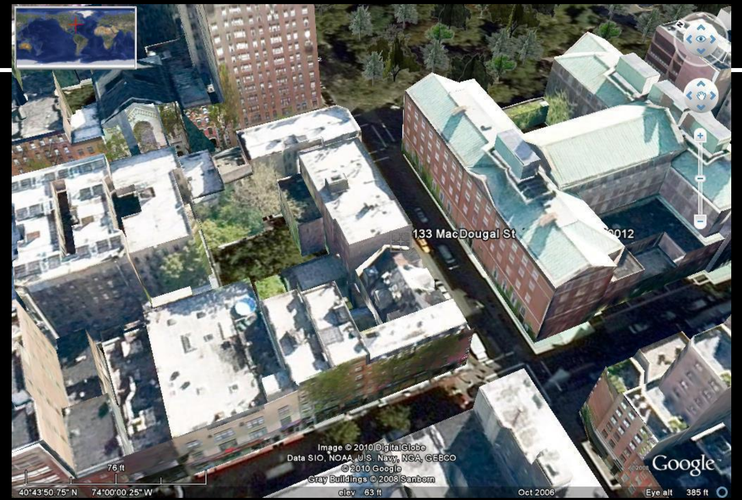
# Project X

New York, NY

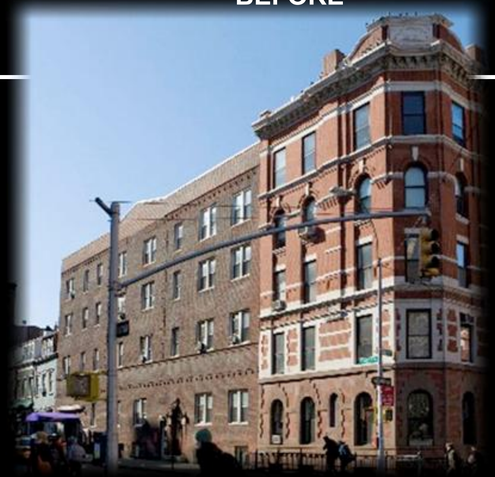



LUKE ARRON GRAY

SENIOR THESIS PRESENTATION

CONSTRUCTION MANAGEMENT | 2010-2011

BEFORE



# PRESENTATION OUTLINE

- Overview
- Structural Bracing
- Electrical connection to CHP
- Matrix Scheduling
- BIM and Facility Management Integration
- Conclusion and Recommendations

AFTER

# PRESENTATION OUTLINE

- Project Overview
- Structural Lateral Bracing
  - Structural Loads
  - Computer Model
  - Conclusion and Recommendations
- Electrical Connection to CHP
  - Electrical Loads
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  - Conclusion and  Recommendations
- Matrix Schedule
  - Create Zones
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- Conclusion and Recommendations

# PROJECT OVERVIEW

- **Location** :  New York City, NY
- **Function**: Office building and theatre
- **Size**: 54,640 Square Feet
- **Stories**: 6 levels
- **Construction Schedule**:  August 2008- July 2010
- **Project Delivery**: Fast track with CM At Risk

**PROJECT TEAM :**
**Contractor**: SKANSKA
**Architect**: MA Architects
**Structural** : Robert Silman Assoc.
**MEP**: FMC Associates

# PROJECT OVERVIEW



# PRESENTATION OUTLINE

- Project Overview
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# PROJECT OVERVIEW

**STRUCTURAL SYSTEM:**
**10” DEEP TWO-WAY FLAT PLATE FLOOR SLAB**
**COLUMNS 24” x 24”**

**BUILDING ENCLOSURE:**
**GRANITE BASE**
**MASONRY BRICK WITH CMU BACKUP**
**GLASS CURTAIN WALL**
**TERACCOTA CROWN**

**ELECTRICAL SYSTEM:**
**208Y/120V, 3-PHASE**

**MECHANICAL SYSTEM:**
**HW/CW SUPPLIED BY CENTRAL UTILITY PLANT**

# PROJECT OVERVIEW



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## STRUCTURAL BRACING

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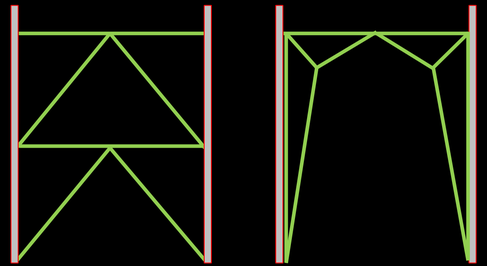
# STRUCTURAL BRACING

**BACKGROUND :**

- **Original building** 33,000 SF since1918
- Volume of the theater to remain

**PROBLEM :**

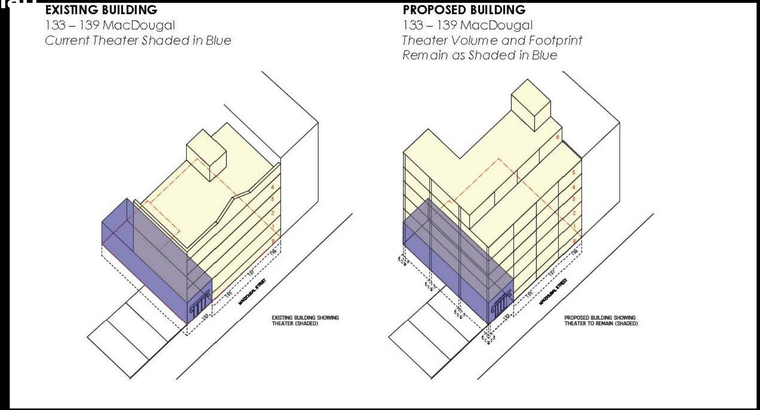
- **The original two story k-bracing increased site congestion**
- **The original two story k-bracing was only used temporary bracing**





**GOALS**

- **Increase productivity on site by reducing site congestion**
- **Use the light wt. bracing for temporary shoring of the concrete slab**



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# STRUCTURAL BRACING

WIND LOADS:
$F=q_z GC_f A_f (lb)(N)=0.0171ksf$

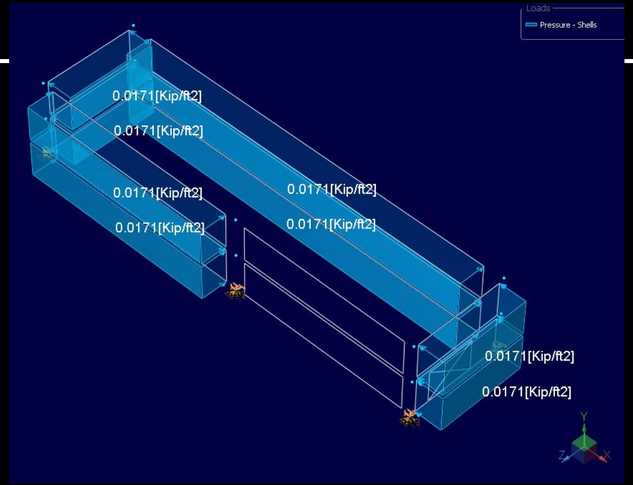
SELF WEIGHT:
Type M mortar three coarses thick brick=2klf

CONTROLLING LOAD COMBINATION:
$D_3=1.2DL+1.6W$

➢Structural Loads → ➢Computer Model → ➢Results

# STRUCTURAL BRACING





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# STRUCTURAL BRACING

MOMENT CAPACITY OF MASONRY WALL:
0.88 kip*ft/ft

MOMENT WITHOUT BRACING:
3.91 kip*ft/ft

MOMENT OF MASONRY WITH BRACING:
0.8kip*ft/ft

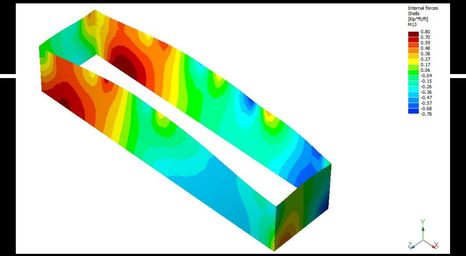
DEFLECTION:
L/240=0.85in

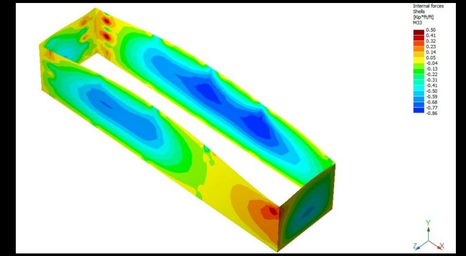
MODEL'S MAXIMUM DEFLECTION:
0.33in

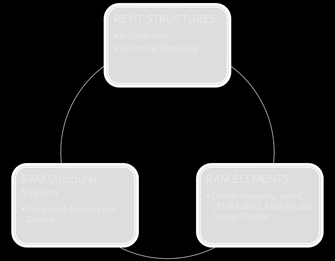
➢Structural Loads → ➢Computer Model → ➢Results

# STRUCTURAL BRACING









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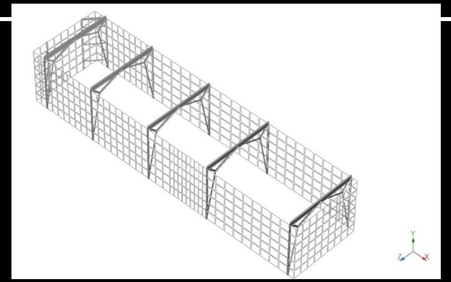
# STRUCTURAL BRACING

MATERIAL TAKEOFF WITH RAM ELEMENTS

- L 3x3x3/16
- L 5x5x5/16
- MC 6x12
- W6x9



COST

$32,000

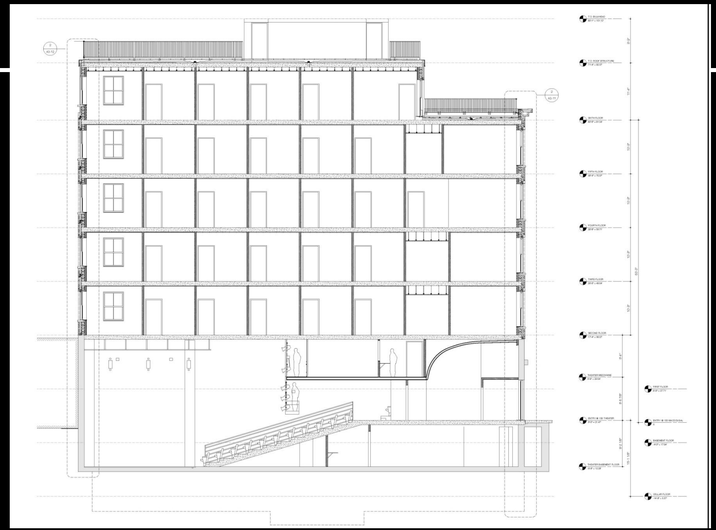
SCHEDULE

- Original 18.9 days
- Alternative 25.1 days

➢Structural Loads → ➢Computer Model → ➢Results

# STRUCTURAL BRACING





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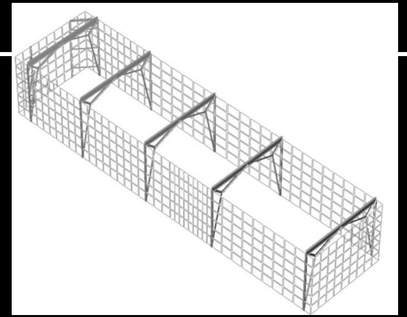
# STRUCTURAL BRACING

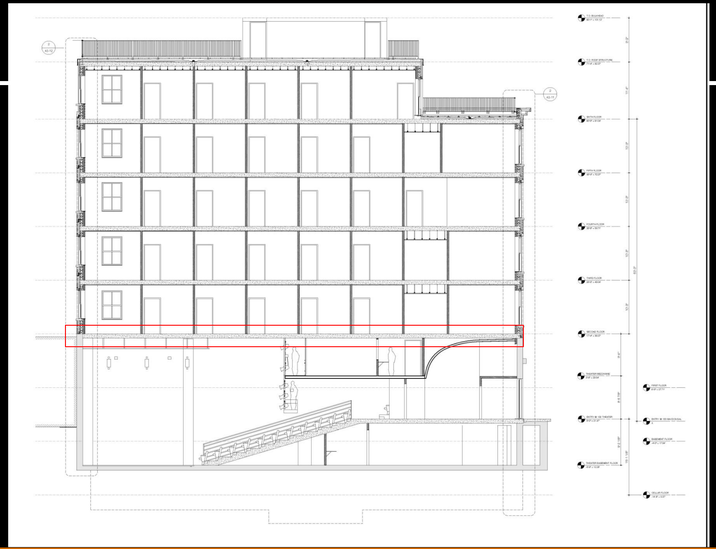
ADVANTAGES:
- Decreased site congestion
- Decreased required shoring

DISADVANTAGE:
- Increased steel installation time



- Structural Loads
- Computer Model
- Results

# STRUCTURAL BRACING



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# ELECTRICAL  CHP CONNECTION

# PRESENTATION OUTLINE

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# ELECTRICAL CHP CONNECTION

**BACKGROUND :**

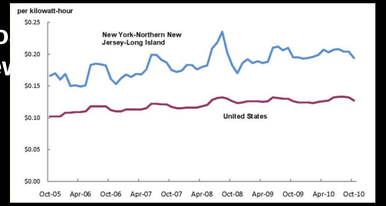
- **Three steam turbines producing a total of 13.4 MW**
- **Emergency electrical power to 18 University's buildings**
- **Connected to 40 cw/hw Universit's buildings**
- **Currently Project X is connected to CHP's Plant cw/hw piping**

**PROBLEM :**

- **Project X is not connected to CHP electrical supply**
- **Rising electricity costs**

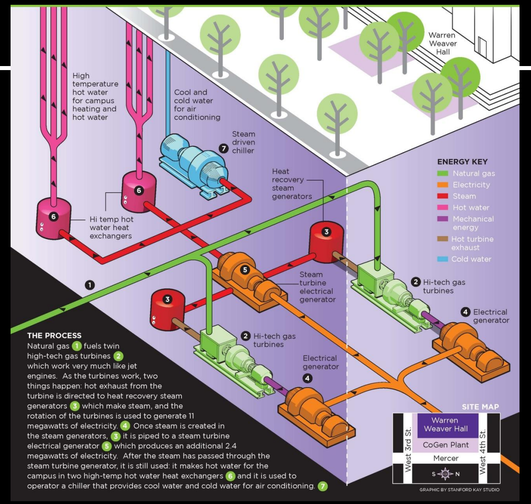
**GOALS**

- **Reduce peak demand electrical lo**
- **Identify financial incentives in Nev**




# ELECTRICAL CHP CONNECTION





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# ELECTRICAL CHP CONNECTION

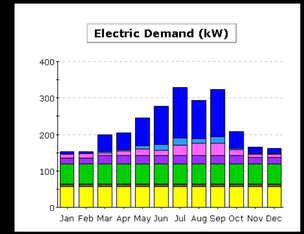
**ELECTRICAL LOADS:**

- **Equest**
  - **Takes into account cw/hw chp plant**
  - **Summer peak electrical load 330 kW**

➢Electrical Loads → ➢Equipment → ➢Results

# ELECTRICAL CHP CONNECTION





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# ELECTRICAL CHP CONNECTION

**ELECTRICAL EQUIPMENT:**

- **Woodward SPM-D21**
- **Woodward 2301D Load sharing and speed control for generator**
- **GE 100kVA transformer**
  - **Δ13.8kVA to 208Y/120**
- **Circuit breakers, conductors, conduit**

$$Is = \frac{kVA}{kV_{secondary}} \; x\; 1.25 = \frac{100kVA}{0.208kV\sqrt{3}} \; x\; 1.25 = 347A$$

$$Ip = \frac{KVA}{KV_{primary}\sqrt{3}} \; x\; 6 = \frac{100KVA}{13.8KV\sqrt{3}} = 25\,A$$

➢Electrical Loads → ➢Equipment → ➢Results

# ELECTRICAL CHP CONNECTION



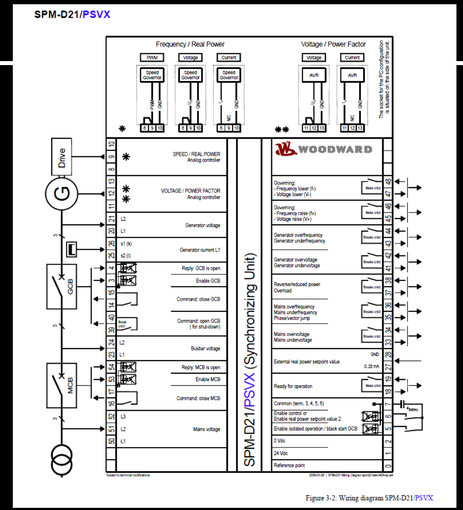
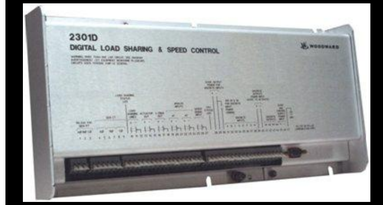
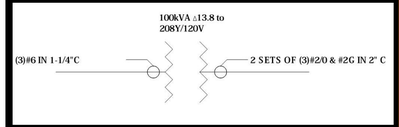



Figure 3-2: Wiring diagram SPM-D21/PSVX

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# ELECTRICAL CHP CONNECTION

**SYSTEM COST**

- **~~$25,000~~**

**INCENTIVES:**

- **Con Edison's Commercial System Relief Program**
- **Program activated by Con Edison during:**
  - **Summer peak days**
  - **System critical situation**

| Annual Savings | |
|---|---|
| Peak Demand | $6,517.05 |
| Con Edison Commercial System Relief Program | $1,650.00 |
| **Total** | $8,167.05 |

➢Electrical Loads ➢Equipment ➢Results

# ELECTRICAL CHP CONNECTION



| Year | Demand & Incentives | System Cost | Payback |
|---|---|---|---|
| 1 | $8,167.05 | 24617 | -$16,449.95 |
| 2 | $14,684.10 | 24617 | -$9,932.90 |
| 3 | $21,201.15 | 24617 | -$3,415.85 |
| 4 | $27,718.21 | 24617 | $3,101.21 |
| 5 | $34,235.26 | 24617 | $9,618.26 |
| 6 | $40,752.31 | 24617 | $16,135.31 |
| 7 | $47,269.36 | 24617 | $22,652.36 |
| 8 | $53,786.41 | 24617 | $29,169.41 |
| 9 | $60,303.46 | 24617 | $35,686.46 |
| 10 | $66,820.52 | 24617 | $42,203.52 |
| 11 | $73,337.57 | 24617 | $48,720.57 |

**PAYBACK:**

- **4 YEARS**

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# MATRIX SCHEDULE

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# MATRIX SCHEDULE

**BACKGROUND :**

➢**~~The underground utilities work was scheduled after the masonry construction~~**

**PROBLEM :**

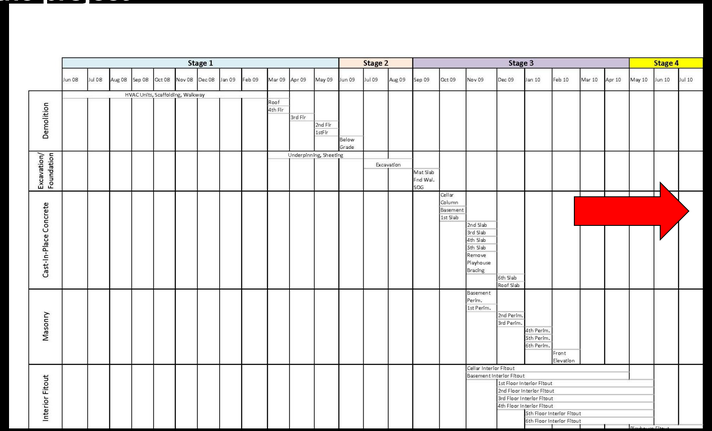
➢**Project delays caused u/g utilities to final month of project**

# MATRIX SCHEDULE



**GOALS**

➢**Re-sequence the under ground utilities during the demolition of the project**



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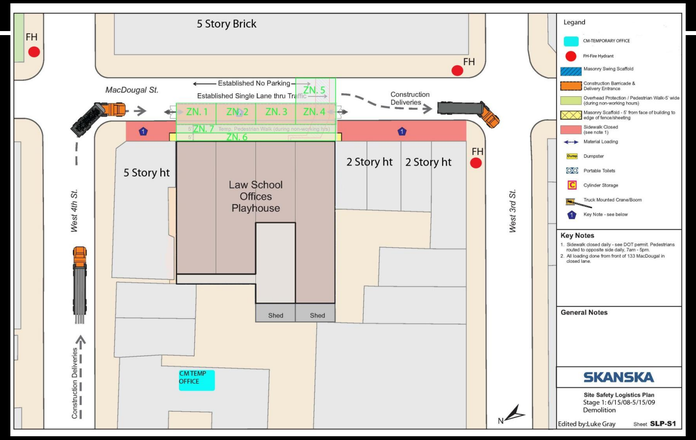


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| KEY |
|---|
| DUMP TRUCK/MATERIAL DELIVERY |
| MATERIAL DELIVERY |
| CRANE |
| OVERHEAD PROTECTION |
| TRASH SHOOTS/ CONSTRUCTION FENCE |
| TRASH SHOOTS/ MASONRY SCAFFOLD |
| SITE UTILITY TIE-IN |
| MEP TIE-IN SERVICES VIA FOUNDATION WALL |
| SOUTH BRACING |
| NORTH BRACING |

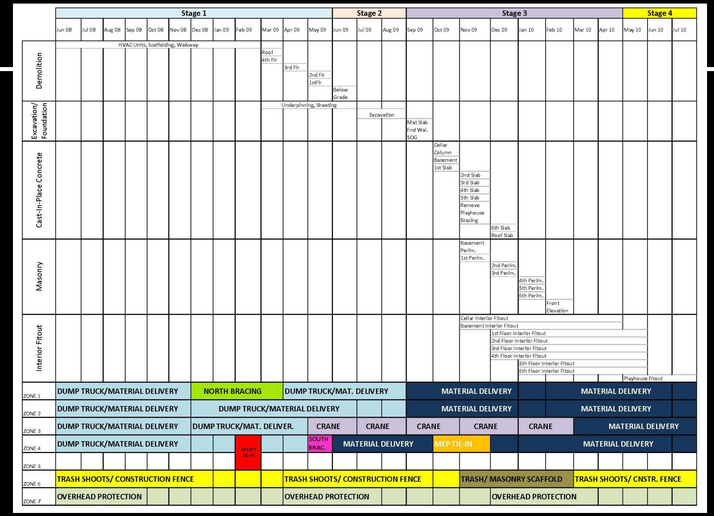
# MATRIX SCHEDULE

**PROJECT PHASES:**

- **Stage 1: UNDER GROUND CHP/UTILITY, DEMOLITION**
- **Stage 2: EXCAVATION, FOUNDATIONS**
- **Stage 3: CAST-IN-PLACE BUILDING FRAME, FAÇADE, INTERIOR FIT-OUT**
- **Stage 4: THEATER INTERIOR FIT-OUT, LANDSCAPING**

# MATRIX SCHEDULE





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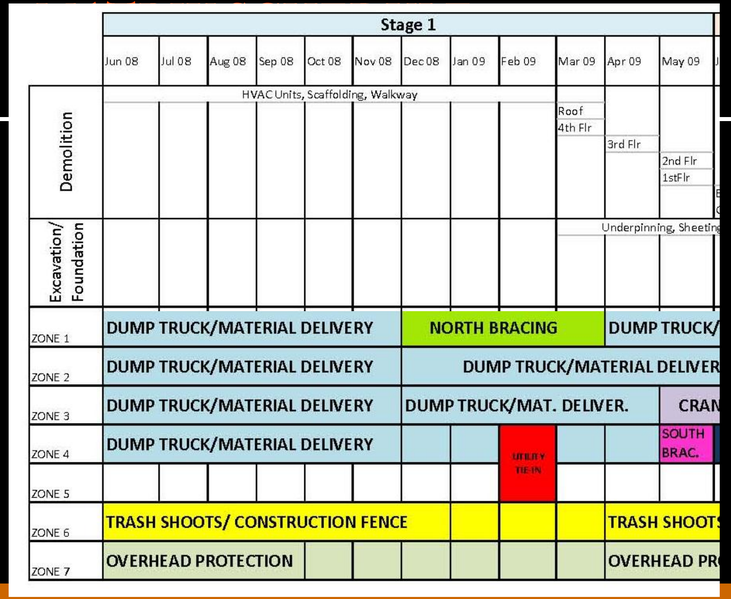


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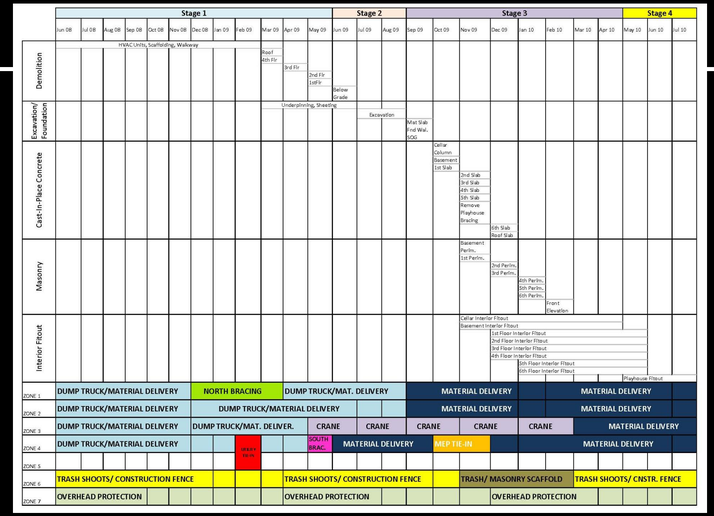

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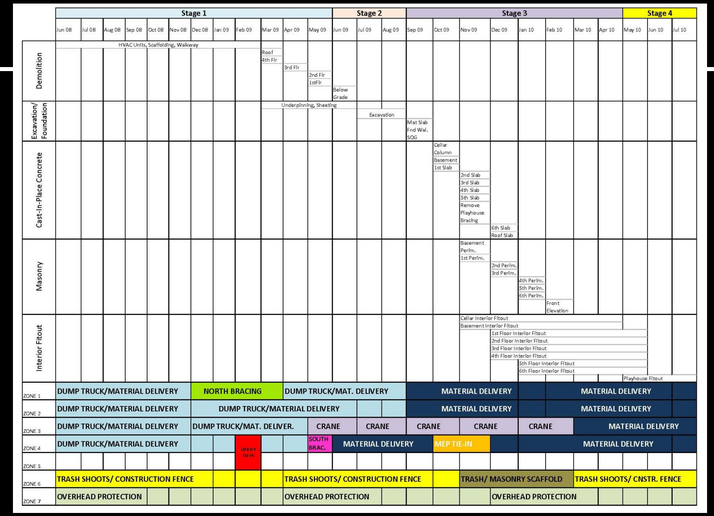
# MATRIX SCHEDULE

**CONCLUSIONS:**

- **FOR LOGISTICAL REASONS IT IS ALWAYS BETTER TO DO THE SITE U/G UTILITY BEFORE THE SUPER STRUCTURE CONSTRUCTION BEGINS**
- **THE CROWDED CONSTRUCTION SITE IN NYC PROVED TO BE THE IDEAL SELECTION FOR CREATING A MATRIX SCHEDULE**

# MATRIX SCHEDULE





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  - Facade Schedule
  - Super Structure Schedule
  - Integrated Schedule
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## BIM AND FM INTEGRATION

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  - Electrical Loads
  - Electrical Equipment
  - Conclusion and Recommendations
- Matrix Schedule
  - Utilities Schedule
  - Facade Schedule
  - Super Structure Schedule
  - Integrated Schedule
  - Conclusion and Recommendations
- BIM and Facility Integration
- Conclusion and Recommendations

# BIM AND FM INTEGRATION

**BACKGROUND :**

**50% of the building construction industry is now using BIM**

**PROBLEM :**

- **Building owners don't know how to use BIM after construction**
- **Building owners don't require the FM data to be included in the BIM**
- **Inputting FM data into CMMS (Computer Maintenance Management System) can take up to six months**

# BIM AND FM INTEGRATION



**GOALS**

Develop a way to utilize the BIM for the owner's CMMS AND HVAC Controls

Identify necessary BIM's assets for maintenance

# PRESENTATION OUTLINE

- Project Overview
- Structural Lateral Bracing
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- Create Zones
- Create Matrix Schedule
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- Conclusion and Recommendations

# BIM AND FM INTEGRATION




➢Available Technology
- ➢Most technicians don't have laptops
- ➢Most only have a PDA
  - ➢Limited screen size and Limited File Size
- ➢Computer work stations are available throughout campus

**Facility Management**

**Work Orders**

Description of Work: Room too cold. HVAC Unit Blowing Cold Air
Location: 0503000-543 DEIKE Building -05 Staff Office
Equipment:
F/P: Facility planning
RPT: 3:45pm 12/15/2010
Location: Hyperlink to drawing
Contact: Name
Equipment: link to equipment's Excel file
Phone Number:

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# BIM AND FM INTEGRATION



- Job Shadowing
  - Field Data
- Parameters
  - Uniformat
  - CoBie
- Process Map

Uniformat

| Asset Information organized according to PSU UNIFORMAT Standard | | |
|---|---|---|
| **D30 HVAC** | | |
| **D3060 Controls & Instrumentation** | | |
| **D3068 Building Automation Systems** | | |
| | Equipment Number | |
| | Operate Range Temp | -20ºF to 140ºF (-29ºC to 60ºC) |
| | Operate Range Humidity | 10 to 90% relative humidity, |
| Multi-Equipment Contoller & Router | Type | Controller & Router |
| Controller, receiver | Model # | ME-LGR Line |
| Electric, Single Snap switch | Manufacturer | ALC |
| | Communication | BACnet Building Controller (B-BC) |
| | Communication | EIA-232-485 port 156kbps |
| | Microprocessor | 32-bit |
| | Memory | 16 Mbyte |
| | Protection | Built-in surge and transient protection |
| | Voltage | 24 V-ac ± 10% |
| | Frequency | 50 to 60Hz |
| | Power | 10 Watts |
| | Services | MS-TP Channel for ctrl integration |

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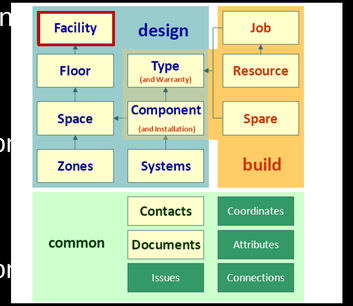


# BIM AND FM INTEGRATION

➢Job Shadowing
  ➢Field Data

➢Parameters
  ➢Uniformat
  ➢COBie

➢Process Map

Type worksheet:
➢Overview of the designers, builders, and manufactures' information.

- Type Worksheet
- Resource Worksheet
- Spare Worksheet
- Job Resource Worksheet
- Component Worksheet

| Type Worksheet | | |
|---|---|---|
| Multi-Equipment Contoller & Router Controller, receiver Electric, Single Snap switch | Name | Contoller & Router |
| | CreatedBy | lag290@psu.edu |
| | CreatedOn | 7/31/2011 |
| | Category | ATC |
| | Description | |
| | AssetType | |
| | Manufacturer | ALC |
| | ModelNumber | ME-LGR Line |
| | PartsWarrantyGuarantor | |
| | PartsWarrantyEndDate | |
| | LaborWarrantyGuarantor | |
| | LaborWarrantyStartDate | |
| | LaborWarrantyEndDate | |
| | ExtSystem | |
| | ExtObject | |
| | ExtIdentifier | |
| | ReplacementCost | |
| | ExpectedLife | |
| | DurationUnit | |
| | WarrantyDescription | |

| Resource Worksheet | | |
|---|---|---|
| Multi-Equipment Contoller & Router Controller, receiver Electric, Single Snap switch | Name | Contoller/Router |
| | CreatedBy | lag290@psu.edu |
| | CreatedOn | 7/31/2011 |
| | Category | ATC |
| | Description | |
| | ExtSystem | |
| | ExtObject | |
| | ExtIdentifier | |

| Component Worksheet | | |
|---|---|---|
| Multi-Equipment Contoller & Router Controller, receiver Electric, Single Snap switch | Name | |
| | CreatedBy | |
| | CreatedOn | |
| | TypeName | |
| | Space Names | |
| | Description | |
| | ExtSystem | |
| | ExtObject | |
| | ExtIdentifier | |
| | SerialNumber | |
| | InstallationDate | |
| | TagNumber | |
| | BarCode | |
| | AssetIdentifier | |

| Spare Worksheet | | |
|---|---|---|
| Multi-Equipment Contoller & Router Controller, receiver Electric, Single Snap switch | Name | |
| | CreatedBy | |
| | CreatedOn | |
| | Category | |
| | Description | |
| | TypeName | |
| | Suppliers | |
| | ExtSystem | |
| | ExtObject | |
| | ExtIdentifier | |
| | SetNumber | |
| | PartNumber | |

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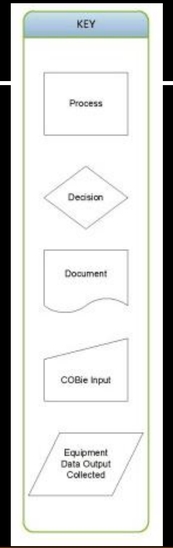
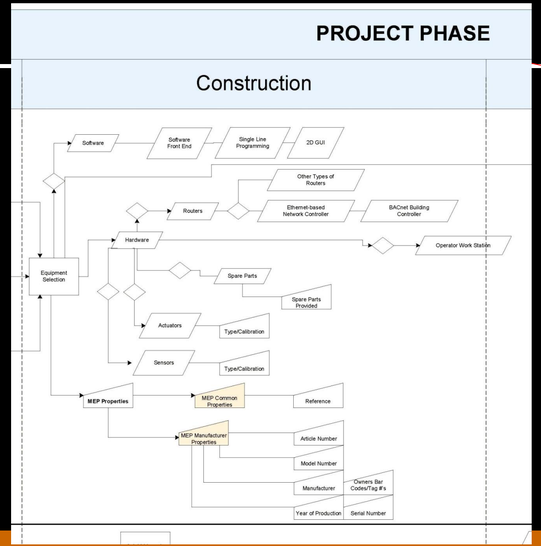
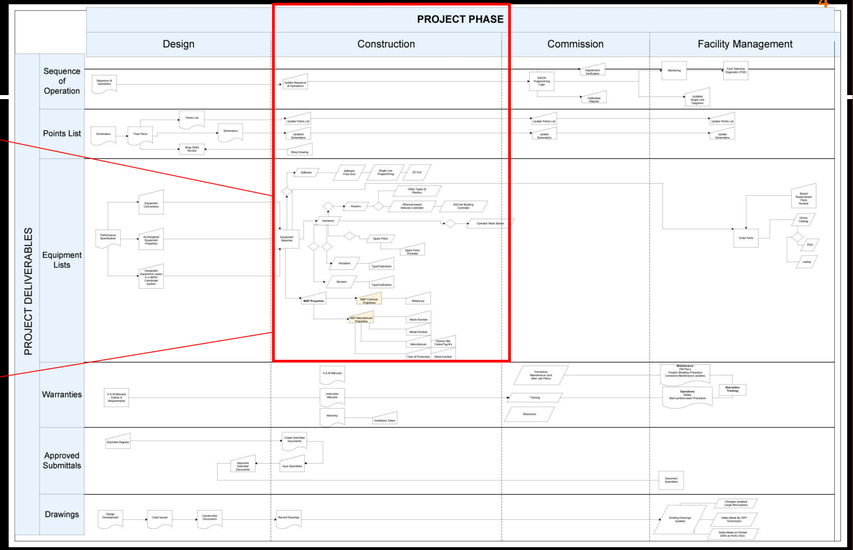



# BIM AND FM INTEGRATION





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# BIM AND FM INTEGRATION

CONCLUSIONS:

- Both Maximo HVAC controls, and Revit can link data to equipment Excel file
  - ODBC-Open database connectivity
- Develop a prototype for one building
- Develop a protocol for flagging changes made to the project in the field
- Develop searchable parameters for BIM

# BIM AND FM INTEGRATION

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# ACKNOWLEDGEMENTS


➢FRIENDS AND FAMILY
➢ARCHITECTURAL ENGINEERING FACULTY
➢SKANSKA BUILDING USA
➢OFFICE OF PHYSICAL PLANT (OPP)


# QUESTIONS

# SUMMARY & CONCLUSIONS

STRUCTURAL BRACING
➢Reduce site congestion
➢Decreased required shoring
➢Increased installation time

ELECTRICAL CHP CONNECTION
➢System cost $25,000 with 4 year payback

MATRIX SCHEDULE
➢For logistical reasons it is always better to do the u/g utilities before structure
➢The crowded construction site of NYC proved to be the ideal selection for creating a matrix schedule.

BIM AND FM INTEGRATION:
➢Both Maximo  HVAC controls and Revit can link data to equipment Excel file
➢Develop a prototype for one building
➢Develop a protocol for flagging changes
➢Develop searchable parameters for BIM and FM

# PRESENTATION OUTLINE



## Project X's Masonry Temporary Bracing

| Project X's Masonry Wall Temporary Bracing | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Quantity | Lb/ft | Quantity | Units | Crew | Daily Output | Labor Hours | Bare Material | Bare Labor | Equip-ment | Total | Total Incl O&P | Total | | Duration Days |
| Steel Pipe, extra strong, no concrete 3" diameter x 12'-0" | | | 8 | Ea. | E2 | 60 | 0.933 | 135 | 39 | 26 | 200 | 245 | $1,960 | 7.5 | 0.9 |
| Steel Pipe, extra strong, no concrete 4" diameter | | | 40 | Ea. | E2 | 58 | 0.9660 | 198.0000 | 40.5000 | 27.0000 | 26.5000 | 317.5000 | $12,700 | 38.6 | 4.8 |
| Angle Framing , shop Fabricated, WT6x17.5 | 96 | 17.5 | 1680 | Lb. | E3 | 440 | 0.055 | 0.81 | 3.95 | 0.29 | 5.05 | 8.18 | $13,742 | 92.4 | 11.6 |
| L 5x 5/16" x 6' | | | 96 | L.F. | E4 | 250 | 0.128 | 17.6 | 5.55 | 0.53 | 23.68 | 29.98 | $2,878 | 12.3 | 1.5 |
| Steel Knife Plate 3/8" | | | 50 | S.F. | E2 | 350 | 0.008 | 16.85 | 5.6 | | 16.85 | 18.5 | $925 | 0.4 | 0.1 |
| | | | | | | | | | | | | Total Cost | $32,205 | 151.2 | 18.9 |

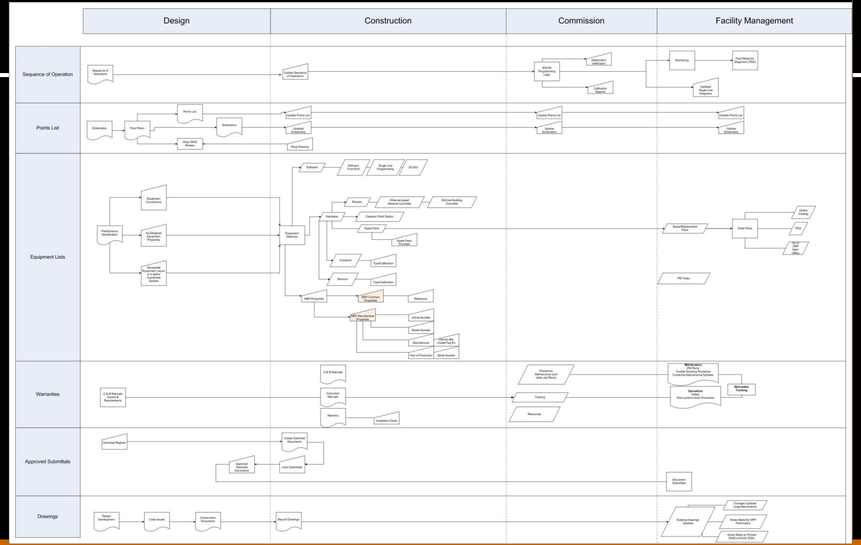
## Project X's Alternative Masonry Temporary Bracing

| Project X's Proposed Masonry Wall Temporary Bracing | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Quantity | Lb/ft | Quantity | Units | Crew | Daily Output | Labor Hours | Bare Material | Bare Labor | Equip-ment | Total | Total Incl O&P | Total | Duration Hours | Duration Days |
| Angle Framing, shop fabricated, L3" x 3" x 3/8" | 44.6 | 7.17 | 319.782 | Lb. | E3 | 440 | 0.055 | 0.81 | 3.95 | 0.29 | 5.05 | 8.18 | $2,616 | 17.6 | 2.2 |
| Angle Framing , shop Fabricated, L4" x 4" x 3/8" | 246.42 | 9.72 | 2395.2024 | Lb. | E3 | 440 | 0.055 | 0.81 | 3.95 | 0.29 | 5.05 | 8.18 | $19,593 | 131.7 | 16.5 |
| Angle Framing , shop Fabricated, L5" x 5" x 5/16" | 27.38 | 10.4 | 284.752 | Lb. | E3 | 440 | 0.055 | 0.81 | 3.95 | 0.29 | 5.05 | 8.18 | $2,329 | 15.7 | 2.0 |
| Shop fabricated W6 x9 | | | 109.5 | LF | E-2 | 600 | 0.093 | 14.85 | 4.06 | 2.9 | 21.81 | 26.5 | $2,902 | 10.2 | 1.3 |
| Channel MC6 x 12" | | | 208 | LF | E4 | 225 | 0.125 | 12.15 | 5.45 | 0.52 | 18.12 | 23.82 | $4,955 | 26.0 | 3.3 |
| | | | | | | | | | | | | Total Cost | $32,394 | 201.2 | 25.1 |

STRUCTURAL BRACING

# PRESENTATION OUTLINE

# BIM




# STRUCTURAL BRACING