reducible) = 100 psf

Snow Load = 18 psf

Total Load = 268 psf

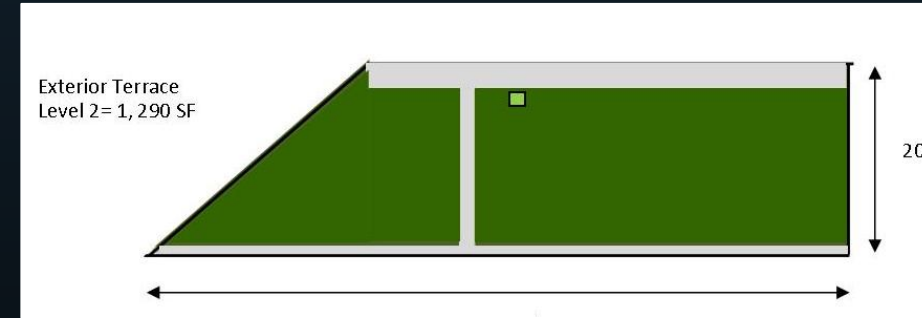
Structural Load + LiveRoof Load	Percent Change
Extensive: 268 psf + 15 psf = 283 psf	5%



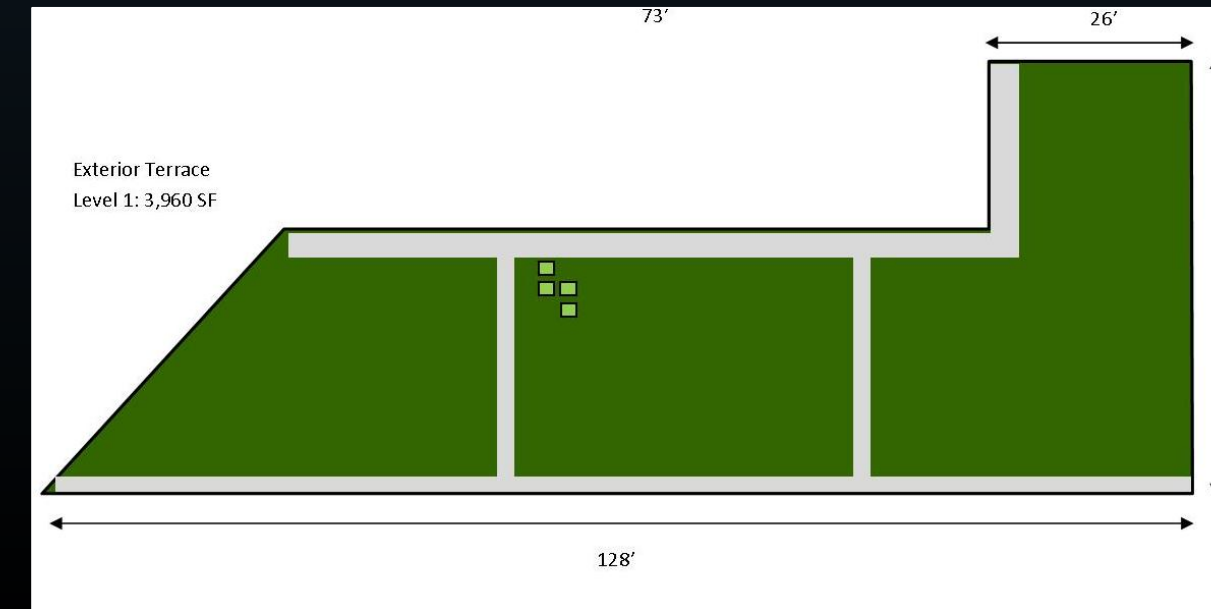
Design Layout

Presentation Outline:

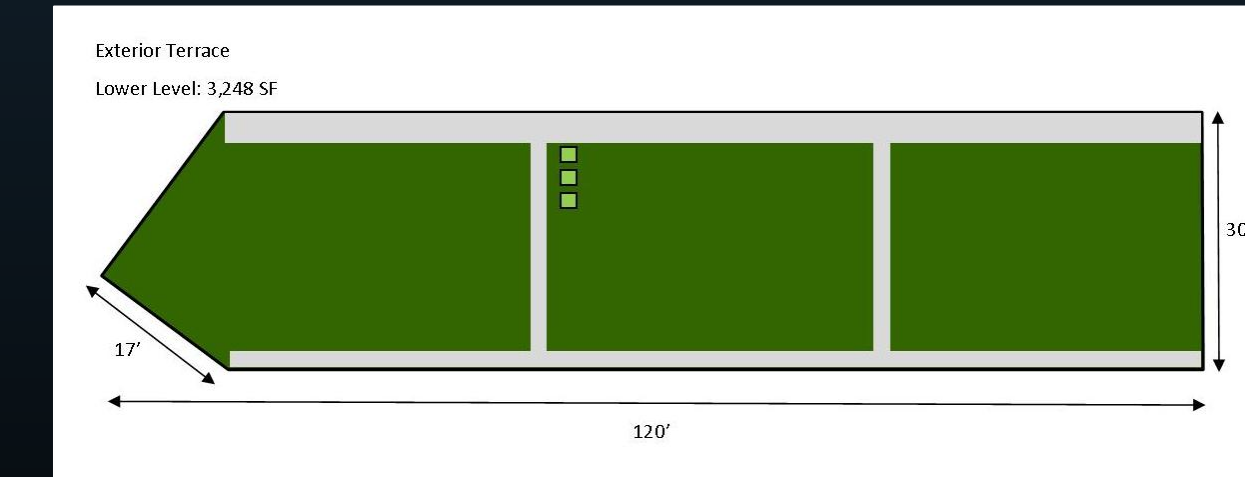
- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements



Lower Level
Terrace: 3,248 SF



First Level
Terrace: 3,960 SF



Second Level
Terrace: 1,290 SF

Total: 8,500 SF

Green Roof Terraces

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

COST

$$8,500 \text{ SF} \times \$16/\text{SF} \\ = \$136,000$$

- Typical payback period of 14 years from energy savings

SCHEDULE

- 8 day duration to complete the 3 Green Roof Terraces

CONCLUSION

It is recommended to utilize Green Roof Terraces when comparing cost of \$136,000 to the many benefits such as the healing process, sustainability, and quality offered.

CONCLUSIONS

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffe Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

Analysis 1: Integrated Project Delivery ✓ Implement

- Help cost & time lost from coffer design issue
- Early collaboration/more enjoyable/ innovative

Analysis 2: Curtain Wall Façade Re-design ✓ Implement

- \$402, 120 cost increase
- No schedule impact
- Improved aesthetics
- Increase water infiltration protection

Analysis 3: LED Temporary Lighting ✓ Implement

- Cost savings: \$165, 842
- Saves 88,036 Watts
- Ease of installation
 - Safety

Analysis 4: Green Roof Terraces ✓ Implement

- Cost: \$136000
- Health benefits
- Sustainable feature

Acknowledgements

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements



Dr. Chimay Anumba

AE Faculty

Family & Friends!

Thank you!

Questions

Presentation Outline:

- Project Background
- Analysis 1-IPD
 - IPD Case Study
 - Coffer Design Overview
- Analysis 2- Curtain Wall System
 - System Design
 - Cost/Schedule Impact
 - Benefit Analysis
- Analysis 3- LED Temp. Lighting
 - FLEX SLS System
 - Lighting/ Electrical Breadth
 - Feasibility Analysis
- Analysis 4- Green Roof Terraces
 - Health Benefit Research
 - Design Layout
- Final Conclusions
- Acknowledgements

