

The Pennsylvania State University

Department of Architectural Engineering



HARRISBURG UNIVERSITY ACADEMIC



Laurel Heather Warner - Project Controls
JACOBS

Construction Management
April 13, 2009

Project Overview

Project Overview

Harrisburg University of Science and Technology

Location: Harrisburg, Pennsylvania

Size: 370,000 SF

Height: 16 Stories

Cost: \$73M

Industry
Research

Breadth 1

Breadth 2

Results

Site Prior to Demolition



Project Overview

Project Overview

Industry
Research

Breadth 1

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Project Team

Owner: Harrisburg University of Science and Technology

Construction Manager: Reynolds Construction Management

Architect & M. P. FP Engineer: Burt, Hill

Structural Engineer: Barber & Hoffman

Civil/Electrical Engineer: Benatec Associates

Electrical Engineer (Lighting): Integrated Engineering Solutions, Inc.

Parking Consultant: Timothy Haahs & Associates

Construction Dates: January 2007—December 2008



Project Overview

Project Overview

Industry Research

Breadth 1

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Results

Academic Facility with:

- Classrooms
- Teaching labs
- Seminar rooms
- Library
- Auditorium space
- Office space
- Parking facility



Project Overview

Project Overview

Industry Research

Breadth 1

Breadth 2

Results

Foundation: 70 caissons averaging 5 feet in diameter and 24" grade beam

Core Structure: precast concrete and structural steel wide-flange beams and girders connecting to W18x480 columns

Shell: non load-baring Curtain wall and aluminum window glazing system

Roof: EPDM rubber elastomer

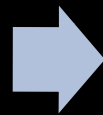


Industry Research

Project
Overview

Growing
Urban
Environments

Industry
Research



Green
Urban
Design
Model

Breadth 1

Breadth 2

Results

Rising Costs
of Energy



Industry Research

Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results



Industry Research

Project
Overview

Building Project Met the Following Criteria:

Industry
Research

- ✓ Non-classified
- ✓ LEED Version 2.0 or Later for NC
- ✓ Within 25% of Gross SF of HBGU
- ✓ Office or Higher Education
- ✓ In an Urban Environment

Breadth 1

Breadth 2

Results



LEED-NC



Industry Research

Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results

Project Name	City	State	Version	Project Type	Owner Type	Occupant Type	Gross Square Feet	Registration Date
DUC Administration Building	Orlando	FL	2.2	Commercial Office	Profit Org	Mixed Occupancy	278,000	Aug 7 2006
Marriott US Headquarters	Boston	MA	2.2	Commercial Office	Federal Government	Federal Government	526,020	Jan 19 2007
Social Security Annex Building	Baltimore	MD	2.0	Commercial Office	Federal Government	Federal Government	406,069	Dec 10 2001
Liberty Mutual Office Building	Dover	NH	2.1	Commercial Office	Profit Org	Profit Org	350,000	Jun 16 2005
Holasky Corporate Center	Las Vegas	NV	2.1	Commercial Office	Profit Org	Mixed Occupancy	265,000	May 2 2005
The Plaza At PPL Center	Allentown	PA	2.0	Commercial Office	Other	Profit Org	280,000	Nov 8 2001
3p Commercial and Trading Office	Houston	TX	2.2	Commercial Office	Profit Org	Profit Org	390,000	Sept 15 2006
Vocation Technology Center, City College	San Diego	CA	2.1	Higher Education	State Government	State Government	336,100	Nov 20 2006
Management Building	Atlanta	GA	2.0	Higher Education	State Government	State Government	248,059	Jan 31 2001
Center for Interdisciplinary Engineering	Durham	NC	2.1	Higher Education	Profit Org	Profit Org	323,000	July 23 2002
Whitehead Biomedical Research Building	Atlanta	GA	2.0	Laboratory	Profit Org	Profit Org	325,000	July 19 2000
San Diego New Main Library	San Diego	CA	2.1	Library	Local Government	Local Government	360,858	May 4 2004
California Academy of Sciences	San Francisco	CA	2.1	Multi-Use	Non-Profit Org	Non-Profit Org	390,000	Mar 19 2003
David Skaggs Research Center	Boulder	CO	2.2	Multi-Use	Federal Government	Federal Government	400,000	Dec 02 2006
Univ of North Florida - Osprey Fountains	Jacksonville	FL	2.2	Multi-Use	State Government	State Government	375,000	Mar 19 2007
Simmons College of Marin	Boston	MA	2.1	Multi-Use	Non-Profit Org	Non-Profit Org	309,660	Dec 9 2005
Hosinc Development	Minneapolis	MN	2.2	Multi-Use	Individual	Mixed Occupancy	350,000	Oct 12 2006
Jefferson Arms	St Louis	MO	2.2	Multi-Use	Profit Org	Mixed Occupancy	509,855	Dec 22 2006
Duke Univ French Family Science Center	Durham	NC	2.1	Multi-Use	Profit Org	Profit Org	273,872	Sep 22 2004
1275 Dean Martin Drive	Las Vegas	NV	2.1	Multi-Use	Profit Org	Profit Org	400,000	Jan 7 2006
1700 Building	Portland	OR	2.2	Multi-Use	Profit Org	Mixed Occupancy	371,000	Aug 20 2001
Two Potomac Yard	Arlington	VA	2.1	Multi-Use	Profit Org	Federal Government	309,270	Jan 31 2005
							Average SF	353,489

Industry Research

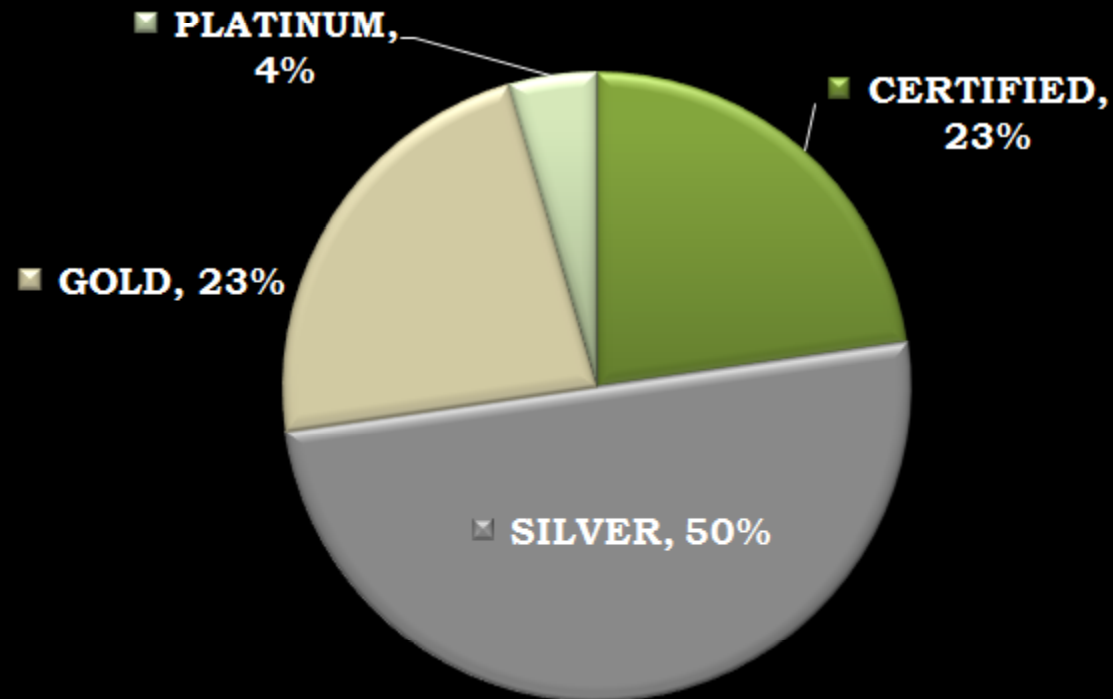
Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results



Industry Research

Project Overview

Industry Research

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LEED-NC	
LEED-NC Version 2.2 Registered Project Checklist	
<< PROJECT NAME >>	
<< CITY, STATE >>	
Yes ? No	
Sustainable Sites 14 Points	
Y	Prereq 1 Construction Activity Pollution Prevention Required
	Credit 1 Site Selection 1
	Credit 2 Development Density & Community Connectivity 1
	Credit 3 Brownfield Redevelopment 1
	Credit 4.1 Alternative Transportation, Public Transportation Access 1
	Credit 4.2 Alternative Transportation, Bicycle Storage & Changing Rooms 1
	Credit 4.3 Alternative Transportation, Low-Emitting and Fuel-Efficient Vehicles 1
	Credit 4.4 Alternative Transportation, Parking Capacity 1
	Credit 5.1 Site Development, Protect or Restore Habitat 1
	Credit 5.2 Site Development, Maximize Open Space 1
	Credit 6.1 Stormwater Design, Quantity Control 1
	Credit 6.2 Stormwater Design, Quality Control 1
	Credit 7.1 Heat Island Effect, Non-Roof 1
	Credit 7.2 Heat Island Effect, Roof 1
	Credit 8 Light Pollution Reduction 1
Yes ? No	
Water Efficiency 5 Points	
	Credit 1.1 Water Efficient Landscaping, Reduce by 50% 1
	Credit 1.2 Water Efficient Landscaping, No Potable Use or No Irrigation 1
	Credit 2 Innovative Wastewater Technologies 1
	Credit 3.1 Water Use Reduction, 20% Reduction 1
	Credit 3.2 Water Use Reduction, 30% Reduction 1
Yes ? No	
Energy & Atmosphere 17 Points	
Y	Prereq 1 Fundamental Commissioning of the Building Energy Systems Required
Y	Prereq 2 Minimum Energy Performance Required
Y	Prereq 3 Fundamental Refrigerant Management Required
	Credit 1 Optimize Energy Performance 1 to 10
	Credit 2 On-Site Renewable Energy 1 to 3
	Credit 3 Enhanced Commissioning 1
	Credit 4 Enhanced Refrigerant Management 1
	Credit 5 Measurement & Verification 1
	Credit 6 Green Power 1

Materials & Resources 13 Points	
Y	Prereq 1 Storage & Collection of Recyclables Required
	Credit 1.1 Building Reuse, Maintain 75% of Existing Walls, Floors & Roof 1
	Credit 1.2 Building Reuse, Maintain 100% of Existing Walls, Floors & Roof 1
	Credit 1.3 Building Reuse, Maintain 50% of Interior Non-Structural Elements 1
	Credit 2.1 Construction Waste Management, Divert 50% from Disposal 1
	Credit 2.2 Construction Waste Management, Divert 75% from Disposal 1
	Credit 3.1 Materials Reuse, 5% 1
	Credit 3.2 Materials Reuse, 10% 1
	Credit 4.1 Recycled Content, 10% (post-consumer + 1/2 pre-consumer) 1
	Credit 4.2 Recycled Content, 20% (post-consumer + 1/2 pre-consumer) 1
	Credit 5.1 Regional Materials, 10% Extracted, Processed & Manufactured Regionally 1
	Credit 5.2 Regional Materials, 20% Extracted, Processed & Manufactured Regionally 1
	Credit 6 Rapidly Renewable Materials 1
	Credit 7 Certified Wood 1
Yes ? No	
Indoor Environmental Quality 15 Points	
Y	Prereq 1 Minimum IAQ Performance Required
Y	Prereq 2 Environmental Tobacco Smoke (ETS) Control Required
	Credit 1 Outdoor Air Delivery Monitoring 1
	Credit 2 Increased Ventilation 1
	Credit 3.1 Construction IAQ Management Plan, During Construction 1
	Credit 3.2 Construction IAQ Management Plan, Before Occupancy 1
	Credit 4.1 Low-Emitting Materials, Adhesives & Sealants 1
	Credit 4.2 Low-Emitting Materials, Paints & Coatings 1
	Credit 4.3 Low-Emitting Materials, Carpet Systems 1
	Credit 4.4 Low-Emitting Materials, Composite Wood & Agrifiber Products 1
	Credit 5 Indoor Chemical & Pollutant Source Control 1
	Credit 6.1 Controllability of Systems, Lighting 1
	Credit 6.2 Controllability of Systems, Thermal Comfort 1
	Credit 7.1 Thermal Comfort, Design 1
	Credit 7.2 Thermal Comfort, Verification 1
	Credit 8.1 Daylight & Views, Daylight 75% of Spaces 1
	Credit 8.2 Daylight & Views, Views for 90% of Spaces 1
Yes ? No	
Innovation & Design Process 5 Points	
	Credit 1.1 Innovation in Design: Provide Specific Title 1
	Credit 1.2 Innovation in Design: Provide Specific Title 1
	Credit 1.3 Innovation in Design: Provide Specific Title 1
	Credit 1.4 Innovation in Design: Provide Specific Title 1
	Credit 2 LEED® Accredited Professional 1
Yes ? No	
Project Totals (pre-certification estimates) 69 Points	
Certified 28-32 points Silver 33-38 points Gold 39-51 points Platinum 52-60 points	

Industry Research

Project Overview

Industry Research

Breadth 1

Breadth 2

Results

Green Urban Design Model		
Sustainable Sites		8/14 Points
Prereq 1	Construction Activity Pollution Prevention	Required
Credit 1	Site Selection	1
Credit 2	Development Density & Community Connectivity	1
Credit 4.1	Alternative Transportation, Public Transportation Access	1
Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
Credit 4.4	Alternative Transportation, Parking Capacity	1
Credit 5.1	Site Development, Protect or Restore Habitat	1
Credit 6.1	Stormwater Design, Quantity Control	1
Credit 6.2	Stormwater Design, Quality Control	1
Water Efficiency		3/5 Points
Credit 1.1	Water Efficient Landscaping, Reduce by 50%	1
Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	1
Credit 3.1	Water Use Reduction, 20% Reduction	1
Energy & Atmosphere		8/17 Points
Prereq 1	Fundamental Commissioning of the Building Energy Systems	Required
Prereq 2	Minimum Energy Performance	Required
Prereq 3	Fundamental Refrigerant Management	Required
Credit 1	Optimize Energy Performance	5
Credit 2	On-Site Renewable Energy	1
Credit 5	Measurement & Verification	1
Credit 6	Green Power	1
Materials & Resources		7/13 Points
Prereq 1	Storage & Collection of Recyclables	Required
Credit 2.1	Construction Waste Management, Divert 50% from Disposal	1
Credit 3.1	Materials Reuse, 5%	1
Credit 3.2	Materials Reuse, 10%	1
Credit 4.1	Recycled Content, 10% (post-consumer + 1/2 pre-consumer)	1
Credit 5.1	Regional Materials, 10% Extracted, Processed & Manufactured Regionally	1
Credit 5.2	Regional Materials, 20% Extracted, Processed & Manufactured Regionally	1
Credit 6	Rapidly Renewable Materials	1
Indoor Environmental Quality		9/15 Points
Prereq 1	Minimum IAQ Performance	Required
Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
Credit 1	Outdoor Air Delivery Monitoring	1
Credit 4.1	Low-Emitting Materials, Adhesives & Sealants	1
Credit 4.2	Low-Emitting Materials, Paints & Coatings	1
Credit 6.1	Controllability of Systems, Lighting	1
Credit 6.2	Controllability of Systems, Thermal Comfort	1
Credit 7.1	Thermal Comfort, Design	1
Credit 7.2	Thermal Comfort, Verification	1
Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1
Credit 8.2	Daylight & Views, Views for 90% of Spaces	1
Innovation & Design Process		2/5 Points
Credit 1.1	Innovation in Design: Provide Specific Title	1
Credit 2	LEED® Accredited Professional	1
Project Totals (pre-certification estimates)		37/69 Points

Industry Research

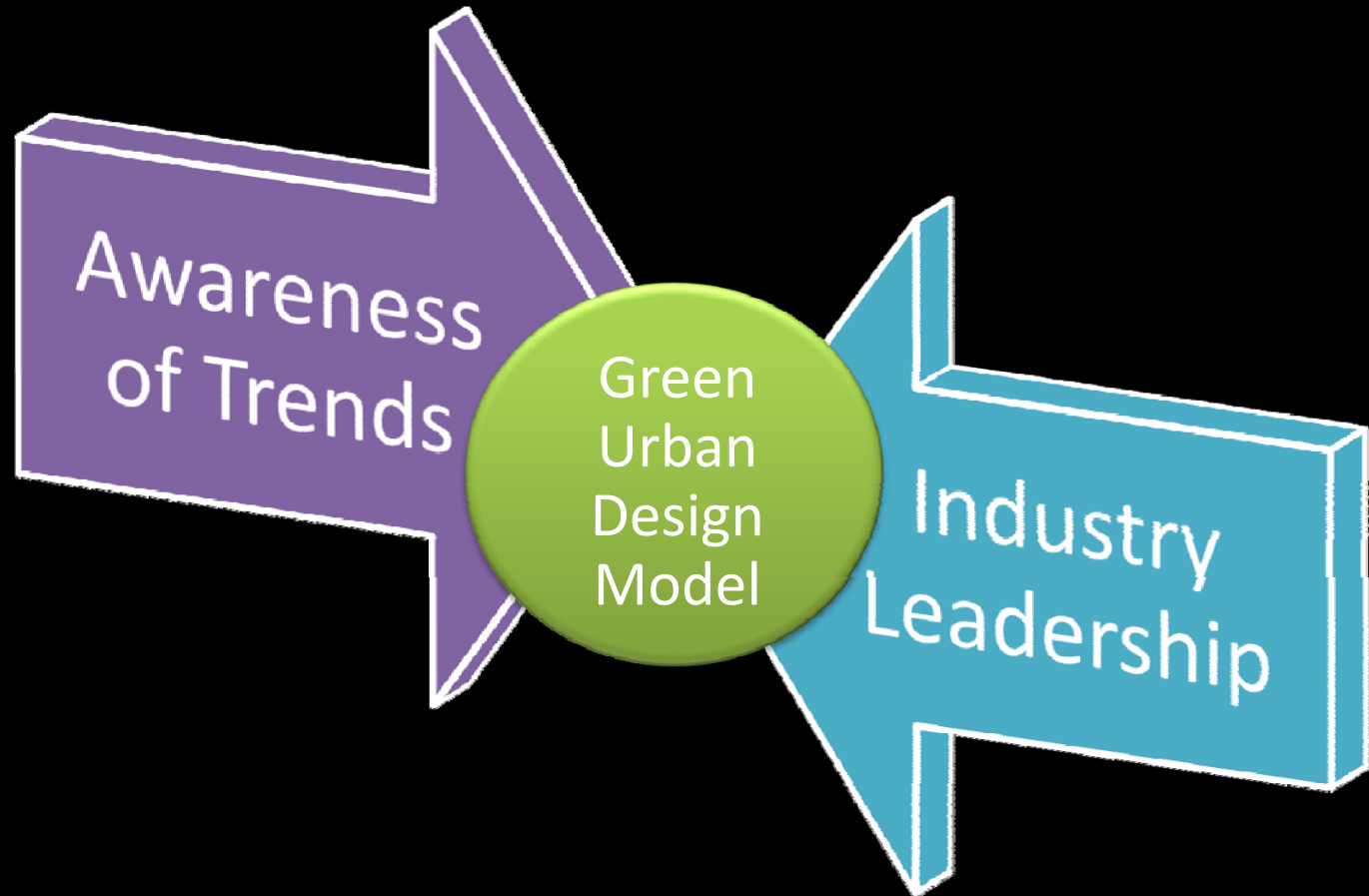
Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results



Breadth 1

Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results

Daylighting a Typical Interior Space



(a)



(b)

Comparison of Office Space with traditional Fluorescent lighting (a) and daylighting (b).

Breadth 1

Project
Overview

Daylighting Analysis:

Industry
Research

LEED EQ 8.1 → Solar light for 75% of regularly occupied spaces

Breadth 1

Breadth 2

Results

$$\text{Glazing Factor} = \frac{\text{Window Area [SF]}}{\text{Floor Area [SF]}} \times \text{Window Geometry Factor} \times \frac{\text{Actual } T_{\text{vis}}}{\text{Minimum } T_{\text{vis}}} \times \text{Window Height Factor}$$

Breadth 1

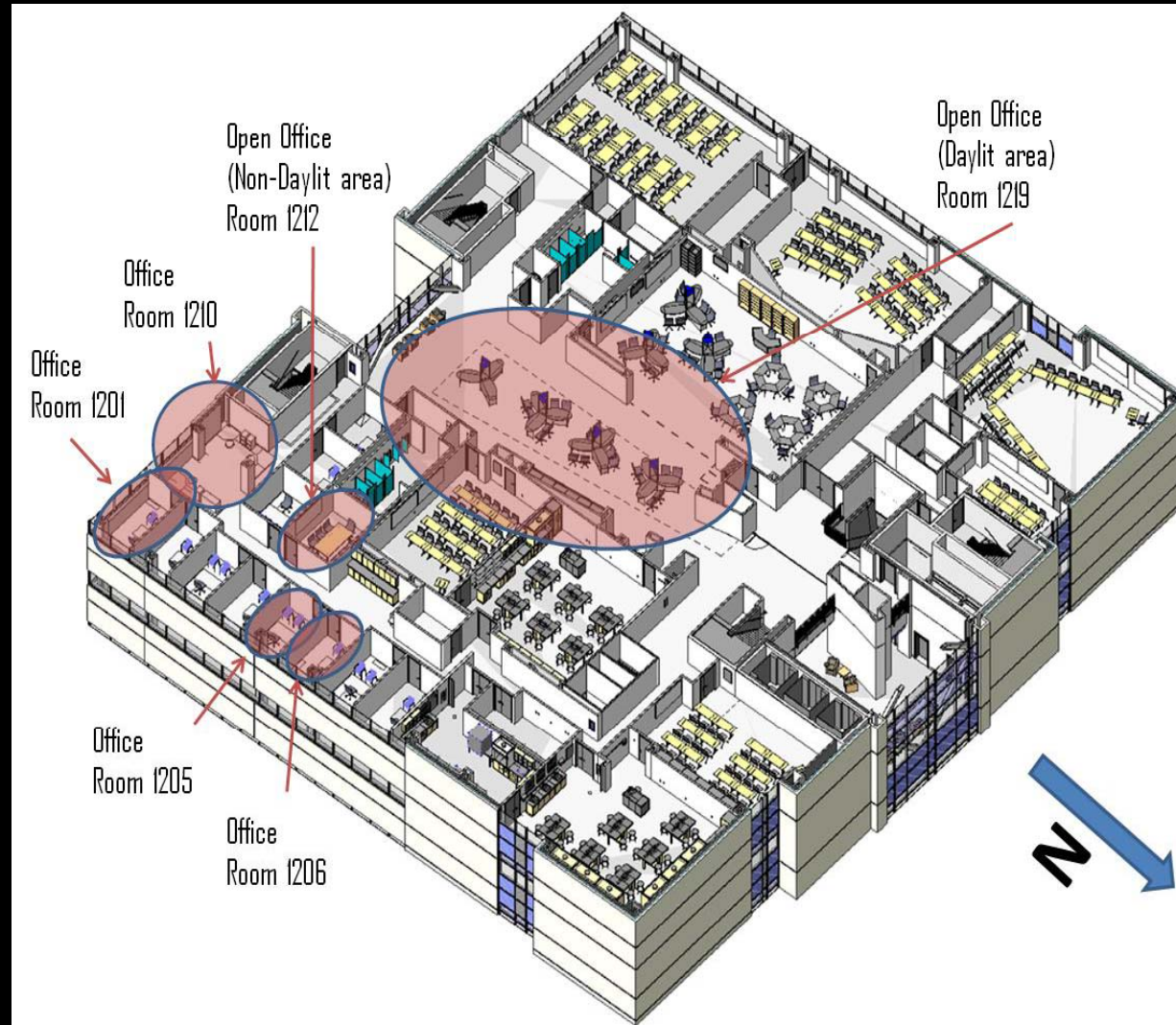
Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results



Breadth 1

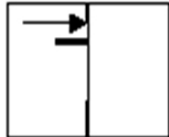
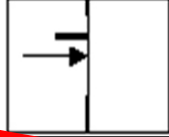
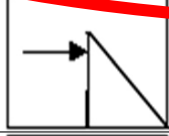

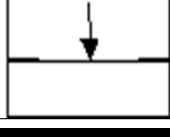
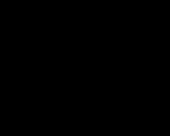
Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results

Window Type		Geometry Factor	Minimum T_{vis}	Height Factor	Best Practice Glare Control Methods
Sidelight, daylight glazing		0.1	0.7	1.4	Adjustable blinds Interior light shelves Fixed translucent exterior shading devices
Sidelight, vision glazing		0.1	0.4	0.8	Adjustable blinds Exterior shading devices
Top lighting, vertical monitor		0.2	0.4	1.0	Adjustable exterior blinds
Top lighting, saw tooth monitor		0.33	0.4	1.0	Exterior louvers
Top lighting, horizontal skylights		0.5	0.4	1.0	Interior fins Exterior fins Louvers

Breadth 1

Project Overview

Industry Research

Breadth 1

Breadth 2

Results

Regularly Occupied Space ID	Regularly Occupied Space Name	Regularly Occupied Space Area (SF)	Sidelighting Vision Glazing		Sidelighting Daylight Glazing		Toplighting Sawtooth Monitor		Toplighting Vertical Monitor		Toplighting Horizontal Skylight		Glazing Factor
			Area (SF)	Tvis	Area (SF)	Tvis	Area (SF)	Tvis	Area (SF)	Tvis	Area (SF)	Tvis	
1201	Office	215	148	0.9	74	0.7	0	N/A	0	N/A	0	N/A	2.7
1205	Office	215	68	0.9	32	0.7	0	N/A	0	N/A	0	N/A	3.9
1206	Office	215	68	0.9	32	0.7	0	N/A	0	N/A	0	N/A	3.9
1210	Open Office (Daylit Area)	566	80	0.9	13	0.7	0	N/A	0	N/A	0	N/A	2.8
1212	Office (NonDaylit Area)	215	0	0.9	0	0.7	0	N/A	0	N/A	0	N/A	0
1219	Open Office	2,678	224	0.9	56	0.7	0	N/A	0	N/A	0	N/A	2.0

Total Regularly Occupied Space Area (SF)	Total Regularly Occupied Space Area with a Minimum 2% Glazing Factor	Percentage of Regularly Occupied Space with a 2% Glazing Factor
4,104	3,889	95%



Glazing Factor Tabulation Spreadsheet

Breadth 1

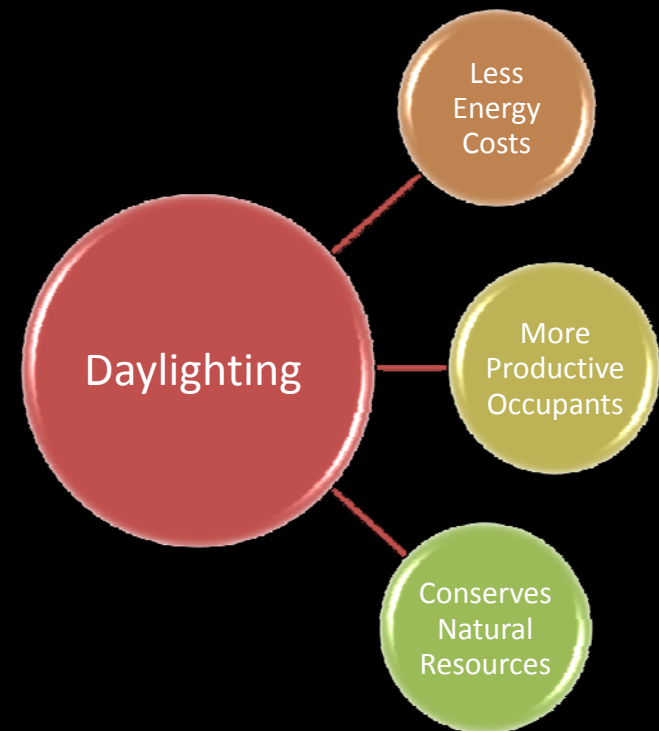
Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results



Breadth 2

Project
Overview

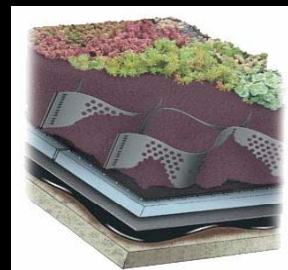
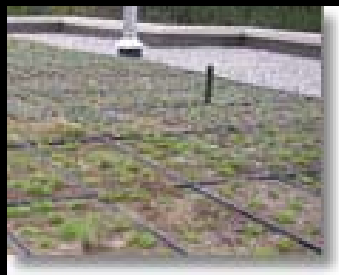
Industry
Research

Breadth 1

Breadth 2

Results

Green Roof Implementation: GreenGrid Extensive System



- Features:
- Lightweight
 - Modular
 - Low maintenance
 - Reduces storm water runoff
 - Helps to mitigate the urban heat island



Breadth 2

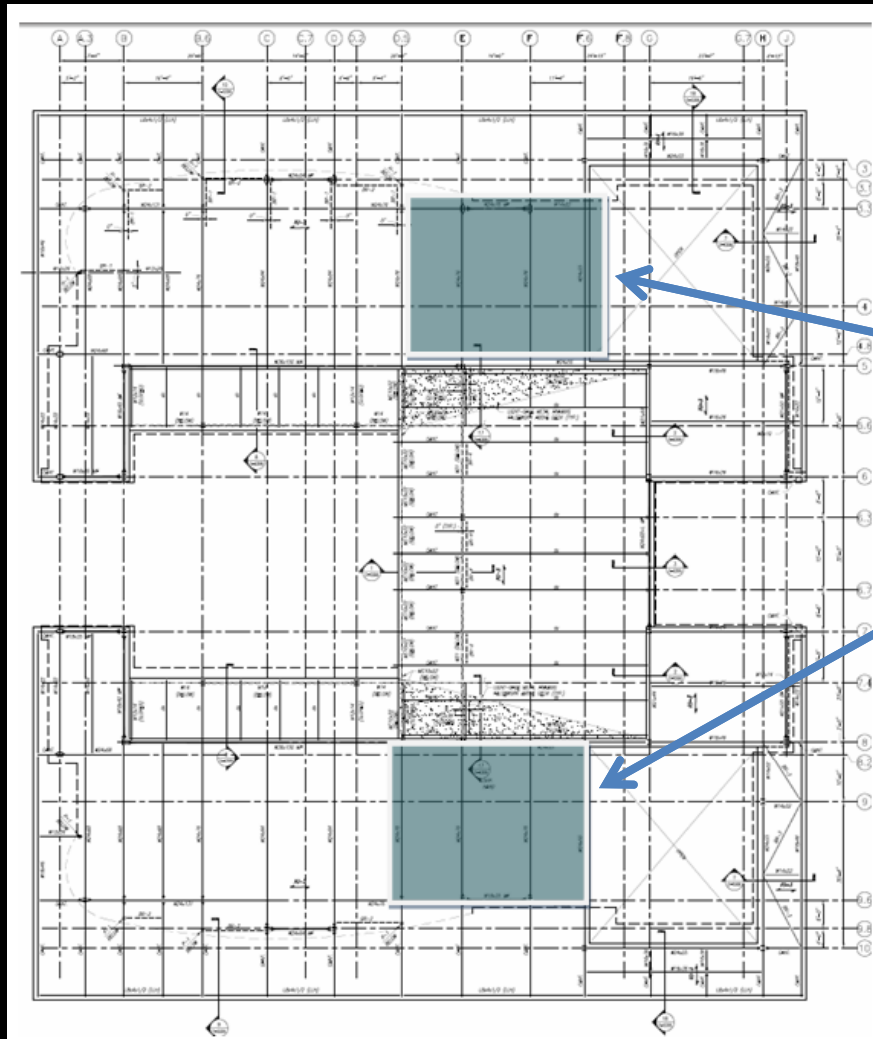
Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results



Green Roof
Placement

Breadth 2

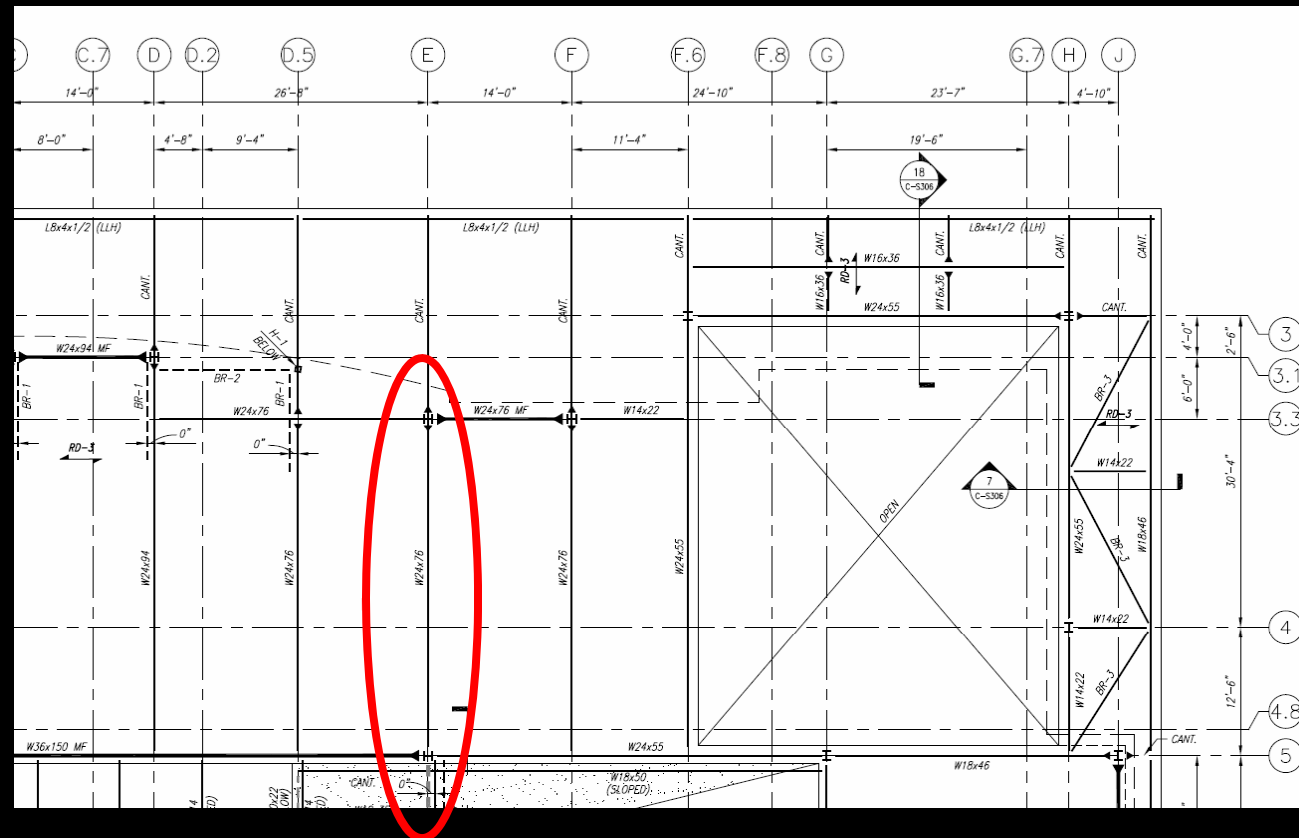
Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results



Breadth 2

Project
Overview

Structural Analysis:

Calculated new loading conditions with added green roof

Industry
Research

Breadth 1

- ✓ Fixed-Pinned W24x76
- ✓ Uniformly distributed load
- ✓ 2-span
- ✓ Tributary width = 13'-4"
- ✓ Length of beam = 42'-10"
- ✓ Total uniform factored load = 167psf

Breadth 2

Results



Breadth 2

Project
Overview



Industry
Research

With GreenGrid modular roofing system
addition, deck would would change from

Breadth 1

Vulcraft 3N20 to 3N16

Breadth 2

and beam from

Results

W24X76 to W24X84

Results

Project
Overview

Credits for Which the Harrisburg University Qualifies Under the LEED Rating System

Industry
Research

Breadth 1

Breadth 2

Results

SS 2	SS 4.1	SS 7.2	EQ 8.1	ID 2
<ul style="list-style-type: none">• Development Density and Community Connectivity	<ul style="list-style-type: none">• Alternative Transportation, Public Transportation Access	<ul style="list-style-type: none">• Heat Island Effect, Roof	<ul style="list-style-type: none">• Daylight & Views, Daylight for 75% of Spaces	<ul style="list-style-type: none">• LEED Accredited Professional

Results

Project
Overview

Industry
Research

Breadth 1

Breadth 2

Results

Focusing on LEED Criteria

-Recommend

Daylighting

-Recommend

Green Roof

-Not Recommend

Acknowledgements

The AE Department

Especially

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Questions?

