THE HOUSING AND FOOD SERVICE WAREHOUSE AND BAKERY EXPANSION





PENN STATE AE SENIOR CAPSTONE



CONSTRUCTION OPTION

PROJECT

JOSEPH RUTT

ADVISOR: ANUMBA

APRIL 13TH, 2016



I. INTRODUCTION

- II. PROJECT OVERVIEW
- III. ANALYSIS #1: SIPS ANALYSIS
- IV. ANALYSIS #2: BIM UTILIZATION
- V. ANALYSIS #3: INDOOR AIR QUALITY
- VI. ANALYSIS #4: LEED CERTIFICATION
- VII. FINAL RECOMMENDATIONS
- VIII. ACKNOWLEDGEMENTS

PROJECT OVERVIEW



Googlemaps.com



INTRODUCTION

ANALYSIS 2 BIM UTILIZATION DESIGN CONSTRUCT OPERATE PLAN

Primary BIM Uses Secondary BIM Use



NSI/ASHRAE Standard 62.1-20

Supersedes ANSI/ASHRAE Standard 62.1-2010

des ANSI/ASHRAF addenda listed in Appe

ANALYSIS 3 INDOOR AIR QUALITY

The Pennsylvania State University BIM Execution Planning Guide



ANALYSIS 4 LEED CERTIFICATION



LEED USGBC



PROJECT BACKGROUND

PRESENTATION OUTLINE:

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Building Information:

- Original Size 94,000SF
- 44,500SF renovation of existing building
- 25,000SF Warehouse addition
- Approximately \$13 Million Project
- March 2015 March 2016
- Design Build

Superintendent Robert Bair

Kinsley Construction





THE HFS WAREHOUSE AND BAKERY ADDITION & RENOVATION





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Schedule Matrix

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Analysis #1 **SIPS** Analysis

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Problem Identification:

- Cannot occupy office space during renovations
- Renovations during two different phases



SIPS SCHEDULE



Proposed Solution:

SIPS Analysis of office renovation

Research Goal:

Schedule Matrix





FURNITURE N.I.C. . TYP.

THE HFS WAREHOUSE AND BAKERY Addition & Renovation



Decrease time to renovate offices



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SCHEDULE MATRIX

THE HFS WAREHOUSE AND BAKERY ADDITION & RENOVATION





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VI. ANALYSIS #4: LEED CERTIFICATION

VII. FINAL RECOMMENDATIONS

VIII. ACKNOWLEDGEMENTS

Schedule:

- About 5 weeks to completely finish one room
- Total of 10 weeks and 2 days to complete
- Finished 5 weeks ahead of the 16 week schedule
- Renovation of both office space during Phase 3

FEASIBILITY ANALYSIS

THE HFS WAREHOUSE AND BAKERY Addition & Renovation





Provided by Kinsley Construction

Provided by Kinsley Construction





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Schedule Impact:

Decreased schedule by 37 Days

Manpower 29 25

RECOMMENDATIONS

Schedule **16 Weeks**

11 Weeks

Recommendation:

Implement the SIPS Analysis for office renovations

Potential Value Added:

- Occupant Satisfaction
- Organized trades
- Decreased schedule





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Analysis #2 **BIM** Utilization

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Problem Identification:

- BIM was not used on this project
- Many RFI's and ASI's
- Large contingency held



BIM UTILIZATION

Proposed Solution:

•3D and 4D coordination

Potential Outcomes:

- outweighs the costs saved from the use of BIM. substantial and therefore BIM should be utilized.
- Cost of creating 3D and 4D model is too high • Amount of time saved by limiting RFI's is • Amount of time added by the creation of the 3D
- and 4D model is more than the time saved.





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Tasks:

- Create a 3D model of existing building
- Utilize clash detection
- 4D model of warehouse bay and storage

X	Plan	х	Design	X	Construct	Х	Operate
							Building
	Programming		Design Authorizing	X	Site Utilization Plan	X	Maintenance
X	Site Analysis	X	Design Reviews	X	Construction System		System Analysis
			3D Coordination		3D Coordination		Asset Management
			Structural Analysis		Digital Fabrication		Space Tracking
			Lighting Analysis		3D Planning		Disaster Planning
			Energy Analysis		Record Modeling		Record Modeling
			Mechanical Analysis				
			Other Analysis				
		X	Sustainability				
			Code Validation				
x	4D Modeling		4D Modeling	X	4D Modeling		4D Modeling
x	Cost Estimation	X	Cost Estimation	X	Cost Estimation	X	Cost Estimation
	Existing Conditions	X	Existing Conditions	X	Existing Conditions	X	Existing Conditions

FEASIBILITY ANALYSIS

Predicted Outcome

- 3D model relieves issues with as-built drawings
- Eliminate RFI's and ASI's
- 4D model sequence phases and create maps for construction site





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Recommendation:

- BIM is recommended for this project
- Reduces problems with asbuilt model
- Reduces RFI's and ASI's

RECOMMENDATION

Гне	HFS	WAR
		Add

		1	BIM US	E Selecti	ion	
		Res	ponsible P	arties		
IM Uses per Phase	Desire to Implement (Y/N/Maybe)	Lead Team Member	Addt'l Team Members	Experience Level (1-5) 5=High	Process Map Available?	Comments
rations Phase						
Record Model	Y	Contractor		2	N	
			MEP Subs	1	N	Responsible for As-Built Model / Info
			A/E	2	N	Provide input on information required
Building stem Analysis Building	Maybe	Contractor		3	N	
aintenance neduling	Y	Owner		4		
struction se						
Site Utilization Inning	Maybe	Contractor		3	N	Staging, Temp Utilities, Crane Info
			MEP Subs	2	N	Underground Modeling / Information
3D Control and Inning	N					
3D Design / EP						
ordination	Maybe	Contractor	MEP Subs	4	Y	See Project Map

Design Phase						
Design						
Authoring	Y	Arch		4	N	Level of Detail Needs Defined
Engineering						
Analysis	Maybe	Contractor		2		
Planning Phase						
Programming	Maybe	Arch		2	N	Software Requirement
			Owner			Initial Input Required
Site Analysis	Y	Arch	Owner	3		Schedule and Software - see Map
Multi-Phase						
Phase Planning						
(4D Modeling)	N					
Cost						
Estimation	Y	Contractor		3	N	Scope Needs Defined
			Arch	3	N	Level of Detail Needs Defined
Existing						
Conditions						
Modeling	Ν					

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Analysis #3

Indoor Air Quality

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Problem Identification:

Poor air quality can effect occupant's health

Proposed Solution:

Increase the quality of air for the occupants

Research Goal:

- Find breathing zone outdoor airflow
- Air distribution effectiveness
- Zone outdoor airflow

INDOOR AIR QUALITY

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Supersedes ANSI/ASHRAE Standard 62.1-2010

Ventilation for Acceptable Indoor Air Quality

see Appendix | for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the America National Standards Institute

nittee has established a documented program for regular publication of addenda or revisions, including procedures for timeh ocumented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Manager of andards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from SHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@sahrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to ww.aslyze.org/permit

2013 ASHRAE



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ASHRAE Standard 62.1 - 2013





Unit H – Office Space



INDOOR AIR QUALITY

PRESENTATION OUTLINE:	Desething Zerry Outdays Al flow			Indoor Air (Quality Analysis - Unit H		
T T	Breathing Zone Outdoor Airflow	7	Zone Area	Zone Population	Breathing Zone Outdoor Airflow	Zone Air Distribution	Zone Outdoor Airflow
I. INTRODUCTION	Vbz (cfm)	Zone name	Az (ft^2)	Pz (people)	Vbz (cfm)	Effectiveness Ez	Voz (cfm)
II. PROJECT OVERVIEW	0	Restroom	214	2.00	0	1.00	0
		Reception	144	1.44	16	1.00	16
III. ANALYSIS #1: SIPS ANALYSIS	16	Chef Office	215	4.30	58	1.00	58
IV ANALYSIS #2. DIM LITH PATION	58	Copy Room	152	1.52	17	1.00	17
IV. ANALYSIS #2. DIWI UTILIZATION	17	Shared Confrence Room	488	4.88	54	1.00	54
V. ANALYSIS #3: INDOOR AIR QUALITY	1/	Break Room	206	10.00	62	1.00	62
	54	Storage	115	0.23	15	1.00	15
PROBLEM IDENTIFICATION	62	Supply Closet	62	0.62	11	1.00	11
FEASIBILITY ANALYSIS	15	Corridor	226	0.00	0	1.00	0
	15	Office A	256	2.56	28	1.00	28
RECOMMENDATION	11	Office B	156	1.56	17	1.00	10
MECHANICAL DELADTI	0	Office C	155	1.55	17	1.00	10
MECHANICAL DREADTH							
VI. ANALYSIS #4: LEED CERTIFICATION	28	System Area (sq ft)	3,015				
	17	System Population (people)	30.66				
VII. FINAL RECOMMENDATIONS		Uncorrected Outdoor Air Intake (cfm)	295				
VIII. ACKNOWLEDGEMENTS	17	Outdoor Air Intake Flow (+30%) (cfm)	383				

Calculating Breathing Zone Outdoor Air Flow (V_{hz}) :

$$V_{bz} = R_p \times P_z -$$

Where

 A_z = Zone floor area, the net occupiable floor area of the ventilation zone, ft²

- P_z = Zone population, the number of people in the ventilation zone during typical usage R_p = Outdoor airflow rate required per person as determined from Table 6.2.2.1
- $R_a = 0$ Outdoor airflow rate required per unit area as determined from Table 6.2.2.

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 $+ R_a \times A_z$



INDOOR AIR QUALITY

PRESENTATION OUTLINE:	Zone Air Distribution	Indoor Air Quality Analysis - Unit H										
		7000 0000	Zone Area	Zone Population	Breathing Zone Outdoor Airflow	Zone Air Distribution	Zone Outdoor Airflow					
I. INTRODUCTION	Effectiveness Ez	Zone name	Az (ft^2)	Pz (people)	Vbz (cfm)	Effectiveness Ez	Voz (cfm)					
I. PROJECT OVERVIEW	1.00	Restroom	214	2.00	0	1.00	0					
	1.00	Reception	144	1.44	16	1.00	16					
II. ANALYSIS #1: SIPS ANALYSIS	1.00	Chef Office	215	4.30	58	1.00	58					
\mathbf{W} Analysis #2. BIM Uth ization	1.00	Copy Room	152	1.52	17	1.00	17					
V. ANALISIS $\pi 2$. DIVI O IILIZATION	1.00	Shared Confrence Room	488	4.88	54	1.00	54					
V. ANALYSIS #3: INDOOR AIR QUALITY	1.00	Break Room	206	10.00	62	1.00	62					
	1.00	Storage	115	0.23	15	1.00	15					
PROBLEM IDENTIFICATION	1.00	Supply Closet	62	0.62	11	1.00	11					
FEASIBILITY ANALYSIS	1.00	Corridor	226	0.00	0	1.00	0					
		Office A	256	2.56	28	1.00	28					
RECOMMENDATION	1.00	Office B	156	1.56	17	1.00	10					
Mechanical Breadth	1.00	Office C	155	1.55	17	1.00	10					
VI ANALYSIS #4. LEED CERTIFICATION	1.00	System Area (sq ft)	3,015									
	1.00	System Population (people)	30.66									
VII. FINAL RECOMMENDATIONS	1.00	Uncorrected Outdoor Air Intake (cfm)	295									
VIII ACKNOWIEDCEMENTS	1.00	Outdoor Air Intake Flow (+30%) (cfm)	383									

Тне	HFS	WAR
		Add

Determine Zone Air Distribution Effectiveness (E₇):

E_z is determined using Table 6.2.2.2 in Standard 62.1

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PRESENTATION OUTLINE:

Zone Outdoor Airflow			Indoor Air	Quality Analysis - Unit H		
2011e Outdoor Airriow	Zana nama	Zone Area	Zone Population	Breathing Zone Outdoor Airflow	Zone Air Distribution	Zone Outdoor Airflow
Voz (cfm)	Zone name	Az (ft^2)	Pz (people)	Vbz (cfm)	Effectiveness Ez	Voz (cfm)
0	Restroom	214	2.00	0	1.00	0
10	Reception	144	1.44	16	1.00	16
16	Chef Office	215	4.30	58	1.00	58
58	Copy Room	152	1.52	17	1.00	17
17	Shared Confrence Room	488	4.88	54	1.00	54
17	Break Room	206	10.00	62	1.00	62
54	Storage	115	0.23	15	1.00	15
62	Supply Closet	62	0.62	11	1.00	11
15	Corridor	226	0.00	0	1.00	0
15	Office A	256	2.56	28	1.00	28
11	Office B	156	1.56	17	1.00	10
0	Office C	155	1.55	17	1.00	10
28	System Area (sq ft)	3,015				
10	System Population (people)	30.66				
10	Uncorrected Outdoor Air Intake (cfm)	295				
10	Outdoor Air Intake Flow (+30%) (cfm)	383				

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Calculating Zone Outdoor Airflow (V_{07}) :



 $V_{oz} = \frac{V_{bz}}{E_z}$



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		Indoor Air Quality Analysis - Unit H										
		Zone name	Zone Area	Zone Population	Breathing Zone Outdoor Airflow	Zone Air Distribution	Zone Outdoor Airflow					
		zone name	Az (ft^2)	Pz (people)	Vbz (cfm)	Effectiveness Ez	Voz (cfm)					
		Restroom	214	2.00	0	1.00	0					
		Reception	144	1.44	16	1.00	16					
System Area (saft)	2 015	Chef Office	215	4.30	58	1.00	58					
System Alea (Sq It)	5,015	Copy Room	152	1.52	17	1.00	17					
System Population (people)	30.66	Shared Confrence Room	488	4.88	54	1.00	54					
Lissense stand Quitide on Alis Interlay (sfor)	205	Break Room	206	10.00	62	1.00	62					
Uncorrected Outdoor Air Intake (cfm)	295	Storage	115	0.23	15	1.00	15					
Outdoor Air Intake Flow (+30%) (cfm)	383	Supply Closet	62	0.62	11	1.00	11					
	000	Corridor	226	0.00	0	1.00	0					
		Office A	256	2.56	28	1.00	28					
		Office B	156	1.56	17	1.00	10					
	\searrow	Office C	155	1.55	17	1.00	10					
		System Area (sq ft)	3,015									
		System Population (people)	30.66									
		Uncorrected Outdoor Air Intake (cfm)	295									
		Outdoor Air Intake Flow (+30%) (cfm)	383									

RECOMMENDATION

Conclusion:

Uncorrected Outdoor Air Intake: 295 CFM

Outdoor Air Intake Flow (+30%): 383 CFM

The mechanical system requires an additional 383 CFM of outdoor air to reach the requirement for the LEED Credit.





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	User Override	Standard Default	ASHI © 0.4%	RAE MaxDB C 1%	/М(
Dry bulb		90	92.7	90.1	8
Wet bulb		74	75.6	74.5	7
nter Design	Heating User C Override	Standard • Default	C 99.6%	C 99%	
Dry bulb		14	11.6	15.8	1
itional Direc	t Dehumidifica ASHF C 0.4%	ation Weathe RAE MaxDP/ C 1%	MCDB		
ntional Direc None Dry bulb	t Dehumidifica ASHF O 0.4%	ation Weathe RAE MaxDP/ C 1% 81.7	r MCDB C 2%	۴F	
etional Direc None Dry bulb Wet bulb	t Dehumidifica ASHF © 0.4% 83 77.4	Ation Weather RAE MaxDP/ 1% 81.7 76.3	MCDB C 2% 80.4 75.1	°F °F	



MECHANICAL BREADTH

Determining the cooling load for Unit H:

The cooling load the design parameters for Summer Design Cooling are:

- 90.1 Dry bulb
- 74.5 Wet bulb
- Relative humidity of 60%
- Indoor temperature of 75° F.

 $\dot{q}(btu) = 4.5 \ CFM \ \Delta h$

 $\dot{q}(btu) = 4.5 (383) (38.8 - 30.4)$

q(*btu*) = 14,477.4 *btuh* = **14**. **5** *mbh*







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otional Direc	t Dehumidifica ASHF C 0.4%	Ation Weathe RAE MaxDP/ C 1%	MCDB C 2%	۰ ۲	
itional Direc None Dry bulb	t Dehumidifica ASHF © 0.4%	Ation Weathe RAE MaxDP/ C 1% 81.7	MCDB C 2%	°F	
ntional Direc	t Dehumidifica ASHF C 0.4% 83 77.4	Ation Weathe RAE MaxDP/ 1% 81.7 76.3	MCDB C 2% 80.4 75.1	°F °F	



MECHANICAL BREADTH

Determine the heating load for Unit H:

From the Psychrometric Chart: h1 = 38.8 btu/lbm h2 = 30.4 btu/lbm

 $\dot{q} sens = 1.08 \ CFM \ \Delta T$

 $\dot{q} sens = 1.08 (383) (75 - 15.8)$

ġ sens = 24,487.5 *btuh* = **24**. **5** *mbh*

The heating load above is added to the current load of 100 mbh for a total of 124.5 mbh load for Unit H

THE HFS WAREHOUSE AND BAKERY Addition & Renovation





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Recommendation:

- 100% outdoor air system
- Cost of change is low and may be negligible
- Provides occupants with a higher quality work environment

ASHRAE PSYCHROMETRIC CHART

MECHANICAL BREADTH



$$q(btu) = 14,477.4 \ btuh = 14.5 \ r$$

Total of 124.5 mbh load for Unit H



mbh

mbh



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Analysis #4 **LEED Certification**

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Problem Identification:

- No considerations to pursue LEED Certification
- Project is capable of achieving at least 40 points

LEED CERTIFICATION



Proposed Solution:

Acquire at minimum 40 points to become a LEED Certified building

Research Goal:

- Benefits lifespan of project
- Lower operating costs
- Reduced project waste
- Energy conservation
- Reduced greenhouse gas emissions
- Tax rebates







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C			LEED v4 for BD+C: Warehouses and Distribu Project Checklist	ution Centers
Y 1	?	N	Creat Integrative Process	1
10	1	5	Location and Transportation	16
			Creat LEED for Neighborhood Development Location	16
1			Creat Sensitive Land Protection	1
1	1		Creat High Priority Site	2
2		3	Credit Surrounding Density and Diverse Uses	5
5			creat Access to Quality Transit	5
1			Credit Bicycle Facilities	1
		1	Credit Reduced Parking Footprint	1
		1	Credit Green Vehicles	1
3	2	5	Sustainable Sites	10

3	2	5	Sustainable Sites				
Y			Proreq	Construction Activity Pollution Prevention	Required		
1			Credit	Site Assessment	1		
		2	Credit	Site Development - Protect or Restore Habitat	2		
1			Credit	Open Space	1		
1	2		Credit	Rainwater Management	3		
		2	Credit	Heat & land Reduction	2		
		1	Credit	Light Pollution Reduction	1		



LEED CERTIFICATION

THE HFS WAREHOUSE AND BAKERY ADDITION & RENOVATION

4	Wate	Efficiency	11
	Prereq	Outdoor Water Use Reduction	Required
	Pereq	Indoor Water Use Reduction	Required
	Prereq	Building-Level Water Metering	Required
2	Credit	Outdoor Water Use Reduction	2
2	Credit	Indoor Water Use Reduction	6
	Credit	Cooling Tow er Water Use	2
	Credit	Water Metering	1
#	Energ	y and Atmosphere	33
	Prereq	Fundamental Commissioning and Verification	Required
	Prereq	Minimum Energy Performance	Required
	Prereq	Building-Level Energy Metering	Required
	Prereq	Fundamental Refrigerant Management	Required
	Credit	Enhanced Commissioning	6
10	Credit	Optimize Energy Performance	18
	Credit	Advanced Energy Metering	1
2	Credit	Demand Response	2
	Credit	Renew able Energy Production	3
	Credit	Enhanced Refrigerant Management	1
	Credit	Green Pow er and Carbon Offs ets	2
6	Mate	rials and Resources	13
	Pereq	Storage and Collection of Recyclables	Required
	Prereq	Construction and Demolition Waste Management Planning	Required
	Credit	Building Life-Cycle Impact Reduction	5
2	Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
2	Credit	Building Product Dis clos une and Optimization - Sourcing of Raw Materials	2
2	Credit	Building Product Dis clos ure and Optimization - Material Ingredients	2
	Credit	Construction and Demolition Waste Management	2

9	1	6	Indoor Environmental Quality	
Y			Prereq	Minimum Indoor Air Quality Performance
Y			Prereq	Environmental Tobacco Smoke Control
2			Credit	Enhanced Indoor Air Quality Strategies
3			Credit	Low - Emitting Materials
1			Credit	Construction Indoor Air Quality Management Plan
2			Credit	Indoor Air Quality Assessment
		1	Credit	Thermal Comfort
1	1		Credit	Interior Lighting
		3	Credit	Daylight
		1	Credit	Quality Views
		1	Credit	Acoustic Performance
1	2	3	Innova	ition

1	2	5	Innovation	
	2	3	Credit	Innovation
1			Credit	LEED Accredited Professional

2	0	2	Regional Priority	
1			Credit Regional Priority: Specific Credit	
1			Credit Regional Priority: Specific Credit	
		1	Credit Regional Priority: Specific Credit	
		1	Cred It Regional Priority: Specific Credit	

42 22 43 TOTALS

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110



	16
	Required
	Required
	2
	3
	1
	2
	1
	2
	3
	1
	1
	6
	5
	1
	4
	1
	1
	1
	1
ssible Points:	110



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Recommendation:

Pursue the lowest LEED Certification with a minimum of 40 points



RECOMMENDATION

Components:

- Integrative Process 1 point
- Location & Transportation 10 points
- Sustainable Site 3 points
- Water Efficiency 5 points
- Energy & Atmosphere 9 points
- Material & Resources 2 points
- Indoor Environmental Quality 9 points
- Innovation 1 point
- Regional Priority 2 points

Total points: 42 LEED Certified





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Provided by Kinsley Construction

ANALYSIS 1 SIPS ANALYSIS

- Implement the SIPS Analysis for office renovations
 - Occupant Satisfaction
- Organized trades
- Decreased schedule

CONCLUSION

ANALYSIS 2 BIM UTILIZATION

- BIM is recommended for this project
 - Reduces problems with asbuilt model
 - Reduces RFI's and ASI's

ANALYSIS 3 INDOOR AIR QUALITY

Implementation of the mechanical system is recommended to achieve the LEED credit



ANALYSIS 4 LEED CERTIFICATION There are at least 42 possible points for this building, strongly recommend pursuit of LEED Certified Building



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Dr. Chimay Anumba (Advisor)



My Family & Friends **Kevin Finke – Kinsley Construction** Justin Osmolinski – Kinsley Construction **PACE Industry Members**



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THE HFS WAREHOUSE AND BAKERY Addition & Renovation







Sweetland Engineering & ASSOCIATES, INC.





THANK YOU

Questions & Comments

ADDITION & RENOVATION THE HFS WAREHOUSE AND BAKERY

