Student Life Building

Northampton Community College

Kendall Slivka
Construction Management
Advisor: Robert Leicht

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

General Building Data	
Location	Rt 715 & Railroad Drive Pocono Township, Monroe County, PA
Occupant	Northampton Community College
Function	Gymnasium, Fitness Center, Cafeteria, Conference Rooms
Size	68,000 SF
Number of Stories	One Story with Basement
Dates of Construction	January 2012- January 2014
Project Delivery Method	Design-Bid-Build
Cost	$18 Million
LEED certification	Silver

DEI
D'HUY Engineering, Inc.
A TRADITION OF EXCELLENCE

MK SD
architects

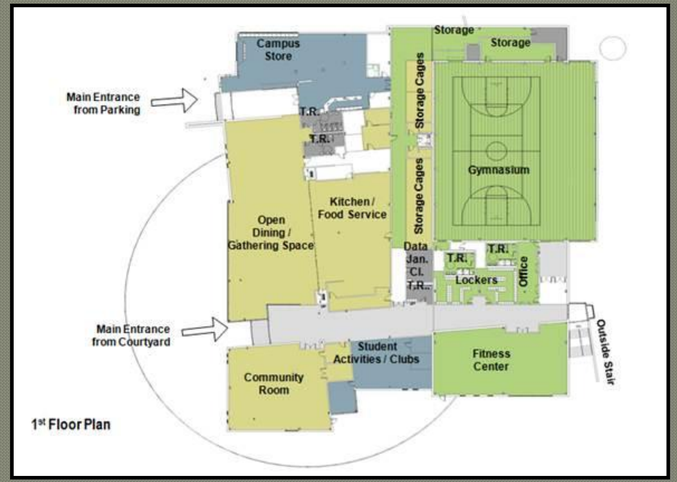
Pennoni
PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

Northampton
Community College

"We believe that learning thrives when there is a sense of curiosity and excitement about the world in which we live. As such, we value:
Excellence, Innovation, Sustainability, Accountability, Integrity, and Engagement."



Student Life Building

Northampton Community College

Introduction

Project Overview

Braced Frame Analysis

Fire Suppression Analysis

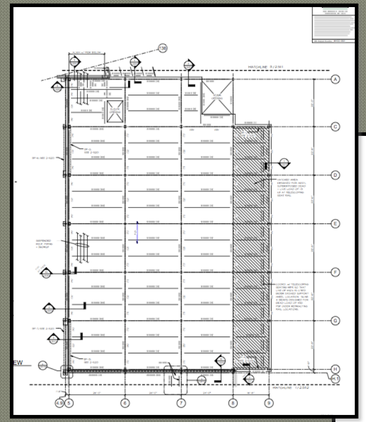
Roofing Analysis

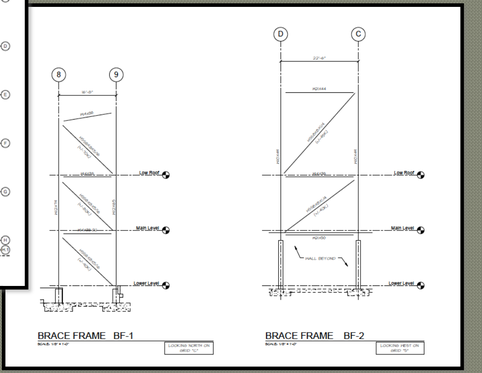
Project Delivery Study

Final Recomendations

Acknowledgments

- Braced Frame Analysis
  Structural Breadth
- Fire Suppression System
  Mechanical Breadth
- Roofing Membrane Analysis
- Project Delivery Research





Student Life Building

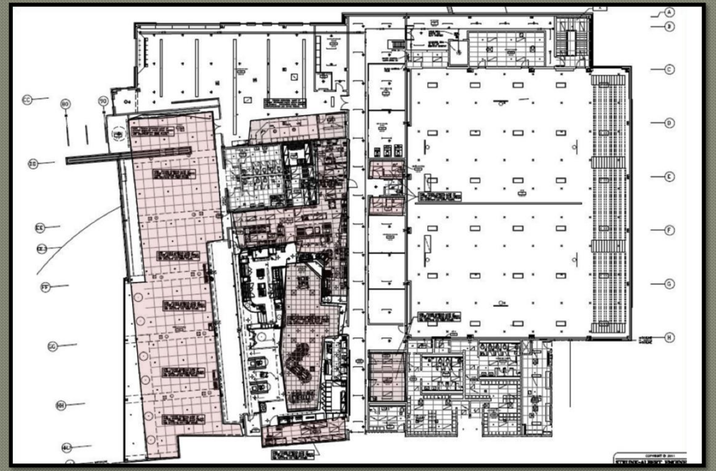
Northampton Community College

Introduction

Project Overview

Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

- Braced Frame Analysis
  Structural Breadth
- Fire Suppression System
  Mechanical Breadth
- Roofing Membrane Analysis
- Project Delivery Research



Student Life Building
Northampton Community College

Introduction

Project Overview

Braced Frame Analysis

Fire Suppression Analysis

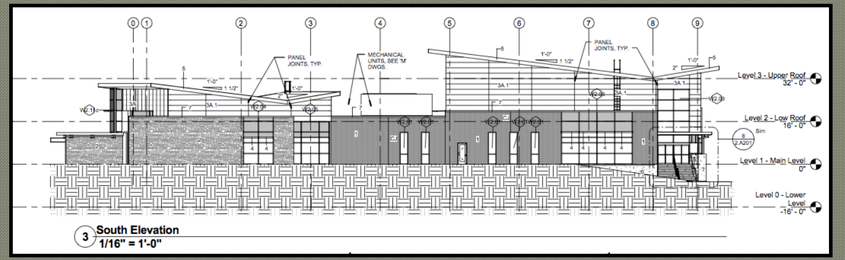
Roofing Analysis

Project Delivery Study

Final Recomendations

Acknowledgments

- Braced Frame Analysis
  - Structural Breadth
- Fire Suppression System
  - Mechanical Breadth
- Roofing Membrane Analysis
- Project Delivery Research



Student Life Building

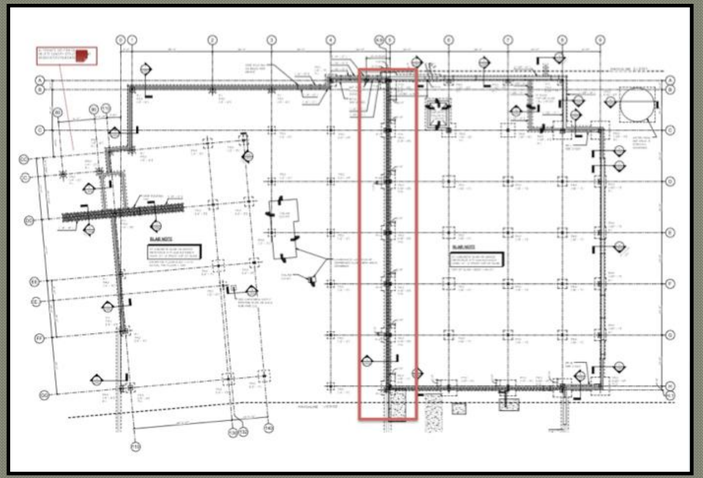
Northampton Community College

Introduction

Project Overview

Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

- Braced Frame Analysis
  Structural Breadth
- Fire Suppression System
  Mechanical Breadth
- Roofing Membrane Analysis
- Project Delivery Research

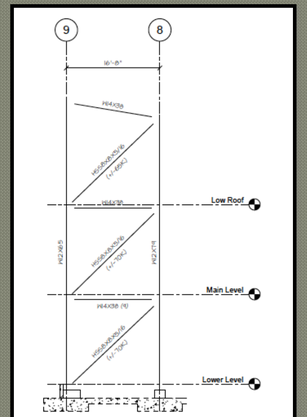


Student Life Building
Northampton Community College

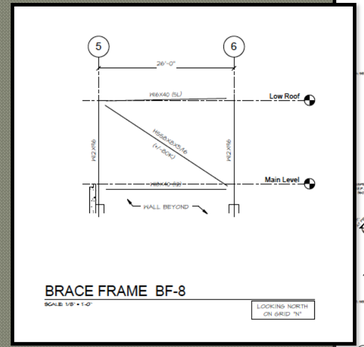
Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

Problem Statement: Braced walls interfere with building expansion and curtain walls.

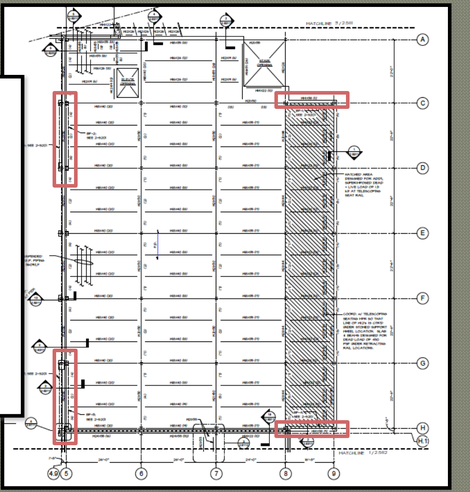
Research Goal: Resize columns to withstand load, and compare costs of each alternative.



BRACE FRAME BF-4
SCALE: 1/8" = 1'-0"
LOOKING SOUTH ON GRID "H"



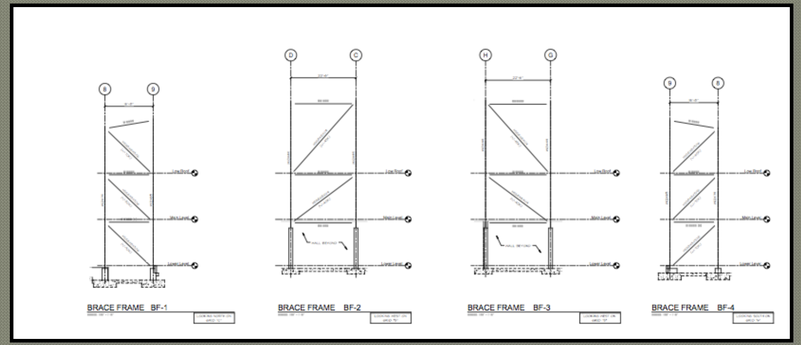
BRACE FRAME BF-8
SCALE: 1/8" = 1'-0"
LOOKING NORTH ON GRID "N"



Student Life Building
Northampton Community College

Current System Estimate:

Frame	Location	Size	Length	Unit Weight (lb/ft)	Total Weight (tons)
BF 1	8 and 9	W14X38	16.6	38	0.3154
		HSS8X8X5/16	21.5	31.84	0.34228
		W14X38	16.67	38	0.31673
		HSS8X8X5/16	21.5	31.84	0.34228
		W14X38	16.67	38	0.31673
		HSS8X8X5/16	21.5	31.84	0.34228
		W12X79	48	79	1.896
		W12X65	50.77	65	1.650025
BF 2	D and C	W24X55	22.5	44	0.495
		HSS8X8X1/4	32.3	25.82	0.416993
		W14X38	22.5	38	0.4275
		HSS8X8X1/4	26.4	25.82	0.340824
		W21X50	22.5	50	0.5625
		W10X49	57	49	1.3965
		W10X49	57	49	1.3965



System Estimate $84,000

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

FLOOR LOADS	
ITEM	VALUE (PSF)
FINISH	1
4 1/2" N.W. CONC. SLAB	42
MTL. DECK	3
FRAMING	6
MECH'L & MISC.	7
DEAD LOAD	59
LIVE LOAD	100
TOTAL	159

ROOF DESIGN LOADS	
DEAD LOAD	
ITEM	VALUE (PSF)
ROOFING	7
ROOF DECK	2
FRAMING	6
MECHANICAL & MISC.	7
FUTURE SOLAR PANELS	5
LIVE LOAD	
BASIC LIVE LOAD	20

SNOW DESIGN LOADS
ASCE 7-05

ITEM	SYMBOL	VALUE	REFERENCE
GROUND SNOW LOAD	P_g	40 PSF	FIGURE 7-1
SNOW EXPOSURE FACTOR	C_e	1.0	TABLE 7-2
SNOW LOAD IMPORTANCE FACTOR	I_s	1.1	TABLE 7-4
THERMAL FACTOR	C_t	1.0	TABLE 7-3
ROOF SNOW LOAD (*)	P_f	30.8 PSF	SECTION 7.3

Proposed System Estimate:

L = length K = .5

r_x, r_y from table 1.1 in Steel Manual

$$F_e = \frac{\pi^2 (29000)}{\left(\frac{.5(L)}{r_x \text{ or } r_y}\right)^2}$$

$$F_{cr} = .654^{\left(\frac{50}{F_e}\right)} \times 50$$

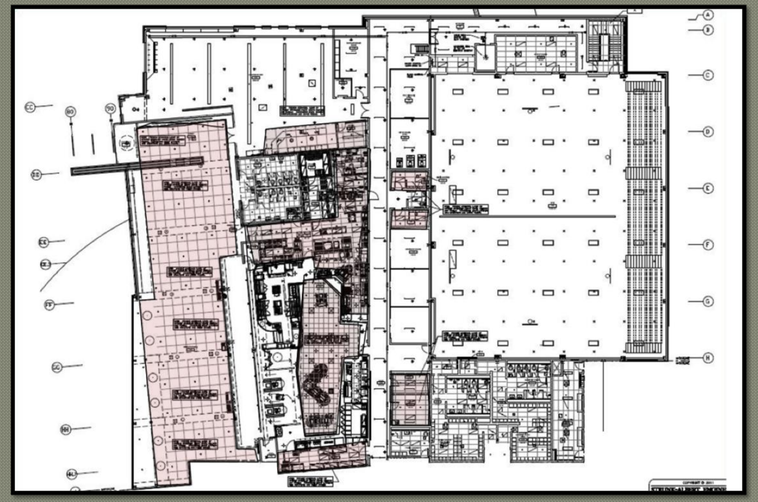
$$\phi P_n = F_{cr}(\phi)(\text{wt from 1.1})$$

System Estimate $94, 300

Column to use	Height	Total Weight (ton)
W12x72	51	0.0255
W12x72	49	0.0245
W12x72	51	0.0255
Total	151	
W12x87	49	0.0245
Total	49	
W12x120	17.5	0.00875
W12x120	17.5	0.00875
Total	35	
W10x60	44	0.022
W10x60	44	0.022
W10x60	44	0.022
W10x60	44	0.022
W10x60	17.5	0.00875
W10x60	17	0.0085
W10x60	17.17	0.008585
W10x60	17.17	0.008585
W10x60	17.17	0.008585
W10x60	17.17	0.008585
Total	279.18	

Student Life Building

Northampton Community College



Problem Statement: The system being used seems redundant and will be expensive.

Research Goal: Redesign the system so that only one layer of sprinkler heads is needed.

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

FIRST FLOOR DESIGN CRITERIA

NFPA 13 (2007) - Light Hazard
Sprinkler discharge density: .10 gpm/sq. ft.
Area of application: 1500 sq. ft.
Outside hose allowance: 100 GPM
Maximum Sprinkler Coverage: 225 sq. ft.

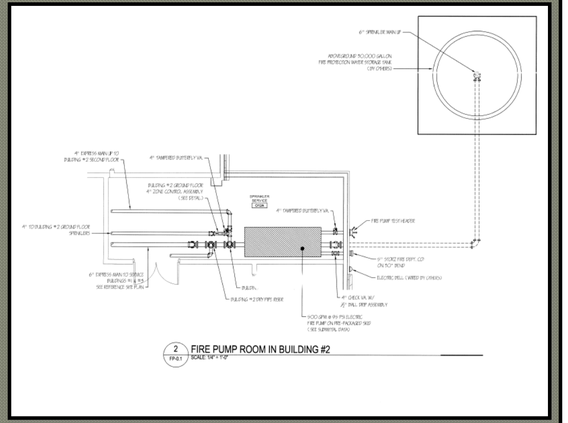
NFPA 13 (2007) - Ordinary Hazard Group 1
Sprinkler discharge density: .15 gpm/sq. ft.
Area of application: 1500 sq. ft.
Outside hose allowance: 250 GPM
Maximum Sprinkler Coverage: 130 sq. ft.

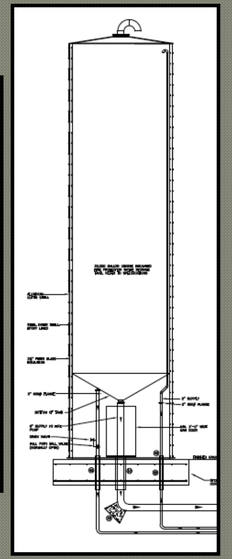
NFPA 13 (2007) - Ordinary Hazard Group 2
Sprinkler discharge density: .20 gpm/sq. ft.
Area of application: 1500 sq. ft.
Outside hose allowance: 250 GPM
Maximum Sprinkler Coverage: 130 sq. ft.

SECOND FLOOR DESIGN CRITERIA

NFPA 13 (2007) - Light Hazard
Sprinkler discharge density: .10 gpm/sq. ft.
Area of application: 1500 sq. ft.
Outside hose allowance: 100 GPM
Maximum Sprinkler Coverage: 225 sq. ft.

NFPA 13 (2007) - Ordinary Hazard Group 1
Sprinkler discharge density: .15 gpm/sq. ft.
Area of application: 1500 sq. ft.
Outside hose allowance: 250 GPM
Maximum Sprinkler Coverage: 130 sq. ft.





Student Life Building
Northampton Community College

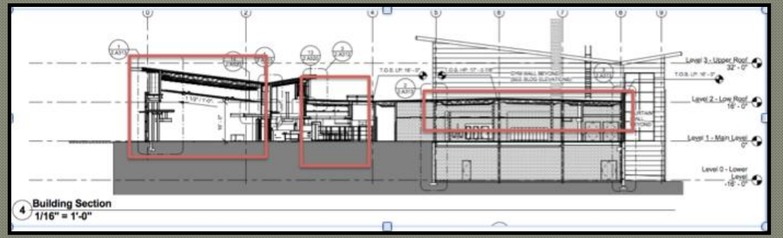
Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

Current System Estimate:

Pipe Diameter (in)	Length (ft)
1	1265.99
1.25	4815.21
2.25	584.83
3	586.68
4	395.4
6	96.58

Sprinkler Type	Basement	First Floor	Total
Upright	152	122	274
Sprigged Upright	43	151	194
Pendant Drop	2	172	174

System Total $239,500



Acoustic Ceiling				
Item Description	Takeoff Quantity	Unit	Unit Price	Total
Detailing	5000	S.F	2	$10,000.00
Acoustic Tiles 2X2	12100	S.F	2	$24,200.00
Acoustic Tiles 4X4	7200	S.F	2	$14,400.00
Suspended Grid 2X2	12100	S.F	3	$36,300.00
Suspended Grid 4X4	7200	S.F	3	$21,600.00
			Total	$106,500.00

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recommendations
Acknowledgments

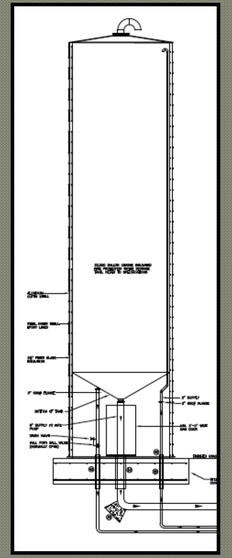
Proposed System:

- Wet System
- Code Requirements Remain Same
- Keep Water Storage Tank
- Paint Exposed Ceiling Space

Quantity	LineNumber	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Total	Ext. Total
19300	099123740880	Paints & Coatings, walls & ceilings, interior, concrete, drywall or plaster, zero voc latex, 2 coats, smooth finish, spray	1 Pord	1625	0.01	S.F.	$ 0.11	$ 0.18	$ 0.29	$ 5,597.00
1	099123740880	Paints & coatings, walls & ceilings, interior, zero voc latex, for work 8'-15' high, add		0	0	S.F.	$ -	$ 0.02	$ 0.02	$ 347.40
Total										$5944.40

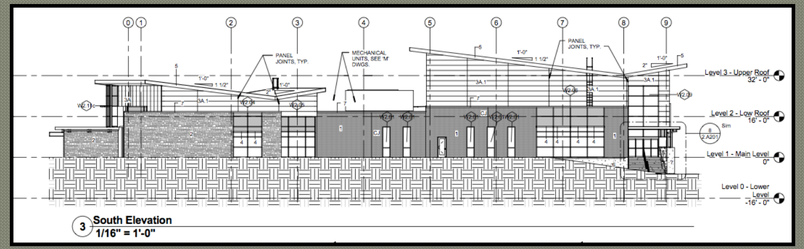
Sprinkler Type	Basement	First Floor	Total
Upright	152	122	274

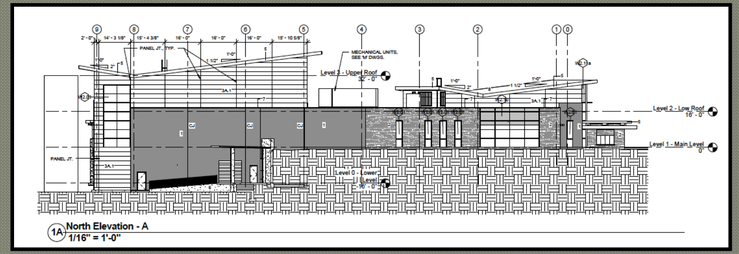
System Total $187,500



Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recommendations
Acknowledgments





Problem Statement: The single-ply TPO system may not be able to withstand the mixture of environmental factors and sloped angles.

Research Goal: Determine a new system that is proven to work, and will be economical.

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

Current System:

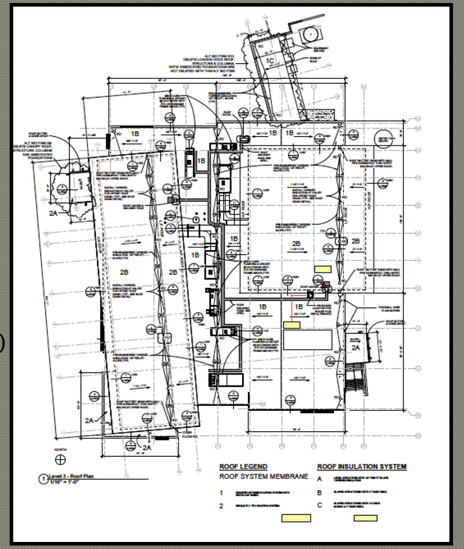
Single Ply TPO

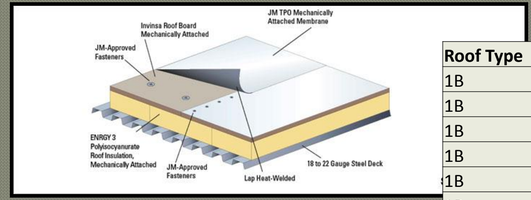
4'' insulation (2B)

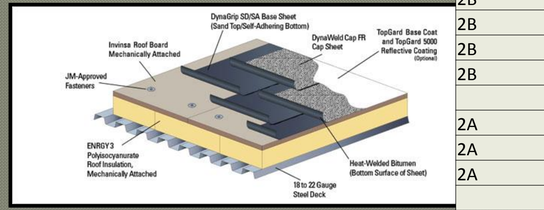
1½ '' insulation(2A)

Modified Bitumen

4'' insulation (1B)







Roof Type	Roof Section	Area (ft2)
1B	3	6190
1B	4	7467
1B	5	4926
1B	9	940
1B	10	920
1B	11	770
	SUM	21213
2B	1	11549.7
2B	2	4556.72
2B	6	3020.94
2B	7	10748.75
	SUM	29876.11
2A	8	501
2A	12	644
2A	13	440
	SUM	1585

System Estimate $246,800

Student Life Building
Northampton Community College

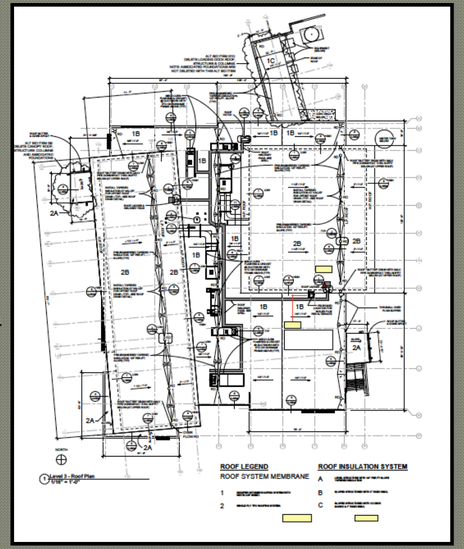
Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recomendations
Acknowledgments

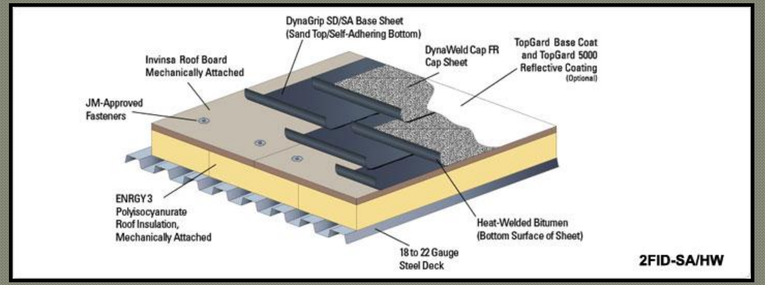
Proposed System:

Modified Bitumen

4” insulation

1 ½ ” insulation



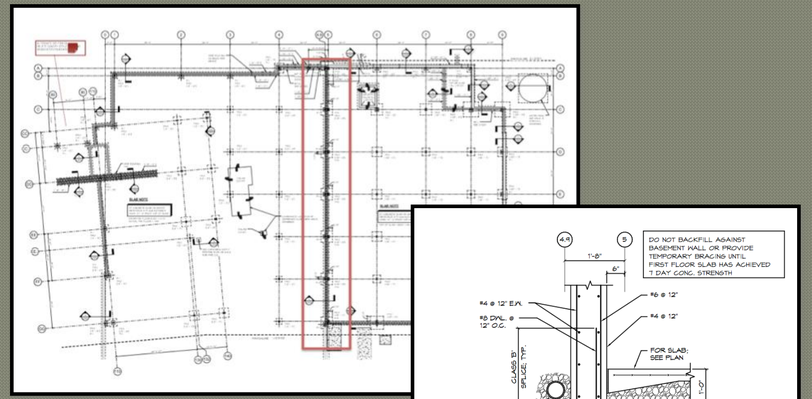


Quantity	LineNumber	Unit	Total	Ext. Total	Total O&P	Ext. Total O&P
52711	075216102000	S.F.	$ 2.61	$137,575.71	$ 3.74	$197,139.14
51126	072216101932	S.F.	$ 1.81	$ 92,538.06	$ 2.16	$ 110,432.16
Total				**$230113.77**		**$307,571.30**

System Estimate $307,570

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recommendations
Acknowledgments



Problem Statement: Constructability issues with retaining wall show a larger issue with the use of multiple prime contractors.

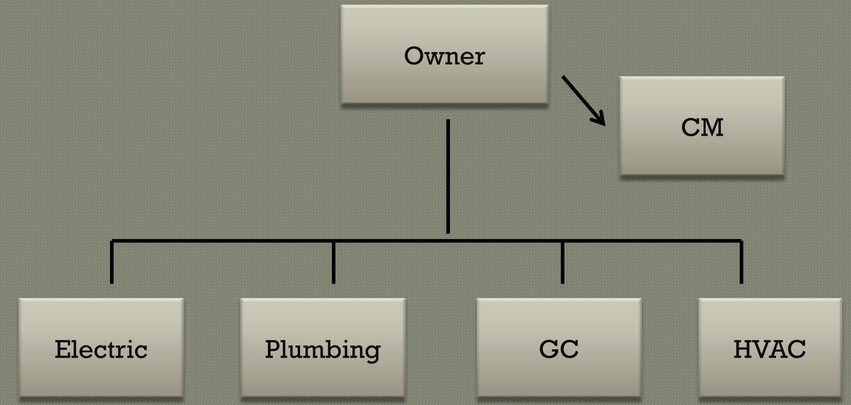
Research Goal: Study industry feelings toward multiple prime contracts to gauge what would be a better delivery method.

Student Life Building
Northampton Community College

Introduction
Project Overview
Braced Frame Analysis
Fire Suppression Analysis
Roofing Analysis
Project Delivery Study
Final Recommendations
Acknowledgments

Multiple Prime Contracts:

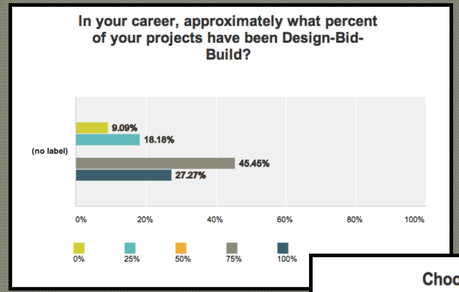
- Pennsylvania Separation Act 1913
- Projects > $4,000
- Separated between 4 trades
- Publically Bid
- Risk stays with owner

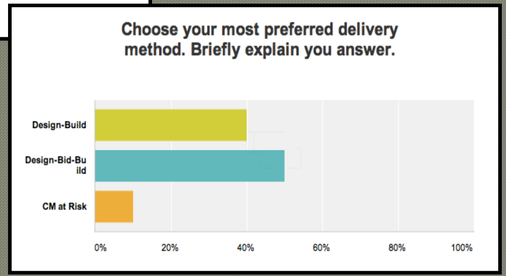


Student Life Building
Northampton Community College

Industry Survey:

- Most polled from Pa
- Majority CM, contractor
- Prefer design-bid-build
- Prefer GMP contract
- Most familiar with CM at risk/multiple prime





Student Life Building
Northampton Community College

Braced Frame Analysis

Fire Suppression Redesign

Roofing System Analysis

Delivery Method Study

Thank You

I'd like to thank everyone involved with my Thesis project;

- Team members at D'Huy Engineering, most especially Jim Hana and Joseph Herman. Thank you for taking the time to walk me through the site every chance you got, and thank you for your availability.
- Rob Leicht, thank you for always steering me in the right direction.
- Northampton Community College for allowing me to use their project
- All participants in the industry survey
- My structural option friends that helped with my structural systems
- My sisters for helping me concentrate and keeping me focused
- My family for always encouraging me.

Thank You