Square 1400 Apartments

Fairfax, VA

PENN STATE AE SENIOR CAPSTONE PROJECT

Anthony Grab | CONSTRUCTION MANAGEMENT

Raymond Sowers - CM ADVISOR

PRESENTATION OUTLINE:

Square 1400 Apartments

Fairfax, VA

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Project Background

ANALYSIS 1: Change in Cast-In-Place

ANALYSIS 2: FAÇADE RE-DESIGN

ANALYSIS 3: SIPS

ANALYSIS 4: OPERATIONS AND MAINTENANCE

PROJECT BACKGROUND

Square 1400
Apartments
Fairfax, VA
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PRESENTATION OUTLINE:

IMAGE COURTESY OF HITT Contracting

LOCATION:

- 2700 Dorr Ave, Fairfax, VA
- Home of the previous HITT Headquarters

BUILDING PARAMATERS:

- 327,431 SF gross building area
- 11 Story Apartment Building/4 Story Parking Garage

PROJECT PARAMETERS:

- Total Project Cost: $40 Million
- Dates of Construction: January 2012 – October 2013
- Delivery Method: Design-Bid-Build
- LEED Certification: Silver

IMAGES COURTESY OF GOOGLE MAPS

PROJECT BACKGROUND

Square 1400
Apartments
Fairfax, VA
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PRESENTATION OUTLINE:

IMAGE Developed by Anthony Grab

STRUCTURAL SYSTEM:

- Cast-in-place Concrete with Post Tension Cables
- 30,000 SF per floor
- 5 Pours per floor

BUILDING ENCLOSURE:

- Multi Color style brick with Light Gage Studs
- Roof – Parapet wall with 6" insulation

CONSTRUCTION LOGISTICS:

- Phase One: Demo Existing Structures, Utility relocation
  Phase Two: Excavation, Building Structure
- Phase Three: Building Exterior Façade

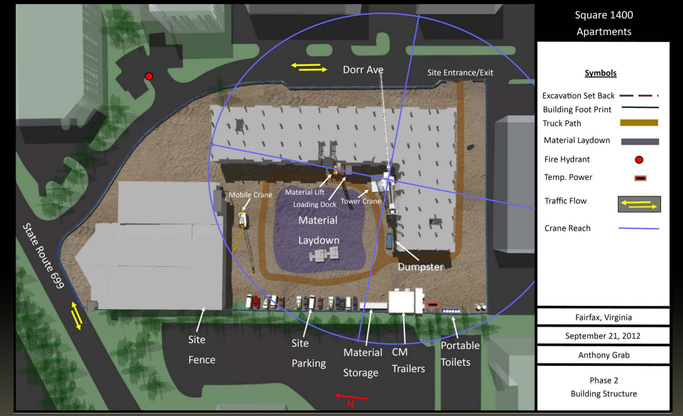


IMAGE Developed by Anthony Grab

Analysis 1: Change in Cast-In-Place

Square 1400
Apartments
Fairfax, VA
Anthony Grab | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

IMAGE Taken by Anthony Grab

PROBLEM IDENTIFICATION:

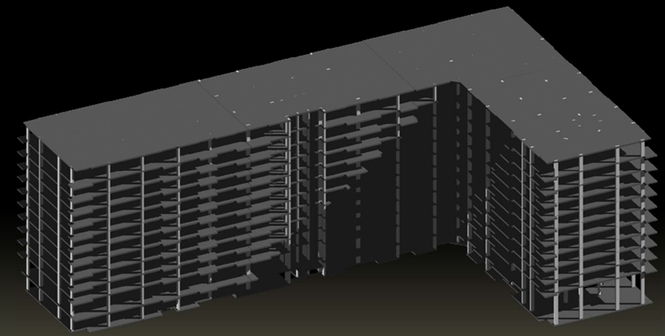
- High Level of Detail Cast-In-Place Structure
- Impacts on critical path schedule
- Require a large amount of man power

RESEARCH GOAL:

- Investigate alternative structure system
- Assess changes in strategies for constructing the new system

INDUSTRY MEMBER INTERVIEWS:

- Raymond Sowers .....Penn State OPP
- Brian Abel .....Able Consulting Engineers
- Bill Holley.....Infinity Structures



Model Produced by Anthony Grab

Analysis 1: Change in Cast-In-Place

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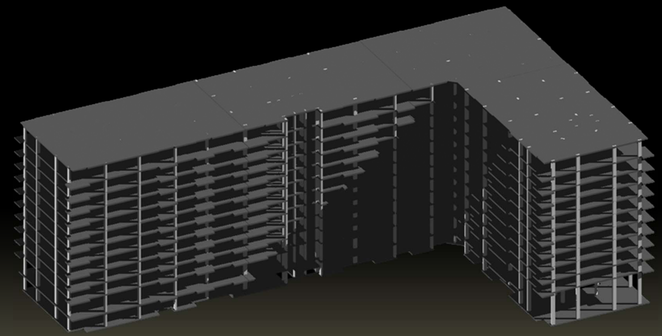
PRESENTATION OUTLINE:

Image COURTESY OF www.infinitystructures.com

ISSUES DISCUSSED IN INTERVIEWS:

- Factors influencing shifts in strategy
- Constructability and Limitations
- Design Layout
- Cost and duration
- Benefits of the infinity system
- Downfalls of Cast-In-Place Concrete
- Manufacturing of Infinity System Panels



Model Produced by Anthony Grab

Analysis 1: Change in Cast-In-Place

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PRESENTATION OUTLINE:

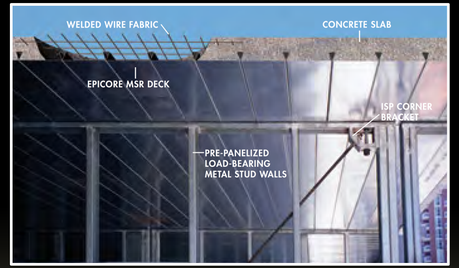
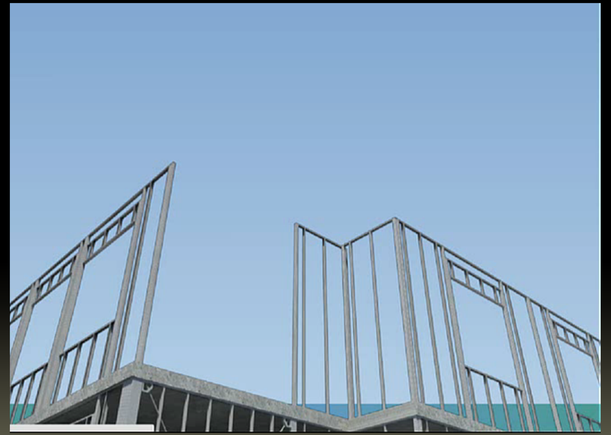


Image COURTESY OF www.infinitystructures.com

How the Infinity System Works

- EPICORE MSR Composite Floor with WWF
- Panelized Load-bearing Metal Studs
- Spans up to 27 feet
- 4” to 8” Slab Thickness
- 4,000 psi Regular Weight Concrete



Video COURTESY OF www.infinitystructures.com

Analysis 1: Change in Cast-In-Place

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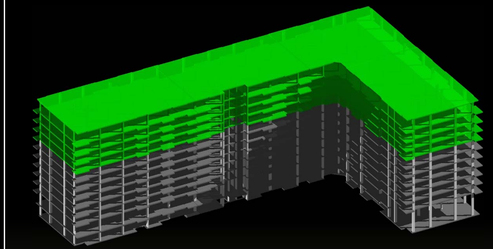
PRESENTATION OUTLINE:



Model Produced by Anthony Grab

ADVANTAGES

Infinity System :

- About 1 week per floor to construct
- Economical traditionally low cost than Cast-In-Place
- Quality control in Factory environment
- Uniform Load

Cast-In-Place Concrete

- Can build many stories
- More freedom with floor plan design

DISADVANTAGES

Infinity System :

- Difficult To Come Back a Redesign Floors
- Limited to 5 Stories

Cast-In-Place Concrete

- About 2 weeks per floor to construct
- Cost

ANALYSIS 1: CHANGE IN CAST-IN-PLACE

SQUARE 1400
APARTMENTS
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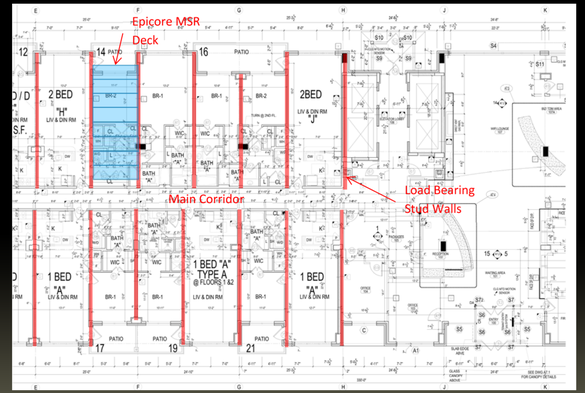
ANTHONY GRAB | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

Design Loads	
Rood Dead Loads	
Roof Dead Loads	5.0 PSF
Roofing	3.5 PSF
Sheathing/Insulation	3.5 PSF
Ceiling	4.0 PSF
Mech. & Misc.	5.0 PSF
Total	**21 PSF**
Rood Live Loads	
Total	**25 PSF**
Floor Dead Loads	
8" Concrere Concrete Slab	90 PSF
Ceiling	4.0 PSF
Mech./Electrical	3 PSF
Sprinklers	2.5 PSF
Misc.	2.5 PSF
Total	**102 PSF**
Floor Live Loads	
Total	**40 PSF**

BREADTH 1 DESIGN OF THE INFINITY SYSTEM

- EPICORE MSR 22 GAGE COMPOSITE DECK
- SIMPLE SPAN CONDITION
- CONCRETE STRENGTH 4,000 PSI
- LIVE LOAD 40 PSF
- DEAD LOAD 20 PSF OF EPICORE MSR DECK
- CONCRETE SLAB 8" THICK
- DEFLECTION IS ACCOUNTED FOR WITHIN TABLE VALUES
- NO REINFORCING IS REQUIRED FOR SIMPLE SPAN OTHER THAN EPICORE MSR
- 4T10 METAL STUDS TO BE USED



Analysis 1: Change in Cast-In-Place

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PRESENTATION OUTLINE:

Image COURTESY OF www.infinitystructures.com

Conclusion and Recommendations :

- 42 Day Savings
- Light Weight
- Less Weather Sensitive during construction
- Prefabricated Panels
- I would highly recommend the implantation on an Infinity Structure System

Image COURTESY OF www.infinitystructures.com

ANALYSIS 2: BRICK FAÇADE RE-DESIGN

Square 1400
Apartments
Fairfax, VA
Anthony Grab | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

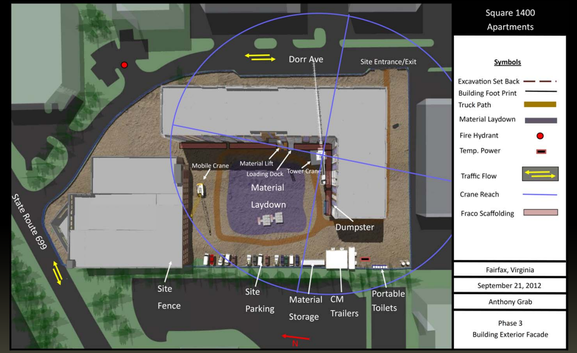
IMAGE COURTESY OF HITT CONTRACTING

PROBLEM IDENTIFICATION:

- SITE CONGESTION DUE TO CONCRETE AND MASONRY OVERLAP
- POTENTIAL DELAYS IN DRYING DEAD LINE
- COMPLEXITY OF BRICK FAÇADE

RESEARCH GOAL:

- DETERMINE NEW TYPE OF EXTERIOR FACADE
- REDUCE SITE CONGESTION AND TRADE COORDINATION ON-SITE
- REDUCE SCHEDULE



ANALYSIS 2: BRICK FAÇADE RE-DESIGN

Square 1400
Apartments
Fairfax, VA
Anthony Grab | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

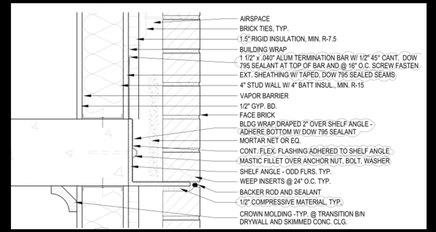


IMAGE COURTESY OF Meyer Consulting Engineers

ORIGINAL FACADE:

- 4" brick on Metal Metal Stud
- $7.4 million masonry package
- 4.2 month construction duration

PROPOSED GFRC FACADE:

- Prefabricated Panels
- Varity of Sizes and Colors
- Sustainable
- Improved Site Logistics
- No Structure Redesign

IMAGE COURTESY OF Stromberg Architectural Products

ANALYSIS 2: BRICK FAÇADE RE-DESIGN

Square 1400
Apartments
Fairfax, VA
Anthony Grab | construction management

PRESENTATION OUTLINE:

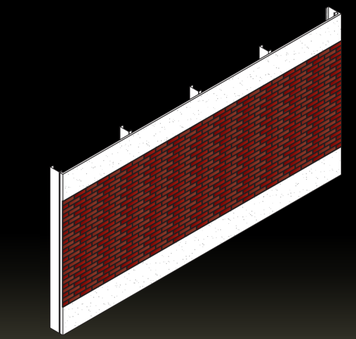


IMAGE COURTESY OF Stromberg Architectural Products

SCHEDULE REDUCTION:

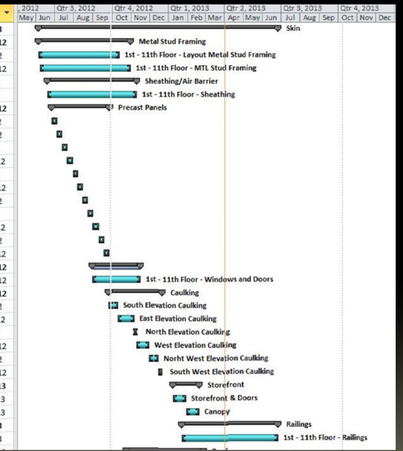
- Original masonry façade duration = 126 days
- GFRC erection = 6 days/floor
- GFRC façade duration = 67 days

IMPACT ON PROJECT:

- No overlap of concrete and façade trades
- Façade is on critical path – Potential 59 days savings

Façade Schedule Duration Comparison	
	Durations
Standard Brick System	126
GFRC System	67
Difference (Days)	**59**

	Task Name	Duration	Start	Finish
60	Skin	276 days	Tue 6/5/12	Tue 6/25/13
61	Metal Stud Framing	106 days	Tue 6/5/12	Tue 10/30/12
62	1st - 11th Floor - Layout Metal Stud Framin	94 days	Tue 6/5/12	Fri 10/12/12
63	1st - 11th Floor - MTL Stud Framing	104 days	Thu 6/7/12	Tue 10/30/12
64	Sheathing/Air Barrier	104 days	Tue 6/19/12	Fri 11/9/12
65	1st - 11th Floor - Sheathing	104 days	Tue 6/19/12	Fri 11/9/12
66	Precast Panels	67 days	Tue 6/26/12	Wed 9/26/12
67	Install Precast Panels 1st Floor	7 days	Tue 6/26/12	Wed 7/4/12
68	Install Precast Panels 2nd Floor	7 days	Wed 7/4/12	Thu 7/12/12
69	Install Precast Panels 3rd Floor	7 days	Thu 7/12/12	Fri 7/20/12
70	Install Precast Panels 4th Floor	7 days	Fri 7/20/12	Mon 7/30/12
71	Install Precast Panels 5th Floor	7 days	Mon 7/30/12	Tue 8/7/12
72	Install Precast Panels 6th Floor	7 days	Tue 8/7/12	Wed 8/15/12
73	Install Precast Panels 7th Floor	7 days	Wed 8/15/12	Thu 8/23/12
74	Install Precast Panels 8th Floor	7 days	Thu 8/23/12	Fri 8/31/12
75	Install Precast Panels 9th Floor	7 days	Fri 8/31/12	Mon 9/10/12
76	Install Precast Panels 10th Floor	7 days	Mon 9/10/12	Tue 9/18/12
77	Install Precast Panels 11th Floor	7 days	Tue 9/18/12	Wed 9/26/12
78	Windows/Balcony Doors	55 days	Fri 8/31/12	Thu 11/15/12
79	1st - 11th Floor - Windows and Doors	55 days	Fri 8/31/12	Thu 11/15/12
80	Caulking	62 days	Wed 9/26/12	Thu 12/20/12
81	South Elevation Caulking	10 days	Wed 9/26/12	Tue 10/9/12
82	East Elevation Caulking	20 days	Tue 10/9/12	Mon 11/5/12
83	North Elevation Caulking	5 days	Mon 11/5/12	Fri 11/9/12
84	West Elevation Caulking	15 days	Fri 11/9/12	Thu 11/29/12
85	Norht West Elevation Caulking	12 days	Thu 11/29/12	Fri 12/14/12
86	South West Elevation Caulking	5 days	Fri 12/14/12	Thu 12/20/12
87	Storefront	30 days	Tue 1/8/13	Mon 2/18/13
88	Storefront & Doors	15 days	Tue 1/8/13	Mon 1/28/13
89	Canopy	15 days	Tue 1/29/13	Mon 2/18/13
90	Railings	111 days	Tue 1/22/13	Tue 6/25/13
91	1st - 11th Floor - Railings	111 days	Tue 1/22/13	Tue 6/25/13



Schedule Produced by Anthony Grab

ANALYSIS 2: BRICK FAÇADE RE-DESIGN

Square 1400
Apartments
Fairfax, VA
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PRESENTATION OUTLINE:

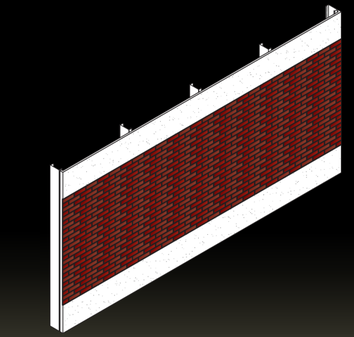


IMAGE COURTESY OF Stromberg Architectural Products

MATERIAL PRICING:

- $45.00/sf Glass Fiber Reinforced Cladding
- $00.45/sf cost Fiberglass 3-1/2", R15 Insulation

COST REDUCTION:

- GFRC façade costs approximately 27% less than masonry
- $2,018,000.00 overall savings from façade re-design

GFRC Cost Estimate									
Item	Units	Quantity	Unit Mat.	Mat. Cost	Unit Labor	Labor Cost	Unit Equip.	Equip. Cost	Total Item Cost
GFRC Panel	sf	119600	$45.00	$ 5,382,000	-	-	-	-	$ 5,382,000.00
fiberglass 3-1/2" , R15	sf	119600	0.48	$ 57,408	-	-	-	-	$ 57,408.00
								Total Cost	$ 5,439,408.00

Cost Comparison of Façade Systems	
Item	Cost
GFRC System	$5,382,000.00
Standard Brick System	$7,400,000.00
Difference in Cost	$2,018,000.00

ANALYSIS 2: BRICK FAÇADE RE-DESIGN

SQUARE 1400
APARTMENTS
FAIRFAX, VA
ANTHONY GRAB | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

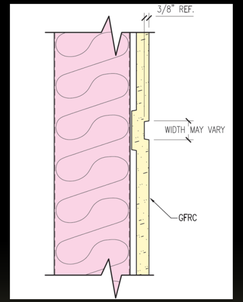
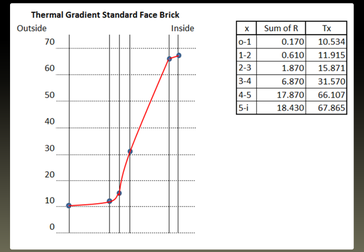


IMAGE COURTESY OF STROMBERG ARCHITECTURAL PRODUCTS

BREADTH 2: MECHANICAL – THERMAL QUALITY

Standard Face Brick Construction

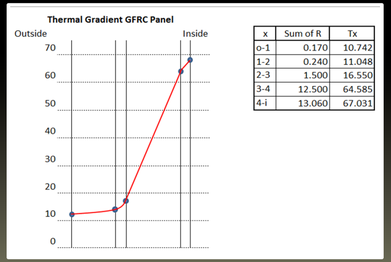
Wall U-Value		Framing	Insulating
R0	Outside	0.170	0.170
R1	4" Face Brick	0.440	0.440
R2	3/4" Air Space	1.260	1.260
R3	1.5" Rigid Insulation Board	5.000	5.000
R4	Metal Stud/3-5/8" Fiberglass batt	0.380	11.000
R5	5/8" GWB	0.560	0.560
Ri	Inside	0.680	0.680
ΣR		8.490	19.110
U		0.118	0.052
%		0.150	0.850
u		0.118	0.052
% x U		0.018	0.044
Uavg		0.062	



x	Sum of R	Tx
o-1	0.170	10.534
1-2	0.610	11.915
2-3	1.870	15.871
3-4	6.870	31.570
4-5	17.870	66.107
5-i	18.430	67.865

GFRC Panel

Wall U-Value		Framing	Insulating
R0	Outside	0.170	0.170
R1	1" Face Brick GFRC	0.070	0.070
R2	3/4" Air Space	1.260	1.260
R3	Metal Stud/3-5/8" Fiberglass batt	0.380	11.000
R4	5/8" GWB	0.560	0.560
Ri	Inside	0.680	0.680
ΣR		3.120	13.740
U		0.321	0.073
%		0.150	0.850
u		0.321	0.073
% x U		0.048	0.062
Uavg		0.110	



x	Sum of R	Tx
o-1	0.170	10.742
1-2	0.240	11.048
2-3	1.500	16.550
3-4	12.500	64.585
4-i	13.060	67.031

ANALYSIS 2: BRICK FAÇADE RE-DESIGN

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Fairfax, VA
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PRESENTATION OUTLINE:

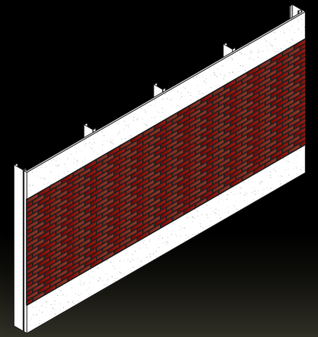


IMAGE COURTESY OF Stromberg Architectural Products

FINAL CONCLUSIONS

- GFRC façade reduces schedule and cost
- Eliminates site congestion and inefficiencies
- Minor architectural implications
- Met goal of analysis to reduce site congestion issues

RECOMMENDATION:

- Pursue GFRC façade based on constructability concerns , cost and schedule

ANALYSIS 3: IMPLEMENTATION OF SIPS

Square 1400
Apartments
Fairfax, VA
Anthony Grab | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

IMAGE taken by Antony Grab

PROBLEM IDENTIFICATION:

- Complexity of Cast-In-Place PT Concrete
- 5 pours per floor
- Crew Management

RESEARCH GOAL:

- Streamline Cast-In-Place Erection
- reduce Schedule
- Potential Cost Savings

IMAGE COURTESY OF HITT Contracting

ANALYSIS 3: IMPLEMENTATION OF SIPS

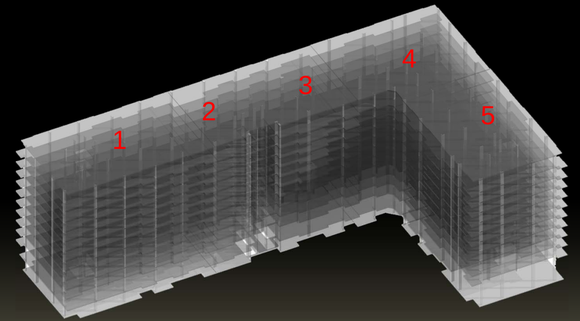
Square 1400
Apartments
Fairfax, VA
Anthony Grab | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE:

Task	Duration (Dyas)	Crew Size
Frame Pour	2	3
Install PT & Rebar	2	3
MEP Sleeves	1	2
Pour Slab	1	3
Concrete Cure	3	0
Stress PT	1	2
Strip & Reshore	3	3

Implementation:

- Traditional SIPS
- Schedule Between Pours with a Floor
- Distant Work Tasks
- One Fixed Crane Location
- Establish Critical Durations
- (8) 5-day work week



Model Produced by Anthony Grab

Analysis 3: Implementation of SIPS

Square 1400
Apartments
Fairfax, VA
Anthony Grab | Construction Management

Presentation Outline:

Color Code	Task	Duration (Days)	Crew Size
	Frame Pour	3	3
	Install PT & Rebar/Pour Slab	3	3
	MEP Sleeves	0	2
	Concrete Cure/Stress PT	3	2
	Strip & Reshore	3	3

Results:

- Resequenced Work
- Saved 11 Days
- Savings from Crane and Other General Conditions Costs

Recommendations:

- It is In the best interest of Square 1400 to utilize SIPS for the erection of the Cast-In-Place Structure

	March		April									May				
AREA		28	2	5	8	12	15	18	21	24	27	30	3	6	9	12	15
Pour 1-1																	
Pour 1-2																	
Pour 1-3																	
Pour 1-4																	
Pour 1-5																	

ANALYSIS 4: OPERATIONS AND MAINTENANCE

Square 1400
Apartments
Fairfax, VA
Anthony Grab | construction management

PRESENTATION OUTLINE:

IMAGE COURTESY OF HTTP://GREENTECHADVOCATES.COM/

PROBLEM IDENTIFICATION:

- COMPLEX/DIFFICULT TO OPERATE BUILDING SYSTEMS
- HIGH DEMAND FOR INFORMATION RICH MODELS
- CHALLENGING TO MONITOR ENERGY WITHIN A BUILDING

RESEARCH GOALS:

- THE IMPLANTATION OF A ENERGY SAVING DASHBOARD WILL RESULT IN APARTMENT RESIDENTS USING LESS ENERGY

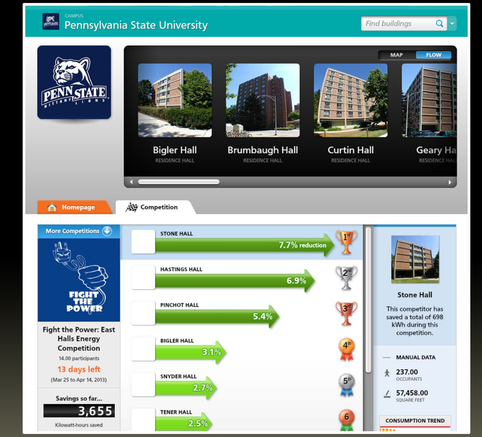


IMAGE COURTESY OF PENN STATE UNIVERSITY

ANALYSIS 4: OPERATIONS AND MAINTENANCE

Square 1400
Apartments
Fairfax, VA
Anthony Grab | construction management

PRESENTATION OUTLINE:

IMAGE COURTESY OF WYBLE AND ASSOCIATES

BUILDING COMPATIBILITY

- ACS320 HVAC CONTROL

COST AND PAYBACK:

- 25 % PERCENT TOTAL BUILDING ENERGY SAVINGS

Organization	Duration	Savings	Top Reductions
Franklin & Marshall College	16 days	8,089 kWh	Top reducing residence hall: 17.3% (7 buildings participating)
St. Lawrence University	18 days	3,357 kWh	Top reducing residence hall: 20.2% (22 buildings participating)
University of Victoria	19 days	40,219 kWh	Top reducing residence hall: 56.4% (9 buildings participating)
Google NYC office	28 days	3,146 kWh	Top reducing floor: 30.4% (13 floors participating)
Agnes Scott College	7 days	8,899 kWh	Top reducing residence hall: 34.8% (5 buildings participating)
Phillips Academy at Andover v. Deerfield Academy	27 days	15,160 kWh	Top reducing residence hall: 45.4% (42 buildings participating)
Bowdoin College	30 days	16,893 kWh	Top reducing residence hall: 29.1% (21 buildings participating)
Elon University	49 days	231,454 kWh	Top reducing residence hall: 36.9% (41 buildings participating)
Bowdoin College	11 days	4,376 kWh	Top reducing residence hall: 17.2% (11 buildings participating)
St John's University	14 days	22,320 kWh	Top reducing residence hall: 15.8% (6 buildings participating)
Hamilton College	15 days	44,345 kWh	Top reducing residence hall: 40.9% (11 buildings participating)
Oberlin College	14 days	10,675 kWh	Top reducing residence hall: 42.5% (17 buildings participating)
Boston College	28 days	15,212 kWh	Top reducing residence hall: 9.1%

TABLE COURTESY OF LUCID

Analysis 4: Operations and Maintenance

Square 1400
Apartments
Fairfax, VA
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Presentation Outline:

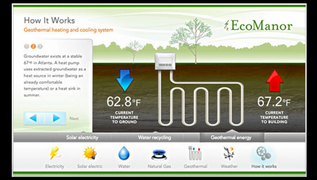

IMAGE COURTESY OF Lucid

IMAGE COURTESY OF Lucid

Dashboard Information

- Competitions
- Comparisons
- Green Features
- Renewables
- Unit Equivalents

Conclusion and Recommendations

- New Technology - Few Studies
- Hard to Justify its implementation
- Potential Long term savings

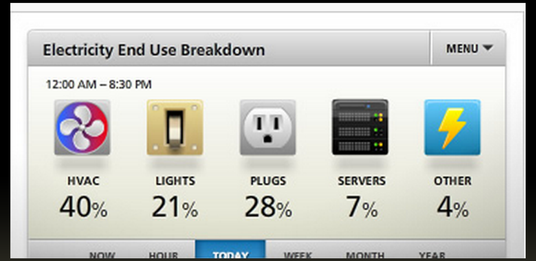

IMAGE COURTESY OF Lucid

LESSONS LEARNED

Square 1400
Apartments
Fairfax, VA
Anthony Grab | Construction Management

PRESENTATION OUTLINE:

ANALYSIS 1:

- An Infinity System is a great solution to reduce cost, decrease schedule duration, while maintaining a high level of quality

ANALYSIS 2:

- GFRC panels can be cost and time effective
- Pursue GFRC façade based on constructability concerns
- Met goal of analysis to reduce site congestion issues

ANALYSIS 3:

- It is In the best interest of Square 1400 to utilize SIPS for schedule impacts

ANALYSIS 4:

- Hard to Justify its implementation
- Potential Long term savings

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Square 1400
Apartments
Fairfax, VA
Anthony Grab | Construction Management

PRESENTATION OUTLINE:

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My Family and Friends

ADDITIONAL INFORMATION

SQUARE 1400
APARTMENTS
FAIRFAX, VA
ANTHONY GRAB | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE: