1099 New York Avenue

Washington, D.C.

William D. Cox
Construction Management

April 14, 2008

Presentation Outline

- **Project Overview**
- **LEED Evaluation**
- **Green Roof Energy Analysis** ***(Mechanical Breadth)***
- **Green Roof Structural Analysis** ***(Structural Breadth)***
- **Process Mapping MEP Coordination with Building Information Modeling**
- **Summary & Conclusions**
- **Questions**

Project Overview

Agenda

Project Overview

LEED Evaluation

Green Roof Energy Analysis

Green Roof Structural Analysis

Process Mapping MEP Coordination

Summary & Conclusions

- **173,260 Square Feet of Premier Office and Retail Space**
- **11 Stories Above Grade, 4 Stories Below Grade Parking**
- **Construction Costs: $31,600,000**
- **Project Duration: June 2006 through March 2008**

Project Team

Agenda

- Project Overview
- LEED Evaluation
- Green Roof Energy Analysis
- Green Roof Structural Analysis
- Process Mapping MEP Coordination
- Summary & Conclusions

Owner

Tishman Speyer

Architect

Thomas Phifer and Partners

Structural Engineer

Tadjer-Cohen-Edelson

MEP Engineer

Syska Hennesy Group

General Contractor

James G. Davis Construction

Project Features

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Structure

- **Foundation rests on 3,000psi Grade Beams and Spread Footings**
- **Parking Deck Structure comprised of combination 4", 8" and 12" reinforced concrete decks**
- **Building frame is 4,000 psi post-tensioned concrete with an Effective Post Tensioning Strength between 100 and 1000 kips**

Project Features

Mechanical

- (2) 1440 GPM 500 ton Cooling Towers serve (15) Self-Contained Water Cooled Air Conditioning Units at each level

- VAV Boxes with Reheat Coils to distribute air throughout occupied spaces

Project Features

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Electrical

- **Building Serviced by a 3ϕ, 4-Wire, 460/265 Volt, 4000A Main Bus that steps down through (3) 30KVA, 3ϕ, 460/120V Transformers**
- **Emergency Power Supplied by (1) 350/438 KW/KVA 480/277V Generator**

Project Features

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Curtainwall

- South and West facades are constructed of a high performance, low-e coated insulated glass system
- "Fish-scale" assembly, each panel lies in a separate geometric plane
- North and East facades composed of face brick and punch-out windows

Achieving Sustainability

Achieving Sustainability

Achieving Sustainability

Agenda

Problem

- After construction for 1099 New York Avenue had already been underway, Tishman Speyer enacted a new policy that state all new construction projects must be a minimum of LEED Silver

Objective

- Investigate project as designed to determine the credits already earned
- Develop guidelines for areas of improvement on 1099 New York Avenue and Future Projects

Achieving Sustainability

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LEED Silver

- **United States Green Building Council states that a core and shell construction project must earn a minimum of 28 Credits to be rated LEED Silver**

- **Six areas of focus**
  1. Sustainable Sites
  2. Water Efficiency
  3. Energy & Atmosphere
  4. Materials & Resources
  5. Indoor Environmental Quality
  6. Innovation & Design process

Achieving Sustainability

Evaluation of Current Credits Obtained

Sustainable Sites (3 Credits)

Water Efficiency (2 Credits)

Energy & Atmosphere (3 Prerequisites)

Materials & Resources (2 Credits)

Indoor Environmental Quality (1 Prerequisite, 2 Credits)

Achieving Sustainability

Evaluation of Credits to be Obtained

Target Areas

- Sustainable Sites (5 Credits)
- Water Efficiency (1 Credit)
- Energy & Atmosphere (3 Credits)
- Materials & Resources (1 Prerequisite, 4 Credits)
- Indoor Environmental Quality (1 Prerequisite, 6 Credits)

9 Previously Earned

+ 19 To be Earned

Total: 28 Credits

Achieving Sustainability

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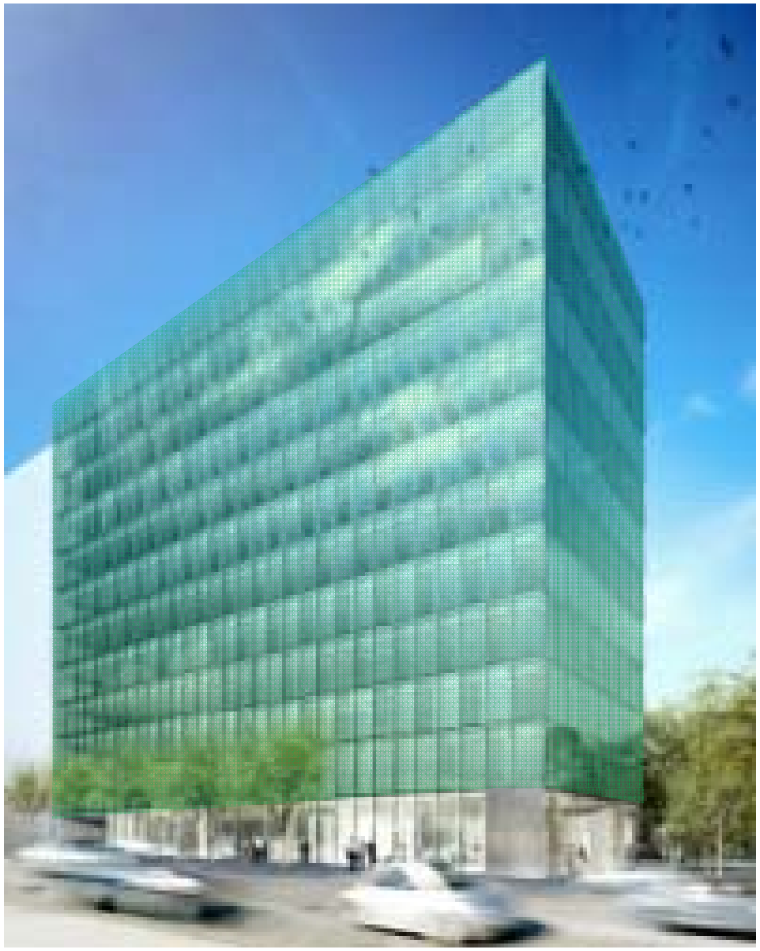
How can these credits be obtained?

- ➢ **Install bicycle racks within close proximity of the fitness center**
- ➢ **Reserve priority parking spaces for fuel efficient vehicles**
- ➢ **Reduce water usage by 20%**
- ➢ **Install a green roof that covers more than 50% of the building footprint**
- ➢ **Implement a Construction Waste Management Plan**
- ➢ **Use materials containing recycled content**
- ➢ **Control pollution of the indoor environment**

Achieving Sustainability

Why a Green Roof?

- **Reduce Stormwater Runoff**
  - Can retain up to 2" of rainfall
- **Reduce Urban Heat Island**
  - Decreases in the release of greenhouse gases
- **Increased Service Life of Materials**
  - Standard life cycle of 50 years
- **Energy Conservation**
  - Up to 50% reduction in consumption on the top floor
- **Improvement of the Aesthetic Environment**
  - Building already has a public access roof, enhance it!
- **Re-Green Washington, D.C.**
  - Initiative by ASLA for 21,700,000 sq ft of green roofs to be installed within the District of Columbia in the next 20 years



Green Roof Energy Conservation Analysis

Green Roof Energy Analysis

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Problem

➢ **The performance of a green roof varies upon:**
- Material Composition
- Orientation
- Area of Coverage
- Ratio of Coverage Area to Building Area

Objective

➢ **Develop an energy model of the building using TRACE 700 that includes the thermal properties of a green roof and compare against an energy model of the building as it was originally designed**

Green Roof Energy Analysis

Agenda

Estimated Energy Savings

Description	Electric Consumption (kWh)	Water Consumption (1000 gal)	Total Source Energy (kBtu/yr)
Primary Heating	101,605.4		10,404.4
Primary Cooling			
Cooling Compressor	278,840.5		28,553.3
Tower/Condenser	89,797	1,904.7	9,195.2
Cooling Accessories	8,760		897
Totals	**479,002.9**	**1,904.7**	**49,049.9**

Description	Electric Consumption (kWh)	Water Consumption (1000 gal)	Total Source Energy (kBtu/yr)
Primary Heating	95,785.6		9,808.5
Primary Cooling			
Cooling Compressor	274,133.8		28,071.4
Tower/Condenser	83,382.0	1,927.2	8,538.3
Cooling Accessories	8,760.0		897.0
Totals	**462,061.0**	**1,927.2**	**47,315.2**

Green Roof Energy Analysis

Estimated Energy Savings

Total Source Energy as Designed (kBtu/yr)	Total Source Energy w/ Green Roof (kBtu/yr)	Estimated Savings
49,049.9	47,315.2	3.54%

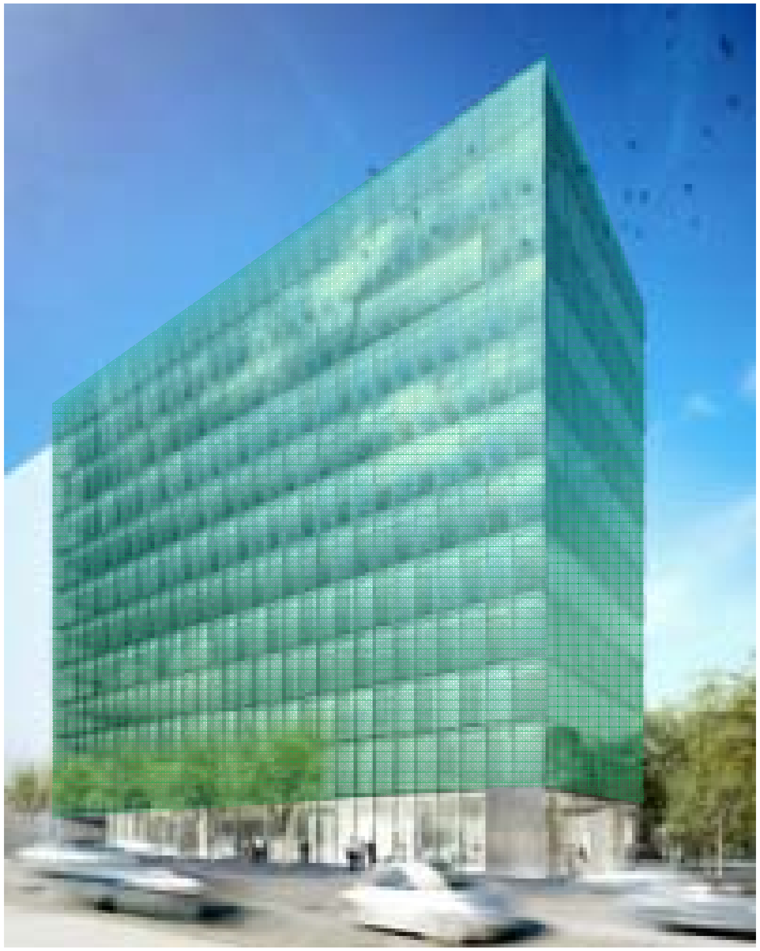
Estimated Cost Savings

Initial Cost Increase	Energy Savings (1 yr)	Energy Savings 20 yr (Life of Mechanical Equip.)	Energy Savings 50 yr (Life of Green Roof)
$82,700	$845	$16,900	$42,250

Green Roof Energy Analysis

Conclusions & Recommendations

- **Green Roofs are not the miracle cure for energy savings**
- **Less effective on taller buildings**
- **Despite small savings in performance, green roofs still offer other environmental benefits and installation is recommended**



Green Roof Structural Analysis

Green Roof Structural Analysis

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Problem

- The selected green roof system adds a load of 26 lbs/sq ft to the roof structure. The lower roof currently supports 22 lbs/sq ft, the penthouse roof only supports 8 lbs/sq ft.

Objective

- Analyze the current penthouse roof structure to determine if it can support the increased the load from the extensive green roof system. A slab redesign will be performed if necessary.

Green Roof Structural Analysis

Current Conditions

Loading (from ASCE7):

Live Load: 30 psf

Snow: 30 psf

Gravel Ballast: 5 psf

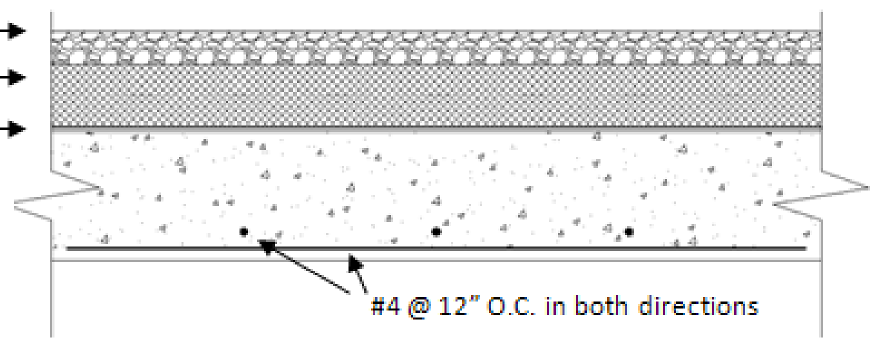
Polystyrene Foam Insulation: 1 psf

Filter Fabric: 1 psf

Waterproofing Membrane: 1 psf

Total Live Load = 30 psf

Total Dead Load = 38 psf



Current Penthouse Roof Section

Factored Loading: 1.2 D + 1.6 (L) + 0.5 (S) = 1.2 (8 psf) + 1.6 (30 psf) + 0.5 (30 psf) = 72.6 psf

Green Roof Structural Analysis

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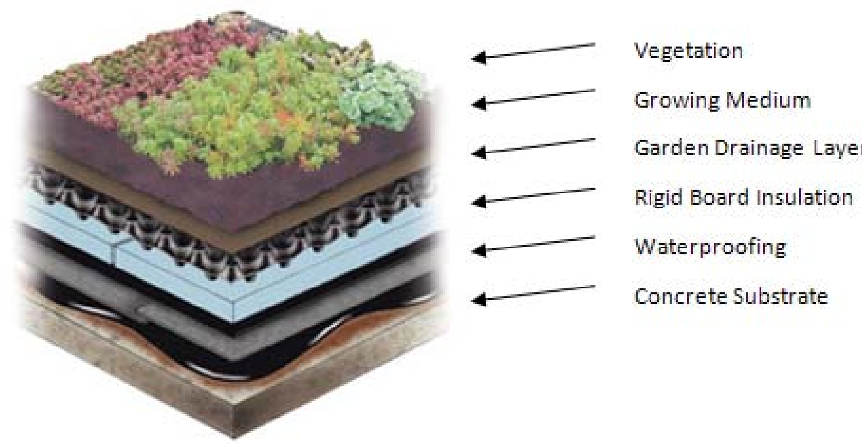
Proposed Conditions

Extensive Green Roof Loading:

Live Load: 30 psf
Snow Load: 30 psf
Extensive Green Roof System: 26 psf

Total Live Load = 30 psf
Total Dead Load = 56 psf



Factored Loading: 1.2 D + 1.6 (L) + 0.5 (S) = 1.2 (26 psf) + 1.6 (30 psf) + 0.5 (30 psf) = 94.2 psf

Green Roof Structural Analysis

Direct Design Method for Two-Way Slabs

	Location	M_u (ft-k)	b (in)	d (in)	M_u x 12/b (ft-k)	ρ	A_s (in^2)	Bars
Long Span								
(2) Half Col. Strip	Int. Neg.	50.3	84	7	7.2	0.0025	0.236	#5@12” O.C.
	Ext. Neg.	18.7	84	7	2.67	0.0021	0.200	#5@12” O.C.
	Positive	29.9	84	7	4.3	0.0021	0.200	#5@12” O.C.
Mid. Strip	Int. Neg.	16.8	132	7	1.5	0.0021	0.200	#5@12” O.C.
	Ext. Neg.	6.2	132	7	0.6	0.0021	0.200	#5@12” O.C.
	Positive	20	132	7	1.8	0.0021	0.200	#5@12” O.C.
Short Span								
Ext. Col. Strip	Negative	15.5	42	6	4.4	0.0024	0.230	#5@12” O.C.
	Positive	24.7	42	6	7.1	0.0029	0.280	#5@12” O.C.
Middle	Negative	13.9	84	6	2.0	0.0024	0.230	#5@12” O.C.
	Positive	16.5	84	6	2.4	0.0024	0.230	#5@12” O.C.
Int. Col. Strip	Negative	41.6	42	6	11.9	0.0050	0.480	#5@7 ½ ” O.C.
	Positive	324.7	42	6	7.1	0.0029	0.280	#5@12” O.C.

Green Roof Structural Analysis

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Green Roof Structural Analysis

Process Mapping MEP Coordination

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Slab Redesign

- **The slab was checked for punching shear. The nominal shear strength for the slab was calculated to be ϕV_c = 111.4 kips, factored shear was determined to be V_u = 53.9 kips**
- **No additional shear reinforcement was required**
- **Existing Drop Panels can be eliminated for savings**

Green Roof Structural Analysis

Cost Comparison

- **The green roof adds an additional $10 per sq ft**

Description	Cost
Original Roof Cost	$275,000
Additional Cost for Green Roof Material	$82,700
Increased Reinforcement	$1,000
Concrete Material Savings	($2,100)
Concrete Labor Savings (1 day)	($300)
Total Cost	**$356,300**

- **Total roofing cost is increased by 30%**

Green Roof Structural Analysis

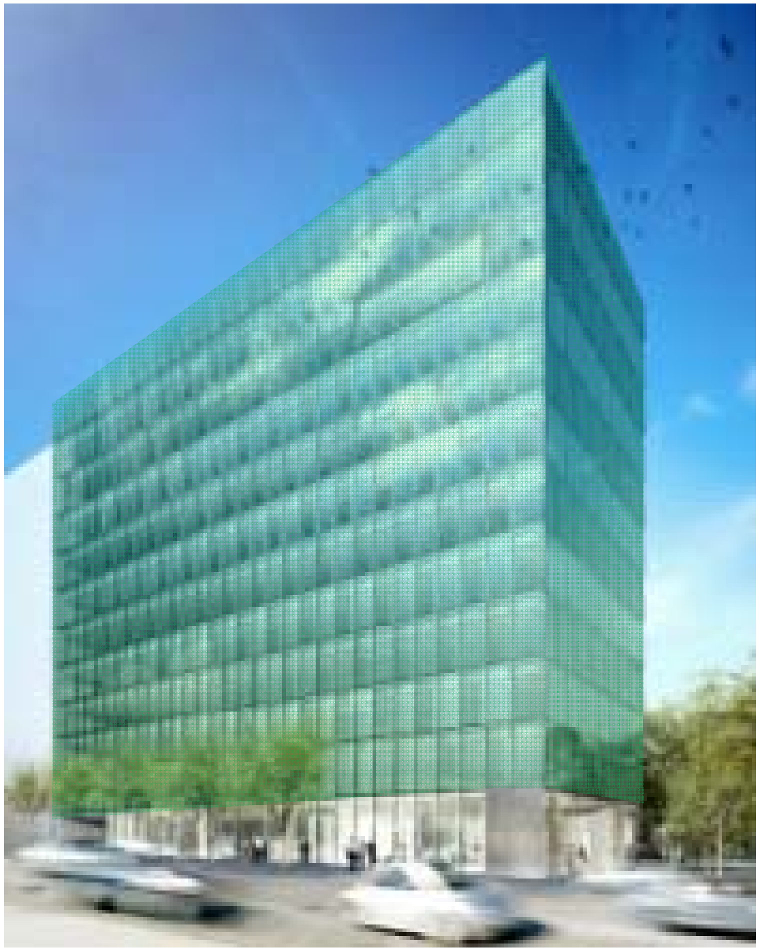
Schedule Impact

- The installation of a green roof would require an additional 2-3 days beyond the planned 35 days
- With the drop heads no loner being required, there is over 500 sq ft of formwork that no longer needs to be installed, a savings of one day

Green Roof Structural Analysis

Conclusions & Recommendations

- Structural design is simple
- Cost to redesign is feasible, in fact it's less
- Change in schedule is minimal
- Recommendation for green roof installation remains



Mapping & Testing the MEP Coordination Process

Thinking Lean

Principles of Lean Thinking

1. **Specify what does and does not create value from the customer's perspective**
2. **Identify all the steps necessary to design, order, and produce the products across the whole value stream**
3. **Make those actions that create value flow**
4. **Only make what is pulled by the customer**
5. **Strive for perfection by continually removing successive layers of waste**

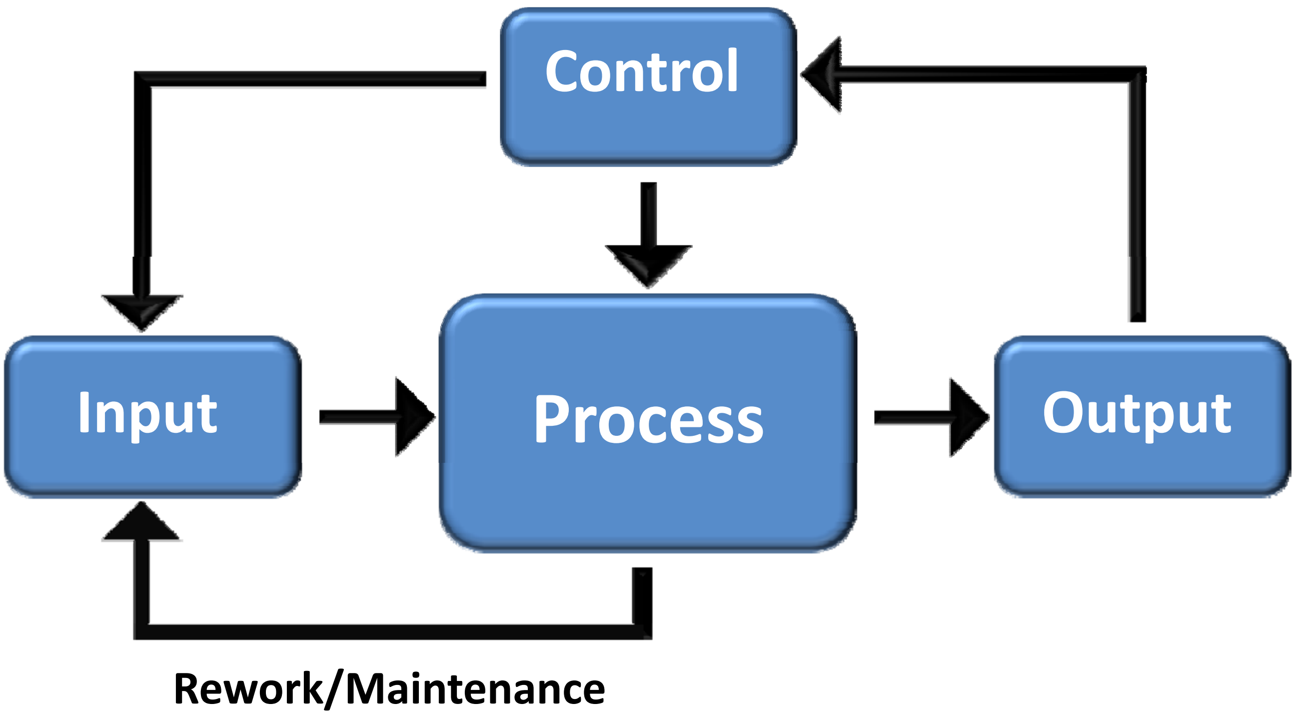
Thinking Lean

Moving Towards Lean Thinking

1. **Understand Waste**
2. **Establish Direction**
3. **Understand the process**
4. **Map the Process**

Process Mapping

Alexander's Dynamic System Model



Mapping MEP Coordination

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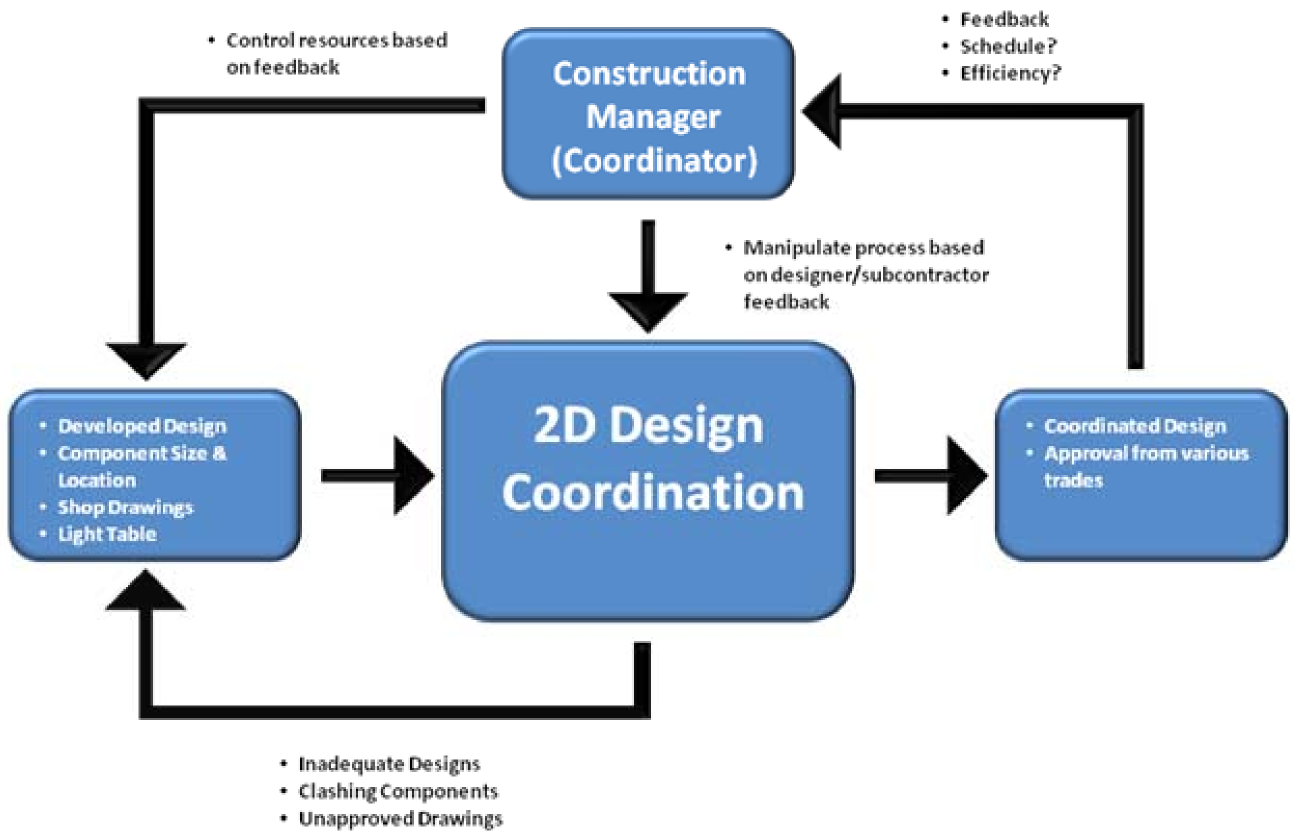
Process Mapping MEP Coordination

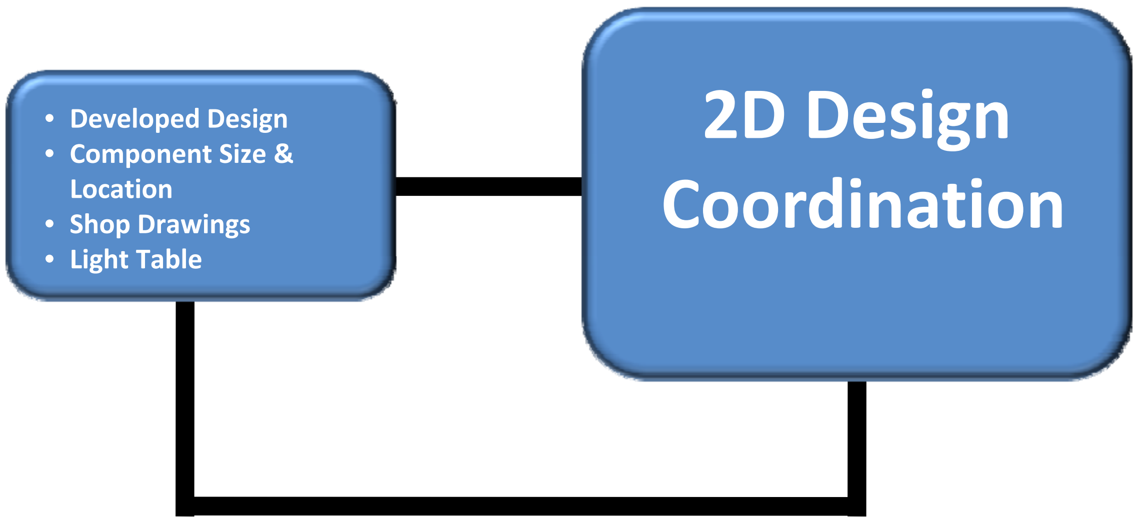
Summary & Conclusions

The 2D Design Coordination Process



Mapping MEP Coordination

Understand Waste/Establish a Direction



- Inadequate Designs
- Clashing Components
- Unapproved Drawings

Mapping MEP Coordination

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Process Mapping MEP Coordination

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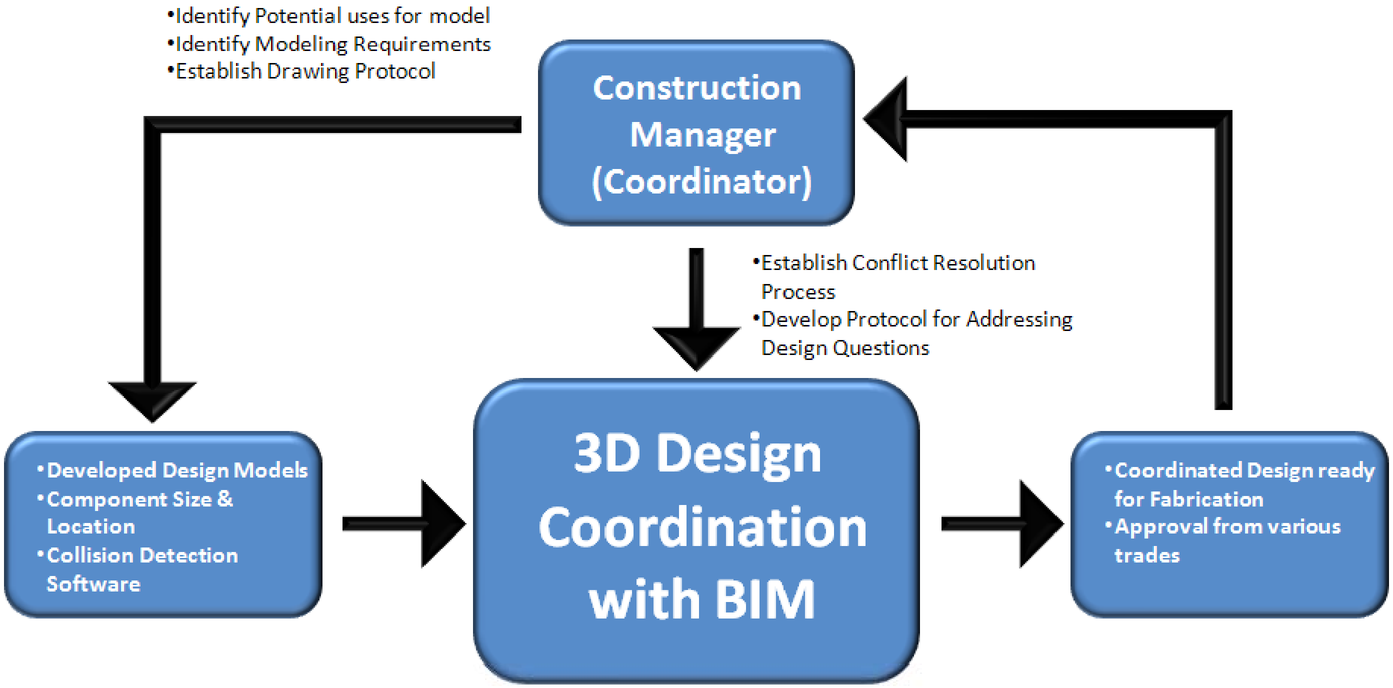
Mapping the 3D Design Coordination Process



Mapping MEP Coordination

Mapping the 3D Design Coordination Process

3D Design Coordination with BIM

- Integrate Discipline Specific 3D Models
- Identify Conflicts between Components/Systems
- Develop Solutions for the identified Conflicts
- Document Conflicts and Solutions

Mapping MEP Coordination

Problem

- During core construction, it was discovered that although the MEP Systems had been coordinated on the drawings, there was difficulty with fitting all of the components into the available space. This same problem was also noticed in the main lobby.

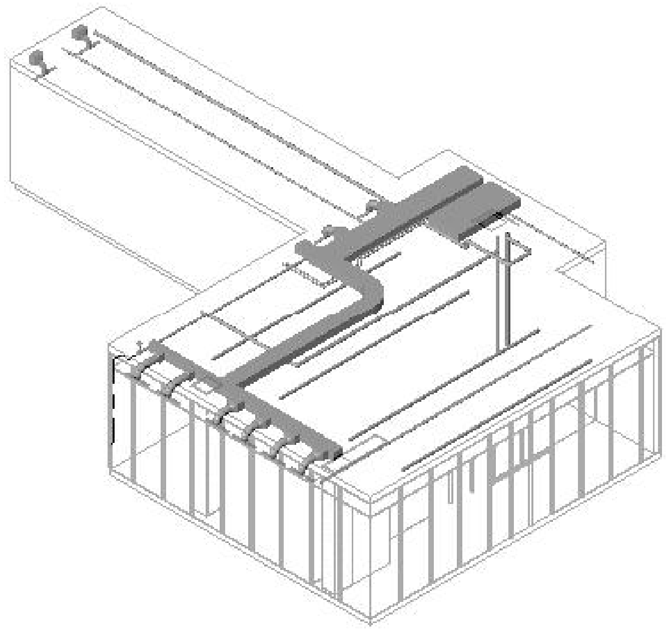
Objective

- Compare the 2D Design Coordination Process against the 3D Process to determine the potential time and cost savings.

Mapping MEP Coordination

Testing the 3D Design Coordination Process

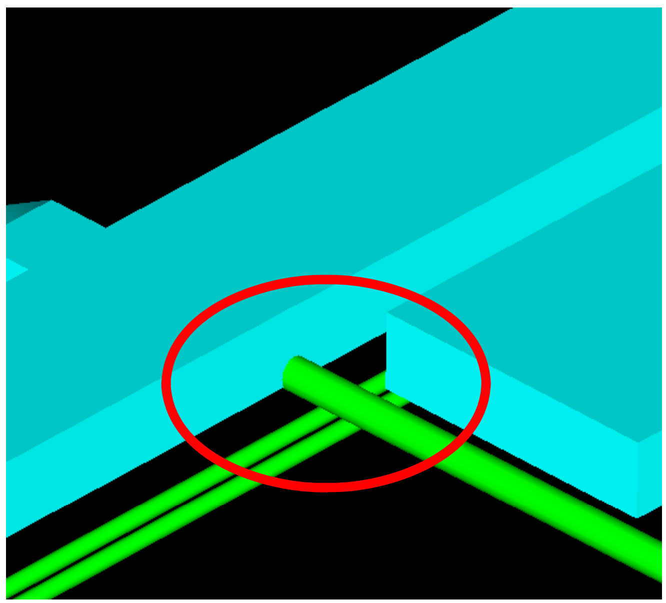
- **A 3 Dimensional Model of the Main Lobby and its MEP Components was constructed**



Mapping MEP Coordination

Testing the 3D Design Coordination Process

- The model was imported into Navisworks for the mechanical and plumbing systems were compared against each other



Mapping MEP Coordination

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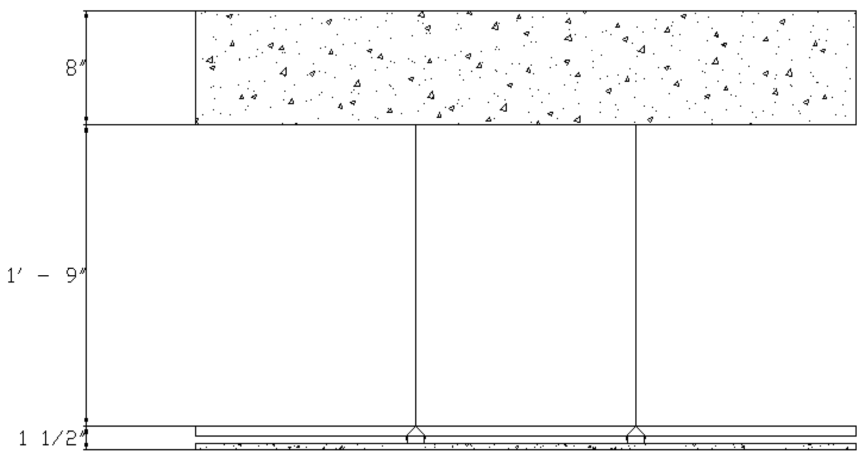
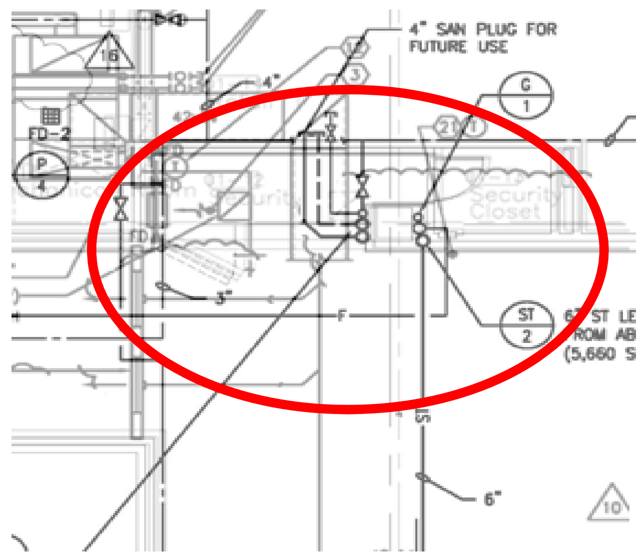
- **Process Mapping MEP Coordination**
- Summary & Conclusions

Why was there a collision?

- **System components with a combined depth of 2’ – 3” must pass through a plenum space that is only 1’ – 9” deep**

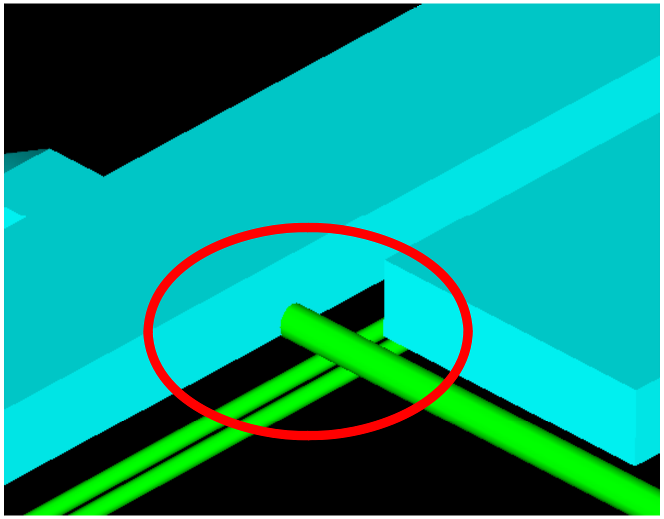


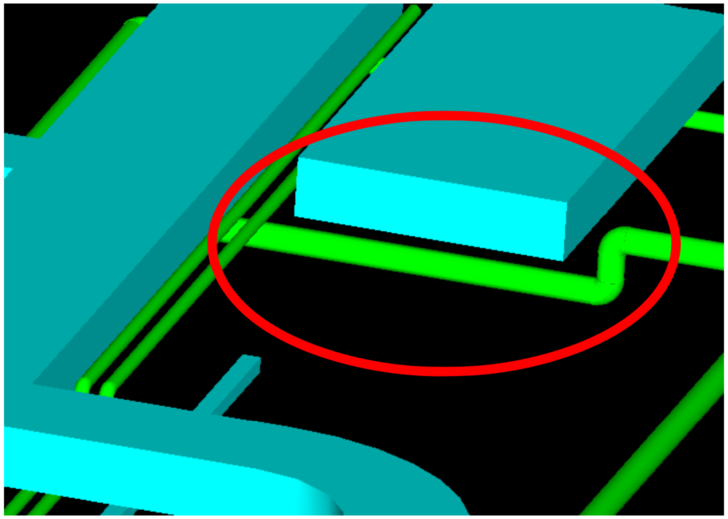


Mapping MEP Coordination

Finding a Solution

- **Two possible solutions:**
  1. Resize the pipe
  2. Relocate the pipe





Verifying the Process

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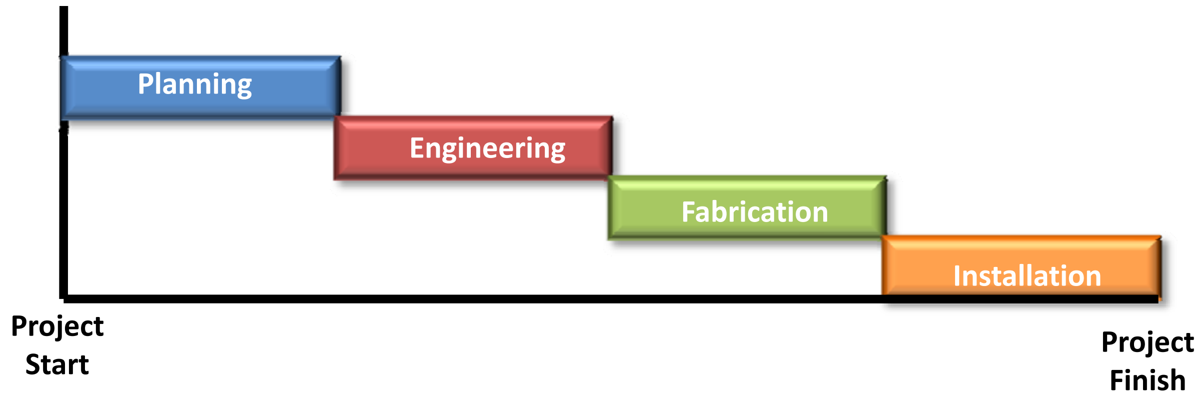
3D Design Coordination Experience

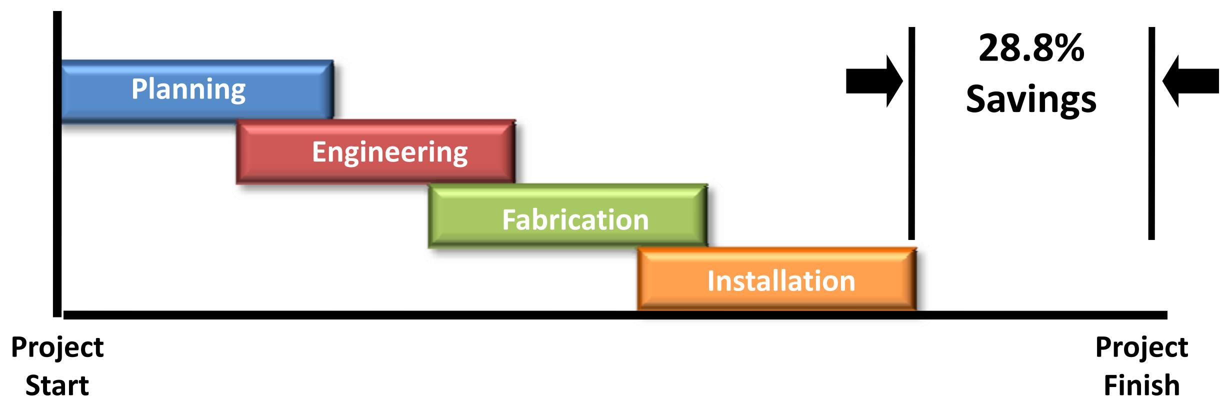
- **A series of five case studies were researched to determine the average increase in productivity while implementing BIM**

Project	Description	Estimated Increase in Productivity
A	General Motors Manufacturing Facility	30%
B	The Camino Medical Group Project	25%
C	Harborview Medical Center	50%
D	Alcoa World Alumina Plant	20%
E	NLA Federal Building	19%
	Average Productivity Increase	**28.8%**

Verifying the Process

Potential Savings

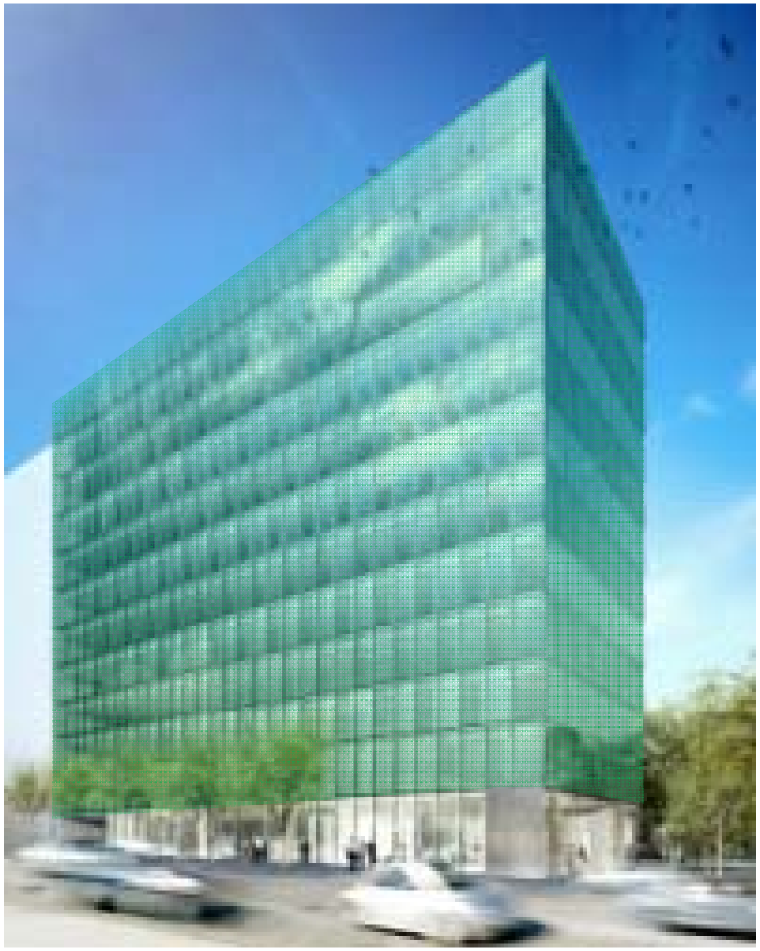




Mapping MEP Coordination

Conclusions & Recommendations

- **The majority of the projects surveyed were either healthcare or manufacturing facilities**
- **1099 New York Avenue is a Core & Shell Project, not MEP intensive**
- **Increased Productivity should be estimated as 60% of observed value**
- **Increase of 17.3% provides a four month schedule acceleration**
- **With such potential for efficiency and savings, begin implementing 3D Design Coordination Process as part of the LEED initiative**



Summary & Conclusions

Summary & Conclusions

Achieving Sustainability

- Easy to achieve when implemented at the correct stage of design
- Team effort, creating guidelines is the responsibility of the owner

Energy Considerations for Green Roofs

- Green roofs are not the miracle cure for optimizing energy performance
- Still has other environmental benefits

Summary & Conclusions

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Process Mapping MEP Coordination

Summary & Conclusions

Structural Considerations for Green Roofs

- Cost of structural redesign is feasible
- A green roof can pay for itself over a period of 20 years

Mapping & Testing the MEP Coordination Process

- Potential for 17.3% increase in productivity, 4 month schedule acceleration
- Implement Lean Process as part of the sustainability policy

Acknowledgements

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James G. Davis Construction Corporation

Bill Moyer
Fulya Kocak
Jim Dugan
Dave Masters
Andy Cecere
Dan Hardnock
Joel Miller

Tishman Speyer Properties

Charlie Yetter
Cynthia Bowden

Syska Hennesey Group

Jim Miller

Barton Malow Company

Mark Falzarano
Corinne Ambler

ONCORE Construction

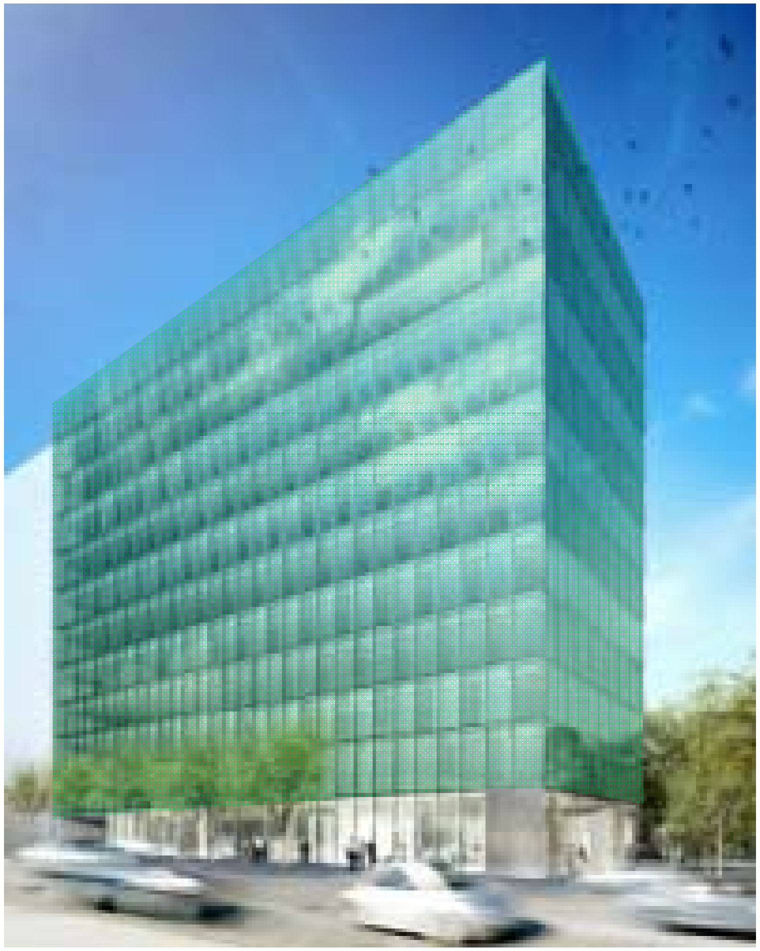
Ray Sowers

Prospect Waterproofing

Jay Britton

The Pennsylvania State University

Dr. Bahnfleth
Dr. Riley
Dr. Horman
M. Kevin Parfitt
Dr. Messner



Questions?