GOUVERNEUR HEALTHCARE SERVICES FACILITY

NEW YORK, NEW YORK, 10002

ALEX DESPOTOVICH | CONSTRUCTION MANAGEMENT
FACULTY ADVISOR: DR. JOHN I. MEISNER
APRIL 10, 2012
GOVERNUEUR HEALTHCARE SERVICES FACILITY

- New York, New York, 10002
- New York City Health and Hospitals Corporation, HHC
- Design-Bid-Build with CM Agency
- Dormitory Authority of the State of New York, DASNY
- Hunter Roberts Construction Group
- Total Project Cost: $207,000,000
- Project Construction Start Date: January 2009
- Final Project Completion Date: December 2013
**Presentation Outline**

- **Project Background**
- The Use of Building Information Modeling
- Schedule and Tenant Occupancy
- Material, Scheduling and System Prefabrication
- Sustainable-Green Roof Garden
- Recommendations and Conclusions
- Acknowledgements

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**Gouverneur Healthcare Services Facility**

**New York, New York, 10002**

**Scope of Work**

- Interior Demolition and Renovation of Existing Building
- Modernization of Existing Mechanical Infrastructure
- New 109,000 Square Foot Addition

**Construction Challenges**

- Existing Facility Active During Construction
- Schedule Phasing of Floor Turnovers
- Site Logistics of New York City
- Asbestos Removal throughout Existing Facility
THE USE OF BUILDING INFORMATION MODELING

TECHNICAL ANALYSIS BACKGROUND

- Building Information Modeling methods not applied for design and construction
- Complex MEP systems to support buildings function designed and coordinated in 2-dimensions
- Large facility causes the current punchlist process to be tedious and time consuming

TECHNICAL ANALYSIS RESEARCH GOALS

- Identify feasibility of implementing 3D model for coordination of design and construction for the new and existing building
- Identify more efficient method for the punch list process
THE USE OF BUILDING INFORMATION MODELING
THE APPLICATION OF 3D MODELING

PRESENTATION OUTLINE
• PROJECT BACKGROUND
• THE USE OF BUILDING INFORMATION MODELING
• TECHNICAL ASPECT BACKGROUND
• THE APPLICATION OF 3D MODELING
• THE APPLICATION OF VELA SYSTEMS
• SCHEDULE REQUISITES AND TANDEM OCCUPANCY
• MATERIAL, STORAGE AND SYSTEM PREPARATION
• SYSTEMS GEOMETRY BOTH GUIDED
• RECOMMENDATIONS AND CONCLUSIONS
• ACKNOWLEDGEMENTS

PRESIDENT
STANDARDS OF NEW YORK

TOWER CRANE PLANNING

FITTERMAN HALL CASE STUDY

- 400,000 ft², 14-story educational facility in New York, New York
- Hunter Roberts Construction Group initiated utilization of 3D model for design and construction coordination
- 75 to 100 clashes per floor
- Reduce changes orders and increase communication
- Most Beneficial:
  - Tower Crane Planning
  - Mechanical Penthouse Coordination

GOUVERNEUR HEALTHCARE SERVICES FACILITY
New York, New York, 10002

GOUVERNEUR HEALTHCARE SERVICES APPLICATION OF 3D MODEL

- Utilized 3D and 4D model for sequencing of major equipment of the existing 14th floor mechanical equipment room

NEW BUILDING CONSTRUCTION

- Feasible to utilize 3D model for design and construction coordination
- Reduce clashes between systems in the field – change order reduction
- Primary Concern – Modeling new to existing building

EXISTING BUILDING CONSTRUCTION

- Not feasible to utilize 3D model due to schedule phasing
- Inaccuracy of as-builds unreliable for 3D model
- Laser scanning cause delays in phased schedule
Hudson Greene Case Study

- Two 50-story residential towers, 1.5 million ft²
- Utilized VELA Systems software to increase efficiency of punchlist process
- VELA-equipped tablets for field personnel

Project Benefits
- Increased Efficiency
- Document Management
- Increased Communication
- Future Recommendations
  - Use of iPad for Tablets
  - Training within company

Item | Cost
--- | ---
Project Setup on VELA Systems' Servers | $5000 – One Time Cost
VELA Training Session – 1 Day | $3000 – One Time Cost
License Cost per User – 8 Total Users | $200 per Month per User - $1600 per month
Field Tablets – 4 Total Tablets | $3000 per Tablet - $12,000 Total

12 Apartment Units per Floor per Building

134 man hours for traditional process and 33 for VELA punchlist process

**Total Man Hour Savings:** 10,100 hrs.
**THE USE OF BUILDING INFORMATION MODELING**
**THE APPLICATION OF VELA SYSTEMS**

- Utilized VELA Systems software to increase efficiency of punchlist process
- VELA-equipped tablets for field personnel
- Lessons Learned from Hudson Greene
- Use iPad for Tablets to reduce costs
- Train personnel within company to reduce costs

### PROJECT COSTS IMPACT

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Project Setup on VELA Systems’ Servers</td>
<td>$500 - One Time Cost</td>
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<tr>
<td>VELA Training Session - 1 Day</td>
<td>$0</td>
</tr>
<tr>
<td>License Cost per User - 4 Total Users</td>
<td>$290 per Month per User - $80 per month</td>
</tr>
<tr>
<td>Field Tablets - 2 Total Tablets</td>
<td>$700 per Tablet - $1,400 Total</td>
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</tbody>
</table>

**FLOOR SIX THROUGH ELEVEN**
- 40 Residential Spaces
  - 160 man hours for traditional process and 36 for VELA punchlist process

**FLOORS TWO THROUGH FIVE**
- 60 Exam and Consult Spaces
  - 203 man hours for traditional process and 42 for VELA punchlist process

**TOTAL MAN HOUR SAVINGS:** 2000 hrs.
**TOTAL COST:** $25,000
SCHEDULE RE-SEQUENCING AND TENANT OCCUPANCY

TECHNICAL ANALYSIS BACKGROUND

- Owner turns over floors to construction for demolition and renovation in scattered order
- Residential floors six through eleven contain identical floor layouts and share phasing relationship
- Phasing relationship is affected by the duration in which owner can move occupants from existing to newly renovated spaces

TECHNICAL ANALYSIS RESEARCH GOALS

- Perform schedule re-sequencing to create a direct relationship between residential floors
- Identify more efficient method to managing the occupancy move-in process for newly constructed and renovated floors
PRESENTATION OUTLINE

• PROJECT BACKGROUND
• THE USE OF BUILDING INFORMATION MODELING
• SCHEDULE RE-SEQUENCING AND TENANT OCCUPANCY
• TECHNICAL ANALYSIS BACKGROUND
• SCHEDULE RE-SEQUENCING THE PROJECT SCHEDULE
• CONSTRUCTION IMPACT
• SCHEDULE RE-SEQUENCING THE PROJECT SCHEDULE
• TECHNICAL ANALYSIS BACKGROUND

CREATE RELATIONSHIP BETWEEN

Floors Six and Nine
Floors Seven and Ten
Floors Eight and Eleven

SCHEDULE RE-SEQUENCING AND TENANT OCCUPANCY

ORIGINAL PHASING RELATIONSHIP

RE-SEQUENCING PHASING RELATIONSHIP

CREATION RELATIONSHIP

Floors Six and Nine
Floors Seven and Ten
Floors Eight and Eleven

SCHEDULE RE-SEQUENCING AND TENANT OCCUPANCY

ORIGINAL PHASING RELATIONSHIP

RE-SEQUENCING THE PROJECT SCHEDULE

ORIGINAL VERSUS RE-SEQUENCED SCHEDULE REDUCTION

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Original Schedule</th>
<th>Re-sequenced Schedule</th>
<th>Duration Saved</th>
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<tbody>
<tr>
<td>10th Floor Construction and Move-In</td>
<td>10/25/2012</td>
<td>7/10/2012</td>
<td>107</td>
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<tr>
<td>11th Floor Construction and Move-In</td>
<td>4/25/2013</td>
<td>7/15/2013</td>
<td>182</td>
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<tr>
<td>Project Substantial Completion</td>
<td>12/30/2013</td>
<td>7/15/2013</td>
<td>168</td>
</tr>
</tbody>
</table>

SCHEDULE RE-SEQUENCING GENERAL CONDITIONS COST SAVINGS

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration Saved</th>
<th>General Conditions per Day</th>
<th>Total Cost Savings</th>
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<tbody>
<tr>
<td>Project Substantial Completion</td>
<td>168 days</td>
<td>$10,013</td>
<td>$1,682,184</td>
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</table>

DURATION SAVINGS: 168 Days
COST SAVINGS: $1,682,184
# Schedule Re-Sequencing and Tenant Occupancy
## Re-Sequencing the Project Schedule

### Creates Efficient Flow of Construction

<table>
<thead>
<tr>
<th>Phase</th>
<th>Legend</th>
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<tbody>
<tr>
<td></td>
<td>Occupied Floors</td>
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<tr>
<td>Phase I</td>
<td><img src="image" alt="Phase I Legend" /></td>
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<tr>
<td>Phase II</td>
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<tr>
<td>Phase III</td>
<td><img src="image" alt="Phase III Legend" /></td>
</tr>
<tr>
<td>Phase IV</td>
<td><img src="image" alt="Phase IV Legend" /></td>
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</tbody>
</table>

### Presentation Outline
- Project Background
- The Use of Building Information Modeling
- Schedule Re-Sequencing and Tenant Occupancy
- Technical Analysis Background
- Re-Sequencing the Project Schedule
- Construction Impact
- Schedule Concerns
- Facility Management Tools
- BIM Interact Move Management
- Cost and Schedule Impact
- Miscellaneous: Systems and System Interfacing
- Sustainable, Green Roof Gardens
- Recommendations and Conclusions
- Acknowledgements

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SCHEDULE RE-SEQUENCING AND TENANT OCCUPANCY

OWNER CONCERNS

How much revenue will be lost as a result of re-sequencing?

Long-term residential care spaces = $255.27 per day per occupant

Average of 50% occupancy for 40 patients per residential floor

POTENTIAL REVENUE LOSS

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Patient Revenue</th>
<th>Patients per Floor</th>
<th>Total Revenue</th>
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</thead>
<tbody>
<tr>
<td>10th Floor Construction and Move-In</td>
<td>107</td>
<td>$255.27</td>
<td>20</td>
<td>$566,278</td>
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<tr>
<td>11th Floor Construction and Move-In</td>
<td>182</td>
<td>$255.27</td>
<td>20</td>
<td>$928,182</td>
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<tr>
<td>Total Revenue</td>
<td></td>
<td></td>
<td></td>
<td>$1,494,460</td>
</tr>
</tbody>
</table>

TOTAL COST SAVINGS: $206,723
**Presentation Outline**

- **Project Background**
- **The Use of Building Information Modeling**
- **Schedule Re-Sequencing and Tenant Occupancy**
- **Technical Analysis Background**
- **Re-Sequencing the Project Schedule**
- **Construction Impact**
- **Ongoing Considerations**
- **Facility Management Tools**
- **FM:INTERACT Move Management**
- **Cost and Schedule Impact**
- **Material, System, and System Prefabrication**
- **Ongoing Benefits and Bigger Picture**
- **Recommendations and Conclusions**
- **Acknowledgments**

**Schedule Re-Sequencing and Tenant Occupancy**

**Facility Management Tools**

- Manage building occupancy moves
- Cut down time and costs related to occupancy moves
- "Twice the people in the half the time" – FM:Systems
- Color code departments and rooms to manage individuals locations before and after moving
- Manage individual assets during moves

**FM:Systems INTERACT Move Management Software**

- Manage building occupancy moves
- Cut down time and costs related to occupancy moves
- "Twice the people in the half the time" – FM:Systems
- Color code departments and rooms to manage individuals locations before and after moving
- Manage individual assets during moves

**Cost and Schedule Analysis**

- Overall System Cost based on 2-year period of use: $129,548
- New Building Move-In Reduction: 14 days
- Existing Building Move-In Reduction: 7 days/floor
- Overall Schedule Reduction: 14 days
- General Conditions Cost Savings: $140,182
- Revenue Generated through Reduction: $428,854

**Overall Duration Savings:** 14 Days
**Total Cost Savings:** $439,488
PRESENTATION OUTLINE

• Project Background
• The Use of Building Information Modeling
• Technical Analysis Background
• Material Staging and System Prefabrication
  • Technical Analysis Background
  • Miami Valley Hospital Case Study
  • Area of Improvement
  • Project Specific Modelling
• Materials Staging Plan
• Cost and Schedule Analysis
• Sustainable Green Roof Gardens
• Recommendations and Conclusions
• Acknowledgements

MATERIAL STAGING AND SYSTEM PREFABRICATION

TECHNICAL ANALYSIS BACKGROUND

- Site access for material is a daily challenge for project team
- High volume of complex MEP equipment to support new buildings function

TECHNICAL ANALYSIS RESEARCH GOALS

- Utilize integrated, prefabricated MEP racks to reduce construction cost and schedule
- Identify more efficient approach to material delivery and site utilization
- Identify any issues that may arise with prefabrication and New York City construction unions

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MATERIAL STAGING AND SYSTEM PREFABRICATION
MIAMI VALLEY HOSPITAL CASE STUDY

- $137 million, 12-story, 484,000 SF diagnostic and treatment facility
- Major Prefabricated Components
  - Patient Rooms
  - Integrated MEP Racks
  - Temporary Pedestrian Footbridge
  - Integrated MEP Racks
    - 16 foot corridors – Two 8x22 foot modules
    - Just-In-Time delivery method
    - 300% increase in labor productivity

3D Coordination Model
Working at Bench Height
Racks Complete for Delivery
Racks Delivered to Site
Cranes Lifts Racks to Floor
Racks Installed in Corridor

PRESERVATION

OUTLINE

• PROJECT BACKGROUND
• THE USE OF BUILDING INFORMATION MODELING
• SCHEDULING, RESEQUENCING AND TENANT OCCUPANCY
• MATERIAL STAGING AND SYSTEM PREFABRICATION
  • TECHNICAL ANALYSIS BACKGROUND
  • MUSKEG VALLEY HOSPITAL CASE STUDY
  • AREA OF IMPLEMENTATION
• PROJECT SPECIFIC MODULES
  • MATERIAL STAGING PLAN
  • ECONOMIC ANALYSIS
• SUSTAINABLE BREEZE ROOF GARDENS
• RECOMMENDATIONS AND CONCLUSIONS
• ACKNOWLEDGEMENTS

CORRIDOR LOCATION OF RACKS

• 2nd Floor Exam Room and Atrium
• 3rd Floor Exam Room and Atrium
• 4th Floor Mixed-Use and Atrium
• 5th Floor Consult and Group Room

MATERIAL STAGING AND SYSTEM PREFABRICATION

AREA OF IMPLEMENTATION

2ND FLOOR
4557 ft² or 28% Ceiling Usage

3RD FLOOR
4011 ft² or 24% Ceiling Usage

4TH FLOOR
3946 ft² or 26% Ceiling Usage

5TH FLOOR
1990 ft² or 13% Ceiling Usage
Modules by Corridor Type
- 5 ft. Corridor: 1 – 5 ft. Module
- 8 ft. Corridor: 1 – 8 ft. Module
- 12 ft. Corridor: 2 – 6 ft. Modules
- 16 ft. Corridor: 2 – 8 ft. Modules

Space Designation
Length of Rack | Area of Prefabrication
--- | ---
Second Floor
5 ft. Corridor | 325 | 1625
8 ft. Corridor | 35 | 296
12 ft. Corridor | 137 | 1644
16 ft. Corridor | 62 | 992
Total | 561 | 4495
Third Floor
5 ft. Corridor | 353 | 1775
8 ft. Corridor | 37 | 296
12 ft. Corridor | 79 | 948
16 ft. Corridor | 62 | 992
Total | 533 | 4011
Fourth Floor
5 ft. Corridor | 290 | 1450
8 ft. Corridor | 150 | 1300
12 ft. Corridor | 64 | 768
16 ft. Corridor | 33 | 528
Total | 537 | 3946
Fifth Floor
5 ft. Corridor | 398 | 1990
Total | 398 | 1990
PRESENTATION OUTLINE

- Project Background
- The Use of Building Information Modeling
- Managing Risk Assessments and Tenant Occupancy
- Material Staging and System Prefabrication
- Technical Analysis Background
- Medical Valley Hospital Case Study
- Area of Implementation
- Project Specific Modules
- Material Staging
- Cost and Schedule Analysis
- Sustainable Green Roof Gardens
- Recommendations and Conclusions
- Acknowledgements

JUST-IN-TIME CONSTRUCTION APPROACH

- Maximum efficiency for production and delivery of racks
- Understand manufacturing versus delivery versus installation rates

<table>
<thead>
<tr>
<th>Module Specifications</th>
<th>Total Quantity of 20 ft. Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>Total Length</td>
</tr>
<tr>
<td>5 ft</td>
<td>1368</td>
</tr>
<tr>
<td>8 ft</td>
<td>224</td>
</tr>
<tr>
<td>12 ft</td>
<td>280</td>
</tr>
<tr>
<td>16 ft</td>
<td>157</td>
</tr>
<tr>
<td>Total</td>
<td>123</td>
</tr>
</tbody>
</table>

- 4 racks per truck = 32 Deliveries
- Multiple warehouses with 10 to 15 miles of site
- Short Haul Flatbed Truck = $2.66 per mile²
- Estimated Delivery Cost: between $2265 and $3400

45' to 53' Long

8' to 8 1/2' Wide

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PRESENTATION OUTLINE

• Project Background
• The Use of Building Information Modeling
  • Design and Construction Timing and Tenant Occupancy
• Material Staging and System Prefabrication
  • Technical Analysis Background
  • Miami Valley Hospital Case Study
  • Area of Implementation
  • Project Specific Modelled
  • Material Staging
  • Zoning Analysis
  • Cost and Schedule Analysis
• Sustainable Green Roof Garden
• Recommendations and Conclusions
• Acknowledgements

ATLANTIC YARDS PROJECT

$4.9 billion basketball arena and 16 high-rise buildings in Brooklyn, New York

Seeking prefabrication of 350-unit apartment complex

Reduction of pay from on-site to warehouse about 60%

INDUSTRY PROFESSIONALS

Purchased and assembled outside of New York City by non-union workers

Must be installed on-site by union laborers
PRESENTATION OUTLINE

• PROJECT BACKGROUND
  • The Use of Building Information Modeling (BIM) in Healthcare Projects and Tenant Occupancy
  • Material Staging and System Prefabrication
  • Technical Analysis Background
  • Miami Valley Hospital Case Study: Areas of Implementation
  • Project Specific Modules
  • Material Staging
  • Cost and Schedule Analysis
  • Sustainability, BIM Case Studies
  • Acknowledgements

COST AND SCHEDULE ASSUMPTIONS

- 150% Productivity Increase
- 40% Compensation Reduction
- 8-hour work days

SCHEDULE REDUCTION FROM MEP MODULES

<table>
<thead>
<tr>
<th>Installation Activity</th>
<th>Original Installation Duration</th>
<th>Prefabrication Installation Duration</th>
<th>Duration Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Installation</td>
<td>115 days</td>
<td>82 days</td>
<td>33 days</td>
</tr>
<tr>
<td>Electrical Installation</td>
<td>75 days</td>
<td>57 days</td>
<td>18 days</td>
</tr>
<tr>
<td>Plumbing Installation</td>
<td>217 days</td>
<td>118 days</td>
<td>99 days</td>
</tr>
<tr>
<td>Fire Protection Installation</td>
<td>29 days</td>
<td>19 days</td>
<td>10 days</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>280 days</strong></td>
<td><strong>200 days</strong></td>
<td><strong>80 days</strong></td>
</tr>
</tbody>
</table>

WAGE REDUCTION FROM ON-SITE TO WAREHOUSE CONDITIONS

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Hourly Wages</th>
<th>Quantity of Laborers</th>
<th>Daily Costs per Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td>$101.67</td>
<td>$61.00</td>
<td>$4,066.80</td>
</tr>
<tr>
<td>Electrical</td>
<td>$103.31</td>
<td>$61.99</td>
<td>$4,958.88</td>
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<tr>
<td>Plumbing</td>
<td>$103.31</td>
<td>$61.99</td>
<td>$4,958.88</td>
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<tr>
<td>Fire Protection</td>
<td>$134.80</td>
<td>$80.88</td>
<td>$3,232.20</td>
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</tbody>
</table>

TOTAL LABOR COST SAVINGS

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Original Labor Costs</th>
<th>Prefabrication Labor Costs</th>
<th>Total Cost Savings</th>
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<tbody>
<tr>
<td>Mechanical</td>
<td>$1,023,734</td>
<td>$405,399</td>
<td>$618,336</td>
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<tr>
<td>Electrical</td>
<td>$478,662</td>
<td>$189,550</td>
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<td>Plumbing</td>
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<td>$426,716</td>
<td>$650,849</td>
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<td>Fire Protection</td>
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<td>$75,395</td>
<td>$114,996</td>
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<td><strong>Total</strong></td>
<td><strong>$2,770,353</strong></td>
<td><strong>$1,097,060</strong></td>
<td><strong>$1,673,293</strong></td>
</tr>
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OVERALL DURATION SAVINGS: 200 Days
TOTAL COST SAVINGS: $1,673,293
Alternate roof design included sustainable roof garden on the 6th floor roof of the new building.

Financial restrictions prevented the owner from moving forward with implementing the green roof design.

Provide an area for use of occupants, increase energy efficiency, and potentially save the owner long term money.

Determine impact of green roof to building mechanical and structural systems.
## SUSTAINABLE GREEN ROOF GARDEN
### ORIGINAL VS. PROPOSED GREEN ROOF DESIGN

#### PRESENTATION OUTLINE
- Project Background
- The Use of Building Information Modeling (BIM) in Project Management and Tenant Occupancy
- Materials, Systems, and System Prefabrication
- Sustainable Green Roof Gardens
  - Technical Analysis Background
- Original vs. Proposed Green Roof Design
- Proposed Green Roof Design
- Constructability Review
- Structural BREEAM Analysis
- Mechanical BREEAM Analysis
- Cost and Schedule Analysis
- Recommendations and Conclusions
- Acknowledgements

#### LEGEND
- Utilized Green Roof Space
- Potential Green Roof Space
- Mechanical Space

<table>
<thead>
<tr>
<th>Original Green Roof Design</th>
<th>2250 ft² of Roof Utilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilized Green Roof Space</td>
<td>7050 ft² of Roof Utilized</td>
</tr>
</tbody>
</table>

**Legend**
- Utilized Green Roof Space
- Potential Green Roof Space
- Mechanical Space

**Map**
- Utilized Green Roof Space
- Potential Green Roof Space
- Mechanical Space

**Original Green Roof Design**
- 2250 ft² of Roof Utilized

**Proposed Green Roof Design**
- 7050 ft² of Roof Utilized
GROOF GREEN ROOF SYSTEM

- 18”x18”x4.5” Extensive I Hybrid Modular Green Roof system
- Interlocking trays with 100% removable side panels
- Allows for full soil integration with adjacent modules maximizing the thermal value of the system
- GroRoof Paver Modules with 2” Lightweight Concrete Pavers

ROOFING MATERIAL BREAKDOWN

<table>
<thead>
<tr>
<th>Material</th>
<th>Total Square Footage</th>
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<tbody>
<tr>
<td>GroRoof Extensive I modules</td>
<td>4075 SF</td>
</tr>
<tr>
<td>GroRoof Paver Platforms and 2” Pavers</td>
<td>1030 SF</td>
</tr>
<tr>
<td>Roofing Ballast</td>
<td>1945 SF</td>
</tr>
<tr>
<td>Total</td>
<td>7050 SF</td>
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</tbody>
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**SUSTAINABLE GREEN ROOF GARDEN**  
**STRUCTURAL BREADTH ANALYSIS**

### Equations

#### Live Load Reduction

\[ L_p = L_e \left( 1 - \frac{15}{L_e} \right) \]

#### Factored Distributed Load

\[ W = (1.2)(0.2) + (1.6)\left( \frac{W}{1000} \right) \]

#### Factored Bending Moment

\[ M_{fact} = \frac{W}{10} \left( \frac{L}{2} \right) \]

#### Factored Shear

\[ V_{fact} = \frac{W}{2} \left( \frac{L}{2} \right) \]

---

**TYPICAL SIXTH FLOOR BAY**

**Structural Members**

- **Girders:**
  - (1) – 30 ft. W24x55
  - (1) – 30 ft. LB21x53/74 (36)

- **Beams:**
  - (2) – 22 ft. LB27x35 (24)
  - (2) – 22 ft. W14x68

---

**ALL MEMBERS - ACCEPTABLE DESIGN**

---

**LIVE AND DEAD LOADS ON SIXTH FLOOR ROOF**

<table>
<thead>
<tr>
<th>Item</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling</td>
<td>20 lb/ft²</td>
</tr>
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</tr>
<tr>
<td>Insulation</td>
<td>1 lb/ft²</td>
</tr>
<tr>
<td>GroRoof Extensive Hybrid Modules</td>
<td>26 lb/ft²</td>
</tr>
<tr>
<td>BeamGard Self-Weight (Assumption)</td>
<td>5 lb/ft²</td>
</tr>
<tr>
<td>Dead Load</td>
<td>104 lb/ft²</td>
</tr>
<tr>
<td>ASCE Roof Garden Live Garden (Table 4)</td>
<td>100 lb/ft²</td>
</tr>
</tbody>
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---

**PRESENTATION OUTLINE**

- Project Background
- Use of Building Information Modeling (BIM) and Renovation & Thermal Occupancy
- Material, System, and System Prefabrication
- Sustainable Green Roof Gardens
- Technical Analysis Background
- Condition vs. Proposed Green Roof Design
- Proposed Green Roof Design
- Capacity Review
- Structural Breadth Analysis
- Mechanical Breadth Analysis
- Cliff and Schedule Analysis
- Recommendations and Conclusions
- Acknowledgements

---

**AXIS DESPOTOVICH | CONSTRUCTION MANAGEMENT**

**FACULTY ADVISOR: DR. JOHN L. MESSNER**

**GOVERNOR'S HEALTHCARE SERVICES FACILITY**

**NEW YORK, NEW YORK, 10002**

---

**ALEX DESPOTOVICH | CONSTRUCTION MANAGEMENT**

**FACULTY ADVISOR: DR. JOHN L. MESSNER**

**GOVERNOR'S HEALTHCARE SERVICES FACILITY**

**NEW YORK, NEW YORK, 10002**

---

**GroRoof Extensive Hybrid Modules**

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</tr>
</tbody>
</table>
**PRESENTATION OUTLINE**

- **PROJECT BACKGROUND**
- **THE USE OF BUILDING INFORMATION MODELING TO ENHANCE BID QUOTATIONS AND TENDERS OCCUPANCY**
- **MATERIAL, SYSTEM AND SYSTEM SUBSYSTEMIZATION**
- **SUSTAINABLE GREEN ROOF GARDEN MECHANICAL BREATH ANALYSIS**
  - **SCHEDULE RESCHEDULING AND TENANT OCCUPANCY**
  - **MATERIALS TAGGING AND SYSTEM PREFABRICATION**
  - **SUSTAINABLE GREEN ROOF GARDEN MECHANICAL BREATH ANALYSIS**
  - **TECHNICAL BACKGROUND**
  - **ORIGINAL VS PROPOSED GREEN ROOF DESIGN**
  - **CONSTRUCTABILITY REVIEW**
  - **STRUCTURAL BREADTH ANALYSIS**
  - **MECHANICAL BREADTH ANALYSIS**
  - **COFFEE AND COOLING LOAD ANALYSIS**
  - **ECONOMICS**
  - **ACKNOWLEDGEMENTS**

**ASSUMPTIONS**

- New York City Central Park, NY, USA (73.97W, 40.78N)
- Base Temperature = 65°F
- Roof Area = 7050 ft²
- COP = 3.5 and η = 71.33%

**EQUATIONS**

- Monthly Heating or Cooling Load: 
  \[ Q_{\text{monthly}} = (U\Delta T) \times BD \times 24 \text{ hrs/day} \]
- Total Heating or Cooling Energy: 
  \[ E_T = \sum Q_{\text{monthly}} \times \text{η or COP} \]

**HEATING AND COOLING LOAD CALCULATIONS**

- **Original Roof Material:** R-Value = 6.63 and U-Value = 0.15
- **Proposed Green Roof Material:** R-Value = 12.43 and U-Value = 0.08

<table>
<thead>
<tr>
<th>Month</th>
<th>Degree Days</th>
<th>HEating Load</th>
<th>Cooling Load</th>
<th>η</th>
<th>COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>722</td>
<td>18,425,701</td>
<td>9,328,029</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
<tr>
<td>April</td>
<td>349</td>
<td>9,417,814</td>
<td>4,978,457</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
<tr>
<td>May</td>
<td>139</td>
<td>3,374,303</td>
<td>1,982,180</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
<tr>
<td>October</td>
<td>272</td>
<td>6,941,538</td>
<td>3,702,526</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
<tr>
<td>November</td>
<td>661</td>
<td>16,368,109</td>
<td>9,460,552</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
<tr>
<td>December</td>
<td>840</td>
<td>21,437,104</td>
<td>11,434,272</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
<tr>
<td>January</td>
<td>840</td>
<td>21,437,104</td>
<td>11,434,272</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
<tr>
<td>February</td>
<td>710</td>
<td>18,119,457</td>
<td>9,664,682</td>
<td>0.7133</td>
<td>3.5</td>
</tr>
</tbody>
</table>

**HEATING ENERGY COST SAVINGS**

- Average Cost of Electricity in New York City = $0.16/kWh
- Average Annual Energy Savings: 23,410 kWh
- Annual Cost Savings: $3,746/year

**ANNUAL COST SAVINGS**

- Average Annual Energy Savings: 23,410 kWh
- Annual Cost Savings: $3,746/year
PRESENTATION OUTLINE

- Project Background
- The Use of Building Information Modeling (BIM) in Scheduling and Tenant Occupancy
- Material, Systems and System Prefabrication
- Sustainable Green Roof Gardens
- Technical Analysis Background
- Original vs. Proposed Green Roof Design
- Preliminary Green Roof Design
- Constructability Review
- Structural, Mechanical Analysis
- Cost and Schedule Analysis
- Recommendations and Conclusions
- Acknowledgements

SCHEDULE ASSUMPTIONS

- Two sections for simultaneous installation of materials

MATERIAL DURATIONS:

- Green Roof Modules, Concrete Pavers and Roof Ballast = 4000 ft2/day
- Concrete Pavers = 5000 ft2/day

GREEN ROOF SYSTEM COST

<table>
<thead>
<tr>
<th>Material</th>
<th>Total SF</th>
<th>Total Cost per SF</th>
<th>Total System Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>GroRoof 18&quot;x18&quot;x4.5&quot; Extensive I Hybrid modules</td>
<td>4075 SF</td>
<td>$14.00</td>
<td>$57,050</td>
</tr>
<tr>
<td>GroRoof Paver Platforms</td>
<td>1030 SF</td>
<td>$9.50</td>
<td>$9,785</td>
</tr>
<tr>
<td>2&quot; Concrete Pavers</td>
<td>1030 SF</td>
<td>$7.00</td>
<td>$7,210</td>
</tr>
<tr>
<td>Roof Ballast</td>
<td>1945 SF</td>
<td>$2.00</td>
<td>$3,890</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$77,935</td>
</tr>
</tbody>
</table>

LIFE-CYCLE COST ANALYSIS

- PAYBACK PERIOD – 21 YEARS
- COST SAVINGS - $113,090
PRESENTATION OUTLINE
• Project Background
• The Use of Building Information Modeling
• Schedule Re-sequencing and Tenant Occupancy
• Materials Staging and System Prefabrication
• Sustainable Green Roof Garden
• Recommendations and Conclusions
• Acknowledgements

RECOMMENDATIONS AND CONCLUSIONS

THE USE OF BUILDING INFORMATION MODELING
- Implement 3D Model for New Building Design and Construction
- Do Not Implement 3D Model for Existing Building Design and Construction
- Utilize VELA Systems for Punchlist
  - 2000 Man Hour Savings

SCHEDULE RE-SEQUENCING AND TENANT OCCUPANCY
- Re-Sequence the Project Schedule for
  - Schedule Reduction of 168 days
  - Cost Savings of $206,725
- Utilize FM:Interact Move Management for
  - Overall Schedule Reduction of 14 days
  - Cost Savings of $439,488

MATERIAL STAGING AND SYSTEM PREFABRICATION
- Implement Integrated, Prefabricated MEP Racks for
  - Schedule Reduction of 200 Days
  - Labor Cost Savings of $1,673,293

SUSTAINABLE GREEN ROOF GARDEN
- Implement Proposed Green Roof Garden for
  - Annual Cost Savings of $3,746 per Year
  - Payback Period of 21 Years
  - Overall Cost Savings of $113,090
PRESENTATION OUTLINE

• PROJECT BACKGROUND
• THE USE OF BUILDING INFORMATION MODELING IN SCHEDULE RESOLUTION AND TENANT OCCUPANCY
• MATERIAL SPECIFICATION AND SYSTEM PRE-ASSEMBLY
• SUSTAINABLE-GREEN ROOF GARDENS
• RECOMMENDATIONS AND CONCLUSIONS

ACADEMIC ACKNOWLEDGEMENTS

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Dr. Robert Leicht
Dr. Craig Dubler
Dr. Stephen Treado
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SPECIAL THANKS TO:

James Palace, Michael Creighton, Marcus Ciamano, and Julia Drake of the Hunter Roberts Construction Group Gouverneur Healthcare Services Project Team
Sean O'Connor and Gavin Schiraldo of the Hunter Roberts Construction Group Fiterman Hall Project Team
Leasha Jackson, Lead Development Representative at FM:Systems
Zach Miller, Director of Technical Sales at Metro Green Visions
My Family and Friends
Traditional Punchlist Procedure  | VELA Punchlist Procedure  | Min Hours  
---|---|---
HRCG punchlist hand written during walkthrough  | HRCG punchlist entered into Vela during walkthrough  | 16  
HRCG punchlist entered into fixed and delivered to Owner  | HRCG punchlist entered into fixed and delivered to Owner  | 8  
Owner reviews and adds to punchlist via Vela  | Owner reviews hard copy and adds handwritten list to punchlist  | 48  
Owner enters hard written items into fixed and delivered to HRCG  | Owner enters hard written items into fixed and delivered to HRCG  | 8  
HRCG combines lists in excel, sorts by subcontractor and prints legible reports for sub to complete  | HRCG combines lists in excel, sorts by subcontractor and prints legible reports for sub to complete  | 6  
Subcontractor completes list  | Subcontractor completes list  | -  
HRCG reviews list to see if complete and hard copies updated  | HRCG reviews list to see if complete and hard copies updated  | 16  
HRCG updates fixed spreadsheet to reflect completed items  | HRCG updates fixed spreadsheet to reflect completed items  | 16  
Owner reviews Vela to confirm items are completed  | Owner reviews Vela to confirm items are completed  | 16  
List of completed items is updated in fixed and returned to HRCG via Vela  | List of completed items is updated in fixed and updated to fixed and returned to HRCG via Vela  | 8  
Total Hours Prior to Vela  | Total Hours Using Vela  | 134  

| TABLE | VELA Punchlist Procedure  | Min Hours  
---|---|---
Traditional Punchlist Procedure  | VELA Punchlist Procedure  | Min Hours  
---|---|---
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| APPENDIXES: BIM |  
---|---|---
Table I: Traditional Punchlist Versus Vela Punchlist Procedure  | Min Hours  
---|---|---
HRCG punchlist hand written during walkthrough  | HRCG punchlist entered into Vela during walkthrough  | 16  
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List of completed items is updated in fixed and updated to fixed and returned to HRCG via Vela  
Total Hours Prior to Vela  
Total Hours Using Vela
### Table 17: Original and Reduced Tenant Phasing Schedule Reduction

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Original Schedule</th>
<th>Re-Sequenced Schedule</th>
<th>Duration Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Building Occupancy Move-In</td>
<td>9/22/2011</td>
<td>9/20/2011</td>
<td>14</td>
</tr>
<tr>
<td>Existing Tenant Move-In</td>
<td>8/22/2011</td>
<td>8/20/2011</td>
<td>14</td>
</tr>
<tr>
<td>13th Floor Occupancy Move-In</td>
<td>9/7/2011</td>
<td>9/5/2011</td>
<td>14</td>
</tr>
<tr>
<td>5th Floor Occupancy Move-In</td>
<td>10/11/2012</td>
<td>10/9/2012</td>
<td>14</td>
</tr>
<tr>
<td>8th Floor Occupancy Move-In</td>
<td>10/11/2012</td>
<td>10/9/2012</td>
<td>14</td>
</tr>
<tr>
<td>10th Floor Occupancy Move-In</td>
<td>10/11/2012</td>
<td>10/9/2012</td>
<td>14</td>
</tr>
<tr>
<td>11th Floor Occupancy Move-In</td>
<td>10/11/2012</td>
<td>10/9/2012</td>
<td>14</td>
</tr>
</tbody>
</table>

### Table 19: Reduced Tenant Phasing Schedule Revenue Cost Savings

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration Saved</th>
<th>Patient Revenue per Day</th>
<th>Patients per Floor</th>
<th>Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Building Occupancy Move-In</td>
<td>14</td>
<td>255.27</td>
<td>20</td>
<td>71,476</td>
</tr>
<tr>
<td>Existing Tenant Move-In</td>
<td>7</td>
<td>255.27</td>
<td>20</td>
<td>71,476</td>
</tr>
<tr>
<td>5th Floor Occupancy Move-In</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8th Floor Occupancy Move-In</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
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<td>255.27</td>
<td>20</td>
<td>71,476</td>
</tr>
<tr>
<td>Total Cost Savings</td>
<td>428,854</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>Cost</td>
<td>Schedule</td>
<td>Scope</td>
<td>Quality</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
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<td>-------</td>
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<tr>
<td>Project 1</td>
<td>$100,000</td>
<td>12 months</td>
<td>Comprehensive</td>
<td>High</td>
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<tr>
<td>Project 2</td>
<td>$200,000</td>
<td>18 months</td>
<td>Minimal</td>
<td>Medium</td>
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<tr>
<td>Project 3</td>
<td>$300,000</td>
<td>24 months</td>
<td>Detailed</td>
<td>Low</td>
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</table>

**Project Details**

- **Project 1**: Construction of a new healthcare facility in New York, New York, 10002.
- **Project 2**: Expansion of an existing healthcare facility in New York, New York.
- **Project 3**: Renovation of a healthcare facility in New York, New York.

**Team Members**

- **Alex Espovitch**: Construction Manager
- **Dr. John Messner**: Faculty Advisor

**Contact Information**

- **Alex Espovitch**: alex@espovitch.com, 555-123-4567
- **Dr. John Messner**: john@messner.com, 555-987-6543
## APPENDICES: GREEN ROOF

<table>
<thead>
<tr>
<th>Material</th>
<th>Original Roof R-Value (ft²·°F·hr/BTU)</th>
<th>Green Roof R-Value (ft²·°F·hr/BTU)</th>
<th>Original Roof U-Value (BTU/ft²·°F·hr)</th>
<th>Green Roof U-Value (BTU/ft²·°F·hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; GroRoof System</td>
<td>0.2</td>
<td>6</td>
<td>5.00</td>
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<tr>
<td>Stone Roof Ballast</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2&quot; Thick Drainage Insulation Panels</td>
<td>5.88</td>
<td>5.88</td>
<td>0.17</td>
<td>0.17</td>
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<tr>
<td>Hot Fluid Applied, Rubberized Asphalt</td>
<td>0.15</td>
<td>0.15</td>
<td>6.67</td>
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<tr>
<td>Waterproofing Membrane</td>
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<tr>
<td>4&quot; Concrete Slab</td>
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<td>0.4</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>6.33</strong></td>
<td><strong>12.43</strong></td>
<td><strong>0.15</strong></td>
<td><strong>0.08</strong></td>
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