

Geisinger Gray's Woods  
Ambulatory Care Campus Phase I



Erica L. Craig  
Construction Management - Dr. Riley

The Pennsylvania State University

# Geisinger Gray's Woods Ambulatory Care Campus Phase I

## Introduction

Project Overview

Green Roof Design

- Existing Conditions

- Critique & Proposal

- Architectural Impacts

- Mechanical Impacts

- Conclusion & Recommendation

Floor Sub System

- Structural Impact

Approvals & Permitting

- Project Conditions

- Critique

- Permitting History

- Industry Survey

- Conclusion & Recommendation

Final Remarks



**Enhance Quality for the Owner Through a Balance of  
Constructability, Budgeting, and Development**



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### Building Size:

64,350 SF

### Construction Costs:

\$15 Million

### Construction Dates:

April 07' – June 08'

## Building Functions

70 Exam Rooms, 16 Procedure Rooms, Imaging Center, Laboratory Services,  
On-Site Pharmacy

Multi-Specialty Out Patient Services:  
OBGYN Practice, Pediatrics, Family Medicine

Specialty Services:  
ENT, Cardiology, Urology, Ophthalmology



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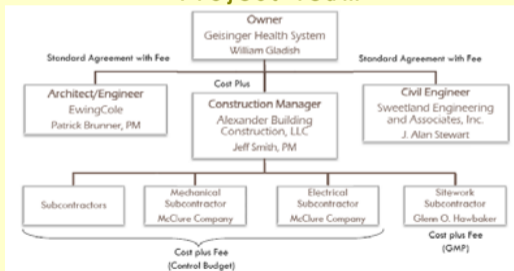
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## Project Team





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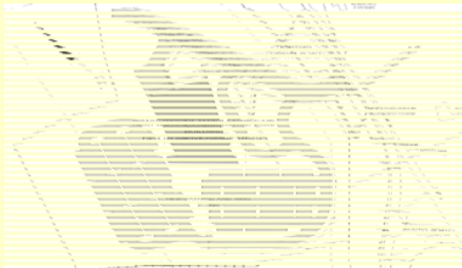
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52 Acre Lot  
Off I-99 Interchange

### Project Site Plan





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### Structural System

CIP Concrete Pier Foundations

ASTM Structural Steel Framing

Concrete Slab on Composite Metal Decking



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### Electrical System

2500A, 480/277 Volt Service

250 kW, Diesel-Driven Emergency  
Generator

T8 Lamps, Compact Fluorescent,  
Occupancy Sensors

### Mechanical System

400-Ton Cooling Tower

Water-Cooled 250-Ton Electric Chiller

Three 19,000 CFM Modular Rooftop Air-Handling Units

Gas Hot Water Boiler



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### Building Envelope

Aluminum Curtain Wall System on Metal Studs

Brick Masonry and EIFS on CMU and CIP Concrete Walls

Metal Roofing System and Skylights on Metal Studs





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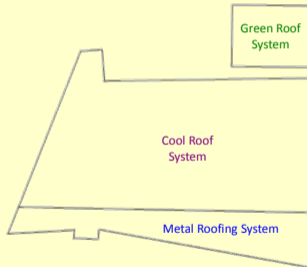
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### Roofing Systems

Aluminum Metal Roof System with Skylights on Front Sloped Roof

Cool Roof on Main Flat Roof

Green Roof on Separate Chiller/Boiler Room

Systems used primarily to obtain LEED Credits for heat island effect as well as aesthetics and to reduce the buildings heat gain.



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### Green Roof

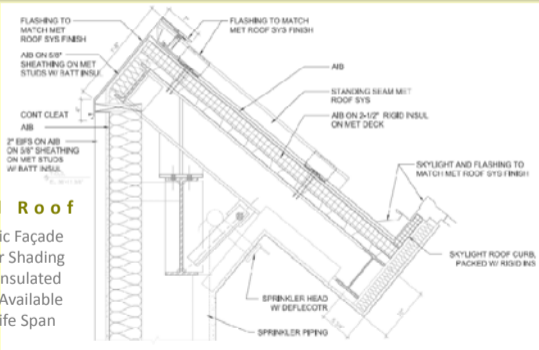
Storm Water Management  
Views from Future Parking Garage  
Highly Insulated  
Extensive System  
Reduce Heat Island Effect  
Long Life Span

### Cool Roof

Reduce Heat Island Effect  
Highly Insulated  
Long Life Span  
Easy Installation

### Metal Roof

Dramatic Façade  
Summer Shading  
Highly Insulated  
Locally Available  
Long Life Span



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Construction Management



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### Design Critique

Green Roof Hidden  
Behind Building

Thermal Benefits of  
Green Roof Lost

### Proposal

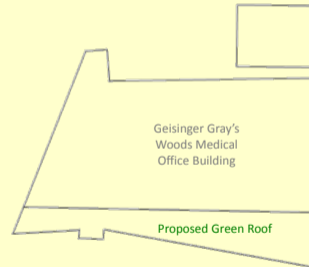
Relocate Green Roof to Sloped Roof:

Various Green Roof Systems

Rendering

Building Section

Thermal Heat Gain Calculations





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## Proposed Green Roof Rendering





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## Xero Flor Green Roof System

Lightweight Extensive System

Drought Resistant & Low Profile  
Plants

Textile Carrier Design

Pre-Vegetate Mat Design

Low Maintenance

## Proposed Green Roof



XF301 Sedum Mat (1 1/2")  
 XF159 Water Retention Fleece (1/2")  
 XF108H Drainage Layer (1/2")  
(not shown: XF112 Root Barrier 20mil LDP)



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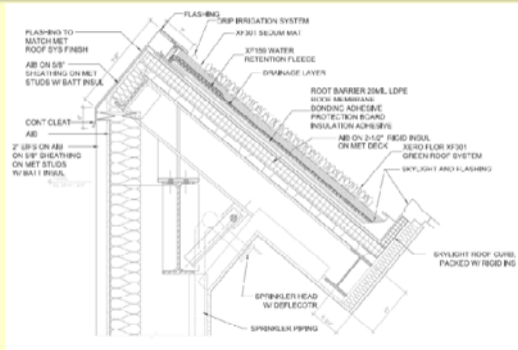
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## Xero Flor Green Roof System





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## American Hydrotech Green Roof System

Lightweight and Low Profile  
Extensive System

Low Maintenance

Gardnet Soil Stabilization

Plants Include Sedum, Herbs, &  
Grasses

## Proposed Green Roof



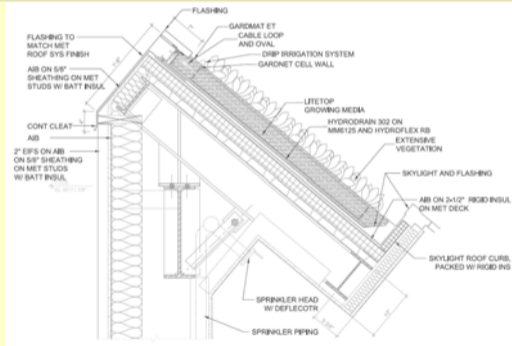
“EXTENSIVE” VEGETATION
UTETOP® GROWING MEDIA
SYSTEMFILTER
GARDENDRAIN™ GR15 OR GR30
MOISTURE MAT (OPTIONAL)
HYDRODRAIN® (OPTIONAL)
STYROFOAM®
ROOT STOP
HYDROFLEX®
MONOLITHIC MEMBRANE G125®EVFR
SURFACE CONDITIONER
SUBSTRATE



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## American Hydrotech Green Roof System







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Portion of Cooling Load on Equipment

Roof Area Only :  
5015 SF

Design Temperature Change :  
20° F

### Thermal Resistance

R-Value of Varying Roofing Systems

	Metal Roof Current Design	Xero Flor Roof	Hydrotech Roof
R-Value	21.83	23.48	23.34
Difference from Current Design		-1.65	-1.51

Heat Flow Rate Calculations

$$\text{Heat Flow Rate} = \frac{\text{Area of Roof} \times \text{Design Temperature Change}}{\text{R-value of Roof System}}$$



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Higher R-Value = Reduced Heat Gain

Green Roof Systems Provide About a  
7% Heat Gain Reduction

## Thermal Resistance

Cooling Load on Equipment

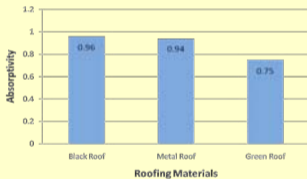
	<b>Metal Roof Current Design</b>	<b>Xero Flor Roof</b>	<b>Hydrotech Roof</b>
<b>Btu/Year</b>	543,191,351	505,019,898	508,049,152
<b>Difference from Current Design</b>		38,171,454	35,142,200



# Geisinger Gray's Woods Ambulatory Care Campus Phase I

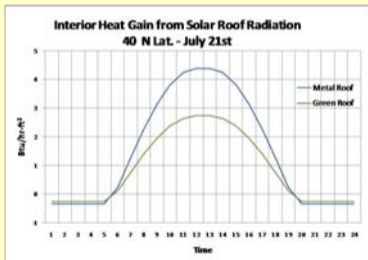
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### Absorptivity of Roof Materials



## Solar Radiation

### Interior Heat Gain

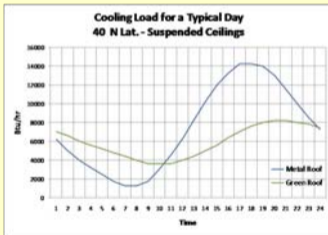




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Cooling Load for Typical Sunny Day



### Solar Radiation

Solar and Interior Heat Gain

$$\text{Cooling Load from Heat Gain} = \frac{\text{Area of Roof} \times \text{Cooling Load Temperature Difference (CLTD)}}{\text{R-value of Roof System}}$$

Cooling Load on Equipment

	<b>Total Btu/Day</b>	<b># of Sunny Days Per Year</b>	<b>Total Btu/Year</b>
<b>Metal Roof</b>	177,250	215	38,108,750
<b>Green Roof</b>	142,000	215	30,530,000



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### Thermal Resistance

	Metal Roof Current Design	Xero Flor Roof	Hydrotech Roof
Btu/Year	581,300,101	535,549,898	538,579,152

### Solar Radiation

	Total Btu/Day	# of Sunny Days Per Year	Total Btu/Year
Metal Roof	177,250	215	38,108,750
Green Roof	142,000	215	30,530,000

### Thermal Resistance and Solar Radiation

#### Total Cooling Load on Equipment

	Metal Roof Current Design	Xero Flor Roof	Hydrotech Roof
Btu/Year	581,300,101	535,549,898	538,579,152
Difference from Current Design		45,750,204	42,720,950



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### Initial Building Costs

Includes Standard Components

Other Components Added for Green  
Roof Systems

Includes Labor and Installation Costs

#### Current Roofing Systems

	Amount	Cost	Total
Green Roof - Boiler Room	3290 SF	25 \$/SF	82,250
+ Plants for Green Roof	3290 SF	5 \$/SF	16,450
Cool Roof - Flat Main Roof	24200 SF	10 \$/SF	242,000
Metal System	5105 SF	16 \$/SF	81,680
<b>PRICE</b>			<b>\$422,380</b>

#### Relocation of Green Roof - XeroFlor

	Amount	Cost	Total
Cool Roof - Boiler Room	3290 SF	10 \$/SF	32,900
Cool Roof - Flat Main Roof	24200 SF	10 \$/SF	242,000
Green Roof - Sloped	5105 SF	13 \$/SF	66,365
+ Shipping Costs	5105 SF	0.25 \$/SF	1,500
+ Roofing Membrane & Insulation	5105 SF	8 \$/SF	40,840
+ Tacking and Accessories	5105 SF	2 \$/SF	10,210
+ Irrigation			2,500
<b>PRICE</b>			<b>\$396,315</b>

#### Relocation of Green Roof - Hydrotech

	Amount	Cost	Total
Cool Roof - Boiler Room	3290 SF	10 \$/SF	32,900
Cool Roof - Flat Main Roof	24200 SF	10 \$/SF	242,000
Green Roof - Sloped	5105 SF	32 \$/SF	163,360
+ Irrigation			2,500
+ Plants for Green Roof	5105 SF	5 \$/SF	25,525
<b>PRICE</b>			<b>\$466,285</b>



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+ Plants for Green Roof	5105 SF	5 \$/SF	25,525
			<b>PRICE \$466,285</b>

### Initial Building Costs

	Current Roofing System	Relocation with Xero Flor	Relocation with Hydrotech
Initial Cost	\$422,400	\$396,300	\$466,300
Difference		-\$26,100	\$43,900

### Yearly Operating Costs

	Current Roofing	Relocation with Xero Flor	Relocation with Hydrotech
Yearly Operating Costs	\$15,680.00	\$14,530	\$14,480
Difference		-\$1,150	-\$1,200



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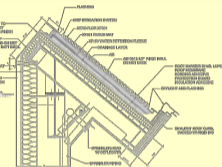
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### Aesthetics Play a Huge Part in Decision

Green Roofs Reduce Heat-Gain but  
Research Not Inclusive

Initial Cost Savings of Xero Flor

Yearly Utility Savings of Either Green Roof

Green Roof Training Time vs. Metal Roof  
Installation Time

Structural Implications

	Current Roofing System	Relocation with Xero Flor	Relocation with Hydrotech
Initial Cost	\$422,400	\$396,300	\$466,300
Difference		-\$26,100	\$43,900

	Current Roofing	Relocation with Xero Flor	Relocation with Hydrotech
Yearly Operating Costs	\$15,680.00	\$14,530	\$14,480
Difference		-\$1,150	-\$1,200

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Construction Management





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## Design Critique

Premium Cost of Lightweight Concrete

## Proposal

Current System

Lightweight Concrete on Composite Metal Decking

Normal Weight Concrete on Composite Metal Decking

Normal Weight Concrete on Form Decking and Joists

## Existing Conditions

Lightweight Concrete on Composite Metal Decking

(26) 30' x 30' bays





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### LW to NW Concrete

Normal Weight Concrete on  
Composite Metal Decking

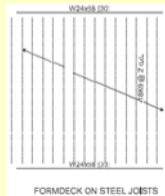
(26) 30' x 30' bays



### Composite to Form Decking

Normal Weight Concrete on Form  
Decking and Joists

(26) 30' x 30' bays



System	Cost	Difference
2" Decking with LW Concrete - <i>Current Design</i>	\$347,942	-
2" Decking with NW Concrete	\$382,481	\$34,539
9/16" Form Decking with NW Concrete	\$331,339	-\$16,604

**NW and Form Deck ONLY  
for Typical Bays**

**Negligible Schedule  
Changes for Structural  
System**

**Overhead MEP  
Installation and  
Coordination**



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### Geisinger Gray's Woods Conditions

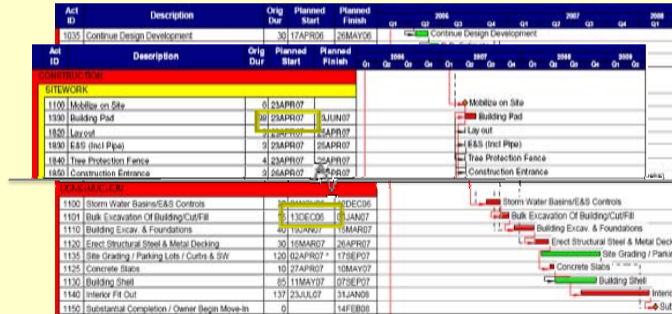
Delayed the Start of Construction  
Project

Involved with About Six Agencies

Entire Process Took Over a Year – 13  
Months

Schedule to Start December '06

Actual Start April '07





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### **Critique**

Time Delays

Owner Occupancy and  
Revenue Delayed

Causes Frustration and  
Aggravation for All

### **Proposal**

Continuing Education for Codes

Increase Number of Code Review  
Officials

Research of Other Permitting  
Processes



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### Services of ICC

- Education and Certification Programs
- Plan Reviews
- Magazines and Newsletters
- Training and Informational Videos
- Code Change Publications

## International Code Council

Founded in 1994

Develops Codes for Commercial  
and Residential Buildings

Combination of BOCA, ICBO, and  
SBCCI

Non-Profit Organization



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Name	Position	Municipality, Company
Michael Rupert	Senior Building Inspector	Centre Region Code Administration
Donald Fure	Code Enforcement Officer	Swatara Township
Ned Liggett	Commercial Plan Examiner	Centre Region Code Administration
Rod Sney	Manager	Bureau Veritas
Albert Wrightstone	Building Inspector	Susquehanna Township
Dan Slatt	Building Inspector	Lower Paxton Township

### Permitting in Central Pennsylvania

Handled by the Municipality in  
which the Project is Located

#### Two Approaches:

In Office Reviews

Third Party Reviews



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**In-Office Reviews**

Used by Regions: 1 Plan Reviewer/554 SM

On All Projects: Of Any Size

Used in Rural Areas

30 Day Time Limit for Approvals

Easily Navigated Website with  
Documentation

On-Site Meetings and Inspections

**Third Party Reviews**

Used by Small Municipalities: 1 Plan Reviewer  
/9 SM

On Large Projects: (> 5,500 SF)

Smaller Projects Reviewed In-Office

30 Day Time Limit for Approvals

Basic Website Design with Limited Information

On-Site Meetings and Inspections



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### Best Ways For Contractors and Design Professionals to Improve the Permitting Process

- Schedule a Preliminary Meeting with Region Office
- Communication Between All Parties Involved with Plans and Plan Review
- Properly Prepare Permitting Packages Prior to Submittal





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## Green Roof Design

Aesthetics Play a Huge Part in Decision

Initial Cost Savings of Xero Flor of  
\$26,000

Yearly Utility Savings of Either Green  
Roof of \$1,000

## Floor Sub System

NW and Form Deck ONLY for Typical Bays  
to Save \$16,000

Overhead MEP Installation and  
Coordination

## Approvals & Permitting

Preliminary Meeting Scheduled Early in  
Design Phase

Communication Key Between All Parties  
Involved

Prepare Complete Permitting Packages

Continuing Education on Codes



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### Special Thank You To:

Alexander Building Construction, LLC

EwingCole

Geisinger Health System

PSU AE Faculty

Family and Friends

Industry Members

## Questions & Comments

# Geisinger Gray's Woods Ambulatory Care Campus Phase I



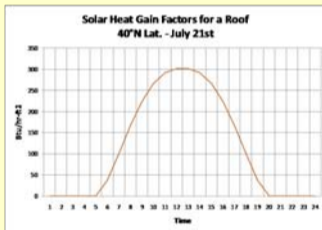


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## Solar Radiation



**Solar Radiation Calculations for Geisinger Gray's Woods - 40°N Latitude - July 21st - Roofs with Suspended Ceilings**

Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
WOR	0	0	0	0	0	32	88	145	194	231	254	262	262	254	231	194	145	88	32	0	0	0	0	0	
x 3.15	0.00	0.00	0.00	0.00	0.00	36.80	101.20	166.75	223.10	265.65	292.10	301.30	305.30	292.10	265.65	223.10	166.75	101.20	36.80	0.00	0.00	0.00	0.00	0.00	
Hour	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	
Metal Roof	-0.35	-0.35	-0.35	-0.35	-0.35	0.23	1.24	2.26	3.15	3.81	4.23	4.37	4.37	4.23	3.81	3.15	2.26	1.24	0.23	-0.35	-0.35	-0.35	-0.35	-0.35	
Green Roof	-0.28	-0.28	-0.28	-0.28	-0.28	0.09	0.73	1.39	1.95	2.36	2.64	2.73	2.73	2.64	2.36	1.95	1.39	0.73	0.09	-0.28	-0.28	-0.28	-0.28	-0.28	
CLTD																									
Metal Roof	25	20	16	13	10	7	5	5	7	12	18	25	33	41	48	53	57	57	56	53	46	40	34	29	
Green Roof	35	33	30	28	26	24	22	20	18	18	18	20	22	25	28	32	35	38	40	41	41	40	39	37	
Cooling Load																									
Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Metal Roof	6250	3000	4000	3250	2100	1750	1250	1750	3000	4500	6250	8250	10250	12000	13250	14250	14000	13000	11000	10000	8000	6000	4000	2250	
Green Roof	7000	6400	6000	5600	5200	4800	4400	4000	3600	3400	3600	4000	4400	5000	5600	6400	7000	7400	8000	8300	8300	8000	7600	7400	
Total Btu/Day																									
Number of Sunny Days																									
Per Year																									
Total Btu/Year																									
Cost/Year																									
Metal																									
Green																									

Metal Roof Thermal Calculations					Hydrotech Green Roof					Kera-Floor Green Roof					
Design Temp Change	20 °F				Design Temp Change	20 °F				Design Temp Change	20 °F				
Area of Roof	5025 SF				Area of Roof	5025 SF				Area of Roof	5025 SF				
Material	Thickness	Thermal Conductance	Thermal Resistance	Temperature Change	Material	Thickness	Thermal Conductance	Thermal Resistance	Temperature Change	Material	Thickness	Thermal Conductance	Thermal Resistance	Temperature Change	
	inches	Btu/hr-ft²/°F	ft²/hr-ft²/°F	Δ		inches	Btu/hr-ft²/°F	ft²/hr-ft²/°F	Δ		inches	Btu/hr-ft²/°F	ft²/hr-ft²/°F	Δ	
Inside Air Film	-	1.64	0.61	0.56	Inside Air Film	-	1.64	0.61	0.52	Inside Air Film	-	1.64	0.61	0.52	
Gypsum Wallboard	0.50	2.22	0.45	0.41	Gypsum Wallboard	0.50	2.22	0.45	0.20	Gypsum Wallboard	0.50	2.22	0.45	0.20	
Air Space	6.00	-	1.00	0.92	Air Space	6.00	-	1.00	0.86	Air Space	6.00	-	1.00	0.86	
Metal Decking	1.00	-	0.00	0.00	Metal Decking	1.00	-	0.00	0.00	Metal Decking	1.00	-	0.00	0.00	
Rigid Insulation	2.50	0.07	15.00	14.02	Rigid Insulation	2.50	0.07	15.00	13.11	Rigid Insulation	2.50	0.07	15.00	11.00	
AS	1.00	0.23	4.30	3.94	Acoustical Board	1.00	0.23	4.30	3.68	Acoustical Board	1.00	0.23	4.30	3.26	
Metal Roof	0.04	-	0.00	0.00	HydroFlex 30	0.09	16.67	0.06	0.05	Drainage Layer	0.50	2.02	0.45	0.39	
Outside Air Film	-	5.88	0.17	0.16	HydroDrain 300	0.22	2.22	0.45	0.39	Water Retention Pledge	0.50	2.02	0.45	0.39	
Total			0.05	21.83	20.00	Use/Top Soil	1.00	1.00	0.86	Sedum Mat	1.50	1.00	1.00	0.85	
					Outside Air Film	-	5.88	0.17	0.15	Outside Air Film	-	5.88	0.17	0.14	
					Total			0.24	20.34	20.00			0.04	20.48	20.00
Heat Flow Rate	4,334.10 Btu/hr				Heat Flow Rate	4,297.34(310) Btu/hr				Heat Flow Rate	4,275.70 Btu/hr				
Degree Days	4926				Degree Days	4926				Degree Days	4926				
	164,191,261.25 Btu/Year					163,840,912.7 Btu/Year					163,535,897.79 Btu/Year				
	\$12,957.63 kWh/Year					\$12,434.75 kWh/Year					\$12,308.37 kWh/Year				
	\$0.29 /kWh					\$0.29 /kWh					\$0.29 /kWh				
Cost for Entire Year	\$14,966.17 /Year				Cost for Entire Year	\$13,751.33 /Year				Cost for Entire Year	\$13,435.54 /Year				



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## Structural Impacts

<b>CURRENT DESIGN</b>	Size
LW Concrete	3.5"
Concrete Placing	< 6" thick
Steel Decking	2" LOK
Steel Beams	W 16x26     3
Steel Girders	W24x55     1
Steel Columns	W10x68     2
Fireproofing	

<b>NW CONCRETE</b>	Size
NW Concrete	4.5"
Concrete Placing	< 6" thick
Steel Decking	2" LOK
Steel Beams	W14x22     4
Steel Girders	W24x68     1
Steel Columns	W10x88     2
Fireproofing	

<b>FORMDECK</b>	Size
NW Concrete	3"
Concrete Placing	< 6" thick
Steel Decking	9/6" FD
Steel Joists	18K9     10
Steel Girders	W24x76     1
Steel Columns	W10x88     2
Steel Dunnage	
Fireproofing	



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## Design Review Program



## Case Study: Department of Planning and Development (DPD)

- Located in Seattle, Washington
- No Financial Compensation for Members
- 35 Members, 5 for each of the Seven Districts
- Easy to Navigate Website with Documentation Available
- Meet Two Times a Month
- Design Review Process Designed to Open Lines of Communication, be Flexible, and Encourage Great Design
- Perform On-Site Inspections and Approves Land and Construction Related Permits