CONSTRUCTION OPTION JOSUE FERNANDEZ

[BLOCK 12]

Construction Option

Josue Fernandez

[BLOCK 12]

OUTLINE

Project Overview

Location:
_Rockville, MD

Size:
_285,000 Square Feet
_4 Total Floors and 2 Sublevels

Function:
_Retail & Residential Apts.

Schedule:
_October 2012 - May 2014
_20 Months

Project Overview

Cost:
_$36 Million

Delivery Method:
_Design-Bid-Build

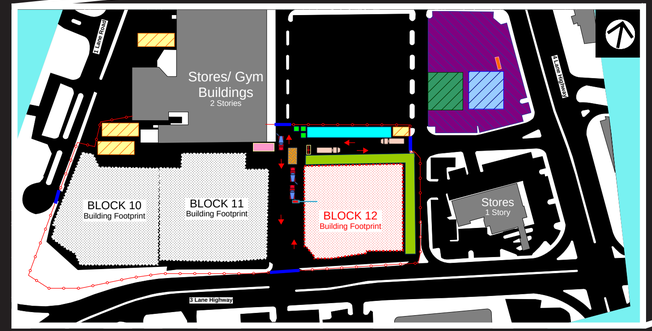
Owner:
_Federal Realty Investment Trust

Federal Realty INVESTMENT TRUST

WT WHITING-TURNER

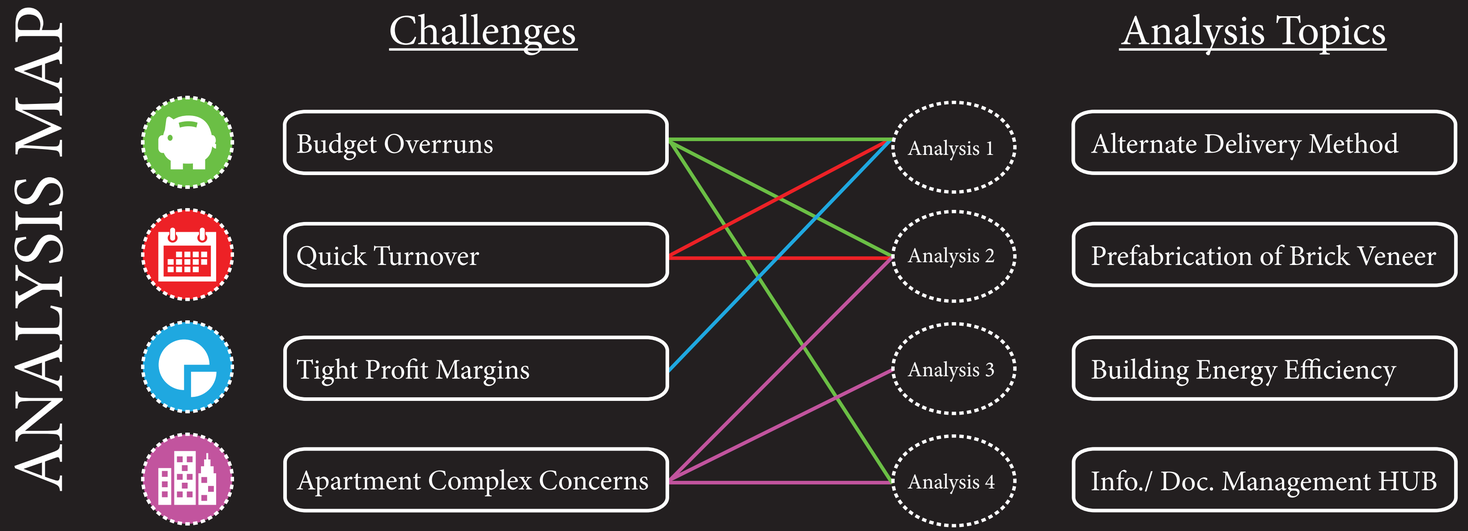
OUTLINE

Construction Conditions



OUTLINE

ANALYSIS MAP



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OUTLINE

Analysis Topic 1: Alternate Delivery Method

Goal of Analysis #1

To validate the advatages and disadvantages of a contractor led Design-Build Delivery Method

Current: DBB Delivery Method

Advantages:

_Familiar delivery method
_Construction price before construction starts
_Opportunity for competitive bidding

Disadvantages:

_No subcontractor input
_Design must be complete prior to construction
_Designer and contractor develop work autonomously
_Prices & schedules based on construction documents

Proposed: DB Delivery Method

Advantages:

_Construction input in the design phase
_Good communication & relationships
_Eliminates responsability and finger-pointing when conflict occurs
_Iterative cost estimating from early collaboration by constrcution team

Disadvantages:

_Difficult to provide firm, fixed price before project begins
_Owner may perceive less design control
_No independent oversight of work performed

[BLOCK 12]

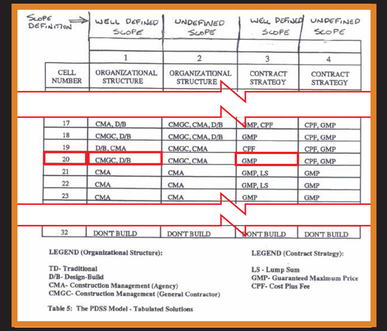
OUTLINE

Delivery Method Difference

	DBB w/ CM @ Risk	Design-Build
Design complete before contractor involved	No	No
Advesarial relationship between designer & contractor	Possible	No
Can fast track?	Likely	Yes
Contractor feedback on design?	No	Yes
# of parties responsible for construction?	1	1
List parties contracted with owner	2	1
Owner has design control	Yes	Some

Organizational structural difference (Messner, 2012)

Project Delivery Method Selection System



SCOPE DEFINITION →	WELL DEFINED SCOPE	UNDEFINED SCOPE	WELL DEFINED SCOPE	UNDEFINED SCOPE
	1	2	3	4
CELL NUMBER	ORGANIZATIONAL STRUCTURE	ORGANIZATIONAL STRUCTURE	CONTRACT STRATEGY	CONTRACT STRATEGY
17	CMA, D/B	CMGC, CMA, D/B	GMP, CPF	CPF, GMP
18	CMGC, D/B	CMGC, CMA, D/B	GMP	CPF, GMP
19	D/B, CMA	CMGC, CMA	CPF	CPF, GMP
20	CMGC, D/B	CMGC, CMA	GMP	CPF, GMP
21	CMA	CMA	GMP, LS	GMP
22	CMA	CMA	GMP, LS	GMP
23	CMA	CMA	GMP	GMP
32	DON'T BUILD	DON'T BUILD	DON'T BUILD	DON'T BUILD

LEGEND (Organizational Structure):

TD- Traditional
D/B- Design-Build
CMA- Construction Management (Agency)
CMGC- Construction Management (General Contractor)

LEGEND (Contract Strategy):

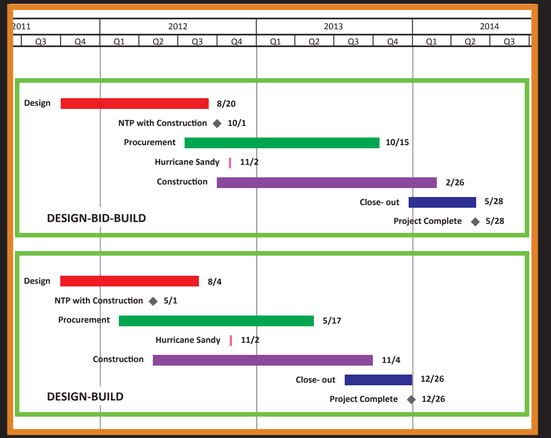
LS - Lump Sum
GMP- Guaranteed Maximum Price
CPF- Cost Plus Fee

Table 5: The PDSS Model - Tabulated Solutions

The PDSS Model- Tabulated Solutions (Vesay, 1991)

#20- CMGC, D/B

Schedule Comparison



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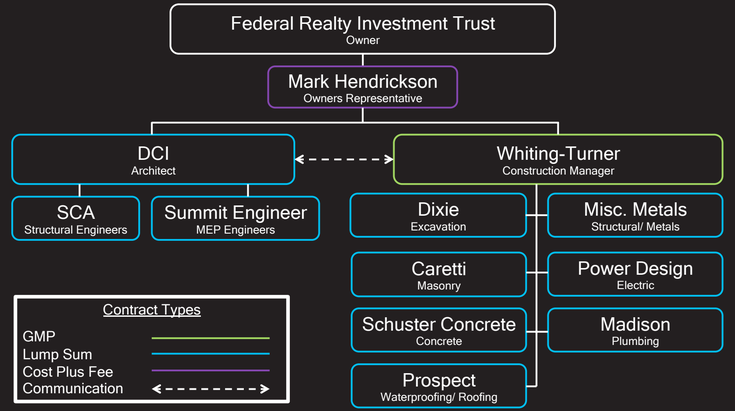
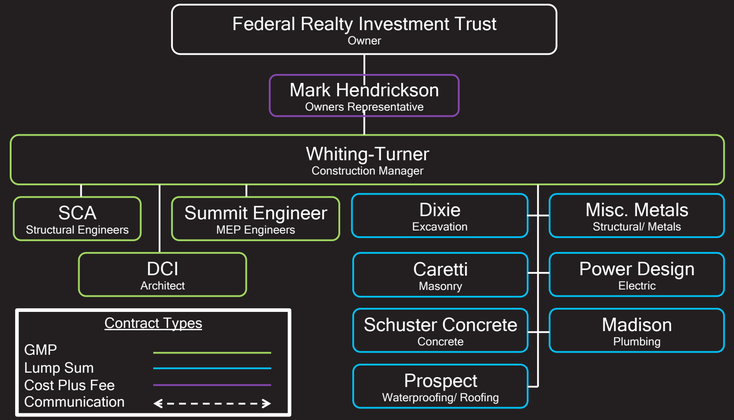
OUTLINE

Current: DBB Delivery Method



Proposed: DB Delivery Method



OUTLINE

South Hall Project:

Block 12 Problems	South Halls Benefits from Design-Build Delivery Method
Budget Overruns	Barton Malow assumes more risk for design mistakes, but is able to charge a higher fee.
	Delivery method allowed early subcontractor input before drawings were complete, which enabled real time cost tracking during design
	Early input from subcontractors helped in owner decision making process
Project Turnover	Harnessed a more collaborative enironment, leading to a much more effective communication
Profit Margins	Project is on budget
Complex Concerns	Early identification of desired energy efficient materials and equipement were identified early in design

Conclusion:

Contractor led Design-Build Delivery Method is recommended

Analysis Topic 2: Premanufactured Brick Veneer Panels

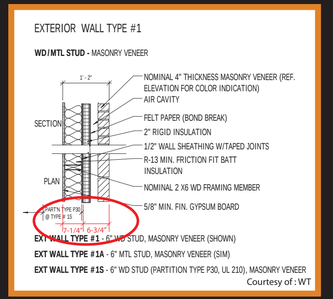
Goal of Analysis #2

To reduce the brick veneer installation time in order to accelerate the overall schedule

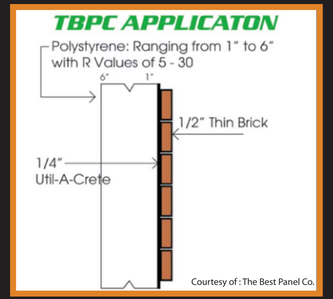
Thin Brick By Owensboro Panel Information

16” x 48” Panels

Section Cut



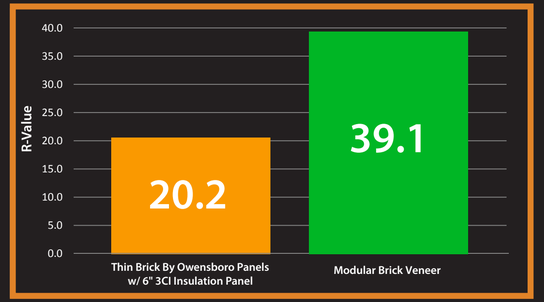
Current:
6-3/4”



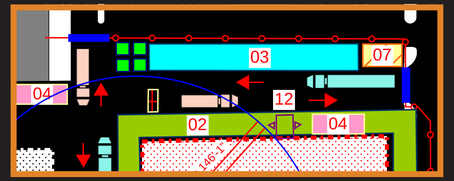
Proposed:
6-3/4”

Util-A-Crete Panel System + 6” Polystyrene 3CI Panel

Thermal Performance



Transportation Logistics



_5 Deliveries
_One 48” Flatbed & Four 45” Flatbeds
_176 total Pallets (18 panels per pallet)

Schedule

Modular Brick= 177 days

Premanufactured Panels= 119 days

Assumption: 75% time saving on schedule

Time Saving= 43 Days

Cost

Modular Brick=	$89,313.68
Premanufactured Panels=	$206,287.94
Difference=	$116,974.26
General Conditions=	$135,248.00
SAVINGS=	$18,274.10

Recommendation

Premanufactured panels accelerate the schedule and yield savings. The premanufactured panels are recommended.

Analysis Topic 3: Building Energy Efficiency

Goal of Analysis #3

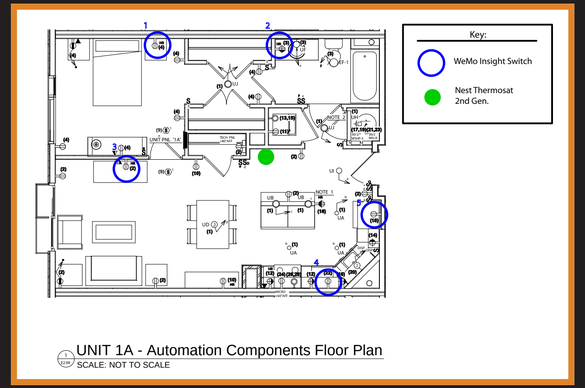
To reduce the building's energy consumption to help maintain the building's energy efficiency.

Building Automation Components (Residential Level)

Belkin Wemo

Nest Thermostat

Components Layout Plan



Plug Load Analysis (Typical Residential Unit)

Plug Load Analysis for a Typical Unit in Block 12

WeMo Insight Switch #	Electronics	Wattage	Phantom Load
1	Alarm Clock	4	YES
	Cell Phone Charger	10	YES
	Laptop	60	YES
	Portable Electric Heater	1200	NO
	Fans	100	NO
	Desk & Table Lamps	100	NO
	Printer/ Scanner	100	YES
2	Hair Dryer	920	YES
	Hair Curler	320	YES
	Shaver	20	YES
	Electric Tooth Brush	10	YES
3	Television	100	YES
	DVD/VCR Player	40	YES
	Game Console	250	NO
	Stereo System	30	YES
	Aquarium	1210	NO
4	Coffee Maker	900	YES
	Toaster Oven	630	NO
	Blender		NO
5	Microwave	1050	YES

*information provided by http://energy.maryland.gov/

Phantom Load Analysis (Typical Residential Unit)

Phantom Load Spreadsheet: Typical Unit in Block 12

$ 0.11629 per kWh

1	2	3	4	5	6	7	8
WeMo Insight Switch #	**Electronics**	**Quantity In Use**	**Typical Hours "off" or Standby, Daily**	**Wattage off/Stand-by Mode**	**Days per Month in Operation**	**Monthly kWh**	**Monthly Cost**
1	**Alarm Clock**	1	24	1.5	30	1.1	$ 0.13
	Cell Phone Charger	1	21	2.5	20	1.1	$ 0.12
	Laptop	1	16	4.4	20	1.4	$ 0.16
	Printer/ Scanner	1	23	7.6	20	3.5	$ 0.41
2	**Hair Dryer**	1	22	2.3	30	1.5	$ 0.18
	Hair Curler	1	22	2.6	20	1.1	$ 0.13
	Shaver	1	23	0.6	20	0.3	$ 0.03
	Electric Tooth Brush	1	23	1.6	30	1.1	$ 0.13
3	**Television**	1	23	3.5	20	1.6	$ 0.19
	DVD/VCR Player	1	23	5.2	20	2.4	$ 0.28
	Stereo System	1	23	3.5	20	1.6	$ 0.19
4	**Coffee Maker**	1	21	1.5	20	0.6	$ 0.07
5	**Microwave**	1	23.5	2.5	20	1.2	$ 0.14
	TOTAL					**18.5**	**$ 2.16**

*information based from "Phantom Load Spreadsheet" from www.NEED.org

Simple Payback

5 Belkin WeMo Components

Phantom Load= $2.16 /month*12 months = $25.92 /year
Payback Period= 17 years

Nest Thermostat- Energy Savings (Typical Residential Unit)

Component	Energy Savings on Heating and Cooling Costs	
Nest Learning Thermostat 2nd Generation	**$173 per year**	**19.5% per device**

* Results obtained from the "Nest Learning Thermostat Efficiency Simulation: Update Using Data from First Three Months" report done by Nest Labs on April 2012

Simple Payback

1 Nest Thermostat

Yearly Savings= $173 /year
Payback Period= 2 years

Recommendation

_Belkin WeMo is not recommended for this project

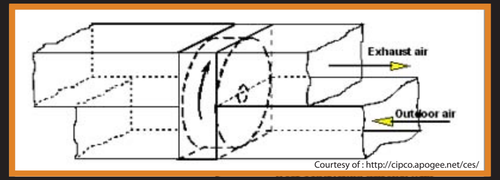
_Nest Thermostat is recommended

Mechanical Beadth: Sensible Wheel (Retail Level)

Goal of Mechanical Breadth

To reduce the building's energy consumption to help maintain the building's energy efficiency.

Sensible Wheel in RTU Unit



Courtesy of : http://cipco.apogee.net/ces/

Advantages

_Wheels are compact and can achieve high heat transfer effectiveness
_Low air pressure drop (0.4-0.7 in. of water)

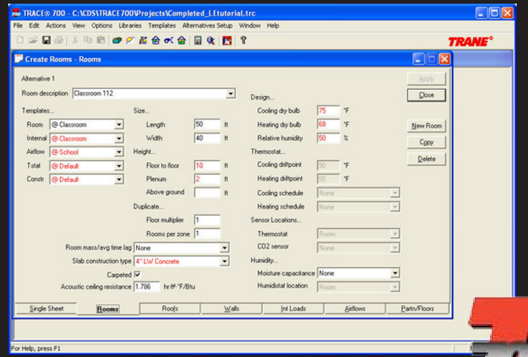
_Potential for cooling or heating equipment size reduction

Disadvantages

_Initial first cost of equipment and fan power requirement to overcome resistance
_Requires periodical maintenance of rotating mechanism and cleaning of fill medium

_Some cross-contamination of two air streams, due to carryover and leakage

Energy Model- TRANE TRACE



[BLOCK 12]

OUTLINE

Energy Use (Retail Level)

Monthly Energy Usage

Month	Energy			Gas		
	Baseline (kWh)	Redesign (kWh)	Difference (kWh)	Baseline (therms)	Redesign (therms)	Difference (therms)
January	19,845	24,875	(5,030)	4,525	1,677	2,848
February	18,018	22,478	(4,460)	4,011	1,515	2,496
March	24,413	27,737	(3,324)	2,928	1,652	1,276
April	23,296	25,038	(1,742)	1,846	1,305	541
May	30,175	31,163	(988)	433	403	30
June	32,467	33,198	(731)	36	24	12
July	31,982	32,507	(525)	-	-	-
August	35,153	35,950	(797)	23	13	10
September	28,204	29,093	(889)	311	286	25
October	26,313	27,563	(1,250)	1,864	1,308	556
November	23,692	25,726	(2,034)	2,397	1,479	918
December	19,565	24,037	(4,472)	3,989	1,677	2,312
	Largest Difference		(5,030)	Largest Difference		2,848
	Average Value		(2,186.83)	Average Value		918.67

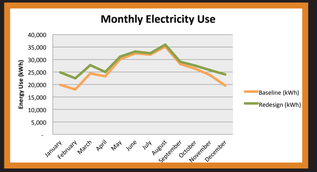
Yearly Energy Usage and Cost

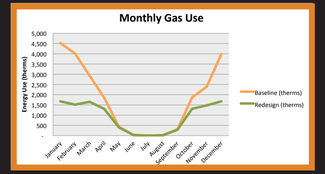
	Baseline		Redesign		Energy Cost for Change	
	Use	Cost	Use	Cost	Use	Cost
Electricity (kWh)	313,122	$ 36,413	339,366	$ 39,465	(26,244)	$ (3,052)
Gas (therms)	22,363	$ 21,021	11,338	$ 10,658	11,025	$ 10,364
Building (Btu/ft^2-yr)	69,065	$ -	65,671	$ -	3,394	$ -
Source (Btu/ft^2-yr)	168,651	$ -	177,481	$ -	(8,830)	$ -
Floor Area (ft^2)	112940					

Unit Cost of Energy	
Electricity ($/kWh)	$ 0.11629
Gas ($/therms)	$ 0.94000

Yearly Energy Savings

	Cost
Electricity (kWh)	$ (3,052)
Gas (kBtu)	$ 10,364
Savings for Building with Enthalpy wheel	$ 7,312





Yearly Environmental Impact

	Baseline	Redesign	Increase in Emissions
	Use	Use	Use
CO2 (lbm/year)	4,534,850	5,121,007	13%
SO2 (gm/year)	16,212	18,307	13%
NOX (gm/year)	6,920	7,815	13%

_Increase electricity
_Decrease gas
_$7,312 yearly energy savings

Coil Selection

Coil Selection

	Heating Coil Selection				Cooling Coil Selection			
	Capacity (Mbh)	Coil Airflow (CFM)	Ent. (°F)	Lvg. (°F)	Capacity (Mbh)	Coil Airflow (CFM)	Ent. (°F)	Lvg. (°F)
Baseline	(812.8)	14,297	17.0	68.0	545.7	14,297	90.6	69.8
Redesign	(187.7)	14,297	56.2	68.0	354.2	14,297	79.1	69.8
Change	77% reduction		39.2 °F higher entering temp		35% reduction		11.2 °F higher entering temp	

_35% Cooling coil reduction
_77% Heating coil reduction

Recommendation

The sensible wheel is recommended for yearly energy savings and further savings in reduction of coils

Final Conclusions

Alternate Delivery Method:
_More collaborative
_Early contractor input
_Maintain project on budget

Prefab. of Brick Veneer:
_Higher R-Value
_Higher cost, but GC savings - $18k
_Schedule accelerated 43 days

Building Energy Efficiency:
_Belkin WeMo Component
_17 yr. payback period
_Nest Thermostat Component
_2 yr. payback period

Sensible Wheel:
_$7,312 yearly energy savings
_35% cooling coil reduction
_77% heating coil reduction

Recommendation

Alternate Delivery Method:
_Contractor led Design-Build delivery method is recommended, and could have helped in hindsight

Prefab. of Brick Veneer:
_Recommended for cost savings and schedule acceleration

Building Energy Efficiency:
_ Belkin WeMo component is not recommended, long payback period
_Nest Thermostat component is recommended, short payback period

Sensible Wheel:
_Implement sensible wheel for energy savings and cooling/ heating coil reduction

Acknowledgements

Academic Acknowledgements

Penn State Architectural Engineering Faculty & Staff
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Special Thanks!

Steven Rogers
Patrick Laninger
Gabe Powers
Family & Friends

BLOCK 12

OUTLINE

Questions?

Appendix: Analysis 2

R-value

Thin Brick By Owensboro Panels w/ 6" 3CI Insulation Panel (1'-2")

Component	Thickness (in.)	R-Value per Inch (hr*ft^2**F/BTU*in.)	R-Value per Unit (hr*ft^2**F/BTU)	R-Value (hr*ft^2**F/BTU)
Outside	-	-	0.17	0.17
1/2" Thin Brick, 1/4" Util-A-Crete, and 6" Polystyrene	6-3/4"	-	30.00	30.00
Zip Wall (Taped)	1/2	-	0.62	0.62
Mtl Stud Fram. with R-19 Batt Ins.	6	-	7.10	7.10
G.W.B.	5/8	-	0.56	0.56
Inside	-	-		0.68
R-Value of Thin Brick Assembly				**39.13**

Modular Brick Veneer (1'-2")

Component	Thickness (in.)	R-Value per Inch (hr*ft^2**F/BTU*in.)	R-Value per Unit (hr*ft^2**F/BTU)	R-Value (hr*ft^2**F/BTU)
Outside	-	-	0.17	0.17
Brick	4	-	0.44	0.44
Air Gap	3/4	-	1.00	1.00
Rigid Insulation	2	4.80	-	9.60
Zip Wall (Taped)	1/2	-	0.62	0.62
Mtl Stud Fram. with R-19 Batt Ins.	6	-	7.10	7.10
G.W.B.	5/8	-	0.56	0.56
Inside	-	-		0.68
R-Value of Modular Brick Assembly				**20.17**

Transportation Logistics

Thin Brick Panel Truck Delivery Schedule

Delivery #	Truck Type	Panels		Brickettes		Truck Capacity	
		# of Pallets	# of Panels	# of Pallets	# of Brickettes	Material Load (lbs)	Max Load (lbs)
1	48" Flatbed	38	684	2	250	39,120	45,000
2	45" Flatbed	35	630	2	250	36,300	45,000
3	45" Flatbed	35	630	2	250	36,300	45,000
4	45" Flatbed	35	630	2	250	36,300	45,000
5	45" Flatbed	33	594	1	250	32,720	45,000
Total:		176	3,168	9	1,250		

Schedule

Scheduled Modular Brick Construction Durations

Elevation	Size SF	Productivity SF/Day	Duration Days
North Elevation	2,582	78	33
South Elevation	4,117	94	44
West Elevation	4,597	96	48
East Elevation	2,976	80	37
Courtyard Elevation	2,391	159	15
Total Duration			**177**

Projected Thin Brick Construction Durations

Elevation	Size SF	Productivity SF/Day	Duration Days
North Elevation	2,582	140	18
South Elevation	4,117	140	29
West Elevation	4,597	140	33
East Elevation	2,976	140	21
Courtyard Elevation	2,391	140	17
Total Duration			**119**

Appendix: Analysis 2

Cost

Brick Construction Cost Comparison

Material	Area (SF)	Cost per Unit ($/ SF)	Total Cost ($)
Modular Brick	16,663	$ 5.36	$ 89,313.68
Thin Brick Panels	16,663	$ 12.38	$ 206,287.94
Cost Difference			**$ 116,974.26**

$$\frac{43\ Working\ Days\ of\ Time\ Saved}{6\ Working\ Days} * \frac{\$1{,}509{,}749.46\ General\ Conditions\ Cost}{20\ Months * 4\ \frac{Weeks}{Months}} = \mathbf{\$135{,}248}$$

Appendix: Analysis 3

Payback- Belkin WeMo

$$\frac{5\ Switches * 24\ hours\ active * 1.5\ W * 30\ days\ active}{1000\frac{kW}{kWh}} * 0.11629\ \$\ per\ kWh = \$0.63$$

$$\frac{63.60\ \$\ per\ unit * 5\ units}{\$25.92\ /year - \$7.54\ /\ year} = 17\ years$$

Payback- Nest Thermostat

$$\frac{265\ \$\ per\ unit * 1\ unit}{\$173\ /year} = 2\ years$$