The Heartland Hotel

Alexis Fons

Construction Management

Advisor: Dr. Leicht

The Midwest

Analysis 1:

9th Story Design Change

Analysis 2:

Link Bridge Prefabrication

Analysis 3:

Structural Lift System

Structural Breadth

Mechanical Breadth

Analysis 4:

Field Labor Experience

The Heartland Hotel

Introduction

Analysis 1

Analysis 2

Analysis 3

Analysis 4

Conclusion

Building Details

Location | The Midwest

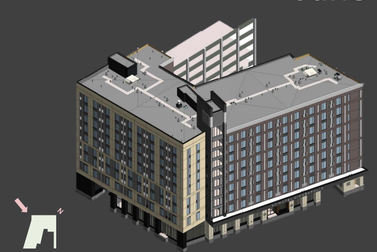
Size | 129,416 square feet

Height | 9 stories above grade

Cost | $40.05 million

Duration | 17 months

June 2015 – October 2016

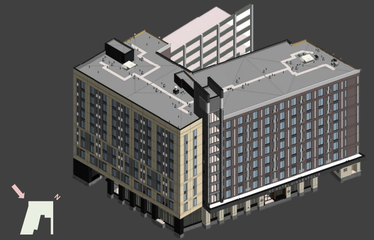


The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Building Details

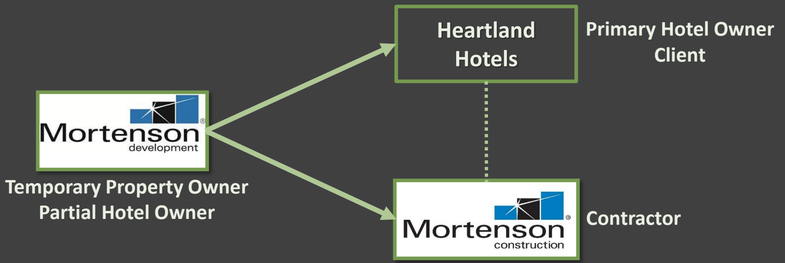
Location | The Midwest
Size | 129,416 square feet
Height | 9 stories above grade
Cost | $40.05 million
Duration | 17 months
June 2015 – October 2016



Project Delivery Method

Delivery Method | Design-Build (Turnkey)

Project Team:



Analysis 1

9th Story Design Change

Background Information

Current Design
- 30 Year City-Improvement Plan
- High-End Luxury Rooms
- 245 Standard Rooms

Opportunity
- Include Suites on 9th Story

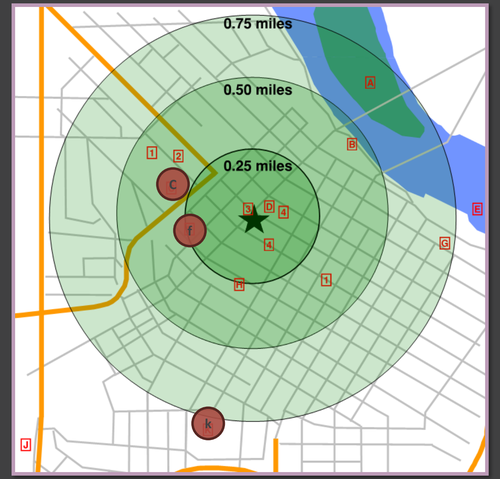
Goals
- ↑ Revenue
- ↑ Variety
- ↓ Cost
- ↓ Schedule

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

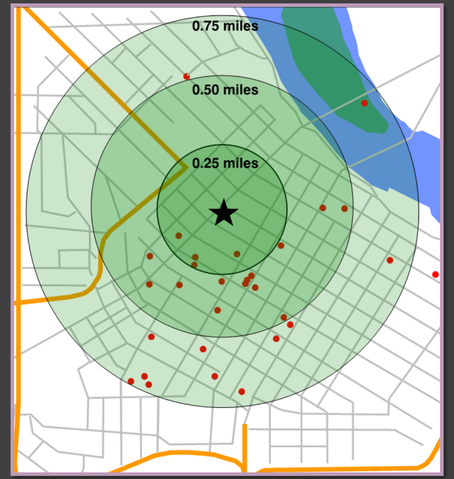
9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

Points of Interest



Point Label	Points of Interest
A	Historic Island
B	River Parkway
C	MLB Field
D	Library
E	Historical Bridge
F	Multi-purpose Arena
G	Historical Society museum
H	Twelve-block Outdoor Mall
J	Art Center
K	Convention Center
Point Label	**Public Transportation**
1	Light Rail Station
2	Train Station
3	Bus Stop
4	Public Bike Sharing Stations

Nearby Hotels



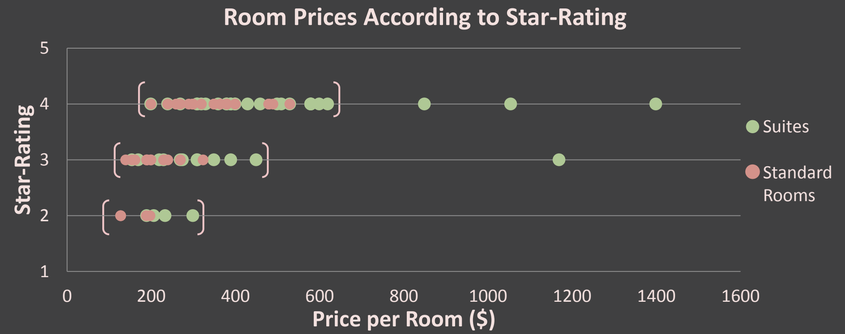
28 Hotels within 0.75 miles

The Heartland Hotel

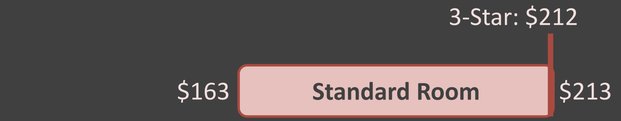
Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

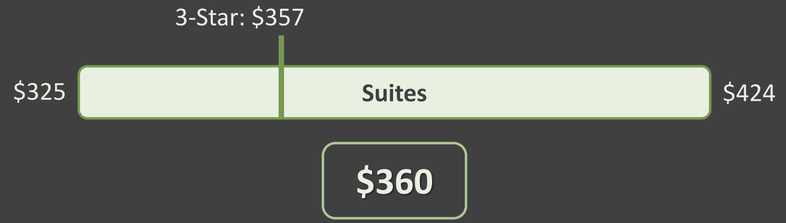
9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

Nearby Hotel Prices



Cost per Square Foot





The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

5 Suite Study

Occupancy Rate	Cost per Suite
100%	$220
87%	$325
82%	$360
72%	$424
0%	$950

Normal Occupancy Rate = 72%

10 Suite Study

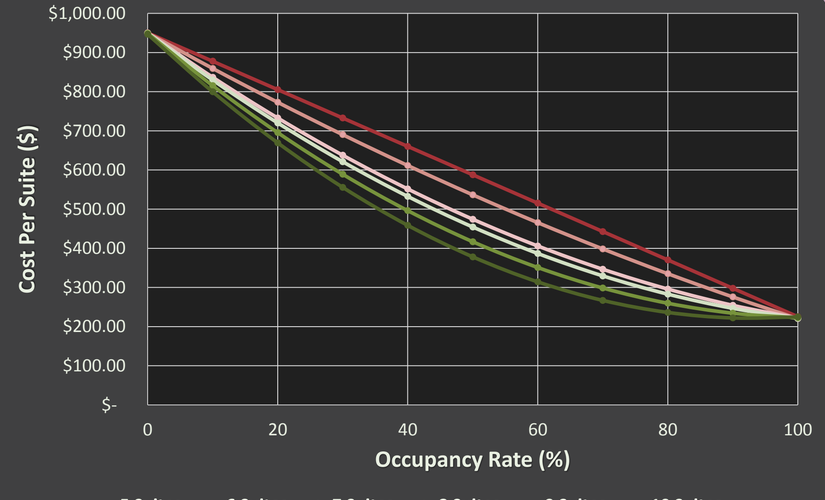
Occupancy Rate	Cost per Suite
100%	$220
62%	$325
52%	$360
42%	$424
0%	$950

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

Suite Profitability

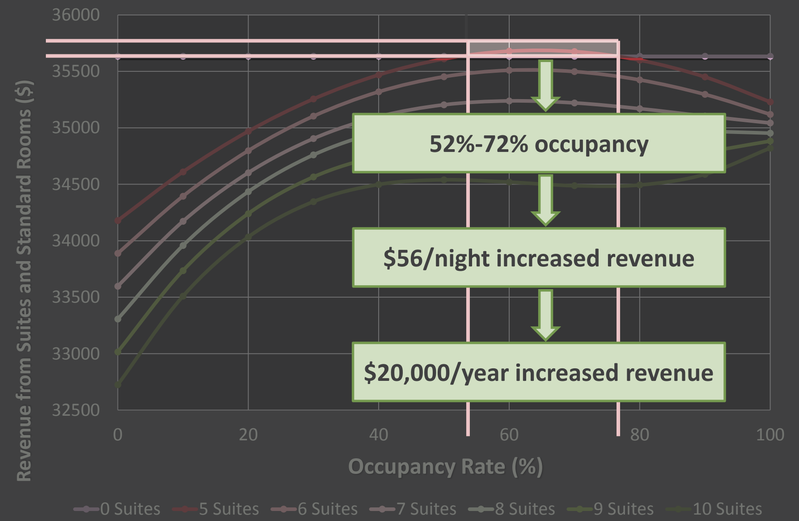


The Heartland Hotel

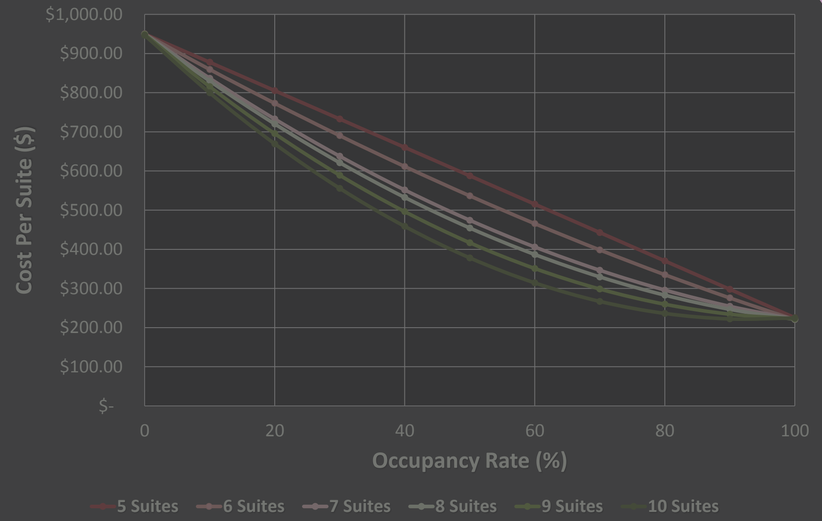
Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

Revenue of Suites



Suite Profitability

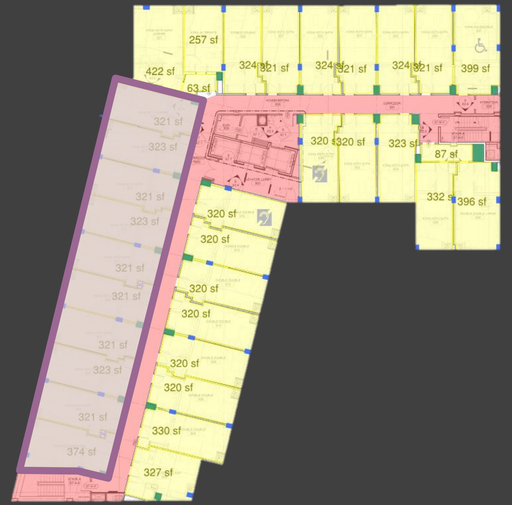


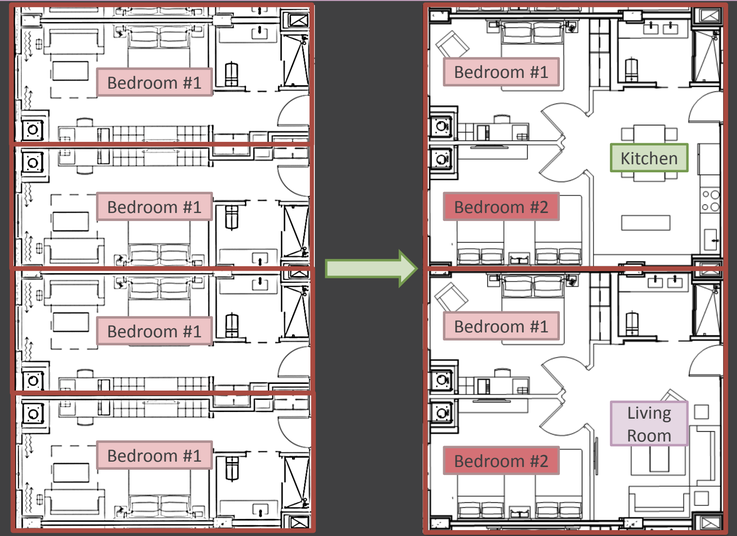
The Heartland Hotel

Floor Plan Redesign

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation





The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

Cost Analysis

Finishes	Paint Flooring Wall Vinyl Tile	$6,000
Furnishings	Standard Furniture Standard Fixtures Kitchen Equipment Living Room Furniture	$8,000
Construction	Wall Studs Insulation Drywall	$19,500

$33,500 saved

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

Schedule Analysis

Finishes	Paint Flooring Wall Vinyl Tile	90 man-hours
Furnishings	Standard Furniture Standard Fixtures Kitchen Equipment Living Room Furniture	10 man-hours
Construction	Wall Studs Insulation Drywall	190 man-hours

9% schedule decrease on the 9th floor

3 day reduction

The Heartland Hotel

Lifecycle Analysis

	Original Design	Suites Included
Cost to Build	$40.05 million	$40.02 million
Revenue per Night	$35,630/night	$35,686/night
Cost-to-Run per Night	$25,755/night	$25,755/night
Capitalization Rate	9.00%	9.06%
Payback Period (Years)	11.11 years	11.04 years

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

9th Story Design Change
Background Information
Locational Information
Occupancy Study
Profitability
Redesign
Cost Analysis
Schedule Analysis
Lifecycle Analysis
Final Recommendation

Analysis 1

9th Story Design Change

Final Recommendation

Goals

- Revenue ✓
- Variety ✓
- Cost ✓
- Schedule ✓

Recommended

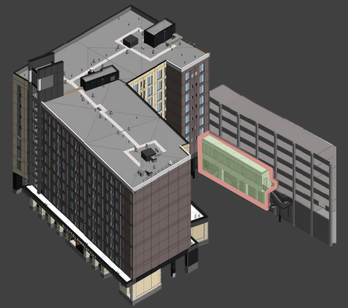
The Heartland Hotel

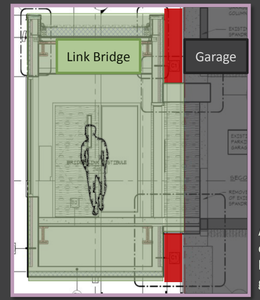
Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Link Bridge Prefabrication
Background Information
Crane Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Analysis 2

Link Bridge Prefabrication





A cross-section of the link bridge and the garage

Background Information

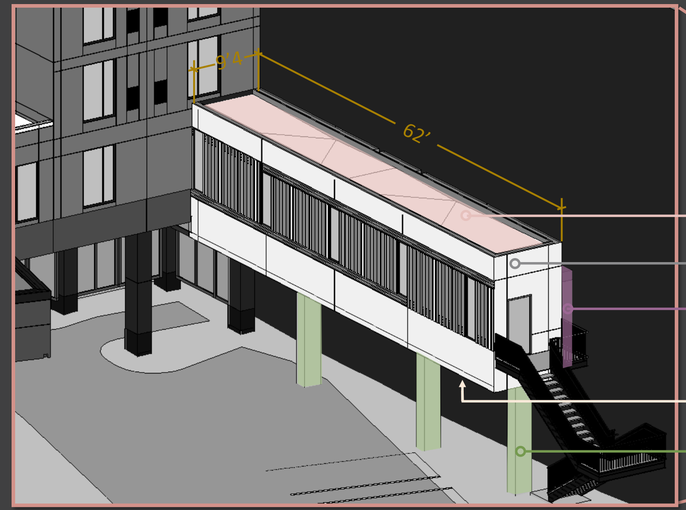
Current Design
62’ Link Bridge
Space Limitation

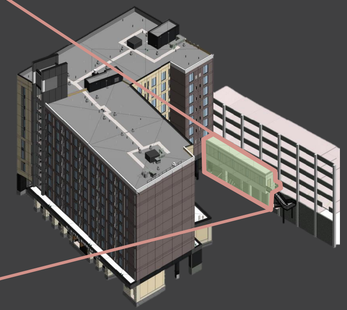
Opportunity
Prefabrication – Modular Unit

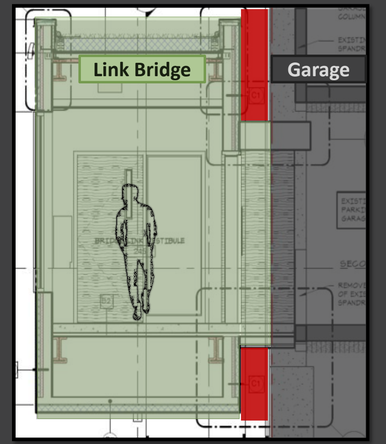
Goals
↑ Constructability
↓ Cost
↓ Schedule

The Heartland Hotel

Bridge Components







A cross-section of the link bridge and the garage

The Heartland Hotel

Crane Logistics

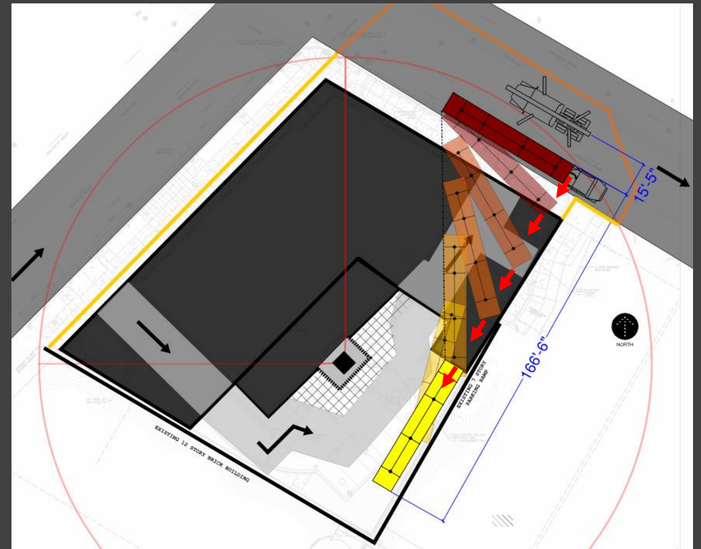
Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Link Bridge Prefabrication
Background Information
Crane Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Bridge Weight | 19 tons

Tower Crane
- Height/Reach | 213’
- Max. Capacity | 7 tons

Hydraulic Truck Crane
- Reach | 231’
- Max. Capacity | 100 tons

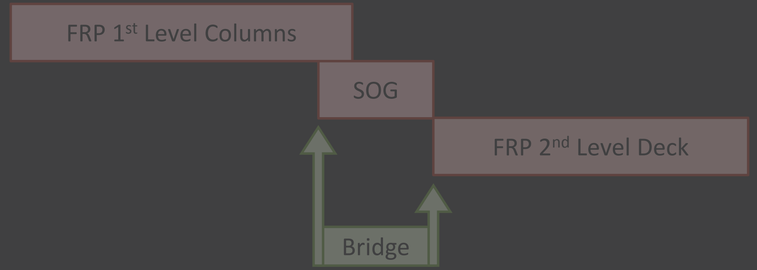


The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Link Bridge Prefabrication
Background Information
Crane Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Schedule Analysis



On-Site Construction Critical Path Activities| 7 Days

7 Day Schedule Reduction

Productivity

9% Increase in Productivity in Prefabrication Environment

$6,500 Labor Reduction

The Heartland Hotel

Cost Analysis

General Conditions Reduction	$23,800
Labor Reduction	$6,500
Truck Crane Usage	$1,400
Transportation Fee	$2,500
Prefabrication Overhead (3%)	$2,000
Temporary Pier	$800

Original Cost | $79,000

Prefabrication Cost | $76,000

$26,500 Savings

7 Day Schedule Reduction

$27,000 Increased Profit

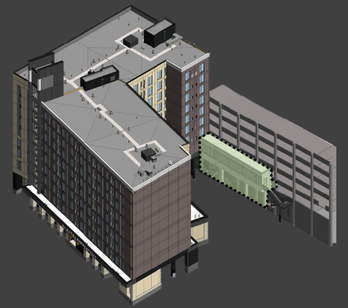
The Heartland Hotel

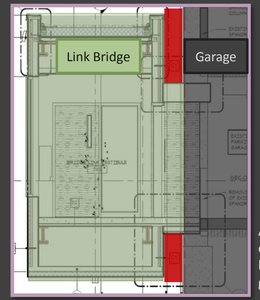
Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Link Bridge Prefabrication
Background Information
Crane Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Analysis 2

Link Bridge Prefabrication





A cross-section of the link bridge and the garage

Final Recommendation

Goals
- Constructability ✓
- Cost ✓
- Schedule ✓

Recommended

Analysis 3

Structural Lift System

Background Information

Current Design
- Stucco in winter weather
- Limited site space
- Renting multiple storage locations

Opportunity
- Upbrella Construction lift method

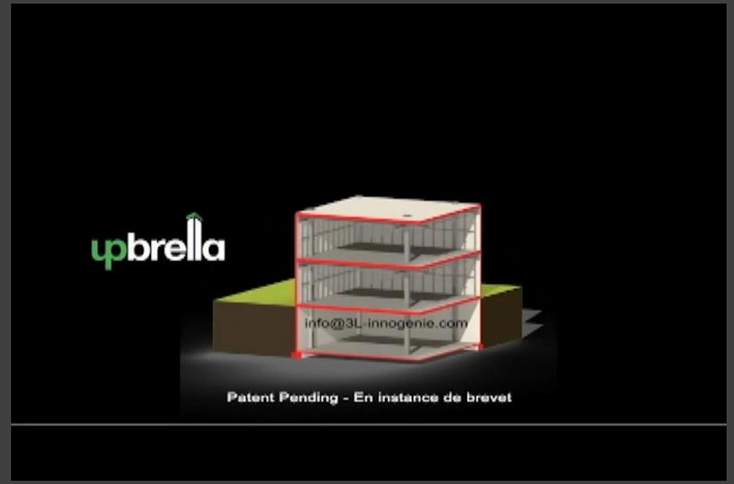
Goals
- ↑ Constructability
- ↑ Innovation
- ↓ Cost
- ↓ Schedule

The Heartland Hotel

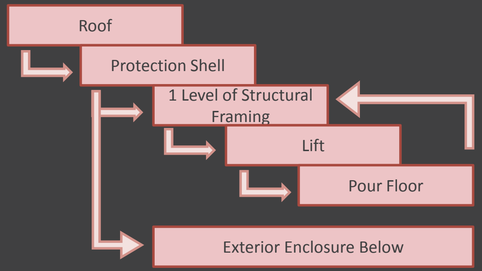
Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Structural Lift System
Background Information
Structural Breadth
Systems Design
Mechanical Breadth
Site Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Upbrella Construction



Video courtesy of Upbrella Construction
(https://www.youtube.com/watch?v=q9bKap4FdCc)



Advantages:

Move in earlier

Early landscaping

Increased safety

Warm environment (stucco)

No crane necessary

More room on site

The Heartland Hotel

Current Construction Method

Post-tensioned concrete floors

5 days/floor

1 level of shoring, 2 levels of re-shoring

Prefabricated column rebar

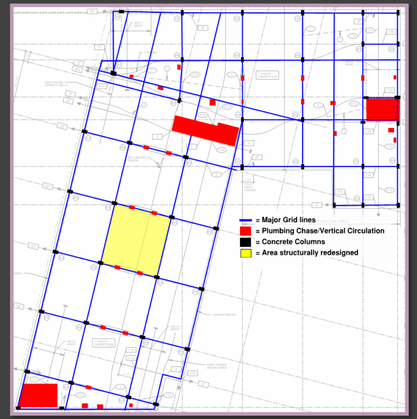
Tower crane

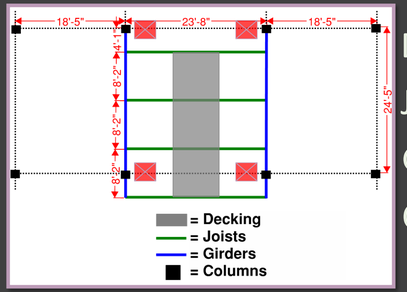
The Heartland Hotel

Structural Breadth

PT Concrete (Current)

- Flying forms X
- Tendon stressing ?
- Delayed column strength X





Loads:

Dead | **10 psf**
Live | **40 psf**
Deck + Concrete | **37 psf**
Joists | **5 psf**
Girders | **2 psf**

Decking | **1.5VL20, t = 3.25”**
Joist | **W12x26**
Girder | **W14x30**
Columns | **W10x49** (floors 1-9)
W10x33 (roof)

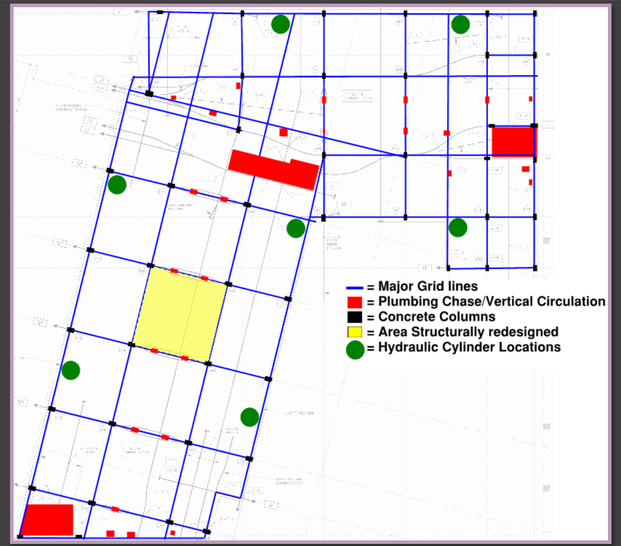
7’ taller building
to maintain floor-to-ceiling height

The Heartland Hotel

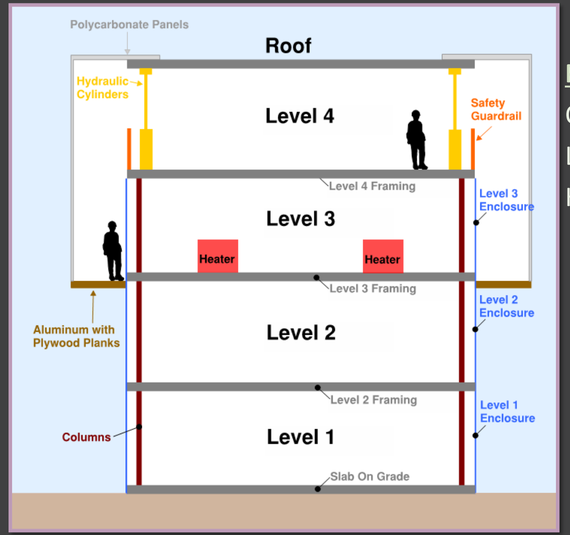
Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Structural Lift System
Background Information
Structural Breadth
Systems Design
Mechanical Breadth
Site Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Hydraulic Cylinders



Protection Shell



Polycarbonate Panels:
OSHA
Light Transmission
High R-Value

The Heartland Hotel

Mechanical Breadth

Concrete Requirements: 55°F

Original Method

Material	Square Footage	R-Value	U-Value	Temperature Change	Total Btu/hr
Tarp	6,240	0.071	14.11	28.5	2,509,322
Formwork (3/4" plywood)	14,596	0.94	1.06	28.5	442,538
Concrete (NW 6.57" thick)	14,596	0.47	2.13	28.5	885,077
				Total Btu/hr for total construction:	3,836,937
This is equivalent to 4 heaters					

Stucco Requirements: 40°F

Original Method

Material	Square Footage	R-Value	U-Value	Temperature Change	Total Btu/hr
Tarp (between scaffolding and building)	6,240	0.071	14.11	10.4	915,683
Tarp (exterior)	6,600	0.071	14.11	10.4	968,510
Scaffolding Wood Planks (1.5” thick)	6,438	1.88	0.53	10.4	35,614
				Total Btu/hr for total construction:	1,919,807
This is equivalent to 2 heaters					

The Heartland Hotel

Mechanical Breadth

Systems Comparison

Constant Heating: 55°F

Proposed Method

Material	Square Footage	R-Value	U-Value	Temperature Change	Total Btu/hr
Polycarbonate Panels	17,079	2.000	0.50	27.5	234,836
Plywood Planks (1.5")	3,219	1.880	0.53	27.5	47,086
Concrete (3.25")	14,596	0.260	3.85	27.5	1,543,808
Roof	14,596	24.000	0.04	27.5	16,725
Metal Deck	14,596	0.000	N/A	27.5	-
Solar Heat Gain Coefficient	N/A	N/A	N/A	N/A	(63,749)
				Total Btu/hr for total construction:	1,778,706
This is equivalent to 2 heaters					

Original Method	Concrete at 55°F Stucco at 40°F	140 days of heat	$21,100
Structural Lift Method	Both systems at 55°F	136 days of heat	$19,500

$1,600

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

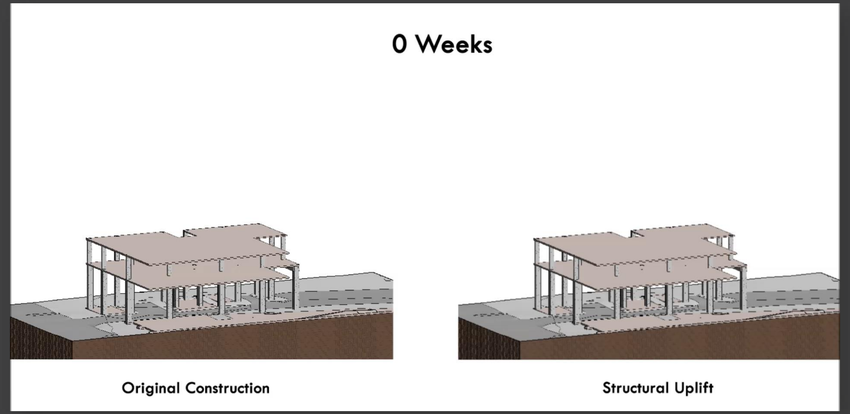
Structural Lift System
Background Information
Structural Breadth
Systems Design
Mechanical Breadth
Site Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Site Plan: *Original*

Site Plan: *Proposed*

The Heartland Hotel

Schedule Analysis



Original Method:

291 days

5 days/floor of structure

Proposed Method:

258 days – 7 weeks shorter

11 days per floor overall

9% productivity increase

Interior Activities – additional overlap

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Structural Lift System
Background Information
Structural Breadth
Systems Design
Mechanical Breadth
Site Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Cost Analysis

Category	Cost Change (Original - Proposed)
Construction Enclosure System	$(75,588.59)
Heating System	$ 1,620.88
Structure	$(629,535.65)
Equipment	$(119,816.39)
Exterior Enclosure	$(171,937.81)
General Conditions	$112,111.93
Total	**$(883,145.63)**

$883,000 cost increase

↓

33 Day Schedule Reduction

$170,000 Increased Profit

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Structural Lift System
Background Information
Structural Breadth
Systems Design
Mechanical Breadth
Site Logistics
Schedule Analysis
Cost Analysis
Final Recommendation

Analysis 3

Structural Lift System

Final Recommendation

Goals

- Constructability ✓
- Innovation ✓
- Cost X
- Schedule ✓

Not Recommended

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Field Labor Experience
Background Information
Current Position
Education
Success as a Superintendent
Final Recommendation

Analysis 4

Field Labor Experience

Background Information

Field Labor → **Superintendent** ← **Office Work**

What benefits does field labor experience provide for a career as a superintendent?

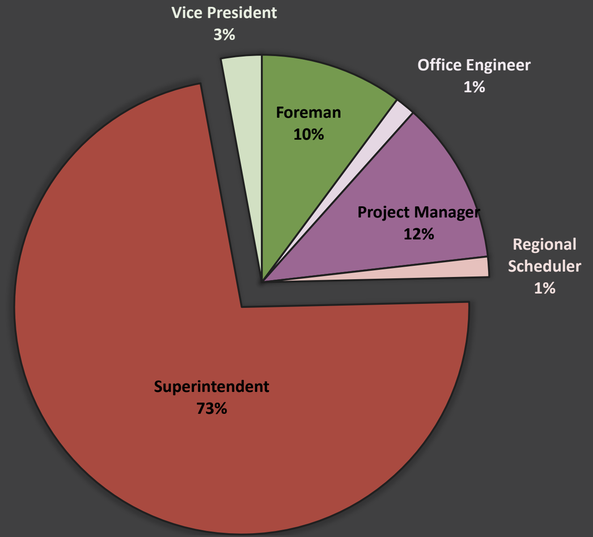
How does field labor impact the role and success of a superintendent?

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

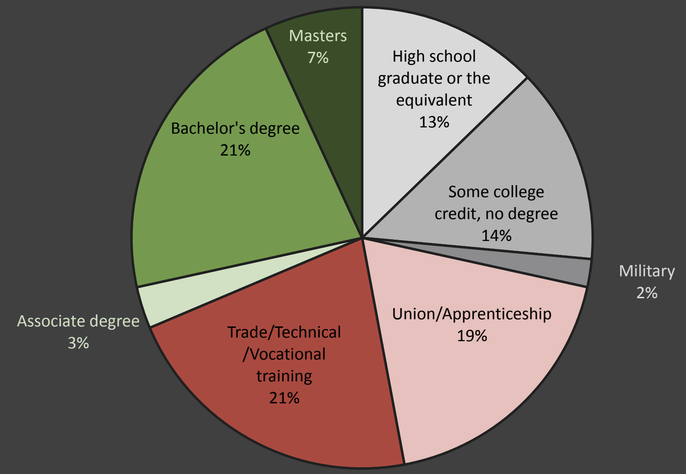
Field Labor Experience
Background Information
Current Position
Education
Success as a Superintendent
Final Recommendation

Current Position



The Heartland Hotel

Level of Education

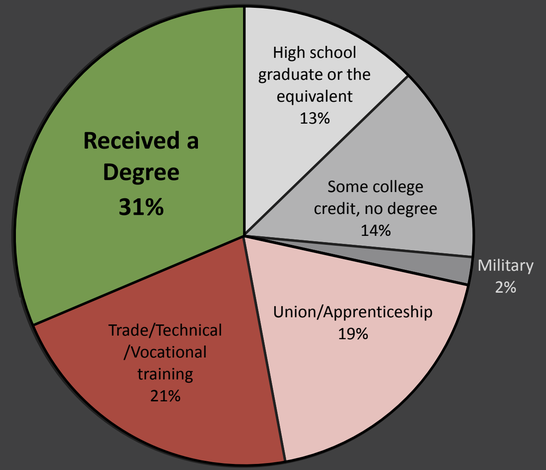


The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Field Labor Experience
Background Information
Current Position
Education
Success as a Superintendent
Final Recommendation

Level of Education



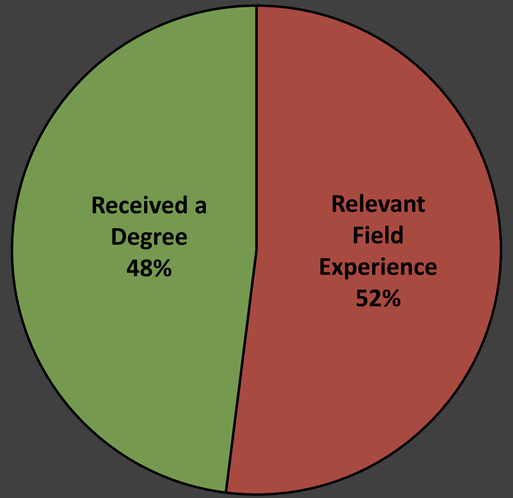
31% of all respondents received a degree

The Heartland Hotel

Superintendent Level of Education

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Field Labor Experience
Background Information
Current Position
Education
Success as a Superintendent
Final Recommendation



48% of superintendents received a degree

Construction Management and Civil Engineering

52% of superintendents went into the field

Carpentry (48%)

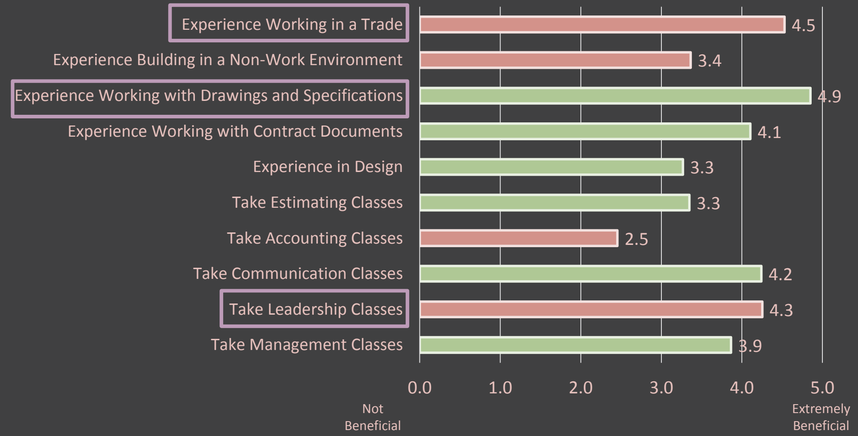
The Heartland Hotel

Success as a Superintendent

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Field Labor Experience
Background Information
Current Position
Education
Success as a Superintendent
Final Recommendation

Experiences which are beneficial to becoming a superintendent



Experience Working with Drawings and Specifications | **4.9/5**

Experience Working in a Trade | **4.5/5**

Taking Leadership Classes | **4.3/5**

The Heartland Hotel

Success as a Superintendent

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Field Labor Experience
Background Information
Current Position
Education
Success as a Superintendent
Final Recommendation

Importance of skills/attributes for becoming a superintendent

More Important	Equally Important	More Important	
The Ability to Teach			The Ability to Learn
Verbal Communication			Written Communication
Field Experience			Office Experience
Time Management			People Management
Field Credibility			Educational Credibility
People-Focus			Goal-Focus
Leading by Example			Leading by Direction
Identifying Resources/Opportunities			Identifying Personality Traits and Abilities
Understanding People			Understanding Systems
The Ability to Work with a Team			The Ability to Work Autonomously

Office vs. Field Experience

Importance of Relationships

Office vs. Field Experience

Field Experience

Field Credibility

Importance of Relationships

Verbal Communication

The Ability to Work with a Team

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Field Labor Experience
Background Information
Current Position
Education
Success as a Superintendent
Final Recommendation

Analysis 4

Field Labor Experience

Final Recommendation

Field Labor and Office Work → Superintendent

According to current superintendents,

field labor experience is more valuable for a career as a superintendent.

Those receiving a higher education – **go out and build.**

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

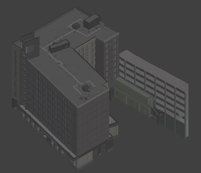
Analysis 1

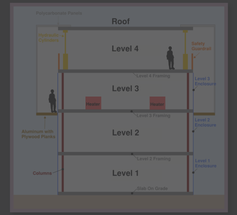
9th Story Design Change

Recommended

Analysis 2

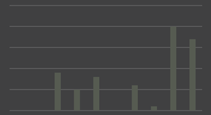
Link Bridge Prefabrication





Analysis 3

Structural Lift System



Analysis 4

Field Labor Experience

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Analysis 1

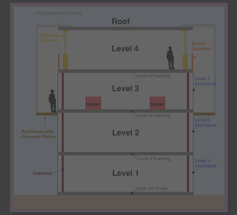
(9th Story Design Change)

[Recommended]

Analysis 2

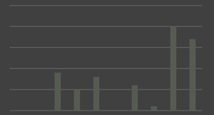
(Link Bridge Prefabrication)

[Recommended]



Analysis 3

(Structural Lift System)



Analysis 4

(Field Labor Experience)

The Heartland Hotel

Analysis 1

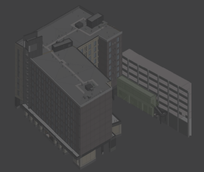
9th Story Design Change

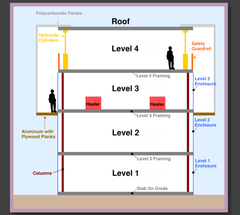
Recommended

Analysis 2

Link Bridge Prefabrication

Recommended

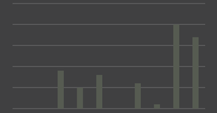




Analysis 3

Structural Lift System

Not Recommended



Analysis 4

Field Labor Experience

The Heartland Hotel

Analysis 1

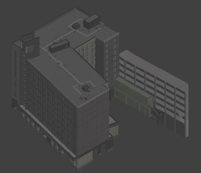
9th Story Design Change

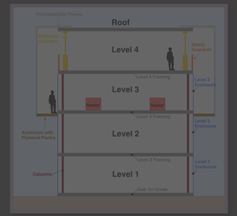
Recommended

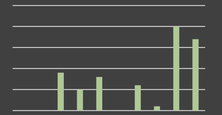
Analysis 2

Link Bridge Prefabrication

Recommended







Analysis 3

Structural Lift System

Not Recommended

Analysis 4

Field Labor Experience

Extremely Beneficial

The Heartland Hotel

Thank you

Jesus
PSU AE Faculty
Mortenson Construction
DPR Construction
Family and Friends

The Midwest

Analysis 1:
9th Story Design Change
Analysis 2:
Link Bridge Prefabrication
Analysis 3:
Structural Lift System
Structural Breadth
Mechanical Breadth
Analysis 4:
Field Labor Experience

9th Story Design Change Appendix

The Heartland Hotel

Mortenson Development Inc.

Partial Owner

Considerations		**Standard Rooms Only**
240-250 rooms	→	245 rooms ✓
Type of Guest	→	Business Personnel ✓
Construction Cost/SF	→	$253/SF ✓

The Heartland Hotel

Introduction

Analysis 1

Analysis 2

Analysis 3

Analysis 4

Conclusion

Nearby Hotel Prices

The Heartland Hotel

5 Suite Study

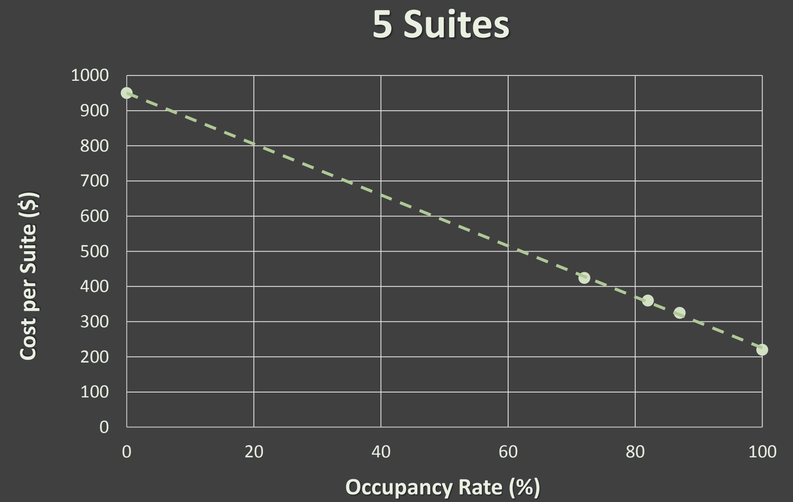
$220 ----▸ 100%

$360 ----▸ 82%

$950 ----▸ 0%

Cost per Suite	Occupancy Rate
$220	100%
$325	87%
$360	82%
$424	72%
$950	0%

Normal Occupancy Rate = 72%



The Heartland Hotel

5 Suite Study

Introduction

Analysis 1

Analysis 2

Analysis 3

Analysis 4

Conclusion

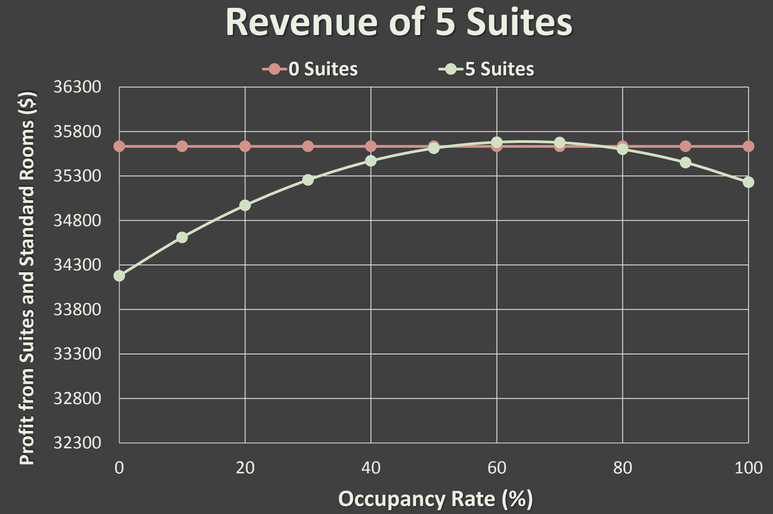
$220 ----▸ 100%

$360 ----▸ 82%

$950 ----▸ 0%

Cost per Suite	Occupancy Rate
$220	100%
$325	87%
$360	82%
$424	72%
$950	0%

Normal Occupancy Rate = 72%



The Heartland Hotel

10 Suite Study

$220 ----▸ 100%

$360 ----▸ 52%

$950 ----▸ 0%

Cost per Suite	Occupancy Rate
$220	100%
$325	62%
$360	52%
$424	42%
$950	0%

Normal Occupancy Rate = 72%

The Heartland Hotel

10 Suite Study

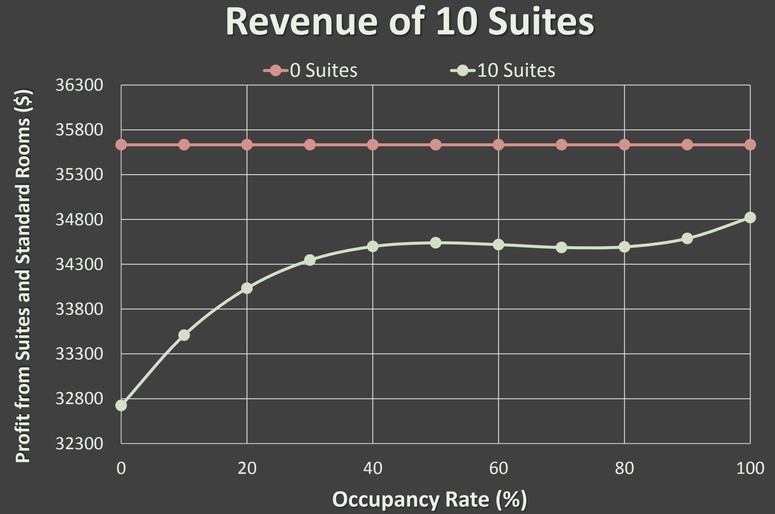
$220 ----▸ 100%

$360 ----▸ 52%

$950 ----▸ 0%

Cost per Suite	Occupancy Rate
$220	100%
$325	62%
$360	52%
$424	42%
$950	0%

Normal Occupancy Rate = 72%



Link Bridge Appendix

The Heartland Hotel

Advantages and Disadvantages

On-Site Construction

- Standard method ✓
- Later design possible ✓
- 1’6-2’6 gap – doesn’t fit men/equipment X
- Safety hazards X
- Weather delays X

Prefabrication

Panels

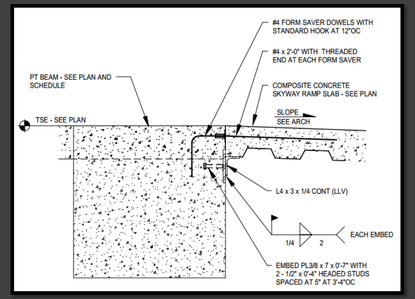
- Small delivery truck ✓
- Lighter crane pick ✓
- Quality control ✓
- Limited access X
- Integrity of seams ?
- Attachment methods ?
- No interior finishes ?

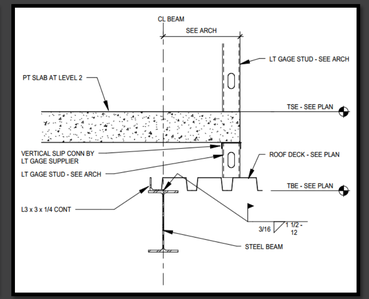
3D Module

- Complete entire unit ✓
- Design already created ✓
- Minimal site construction ✓
- Best quality control ✓
- Larger pick ?
- Larger truck ?

The Heartland Hotel

Connections





The Heartland Hotel

Heartland Hotel Budget

ACTUAL BUDGET	COST
Foundations	$ 713,268.10
Superstructure	$ 4,474,147.48
Exterior Enclosure	$ 2,341,547.31
Roofing	$ 400,820.83
Interior Construction	$ 8,111,096.92
Interior Finishes	$ 3,231,833.54
Conveying & Chutes	$ 807,362.00
Mechanical	$ 5,176,729.00
Fire Protection	$ 296,887.50
Electrical	$ 2,081,009.59
Low Voltage	$ 757,500.00
Equipment	$ 25,500.00
Building Demolition	$ 7,167.73
Site Preparation	$ 466,617.23
Site Improvements	$ 147,464.00
Site Electrical Utilities	$ 81,950.00
Site Services	$ 541,870.30
Furniture, Fixtures & Equipment (FF&E)	$ 3,411,740.28
Operating Supplies & Equipment (OS&E)	$ 830,015.03
General Conditions/Staff	$ 1,732,638.90
Permits & Street/Sidewalk Closure Fees	$ 573,166.00
Third Party Inspections/Testing	$ 160,000.00
Design Fees	$ 950,000.00
Insurance	$ 351,558.00
Design Builders Fee	$ 1,071,898.00
Estimating & Construction Contingency	$ 1,306,212.00
Total:	$ 40,049,999.74

Structural Lift Method Appendix

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Upbrella Construction Breakdown

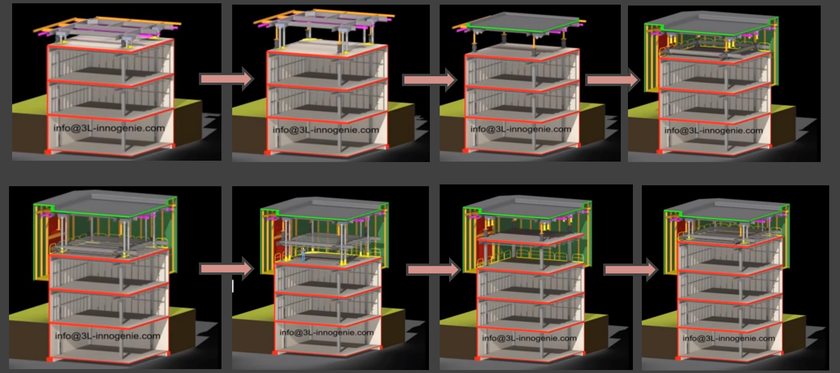


Figure 3.4: This patent pending sequence is courtesy of Upbrella Construction (http://www.3l-innogenie.com/en/upbrella).

Schedule Break Down

Task Name	Duration
Floor Structure	11 days
Construct Floor Framing (Joists and Girders)	5 days
Lift and Install Columns	1 day
Lower System onto Columns	1 day
Finalize Structure (Stairs, Elevator Framing, Rebar, Inspection)	5 days
Pour Floor Concrete	1 day
Wall Enclosure Systems	11 days
Exterior Infill Framing	8 days
Install Stucco	9 days
Install Metal Panels	9 days
Install Glazing Systems	9 days

The Heartland Hotel

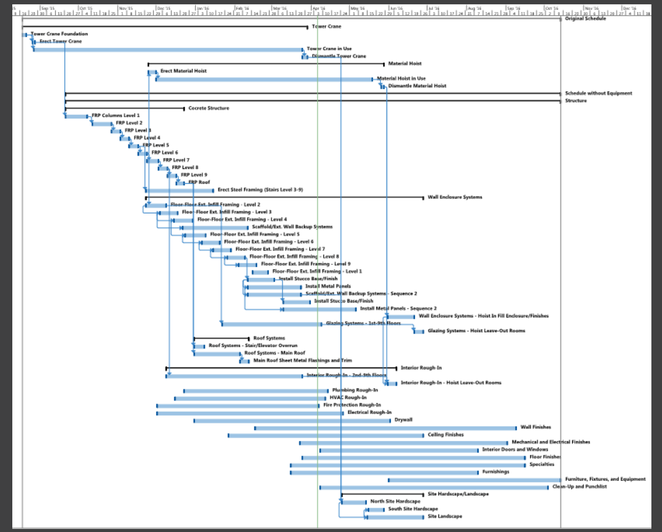
Cost Breakdown

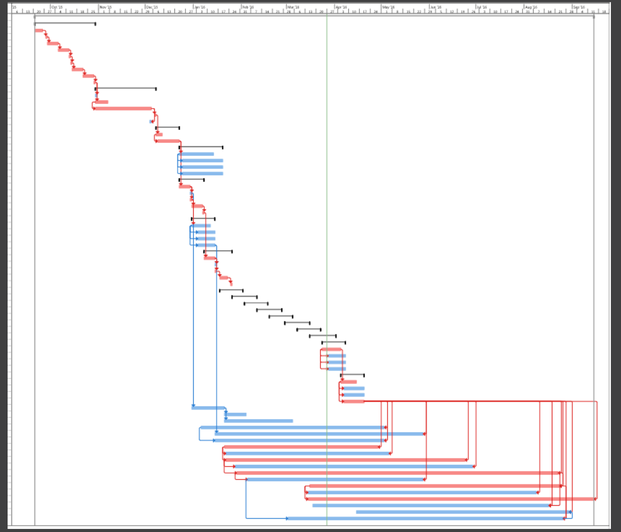
	Category	Material	Description	Amount	Floor Multiplier	Unit	R.S. Means page	Labor-Hour	Material	Labor	Equipment	Total	Areas Totaled	Man-Hours
Structural Uplift System (Proposed Method)	Construction Enclosure System	Polycarbonate Panels	Walls and ceiling	17079.0	1	sf		0.107	$ 1.26	$ 5.64		$ 117,722.13	$ 224,233.26	1,827.45
		7" Aluminum with plywood planks	Floor	88.6	1	ea.		0.33	$ 115.69	$ -		$ 10,250.13		29.24
		Steel Columns (W10x33)		2310.0	1	lf	310	0.093	$ 32.19	$ 5.61	$ 2.78	$ 93,747.47		214.83
		Guardrails	Portable metal with base pads	624.0	1	lf		0.027	$ 2.57	$ 1.46		$ 2,513.52		16.85
	Heating System	Heaters	136 days of heat	4.5	1	month		0	$ -	$ -	$ 1,300.00	$ 5,893.33	$ 19,592.80	-
		Propane for Heaters	8.25 GPH at 81%	7270.6	1	Gallons		0	$ 1.88	$ -	$ -	$ 13,699.47		-
	Structure	1.5VL20 decking	22 ga., 2" galvanized	14596.0	8	sf	168	0.009	$ 2.46	$ 0.55		$ 352,200.31	$ 1,834,730.94	1,050.91
		Concrete topping (3.25")	Lightweight	14596.0	8	sf	97	0.022	$ 1.25	$ 1.06	$ 0.27	$ 300,392.69		2,568.90
		WWF6x6, W1.4xW1.4)		146.0	8	csf	95	0.457	$ 14.59	$ 27.58		$ 49,234.06		533.63
		Joists (W12x16)		1793.0	8	lf	158	0.064	$ 23.64	$ 3.82	$ 1.74	$ 418,928.14		918.02
		Girders (W14x30)		965.0	8	lf	158	0.062	$ 43.76	$ 3.74	$ 1.70	$ 379,838.51		478.64
		Columns (W10x33 - roof)		517.0	1	lf	158	0.093	$ 32.19	$ 5.61	$ 2.78	$ 20,981.58		48.08
		Columns (W10x49 - all other levels)		485.7	8	lf	158	0.102	$ 71.93	$ 6.11	$ 2.55	$ 313,155.66		396.33
	Equipment	Double Girder Bridge Crane	2 Girder, 50' span, 3 ton	2.0	1	ea.	1200	72	$ 46,753.00	$ 4,766.03	$ 355.00	$ 103,748.05	$ 264,680.39	144.00
		Hydraulic Cylinders		7.0	1	ea.		0	$ 12,492.01	$ -		$ 87,444.04		-
		Material Hoist	2 for 5 months	10.0	1	month	1335	0	$ 2,892.25	$ -	$ -	$ 28,922.50		-
		Mast-Climbing Platform	2 for 4 months, 50' wide, less than 100' tall, rent	8.0	1	mast*month	21	0	$ 3,118.60	$ -	$ -	$ 24,948.80		-
		Street Cranes	Truck mounted, 150 tons, 18' radius	10.0	1	days		0	$ 1,961.70	$ -	$ -	$ 19,617.00		-
	Façade	Additional Exterior Enclosure Installation	7' taller building w/624' perimeter; added price is a multiple of the original exterior enclosure cost	4368.0	1	sf		0.28	$ -	$ -	$ -	$ 171,937.81	$ 171,937.81	1,223.04
	Profit	Profit from Opening	Opens 1.5 months earlier	0.0	0			0	$ -	$ -	$ -	$ (170,169.00)	$ (170,169.00)	-
											Total:	$ 2,345,006.19	$ 2,345,006.19	9,449.91
Original Construction Method	Construction Enclosure System	Scaffolding Framing Erection	6-12 stories, 6'4x5	32.9	10.6	100sf	19	3.6	$ 35.21	$ 196.28		$ 80,728.53	$ 148,644.67	1,255.46
		Scaffolding planks 2"x10"x16'	Average cost of below and above 50'	241.0	10.6	ea.	20	0.333	$ 6.04	$ 18.34		$ 62,282.94		850.68
		Scaffolding Tarp	Polyethylene sheet	59.7	7	100sf	23	0.216	$ 4.00	$ 9.47		$ 5,633.20		90.29
	Heating System	Heaters	140 days of heat at 87%	4.7	1	month		0	$ -	$ -	$ 1,300.00	$ 6,066.67	$ 21,213.68	-
		Propane for Heaters	8.25 GPH at 87%	8038.8	1	Gallons		0	$ 1.88	$ -	$ -	$ 15,147.01		-
	Structure	Concrete Slab	6" elevated	14596.0	8	sf	98	0.022	$ 2.04	$ 1.06	$ 0.27	$ 393,192.89	$ 1,205,195.30	2,568.90
		PT Formwork	Multiple by number of forms - 4 uses, so 2x floor	14596.0	3	sf	76	0.086	$ 1.19	$ 4.59		$ 253,061.80		3,765.77
		PT Tendons		9075.0	8	lb.	95	0.027	$ 0.61	$ 1.63	$ 0.03	$ 165,114.18		1,960.20
		Slab Rebar	Elevated slabs, #4-#7	860.0	8	lb.	93	0.006	$ 0.50	$ 0.34	$ -	$ 5,770.39		41.28
		Column Concrete	16x16, less than 2% reinf, 9.57'	30.5	9	cy	97	0	$ 283.69	$ 677.44	$ 46.00	$ 276,818.93		-
		Column Rebar	#3-7 Column Rebar	19936.5	1	lb.		0.011	$ 0.50	$ 0.65	$ -	$ 22,936.10		219.30
		Column Rebar	#8-18 Column Rebar	95703.7	1	lb.		0.007	$ 0.50	$ 0.42	$ -	$ 88,301.01		669.93
	Equipment	Tower Crane		7.5	1	month	1334	0	$ 17,001.40	$ -	$ -	$ 127,510.50	$ 144,864.00	-
		Material Hoist	6 months	6.0	1	month	1335	0	$ 2,892.25	$ -	$ -	$ 17,353.50		-
											Total:	$ 1,519,917.64	$ 1,519,917.64	11,421.81
											Comparative Total (Proposed - Original):	$ 825,088.55	$ 825,088.55	(1,971.89)

The Heartland Hotel

Original Schedule

Proposed Schedule





The Heartland Hotel

Structural Breadth Calculations

Decking

Requirements:

- Composite decking because:
  - Thinner
  - More economic use of materials
  - Efficient
- 3-1/4" topping for fireproofing for lightweight concrete
- 3-spans
- 8'2 spacing
- Unshored

Loads taken from the structural drawings:

- Live Load – 40psf for rooms and corridors above the 2nd floor
- Wind Load – N/A
- Dead Load – assumed 10psf

$Total\ Load = Dead + Live$

$\mathbf{50}\boldsymbol{psf} = 10 + 40$

Decking chosen from Vulcraft Steel Roof and Floor Deck catalog:

1.5VL20 with lightweight concrete
4.75" deep
t=3.25" (for fireproofing)
37psf = concrete + deck self-weight
Recommended Welded Wire Fabric: **6x6 – W1.4xW1.4**
Maximum superimposed load with a 8'6 clearspan: 200psf ✓

Joist

Loads:

- Deck and Concrete load = 37psf
- Joists = Assumed 5psf
- Superimposed dead load = 10psf
- Live load = 40psf
  - Live Load reduction: $K_{LL}A_T$ = 8'2*2*23'8 = 387 < 400 – *not reducible*

Load Combinations:

- Dead: 37+5+10=**52psf**
- Live: **40psf**

1.4D = 75.6psf
1.2D+1.6L = **126.4psf** – *controls*

Check Decking:
126.4psf < 200psf limit ✓

Weight:

$W_u = 126.4psf * \frac{8'2}{1000\frac{lb}{kip}} = 1.03\ klf$

Moment:

$M_U = \frac{wl^2}{8} = \frac{(1.03klf)(23'8)^2}{8} = 72.11ft \cdot kips$ →**W12x16**[2]

$M_U = 72.11 \leq 75.4 = \phi M_n$ ✓

Shear:

$V_U = \frac{wl}{2} = \frac{(1.03klf)(23'8)^2}{2} = 12.19kips$

$V_U = 12.19 \leq 79.2 = \phi V_n$ ✓

Check Self Weight Assumption:

Assumed $5psf > \frac{16lbs}{8'2} = 1.96$ ✓

Final Design:
W12x16

Girder

Spacing:

$\frac{18'5+23'6}{2} = 21.04'$

Span = 24'5

Loads:

- Deck and Concrete load = 37psf
- Joists = 5psf
- Superimposed dead load = 10psf
- Girders = Assumed 2psf
- Live load = 40psf

Live Load reduction

$L = 0.4L_o$ **-or-**

$L = L_o * \left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}}\right) = L_o * \left(0.25 + \frac{15}{\sqrt{(24'5*21.04'+21)}}\right) = 0.72L_o$ – *controls*

Live Load = 40*0.72 = **28.72psf**
Dead Load = 37+5+10+2 = **54psf**

Load Combinations:

1.4D = 75.6psf
1.2D+1.6L = 110.75psf – *controls*

Weight:

$W_u = 110.75psf * \frac{21.04'}{1000\frac{lb}{kip}} = 2.33klf$

Moment:

$M_U = \frac{wl^2}{8} = \frac{(2.33klf)(24'5)^2}{8} = 173.64ft \cdot kips$ →**W14x30**[2]

$M_U = 173.64 \leq 177 = \phi M_n$ ✓

Shear:

$V_U = \frac{wl}{2} = \frac{(2.33klf)(24'5)^2}{2} = 28.45kips$

$V_U = 28.45 \leq 112 = \phi V_n$ ✓

Check Self Weight Assumption:

Assumed $2psf > \frac{30lbs}{21.04'} = 1.43$ ✓

Final Design:
W14x30

Columns

Area:

$A_T = 24'5 * \frac{23'8+18'5}{2} = \mathbf{513.73}\ \boldsymbol{sf}$

Loads:

- Deck and Concrete load = 37psf
- Joists = 5psf
- Superimposed dead load = 10psf
- Girders = 2psf
- Snow Load = 16psf
- Live load = 40psf
- Number of stories: 1 through 9 and the roof = 8 + roof

Live Load reduction

$L = 0.5L_o$ - *controls*

$L = L_o * \left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}}\right) = L_o * \left(0.25 + \frac{15}{\sqrt{(8*513.73)}}\right) = 0.37L_o$

Live Load = 40*0.5 = **20psf**
Dead Load = 37+5+10+2 = **54psf**

Load Combinations for the Roof:

1.2D + 1.6L + 0.5S = **128.8psf** – *controls*
128.8psf * 513.73 sf = 66,168 lbs = **66.17kips** – *for the roof*

Load Combinations for the Floors:

1.2D + 1.6L = **90.4psf** – *controls*
128.8psf * 513.73 sf = 66,168 lbs = **66.17kips** – *for the roof*

$\frac{(Number\ of\ Stories)*(90.4psf)*(513.73sf)}{1000} + 66.17 = Total\ Load$

Columns for Floors	Number of Stories	Total Load (Kips)	Column Design Size	P_u[3]
1-2	8	438		
2-3	7	392		
3-4	6	345		
4-5	5	299	**W10x49**	532 kips ✓
5-6	4	252		
6-7	3	206		
7-8	2	160		
8-9	1	113		
9-Roof	0	66.17	**W10x33**	311 kips ✓

The Heartland Hotel

Mechanical Breadth

SPECIFICATIONS	THP-1000	THP-1100
		
BTU / HR MINIMUM MAXIMUM	48,600 1,000,000	48,600 1,100,000
CFM	6,000	6,000
NATURAL GAS	1" NPT	1" NPT
PROPANE	1" NPT	1" NPT
POWER SUPPLY V/PH/HZ/A	230/1/60/25*	230/1/60/25*
DIMENSIONS L x W x H (IN)	76x35x69	80x36x71
WEIGHT (LBS)	939	889
BASE	CASTERS	CASTERS

http://temp-air.com/heating/direct-fired-heaters-th/

Month	Temperature Range (°F)	Average Temperature (°F)
November	26-41	33.5
December	12-27	19.5
January	8-24	16
February	13-29	21
March	24-41	32.5
April	37-58	47.5

The Heartland Hotel

ACI 306R-10 Guide to Cold Weather Concreting

(ACI 302.1R). Keep the temperature of concrete as placed as close to the recommended minimum value as practicable.

Preparation before concrete is placed requires a temperature increase of the formwork, reinforcement, and other surfaces that will contact fresh concrete so the temperature of the freshly placed concrete will not decrease below the minimums as placed and maintained (Table 5.1). There are many techniques for warming formwork and embedded items, including heated enclosures, electric blankets, hydronic heating systems, or other acceptable means. Best practice indicates that all surfaces should be above the freezing temperature of water. However, take care to limit surface temperatures to no more than 10°F (5°C) greater or 15°F (8°C) less than that of the concrete to avoid inconsistent setting, rapid moisture loss, and plastic shrinkage cracking.

Table 5.1—Recommended concrete temperatures

		Section size, minimum dimension			
		< 12 in. (300 mm)	12 to 36 in. (300 to 900 mm)	36 to 72 in. (900 to 1800 mm)	> 72 in. (1800 mm)
Line	Air temperature	Minimum concrete temperature as placed and maintained			
1	—	55°F (13°C)	50°F (10°C)	45°F (7°C)	40°F (5°C)
		Minimum concrete temperature as mixed for indicated air temperature*			
2	Above 30°F (–1°C)	60°F (16°C)	55°F (13°C)	50°F (10°C)	45°F (7°C)
3	0 to 30°F (–18 to –1°C)	65°F (18°C)	60°F (16°C)	55°F (13°C)	50°F (10°C)
4	Below 0°F (–18°C)	70°F (21°C)	65°F (18°C)	60°F (16°C)	55°F (13°C)
5	—	Maximum allowable gradual temperature drop in first 24 hours after end of protection			
		50°F (28°C)	40° (22°C)	30°F (17°C)	20°F (11°C)

*For colder weather, a greater margin in temperature is provided between concrete as mixed and required minimum temperature of fresh concrete in place.

7.1—Protection methods

Protect concrete from freezing as soon as practicable after placement, consolidation, and finishing. This protection can be provided by concrete mixture acceleration, insulation, heat systems, enclosures, or a combination of these practices, and should be planned before placement. Accelerating the

Table 7.1—Length of protection period for concrete placed during cold weather

		Protection period at minimum temperature indicated in Line 1 of Table 5.1, days*	
Line	Service condition	Normal-set concrete	Accelerated-set concrete
1	No load, not exposed	2	1
2	No load, exposed	3	2
3	Partial load, exposed	6	4
4	Full load	Refer to Chapter 8	

*A day is a 24-hour period.

The Heartland Hotel

Cost Analysis

Category	Original Method	Structural Uplift Method	Cost Change (Original - Proposed)
Construction Enclosure System	$148,644.67	$224,233.26	$(75,588.59)
Heating System	$21,213.68	$19,592.80	$ 1,620.88
Structure	$1,205,195.30	$1,834,730.94	$(629,535.65)
Equipment	$144,864.00	$264,680.39	$(119,816.39)
Exterior Enclosure	$0	$171,937.81	$(171,937.81)
General Conditions	$0	$(112,111.93)	$112,111.93
Total	**$1,519,917.64**	**$2,556,279.89**	**$(883,145.63)**

$883,000 cost increase

↓

33 Day Schedule Reduction

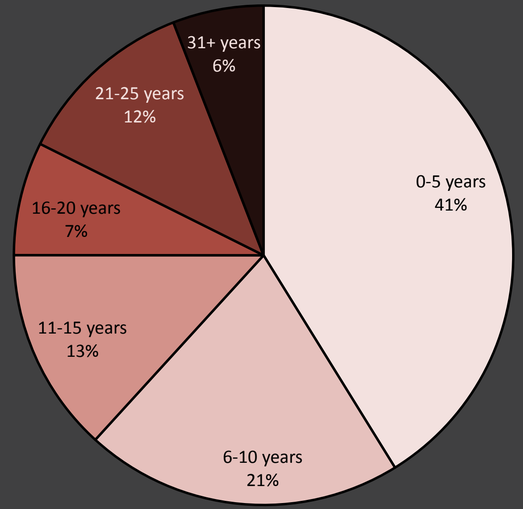
$170,000 Increased Profit

Structural Lift Method Appendix

The Heartland Hotel

Introduction
Analysis 1
Analysis 2
Analysis 3
Analysis 4
Conclusion

Years in Current Position



Years in Construction Industry