State College Area High School

State College, Pennsylvania

Bryce Burkentine

Penn State Architectural Engineering

Construction Management

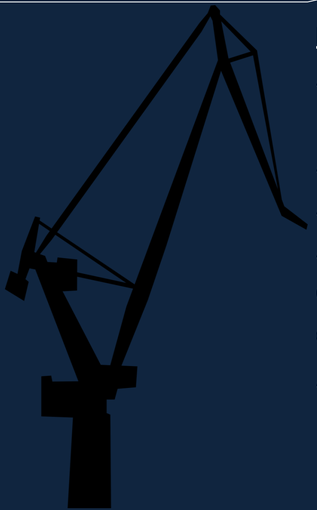
Advisor | Dr. Chimay Anumba

Spring 2016

Project Background

Bryce Burkentine
Construction Management Option

Presentation Outline



Building Name | State College Area High School

Location | State College, Pennsylvania

Project Size | 650,000 square feet

Contract Value | $115 Million Project Cap

Organizational Structure | CM Agency W/ Multiple Prime Contracts

Dates of Construction | October 2015 - Summer 2019

Massaro CM SERVICES, LLC PRESS RELEASE

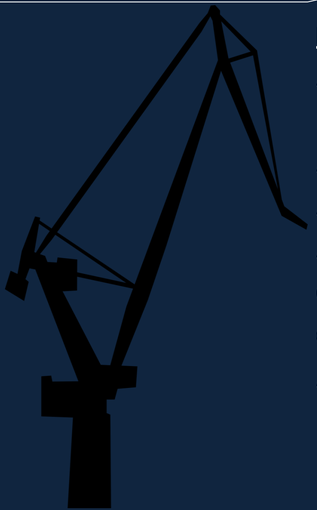
STATE COLLEGE AREA SCHOOL DISTRICT
We are the future!

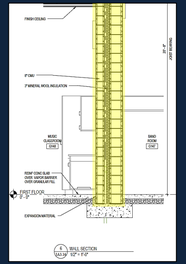
State College Area High School

Plan for the Unexpected

Bryce Burkentine
Construction Management Option

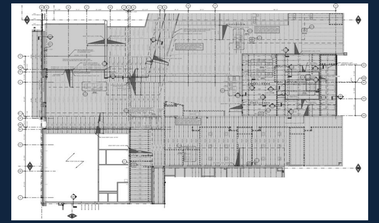
Presentation Outline



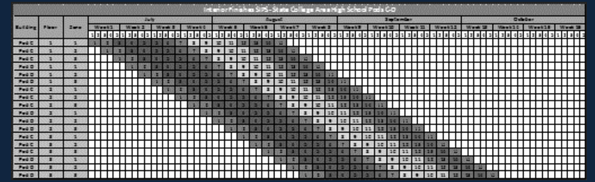


Analysis 1: Design Of Interior Walls And Partitions

Analysis 2: Existing Roof Redesign



Analysis 3: Interior Finishes Pods A-D SIPS



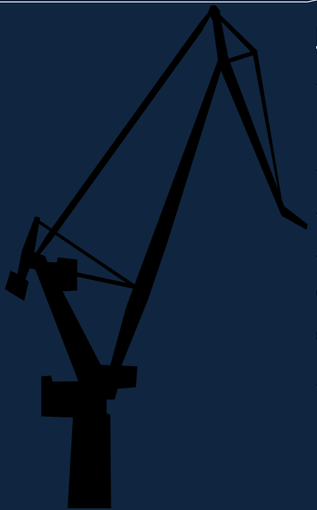
Analysis 4: Safety Provisions During Construction While School Is In Session

State College Area High School

Plan for the Unexpected

Bryce Burkentine
Construction Management Option

Presentation Outline



Project Background

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Conclusions/Recommendations

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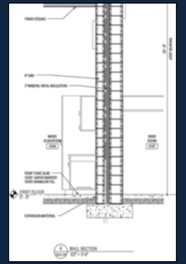

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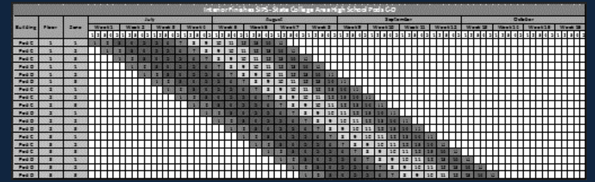

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Plan for the Unexpected

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Construction Management Option

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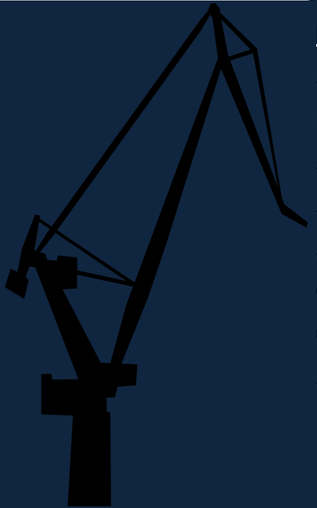

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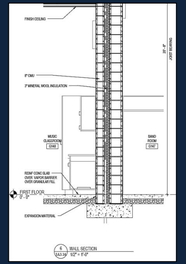

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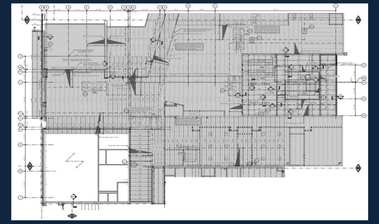

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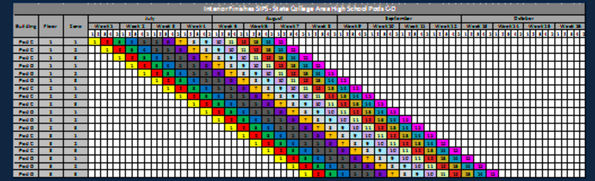

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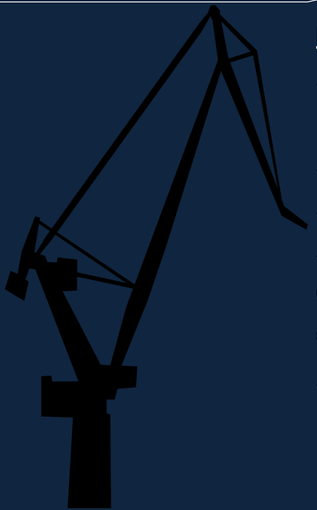
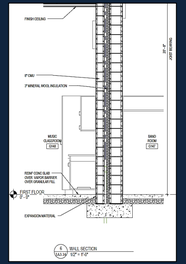
State College Area High School

Plan for the Unexpected

Bryce Burkentine
Construction Management Option

Presentation Outline





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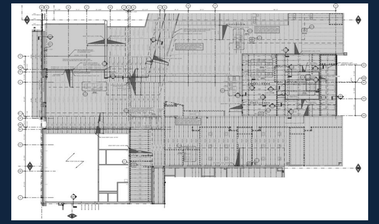

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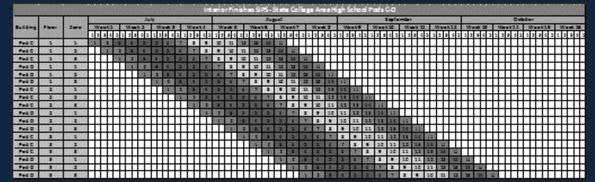

Analysis 4: Safety Provisions During Construction While School Is In Session

Design of Interior Walls and Partitions

Bryce Burkentine
Construction Management Option

Presentation Outline

CMU Walls	Structural Metal Stud Walls
• Great Durability • Good Acoustical Performance • Poor Thermal Performance • “Wet Construction” Needs time to dry in lifts = timely to Construct • Weather Restraints Cold/Wet	• Cost Sensitive • Fast to Construct • Poor Acoustical Performance

Design of Interior Walls and Partitions

Bryce Burkentine
Construction Management Option

Presentation Outline

Structural Metal Stud Wall System Cost	
Metal Studs 12"O.C. w/ Channels	$1,798,600.00
Fasteners	$9,030.00
Assembly screws	$9,000.00
Bracing	$506,000.00
	$2,322,630.00

Cost Per Square Foot

$ 12 CMU

$ 6.84 Cost Difference

$ 5.16 Structural Metal Studs

Design of Interior Walls and Partitions

Bryce Burkentine
Construction Management Option

Presentation Outline

Calculated Durations For Metal Stud Walls

Building Section	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower men/crew x # of crews	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
A	LF	5000	2	34	3	6	4	392.16	49.02
B	LF	5600	2	34	3	6	4	439.22	54.90
C	LF	5600	2	34	3	6	4	439.22	54.90
D	LF	5600	2	34	3	6	4	439.22	54.90
E1	LF	3100	2	34	3	6	4	243.14	30.39
E2	LF	3700	2	34	3	6	4	290.20	36.27
F1	LF	1500	2	34	3	6	4	117.65	14.71
F2	LF	4300	2	34	3	6	4	337.25	42.16
G1	LF	3900	2	34	3	6	4	305.88	38.24
G2	LF	3000	2	34	3	6	4	235.29	29.41
							Total		404.90

Calculated Durations For Drywall Durations

Building Section	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower men/crew x # of crews	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
A	SF	46000	2	675	5	10	84	109.04	13.63
B	SF	44500	2	675	5	10	84	105.48	13.19
C	SF	44500	2	675	5	10	84	105.48	13.19
D	SF	44500	2	675	5	10	84	105.48	13.19
E1	SF	24000	2	675	5	10	84	56.89	7.11
E2	SF	24000	2	675	5	10	84	56.89	7.11
F1	SF	9000	2	675	5	10	84	21.33	2.67
F2	SF	41000	2	675	5	10	84	97.19	12.15
G1	SF	34500	2	675	5	10	84	81.78	10.22
G2	SF	24500	2	675	5	10	84	58.07	7.26
							Total		99.70

Design of Interior Walls and Partitions

Bryce Burkentine
Construction Management Option

Presentation Outline

Direct Structural Wall Schedule Comparison			
Type	**Duration**	**Percent**	**Schedule Difference**
CMU	455	22.2%	101 Days
Structural Metal Studs	354		

Design of Interior Walls and Partitions

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Construction Management Option

Presentation Outline

Overall Schedule Comparison			
Type	**Duration**	**Percent**	**Schedule Difference**
CMU	455	16.7%	76 Days
Structural Metal Studs	379		

Original Schedule: 455 Days

Direct Structural Savings: - 101 Days

Drywall addition: + 25 Days

New Schedule Duration: 379 Days

Presentation Outline

American National Standard Acoustical Performance Criteria

Table B.1 — Minimum STC ratings recommended between an ancillary space and an adjacent space

Receiving ancillary learning space	Adjacent space			
	Corridor or staircase [a], common-use, and public-use toilet and bathing room [b]	Music room	Office or conference room [a]	Mechanical equipment room [f], cafeteria, gymnasium, or indoor swimming pool
Corridor used as ancillary learning space	45	60[c]	45[d]	55[c]
Music room	45	60	60[e]	60
Office or conference room	45 [d]	60[g]	45[d]	60

a) For corridor, staircase, office or conference room walls containing entrance doors to the ancillary learning space, the STC rating of the basic wall, exclusive of the door, should be 45. The entrance door should conform to the requirements of 5.4.2.4.

b) The STC rating for an ancillary space/toilet partition does not apply when the toilet is private and connected to a private office. An STC rating greater than 45 may be required for separating a quiet office or conference room from a common-use or public-use toilet or bathing room.

c) When the corridor will not be used as an ancillary learning space, the minimum STC rating may be reduced to not less than 45. Use of corridors as ancillary learning spaces should be avoided when they are located next to the noisy spaces indicated in the table by the high STC ratings.

d) When acoustical privacy is needed for conversations in an office or conference room, the minimum rating should be a composite STC of 50 instead of 45 that includes the effects of any doors or windows etc.

e) An STC rating of 60 is justified to prevent the music space from interfering with hearing in the office or conference room.

f) Isolation between ancillary learning spaces and mechanical equipment rooms is dependent on the noise level in the mechanical equipment room and can be less than STC 60 in some cases but should never be less than STC 45.

g) The STC rating of 60 does not apply when the office is for the music teacher and opens to the music room.

State College Area High School

Sound Transfer Differences Between CMU Walls and Structural Metal Stud Walls

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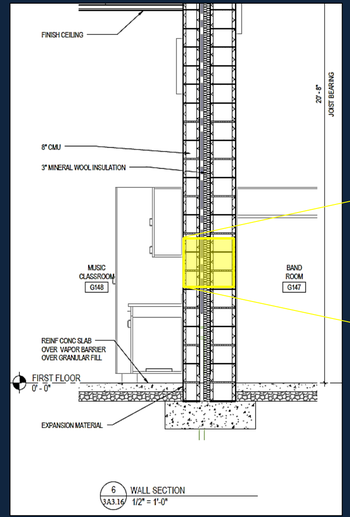
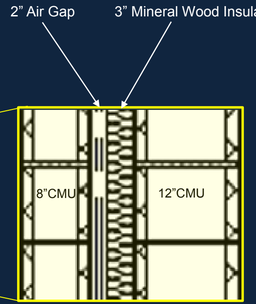
Construction Management Option

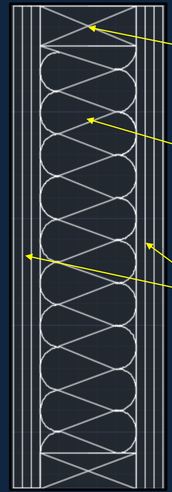
Presentation Outline



CMU Wall System



Structural Metal Stud Wall System



3-5/8" Studs 24" O.C.

3" FG Insulation

3 layers of 5/8" Gypsum Board

Designed to the required STC value of 60

State College Area High School

Sound Transfer Differences Between CMU Walls and Structural Metal Stud Walls

Bryce Burkentine
Construction Management Option

Presentation Outline

CMU Wall System

8" CMU Wall

STC 44

1/3 Octave-Band Frequency (Hz)	Contour Level (dB)	TL (dB)	Deficiency (dB)	Max Deficiency ≤ 8 dB?
125	28	32	0	OK
160	31	32	0	OK
200	34	32	2	OK
250	37	36	1	OK
315	40	38	2	OK
400	43	40	3	OK
500	44	42	2	OK
630	45	43	2	OK
800	46	45	1	OK
1000	47	47	0	OK
1250	48	44	4	OK
1600	48	43	5	OK
2000	48	47	1	OK
2500	48	47	1	OK
3150	48	49	0	OK
4000	48	50	0	OK
		TOTAL	24	0

Wall is STC: 44

12" CMU Wall

STC 39

1/3 Octave-Band Frequency (Hz)	Contour Level (dB)	TL (dB)	Deficiency (dB)	Max Deficiency ≤ 8 dB?
125	23	29	0	OK
160	26	30	0	OK
200	29	31	0	OK
250	32	31	1	OK
315	35	34	1	OK
400	38	34	4	OK
500	39	35	4	OK
630	40	35	5	OK
800	41	33	8	OK
1000	42	35	7	OK
1250	43	41	2	OK
1600	43	45	0	OK
2000	43	48	0	OK
2500	43	50	0	OK
3150	43	52	0	OK
4000	43	54	0	OK
		TOTAL	32	0

Wall is STC: 39

Structural Metal Stud Wall System

STC 60

1/3 Octave-Band Frequency (Hz)	Contour Level (dB)	TL (dB)	Deficiency (dB)	Max Deficiency ≤ 8 dB?
125	44	40	4	OK
160	47	47	0	OK
200	50	51	0	OK
250	53	55	0	OK
315	56	57	0	OK
400	59	60	0	OK
500	60	62	0	OK
630	61	63	0	OK
800	62	64	0	OK
1000	63	64	0	OK
1250	64	65	0	OK
1600	64	64	0	OK
2000	64	58	6	OK
2500	64	58	6	OK
3150	64	62	2	OK
4000	64	66	0	OK
		TOTAL	18	0

Wall is STC: 60

State College Area High School

Sound Transfer Differences Between CMU Walls and Structural Metal Stud Walls

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Construction Management Option

Presentation Outline

CMU Wall System

8" CMU Wall

STC 44

1/3 Octave-Band Frequency (Hz)	Contour Level (dB)	TL (dB)	Deficiency (dB)	Max Deficiency ≤ 8 dB?
125	28	32	0	OK
160	31	32	0	OK
200	34	32	2	OK
250	37	36	1	OK
315	40	38	2	OK
400	43	40	3	OK
500	44	42	2	OK
630	45	43	2	OK
800	46	45	1	OK
1000	47	47	0	OK
1250	48	44	4	OK
1600	48	43	5	OK
2000	48	47	1	OK
2500	48	47	1	OK
3150	48	49	0	OK
4000	48	50	0	OK
		TOTAL	24	0

Wall is STC: 44

+

12" CMU Wall

STC 39

1/3 Octave-Band Frequency (Hz)	Contour Level (dB)	TL (dB)	Deficiency (dB)	Max Deficiency ≤ 8 dB?
125	23	29	0	OK
160	26	30	0	OK
200	29	31	0	OK
250	32	31	1	OK
315	35	34	1	OK
400	38	34	4	OK
500	39	35	4	OK
630	40	35	5	OK
800	41	33	8	OK
1000	42	35	7	OK
1250	43	41	2	OK
1600	43	45	0	OK
2000	43	48	0	OK
2500	43	50	0	OK
3150	43	52	0	OK
4000	43	54	0	OK
		TOTAL	32	0

Wall is STC: 39

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✓

Structural Metal Stud Wall System

STC 60

1/3 Octave-Band Frequency (Hz)	Contour Level (dB)	TL (dB)	Deficiency (dB)	Max Deficiency ≤ 8 dB?
125	44	40	4	OK
160	47	47	0	OK
200	50	51	0	OK
250	53	55	0	OK
315	56	57	0	OK
400	59	60	0	OK
500	60	62	0	OK
630	61	63	0	OK
800	62	64	0	OK
1000	63	64	0	OK
1250	64	65	0	OK
1600	64	64	0	OK
2000	64	58	6	OK
2500	64	58	6	OK
3150	64	62	2	OK
4000	64	66	0	OK
		TOTAL	18	0

Wall is STC: 60

✓

Design of Interior Walls and Partitions

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Construction Management Option

Presentation Outline

Cost and Schedule Savings

Existing Roof Redesign

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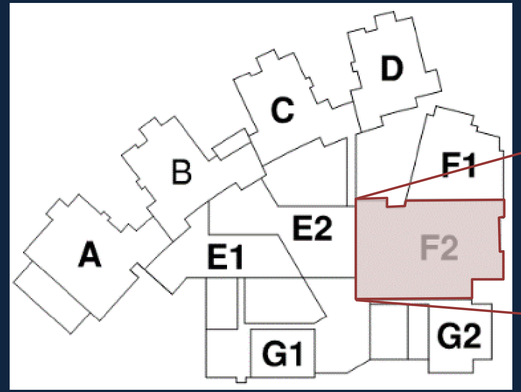
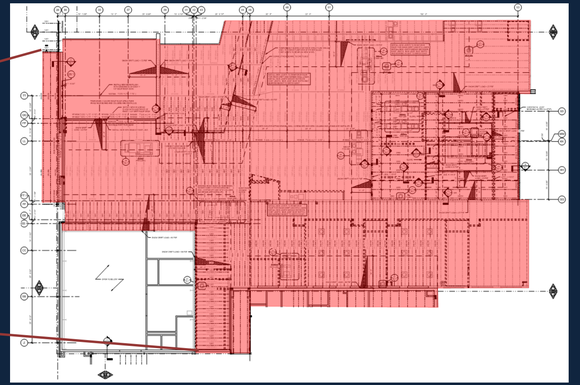
Construction Management Option

Presentation Outline





Existing Roof Redesign

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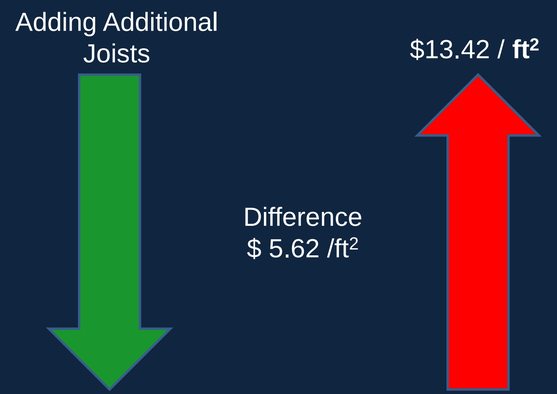
Construction Management Option

Presentation Outline

F2 Redesign of Existing Roof Cost Breakdown									
Item	Amount	Unit	Material Cost	Material Total	Labor Cost	Labor Total	Equipment Costs	Equipment Total	Total Cost
Demolition									
Mixture of Types	50700	CF	$ -	$ -	$ 0.14	$ 7,098.00	$ 0.17	$ 8,619.00	$ 15,717.00
Joists									
12K1 Series	28	Ton	$ 1,625.00	$ 45,500.00	$ 248.00	$ 6,944.00	$ 107.00	$ 2,996.00	$ 55,440.00
Roof Decking									
20ga- 50-500 squares	38000	SF	$ 1.94	$ 73,720.00	$ 0.31	$ 11,780.00	$ 0.04	$ 1,520.00	$ 87,020.00
Insulation									
Fiberboard high density, 1/2" Thick	38000	SF	$ 0.30	$ 11,400.00	$ 0.20	$ 7,600.00	$ -	$ -	$ 19,000.00
Roofing									
Modified Bituminous Membrane	38000	SF	$ 3.30	$ 125,400.00	$ 3.50	$ 133,000.00	$ 1.96	$ 74,480.00	$ 332,880.00
							Total		**$ 510,057.00**



Existing Roof Redesign

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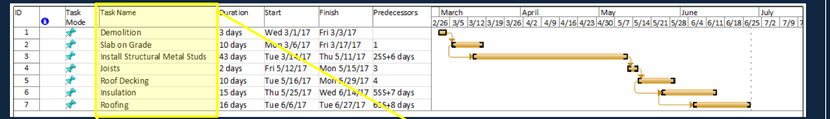
Construction Management Option

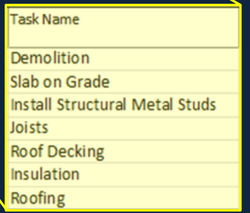
Presentation Outline

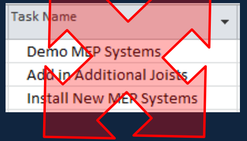
F2- Calculated Durations For Roof Redesign

Activity	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower men/crew x # of crews	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
Demolition	CY	50700	18	5750	1	18	719	70.54	8.82
Joists	Ton	28	13	15	1	13	2	14.93	1.87
Roof Decking	SF	38000	5	4147	1	5	518	73.31	9.16
Insulation	SF	38000	2	2600	1	2	325	116.92	14.62
Roofing	SF	38000	2	2400	1	2	300	126.67	15.83
								Total	**50.30**



ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Demolition	3 days	Wed 3/1/17	Fri 3/3/17	
2		Slab on Grade	10 days	Mon 3/6/17	Fri 3/17/17	1
3		Install Structural Metal Studs	43 days	Tue 3/14/17	Thu 5/11/17	2SS+6 days
4		Joists	2 days	Fri 5/12/17	Mon 5/15/17	3
5		Roof Decking	10 days	Tue 5/16/17	Mon 5/29/17	4
6		Insulation	15 days	Thu 5/25/17	Wed 6/14/17	5SS+7 days
7		Roofing	16 days	Tue 6/6/17	Tue 6/27/17	6SS+8 days



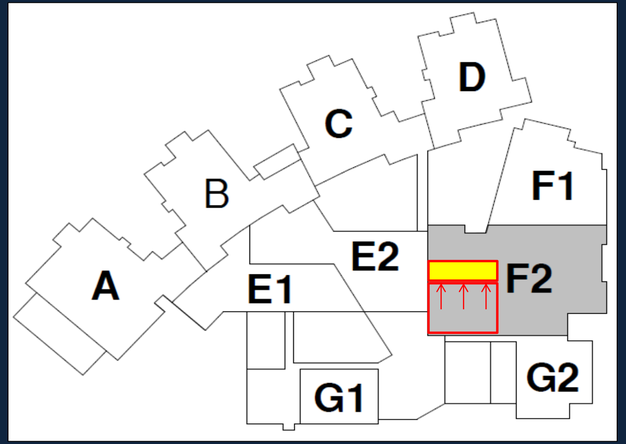


State College Area High School

Determining New Size Joists due to Additional Snow Loads

Bryce Burkentine
Construction Management Option

Presentation Outline

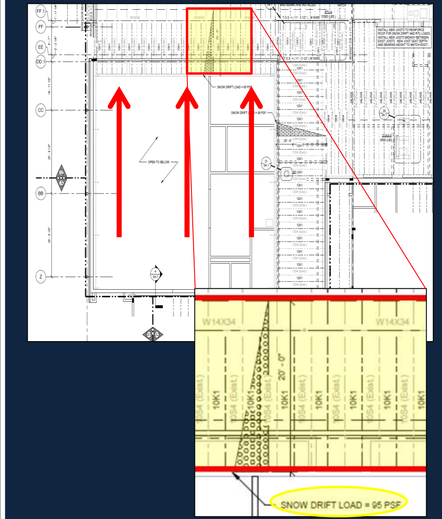


State College Area High School

Determining New Size Joists due to Additional Snow Loads

Bryce Burkentine
Construction Management Option

Presentation Outline



Dead Load:

- Metal Deck - 2psf
- Roofing - 2psf
- Rigid Insulation - 2psf
- MISC Dead Load - 10psf

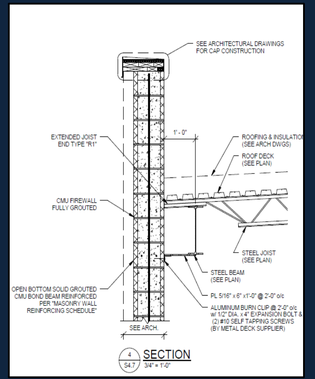
Dead Total = **16psf**

$W_T = (1.2D + 1.6L) \times T_w$
684.8plf=((1.2x16psf)+(1.6x95psf)) x 4ft

$W_{LL} = (L) \times T_w$
380plf=(95psf) x 4ft

825plf>684.8plf
510plf>380plf

Concludes Joists are **12K1**



Existing Roof Redesign

Bryce Burkentine
Construction Management Option

Presentation Outline

Schedule would decrease due to starting MEP work earlier

Cost would increase due to demoing existing roof and constructing a new roof

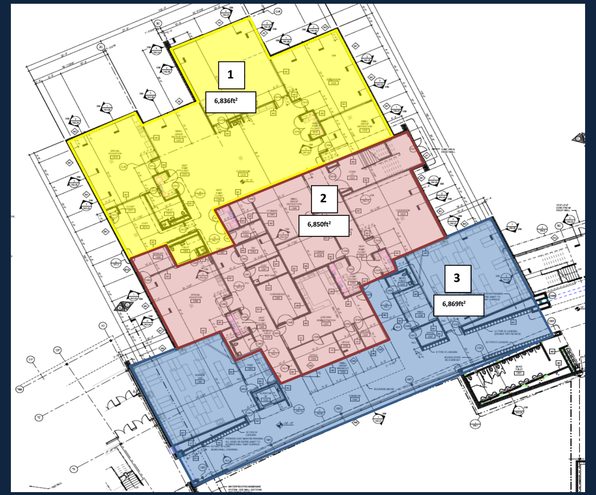
In a few months budget will be known and the board can make an educated decision

State College Area High School

Interior Finishes Pods A-D SIPS

Bryce Burkentine
Construction Management Option

Presentation Outline



Production Rates		
ID	Interior Buildout	Total Manpower
1	Hang Drywall	2
2	Spackle/Finish Drywall	2
3	Install Finish Carpentry and Prehung Doors	2
4	Prep/Prime	2
5	***Paint Walls***	***3***
6	Install Flooring	2
7	Install Casework	2
8	***Install Grids in Ceiling***	***4***
9	MEP Finals	6
10	Install Ceiling Tiles	2
11	Install Door Hardware,Visual Display Units, Lockers	6
12	Final Finish Casework	2
13	Install Carpet	2
14	Final Touch-Ups	2
15	Final Cleaning	2

Interior Finishes Pods A-D SIPS

Bryce Burkentine
Construction Management Option

Presentation Outline

Calculated Durations For Ceiling Grid Installers Pods C & D

Building	Floor	Zone	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower men/crew x # of crews	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
Pod C	1	**1**	SF	6836	1	475	**4**	4	59	28.78	**3.60**
Pod C	1	**2**	SF	6850	1	475	**4**	4	59	28.84	**3.61**
Pod C	1	**3**	SF	6869	1	475	**4**	4	59	28.92	**3.62**
Pod D	1	1	SF	6836	1	475	4	4	59	28.78	3.60
Pod D	1	2	SF	6850	1	475	4	4	59	28.84	3.61
Pod D	1	3	SF	6869	1	475	4	4	59	28.92	3.62
Pod C	2	1	SF	6836	1	475	4	4	59	28.78	3.60
Pod C	2	2	SF	6850	1	475	4	4	59	28.84	3.61
Pod C	2	3	SF	6869	1	475	4	4	59	28.92	3.62
Pod D	2	1	SF	6836	1	475	4	4	59	28.78	3.60
Pod D	2	2	SF	6850	1	475	4	4	59	28.84	3.61
Pod D	2	3	SF	6869	1	475	4	4	59	28.92	3.62
Pod C	3	1	SF	6836	1	475	4	4	59	28.78	3.60
Pod C	3	2	SF	6850	1	475	4	4	59	28.84	3.61
Pod C	3	3	SF	6869	1	475	4	4	59	28.92	3.62
Pod D	3	1	SF	6836	1	475	4	4	59	28.78	3.60
Pod D	3	2	SF	6850	1	475	4	4	59	28.84	3.61
Pod D	3	3	SF	6869	1	475	4	4	59	28.92	3.62

Calculated Durations For Painters Pods C & D

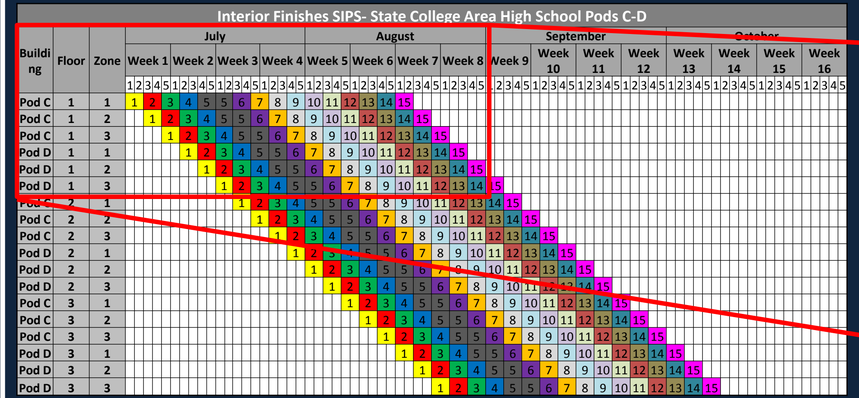
Building	Floor	Zone	Unit	Take-off LF of walls x height	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower men/crew x # of crews	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
Pod C	1	**1**	SF	9187.5	1	2275	**3**	3	284	10.77	**1.35**
Pod C	1	**2**	SF	12075	1	2275	**3**	3	284	14.15	**1.77**
Pod C	1	**3**	SF	7612.5	1	2275	**2**	2	284	13.38	**1.67**
Pod D	1	1	SF	9187.5	1	2275	3	3	284	10.77	1.35
Pod D	1	2	SF	12075	1	2275	3	3	284	14.15	1.77
Pod D	1	3	SF	7612.5	1	2275	2	2	284	13.38	1.67
Pod C	2	1	SF	9187.5	1	2275	3	3	284	10.77	1.35
Pod C	2	2	SF	12075	1	2275	3	3	284	14.15	1.77
Pod C	2	3	SF	7612.5	1	2275	2	2	284	13.38	1.67
Pod D	2	1	SF	9187.5	1	2275	3	3	284	10.77	1.35
Pod D	2	2	SF	12075	1	2275	3	3	284	14.15	1.77
Pod D	2	3	SF	7612.5	1	2275	2	2	284	13.38	1.67
Pod C	3	1	SF	9187.5	1	2275	3	3	284	10.77	1.35
Pod C	3	2	SF	12075	1	2275	3	3	284	14.15	1.77
Pod C	3	3	SF	7612.5	1	2275	2	2	284	13.38	1.67
Pod D	3	1	SF	9187.5	1	2275	3	3	284	10.77	1.35
Pod D	3	2	SF	12075	1	2275	3	3	284	14.15	1.77
Pod D	3	3	SF	7612.5	1	2275	2	2	284	13.38	1.67

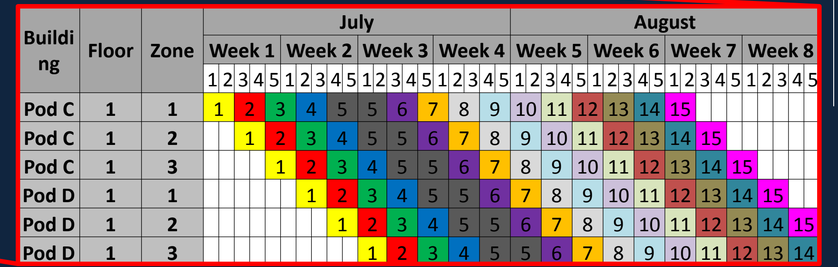
State College Area High School

Interior Finishes Pods A-D SIPS

Bryce Burkentine
Construction Management Option

Presentation Outline





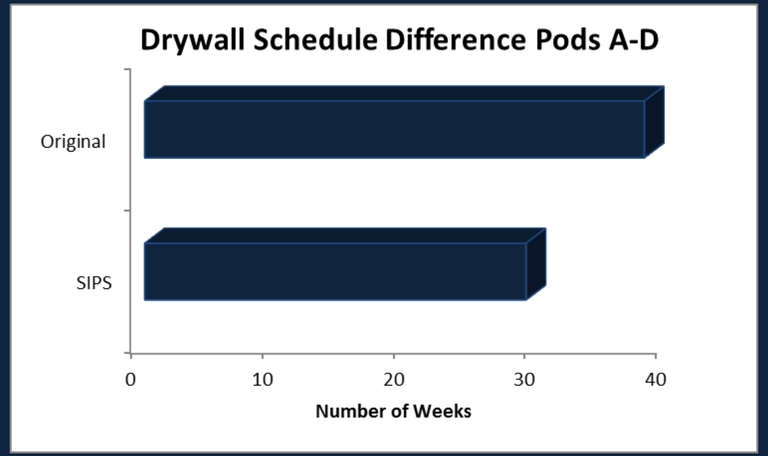
Building	Floor	Zone	July				August			
			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Pod C	1	1	1 2 3 4 5	5 6 7 8 9	10 11 12 13 14	15				
Pod C	1	2		1 2 3 4 5	5 6 7 8 9	10 11 12 13 14	15			
Pod C	1	3			1 2 3 4 5	5 6 7 8 9	10 11 12 13 14	15		
Pod D	1	1				1 2 3 4 5	5 6 7 8 9	10 11 12 13 14	15	
Pod D	1	2					1 2 3 4 5	5 6 7 8 9	10 11 12 13 14	15
Pod D	1	3						1 2 3 4 5	5 6 7 8 9	10 11 12 13 14

Bryce Burkentine
Construction Management Option

Interior Finishes Pods A-D SIPS

Bryce Burkentine
Construction Management Option

Presentation Outline



Original: 38 Weeks
SIPS: 29 Weeks

Safety Provisions During Construction While School Is In Session

Bryce Burkentine
Construction Management Option

Presentation Outline

Research Questions

1. What are the safety provisions set forth in the building codes and regulations for educational projects?

2. What are the practical safety provisions implemented by the industry and educational facility?

3. What are the available safety trainings, which workers and students are exposed to?

State College Area High School

Safety Provisions During Construction While School Is In Session

Bryce Burkentine
Construction Management Option

Presentation Outline

Research Questions

1. What are the safety provisions set forth in the building codes and regulations for educational projects?

2. What are the practical safety provisions implemented by the industry and educational facility?

3. What are the available safety trainings, which workers and students are exposed to?

Why so Important:

- Sexual Predators Around Children
- Students Health
- Curious Students
- Noise Control While Students Are In The Classroom
- Proper Ventilation
- Students Are Still In The Developing Stage

State College Area High School

Safety Provisions During Construction While School Is In Session

Bryce Burkentine
Construction Management Option

Presentation Outline

Exposures

- Trip hazards
- Security Hazards
- Noise Control
- Proper Ventilation
- Falling Objects
- Etc…

Reactive Protocols

- Public School Code
- Occupational Safety and Health Administration (OSHA)
- Environmental Protection Agency (EPA)
- Pennsylvania Building Code
- Massaro Construction Management Services

Subset Acts & Regulations

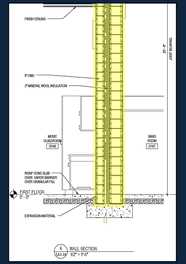
- Pennsylvania State Police Criminal History Record
- Department of Public Welfare Child Abuse Report
- Federal History Record Information
- General Safety and Health Provisions
- The Asbestos Hazard Emergency Response Act
- Centre County Refuse Requirements
- Safety Trainings from 3D Site Tour

= **Full Time Safety Manager**

Conclusions/Recommendations

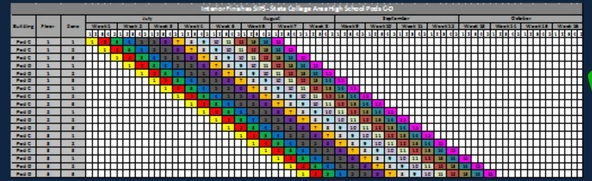
Bryce Burkentine
Construction Management Option

Presentation Outline



Analysis 1: Design Of Interior Walls And Partitions

Analysis 3: Interior Finishes Pods A-D SIPS



Analysis 2: Existing Roof Redesign

Analysis 4: Safety Provisions During Construction While School Is In Session

Academic Acknowledgements

Dr. Chimay Anumba- Faculty Advisor

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Dr. Ryan Solnosky

Dr. Robert Leicht

Architectural Engineering Department

Industry Acknowledgements

Massaro CM SERVICES, LLC
PRESS RELEASE

STATE COLLEGE AREA SCHOOL DISTRICT
We are the future!

Special Thanks To

Tim Jones- Massaro CM Services

Ryan Cole- Massaro CM Services

Edward Poprik- State College High School

Facility Director

PACE Industry Members

My Family and Friends

QUESTIONS?

Design of Interior Walls and Partitions

Bryce Burkentine
Construction Management Option

Presentation Outline

Structural Metal Stud Wall System Cost								
Item	Length	Number	Unit	Material Cost	Material Total	Labor Cost	Labor Total	Total Cost
Metal Studs 12"O.C. w/ Channels								
16 GA	39100		LF	$ 24.00	$ 938,400.00	$ 22.00	$ 860,200.00	$1,798,600.00
Fasteners								
Fasteners		105	Bx	$ 64.00	$ 6,720.00	$ 22.00	$ 2,310.00	$ 9,030.00
Assembly screws								
Assembly screws		200	Ea	$ 23.00	$ 4,600.00	$ 22.00	$ 4,400.00	$ 9,000.00
Bracing								
Metal Stud Bracing	11500		LF	$ 22.00	$ 253,000.00	$ 22.00	$ 253,000.00	$ 506,000.00
							Total	$2,322,630.00

Calculated Durations For Metal Stud Walls									
Building Section	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower men/crew x # of crews	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
A	LF	5000	2	34	3	6	4	392.16	49.02
B	LF	5600	2	34	3	6	4	439.22	54.90
C	LF	5600	2	34	3	6	4	439.22	54.90
D	LF	5600	2	34	3	6	4	439.22	54.90
E1	LF	3100	2	34	3	6	4	243.14	30.39
E2	LF	3700	2	34	3	6	4	290.20	36.27
F1	LF	1500	2	34	3	6	4	117.65	14.71
F2	LF	4300	2	34	3	6	4	337.25	42.16
G1	LF	3900	2	34	3	6	4	305.88	38.24
G2	LF	3000	2	34	3	6	4	235.29	29.41
							Total		404.90

Calculated Durations For Drywall Durations									
Building Section	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower men/crew x # of crews	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
A	SF	46000	2	675	5	10	84	109.04	13.63
B	SF	44500	2	675	5	10	84	105.48	13.19
C	SF	44500	2	675	5	10	84	105.48	13.19
D	SF	44500	2	675	5	10	84	105.48	13.19
E1	SF	24000	2	675	5	10	84	56.89	7.11
E2	SF	24000	2	675	5	10	84	56.89	7.11
F1	SF	9000	2	675	5	10	84	21.33	2.67
F2	SF	41000	2	675	5	10	84	97.19	12.15
G1	SF	34500	2	675	5	10	84	81.78	10.22
G2	SF	24500	2	675	5	10	84	58.07	7.26
							Total		99.70

State College Area High School

Sound Transfer Differences Between CMU Walls and Structural Metal Stud Walls

Bryce Burkentine
Construction Management Option

Presentation Outline

Project Background

Analysis 1: Design Of Interior Walls And Partitions

Analysis 2: Existing Roof Redesign

Analysis 3: Interior Finishes Pods A-D SIPS

Analysis 4: Safety Provisions During Construction While School Is In Session

Conclusions/Recommendations

Acknowledgments

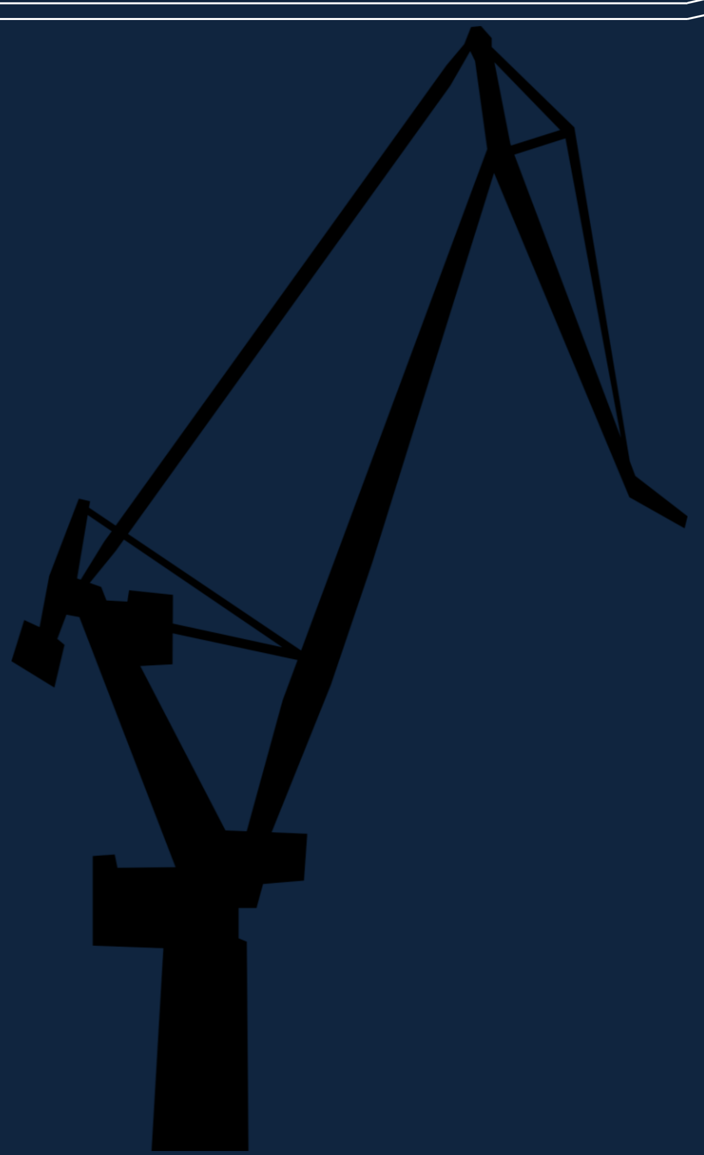
APPENDIX J
Sound Transmission Loss Data

Assembly/Frequency (Hz)	STC	100	125	160	200	250	300	400	500	630	800	1,000	1,250	1,600	2,000	2,500	3,150	4,000
Metal stud, gypsum board (GB) assemblies with or without mineral wool or fiberglass (FG) insulation																		
24 g. studs																		
1/2" GB each side of 2-1/2" studs 24" o.c., 1.5" FG	**45**	19	22	26	31	38	44	48	51	53	55	57	58	58	54	45	43	46
Same as above plus an additional layer GB on one side (2+1 layers)	**50**	22	31	31	38	43	48	51	58	54	56	58	57	59	54	47	47	50
Same as above with two layers GB on each side (2+2 layers)	**53**	28	35	35	41	48	52	54	55	55	57	59	58	60	56	50	51	54
5/8" GB on each side of 2-1/2" studs 24" o.c., no insulation	**39**	22	24	24	28	37	34	41	44	45	47	49	50	44	36	35	40	41
Same as above plus 1-1/2" FG	**46**	17	26	28	37	42	47	51	53	54	56	58	58	57	44	42	46	48
Same as above, but with two layers GB on each side (2+2 layers)	**54**	30	37	37	41	46	50	53	55	55	59	60	58	56	51	51	54	58
1/2" GB on each side of 3-5/8" studs 16" o.c., no insulation	**43**	19	26	23	29	36	36	42	43	47	48	51	54	53	48	42	40	43
Same as above but with 3" FG	**49**	20	28	30	37	43	43	49	51	54	55	58	60	60	55	48	46	50
Two layers 1/2" GB each side of 3-5/8" studs 24" o.c. plus 1-1/2" FG	**55**	31	34	36	46	47	51	55	56	56	60	61	60	63	59	52	54	57
5/8" GB each side of 3-5/8" studs 24" o.c. plus 1-1/2" FG	**45**	22	29	31	39	41	43	49	51	53	55	56	57	55	43	41	46	48
Same as above but with 3" FG	**49**	18	32	33	39	44	45	48	51	55	57	58	58	57	55	45	46	53
5/8" GB (2+1 layers) on 3-5/8" studs 24" o.c. and 2" FG	**51**	28	36	37	42	46	50	52	54	55	59	59	58	58	47	47	51	53
Same as above except 3" FG	**53**	25	35	41	46	51	54	56	59	58	58	58	60	60	55	49	54	59
5/8" GB (2+2 layers) on 3-5/8" studs 24" o.c., no insulation	**48**	27	34	30	37	41	42	48	51	52	53	54	55	56	46	45	48	52
5/8" GB (2+2 layers) on 3-5/8" studs 24" o.c., 3" FG	**57**	28	38	44	47	52	55	58	59	59	60	60	62	61	56	53	58	62
Same as above except 3 + 3 GB layers, a total of 6 GB layers	**61**	33	40	47	51	55	57	60	62	63	64	64	65	64	58	58	62	66
20 g. studs																		
1/2" GB on each side of 3-5/8" studs, no insulation	**39**	16	26	19	26	36	35	40	41	43	45	47	50	48	38	36	40	42
Same as above plus 2" FG	**41**	19	30	29	34	43	44	44	46	48	51	52	52	48	37	38	42	44

Assembly/Frequency (Hz)	STC	100	125	160	200	250	300	400	500	630	800	1,000	1,250	1,600	2,000	2,500	3,150	4,000
Hollow (8") lightweight concrete block masonry																		
Conc. block — plain	**44**	30	32	32	32	36	38	40	42	43	45	47	44	43	47	47	49	50
Same as above, but 2 coats of paint or block filler both sides	**48**	38	38	36	36	38	42	44	45	47	48	50	51	52	52	51	52	55
Conc. block plus 1/2" plaster both sides	**51**	36	36	35	39	41	42	44	48	50	52	54	55	57	60	62	60	60
Conc. block, 5/8" GB on 1-1/2" furring, 1-1/2" FG bet. furring	**55**	29	37	42	49	48	47	49	50	52	55	57	60	62	61	58	61	66
Same as above but GB on resilient channels	**58**	33	35	39	43	47	50	55	56	59	60	60	62	62	62	62	62	64
Same as above but paint block on side opposite GB	**60**	38	41	43	47	49	52	57	58	58	63	66	68	70	69	68	69	72
Conc. block, 5/8" GB on 3" Z-channels	**58**	30	34	38	41	46	52	56	58	60	62	62	64	65	65	62	65	70
Same as above but with 3" FG between Z-channels	**61**	35	42	44	48	49	56	58	59	60	62	62	64	65	65	62	66	72
Conc. block, 2-1/2" metal studs plus 5/8" GB both sides of block, but 2-1/2" FG in one stud cavity	**65**	32	41	47	55	60	69	73	74	74	75	73	72	72	73	71	75	78
Same as above, but FG in both stud cavities	**72**	40	49	54	62	67	73	73	75	74	76	74	73	73	73	72	77	80
Conc. block, 2-1/2" metal studs plus 5/8" GB with 2-1/2" FG on one side, and 3" Z-channels and 5/8" GB on other side	**68**	35	44	48	55	62	70	72	74	76	77	76	74	73	71	69	74	78
Hollow (6") lightweight concrete block masonry																		
Conc. block — plain	**44**	29	29	30	31	33	37	38	40	43	45	47	48	51	55	55	53	54
Same as above but with 2 coats of paint or block filler	**48**	36	38	39	36	34	38	40	43	46	49	52	54	55	58	62	64	65
Conc. block, 1/2" GB on 3/4" furring strips	**49**	30	31	30	33	35	41	43	48	52	55	57	57	58	61	64	63	60
Same as above but with 3/4" FG in cavity between furring strips	**50**	28	28	31	36	37	44	45	49	52	54	56	56	60	63	61	58	61
Conc. block, 1/2" GB on 1-1/2" furring strips and 1-1/2" FG in cavity	**55**	31	38	45	45	42	45	49	51	53	57	60	63	64	66	66	64	67
Conc. block, 2-1/2" metal studs plus 5/8" GB with 2-1/2" FG	**61**	39	44	46	47	48	52	56	58	60	63	65	66	66	67	69	73	76
Hollow (12") lightweight concrete block masonry																		
Conc. block — plain	**39**	26	29	30	31	31	34	34	35	35	33	35	41	45	48	50	52	54
Same as above but with 3 coats of paint or block filler to one side	**51**	28	35	35	40	43	43	44	45	48	50	51	54	56	57	56	58	60
Same as above but add resilient channels and 1/2" GB on one side	**57**	31	37	37	41	46	49	52	55	59	62	66	69	72	72	69	68	70-

Determining New Size Joists due to Additional Snow Loads

Bryce Burkentine
Construction Management Option



Presentation Outline

STANDARD LRFD LOAD TABLE
OPEN WEB STEEL JOISTS, K-SERIES

Based on a 50 ksi Maximum Yield Strength
Adopted by the Steel Joist Institute May 1, 2000
Revised to November 10, 2003 – Effective March 01, 2005

The black figures in the following table give the TOTAL safe factored uniformly distributed load-carrying capacities, in pounds per linear foot, of **LRFD K-Series** Steel Joists. The weight of factored DEAD loads, including the joists, must be deducted to determine the factored LIVE load-carrying capacities of the joists. Sloped parallel-chord joists shall use span as defined by the length along the slope.

The figures shown in **RED** in this load table are the unfactored nominal LIVE loads per linear foot of joist which will produce an approximate deflection of 1/360 of the span. LIVE loads which will produce a deflection of 1/240 of the span may be obtained by multiplying the figures in **RED** by 1.5. In no case shall the TOTAL load capacity of the joists be exceeded.

The approximate joist weights per linear foot shown in these tables do not include accessories.

The approximate moment of inertia of the joist, in inches^4 is;

$I_j = 26.767(W_{LL})(L^3)(10^{-6})$, where W_{LL} = **RED** figure in the Load Table and L = (Span - 0.33) in feet.

For the proper handling of concentrated and/or varying loads, see Section 6.1 in the Code of Standard Practice for Steel Joists and Joist Girders.

Where the joist span exceeds the unshaded area of the Load Table, the row of bridging nearest the mid span shall be diagonal bridging with bolted connections at the chords and intersections.

LRFD

STANDARD LOAD TABLE FOR OPEN WEB STEEL JOISTS, K-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown in Pounds per Linear Foot (plf)

Joist Designation	8K1	10K1	12K1	12K3	12K5	14K1	14K3	14K4	14K6	16K2	16K3	16K4	16K5	16K6	16K7	16K9
Depth (in.)	8	10	12	12	12	14	14	14	14	16	16	16	16	16	16	16
Approx. Wt (lbs./ft.)	5.1	5.0	5.0	5.7	7.1	5.2	6.0	6.7	7.7	5.5	6.3	7.0	7.5	8.1	8.6	10.0

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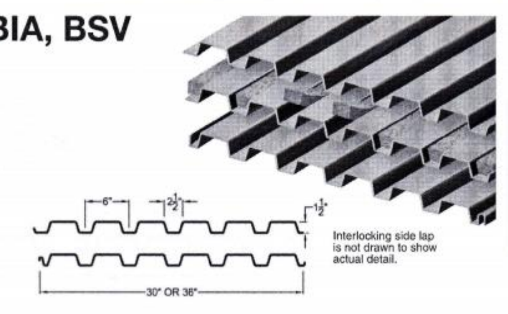
VULCRAFT

1.5 B, BI, BA, BIA, BSV

Maximum Sheet Length 42'-0
Extra charge for lengths under 6'-0
ICC ER-3415
FM Global Approved[2]

ROOF



SECTION PROPERTIES

Deck type	Design thickness in.	W psf	I_p in⁴/ft	S_p in³/ft	I_n in⁴/ft	S_n in³/ft	V_a lbs/ft	F_y ksi
B24	0.0239	1.46	0.107	0.120	0.135	0.131	2634	60
B22	0.0295	1.78	0.155	0.186	0.183	0.192	1818	33
B20	0.0358	2.14	0.201	0.234	0.222	0.247	2193	33
B19	0.0418	2.49	0.246	0.277	0.260	0.289	2546	33
B18	0.0474	2.82	0.289	0.318	0.295	0.327	2870	33
B16	0.0598	3.54	0.373	0.408	0.373	0.411	3578	33

ACOUSTICAL INFORMATION

Deck Type	Absorption Coefficient 125	250	500	1000	2000	4000	Noise Reduction Coefficient[1]
1.5BA, 1.5BIA	.11	.18	.66	1.02	0.61	0.33	0.60

[1] Source: Riverbank Acoustical Laboratories.
Test was conducted with 1.50 pcf fiberglass batts and 2 inch polyisocyanurate foam insulation for the SDI.

total/Live

Type B (wide rib) deck provides excellent structural load carrying capacity per pound of steel utilized, and its nestable design eliminates the need for die-set ends.

1" or more rigid insulation is required for Type B deck.

Acoustical deck (Type BA, BIA) is particularly suitable in structures such as auditoriums, schools, and theatres where sound control is desirable. Acoustic perforations are located in the vertical webs where the load carrying properties are negligibly affected (less than 5%).

Inert, non-organic glass fiber sound absorbing batts are placed in the rib openings to absorb up to 60% of the sound striking the deck.

Batts are field installed and may require separation.

VERTICAL LOADS FOR TYPE 1.5B

No. of Spans	Deck Type	Max. SDI Const. Span	5-0	5-6	6-0	6-6	7-0	7-6	8-0	8-6	9-0	9-6	10-0
1	B24	4'-8	115 / 56	95 / 42	80 / 32	68 / 26	59 / 20	51 / 17	45 / 14	40 / 11	35 / 10	32 / 8	29 / 7
	B22	5'-7	98 / 81	81 / 61	68 / 47	58 / 37	50 / 30	44 / 24	38 / 20	34 / 17	30 / 14	27 / 12	25 / 10

Allowable Total (PSF) / Load Causing Deflection of L/240 or 1 inch (PSF); Span (ft.-in.) ctr to ctr of supports

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