OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES

ANTHONY JURJEVIC | CONSTRUCTION
ADVISOR: DR. ROBERT LEICHT

INTRODUCTION

PRESENTATION OUTLINE:

I. **Project Background**
II. **Prefabricated Application**
    Structural Breadth
III. **BIM Utilization**
IV. **Final Recommendations**
V. **Acknowledgements**

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

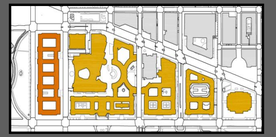
PROJECT BACKGROUND

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

Project Information

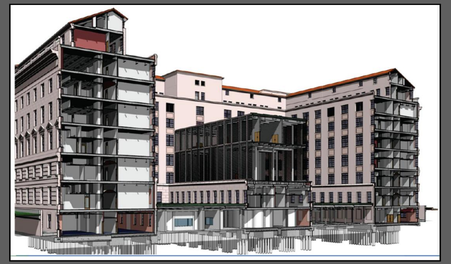
Function: Federal Office Building
Project Cost: $115 million- Phase II
Renovation Area:
264,000 SF- Renovated Office Space
20,000 SF- New Electrical Equipment Enclosure
Construction Dates: 11/15/09- 11/15/11 (24 Months)
Delivery Method: Design-Bid-Build with CM Agency



PRECAST PLANK APPLICATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

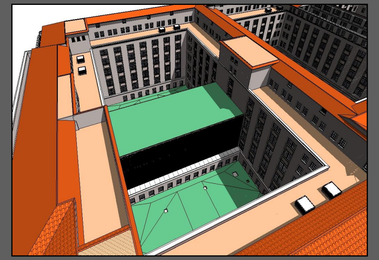


Problem and Background Information

- 20,000 SF Electrical Equipment Enclosure to be erected in courtyard 1
- Designed to house facility's major electric components
- Structural steel design with concrete slab on one way metal decking
- Originally proposed erection schedule: 123 Days
  - Schedule duration due to setting equipment before structural erection proceeds

Research Goal

- Minimize erection schedule by eliminating curing time with cast in place floor system
- Reduce overall structural cost by implementing a more economic floor design



PRECAST PLANK APPLICATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

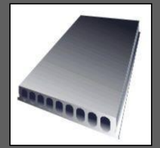
Summary of Major Activities- 2nd Floor	
Activity	**Duration**
Steel Framing	15 Days
Concrete 2nd Floor	7 Days
Concrete up to Strength	15 Days
Set Equipment Pads	5 Days
Rig Equipment	2 Days

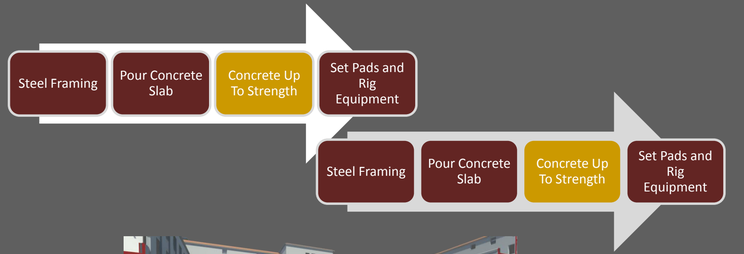
Original Floor Design

- Composite Deck: 3.2” Light Weight Concrete Slab on 2” 20 Ga. Metal Decking
- Curing time of 2nd and 4th floors prolong overall schedule because of large equipment

Proposed Solution

- Redesign facility’s 2nd and 4th floors to be erected with precast hollow core planks
- Use high early strength concrete to reduce curing time
- New floor system will reduce erection time and minimize cost

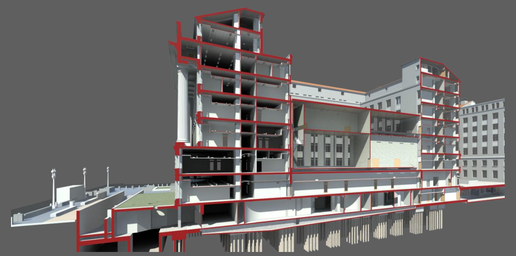




PRECAST PLANK APPLICATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:



Structural Calculations

- Typical bay with largest span and greatest load was redesigned (Most Equipment)
- 6" x 4'-0" Hollow Core Planks- 10 feet length
- All appropriate loads were included to size the plank and new beam locations
  - W_{TL} = 1.2D + 1.6L
  - W_{TL} = 1.2(268.74) + 1.6(40) = 386.48 psf

Prestressed Concrete
6"x4'-0" Hollow Core Plank
2 Hour Fire Resistance Rating With 2" Topping

PHYSICAL PROPERTIES
Composite Section

A_c = 253 in^2	Precast b_w = 16.13 in.
I_c = 1519 in^4	Precast S_{bc} = 370 in^3
Y_{bc} = 4.10 in.	Topping S_{tc} = 551 in^3
Y_{tp} = 1.90 in.	Precast S_{tp} = 799 in^3
Y_{ct} = 3.90 in.	Precast W_c = 195 PLF
	Precast W_c = 48.75 PSF

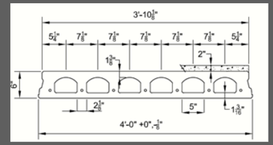
SAFE SUPERIMPOSED SERVICE LOADS — IBC 2006 & ACI 318-05 (1.2 D + 1.6 L)

Strand Pattern		SPAN (FEET)																	
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4 - 1/2"ø	LOAD (PSF)	349	317	290	258	227	197	174	149	127	108	92	78	66	55					
6- 1/2"ø	LOAD (PSF)	524	478	437	377	334	292	269	237	215	188	165	142	122	104	88	73	61	49	39
7 - 1/2"ø	LOAD (PSF)	541	492	451	416	364	331	293	274	242	214	190	167	144	124	107	91	77	64	53

- Planks, Beams, and Girders were resized based on new loads for more efficient design
- Structural components were checked for deflection:
  - Total Deflection: $\Delta_{TL} = 5\ W_{LL}\ L^4\ (1728) / (384\ E\ I)$
  - Allowable Deflection: $\Delta_{TL} = L / 240$
  - Live Load Deflection: $\Delta_{LL} = 5\ W_{LL}\ L^4\ (1728) / (384\ E\ I)$
  - Allowable Deflection: $\Delta_{LL} = L / 360$

- Planks, Beams, and Girders were resized based on new loads for more efficient design
- Example: Beam Design- Check for LL Deflection

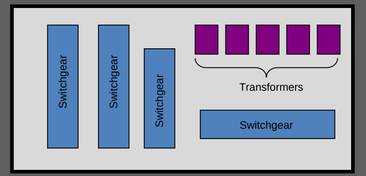
$\Delta_{LL} = 5\ W_{LL}\ L^4\ (1728) / (384\ E\ I)$
E = 29,000,000
I_{W12X35} = 285 in^4
$\Delta_{TL} = 5\ (64)\ 16.4^4\ (1728) / (384 \times 29{,}000{,}000 \times 285) = 0.012$ inches
Allowable Live Load Deflection:
$\Delta_{LL} = L / 360 = (16.4\ ft * 12\ in/ft) / 360 = 0.546$ inches
0.012 inches < 0.546 inches therefore OK



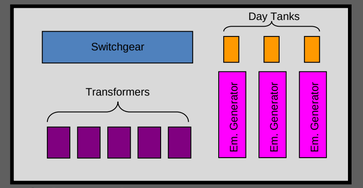
PRECAST PLANK APPLICATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:



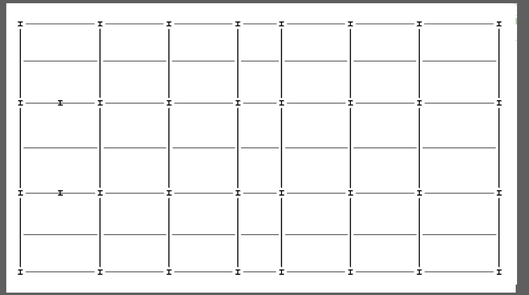
2nd Floor Level



4th Floor Level

New Design Layout

- Precast Hollow Core Plank System requires significantly less steel
  - 15 tons between 2nd and 4th Floors
- 2” Topping included in structural calculations
- Type III High Early Strength Concrete (3000 psi) will be utilized for topping and equipment pads
  - Calcium Chloride Accelerator



2nd Floor EEE: Redesigned Structural Steel Layout

PRECAST PLANK APPLICATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

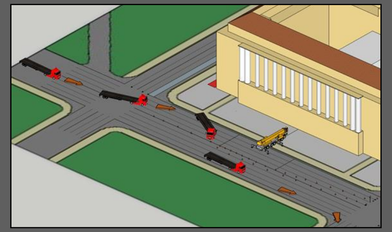
PRESENTATION OUTLINE:

Schedule Acceleration

- Each floor's planks can be erected in 1 day (6,585 SF)
- High early strength concrete drastically decreases erection schedule
- Schedule reduced by 25 regular working days

Crane Use and Occupancy Permit

- Crane use only permitted on weekends
  - Saturday 4 AM- Sunday 7 PM
- 1 additional weekend included in revised schedule for any unforeseen conditions



PRECAST PLANK APPLICATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

Cost Comparison

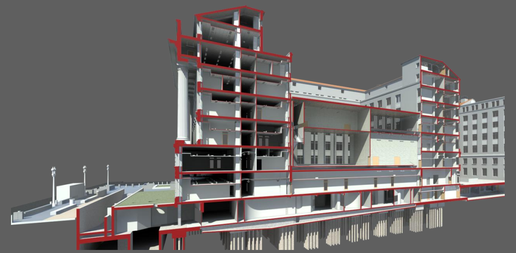
- Significant savings with less steel members and connections
- Precast Hollow Core Planks cost at $ 7.50/SF Area- includes manufacturing, delivery, grouting, etc.
- Columns and Roof structure are to remain consistent
- 1.5 Gallon of admixture used per CY concrete ($5.00 each)
- Total project savings of $98,600.00

Component	Original	Redesign
Formwork	$ 9,289.86	$ 3,096.62
WWF- Rebar	$ 9,823.01	$ 3,274.34
CIP Concrete	$ 47,026.97	$ 22,422.47
Steel (Total QTY)	$ 462,186.67	$ 336,610.84
Steel Connections	$ 30,811.95	$ 7,052.40
Metal Decking	$ 46,637.60	$ 15,540.60
Precast Planks	-	$ 98,775.00
Admixtures	-	$ 402.00
TOTAL	**$ 605,776.06**	**$ 507,174.27**

PRECAST PLANK APPLICATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:



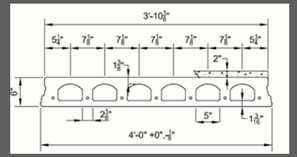
Floor Penetrations and Coordination

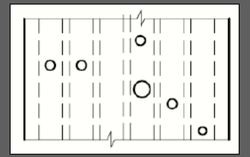
- Coordinating floor penetrations is a major component of applying hollow core planks
- The lead time for designing the plank system is approximately 12 weeks
  - Most of this time is dedicated to preparing and approving design drawings
  - Manufacturing will only take approximately 2-3 days

Final Conclusion and Recommendations

- Proposed redesign will save approximately $ 98,000.00
- Erection schedule will be reduced by 25 working days
- Coordinating floor penetrations are crucial to implementing this system
- Any changes in design will severely impact project cost
- High early strength concrete should be utilized on existing EEE structural design
  - Minimizes risk of any change order impacts

- Penetrations should be avoided whenever possible, especially across the plank's webs
- Holes are not to be concentrated at one place along the plank
- When large penetrations are necessary:
  - Only in 4' wide planks with no factory cut openings
  - Only 2 webs may be cut per plank
  - Cuts may not be done closer than every fourth plank
- Most importantly, a professional engineer must be contacted for consultation regarding any floor penetrations

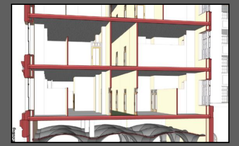


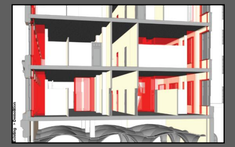


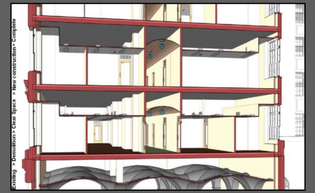
OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

BIM UTILIZATION

PRESENTATION OUTLINE:





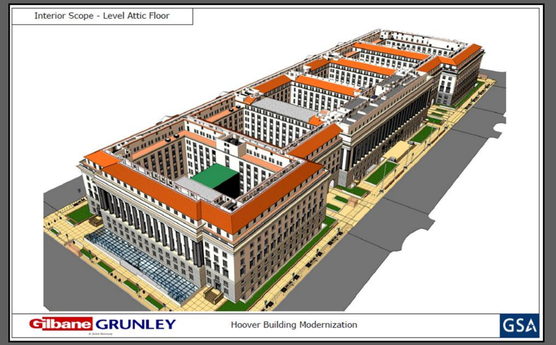


Background Information

- Funding allocated for renovation before 2007 : Prior to GSA BIM requirements
- Architect's drawings and design completed in 2D AutoCAD
- GGJV uses BIM technology for 3D coordination and design reviews
- Grunley has created a 3D Revit Model for existing, demolition, and new conditions

Research Goal

- Identify BIM Uses GGJV can apply to the existing 3D Model
- Apply the 3D Revit Model for facility management applications
- Utilize building information technology to better coordinate phase planning



BIM UTILIZATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

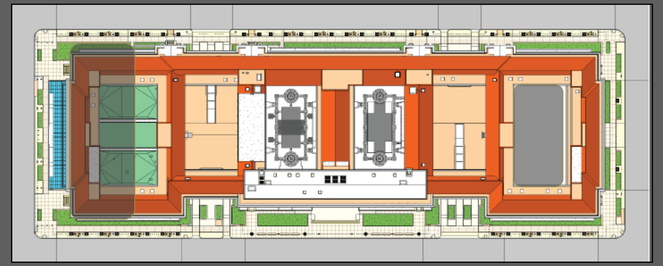
BIM Execution Planning Guide Overview	
Priority	**Potential BIM Uses**
1	3D Coordination
1	Design Reviews
2	Existing Conditions Modeling
2	Record Modeling
*1	Space Management and Tracking
*1	Phase Planning
*2	Building Maintenance Scheduling

Penn State BIM Execution Planning Guide

- BIM Execution Guide used to identify Uses
- Focus on which Uses can be built on the existing 3D Model

Move Management and Phase Planning

- Phase 2 required the relocation of 500 employees into the Phase 1 Temporary Office Facility
- Transition stage duration was 39 days
- How can GGJV and GSA minimize move time while managing resources throughout the renovation?



BIM UTILIZATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

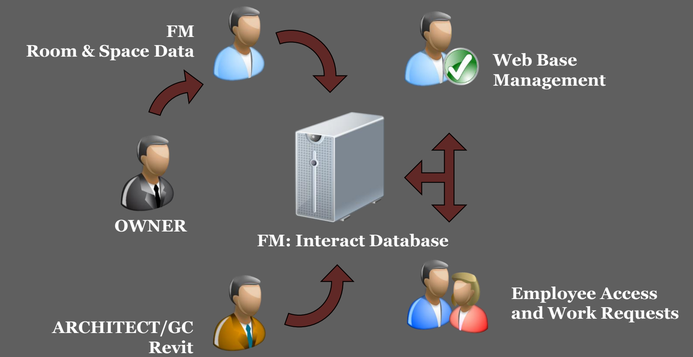
Proposed Solution

- FM: Systems' FM: Interact Workplace Management Suite
  - Transition Planning and Space Management
  - Asset Management
  - Maintenance Scheduling

FM:Systems

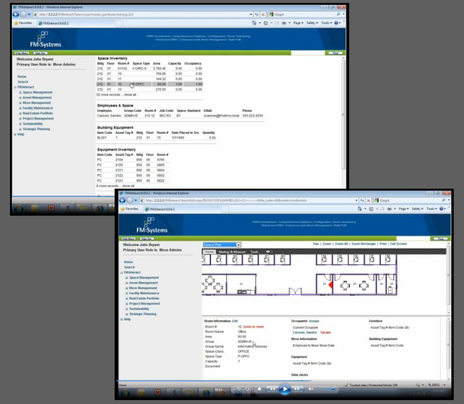
Utilizing Existing Information

- GSA currently has Room Data Sheets with general information on the facility
- Grunley has completed a phase filtered Revit Model with existing and new conditions



OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

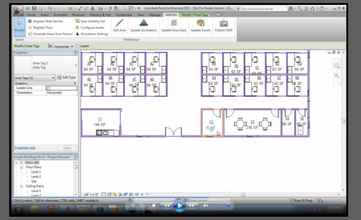


Applying FM:Interact

- Web-based information database
- Bi-lateral updating- Revit Model information and Room Data input
- Extensive interface with custom views and reports

Room Data and Information

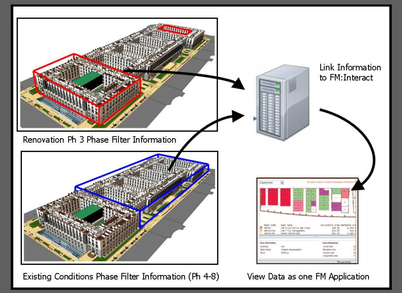
- Room Number, Name, Capacity, and Total Area
- Occupant Information
- Furniture and Building Equipment
- Move Status and Information



BIM UTILIZATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:



Phase Planning

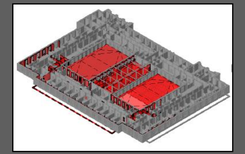
- Coordinate Move dates with Facility Management and Building Occupants
- Communicate information through web notifications
- Provide visual of existing and new occupant location

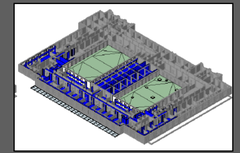
Space and Asset Management

- Data input can begin with Revit Model (Room Numbers, area, equipment)
- User friendly interface for easy information searches

Maintenance Scheduling

- Communicate work orders directly through web service
- Visual aid for coordinating building maintenance schedule





BIM UTILIZATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

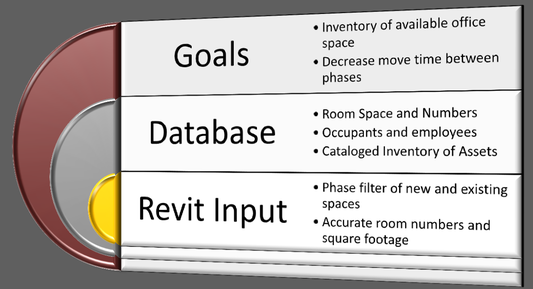
PRESENTATION OUTLINE:

Implementation Process

- Establish Goals and Information to Include
- Configure web and data links
- Import CAD data
- Train FM Users and System Testing
- Maintenance

Timeline for Implementation

- Expected implementation time is 3-6 months
- Phase 3 originally scheduled to begin in December 2011 (8 Months)
- Similar case study presented implementation time of 2 months (including training and move)



BIM UTILIZATION

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

Criticisms for Improvement

- Significant data entry required before utilizing FM: Interact
- No 4D phase planning capabilities- Information can not be linked to a schedule
- Limited interoperability with bar-codes or enterprise resource planning (ERP) systems
- Quantitative data and in depth case studies is extremely limited

Final Conclusions and Recommendations

- GGJV to implement FM:Interact with facility management during the Phase 3 transition period
- Quantitative data to compare software benefits
- GGJV can become industry leader in developing life-cycle models for renovations with FM:Interact

FM:Systems

LESSONS LEARNED

Analysis 1

- Precast Hollow Core planks significantly increase on site productivity
- Penetrations and Coordination are crucial elements in a successful precast design
- Crane use has great impact on production and schedule coordination

Analysis 2

- BIM is much more than clash detection and 3D modeling
- Implementing construction models to the operations phase of a building is feasible
- BIM technologies are still new- it is difficult to find quantitative data illustrating results

Analysis 3 (Photovoltaic Feasibility Study)

- Photovoltaic systems are cost effective over their lifetime
- Installation and system tie in are major issues to consider
- Rebates and Incentives make on-site renewable energy more endising

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

ACKNOWLEDGEMENTS

Academic Acknowledgements

- Dr. Robert Leicht –Thesis Advisor
- Dr. David Riley
- Dr. John Messner

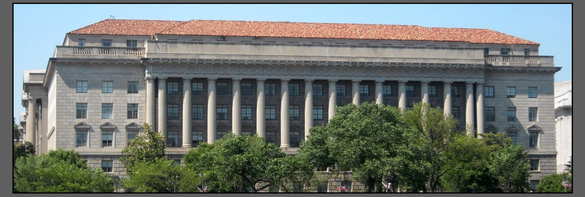
Industry Acknowledgements

- Gilbane- Grunley Joint Venture
- General Services Administration
- Group Goetz Architects
- Nitterhouse Concrete Products
- FM: Systems

Special Thanks

- Steve Monroe, Chris Chacey, Jeremy Thibodeau
- Mark Taylor
- Gerad Johnson
- Andy Mackey
- Matt Dabrowski, Eric Fedder

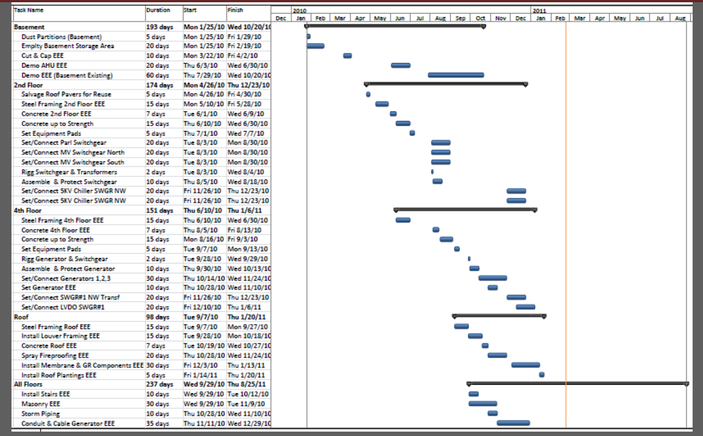
OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT



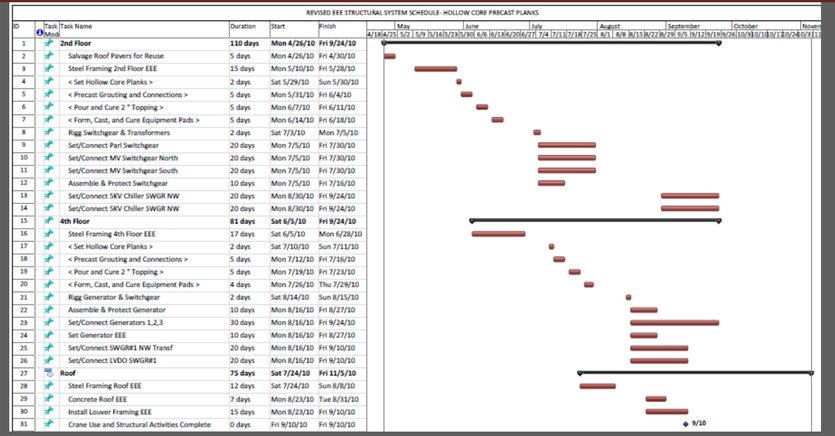
APPENDICES (Q&A)

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

Appendices Pages For Q&A

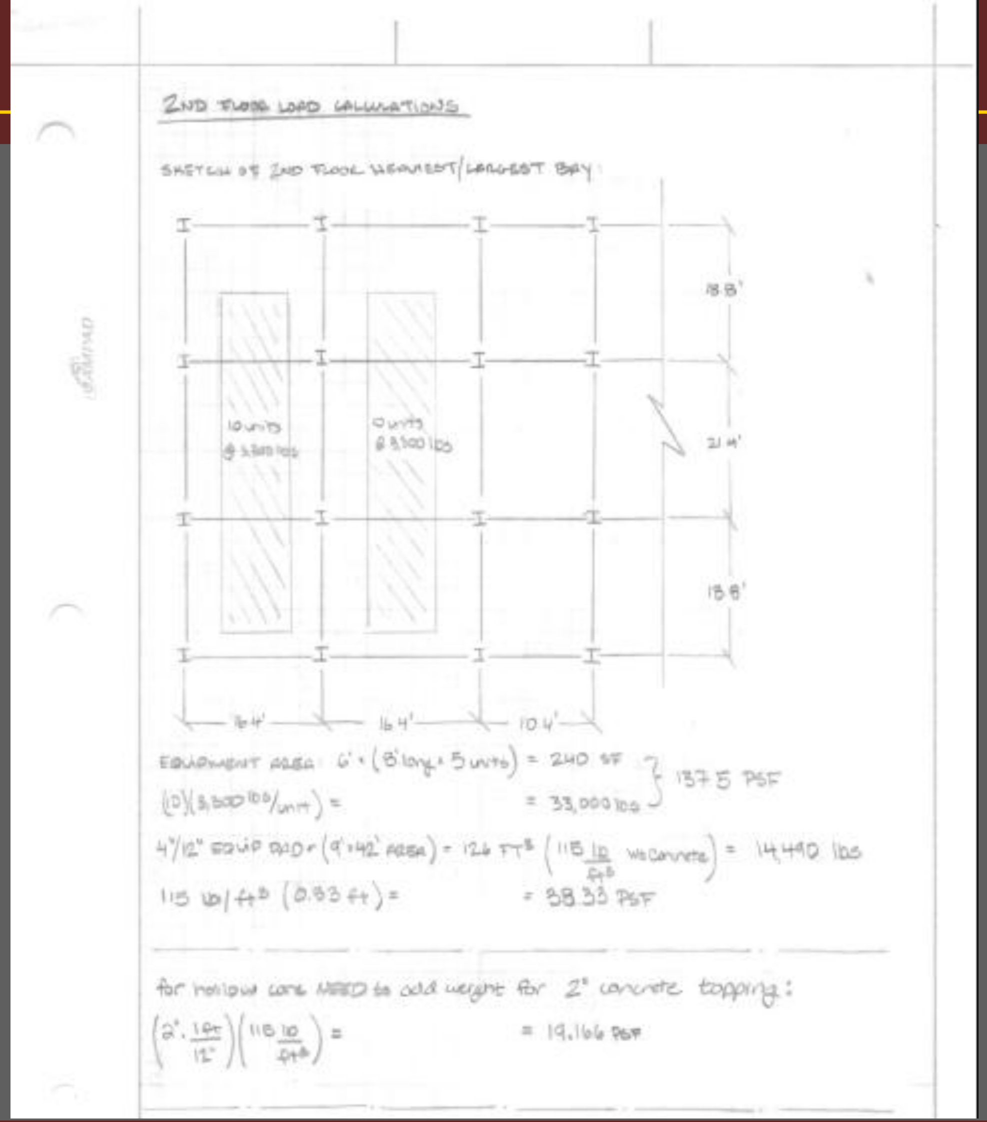


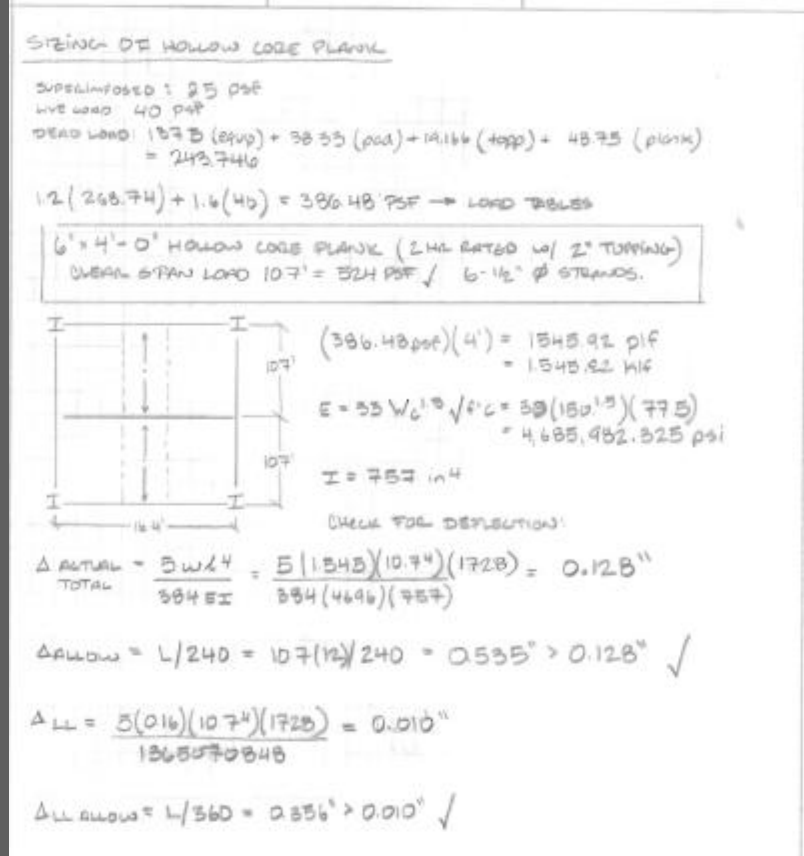
Task Name	Duration	Start	Finish
Basement	**193 days**	**Mon 1/25/10**	**Wed 10/20/10**
Dust Partitions (Basement)	5 days	Mon 1/25/10	Fri 1/29/10
Empty Basement Storage Area	20 days	Mon 1/25/10	Fri 2/19/10
Cut & Cap EEE	10 days	Mon 3/22/10	Fri 4/2/10
Demo AHU EEE	20 days	Thu 6/3/10	Wed 6/30/10
Demo EEE (Basement Existing)	60 days	Thu 7/29/10	Wed 10/20/10
2nd Floor	**174 days**	**Mon 4/26/10**	**Thu 12/23/10**
Salvage Roof Pavers for Reuse	5 days	Mon 4/26/10	Fri 4/30/10
Steel Framing 2nd Floor EEE	15 days	Mon 5/10/10	Fri 5/28/10
Concrete 2nd Floor EEE	7 days	Tue 6/1/10	Wed 6/9/10
Concrete up to Strength	15 days	Thu 6/10/10	Wed 6/30/10
Set Equipment Pads	5 days	Thu 7/1/10	Wed 7/7/10
Set/Connect Parl Switchgear	20 days	Tue 8/3/10	Mon 8/30/10
Set/Connect MV Switchgear North	20 days	Tue 8/3/10	Mon 8/30/10
Set/Connect MV Switchgear South	20 days	Tue 8/3/10	Mon 8/30/10
Rigg Switchgear & Transformers	2 days	Tue 8/3/10	Wed 8/4/10
Assemble & Protect Switchgear	10 days	Thu 8/5/10	Wed 8/18/10
Set/Connect 5KV Chiller SWGR NW	20 days	Fri 11/26/10	Thu 12/23/10
Set/Connect 5KV Chiller SWGR NW	20 days	Fri 11/26/10	Thu 12/23/10
4th Floor	**151 days**	**Thu 6/10/10**	**Thu 1/6/11**
Steel Framing 4th Floor EEE	15 days	Thu 6/10/10	Wed 6/30/10
Concrete 4th Floor EEE	7 days	Thu 8/5/10	Fri 8/13/10
Concrete up to Strength	15 days	Mon 8/16/10	Fri 9/3/10
Set Equipment Pads	5 days	Tue 9/7/10	Mon 9/13/10
Rigg Generator & Switchgear	2 days	Tue 9/28/10	Wed 9/29/10
Assemble & Protect Generator	10 days	Thu 9/30/10	Wed 10/13/10
Set/Connect Generators 1,2,3	30 days	Thu 10/14/10	Wed 11/24/10
Set Generator EEE	10 days	Thu 10/28/10	Wed 11/10/10
Set/Connect SWGR#1 NW Transf	20 days	Fri 11/26/10	Thu 12/23/10
Set/Connect LVDO SWGR#1	20 days	Fri 12/10/10	Thu 1/6/11
Roof	**98 days**	**Tue 9/7/10**	**Thu 1/20/11**
Steel Framing Roof EEE	15 days	Tue 9/7/10	Mon 9/27/10
Install Louver Framing EEE	15 days	Tue 9/28/10	Mon 10/18/10
Concrete Roof EEE	7 days	Tue 10/19/10	Wed 10/27/10
Spray Fireproofing EEE	20 days	Thu 10/28/10	Wed 11/24/10
Install Membrane & GR Components EEE	30 days	Fri 12/3/10	Thu 1/13/11
Install Roof Plantings EEE	5 days	Fri 1/14/11	Thu 1/20/11
All Floors	**237 days**	**Wed 9/29/10**	**Thu 8/25/11**
Install Stairs EEE	10 days	Wed 9/29/10	Tue 10/12/10
Masonry EEE	30 days	Wed 9/29/10	Tue 11/9/10
Storm Piping	10 days	Thu 10/28/10	Wed 11/10/10
Conduit & Cable Generator EEE	35 days	Thu 11/11/10	Wed 12/29/10

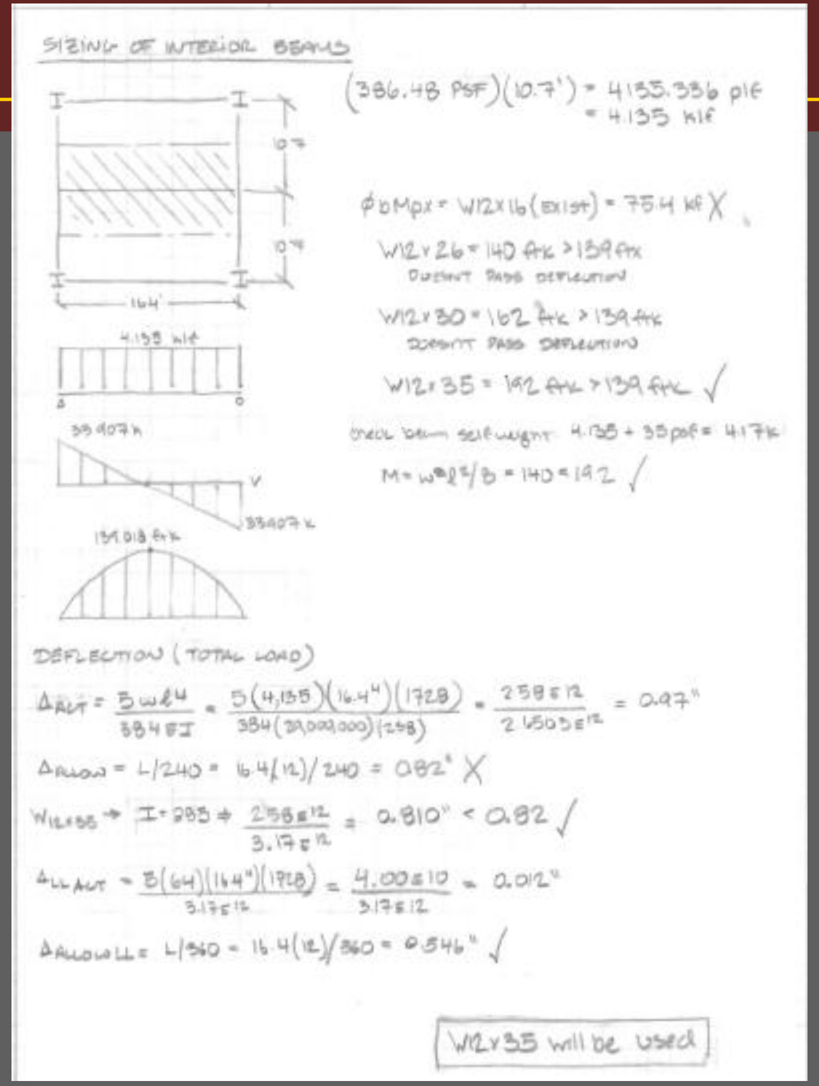


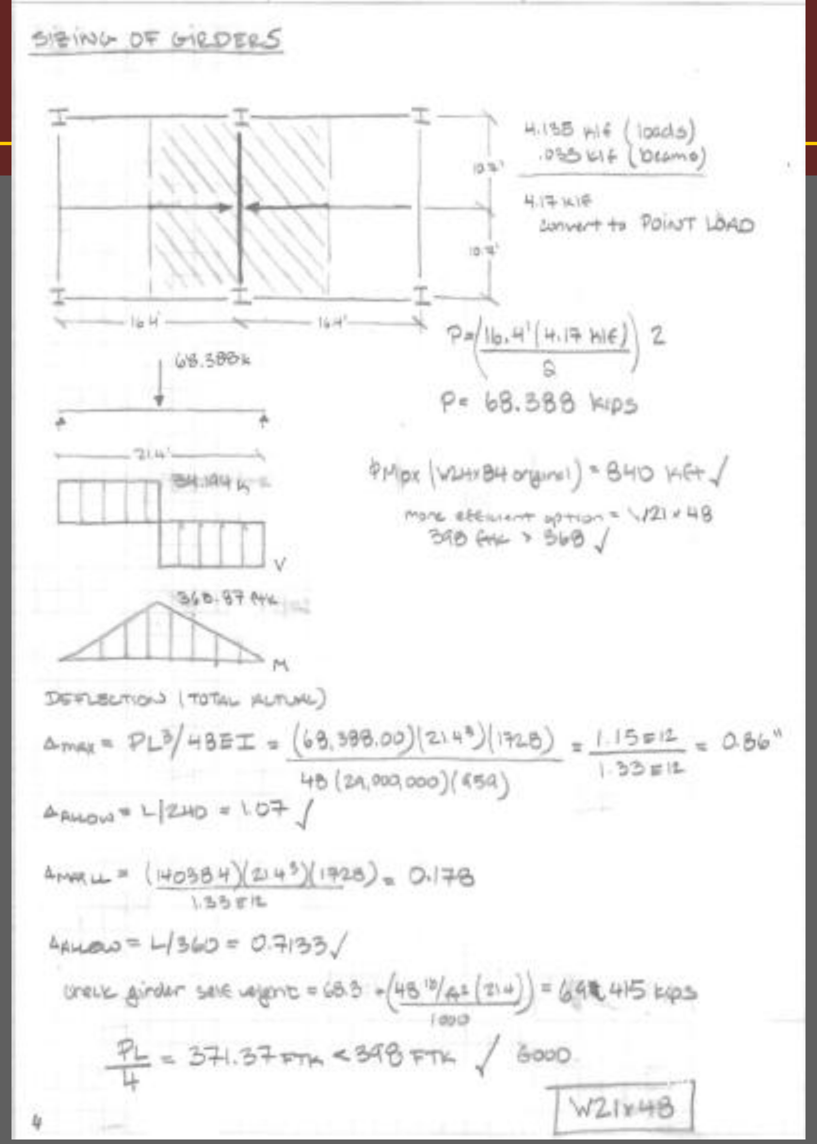
REVISED EEE STRUCTURAL SYSTEM SCHEDULE- HOLLOW CORE PRECAST PLANKS

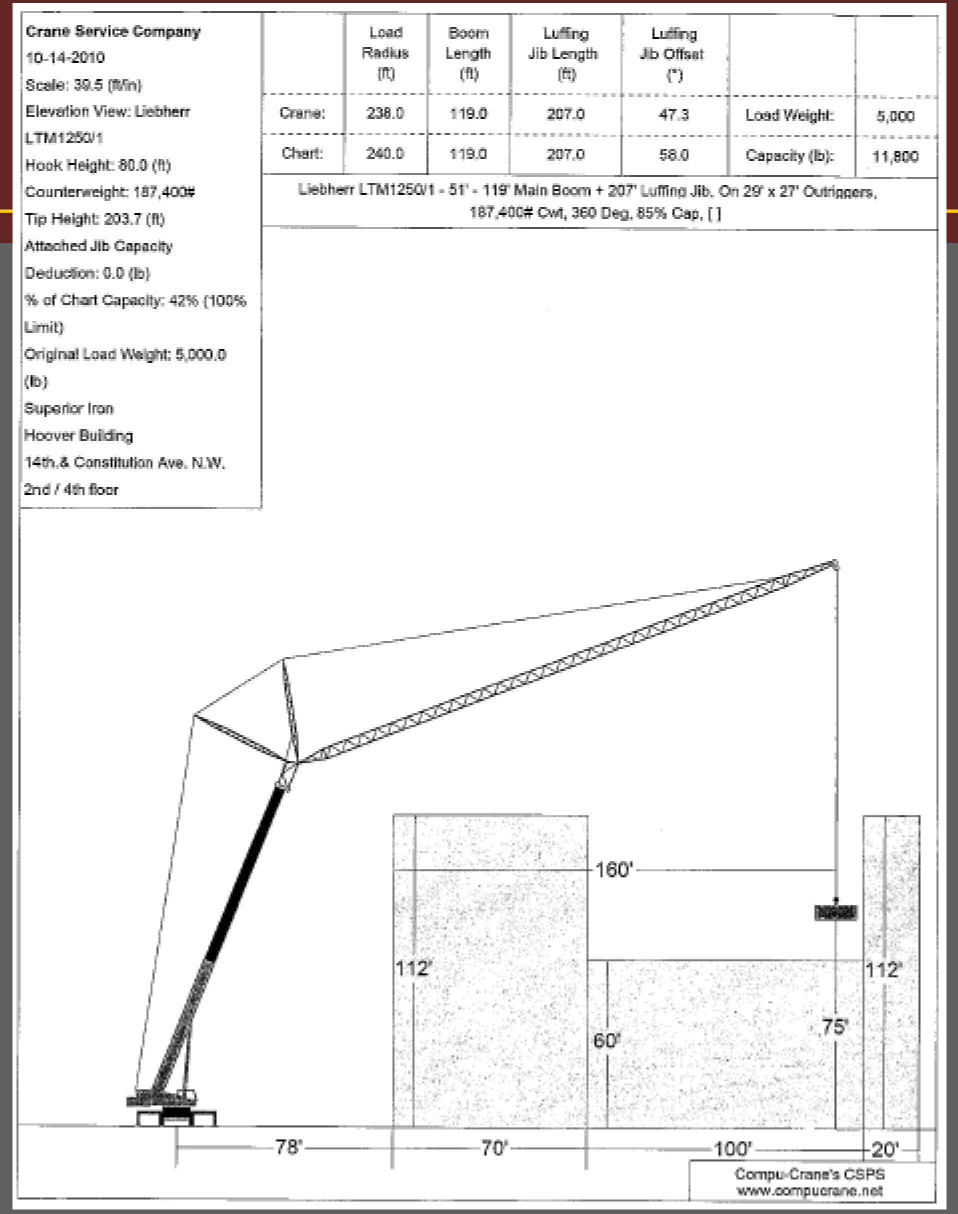
ID	Task Mode	Task Name	Duration	Start	Finish
1		**2nd Floor**	**110 days**	**Mon 4/26/10**	**Fri 9/24/10**
2		Salvage Roof Pavers for Reuse	5 days	Mon 4/26/10	Fri 4/30/10
3		Steel Framing 2nd Floor EEE	15 days	Mon 5/10/10	Fri 5/28/10
4		< Set Hollow Core Planks >	2 days	Sat 5/29/10	Sun 5/30/10
5		< Precast Grouting and Connections >	5 days	Mon 5/31/10	Fri 6/4/10
6		< Pour and Cure 2 " Topping >	5 days	Mon 6/7/10	Fri 6/11/10
7		< Form, Cast, and Cure Equipment Pads >	5 days	Mon 6/14/10	Fri 6/18/10
8		Rigg Switchgear & Transformers	2 days	Sat 7/3/10	Mon 7/5/10
9		Set/Connect Parl Switchgear	20 days	Mon 7/5/10	Fri 7/30/10
10		Set/Connect MV Switchgear North	20 days	Mon 7/5/10	Fri 7/30/10
11		Set/Connect MV Switchgear South	20 days	Mon 7/5/10	Fri 7/30/10
12		Assemble & Protect Switchgear	10 days	Mon 7/5/10	Fri 7/16/10
13		Set/Connect 5KV Chiller SWGR NW	20 days	Mon 8/30/10	Fri 9/24/10
14		Set/Connect 5KV Chiller SWGR NW	20 days	Mon 8/30/10	Fri 9/24/10
15		**4th Floor**	**81 days**	**Sat 6/5/10**	**Fri 9/24/10**
16		Steel Framing 4th Floor EEE	17 days	Sat 6/5/10	Mon 6/28/10
17		< Set Hollow Core Planks >	2 days	Sat 7/10/10	Sun 7/11/10
18		< Precast Grouting and Connections >	5 days	Mon 7/12/10	Fri 7/16/10
19		< Pour and Cure 2 " Topping >	5 days	Mon 7/19/10	Fri 7/23/10
20		< Form, Cast, and Cure Equipment Pads >	4 days	Mon 7/26/10	Thu 7/29/10
21		Rigg Generator & Switchgear	2 days	Sat 8/14/10	Sun 8/15/10
22		Assemble & Protect Generator	10 days	Mon 8/16/10	Fri 8/27/10
23		Set/Connect Generators 1,2,3	30 days	Mon 8/16/10	Fri 9/24/10
24		Set Generator EEE	10 days	Mon 8/16/10	Fri 8/27/10
25		Set/Connect SWGR#1 NW Transf	20 days	Mon 8/16/10	Fri 9/10/10
26		Set/Connect LVDO SWGR#1	20 days	Mon 8/16/10	Fri 9/10/10
27		**Roof**	**75 days**	**Sat 7/24/10**	**Fri 11/5/10**
28		Steel Framing Roof EEE	12 days	Sat 7/24/10	Sun 8/8/10
29		Concrete Roof EEE	7 days	Mon 8/23/10	Tue 8/31/10
30		Install Louver Framing EEE	15 days	Mon 8/23/10	Fri 9/10/10
31		Crane Use and Structural Activities Complete	0 days	Fri 9/10/10	Fri 9/10/10


2ND FLOOR LOAD CALCULATIONS

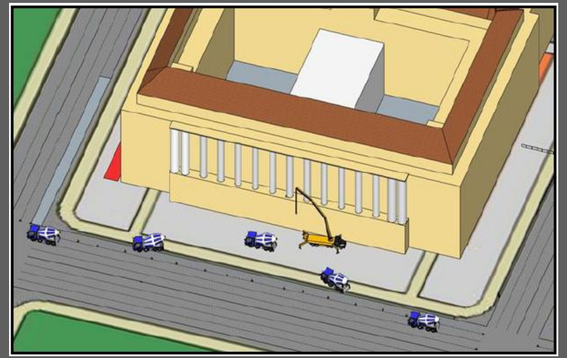

SIZING OF HOLLOW CORE PLANK

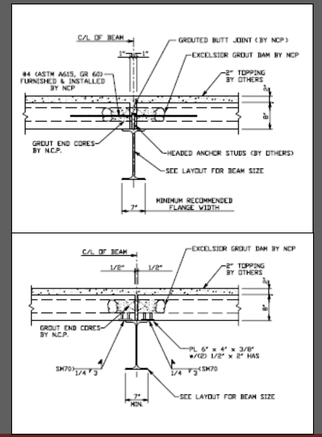

SIZING OF INTERIOR BEAMS
W21x35 will be used

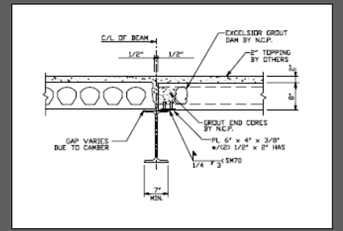

SIZING OF GIRDERS
W21x48

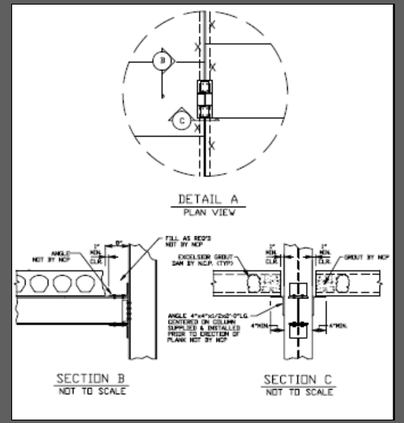

Crane Service Company
10-14-2010
Scale: 39.5 (ft/in)
Elevation View: Liebherr LTM1250/1
Hook Height: 80.0 (ft)
Counterweight: 187,400#
Tip Height: 203.7 (ft)
Attached Jib Capacity Deduction: 0.0 (lb)
% of Chart Capacity: 42% (100% Limit)
Original Load Weight: 5,000.0 (lb)
Superior Iron
Hoover Building
14th & Constitution Ave. N.W.
2nd / 4th floor
Liebherr LTM1250/1 - 51' - 119' Main Boom + 207' Luffing Jib. On 29' x 27' Outriggers, 187,400# Cwt, 360 Deg, 85% Cap, [ ]
160'
112'
60'
75'
78'
70'
100'
20'
Compu-Crane's CSPS
www.compucrane.net

Estimated Actvity Durations (RS Means Cost Data 2011)				
Activity	Unit	Daily Output	Quantity	Duration (Days)
2nd Floor				
2" Topping- self level dry 3000 psi, pumped	SF	12000	6585	0.548
Topping Cure Time				2.0
Forms in Place for Equipment Pads (4 use)	SFCA	205	109	0.532
Set Equipment Pads- 4" Elevated Pad	SF	2613	1152.9	0.44
Equipment Pad Cure Time				2.0
Stripping of Equipment Pad Formwork	SFCA	205	109	0.532
4th Floor				
2" Topping- self level dry 3000 psi, pumped	SF	12000	6585	0.548
Topping Cure Time				2.0
Forms in Place for Equipment Pads (4 use)	SFCA	205	133	0.648
Set Equipment Pads- 4" Elevated Pad	SF	2613	1114.575	0.42
Equipment Pad Cure Time				2.0
Stripping of Equipment Pad Formwork	SFCA	205	133	0.548




C/L OF BEAM
GROUTED BUTT JOINT (BY NCP)
EXCELSIOR GROUT DAM BY NCP
#4 (ASTM A615, GR 60) FURNISHED & INSTALLED BY NCP
2" TOPPING BY OTHERS
GROUT END CORES BY N.C.P.
HEADED ANCHOR STUDS (BY OTHERS)
SEE LAYOUT FOR BEAM SIZE
MINIMUM RECOMMENDED FLANGE WIDTH
C/L OF BEAM
EXCELSIOR GROUT DAM BY NCP
2" TOPPING BY OTHERS
GROUT END CORES BY N.C.P.
PL 6" x 4" x 3/8" w/(2) 1/2" x 2" HAS
SM70
SEE LAYOUT FOR BEAM SIZE


C/L OF BEAM
EXCELSIOR GROUT DAM BY N.C.P.
2" TOPPING BY OTHERS
GROUT END CORES BY N.C.P.
GAP VARIES DUE TO CAMBER
PL 6" x 4" x 3/8" w/(2) 1/2" x 2" HAS
SM70


DETAIL A
PLAN VIEW
SECTION B
NOT TO SCALE
SECTION C
NOT TO SCALE
EXCELSIOR GROUT DAM BY N.C.P. (TYP)
GROUT BY NCP

PHOTOVOLTAIC FEASIBILITY ANALYSIS

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

Photovoltaic Analysis Slides (Not Presented)

PHOTOVOLTAIC ANALYSIS

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

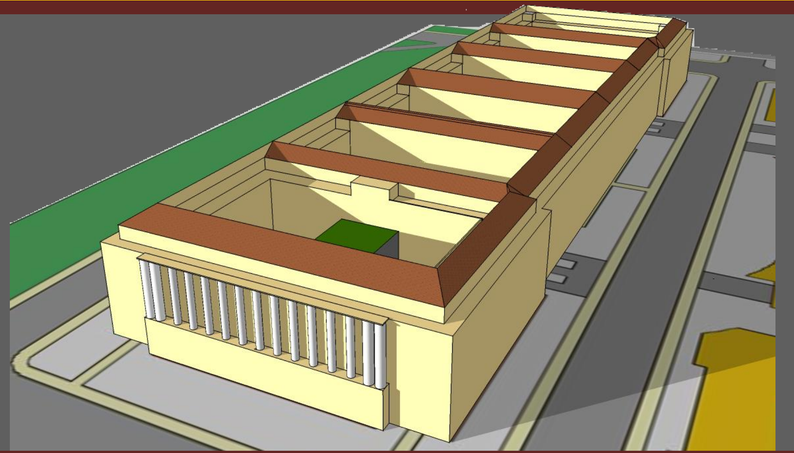
PV ARRAY PARAMETERS	
Available Roof Area	5,760 SF
Slope of Roof	3:5 (31 Degrees)
Orientation	Directly South
Optimum Tilt Angle	31 Degrees
Summer	24 Degrees
Fall/Spring	39 Degrees
Winter	54 Degrees
Sun Hours/Day	4.9

Background Information

- Renovation project in pursuit of LEED Gold Certification- LEED V2.2
- No current initiative to obtain credits for On-Site Renewable Energy
- Roof Orientation and pitch ideal for PV array

Research Goal

- Perform a photovoltaic feasibility study
- Examine life cycle costs and payback period



PHOTOVOLTAIC ANALYSIS

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

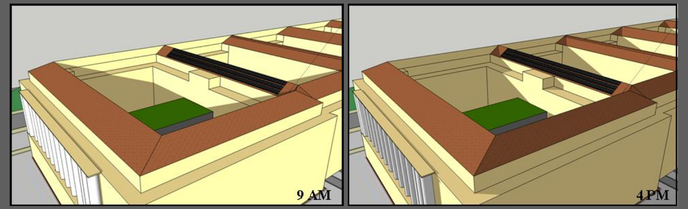
KYOCERA - Calculation for the Electrical Equipment Enclosure		
Step	Value	Comment / Description
1	4.9	sun hours per day
2	91224	watt-hours energy load (5% Waste Factor Included)
3	18617	watts/hour of sunlight
4	102.7	amperage x charging voltage for model KD210GX-LP
5	181.3	# of models required
	190	**Units Required**

Electrical Equipment Enclosure Lighting Loads

- 2nd Floor: (37) 48 Watt 2 Lamp Pendant Mounted Fluorescent Industrial Luminaries-
  - 15 Hours/Day operation: 53.28 kWh
- 4th Floor: (40) 28 Watt 2 Lamp Pendant Mounted General Purpose Industrial Luminaries-
  - 15 Hours/Day operation: 33.6 kWh
- 91,224 Total Watt-Hours Energy Load (5% Waste Factor Included)

Design Process

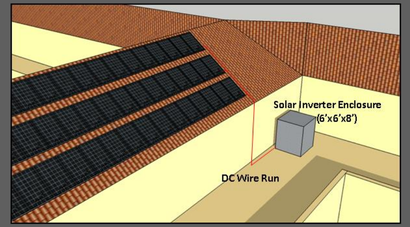
- Kyocera Solar Panel Design Process utilized
- 5 Step Process for determining the number of panels needed to power load
- Kyocera KDL210GX-LP panels were utilized
- 192 59”x39” will be laid out in three rows across the length of the roof



PHOTOVOLTAIC ANALYSIS

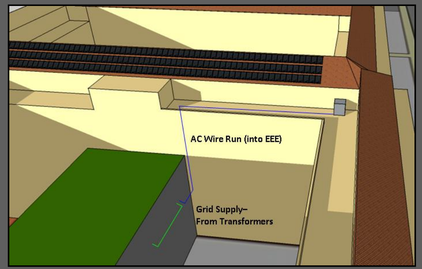
OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:



System Tie-In

- PV Array will be tied into the facility's energy provider grid
- System will not be directly powering EEE's lighting loads
- Balance of Systems equipment will provide disconnects for AC and DC wire runs, ground and overcurrent protection
- (6) SB-6000 US inverters will be housed near the system to convert DC power into AC power to tie into the grid
- System will be connected to the main distribution panel in the EEE



PHOTOVOLTAIC ANALYSIS

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

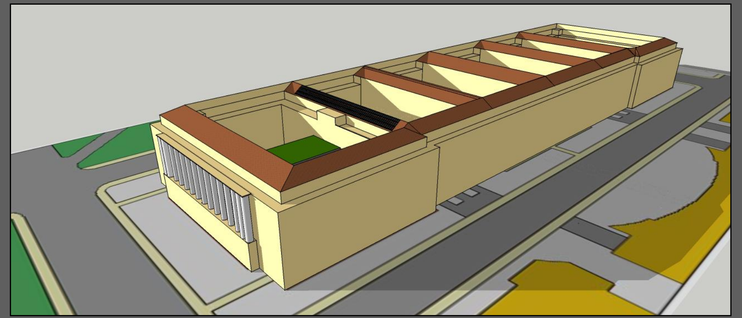
SAVINGS AND INCENTIVES APPLICABLE		
Northeast, United States		
Program	**Incentive Type**	**Amount**
Utility Company: Existing Buildings Energy Efficient Program	Grant	$ 20,000.00
Net Metering	Performance Incentive	$140/ MWh
PSC Solar Renewable Energy Certificates	Performance Incentive	$460/ MWh

Energy Production

- The panels combine to produce a total of 40.3 kW (DC)
- Referencing PVWatts V.1 Calculator: Annual AC Energy produced is 49,766 kWh
- At $0.08/kWh, the system produces $3,981.00 of energy annually

System Cost and Renewable Energy Incentives

- Research shows similar systems cost approximately $7.60 per watt of energy produced ($7.80)
- The 40.3 kW system will cost approximately $314,340.00
- Federal buildings are applicable to limited incentives for on-site renewable energy systems



PHOTOVOLTAIC ANALYSIS

OFFICE RENOVATION BUILDING
NORTHEAST, UNITED STATES
ANTHONY JURJEVIC | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

Market		
Retail Cost of Electricity	0.13	$/kWh
Elec. Rate increase	2.50%	
AECs Value	590	$/MWh
Loan		
Percentage Borrowed	0.00%	
Loan Value	$0.00	
Interest rate	3.00%	APY
Period	25	Years
CRF	0.004742113	

Summary of System Cost and Savings	
Upfront Cost	$ 294,390.00
Average Monthly Savings	$ 2,980.00
Pay Back Period	8 Years, 2 Months
Total Savings (25 Years)	$ 660,007.89

Payback Analysis

- Payback Calculator created by Andy Mackey M.S. Construction Management
- Calculation based on owner supplying upfront costs for system
- Payback period just over 8 years
- Lifetime savings of $660,000.00 over the course of 25 years

Final Conclusion and Recommendations

- Project owner should invest in applying photovoltaic system
- Visually represents owner investment in sustainable practices
- Investment returns life time savings greater than $660,000.00