State College Area High School



Thesis Report

Senior Thesis

Bryce Burkentine

Construction Management

Project Location: State College, PA

Advisor: Dr. Chimay Anumba

Spring 2016

State College Area High School

State College, PA

Owner: State College High School Construction Contractor: Massaro CM

Services

Architect: Crabtree, Rohrbarugh &

Associates

Structural MEP Engineer, Lighting Security Consultants: Centerpoint

Engineering

Civil Landscape Engineer: ELA Group Food Service Consultant: McFarland

Kistler & Associates



Image: Massaro Construction

Building: South Building

Project Delivery Method: Design- Bid- Build Organizational Structure: Construction

Manager Agency W/ Multiple Prime Contracts

Dates of Construction: October 2015- August

2017

Total Construction Costs: \$101,235,000

Architecture:

- 3 Stories
- 488,200 Gross Square Feet
- 4 Pods- Consists of- Classrooms, Break Out

Rooms, Mini-Meeting Rooms, Bathrooms

 Exterior Facade: Aluminum Storefront System and Manufactured Brick Material

Structural System:

- Foundation- Typical Spread Footing
- Main Structure- Masonry Bearing Walls
- Flooring Support- K & LH Series Steel Joists
- Slab-on-Grade- 3000 PSF Concrete
- Elevated Slabs- Composite Metal Deck w/ Fiber Reinforcement w/ 3000 PSF Concrete
- Interior Wall Structure: Metal Stud Walls

Sustainability System:

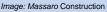
- LEED Gold Certified
- Increased Roof R-Values
- Green Roof System
- Solar Array System
- High Performance MEP Systems
- Construction Waste Management

MEP Systems:

- HVAC System- Water Source Heat Pumps
- Classrooms to be Served by 3.5 Ton Units w/

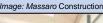
Ductwork Distribution to Ceiling Diffusers

- Large Rooftop Units for Common Areas such as Cafeteria and Library
- Hot Water to be Distributed at 140 Degrees Fahrenheit
- Hot Water Return System Controlled by Occupancy Schedule
- Two New Separate Electrical Services 400A,
 480V, 3-Phase, 4-Wire
- Sustainable Design in Lighting- Mounted Occupancy Sensors, Day-Light Harvesting, and Time On/Off Control





Bryce Burkentine
Senior Thesis
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m/2016maethesis





Bryce Burkentine | Construction | Dr. Anumba | State College Area High School | State College, PA | April 8th, 2016

Executive Summary

This proposal includes opportunities available for analysis on the State College Area High School project located in State College, Pennsylvania. These analyses will be performed to decrease costs, accelerate the schedule, and provide a better quality building for all the stakeholders. This proposal includes four different analyses and they are as follows; design of interior walls partitions, existing roof redesign, SIP schedule for interior finishes on Pods A–D, and safety provisions during construction while school is in session. The Master Class, AE 570, will help in developing the SIP Schedule for PODs A–D. This class incorporated concepts of lean construction tools and how to minimize waste on a project.

Analysis 1: Design of Interior Walls/Partitions

Most of the interior walls are structural bearing CMU walls. In order to save time and money, the interior walls could be redesigned to structural metal studs. This in turn will increase productivity of the structure, and allow for cost and schedule savings. The structural costs directly go down, while indirectly the overall cost is affected because of the increase labor and material costs for drywall. The direct structural savings is around \$7 per square foot and the overall savings cost is about \$5.50 per square foot. The direct structural schedule savings is 101 days but due to the additional drywall the schedule savings is 76 days.

Analysis 2: Existing Roof Redesign

Saving time on this project is crucial, but it should not be at the sacrifice of the quality of the school. The existing one story roof will have to be redesigned due to the additional snow load it will be experiencing from the new adjacent 3 story building. The existing plan right now is to add in the same size joists next to the existing ones. This is a logistical problem, maneuvering them through the building and installing the joists in place. To save time the roof should be demolished and new steel joists should be set. This in turn would accelerate the start of the MEP trades provide a better quality project in the long run.

Analysis 3: SIPS- Interior Finishes Pods A-D

The interior finishes for the State College Area High School project will play a very crucial part in the buildings completion. The schedule for the project cannot be deviated from due to the school calendar. To ensure the deadlines are met, a SIP Schedule will be developed for the interior finishes in PODs C–D. This will accelerate the schedule and if any delays were accrued earlier in the project. A total of 4.5 weeks were taken off the original finish schedule resulting to about a 14.5-week duration to finish Pods C and D. Multiplying this out through Pods A and B, 9 total weeks will be saved on the schedule.

Analysis 4: Safety Provisions during Construction while School is in Session

Construction safety is always a top concern on any project. Research into this critical issue involving safety will explore different safety provisions and mechanisms to ensure the jobsite is safe while working concurrently when school is in session. The research focused on a case study of the State College Area High School. There are a number of provisions and regulations that must be abided by. In order to achieve these provisions and regulations successfully there needs to be quality controls in place.

<u>Acknowledgements</u>



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State College Area High School





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PACE Industry Members

My Family and Friends

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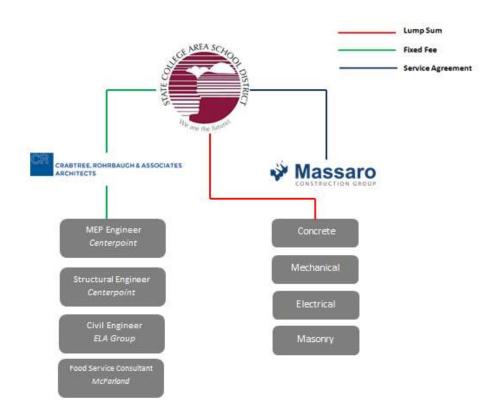
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Existing Conditions

The existing High School consists of the North Building and South Building. Westerly Parkway divides these two buildings as well as the campus, which provides access to the North and South Buildings. Both buildings are more than 59 years old and serve as a high school for the community. Currently the North building serves $11^{th} - 12^{th}$ grades and the South building serves $9^{th} - 10^{th}$ grades. The campus sits on 79.2 acres between the North and South buildings. The North building has 258,398 square feet and the South Building has 191,280 square feet. At the completion of this project the South building will be about 3 times the size of the North building.

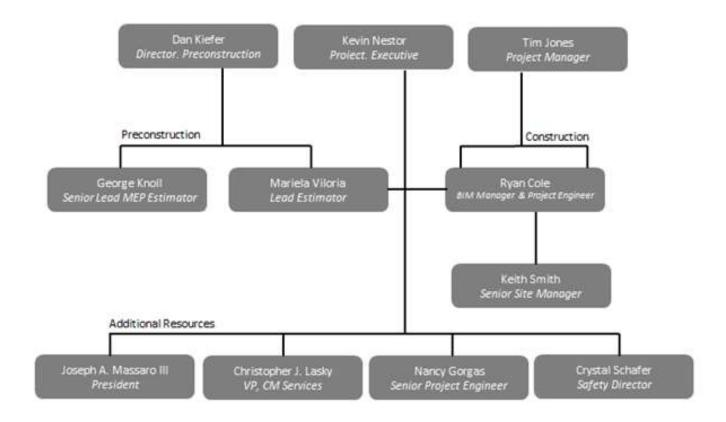
Project Delivery System

The procurement method for this project was Design-Bid-Build. Massaro was selected by State College Area High School by a price proposal and qualifications. The organizational structure is construction management agency with multiple-prime contracts. Massaro oversees the construction process working with State College High School directly. The contracts held with the State College Area High School are a fixed fee contract with the architect, lump sum contracts with the trades, and a service agreement with Massaro Construction Group.



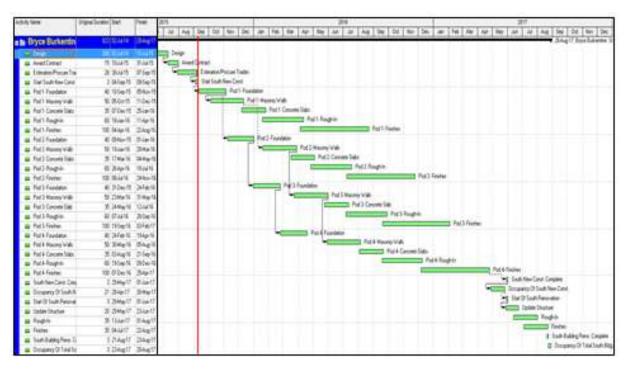
Staffing Plan

Massaro Construction Company staffed this project in a traditional structure. At the top there is Dan Kiefer, Director of Preconstruction, who will oversee the project from beginning until the end. Tim Jones, project manager, Ryan Cole, BIM manager and project engineer, Keith Kephart, senior site manager will stay on the project from start to finish. The project manager and site managers will be in the same office which will promote collaboration among the office and field teams and various trades that talk to these two positions frequently. The project staff will continually grow as the project really gets off its feet by hiring assistant superintendents and more project engineers. Additional resources if needed are the president of the Massaro, vice president of construction management services, senior project engineer, and safety director.



Summary Schedule

Phase 1 will consist of new construction in the South parking lot. During this period, classes will be held in the existing South Building from October 2015 to June 2017. Phase 2 will consist of renovations and additions to old portions of the South Building with classes in the new South Building. Phase 2 construction will be from June 2017 to August 2017. The North Building will be demolished and rebuilt for phase 3, which will complete the State College Area High School project in July 2018.



Cost Analysis

The total value of the project right now is \$117,003,000. The south building is \$101,235,000. This price consists of new construction, demolition, and renovation. The price per square foot is around \$207.36, which is less than the RS Means predicted square foot value of \$211.56 per square foot. The RS Means total value for the south building is \$103,281,318.94. This is \$2,000,000 or 2% off from what the actual project costs are. One of the main discrepancies between the actual project cost and RS Means predicted value is renovations are not taken into account. 58,000 square feet of renovations in the south building could skew the numbers some because RS Means is treating that as new construction at \$229 per square foot, in reality it would be less than that because it is a renovation which would entail a lower square foot cost. Also the actual construction costs differ from the RS Means construction costs because the superstructure, exterior enclosure, interiors, and HVAC were much more as a percentage. The total project costs came into agreement with RS Means because site work, general requirements, and contingencies were added in.

Lighting/Electrical

The South Building will consist of two new separate electrical services installed at 400A, 480V, 3-phase, 4-wire. New transformers will be installed to feed the new switchboards. The existing electrical services will remain live until construction is completed and the two new services are ready to be operable. The lighting throughout the building will meet LEED Gold Criteria such as: LED type fixtures, foot candle levels, vacancy sensors, etc. The interior and exterior lighting control system will be monitor by manual and automatic controls with the automatic controls consisting of: mounted occupancy sensors, day light harvesting, and time on/off control.

Mechanical

Since there is renovation and new construction all the existing HVAC equipment, piping and associated controls will be removed and replaced with new systems. HVAC system will be water source heat pumps. Classrooms will be served by 3.5 ton units with ductwork distribution to ceiling diffusers. Auditorium and Cafeteria will be served by water source heat pump rooftop units. Energy efficient methods of ventilation will be required for LEED Certification and therefore energy recovery wheels with 70% minimum effectiveness will be used.

All the plumbing fixtures shall be installed to meet ADA standards where required. Hot water will be distributed throughout the building at 140 Degrees Fahrenheit and controlled at each individual fixture. Also, a return hot water loop will be installed and controlled according to the occupancy schedule.

Structural

The foundation is a typical spread footing with an allowable bearing pressure of 3,000 psf. Footings that experience poor soils will be removed and replaced with structural fill. Any limestone present that shows high risk of sink holes will result in pressure grouting to secure the existing soils.

The main structure will consist of masonry bearing walls with steel joists spanning the horizontal runs. The load bearing walls will be 8", 12", or 16" concrete masonry units. The first floor will consist of a concrete slab on grade with a minimum thickness of 4". Elevated slabs will be constructed of concrete over a composite metal deck with a minimum total thickness of 4" with fiber reinforcement. Elevated floors will be supported by steel joists bearing on masonry walls. The steel joists are K and LH Series fabricated.

Building Façade System

The façade of the structure is mainly composed of aluminum storefront system and manufactured brick material. As part of the sustainable design sunshades will be incorporated into the design. There will be an upgraded 3 inch cavity spray foam insulation that will increase the R-Value on the CMU wall. The perimeter walls are composed of 3" insulated metal panel system, 3 5/8" metal studs, 8" CMU, and 5/8" GWB on 1 5/8" metal studs.

Sustainability System

The goal of the building process was to create and obtain a LEED certification through the United States Green Building Council of LEED Gold. Some of the means by which this rating will be achieved include the coordination of increased roof R-values, green roof system, solar array system, high performances building systems such as the MEP systems, and construction waste management.

Fire Protection

The fire protection system for State College Area High School is a wet and dry system that employs automatic sprinklers attached to a piping system containing water and/or compressed air. Sprinkler protection is based on light hazard (225 SF per head) and ordinary hazard (130 SF per head) criteria.

Telecommunications

There is an existing district wide data center located in the North Building. As part of the summer project, Massaro rerouted conduits through the North parking lot and across Westerly Parkway so it will hit the new MDF room in the South Building. During construction, temporary connections will need to be made in the South Building to existing IDFs and the new MDF to allow service to remain in the occupied parts of the school. Additionally, the Data center in North will be moved to its new location over a span of months to limit disruptions.

Storm Water Management System

Storm water detention basins will be used during construction to hold water run off on site. This will ensure streams and inlets are not contaminated due to the site run off. Trench drains, water quality structures, and energy dissipaters will be used where necessary.

Analysis 1: Design of Interior Walls/Partitions

Problem Identification

The interior & exterior walls are CMU bearing walls supporting steel joists. The CMU walls account for much of the masonry work on the job. The mason contractor will have the exterior and interior CMU walls and brick veneer to erect. The mason should only have to concentrate on the exterior CMU walls with brick veneer. CMU walls are lengthy tasks to construct and can be more costly to other alternatives like structural metal studs. If the masons could focus on the exterior walls while another contractor could focus on the interior walls then the structure would go up quicker.

Process

The goal of this analysis is to evaluate the interior structural system. In order to develop this analysis the cost and schedule will need to be analyzed for the structural metal stud system. To develop the cost estimate the necessary materials must be determined, size gauge for the structural metal studs for the 1st, 2nd and 3rd floors and the materials needed to install the wall. To analyze the schedule, production rates and crew sizes will have to be evaluated to determine the daily output per day. Determine if there are any other associated costs with changing the structural system. The cost and schedule will be contrasted to the original structure type to determine if there were any cost or schedule savings.

Cost Analysis

The materials in the structural metal stud system have metal studs, fasteners, assembly screws, and bracing that need to be quantified and priced. The breakdown of these items can be found in Table 1.1. The total cost for changing the interior CMU walls to structural metal stud system is \$2,322,630. The exterior walls and auditorium walls will remain load bearing CMU walls. The cost per square foot for the structural metal stud walls is around \$5.16 compared to the structural CMU walls at \$12 per square foot. The direct structural savings is around \$7 per square foot. This is not a true number in regards to costs for changing to a new system because there are additional items that are affected. Some walls will need additional material for finishing and to create a sound barrier between loud spaces and classrooms. This study is more develop in the Acoustical Breadth. One item that will be affected dramatically is the amount of drywall that will now be needed. The CMU block was primed and painted right on the face and did not need any additional materials.

To calculate the additional costs, the drywall procures a material rate of \$0.46 and a labor rate of \$1.15 per square foot. A total of 336,500 square feet of additional drywall is needed. The extra cost that is obtained from this is \$541,765. Adding this to the structural metal stud system the overall price for

installing the metal studs plus additional drywall is \$2,864,395. The total cost per square foot including the additional drywall expense is about \$6.50. This concludes that the overall savings is about \$5.50 per square foot. Quantities were first derived from the construction drawings while pricing was then determined from online resources and RS Means cost data.

Table 1.1: Structural Metal Stud Wall Cost Breakdown

Structural Metal Stud Wall System Cost											
Item	Length	Number	Unit	Material C	ost	Material Total	Lab	or 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	Вх	\$ 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

Schedule Analysis

With the schedule being a very important factor in this project, it is imperative to find ways to decrease the schedule without decreasing quality. The current structural system is scheduled to take 455 days which includes some time for MEP rough-in since those two activities have to work concurrently. The structural metal stud system is excepted to take 405 days. The quantities were based off the construction plans broken into 10 sections. The construction duration is based off a crew size of two workers with a daily crew output of 34 linear feet per day. The daily output is minimum per crew because the studs will be placed 12 inches on center. A company installing structural wall systems would be able to put at least 3 crews on site until their job is finished. This data is represented in Table 1.2. Table 1.4 compares the original project schedule of 455 days to install the CMU walls to the structural metal stud system of 405 days per section. An important item to note is when installing structural CMU walls the rough-in MEP systems go along with the construction of the CMU walls. When installing structural metal stud walls the walls must go up first then the MEP trades come in after instead of working concurrently. The MEP trades will be able to work right behind the structural metal stud crew concurrently while the floors are being formed and poured, just not in the same area. Since the structural walls are a critical path activity every day saved will result in turning over the project earlier. This will result in general conditions cost savings. The added schedule time will result from hanging additional drywall. This is referred to in Table 1.3. To install the additional drywall the duration is 100 days. This duration does not increase the schedule 100 days because the drywall trade will be able to hang and finish right after the MEP rough-Ins. The drywall trade's daily output per hour doubles what the structural crew can do per linear foot based off 10 foot ceilings. If the drywall crew starts while the structural metal crew is half way done they should be able to

finish close to the same time. To give float for the drywall crew, a 25 day extension can be added to the schedule.

The Gantt Schedule shows how the schedule will operate. The schedule will be 405 working days if each building section started when the other finished. The Gantt Schedule represents the flow of work. When moving to a different floor the workers will be able to start- to- start from the previous section. For example ID 3 shows 2SS + 13 days. This means that pod A 2nd floor will start 13 days after pod B 1st floor starts. This saves 4 days between these two activities because it is not a finish to start relationship. While taking this into consideration the duration to install metal studs would decrease to 354 days. The additional 25 days for the drywall crew will total 379 days. This results in a schedule savings of 76 days.

Table 1.2: Durations for Metal Stud Walls

	Calculated Durations For Metal Stud Walls								
Building Section	Unit	Take-off	Men per Crew	Daily Crew Output	number of crews	Total Manpower	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(#of crews x output per hour)	Duration (Days) # hours/8
Α	LF	5000	2	34	3	6	4	392.16	49.02
В	LF	5600	2	34	3	6	4	439.22	54.90
С	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
							Tota	nl .	404.90

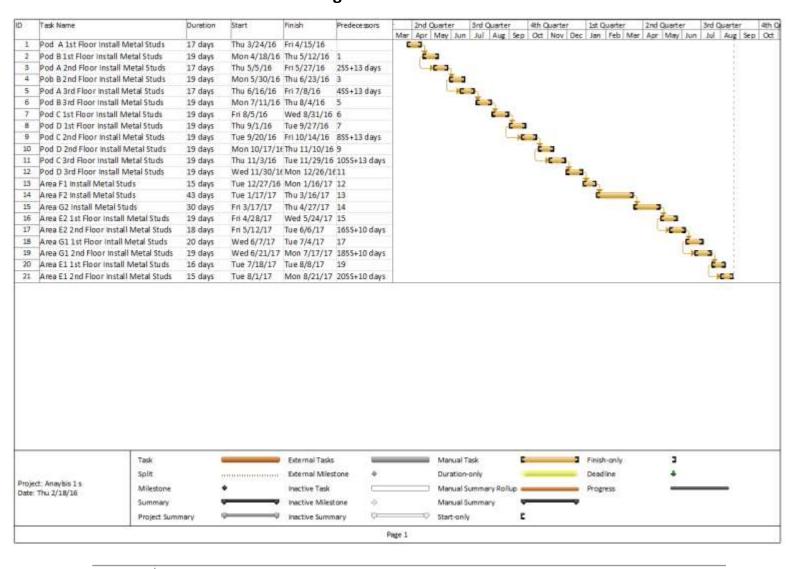
Table 1.3: Durations for Drywall Installation and Finishing

	Calculated Durations For Drywall Durations								
Building Section	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower	Output Per Hour daily output/8hr	Duration (Hrs) takeoff/(# of crews x output per hour)	Duration (Days) # hours/8
Α	SF	46000	2	675	5	10	84	109.04	13.63
В	SF	44500	2	675	5	10	84	105.48	13.19
С	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
							Tota	al	99.70

Table 1.4: S-F Durations for CMU vs. Metal Stud

Durations for CMU vs. Metal Stud Walls							
Building Section	CMU Walls Schedule Duration (Days)	Metal Stud Walls Schedule Duration (Days)					
А	65	49.02					
В	75	54.90					
С	75	54.90					
D	75	54.90					
E1	20	30.39					
E2	25	36.27					
F1	10	14.71					
F2	45	42.16					
G1	40	38.24					
G2	25	29.41					
Total	455	404.90					
	Time Savings	50.10					

Fig 1.1: Gantt Schedule



Conclusion and Recommendation

After completing the cost and schedule analysis changing the interior CMU walls to structural metals studs will result in schedule and cost savings. Directly the structural costs go down but indirectly the overall cost is affected because of the increase labor and material costs for drywall. The direct structural savings is around \$7 per square foot and the overall savings cost is about \$5.50 per square foot. The schedule can only move as fast as the resources available let you. This means that if the structural metal stud contractor is down a crew due to illness the schedule will fall behind because the resources are not available to keep up with the necessary daily output needed to keep schedule. The direct structural schedule savings is 101 days but due to the additional drywall the schedule savings is 76 days. One reason the school district might not have went with a system like this is durability. CMU walls do not wear and tear like drywall does.

Acoustical Breadth

Sound Transfer differences between CMU Walls and Structural Metal Stud Walls

Research

There are standards in today's industry that regulate how much sound can pass or be transmitted through walls, ceilings, floors, etc. This is standardized by the sound transmission class (STC) which is a single number rating of the sound transmission loss (TL) of an assembly measured at standard one-third octave band frequencies. STC levels depend on what noise levels will be occupying the room. The American National Standard for Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools specify the STC value in which specific rooms must have. Table B.1 shows music rooms have a recommended STC value of 60.

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

	Adjacent space							
Receiving ancillary learning 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 ¹ , cafeteria, gymnasium, or indoor swimming pool				
Corridor used as ancillary learning space	45	60 ^{c)}	45 ^{d)}	55 ⁹				
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.

Analysis

For this analysis the original wall system between the music classroom and the band room consist of an 8" CMU on the music classroom side with 3" mineral wool insulation in the middle and 12" CMU wall on the band room side as seen in Fig 1. This wall will be compared to the new structural metal stud wall being studied as the new potential interior structural wall. The structural metal stud wall being studied will consist of 24 gauge studs, 3 layers of 5/8" gypsum board on each side of 3-5/8" studs 24" O.C., with 3" FG shown in Fig. 1.3.

Fig. 1.2: 3A3.16 Wall Section: Music Classroom-Band Room

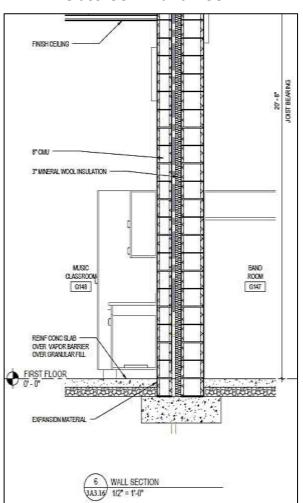


Fig. 1.3: Designed Metal Stud Wall

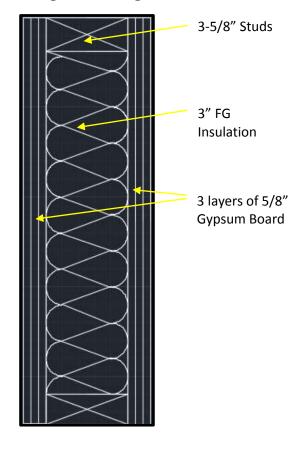


Table 1.5 and Graph 1.1 show the STC value for the potential structural metal stud wall. This wall was designed to meet the recommended rating of 60 STC. The graphs can be better represented in the form of the tables to show the magnitude and number of deficiencies that are in the graphs. A deficiency cannot be any higher than 8 and there can also be no more than 32 total deficiencies. The TL values are given from Architectural Acoustics, Appendix J.

Table 1.5: Sound Transmission Class (STC): 24g studs, 5/8" GB (3+3 layers) on 3-5/8" Studs 24" o.c., 3"FG

STC	60
-----	----

1/3 Octave- Band Frequency	Contour Level	TL	Deficiency	Max Deficiency ≤ 8 dB?
(Hz)	(dB)	(dB)	(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

Graph 1.1: Sound Transmission Class (STC): 24g studs, 5/8" GB (3+3 layers) on 3-5/8" Studs 24" o.c., 3"FG

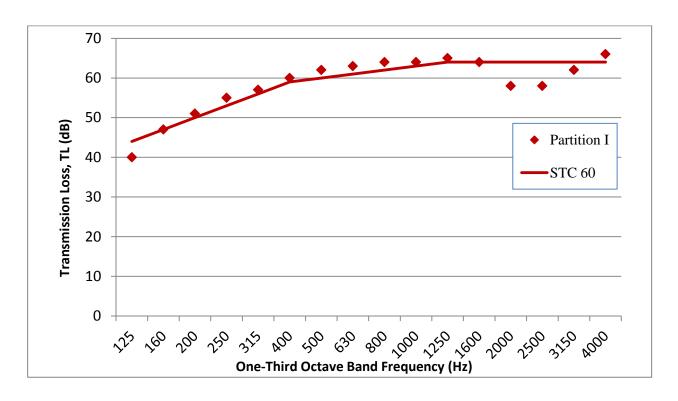


Table 1.6 and Graph 1.2 show the STC value for an 8" CMU wall. Table 1.7 and Graph 1.3 should the STC value for a 12" CMU wall. Also since there is 3" wool insulation between the CMU walls it can be determined that the STC value through this wall would exceed 60 in which the wall that is planned to be built will be more efficient of blocking noise than the structural metal stud wall. The combined STC value is around 60 for the structural metal stud wall. It is difficult to determine exact STC of an assembly without physically testing it in lab setting. The measurements that are found in Appendix J are laboratory measurements. All leaks are sealed and any flanking transmission is at a minimum.

Table 1.6: Sound Transmission Class (STC): Hollow (8") Lightweight CMU

1/3 Octave- Band Frequency	Contour Level	TL	Deficiency	Max Deficiency ≤ 8 dB?
(Hz)	(dB)	(dB)	(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	ОК
400	43	40	3	ОК
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

Graph 1.2: Sound Transmission Class (STC): Hollow (8") Lightweight

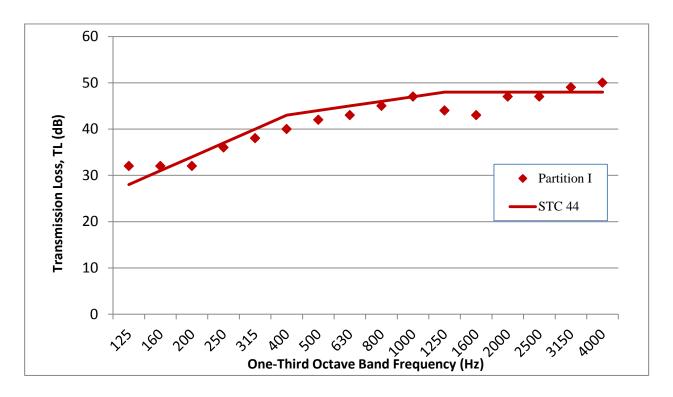


Table 1.7: Sound Transmission Class (STC): Hollow (12") Lightweight CMU

STC	39

1/3 Octave- Band Frequency	Contour Level	TL	Deficiency	Max Deficiency ≤ 8 dB?	
(Hz)	(dB)	(dB)	(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	ОК	
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	ОК	
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

Graph 1.3: Sound Transmission Class (STC): Hollow (12") Lightweight

Conclusion

Both wall systems will deliver the recommended STC values for music classrooms of 60 or above. The existing design of the CMU walls will have a higher STC rating but there will be no adverse effect of changing systems when it comes to sound transfer performance. The recommendation from this study is that a music room should have a very high STC value. If the walls were changed to structural metal studs then the wall needs to be designed to the STC value desired.

Analysis 2: Existing Roof Redesign

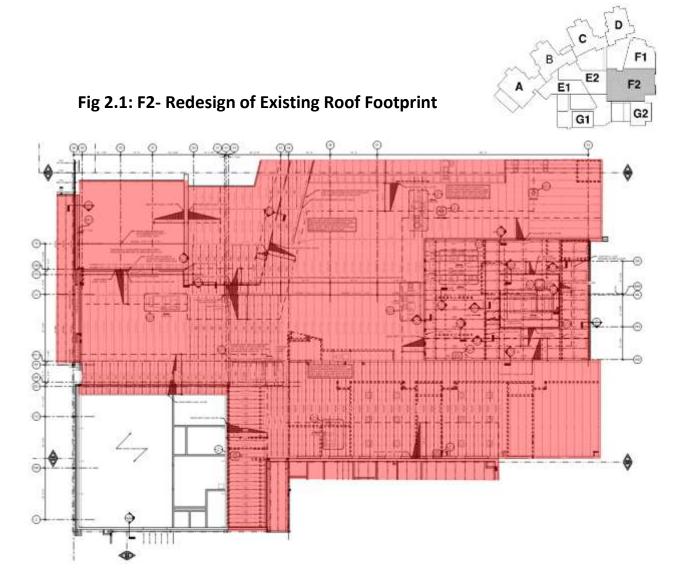
Problem Identification

There are areas that will experience additional snow loads on the roof. The existing one story roof will have to be redesigned due to the additional snow load it will be experiencing from the new adjacent 3 story building. While the old steel joists were not designed to carry additional snow load from the adjacent stories there needs to be additional joists install. The existing plan right now is to add in the same size joists next to the existing ones. This is a logistical problem, maneuvering them through the building and installing the joists in place. To save time the roof should be demolished and new steel joists should be set.

Process

In section F2 in the South Building there will be demolition and renovation. Part of the renovation will be adding additional joists to support snow load that will be experienced from larger stories from the new adjacent construction. In order to install these new joists all the MEP systems will have to be dissembled. This will allowed new systems to be installed with the updated building except the plan is not to update the roof until further down the road. Logistically, this is not the best plan because there will be demolition all around this area. Since the demolition will be in the same the joists could be replaced with higher gauge to support the additional snow load and to update the roofing. Spending 120 million dollars on a building and not update part of the roof sounds obscure. This should be one of the first items updated before anything else.

The items that need to be analyzed in this study is to determine the cost of demolition. This includes ripping out the existing steel joists and MEP systems. Evaluate the sequence of demolition and installation of new roof. Determine production rates for demolition of the joists and installation of the new roof. Not all the joists will be the same size but for scheduling and pricing simplicity the 12k1 series joists were priced and scheduled to the production rate. Fig. 2.1 shows which area will require additional joists and the proposed area for demolition. Quantities were first derived from the construction drawings while pricing was then determined from online resources and RS Means cost data.



Cost Analysis

The cost breakdown of the proposed task can be found in Table 2.1. The total cost for demoing the existing roof structure and replacing the roof plus joists is \$510,057. A The Demolition cost does include the demo and take away of the debris. This was the lowest line item at \$15,717 and the highest line item being the modified bituminous membrane roofing at \$332,880. Massaro does not have a specific cost associated with this activity in this stage of the project. The project manager and superintendent are pushing to demo the existing roof and replace it to the school board, but in the end it will come down to how the budget works out.

Table 2.1: F2- Redesign of Existing Roof Cost Breakdown

F2 Redesign of Existing Roof Cost Breakdown										
Item	Amount	Unit Material Cost		Material Total	Labor Cost	Labor Total	Equipme nt 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	
					Т	otal	\$ 510,057.00			

Schedule Analysis

The new schedule duration for demoing the existing roof, roof structure and MEP systems, installing new joists, and installing new roofing comes to 50 day duration. The Demolition and installing new joists is scheduled to only take about 9 days. Massaro plans on cutting out the MEP systems while adding more joists to support the additional load. Cutting the MEP systems out will be a strenuous task. Maneuvering these joists through the school and up into place will take time. These activities will have to be sequenced from start to finish and will result in at least a 3 week duration. The new plan with demoing the roof and joist structure will allow the joists to be set then beneath the joists the MEP trades can begin and above the joists the roof can be started. Allowing the MEP trades to start 11 days after demoing proves that this could be a quicker construction process. Installing the joists, roof decking, insulation, and roofing can be installed in a concurrent matter referred to in Fig 2.2. This will allow the new roof to be completed as fast as possible while the MEP trades start rough-in. Demoing the existing roof and joist structural will allow a higher quality job.

Table 2.2: F2- Redesign of Existing Roof Activity Durations

F2- Calculated Durations For Roof Redesign										
Activity	Unit	Take-off	Men per Crew	Daily Crew Output	Number of Crews	Total Manpower	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	



Fig 2.2: Gantt Schedule

Conclusion and Recommendation

The decision to modify the roof or to replace it is up to the school board. The concluding evidence from this study is that the schedule would actually be decreased in the allowance to start MEP work. At this time the costs cannot be compared due to not having an original cost breakdown. What can be inferred from this analysis is that the costs will probably come out higher for replacing the roof and roof structure. This will result in a higher quality project from the beginning for years to come.

Structural Breadth Analysis Determining New Size Joists due to Additional Snow Loads

Research

The State College High School consists of renovations, demolitions, and new construction; because of this the existing roof structures will be experiencing additional loads due to drifting snow. This in turn will create additional stress on the supporting joists causing failure. To prevent this from happening, a structural analysis will be performed on the roof structure to determine the new joists that are needed. The highlighted area is where the structural analysis will be performed.

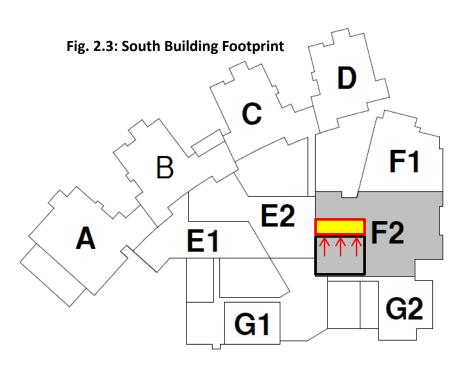


Fig. 2.4: Rendering of South Building



Analysis

The existing roof structure that will be experiencing most of the snow drift will be the area highlighted in yellow. This area will be experiencing 95psf of additional snow load due to the higher roof adjacent to this area. The length of the space is 76.12 feet and the width is 12.7 feet. There are 19 joists space evenly at 4 feet apart. The length of each joist will be 12.7 feet with a tributary width of 4 feet. Fig. 2.5 was used to determine the materials that were used for the roof.

Dead Load:

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

 $D_T = 16psf$

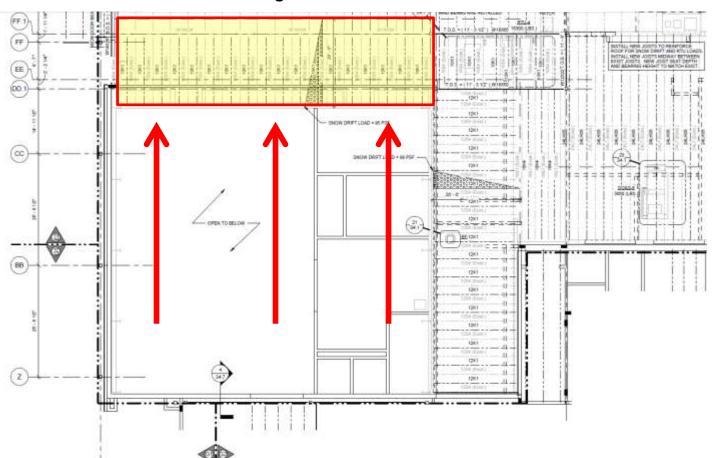


Fig. 2.5: 2S1.6 Roof Structure

The first step will be determining the roof decking. When calculating the roof decking equation 1 and 2 are used. D stands for Dead Load and L stands for Live Load.

$$W_T = 1.2D + 1.6L$$
 (Equation 1)

$$W_{LL} = L$$
 (Equation 2)

In Equation 1, D equals 16psf and L equals 95psf, in which W_T equals 171.2 psf. Equation 2, L equals 95psf which is the snow live load. Using Vulcraft Steel Roof and Floor Deck Catalog and the table for Vertical Loads for Type 1.5B it was determine that the roof decking should be 1.5B19, Appendix C shows the table that was used; 186psf is greater than 171.2psf and 250psf is greater than 95psf it is concluded that the roof decking is 1.5B19.

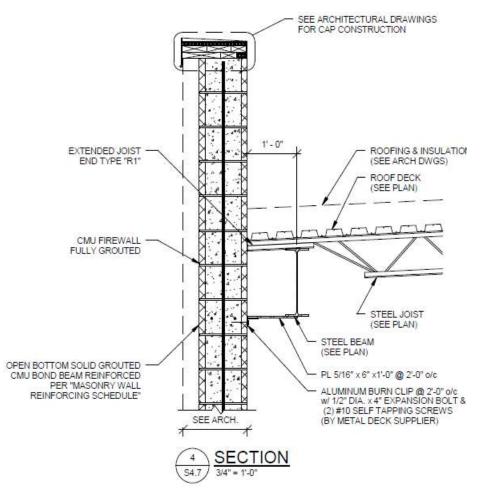


Fig. 2.6: Section 4- S4.8

To determine the steel joists equations 3 and 4 were used. D stands for Dead Load, L stands for Live Load, and T_w stands for Tributary Width.

$$W_T = (1.2D + 1.6L) \times T_w$$
 (Equation 3)

$$W_{LL} = (L) \times T_w$$
 (Equation 4)

In Equation 3, D equals 16psf, L equals 95psf, and T_W equals 4 feet in which W_T equals 684.8plf. Equation 4, L equals 95psf and T_W equals 4 feet, W_{LL} equals 380plf. Using the 42nd Edition Catalog of Standard Specifications and the table for Standard LRFD it was determined the joists to be a 12K1. Appendix D shows the table that was used; 825plf is greater than 684.8plf and 510plf is greater than 380plf concludes the joists are 12K1.

Conclusion

The steel joists that have to be used when replacing the roof in this particular spot will need to be 12K1. Massaro is planning to keep the existing joists there and installing new joists which are 10K1. This makes sense that they would use a smaller gauge joists because the existing joists still help support the load.

Analysis 3: SIPS- Interior Finishes Pods A-D

Problem Identification

Interior finishes, sequence properly, is where a project can pick up lost time. Creating a schedule that is effective and efficient will allow the interior finishes to flow in a sequence with less errors and a better quality of work. Construction projects always face delays, whether it is from unforeseen conditions or from contractor errors. Unforeseen conditions could happen in this project because of the demolition, renovation, and new construction all in the same building. This will cause the schedule to be delayed and lengthen. In order to prepare for these delays there needs to be a Short Interval Production Schedule developed for the interior trades, where time can be made up. Since this is a school project, the schedule has to align with the school calendar so the students are not disrupted in the middle of the school year.

Process

The goal of this analysis is to demonstrate the potential scheduled benefits that a short interval production can provide to the construction of the interior finishes on the pods C through D. Through the studies of the Masters Classes in Architectural Engineering a Short Interval Production Schedule will be developed in order to maximize the efficiency of the interior trades of Pods A-D. Analyzing the schedule for the interior finishes starting with hanging drywall and finishing with final cleaning will result in a more accurate and shorten duration for the project. Realizing there is no option for delay on this project due to school being concurrently in working operation with construction, it is imperative that students are not disrupted in moving classrooms half way through the semester. In order to understand that there are always unforeseen delays the project staff needs to have a way to maintain the schedule by speeding up production. This will allow management to ensure subcontractors have better production and maintain the schedule. In the end it helps the subcontractors by having better production rates and overall saving costs on their end.

Each pod was broken up into three zones. The zones were broken up to ensure each zone had about the same amount of work per task and trade. For instance the square footage is around the same for installing ceiling tile, flooring and painting. The square footage for zone 1 is 6,836 sq. ft., zone 2 is 6,850 sq. ft. and zone 3 is 6869 sq. ft. The area was also divided up by the number of heat pumps, plumbing fixtures and lockers as seen in Fig 3.1.

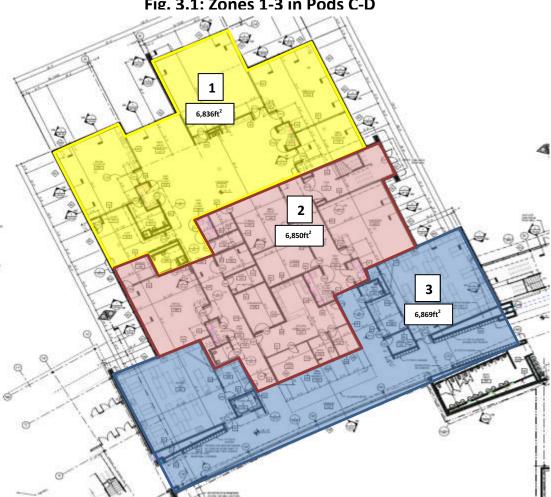


Fig. 3.1: Zones 1-3 in Pods C-D

Interior Trade Analysis

The next step in creating the Short Interval Production Schedule is to determine the trades needed for the construction of the interior. Table 3.1 represents the trades that are needed and required for the completion of the interior. ID number 5 is paint. Painting will be further analyzed since it is a critical activity because of the amount of work there is. To ensure it is completed in a specified duration the production rates were evaluated in Fig 3.3. Also ID 8 was analyzed because of the amount of work and time it takes to complete the activity. The activity is installing the grids in the ceilings for the ceiling tiles. ID 9 and 11 have a combined three activities in each group since these trades can work concurrently together and not be in each other's way.

Table 3.1: Interior Trade's Manpower

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						

Further Analysis of Finishing Trades

In tables 3.2 and 3.3 show the production rates for tasks installing ceiling grids and paint. Table 3.2 has each zone and the amount of square footage associated with the daily crew output. The daily crew output is 475 square feet. Each crew is made up of one crew member. The output per hour is 59 square feet. In order to create a two day duration per zone, there would need to be a total of eight crews. Realizing this is not the most realistic expectation, this activity will take a total of four days. For this task to be completed in four days, four crews will be needed. Table 3.3 shows the amount of paint that needs to be completed in each zone. The square footage is based off the linear footage of walls times an average height of ten feet per floor. Due to creating zones similar in square footage, the number of mechanical fixtures and number of miscellaneous tasks the square footage for the walls are larger in zone 2 with 12,075 sq. feet, zone 1 with 9,188 sq. feet and the smallest zone is zone 3 with 7,613 sq. feet. The daily crew output for painting is 2,275 square feet. Each crew has one painter and the output per hour is 2,084 square feet per hour. Zone 1 and zone 2 will need three crews in order to maintain a two day duration per zone. Zone 3 will need two crews in order to maintain a two day duration. Because Zone 3 is the smallest zone, and needs one less crew to maintain the necessary duration of two days, that crew can be utilized to prep and finalize Zones 1 and 2. The crew rates were determined with information from RS Means 2016.

Table 3.2: Durations for Ceiling Grid Install Pods C-D

	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	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

Table 3.3: Durations for Paint Install Pods C-D

	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	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

SIP Schedule

The short interval production schedule is based off of fifteen tasks, maintaining a two day duration as seen in Fig. 3.2. The outlier task is installing ceiling grids, which will maintain a four day duration per zone. The short interval production schedule for pods C-D begins the first week in July 2016. Each zone will begin two days after the previous zone has begun. The sequence will begin with the first floor of Pod C zone 1 and move to first floor Pod C zone 2 and 3. After the completion of the first floor of Pod C, the trades will move on to the first floor of Pod D, working from zone 1 to zone 3. The linear progression from the first floor of Pod c to the first floor of Pod D will require less vertical transportation of workers and material. This will result in time and schedule savings. After the first floor of Pod C and the first floor of Pod D are completed, interior trades will move on to the second floor and work from Pod C zones 1, 2, and 3, going on to the second floor of Pod D Zones 1, 2 and 3. The third floor will work in the same sequence. Using this method, a total of 5 weeks were taken off the original finish schedule resulting to about a 14.5 week duration to finish Pods C and D compared to the 19 week duration. Multiplying this out through Pods A and B, 9 total weeks will be saved on the schedule.

Building | Floor | Zone | Floor | Floo

Fig. 3.2: SIP Schedule for Pods C-D Interior Trades

Conclusion and Recommendation

The goal of this analysis is to demonstrate the potential schedule benefits that a short interval production schedule can provide to the construction of the interior finishes on the pods A through D. This will allow management to ensure subcontractors have better production and maintain the schedule. A total of 4.5 weeks were taken off the original finish schedule resulting to about 14.5 week duration to finish Pods C and D. Multiplying this out through Pods A and B, 9 total weeks will be saved on the schedule. This schedule savings will allow the project to maintain the schedule, regardless of any delays.

Analysis 4: Safety Provisions and Regulations during Construction while School is in Session

Problem Statement

The construction industry has safety hazards that workers and occupants are exposed on a daily occurrence. In order to maintain a safe work environment while building on an operating school there are regulations, provisions and trainings that the workers and students need to be exposed to. The purpose of this qualitative and descriptive study is to analyze the safety regulations, provisions, and trainings for workers and students at the construction site of State College Area High School. The research data will be gathered through literature review and interviews with the construction manager and the facility director of State College Area High School.

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?

Introduction

According to the U.S. Department of Education, Seventy-three percent of public schools report having undergone at least one major renovation (How Old Are America's Public Schools). With that being said, it is of the upmost importance to regulate the safety in the schools where construction is occurring. It is believed that the safety in the construction industry is still not among the top priorities in the field. According to the Occupational Safety & Health Administration (OSHA), one in ten construction workers are injured every year. OSHA also explains that these workers engage in many activities that expose them to serious hazards like falling, unguarded machinery, equipment accidents, electrocutions, silica dust and asbestos.

The construction industry is also ranked number two for most fatal injuries to workers under the age of eighteen (Construction Is 4th Most Dangerous Profession with 2nd Most Fatal Injuries). With that being said, the likelihood for harm to bystanders to construction is very likely as well. Safety is essential while working around students in an operating school. An operating school is extremely hard environment to work around. Although there are certain safety provisions and procedures to be set forth by the construction industry, they are not always implemented in the manner that they should be.

Construction in hospitals have very strict guidelines and codes to follow while working concurrently when the hospital is running and so should a school with children. The most interesting discussion in this topic is the lack of research done in the field. Although there are many statistics done about safety in the entire construction industry, there is a lack in school related construction. With the amount of schools

undergoing construction each year, safety plans and procedures should be laid out so the logistical part falls right into place.

The research topic will be designed to gather qualitative data on the guidelines, codes, provisions that are set forth in the construction industry while school is still in session. The philosophical view will be social constructionist because it will take the opinions and views from the participants to shape the codes and provisions that should be implemented into the construction industry.

Literature Review

Construction on operating schools is increasingly more difficult to facilitate and plan than other forms of construction. Although it may not be the most demanding or difficult in practice, its preparing and executing can be challenging. The challenges are communicating how to safely be on site, in school, while construction is happening around the occupants. Many times, school construction must take place while children are in school, even if contractors make the most of summer months and holidays. While projects may be small, there is much more risk due to the safety of the children. This includes trip hazards, security hazards, noise control, proper ventilation, falling objects, etc. The safety of the children not only comes from the facilitation of the construction, but also stems from contractors and subcontractors who work on the job. Maintaining the upmost safety begins with supplementary instructions given to bidders on a job. These supplementary instructions serve as an agreement that the signatory contractor will comply with all laws. These laws and duties stem from background checks for anyone working in a school near children, to any negligence caused on the job.

The first step when thinking about performing any kind of construction while students are in school is to pre-plan. Pre- construction planning will help all parties (students and contractors) to maintain a safe work environment. This includes all of the following: hazards, site preparation, scheduling and communication. Certain health matters must be addressed in the pre-construction stage, including, pollutants, toxic products, disturbance of toxic materials, dust and similar contaminants, odors, mold and noise. Pre planning for these measures may mean only allowing students in certain sections of the building, or requiring all workers and students to wear masks to prevent the spread of bacteria. By providing adequate ventilation systems from the start, there should be no problems in this area. These ventilation systems should be monitored throughout the project time.

Safety is another important step in the pre planning stages of construction. General isolation of construction areas from other school activities is recommended where possible. This eliminates the opportunity for any safety concerns to arise. Traffic, fires, unattended tools and equipment and open trenches are just a few of the many areas of concern for safety. Safety not only includes possible neglect and harm by the environment, but also by construction workers. Environmental hazards include dust, asbestos, and other possible dangers that are not caused workers themselves. By considering the work environment and separating workers from staff and students, you eliminate the possibility of harm or wrong doing by all parties. Pre planning in this stage requires special arrangements to be made for the use of hallways, stairways, elevators, etc. to ensure that only one party at a time is able to use. Some projects even require badge systems to be used at all times, so only approved workers may enter the building.

Project managers should do their best to schedule construction activity during summer months or while students and staffs are not working. This may require workers to work through the evenings, early mornings or on holidays. Any work that produces an excessive amount of noise, or debris should absolutely be performed when school is not in session. The creation of swing spaces are a useful technique

in these situations. This allows for activities to take place in other locations during construction. Certain areas of a school where things may be easily damaged may require more attention for this process to work. Advanced planning for scheduling and movement is crucial for a project to run smoothly.

Preparing the site for construction is absolutely necessary. By including this in the construction contract, you automatically eliminate the chance for this stage to get passed by. The contract should entail that the location must provide security, updated traffic patterns, barriers to separate construction, contaminant shields, fencing, overhead protection, noise control & debris removal. Project managers should hire qualified personnel to inspect and approve the site prior to the beginning of a project to ensure everything is up to standard.

The most important aspect of pre planning is communication. Communication needs to begin early and extend past the completion of a project. Communication extends not only to workers and managers, but to students, staff, parents and the entire community. Schools should take proper measures to insure that everyone on their end is informed. This may mean organizing a committee to relay messages to students and faculty about safety measures and rules during a construction period. Schools should also send out news letters to parents about the project, its length and safety precautions. As far as questions and complaints, the school must provide a way for these messages to be relayed. If there are any problems, they must be reported to an administrator as soon as possible. Opening the lines of communication can greatly affect the success of a project.

Preparation for emergencies requires a list of defined situations and their appropriate responses to be noted. Contacts for police, fire, hazardous materials, healthcare professionals and anyone else should be readily available. Staff members and administrators should be assigned various responsibilities and tasks so in the case of an emergency, there is an action plan that can be immediately put into place. As in any other emergency action plan, an evacuation plan must be laid out. Accidental fire alarm triggering increases during construction times, so plans to deal with it should also be put in place. All plans must also consider staff and students of special needs who may need help in relocation plans.

Methodology

In order to complete this analysis the following deliverables must be completed:

- Research different provisions set forth in building codes and regulations for educational facilities.
- Investigate practical safety provisions implemented in the industry and educational facilities.
- Research available safety trainings that workers and students are exposed to.
- Ask open-ended questions from management at Massaro to understand their plan for safety on the job with open ended questions
- Conduct interviews with the facility director for the State College High School to understand their safety plan during construction with open ended questions
- Examine other case studies and their implementation of safety on an operating school along with construction.
- Evaluate the safety provisions, regulations and trainings.
- Analyze Massaros' and State College High Schools' safety plans to investigate what provisions and regulations are needed.
- Determine if other necessary provisions and relegations need to be enforced in order to keep a safe project.

Results and Discussion

The Public School Code requires that the contractors are required to submit their background check reports to the owner. The background checks cannot be more than one year old at the time submitted to the owner. There are three required background checks for all contactors employees, prospective employees, and subcontractors that must be submitted which are: Pennsylvania State Police Criminal History Record, Department of Public Welfare Child Abuse Report and Federal Criminal History Record Information. These checks are required by the owner for purpose that the contractors will be working alongside an operating school with children. Some of these workers will be in direct contact with students and it is imperative that the workers will be identified as safe to be around children. It contractor does not submit these background checks or falsifies them they are subject to any claim, proceeding, lawsuit, fine, civil penalty or other legal involvement arising from neglect or failure of the contractor (Public School Code Agreement).

Occupational Safety and Health Administration (OSHA), (General Safety and Health Provisions), section 1926, Safety and Health Regulations for Construction; programs from this section shall be enforced by the employer on the project. These programs include:

- Frequent and regular inspections of the job sites, materials, and equipment to be made by competent persons designated by the employers.
- Machines, tools, materials should be identified as unsafe by tagging or locking the controls to disable the item or should be removed from the operation.
- Employees operating equipment or machinery should be qualified by training or experience.
- Inspections to ensure all employees wear Personal Protective Equipment (PPE).
- To ensure there are training sessions on hazards related to matters exposed to on the specific site.

Environmental Protection Agency (EPA) has an act called The Asbestos Hazard Emergency Response Act (AHERA, (School Buildings), which provides steps on how to properly deal with asbestos abatement. Its regulations require public school districts and non-profit schools including charter schools and schools affiliated with religious institutions to inspect their schools for asbestos containing building material and prepare management plans for the prevention and reduction of asbestos hazards. If schools are in session and abatement is happening, the schools have to abide by the Asbestos National Emissions Standards for Hazardous Air Pollutants (NESHAP). This act specifies particular manufacturing and fabrication operations either cannot emit visible emissions into the outside air or must follow air cleaning procedures.

Tim Jones from Massaro Construction Management Services (MCMS) was able to provide information on safety aspects that Massaro will be implementing. No safety items are required for the low bid procurement. Once the trade is procured from the low bid procurement, the trade must provide a site specific safety plan for review. As for the pre-planning process for safety, Massaro starts each meeting with safety. The construction management firm and trades focus on student safety first and then plan the work for a safe and successful completion. As new subcontractors are mobilizing on site Massaro works with them to review their safety plans for that particular day. Massaro will ensure all companies comply with the Public School Act. All workers will be required to submit clearances prior to starting on the jobsite and will be reviewed by the MCMS and District. Once the worker is approved, they will be able to start work. The workers will be issued a photo ID by MCMS. All workers are required to have their ID visibly displayed at all times per the contract documents. Massaro's management staff will ensure this is done by

review on site.

Dealing with hazardous materials Massaro will obey the OSHA 1926 and DEP regulations when exposed to asbestos and other hazardous materials. Asbestos abatement materials are handled through the DEP regulations, general materials for construction are handled by OSHA 1926 and waste removal needs to comply with the Centre County Refuse requirements. Massaro plans to deal with significantly disrupting activities before or after the school day in order not to disrupt the school day. Massaro has weekly meetings with the High School Principals to coordinate the upcoming disturbances to stay upfront with communication.

Massaro will provide a safe indoor air quality by first starting with proper separation of work between construction and occupied areas. Where there are intake louvers, they may need to be masked off. In the construction zone all ductwork is to be delivered and installed in a sealed condition. A term referred to as "dust down" is to be used when sweeping floors to control airborne dust. To minimize the amount of dust and dirt within the building, it is important to use proper walk off matts and boot brushes and when cutting all saws need to be watered or properly vented. Proper housekeeping is essential to minimizing dust throughout the building.

If there is a problem on site, Massaro will call 911 in an emergency situation first. From there they will coordinate access of first responders through the site to the incident location. Massaro will coordinate with the school district depending if further steps need to be taken like building evacuation. Tim Jones and his team are in constant contact with the building users and likewise Massaro is notified if there is an incident in the building that would affect the safety of the construction workers like fire, an active shooter or bomb threat.

There was a list of questions Edward Poprik, Facility Director of State College High School, responded to about safety on the operating school doing construction. The State College Area High School has employed Massaro Construction Management to execute the overall safety plan for the project. Me. Poprik is generally on site every day to do an informal safety assessment. They also meet Mondays with the building administrators to discuss disturbances as well as any safety related issues. The building principals send weekly updates based on the outcome of their Monday meeting. If there are larger specific issues such as traffic flow, the school will use district emergency phone notification system, text messages, emails, website and social media.

Students will be exposed to a variety of safety concerns which will be discussed below. A specific activity the students do every day is cross the street. The road crossing has been a regular activity for decades. The general routine of having crossing guards will be maintained. The road has always been very well traveled. The school board will require the contractors to limit road activities during key hours. Students are always curious when noticing something different going on around them. To prevent the students from wondering on the job or walking into unsafe areas a perimeter fence will installed. This will maintain a boundary of where and not where the students can access. The interaction between contractors and students is a critical issue. All contractors are required to have background checks and be registered with the construction manager. The phasing plan will limit the amount of time contractors need to spend in occupied buildings.

Conclusions

The report covered a variety of safety provisions and regulations set forth for the construction industry while constructing on an operating school. The analysis focused on a case study of the State College Area High School. There are a number of provisions and regulations that must be abided by. In order to achieve these provisions and regulations successfully there needs to be quality controls in place. The project team must ensure all the provisions and regulations are meant and are in working order. One shortcoming or gab could lead to a serious problem for someone working on the site or an occupant of the building. Recommendation for this analysis is that the construction manager needs to have a full time safety manager that ensures all these provisions and regulations are being meant.

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Conclusions & Recommendations

Analysis 1: Design of Interior Walls/ Partitions

After completing the cost and schedule analysis changing the interior CMU walls to structural metals studs will result in schedule and cost savings. Directly the structural costs go down but indirectly the overall cost is affected because of the increase labor and material costs for drywall. The direct structural savings is around \$7 per square foot and the overall savings cost is about \$5.50 per square foot. The direct structural schedule savings is 101 days but due to the additional drywall the schedule savings is 76 days. The recommendations that should be considered here is if the saved costs can be implemented in updating other parts of the building, such as the roof in section F2.

Analysis 2: Exisiting Roof Redesign

The decision to modify the roof or to replace it is up to the school board. The concluding evidence from this study is that the schedule would actually be decreased about 4 work days because of allowing the MEP trades to start sooner. At this time the costs cannot be compared due to not having an original cost breakdown. What can be inferred from this analysis is that the costs will probably come out higher for replacing the roof and roof structure. This will result in a higher quality project from the beginning and years to come. A recommendation would be to analyze the budget and see where extra costs could be cut. This in turn would free up capital to allow the roof to be demoed and rebuilt without sacrificing the quality of the building.

Analysis 3: SIPS- Interior Finishes Pods A-D

The goal of this analysis is to demonstrate the potential scheduled benefits that a short interval production schedule can provide to the construction of the interior finishes on the pods A through D. This will allow management to ensure subcontractors have better production and maintain the schedule. A total of 4.5 weeks were taken off the original finish schedule resulting to about a 14.5 week duration to finish Pods C and D. Multiplying this out through Pods A and B, 9 total weeks will be saved on the schedule. This schedule savings will allow the project to maintain the schedule, regardless of any delays. The concluding recommendation from this study is to break the interior finishing into fifteen tasks, with a two day duration, and paint with a four day duration, you can save a total of 9 weeks for the build out of the interior.

Analysis 4: Safety Provisions during Construction while School is in Session

This analysis covered a variety of safety provisions and regulations set forth for the construction industry while constructing on an operating school. The analysis focused on a case study of the State College Area High School. There are a number of provisions and regulations that must be abided by. In order to achieve these provisions and regulations successfully, there needs to be quality controls in place. The project team must ensure all the provisions and regulations are meant and are in working order. One shortcoming or gab could lead to a serious problem for someone working on the site or an occupant of the building. Recommendation for this analysis is that the construction manager needs to have a full time safety manager that ensures all these provisions and regulations are being meant.

Appendix A

Acoustical Society of America



Acoustical Society of America

ANSI/ASA S12.60-2010/Part 1 American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools

is made available to the end user as a public service by the following companies.



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

		Adjace	nt space	
Receiving ancillary learning 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 ¹⁾ , 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.

Commentary-5.4.2.3. Composite assemblies are walls, floor-ceiling and roof-ceiling constructions composed of more than one element (for example, a wall with a door, window, or penetrations by HVAC ducts or other services). This standard requires that walls between core learning spaces conform to the composite STC requirement, which means that any door in such a wall will need to be acoustically rated. See 5.4.2.3 for special requirements for doors in corridor, office or conference room walls that are not required to conform to the STC requirements for composite walls including the doors. Walls and floor-ceiling assemblies may not maintain their design STC rating if penetrations or openings for piping; electrical devices; recessed cabinets; soffits; or heating, ventilating or exhaust ducts are unsealed.

Commentary-5.4.2.4. The intent of the STC 30 requirement is to require solid core wood doors or heavy-duty steel doors with good seals. The location of classroom entry doors across a corridor should be staggered to minimize sound transmission between these classrooms. Provisions should be made to ensure that the perimeter seals of sound-rated doors are well maintained. Seals for entrance doors should be inspected and adjusted, as necessary, every six months. Gaskets of door seals should never be painted.

Commentary-5.4.3 Structure-borne impact sound isolation. There is no way to analytically predict an IIC rating. Structures have to be tested. Very little if any test data are available for classroom type structures. Almost all test data are for residential structures with gypsum ceilings. Achieving this rating with frame-type construction usually requires an isolated gypsum ceiling and a cushioning agent under a hard surface floor or the use of carpet. This standard requires conformance to the IIC requirements without carpet even if carpet is to be used.

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Appendix B

Architectural Acoustics: Appendix J

APPENDIX J

Sound Transmission Loss Data

Assembly/Frequency (Hz)		STC	100	125	160	200	250
Metal stud, gypsum board (GB) assemblies with or without mi	nera	al wool	or fiber	glass (F	G) insul	ation	
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
Same as above plus an additional layer GB on one side (2+1 layers)		50	22	31	31	38	43
Same as above with two layers GB on each side (2+2 layers)		53	28	35	35	41	48
5/8" GB on each side of 2-1/2" studs 24" o.c., no insulation		39	22	24	24	28	37
Same as above plus 1-1/2" FG		46	17	26	28	37	42
Same as above, but with two layers GB on each side (2+2 layers)		54	30	37	37	41	46
/2" GB on each side of 3-5/8" studs 16" o.c., no insulation	E	43	19	26	23	29	36
Same as above but with 3" FG	P	49	20	28	30	37	43
wo 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
/8" GB each side of 3-5/8" studs 24" o.c. plus 1-1/2" FG	7	45	22	29	31	39	41
same as above but with 3" FG	C	49	18	32	33	39	44
/8" GB (2+1 layers) on 3-5/8" studs 24" o.c. and 2" FG		51	28	36	37	42	46
same as above except 3" FG		53	25	35	41	46	51
/8" GB (2+2 layers) on 3-5/8" studs 24" o.c., no insulation		48	27	34	30	37	41
/8" GB (2+2 layers) on 3-5/8" studs 24" o.c., 3" FG		57	28	38	44	47	52
same as above except 3+3 GB layers, a total of 6 GB layers	-	61	33	40	47	51	55
20 g. studs							
/2" GB on each side of 3-5/8" studs, no insulation		39	16	26	19	26	36
ame as above plus 2" FG		41	19	30	29	34	43

Note: The TL data presented in this appendix has been compiled from several sources. The data can vary somewhat from laboratory to laboratory, for the exactly same assembly. It can also vary with the density and other properties of material. Although they are reasonably accurate, the values given here should be regarded as representative values only. Laboratory test data and manufacturers' data must be obtained before use in an actual design problem.

300	400	500	630	800	1,000	1,250	1,600	2,000	2,500	3,150	4,000
		= v									
44	48	51	53	55	57	58	58	54	45	43	46
48	51	53	54	56	58	57	59	54	47	47	50
52	54	55	55	57	59	58	60	56	50	. 51	54
34	41	44	45	47	49	50	44	36	35	40	41
47	51	53	54	56	58	58	57	44	42	46,	48
50	53	55	55	59	60	58	56	51	51	54	58
36	42	43	47	48	51	54	53	48	42	40	43
43	49	51	54	55	58	60	60	55	48	46	50
51	55	56	56	60	61	60	63	59	52	54	57
43	49	51	53	55	56	57	55	43	41	46	48
45	48	51	55	57	58	58	57	55	45	46	53
50	52	54	55	59	59	58	58	47	47	51	5
54	56	59	58	58	58	60	60	55	49	54	5
42	48	51	52	53	54	55	56	46	45	48	5
55	58	59	59	60	60	62	61	56	53	58	6
57	60	62	63	64	64	65	64	58	58	62	6
35	40	41	43	45	47	50	48	38	36	40	4
44	44	46	48	51	52	52	48	37	38	42	4

Assembly/Frequency (Hz)	STC	100	125	160	200	250
Hollow (8") lightweight concrete block masonry						
Conc. block — plain	44	30	32	32	32	36
Same as above, but 2 coats of paint or block filler both sides	48	38	38	36	36	38
Conc. block plus 1/2" plaster both sides	51	36	36	35	39	41
Conc. block, 5/8" GB on 1-1/2" furring, 1-1/2" FG bet. furring	55	29	37	42	49	48
Same as above but GB on resilient channels	58	33	35	39	43	47
Same as above but paint block on side opposite GB	60	38	41	43	47	49
Conc. block, 5/8" GB on 3" Z-channels	58	30	34	38	41	46
Same as above but with 3" FG between Z-channels	61	35	42	44	48	49
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
Same as above, but FG in both stud cavities	72	40	49	54	62	67
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
Hollow (6") lightweight concrete block masonry						
Cone, block — plain	44	29	29	30	31	33
Same as above but with 2 coats of paint or block filler	48	36	38	39	36	34
Conc. block, 1/2" GB on 3/4" furring strips	49	30	31	30	33	35
Same as above but with 3/4" FG in cavity between furring strips	- 50	28	28	31	36	37
Conc. block, 1/2" GB on 1-1/2" furring strips and 1-1/2" FG in cavity	55	31	38	45	45	42
Conc. block, 2-1/2" metal studs plus 5/8" GB with 2-1/2" FG	61	39	44	46	47	48
Hollow (12") lightweight concrete block masonry						
Conc. block — plain	39	26	29	30	31	31
Same as above but with 3 coats of paint or block filler to one side	51	28	35	35	40	43
Same as above but add resilient channels and 1/2" GB on one side	57	31	37	37	41	46

800	400	500	630	800	1,000	1,250	1,600	2,000	2,500	3,150	4,000
12											
38	40	42	43	45	47	44	43	47	47	49	50
42	44	45	47	48	50	51	52	52	51	52	55
42	44	48	50	52	54	55	57	60	62	60	60
47	49	50	52	55	57	60	62	61	58	61	66
50	55	56	59	60	60	62	62	62	62	62	64
52	57	58	58	63	66	68	70	69	68	69	72
52	56	58	60	62	62	64	65	65	62	65	70
56	58	59	60	62	62	64	65	65	62	66	72
69	73	74	74	75	73	72	72	73	71	75	78
73	73	75	74	76	74	73	73	73	72	77	80
70	72	74	76	77	76	74	73	71	69	74	78
37	38	40	43	45	47	48	51	55	55	53	54
38	40	43	46	49	52	54	55	58	62	64	65
41	43	48	52	55	57	57	58	61	64	63	60
44	45	49	52	54	56	56	60	63	61	58	61
45	49	51	53	57	60	63	64	66	66	64	67
52	56	58	60	63	65	66	66	67	69	73	76
34	34	35	35	33	35	41	45	48	50	52	54
43	44	45	48	50	51	54	56	57	56	58	60
49	52	55	59	62	66	69	72	72	69	68	70

Appendix C

Vulcraft Steel Roof and Floor Deck Catalog

Appendix 3

Reference Material for AE 404

Pages from 42rd Edition Catalog of Standard Specifications And Load and Weight Tables for Steel Joists And Joist Girders

From http://steeljoist.org

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 inches⁴ is; I_j = 26.767(W_{LL})(L³)(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

		Ba	sed on a							IOISTS, F Pounds p			plf)			
Joist Designation	BK1	10K1	12K1	12K3	12K5	14K1	14K3	14K4	14K6	16K2	16K3	16K4	16K5	16K6	16K7	16K
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
Span (ft.)			1													
8	825 550															
9	825 550		1													
10	825 480	825 550	1													
11	798 377	825 542														
12	666 266	825 455	825 550	825 550	825 550											
13	565 225	718 363	625 510	825 510	825 510											
14	486 179	618 289	755 425	825 463	825 463	825 550	825 550	825 550	825 550							
15	421 145	537 234	651 344	814 428	825 434	766 476	825 507	825 507	825 507							
16	369 119	469 192	570 282	714 351	825 396	672 390	825 467	825 467	825 467	825 550	825 550	825 550	825 550	825 550	825 550	825 550
17		415 159	504 234	630 291	825 366	592 324	742 404	825 443	825 443	768 488	825 526	825 526	825 526	825 526	825 526	825 526
18		369 134	448 197	561 245	760 317	528 272	661 339	795 397	825 408	684 409	762 456	825 490	825 490	825 490	825 490	825 490
19		331	402 167	502 207	681 269	472 230	592 287	712 336	825 383	612 347	682 386	820 452	825 455	825 455	825 455	825 455
20		298 97	361	453 177	613 230	426 197	534 246	642 287	787 347	552 297	615 330	739 386	825 426	825 426	825 426	825
21		-37	327 123	409 153	555	385 170	483 212	582 248	712 299	499 255	556 285	670 333	754 373	822	825 406	825 406
22			298 106	373 132	505	351	439	529 215	648 259	454 222	505 247	609 289	687	747	825	825
23			271 93	340 116	462 150	321 128	402 160	483 188	592 226	415 194	462 216	556	627 282	682 307	760 339	82
24			249 81	312 101	423 132	294	367	442 165	543 199	381 170	424	252 510 221	575 248	627 269	697 298	82 34
25						270	339 124	408 145	501 175	351 150	390 167	469 195	529 219	576 238	642 263	77 31
26						249 88	313	376 129	462 156	324 133	360 148	433 173	489 194	532 211	592 233	71
27						231 79	289 98	349 115	427 139	300 119	334 132	402 155	453 173	493 188	549 208	658 246
28						214	270 88	324 103	397 124	279 106	310 118	373 138	421 155	469 168	510 186	612
29								1.00		289 95	289 106	348 124	391 139	427 151	475 167	570
30										241 86	270 96	324	366 126	399 137	444 151	53
31										226 78	252 87	304	342 114	373 124	415 137	49
32										213	237	285 92	321 103	349 112	388 124	486



Appendix D

42nd Edition Catalog of Standard Specifications

Appendix 1

Reference Material for AE 404

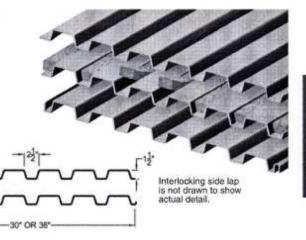
Pages from

Vulcraft Steel Roof and Floor Deck catalog
on Angel drive or
http://www.vulcraft.com (2008)

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 Approved²



SECTION PROPERTIES

Deck	Design	w		Section F	roperties		244	
type	thickness in.	psf	I _p	S _p	L,	S,	V _e lbs/ft	F _y ksi
	1/85		in ⁴ /ft	in ³ /ft	in*/ft	in ³ /ft	80000	11977
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	2.62	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		Ab	sorption	Coeffici	ient		Noise Reduction
Type	125	250	500	1000	2000	4000	Coefficient1
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/Ime

VERTICAL LOADS FOR TYPE 1.5B

Type B (wide rib) dack 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 auditiniums, 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.

	(Hearnest	Max.			Alic	wable Total d	PSF) / Load (Causing Defic	ution of L/24	or 1 inch (P	SF)		
No. of	Deck	5DI Const.	- Charles					n.) ctr to ctr a			-		and the sale
Spans	Type	Span	5-0	5-6	6-0	6-8	7-0	7-6	8-0	5-6	9-0	9-6	10-0
	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	307.14	27 / 12	25 / 10
3.	B20	6'-5	123 / 105	102 / 79	86 / 61	73 / 48	63 / 38	55 / 31	48 / 26	43 / 21	38 / 18	34 / 15	31 / 13
	B19	7:4	146 / 129	121 / 97	101 / 75	88 / 59	74 / 47	66 / 38	67 / 31	51/26	45/22	40 / 19	36 / 16
	B18	7-8	168 / 152	138 / 114	116 / 88	99769	85 / 55	74 / 45	66 / 37	58/31	52 / 26	46 / 22	42 / 11
	B16	8'+8	215 / 196	178 / 147	149 / 113	127 / 89	110 / 71	96 / 58	84 / 48	74 / 40	66 / 34	60 / 29	54/2
	B24	5'-10	124 / 153	103 / 115	88 / 88	74 / 70	64 / 58	56 / 45	49 / 37	43/31	39 / 26	35 / 22	31/1
90.	B22	6'-11	100/213	83 / 160	70 / 124	59 / 97	51/78	45 / 63	39 / 52	35 / 43	31/37	28 / 31	25/2
2	B20	7'-9	128 / 267	106 / 201	89 / 155	76 / 122	66/97	87 / 79	51/65	45 / 54	40 / 46	36 / 39	32/3
	B19	8'-6	150 / 320	124 / 240	104 / 185	89 / 145	77 / 116	67 / 95	59 / 79	52/65	47/55	42/47	38 / 4/
	B18	9'-1	169 / 369	140 / 277	118 / 213	101 / 168	87 / 134	76 / 109	67/90	59 / 75	53 / 63	48 / 54	43 / 4/
	B16	10'-3	213 / 471	176 / 354	149 / 273	127 / 214	110 / 172	95 / 140	84 / 115	74 / 96	66 / 81	60 / 69	54 / 56
	B24	5'-10	154 / 120	128 / 90	108 / 89	92 / 55	79 / 44	69 / 35	61 / 29	54/24	48 / 21	43 / 17	39 / 15
0	B22	67-11	124 / 167	103 / 125	87 / 97	74.176	64 / 61	567.50	49 / 41	43/34	39 / 29	35 / 24	31/2
[3]	B20	7'-9	1597, 509	132 / 157	111 / 121	95 / 95	82 / 76	72 / 62	63/51	56743	50 / 36	45 / 31	40 / 2
	(B193	8'-5	186 / 250	154 / 188	130 / 145	111 / 114	96 / 91	84/74	74/61	65 / 51	58 / 43	52 / 37	47 / 3
	B18.	9'-1	210 / 289	174 / 217	147 / 167	126 / 132	108 / 105	95 / 85	83 / 71	74 / 59	66 / 50	59 / 42	54 / 36
	B16	10'-3	264 / 369	219 / 277	185 / 214	158 / 168	138 / 135	119 / 109	105/90	93 / 75	83 / 63	74 / 54	67 / 46



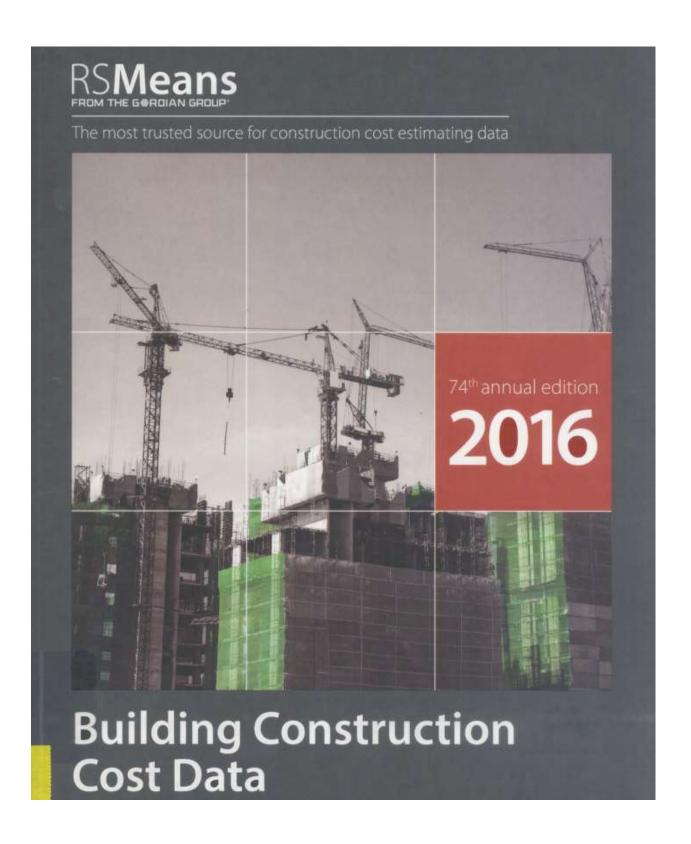
Notes: 1, Minimum exterior bearing length required is 1.50 inches. Minimum interior bearing length required is 3.00 inches.

If these minimum lengths are not provided, web crippling must be checked,

2. FM Global approved numbers and spans available on page 21,

Appendix E

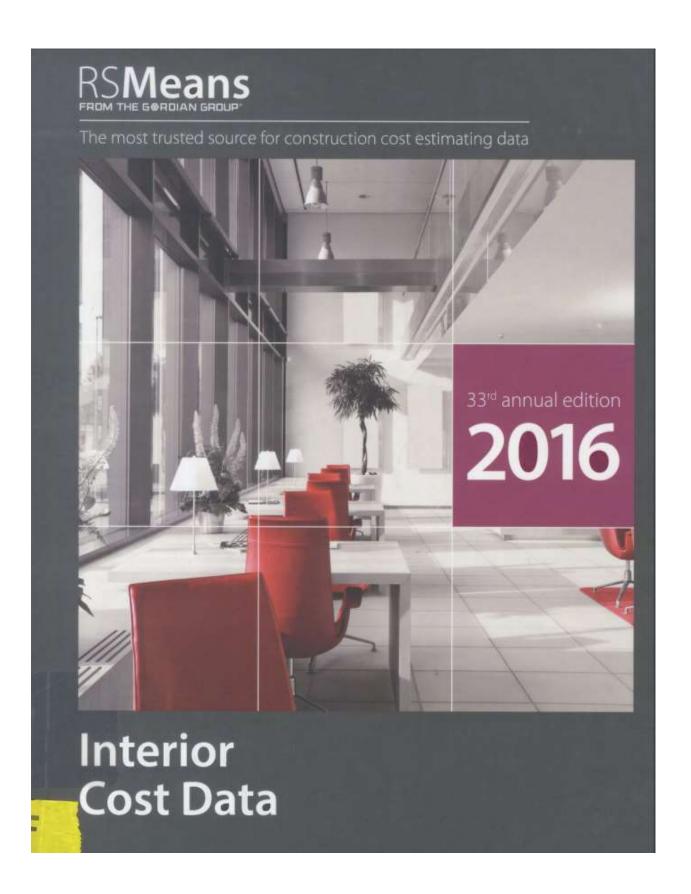
RS Means: Building Construction Cost Data



	41 Demolition 11 13 - Selective Site Demolition									
V2 7	11 13 - Selective Site Delilonation		Daily	Labor-			2016 Barr	e Casts	25	Total
02 41	13.30 Minor Site Demolition	Crew		Hours	Unit	Material		Equipment	Total	Incl 0
0600	Guidenal, corrugated steel, remove only	B-80A	100	.240	LE		9,10	3.07	12.17	1
0850	Remove and reset	-41	40	.600			22.50	7.70	30.20	4
0860	Guide posts, remove only	B-808	120	.267	Ea.		10.85	2.07	12.92	1
0870	Remove and reset	8-55	50	.480	*		18.85	22	40.85	5
1000	Masonry walls, black, solid	B-5	1800	.031	C.E.		1.31	.79	2.10	
1200	Brick, solid		900	.062			2.61	1,58	4.19	
1400	Stone, with mortar		900	.062			2.61	1,58	4.19	
1500	Dry set	4	1500	.037	+		1.57	.95	2.52	
1600	Median barrier, precast concrete, remove and store	8-3	430	.112	LE		4,71	6	10.71	1
1610	Remove and reset	*	390	.123	W.		5.20	6.60	11.80	1
4000	Sidewalk removal, bituminous, 2" thick	8-6	350	.069	S.Y.		2.86	1.04	3.90	
4010	2-1/2" thick	200	325	.074			3.08	1.12	4.20	
4050	Brick, set in mortor		185	.130			5.40	1.98	7.38	1
4100	Concrete, plain, 4"	100	160	.150	W. Take		6.25	2.28	8.53	3
4110	Pluin, 5"		140	171			7.15	2.61	9.76	1
4120	Main, 6"		120	_200			8.35	3.05	11.40	1
4200	Mesh reinforced, concrete, 4 "	E-15	150	.160			6.65	2.44	9.09	3
4210	5" thick		131	.183			7.65	2.79	10.44	-1
4220	6 " frick		112	.214			8.95	3.26	12.21	1
4300	Slob on grade removal, plain	8-5	45	1.244	C.Y.		52	31.50	83.50	11
4310	Mesh reinforced		33	1.697			71	43	114	15
4320	Rod reinforced		25	2.240			94	57	151	25
4400	For cangested sites or small quantities, add up to								200%	20
4450	For disposal on site, add	8-11A	232	.069			3.07	6	9.07	1
4500	To 5 miles, ndd	B-340	76	.105	4		4.55	9.75	14.30	1
02 4	1 13.33 Railtrack Removal									
0010	RAILTRACK REMOVAL									
3500	Railroad track removal, ties and track	B-13	330	.170	LE		7.05	2.27	9.32	-1
3600	Bollast .	8-14	500	.096	C.Y.		3.85	.73	4.58	
3700	Remove and re-install, ties & track using new bolts & spikes		50	.960	L.F.		38.50	7.30	45.80	-
3800	Turnauts using new bolts and spikes	V	1	48	Es.		1,925	365	2,290	5
02 4	1 13.60 Selective Demolition Fencing									
0010	SELECTIVE DEMOLITION FENCING R024119-10									
1600	Fencing, bashed wire, 3 strand	2 Cloh	430	.037	L.F.		1.41		1,41	3
1650	5 strand		280	.057			2.17		2.17	
1700	Chain link, posts & fabric, 8" to 10" high, remove only	8-6	445	.054	4		2.25	.82	3.07	. 56
02	41 16 - Structure Demolition									
02 4	1 16.13 Building Demolition			1/2		-				
0010	The state of the s									
0011	No foundation or dump fees, C.F. is vol. of hullding standing									
0020	Steel	B-8	21500	.003	C.F.		-13	.15	.28	
0050	Concrete			.004			.18	.22	.40	
0080	Masonry	1	20100	.003			.14	.17	.31	
0100	Mixture of types	v	20100	.003	1		.14	.17	,31	
0500	Small bidgs, or single bidgs, no salvage included, steel	B-3	14800		1		.14	.17	.31	
0600	Concrete		11300	.004			.18	.23	.41	
0650	Masony	1	14800		5		14	.17	.31	
0790	Wood	1 4	14800				.14	.17	.31	
0750		1114							30%	1
1000		83	1	48	Fo.		2,025	2,575	4,600	5,90
1020	3200 S.F.	111	.50	96	11	1	4,050	5,150	9,200	11,90

Appendix F

RS Means: Interior Cost Data



	22 Concrete Unit Masonry 22 10 - Concrete Masonry Units									
- LANE	as to - concrete masonly only		Daily	Lobor-	5	-	2016 Ba	en Cach		Total
04 2	2 10.14 Concrete Block, Back-Up	Crew		Hours	Unit	Material	Lobor	Equipment	Total	Ind 08P
0010	\$6660000000000000000000000000000000000							Children .		
0020	Normal weight, 8" x 16" units, tooled joint 1 side									
0050	Not-minforced, 2000 psi, 2" thick	D-8	475	.084	5.F.	1.53	3.62		5.15	7.2
0290	4" flick		460	.087		1.84	3.73		5.57	7.7
0300	6" thick		440	.091		2.40	3.90		6.30	8.6
0350	8" thick		400	.100		2.56	4.30		6.86	9.3
0400	10" thick	*	330	.121		3.03	5.20		8.23	11.3
0450	12" thick	D-9	310	.155		4.17	6.50		10.67	14.5
04 2	2 10.18 Concrete Block, Column				- V					77762
0070	CONCRETE BLOCK, COLUMN or pluster									
0050	Induding vertical minitarcing (4-#4 bors) and grout									
0160	1 piece une, 16" x 16"	D-1	26	.615	VLE	16.25	77		40.00	
0170	7 piece units, 16" x 29"	W.4.	24	.667	-WEIL	21	26 28		42.25	57.5
0180	20" x 20"	E Ta			1111		Series III		49	66
0190	22" x 24"		22	.727		26.50	30.50		57	76.5
0200	20" x 32"		18	.889		40	37.50		77.50	101
10000		V	14	1.143	V	46.50	48		94.50	125
	10.32 Concrete Block, Lintels									
0010	CONCRETE BLOCK, LINTELS, C90, normal weight including grout and hadrontal minforcing									
0200	8" x 8" x 8", 1 #4 box	04	300	107	L.E.	3.87	4.57	.45	8.89	11.7
0250	2 #4 bos		295	.108		4.09	4.65	.46	9.20	12.1
3400	8" x 16" x 8", 1 #4 bar		275	.116		3.90	4.99	.49	9.38	12.4
1450	2 #4 bars		270	.119		4.12	5.10	.50	9.72	12.8
1000	12" x 8" x 8", 1 #4 bor		275	.116		. 5.30	4.99	.49	10.78	14
1100	2 #4 bors		270	.119		5.50	5.10	.50	11.10	14.3
150	2 #5 bors		270	119	100	5.75	5.10	.50	11.35	14.6
200	2 #6 bas		265	.121		6.05	5.15	.51	11.71	15.10
500	12" x 16" x 8", 1 #4 bar		250	.128		5.95	5.50	.54	11.99	15.50
600	2 #3 bos		245	131		6	5.60	.55	12.15	15.70
NAO	2 #4 bos		245	.131		6.15	5.60	.55	12.30	15.90
700	2 #5 bos		240	.133		6.40	5.70	.56	12.66	16.35
	10.33 Lintel Block	-	110000	3.130	4.1	47.10	20.01	140	14,40	1950
State Lamble	UNTEL BLOCK	-	-		-					
1481	Lintel block 6" x 8" x 8"	9-1	200	nes.	*	1.00	-		14.00	1.2
501	6"x16"x8"	SP3	300	.053	Eu.	1.32	2.25		3.57	4.88
1521	8"x8"x8"		275	.058		2.07	2.45		4.52	6
561	8" x 16" x 8"		275	.058		1.19	2.45	_	3.64	5.05
-		¥	250	.064	*	2.09	2.70		4.79	6.40
	10.34 Concrete Block, Partitions									
	CONCRETE BLOCK, PARTITIONS, excludes scaffolding R040513-10									
100	Acoustical slotted block									
200	4" thick, type A-1	D-B	315	.127	SE	4.57	5.45		10.02	13.35
210	8" frick	12-11-11	275	145		5,90	6.25		12.15	16.05
250	8" thick, type Q		275	.145		10.10	6.25		16.35	20.50
260	4" rhick, type RSC		315	.127		7.10	5.45		12.55	16.15
270	6" thick		295	136		7.10	5.80		12.90	16.70
280	8" thick		275	.145		7.10	6.25		13.35	17.35
290	12° thick	CERT	250	160	III et	7.10	6.85		13.95	18.30
300	8" thick, type RSR		275	.145		7.10	6.25		13,35	17.35
100	8" thick, type RSC/RF		275	145		7,45	6.25		13.70	17.75
110	10" thick		260	154		8	6.60		14.60	18.90
420	12" flick		250	.160		8.65	6.85		15.50	20
430	12" thick, type RSC/RF-4		250	160		11.10	6.85		1007-012-018	
-		10	EVV	-100	100	11110	0.03		17.95	22.50

UD 2	11 13 - Deep Longspan Steel Joist Fran	ning									
NF 04	42 E0 Daniel Labor				Labor	100	40.000	2016 Bo		2.0	Total
	13.50 Deep Longspan Joists DEEP LONGSPAN JOISTS		Crew	Output	Hours	Unit	Material	Labor	Equipment	Total	Ind 08P
610	DEH series, 40-ton job lots, bolted cross bridging, shop primer										
015											
	Made from recycled materials	[A]	59	19901	6406		1.000	444	1.00		
040	Spans to 144' (shipped in 2 pieces)	G	E	13	6,154	Ton	1,925	325	140	2,390	2,82
500	For less than 40-ton job lots						1.00				
502	For 30 to 39 tons, add					%	10%				
504	20 to 29 tons, odd						20%				
506	10 to 19 tons, add						30%	1000			
1587	5 to 9 tons, add						50%	25%			
1508	T to 4 tors, add						75%	50%			
509	Less than 1 tan, add					Ψ.	100%	100%			
010	SCH series, 40-ton job lots, bolted cross bridging, shop primer										
040	Spans to 200° (shipped in 3 pieces)	G	E-7	13	6.154	Ton	1,975	325	140	2,440	2,87
100	For less than 40-ton job lots										
102	Far 30 to 39 tons, odd					%	10%				
104	20 to 29 tons, odd						20%				
106	10 to 19 tons, add						30%				
107	5 to 9 tons, odd						50%	25%			
108	T to 4 toes, add						75%	50%			
109	Less than 1 ton, add						100%	100%			
15 2	1 16 - Longspan Steel Joist Framing										
	16.50 Longspan Joists										
Mintelline	LONGSPAN JOISTS									_	_
000	LH sates, 40-ten job lots, boilted cross bridging, shop primer										
015											
	Mode from recycled moterials	(Zin	-	10		-	7 007	no.	***	0.000	
040	Longspon joists, LH series, up to 96'	G	E-7	13	6.154	Ton	1,825	325	140	2,290	2,72
600	For less than 40-ton job lots					200	100				
602	For 30 to 39 tons, add					%	10%				
604	20 to 29 tons, add						20%			- 1	
606	10 to 19 tons, add						30%	2000			
607	5 to 9 tons, add						50%	25%			
803	1 to 4 tons, add						75%	50%			
609	Less than 1 ton, add					*	100%	100%			
000	For welded cross bridging, add							30%			
5 2	1 19 - Open Web Steel Joist Framing										
5 21	19.10 Open Web Joists										
010	OPEN WEB JOISTS	He.							111111		75
015	Made from recycled materials										
050	K series, 40-ton lots, horiz, bridging, spans to 30°, shop primer	[G]	87	12	6.667	Ton	1,650	350	151	2,151	2,575
440	K series, 30" to 50" spons	G			4.706	#.	1,625	248	107	1,980	2,32
800	For less than 40-ton job lots	1			The New L		1,944	7679	(00	1/200	E,UE
802	For 30 to 39 tons, add					%	10%				
904	20 to 29 tons, odd					7	20%				
806	10 to 19 tons, add										
007	5 to 9 store, add					-	30%	new			
							50%	25%			
808	1 to 4 tons, odd						75%	50%			
109	Less than 1 ton, add					79.	100%	100%			
110	CS series, 40-ton job lots, norizontal bridging, shop primer	(20)		my zon	*******		70,000		25000	20000	
40	Spans to 30"	G	E-7	12	6.667	Ton	1,700	350	151	2,201	2,62
00	For less than 40-ton job lots										
02	For 30 to 39 tons, add					%	10%				
04	20 to 29 tons, add						20%				

O'CLE	11 13 - Load-Bearing Metal Stud Fran	ning	,,				390	THE STATE OF			
15 41	13.10 Bridging		Crew	Daily Output	Labor- Hours	Unit	Material	2016 Born Labor	and the second second	Total	Tot Ind (
1120	24" O.C.	G	1 Corp	12	.667	CLE	80.50	32.50	Equipment	113	13
200	16 gn., studs 12" O.C.	G	, corp	5	1.600	Section 1	101	77.50		178.50	20
210	16" O.C.	G		7	1.143		101	55.50		156.50	19
1220	24" O.C.	G		10	.800		101	39		140	T
)5 41	13.25 Framing, Boxed Headers/Beams				-						
	FRAMING, BOXED HEADERS/BEAMS					141				EA	
0015	Made from recycled materials										
1200	Double, 18 ga. x 6" deep	G	2 Corp	220	.073	LE	5.50	3.52		9:02	
210	8" deep	G		210	.076		6.05	3.69		9.74	
0220	10" deep	G		200	.080		7.40	3.88		11.28	
0230	12" deep	G		190	.084		8.05	4.08		12.13	
0300	16 gs. x 8" deep	[G]		180	.089		7	4.31		11.31	
0310	10" deep	G		170	.094		8.45	4.56		13.01	
320	12" deep	G	100	160	100	1	9.15	4.85		14	
400	14 gg, x 10" deep	G		140	114		9.75	5.55		15.30	
410	12" deep	G		130	123		10.65	5.95		16.60	
210	Triple, 18 ga. x 8" deep	G		170	.094		8.75	4.56		13.31	
220	10" deep	G	17	165	.097	1	10.60	4.70		15.30	
230	12" deep	G		160	100		11.60	4.85		16.45	
300	16 ga. x 8" deep	G		145	.110		10.15	5.35		15.50	
310	10" deep	G		140	.114		12.15	5.55		17.70	
320	12" deep	G		135	119		13.25	5.75		19	
400		G								20	
410	14 gp. x 10" deep 12" deep	G		115	139		13.25	6.75 7.05		21.70	
-	1010 (100)	[4]	- 1	100	1193	-9	14.65	7,00		21.70	-
MORNING CO.	13.30 Framing, Stud Walls		-	-		-		_	_	_	-
010	FRAMING, STUD WALLS w/top & bettom track, no openings,										
1020	Needers, beams, bridging or bracing										
0025	Made from recycled materials	Tes.		264	1987	100		47.00		200.00	
100	8' high walls, 18 ga. x 2-1/2" wide, studs 12" O.C.	G	2 Corp	54	296	LF.	9.10	14,35		23.45	
110	16" O.C.	G		77	.208		7.25	10.05		17.30	
1120	24" O.C.	G		107	.150		5.45	7.25		12.70	
1130	3-5/8" wide, studs 12" O.C.	G		53	.302		10.85	14.65		25.50	
140	16" O.C.	G		76	.211		8.70	10.20		18.90	
1150	24" O.C.	G		105	152		6.55	7.40		13.95	
1160	4" wide, studs 12" D.C.	G		52	.308		11,30	14.90		26,20	
170	16" O.C.	G		74	.216		9.05	10.50		19.55	1
180	24" O.C.	G	-	103	.155		6.80	7.55		14.35	
190	6" wide, studs 12" 0.C.	G		51	.314		14.40	15.20		29.60	- 3
200	16" O.C.	G		73	.219		11.55	10.60		22.15	1
210	24" O.C.	G		101	.158		8.70	7.70		16.40	3
220	8" wide, studs 12" O.C.	G		50	.320		17.45	15.50		32.95	3
230	16" Q.C.	G	1000	72	.222	other)	14	10.75		24.75	- 1
240	24" O.C.	G		100	160		10.60	7.75		18.35	3
300	16 ga. x 2-1/2" wide, studs 12" D.C.	G		47	.340		10.85	16.50		27.35	-
310	16" O.C.	[G]		68	.235		8.60	11,40		20	- 3
320	24" O.C.	G		94	.170		6.35	8.25		14.60	- 3
330	3-5/8" wide, studs 12" 0.C.	G		46	.348		12.95	16.85		29.80	1
340	16" D.C.	G		66	242		10.25	11.75		22	12
350	24" O.C.	G		92	.174		7.55	8.45		16	1
360	4" wide, atuds 12" O.C.	G	distant.	45	.356					30.80	
370	4 WIGE, 3700S 12" U.C. 16" O.C.	G					13.55	17.25			1
	I D. W.L.	(3)		65	246		10.75	11,95		22.70	- 3

	1 13 - Load-Bearing Metal Stud F									
	42.20 Francis Stand Walls		Daily				2016 Bo			Total
390	13.30 Framing, Stud Walls 6" wide, studs 12" 0.C.	[G]	Crew Outpu	Hours 364	Unit	Material	Lobor	Equipment	Total	Ind 081
400	16" O.C.	G	2 Corp 44		LE	17.05	17.60	-	34.65	46
410	24" O.C.	[G]	64	250		13.55	12.10		25.65	33.
			88	.182		10.05	8.80		18.85	24.
420	8" wide, studs 12" 0.C.	G	43	.372		21	18.05		39.05	50.
430	16" O.C.	G	63	.254		16.60	12.30		28.90	37
140	24" O.C.	G	86	186		12,30	9		21,30	27.
100	10" high walls, 18 ga. x 2-1/2" wide, studs 12" 0.C.	G	54	296		10.90	14.35		25.25	34
110	16" O.C.	G	77	.208		8.65	10.05		18.70	25
120	24" O.C.	G	107	.150		6.35	7.25		13.60	18
130	3-5/8" wide, studs 12" 0.C.	G	53	.302		13	14.65		27.65	37
140	16" O.C.	G	76	.211		10.30	10.20		20.50	27
150	24" O.C.	G	105	.152		7.60	7.40		15	19.
160	4" wide, studs 12" 0.C.	G	52	.308		13.55	14.90		28.45	38
70	16" O.C.	G	74	.216		10.75	10.50		21,25	28
180	24" D.C.	G	103	.155		7.95	7.55		15.50	20
190	6" wide, studs 12" O.C.	G	51	314		17,25	15.20		32.45	42
900	16° 0.C	G	73	.219		13.70	10.60		24.30	31
10	24° O.C.	G	101	.158	1	10.15	7,70		17.85	
220	8" wide, studs 12" O.C.	G	50	320					VI-002291	23
			100000			21	15.50		36.50	47
30	16" O.C. 24" O.C.	G	72	.222		16.55	10.75		27.30	35
40		G	100	.160		12.30	7.75		20.05	25
00	16 gn. x 2-1/2" wide, studs 12" O.C.	G	47	.340		13.10	16.50		29.60	40
10	16" O.C.	G	68	.235		10.30	11.40		21.70	29
20	24" O.C.	G	94	170		7.45	8.25		15.70	21
30	3-5/8" wide, studs 12" O.C.	G	46	348	140	15.60	16.85		32,45	43
40	16" O.C.	G	66	.242		12.25	11.75		24	31.
50	24" O.C.	G	92	.174		8.90	8.45		17.35	22
60	4" wide, studs 12" 0.C.	G	45	356		16.35	17.25		33.60	44
70	16" O.C.	G	65	.246		12.85	11.95		24.80	32
180	24" O.C.	G	90	178		9,35	8.60		17,95	23
190	6" wide, studs 12" 0.C.	G	44	364		20.50	17.60		38.10	49.
00	16" Q.C.	G	64	.250		16.15	12.10		28.25	36.
10	24" O.C.	G	88	182		11.80	8.80		20.60	26
20	8" wide, studs 12" O.C.	G	43	.372	7	25	18.05		43.05	55
30	16" O.C.	G	63	254		19.80	12.30		32.10	41
40	24" O.C.	G	86	.186		14.45	9		23.45	
90		G	0.0075							29.
	12' high walls, 18 ga. x 6" wide, studs 12" 0.C.	(0)	41	.390		20	18.90		38.90	51
00	16" O.C.	G	58	.276		15.80	13.35		29,15	38
10	24" O.C.	CO	81	198		11.55	9.55		21.10	27.
20	8" wide, studs 12" O.C.	G	40	400		24.50	19.40		43.90	56
30	16" O.C.	G	. 57	.281	50	19.15	13.60		32,75	42
40	24" O.C.	G	80	,200		14	9.70		23.70	30.
90	16 ga. x 6" wide, studs 12" O.C.	G	35	.457		24	22		46	60.
00	16" O.C.	G	51	.314		18.80	15.20		34	44
10	24" O.C.	G	70	.229		13.55	11.05		24.60	32
20	8" wide, studs 12" O.C.	G	34	.471		29,50	23		52.50	67.
30	16" O.C.	G	50	.320		23	15.50		38.50	49.
40	24" O.C.	G	69	.232		16.60	11.25		27,85	35.
30	14 gn. x 3-5/8" wide, studs 12" 0.C.	G	34	471		22.50	23		45.50	60
40	16° 0.C.	G	48	,333		17.75	16.15		33.90	44.
50	24" O.C.	G	65	.246		12.75	11.95		24.70	32.
60	4" wide, studs 12" 0.C.	G	33	.485		24	23.50		47.50	62.
70	16" O.C.	G	47	.340		18.75	16.50		35.25	46
4	A.W. William	[4]	40	-WTM	1.0	107.2	10.20		93:63	40

	26 Veneer Plastering 26 13 - Gypsum Veneer Plastering									
		9	Daily	Labor-		2/10c-3/1	2016 Bo	ore Costs	7-87	1
6500	6 13.20 Blueboard		Output		Unit	Material	Labor	Equipment	Total	Inc
SDEED!	For over 3 studes high, add per story	2100	6100	.003	S.E.		.13		13	
	6 13.80 Thin Coat Plaster									
0010	THIN COAT PLASTER 1 cost veneer, not incl. loth	111	2/00	BYT.	991	11		-	100	
1000	In 50 th. begs	H	3600	.011	S.F.	15.05	.47	.04	15.05	
	III av III. voge				Bag	13,03			13.03	-
09	28 Backing Boards and L	Inderla	ŊΠ	nen	its	1112			1 3	
09	28 13 - Cementitious Backing Boards		M. Abdel		0/54					
09 2	8 13.10 Cementitious Backerboard									
0010	CEMENTITIOUS BACKERBOARD									
0070	Cementiflous backerboard, on floor, 3' x 4' x 1/2" sheets	2 Corp		.030	S.E.	.84	1.48		2.32	
0800	3' x 5' x 1/2" sheets		525	.030		.81	1.48		2.29	
0100	3' x 6' x 1/2" sheets		525	.030	- 20	79	1,48		2.27	
0110	3' x 4' x 5/8" sheets 3' x 5' x 5/8" sheets		525	.030		1.01	1.48		2.49	
0170	3' x 6' x 5/8" sheets		525	.030		1.01	1.48		2.49	
0150	On wall, 3' x 4' x 1/2" sheets		350	.046		.84	2.21		3.05	
0160	3' x 5' x 1/2" sheets		350	.046	100	.81	2.21		3.02	
0170	3' x 6' x 1/2" sheets		350	.046		.79	2.21		3	
0180	3" x 4" x 5/8" sheets		350	.046		1.01	2.21		3.22	
0190	3" x 5" x 5/8" sheets		350	.046		1.01	2.21		3.22	
0200	3' x 6' x 5/8" sheets		350	.046		1	2.21		3.21	
0250	On counter, 3' x 4' x 1/2" sheets		180	.089		.84	4.31		5.15	
0260	3' x 5' x 1/2" sheets		180	.089		.81	4.31		5.12	
3300	3' x 6' x 1/2" sheets 3' x 4' x 5/8" sheets		180	.089		.79	4,31		5.10	
0310	3' x 5' x 5/8" sheets		180	.089		1.01	4.31		5.32	
0320	3' x 6' x 5/8" sheets		180	.007		1,01	4.31		5.31	
09	29 Gypsum Board 29 10 - Gypsum Board Panels	BIR								
19 29	9 10.30 Gypsum Board									
	GYPSUM BOARD on walls & callings RO	92910-10								
1100	Nailed or screwed to study unless offierwise nated									
0110	1/4" fluck, on wolls or cellings, standard, no finish included	2 Corp		.012	S.F.	.36	.58		.94	
0115	1/4" thick, on walls or ceilings, flexible, no finish included		1050	.015	-	.51	.74	T	1.25	
0130	1/4" thick, on columns or soffits, flexible, no finish included 1/4" thick, standard, no finish included, less than 800 S.F.		1050 510	.015		.51	.74		1.25	
1150	3/8" thick, on walls, standard, no finish included		2000	.008		.36 .35	1.52		1.88	
200	On ceilings, standard, no finish included		1800	.009		.35	.43		.78	
250	On beams, columns, or sofflits, no finish included		675	.024		.35	1.15	-	1.50	
300	1/2" thick, on walls, standard, no finish included		2000	.008		_33	.39		.72	
350	Toped and finished (level 4 finish)		965	.017		.38	.80		1.18	
390	With compound skim coot (level 5 finish)		775	.021		.43	1		1.43	
1400	Fire resistant, no finish included		2000	.008		.36	.39		.75	
1450	Toped and finished (level 4 finish)		965	.017		.41	.80		1.21	
1490	With compound skim coat (level 5 finish)		775	.021		.46	1		1.46	
1500 1550	Water resistant, no finish included Topad and finished (level 4 finish)		2000 965	.008		.41	.39		1,26	
			- NO. 19	100		2.6	HEL		1.74	

09 9	29 Gypsum Board 9 10 - Gypsum Board Panels									
			Doily	Labor-			2016 Bo	re Costs		Total
	10.30 Gypsum Board	(rew	Output	Hours	Unit	Material	Lobor	Equipment	Total	Ind O&P
590	With compound skim coat (level 5 finish)	2 Carp		.021	S.E.	.51	1		1.51	2.0
800	Prefinished, vinyl, clipped to studs		900	.018		.49	.86		1.35	1.8
700	Mold resistant, no finish included		2000	.008	400	.43	.39		.82	1.0
710	Taped and finished (level 4 finish)		965	.017		.48	.80		1.28	1.7
0720	With compound skim coat (level 5 finish)		775	.021		.53	1		1.53	2.1
000	On ceilings, standard, no finish included		1800	.009		.33	.43		.76	1.0
050	Toped and finished (level 4 finish)		765	.021		.38	1.01		1.39	1.5
1090	With compound skim coat (level 5 finish).	100	610	.026	min	.43	1.27		1.70	2.5
100	Fire resistant, no finish included		1800	.009		.36	.43		.79	1.0
1350	Taped and finished (level 4 finish)		765	.021		.41	1.01		1.42	2
1195	With compound skim coat (level 5 finish)		610	.026		.46	1.27		1.73	2.4
200	Water resistant, no finish included		1800	.009		.41	.43		.84	1.1
1250	Taped and finished (level 4 finish)		765	.021		.46	1.01		1.47	2.0
1290	With compound skim coat (level 5 finish)		610	.026		.51	1.27		1.78	2.5
1310	Mold resistant, no finish included		1800	.009		.43	.43		.86	1.1
1320	Toped and finished (level 4 finish)	To play	765	.021	100000	.48	1.01		1,49	2.0
1330	With compound skim coat (level 5 finish)		610	.026		.53	1.27		1.80	2.5
1350	Sug resistant, no finish included		1600	.010		.35	.48		.83	1.1
360	Toped and finished (level 4 finish)		765	.021		.40	1.01		1.41	1.5
370	With compound skirn coat (level 5 finish)	TT	610	.026	-	.45	1.27		1.72	2.4
1500	On beams, columns, or soffits, standard, no finish included		675	.024		.38				
1550	Taped and finished (level 4 finish)		540	.030		.38	1.15		1.53	2.1
1590						1000	1.44		1.82	2.6
2000	With compound skim coat (level 5 finish)	1	475	.034		.43	1.63		2.06	2.9
600	Fire resistant, no finish included		675	.024		.36	1.15		1.51	2.1
1650	Toped and finished (level 4 finish)		540	.030		.41	1.44		1.85	2.6
690	With compound skim coat (level 5 finish)		475	.034		.46	1.63		2.09	3,0
1700	Water resistant, no finish included		675	.024	100	.47	1.15		1.62	2.2
1750	Toped and finished (level 4 finish)		540	.030		.46	1.44		1.90	2.7
790	With compound skirn coat (level 5 finish)		475	.034		.51	1.63		2.14	3.0
1800	Mold resistant, no finish included		675	.024		.49	1.15		1.64	2.3
1810	Toped and finished (level 4 finish)		540	.030		.48	1.44		1.92	2.7
820	With compound skim coat (level 5 finish)		475	.034		.53	1.63		2.16	3.0
B50	Sag resistant, no finish included		675	.024		.40	1.15		1.55	2.2
BAD	Toped and finished (level 4 finish)		540	.030		.40	1.44		1.84	2.6
1870	With compound skim coat (level 5 finish)		475	.034		.45	1.63		2.08	3
2000	5/8" thick, on walls, standard, no finish included	177	2000	.008	100	.34	.39		.73	.9
2050	Toped and finished (level 4 finish)		965	.017		.39	.80		1.19	1.6
2090	With compound skim coat (level 5 finish)		775	.021		.44	1		1.44	2.0
2100	Fire resistant, no finish included		2000	.008		.35	.39		.74	.9
1150	Toped and finished (level 4 finish)		965	.017		.40	.80		1.20	1.6
7195	With compound skim coat (level 5 finish)		775	.021		.45	1		1.45	2.0
2200	Water resistant, no finish included		2000	.008		.43	.39		.82	1.0
7250	Toped and finished (level 4 finish)		965	.017		48	.80		1.28	1.7
290	With compound skim coat (level 5 finish)	TT	775	.021		.53	1		1.53	2.1
510	Mold resistant, no finish included		2000	.008		.47	.39		.86	1,1
520	Toped and finished (level 4 finish)		965	,017		.52	.80		1.32	1.8
530	With compound skim coat (level 5 finish)		775	.021		57	1		1.57	2.1
000	On ceilings, standard, no finish included	1	1800	.009	-	34	,43		37	1.0
1050	Toped and finished (level 4 finish)		765	.021		.39	1.01			
1090	With compound skim coat (level 5 finish)		615	.026		.44			1.40	1.9
100							1.26		1.70	2.4
entering	Fire resistont, no ficish included	Total Control	1800	.009	1014	35	.43	- 4	.78	1.0
1150	Toped and finished (level 4 finish)		765	.021		.40	1.01		1.41	1.9
190	With compound skim cost (level 5 finish)		615	.026	1	.45	1.26		1.71	2.4

APP I	10 02 Class Hearing William									
09.	30 23 - Glass Mosaic Tiling		0.4	i l	-					Tal
10.30	93.10 Glass Mosaics	Crew	Daily Output	Labor- Hours	Unit	Material	2016 Bo Lobor	re Costs Equipment	Total	Total Ind 0&I
040	1" x 2" tile on 12" sheet, bland	D-7	73	219	S.E.	19.05	8.70	edolpinom	27.75	34
060	2" file on 12" sheet, blend	Y	73	219		16.50	8.70		25.20	31
080	5/8" x random tile, linear, on 12" sheet, blend		73	.219		25	8.70		33.70	40.
600	Dats on 12" sheet		73	.219	T	25	8.70		33.70	40.
700	For glass mosaic tiles set in dry mortar, add		290	.055		.45	2.19		2.64	3.
720	For glass mosaic tile set in Portland coment mortar, add		290	.055	1	.01	2.19		2.20	3
730	For polyblend sanded tile grout		96.15	.166	lb.	2.19	6.60		8.79	12
93	10 29 - Metal Tiling	A ILI					MAN	MARIE		
30	29.10 Metal Tile									
10	METAL TILE 4" x 4" sheet, 24 gu., tile pottern, notied									
60	Stronless steel	2 Corp	512	.031	S.F.	28	1.51		29.51	33
00	Aluminized steel		512	.031	.01	15.10	1.51		16.61	18
93	0 95 - Tile & Stone Setting Materials	and Spec	ialti	25						
	95.10 Moisture Resistant, Anti-Fracture Membrar	ne								
	MOISTURE RESISTANT, ANTI-FRACTURE MEMBRANE		***	250					2.24	5
10	Elastomeric membrane, 1/16" thick	D-7	275	.058	S.F.	1.07	2.33		3.38	1
34	13.10 Ceramic Tile Waterproofing Membrane CERAMIC TILE WATERPROOFING MEMBRANE Un floors, including flinser		400	1220						
34	CERAMIC TILE WATERPROOFING MEMBRANE Din floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and corner sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide	D-7 ** D-7 1 Tilf	250 250 480 240 180 120	.064 .064 .033 .033 .044	S.F. S.F. L.F.	2.28 2.60 2.28 1.35 1.71 2.08	2.54 2.54 1.32 1.48 1.98 2.97		4.82 5.14 3.60 2.83 3.69 5.05	6 6 6 4 3 3 4 6 24
34	CERAMIC TILE WATERPROOFING MEMBRANE Din floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and corner sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Preformed corners, inside	D-7	250 480 240 180 120 32	.064 .033 .033 .044 .067 .250	S.F.	2.60 2.28 1.35 1.71 2.08 6.95	2.54 1.32 1.48 1.98 2.97 11.15		5.14 3.60 2.83 3.69 5.05 18.10	1 1 4 6 24 24 24 34 34 34 34 34 34 34 34 34 34 34 34 34
34	CERAMIC TILE WATERPROOFING MEMBRANE Din floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and corner sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formed corners, inside Outside	D-7	250 480 240 180 120 32 32	.064 .033 .033 .044 .067 .250 .250	S.F. L.F. En.	2.60 2.28 1.35 1.71 2.08 6.95 7.65	2.54 1.32 1.48 1.98 2.97 11.15 11.15		5.14 3.60 2.83 3.69 5.05 18.10 18.80	1 4 6 24 23 23 24 25 25 25 25 25 25 25 25 25 25 25 25 25
34	CERAMIC TILE WATERPROOFING MEMBRANE Un floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and corner sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formed corners, inside Outside 2" flanged floor drain with 6" steinless steel grate	D-7	250 480 240 180 120 32 32 32 16	.064 .033 .044 .067 .250 .250 .500	S.F. L.F. En.	2.40 2.28 1.35 1.71 2.08 6.95 7.45	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50	24 24 24
34	CERAMIC TILE WATERPROOFING MEMBRANE Din floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and corner sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formed corners, inside Outside	D-7	250 480 240 180 120 32 32	.064 .033 .033 .044 .067 .250 .250	S.F. L.F. En.	2.60 2.28 1.35 1.71 2.08 6.95 7.65	2.54 1.32 1.48 1.98 2.97 11.15 11.15		5.14 3.60 2.83 3.69 5.05 18.10 18.80	2 2 2 44
34	CERAMIC TILE WATERPROOFING MEMBRANE On floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and comer sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formed corners, inside Outside 2" flonged floor drain with 6" steinless steel grate EPS, sloped shower floor	D7	250 480 240 180 120 32 32 16 480	.064 .033 .044 .067 .250 .250 .500	S.F. L.E. En.	2.60 2.28 1.35 1.71 2.08 6.95 7.65 370 4.97	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50 .74		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50 5.71	24 21 44:
34	CERAMIC TILE WATERPROOFING MEMBRANE On floors, including thinser Fleece laminated polyethylene grid, 1/8" thick. 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick. Accessories, including thinset Joint and comer sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formad corners, inside Outside 2" flonged floor drain with 6" stainless steel grate EPS, sloped shower floor Curb 51 Acoustical Ceilings 123 — Acoustical Tile Ceilings 23.10 Suspended Acoustic Ceiling Tiles SUSPENDED ACOUSTIC CEILING TILES, not including	D-7	250 480 240 180 120 32 32 16 480	.064 .033 .044 .067 .250 .250 .500	S.F. L.E. En.	2.60 2.28 1.35 1.71 2.08 6.95 7.65 370 4.97	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50 .74		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50 5.71	4
34	CERAMIC TILE WATERPROOFING MEMBRANE On floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and comer sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Preformed corners, inside Outside 2" flonged floor drain with 6" stainless steel grate EPS, sloped shower floor Curb 51 Acoustical Ceilings 123 — Acoustical Tile Ceilings 23.10 Suspended Acoustic Ceiling Tiles SUSPENDED ACOUSTIC CEILING TILES, not including suspension system	D-7	250 480 240 180 120 32 32 16 480 32	.064 .033 .033 .044 .067 .250 .500 .017 .250	S.F. L.E. S.F. L.E.	2.60 2.28 1.35 1.71 2.08 6.95 7.65 370 4.97 14.05	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50 .74 11.15		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50 5.71 25.20	6 4 4 5 4 4 5 6 6 2 4 4 5 6 6 3 3 2 5 6 6 3 3 2 5 6 6 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6
344 00 00 00 00 00 00 00 00 00 00 00 00 0	CERAMIC TILE WATERPROOFING MEMBRANE On floors, including thinser Fleece laminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece laminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and comer sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formad cerners, inside Outside 2" flonged floor drain with 6" stainless steel grate EPS, sloped shower floor Curb 51 Acoustical Ceilings 123 — Acoustical Tile Ceilings 23.10 Suspended Acoustic Ceiling Tiles SUSPENDED ACOUSTIC CEILING TILES, not including suspension system Fiberglass boards, film faced, 2" x 2" or 2" x 4", 5/8" thick	D-7	250 480 240 180 120 32 32 16 480 32	.064 .033 .033 .044 .067 .250 .500 .017 .250	S.F. L.E. S.F. L.E.	2.60 2.28 1.35 1.71 2.08 6.95 7.65 370 4.97 14.05	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50 .74 11.15		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50 5.71 25.20	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
34	CERAMIC TILE WATERPROOFING MEMBRANE On floors, including thinser Fleece luminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece luminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and comer sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formed cerners, inside Outside 2" flonged floor drain with 6" stainless steel grate EPS, sloped shower floor Curb 51 Acoustical Ceilings 123 — Acoustical Tile Ceilings 23.10 Suspended Acoustic Ceiling Tiles SUSPENDED ACOUSTIC CEILING TILES, not including suspension system Fiberglass boords, film fored, 2" x 2" or 2" x 4", 5/8" thick 3/4" thick	D-7	250 480 240 180 120 32 32 16 480 32 625 600	.064 .033 .033 .044 .067 .250 .500 .017 .250	S.F. L.E. En. L.E. L.E. L.E. L.E. L.E.	2.60 2.28 1.35 1.71 2.08 6.95 7.45 370 4.97 14.05	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50 74 11.15		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50 5.71 25.20	6 4 4 5 3 4 4 6 6 2 4 4 2 3 5 6 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
34	CERAMIC TILE WATERPROOFING MEMBRANE On floors, Including thinser Fleece luminated polyethylene grid, 1/8" thick 5/16" thick On walls, including thinset Fleece luminated polyethylene sheet, 8 mil thick Accessories, including thinset Joint and comer sheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formad cerners, inside Outside 2" flonged floor drain with 6" stainless steel grate EPS, sloped shower floor Curb 51 Acoustical Ceilings 123 — Acoustical Tile Ceilings 23.10 Suspended Acoustic Ceiling Tiles SUSPENDED ACOUSTIC CEILING TILES, not including suspension system Fiberglass boords, film forced, 2" x 2" or 2" x 4", 5/8" thick 3/4" thick 3" thick, thermal, R11	D-7	250 480 240 180 120 32 32 16 480 32 625 600 450	.064 .033 .033 .044 .067 .250 .500 .017 .250	S.F. L.E. En. L.E. L.E. L.E. L.E. L.E.	2.60 2.28 1.35 1.71 2.08 6.95 7.45 370 4.97 14.05	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50 74 11.15		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50 5.71 25.20	6 4 3 3 4 4 6 6 24 4 23 4 45 6 8 3 3 2 2
34	CERAMIC TILE WATERPROOFING MEMBRANE On floors, Including thinser Fleece luminored polyethylene grid, 1/8" thick 5/16" thick On wolls, including thinset Fleece luminored polyethylene sheet, 8 mil thick Accessories, including thinset Joint and commersheet, 4 mils thick, 5" wide 7-1/4" wide 10" wide Pre-formed corners, incide Outside 2" flonged floor drain with 6" steinless steel grate EPS, sloped shower floor Curb 51. ACOUSTICAL Ceilings 123 — ACOUSTICAL TILE Ceilings 23.10 Suspended Acoustic Ceiling Tiles SUSPENDED ACOUSTIC CEILING TILES, not including suspension system Fiberglass boords, film foced, 2" x 2" or 2" x 4", 5/8" thick 3" thick, thermal, R11 Glass cloth foced fiberglass, 3/4" thick	D-7	250 480 240 180 120 32 32 16 480 32 625 600 450 500	.064 .033 .033 .044 .067 .250 .500 .017 .250	S.F. L.E. En. L.E. L.E. L.E. L.E. L.E.	2.60 2.28 1.35 1.71 2.08 6.95 7.45 370 4.97 14.05	2.54 1.32 1.48 1.98 2.97 11.15 11.15 22.50 .74 11.15		5.14 3.60 2.83 3.69 5.05 18.10 18.80 392.50 5.71 25.20 1.67 3.28 3.48 3.50	6 4 4 5 3 4 4 6 6 2 4 4 5 5 6 6 3 3 2 5 6 6 3 3 2 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6

00 5	1 23.10 Suspended Acoustic Ceiling Tiles		Crew	Daily Output	Labor- Hours	Unit	Material	2016 Bo Labor		Total	Total Incl OM
1115	Rough faithred		1 Carp		.013	S.E.	.86	.62	Equipment	1,48	Inci via
1125	3/4" thick, fine textured			600	.013		1.99	.65		2.64	3
1130	Rough textured			600	.013		1.60	.65		2.25	2
1135	Fissured		1	600	.013		1,85	.65	1	2.50	3
1150	Tegular, 5/8" thick, fine textured			470	.017		1.04	.82		1.86	2
1155	Rough textured			470	.017		1.23	.82		2.05	2
1165	3/4" flick, fine textured			450	.018		2.08	.86.		2.94	3
1170	Rough textured			450	.07.8		1,41	.86	House	2.27	2
1175	Fissured		-	450	.018		2.02	.86		2.88	3
1185	For plastic film face, add						.79			.79	
1190	For fee rating, odd						.45		- 1	.45	
1300	Metal panel, lay-in, 2' x 2', sq. edge		1 Corp	500	.016		9.55	.78		10.33	11
1350	Tegular edge			500	.016		13.20	.78		13.98	15
1400	2' x 4', sq. edge			500	.016		12.90	.78		13.68	15
1450	Tegular edge			500	.016		13.20	.78		13.98	15
1500	Perforated plum, dip-in, 2" x 2"			500	.016		13.45	.78		14.23	15
1550	2' x 4'			500	.016		10.85	.78		11.63	13
600	Solid alum, planks, 3-1/4"x12", open reveal			500	.016		2.35	.78		3.13	3
1650	Gosed reveal		-	500	.016		3	.78	-	3.78	4
700	7-1/4" x 12", spen reveal			500	.016		4	.78	15715	4.78	5
750	Closed reveal			500	.016		5.10	.78		5.88	é
1775	Metal, open cell, 2' x 2', 6" cell			500	.016		8.25	.78		9.03	10
1800	8" oil		ш	500	.016		9.15	.78		9.93	11
825	2' x 4', 6" cell			500	.016		5.35	.78		6.13	1
1850 1870	8* cell			500	.016		5,35	.78		6.13	7
1890	Transhoent Iny-in ponels, 2" x 2" 2" x 6"			500	.016		23	.78		23.78	26
3720	Mineral fiber, 24" x 24" or 48", reveal edge, pointed, 5/8" thick		1	500	.016	- 1204	17.20	.78	- 4	17.98	20
3740	3/4" thick			600 575	.013		1.19	.65		1.84	2
5020	66 – 78% recycled content, 3/4" thick	G		600	.013		1.62 2.03	.67		2.29 2.68	2
5040	Mylor, 42% secycled content, 3/4° thick	G		600	.013		4.77	.65		5.42	3
5000	Ramove and replace colleg files, min fiber, 2' x 2' or 2' x 4', 5/6"file.	TORU		335	.024	Total Co.	.96	1.16		2.12	2
2000	23.30 Suspended Ceilings, Complete		II. TO	147	-444	CE C	,70	1.10		4,14	- 4
stocional				-	-		-			_	_
010	SUSPENDED CEILINGS, COMPLETE, including standard										
0010	suspension system but not incl. 1-1/2" corrier channels		Ver-	Penn	2017	44	0.00			0.00	
3600	Fibergloss ceiling board, 2' x 4" x 5/8", plain focad		1 Corp		.016	S.E.	2.02	.78		2.80	3
2700 0800	Offices, 2' x 4' x 3/4"	-	100	380	.021	550	3,40	1.02	-	4.42	3
3810	Mineral fiber, on 15/16" T bor susp. 2' x 2' x 3/4" lay-in board			345	.023		2.98	1.12		4.10	5
1820	2' x 4' x 5/8" file Tegular, 2" x 2' x 5/8" file on 9/16" grid			380	.021	40	2.43	1.02		3.45	4
1830	2' x 4' x 3/4" tile			250	.032		2.45	1.55	alto.	7	5
1900				275	.029	-	2.59	1.41		4	5
200	Liminous panels, prismatik, acrylic Metal pan with acoustic pad, sheel			255 75	.031		3.41	1.52 5.15		4.93	13
300	Pointed oluminum			75	107		5.15 3.23	5.15		10.30	11
500	Aluminum, degreesed finish			75	.107		5.25	5,15		8.38	13
600	Stainless steel		b a	75	.107	NT I	9.75	5.15		10.40	18
800	Tile, Z bor suspension, 5/8" mineral fiber tile			150	.053		2.32	2.58		4.90	16
900	3/4" mineral fiber file			150	.053	34	2.35	2.58		4.93	6
402	For strip lighting, see Section 26 51 13.50		V	120	Juna .	¥	2.33	5.30		4.70	9
500	For rooms under 500 S.F., edd		-			S.E.		25%	-		
200	1-2 double governing the		-3			white		23/8			

3720	66.10 Gymnasium Flooring Insulated with polystyrene, 1" flick, add	Crew	Daily Output	Hours	Unit S.E.	Material	2016 Bare Costs Labor Equipment		Total Incl 082
3750	Running tracks, Sirka spracu surface, 25/32" x 2-1/4"	1 Cap	62	.129	3.5	15.40	6.25	3.07 21.65	1
770	3/4" plywood surface, finished	+	100	.080	*	3.65	3.88	7.53	-
09	65 Resilient Flooring	FI					Hui	715	
09 (55 10 - Resilient Tile Underlayment								
9 63	5 10.10 Latex Underlayment								
1010	LATEX UNDERLAYMENT								
600	Latex underlayment, 1/8" thk., cementitious for resilient flooring	1.70%	160	.050	S.F.	1.22	2.23	3,45	4.
000	Tiquid, fortified				Gal.	32		32	35
200	55 13 - Resilient Base and Accessories			-45					
9 63	5 13.13 Resilient Base								
010	RESILIENT BASE								
690	1/8" viryl base, 2 1/2" H, straight or cove, standard colors	11#	315	.025	L.E.	.68	1.13	1.81	2
700	4" high		315	.025		1.21	1.13	2.34	3
710	6° high		315	.025		1.38	1.13	2.51	3
720 730	Comers, 2 1/2" high		315	.025	Ea.	2.14	1.13	3.27	4
740	4" high 6" high		315	.025		2.35	1.13	3.48	4.
800	1/8" rubber hase, 2 1/2" H, straight or cove, standard colors		315	.025	LE.	2.65	1.13	3.78 2.24	4.
100	4" high		315	025	Life	1.14	1,13	2.27	2
110	6" high		315	.025		1.91	1.33	3.04	3
150	Corners, 2 1/2" high		315	.025	En.	2.25	1.13	3.38	4
153	4" high		315	.025		2.30	1.13	3.43	4
155	6" high		315	.025	+	2.86	1.13	3.99	4
450	For premium color/finish add					50%			
500	Millwork profile	111	315	.025	L.E.	6.15	1.13	7.28	8.
distribution (in	13.23 Resilient Stair Treads and Risers								
010	RESILIENT STAIR TREADS AND RISERS	-		Transport.					
300	Rubber, molded mend, 12" wide, 5/16" thick, black	1 1#	115	_070	LE	15	3.10	18.10	21
400 60D	Colors 1/4" thick, block		115	.070		15.35	3.10	18.45	21
700	Colors		115	.070	T	13.35	3.10	18.05	19.
900	Grip strip safety tread, colors, 5/16" thick		115	.070		20	3.10	23.10	26.
000	3/16" thick		120	.067		14.75	2.97	17.72	20.
200	Landings, smooth sheet rubber, 1/8" thick		120	.067	S.F.	8.15	2.97	11.12	13.
300	3/16" flick	100000	120	.067		8.95	2.97	11.92	14.
500	Nosings, 3" wide, 3/16" thick, block		140	.057	LE,	4.67	2.54	7.21	8
600	Colors		140	.057		5,30	2.54	7.84	9.
800	Risers, 7" high, 1/8" thick, flot		250	.032	427	8.10	1.42	9,52	11
900	Coved		250	.032		9.35	1.42	10.77	12.
100	Vinyl, molded tread, 12" wide, colors, 1/8" thick 1/4" thick		115	.070		5,35	3.10	8.45	10.
200 300	Landing material, 1/8" thick		115	.070	S.E.	6.70	3.10	9.80 7.83	11.
400	Riser, 7" high, 1/8" thick, coved	100	175	.046	D.E.	2.85	2.03	4.88	9.
500	Tread and riser combined, 1/8" thick	HELLE	80	100	D.	10.25	4.45	14.70	17.
10:Tel	THE PROPERTY OF THE PARTY OF TH	-	1177541	THE PARTY		10/00	10.00	1.57.9	.173

10 60	16.10 Rubber and Vinyl Sheet Flooring		(rew	Daily Output	Labor- Hours	Unit	Material	2016 Ba Labor	re Costs Equipment	Total	Total Incl O&P
	RUBBER AND VINYL SHEET FLOORING										
5500	Linoleum, sheet goods	G	1 18	360	.022	S.E.	3.59	.99		4.58	5.40
5300 5300	Righter, sheet goods, 36" wide, 1/8" thick	1351	1,100	120	.067	of the	7.10	2.97		10.07	12.20
	3/16" thick			100	.080		10.45	3.56		14.01	16.75
5950	1/4" flick		7	90	.089	-	12.30	3.96		16.26	19.40
6000	19 A C C C C C C C C C C C C C C C C C C			250	.032		3.69	1.42		5.11	6.15
8000	Vinyl sheet goods, backed, .065" thick, plain pattern/colors			200	.040		4,34	1.78		6,12	7.40
1950	Intricate pattern/colors			230	.035		4.12	1.55		5.67	6.80
8100	.080" thick, plain pattern/colors		-			+	6.45	1.78		8.23	9.75
H150	Intricate pattern/colors			200	,040					5.42	6.55
8250	.125" thick, plain pattern/colors			230	.035		3.87	1.55			
E250	Intricate pattern/colors			200	.040	12	7.50	1.78		9.28	10,90
8400	For weiding seams, add			100	.080	LE	.23	3.56		3,79	5.50
1450	For integral cove base, add		Y	175	.046		.83	2.03		2,86	3.92
8700	Adhesive cernent, 1 gallon per 200 to 300 S.F.					Gal.	29.50			29,50	32
8800	Asphalt primer, 1 gallon per 300 S.F.						14			14	15.40
8900	Emulsion, 1 gallon per 140 S.F.					÷	18.85			18.85	20.50
09 6	5 19 - Resilient Tile Flooring										
9 65	19.19 Vinyl Composition Tile Flooring										
0010	VINYL COMPOSITION TILE FLOORING										
7000	Vinyl composition rile, 12" x 12", 1/16" thick		17#	500	.016	S.F.	1.19	.71		1.90	2.36
1050	Embassed			500	.016		2.21	.71		2.92	3,48
100	Morbleized			500	.016		2.21	.71		2.92	3.48
7150	Solid		П	500	.016		2.85	.71		3.56	4.19
7200	3/32" thick, embossed			500	.016		1.43	.71		2.14	2.62
250	Marbleized			500	.016		2.54	.71		3.25	3.84
300	Solid			500	.016		2.36	.71		3.07	3.65
350	1/8" thick, morbleized		100	500	.016		2.44	-71		3.15	3.73
400	Solid			500	.016		1.55	.71		2.26	2.76
450	Conductive			500	.016		6.05	.71		6.76	7.70
9 65	19.23 Vinyl Tile Flooring										
010	VINYL TILE FLOORING										
500	Vinyl tile, 12" x 12", 3/32" thick, standard colors/patterns		1.18	500	.016	5.5.	3.71	.71		4.42	5.15
558	1/8" thick, standard colors/patterns			500	.016		5.20	.71		5,91	6.75
600	1/8" flúck, premium colors/patterns			500	.016		7			7.71	8.75
650	Solid colors			500	.016		3.25	.71		3.96	4.63
700	Marbleized or Travertine pottern			500	.016		5.90	.71		6.61	7.55
750	Rorentine pattern			500	.016		6.30	.71		7.01	8
800	Premium colors/potterns		1	500	.016	7	6.25	.71		6.96	7.90
-	19.33 Rubber Tile Flooring		diam'r.	-	-						
010	RUBBER TILE FLOORING		11								
050	Rubber tile, morbleized colors, 12" x 12", 1/8" thick		TIM	400	.020	S.F.	5.75	.89		6.64	7.6
100	3/16" thick			400	.020		9.05	.89		9.94	11.2
300	Special tile, plain colors, 1/8" thick			400	.020		7.95	.89		8.64	10.03
350	3/16" thick		I	400	.020		9.05	.89		9.94	11.2
410	Raised, radial or square, .5 mm black			400	.020		7.65	.89		8.54	9.7
430	5 mm colored			400	.020		8.25	.89		9.14	10.4
450	For golf coerse, skoting rink, etc., 1/4" thick			275	.029	1	10.15	1.29		11.44	13.1
130	1 or you course, account man, onc., 1/4: man.		Y	21.3	102.7	T	10/12	1106.7		7,107,1	17.000

09	65 33 - Conductive Resilient Flooring									
	55 33.10 Conductive Rubber and Vinyl Flooring			Labor-	11.0	W	2016 Bo		***	Total
		Crew	Output	mours	Unit	Material	Labor	Equipment	Total	Ind 08
3010			Carre C	0.00	raion					
1700		1 Tot	315	.025	5.E.	6.95	1.13		80.6	9,1
1800			315	.025		6.70	1.13		7.83	9)
	65 66 - Resilient Athletic Flooring									
	55 66.10 Resilient Athletic Flooring									
0010										
1000	The state of the s	118	315	.025	S.F.	2.97	1.13		4.10	4
2000	Vinyl sheet flooring, 1/4" thk.		315	.025		4.39	1.13		5.52	6.
09	66 Terrazzo Flooring									
	66 13 - Portland Cement Terrazzo Floo	ring								
09 6	6 13.10 Portland Cement Terrazzo									
0010	HAT NOT THE PROPERTY OF THE PR	3 11111				TROP :			17. 71	
0020	Cove base, 6" high, 16 ga. zinc	1 Mstz	20	.400	LE	3.30	17.85		21.15	30
0100	Curb, 6" high and 6" wide		6	1.333		5.65	59.50		65.15	94
0300	Divider strip for floors, 14 ga., 1-1/4" deep, zinc		375	.021	700	1.54	.95		2.49	3
0400			375	.021		2.61	.95		3.56	4.
0600	The state of the s		300	.027		2.15	1.19		3.34	4.
0900			300	.027		2.90	1.19		4.09	4.
1200	For thin set floors, 16 ga., 1/2" x 1/2", zinc		350	.023		1.19	1.02		2.21	2.
1300	8mss	144	350	.023		2,60	1.02	100	3,62	4.
1500	Floor, bonded to concrete, 1-3/4" thick, gray cement White cement, mud set	1-3	75	213	S.E.	3.35	8.75	4.13	16.23	21
1800	Not builded, 3" total flickness, gray cement		75 70	.213		3.73 4.17	8.75 9.35	4.13 4.43	16.61	213
1900	White coment, mud set	11	70	.229		4.86	9.35	4.43	17.95 18.64	23.5
2100	For Venetion terruzzo, 1" topping, udd	у.	70	LLI	4	50%	50%	4.40	10.04	24
2200	For heavy duty obrasive terrazzo, add					50%	50%			
2700	Manolithic tenazzo, 1/2" flick					3416	2011			
2710	10' poneis	1-3	125	128	S.F.	3.14	5.25	2.48	10.87	133
3000	Stairs, cost in place, pan filled heads		30	.533	LE	3.59	22	10.35	35.94	48
3100	Treads and risers		14	1.143	1	6.15	47	22	75.15	101
3300	For stair landings, add to floor prices						50%			
3400	Stair stringers and fascia	1-3	30	.533	S.F.	5.25	22	10.35	37.60	49.
3600	For abrasive metal naslegs on stairs, add	- 11	150	.107	LE	9.35	4.37	2.07	15.79	18.5
3700 3900	For abrasive surface finish, add		900	.027	S.F.	1.55	1.09	.52	3.16	3.
4000	For reised abrasive strips, add Wainscot, bonded, 1-1/2" thick		150	.107	LF.	1.35	4.37	2.07	7.79	10.3
4200	1/4" thick		40	.533	S.F.	3.97 5.55	22 16.40	10.35	36.32	48
4300	Stone chips, criya gerostone, per 50 lb. bog	100	40	.400	Bog	16.80	10.40	7.75	29,70 16,80	383
MARKET	66 16 - Terrazzo Floor Tile				reall	10,00			10.00	100
09 6	6 16.10 Tile or Terrazzo Base									
0010	TILE OR TERRAZZO BASE									
0020	Scritch court only	1 Mstz	150	.053	S.E.	.43	2.38		2.81	33
0500	Scratch and brown cost only		75	.107		.82	4.76		5.58	7.9
9 6	6 16.13 Portland Cement Terrazzo Floor Tile						- Indiana			
0010	PORTLAND CEMENT TERRAZZO FLOOR TILE									
1200	Floor tiles, non-slip, 1" thick, 12" x 12"	0-1	60	,267	S.F.	20.50	11.25		31,75	39.5
1300	1-1/4" thick, 12" x 12"		60	.267		20.50	11.25		31.75	40
1500	16" x 16"		50	.320		22.50	13.50		36	45

9 6	6 16 - Terrazzo Floor Tile									
			Daily	Labor	12.	52 NV	2016 Ba			Total
-	16.13 Portland Cement Terrazzo Floor Tile	Crew	Output	Hours	Unit	Material	Lobor	Equipment	Total	Ind 0&P
900	1-1/2" flick, 16" x 16"	D-1	45	.356	S.E.	20.50	15		35.50	45.50
000	For Venetian terrazza, add					6,15			6.15	6.80
700	For white cement, add				*	.58			.58	.64
	16.16 Plastic Matrix Terrazzo Floor Tile									
e de la constante de la consta	PLASTIC MATRIX TERRAZZO FLOOR TILE	1000	113250	1000	120		-		-	200
00	12" x 12", 3/16" thick, Floor tiles w/marble chips	1.18	500	.016	S.E.	7,30	71		8.01	9.10
200	12" x 12", 3/16" thick, Floor tiles w/glass chips		500	.016		7.90	.71		8.61	9,70
300	12" x 12", 3/16" thick, Floor tiles w/recycled content	T Y	500	.016	4	6.20	.71		5.91	7.90
	16.30 Terrazzo, Precast									
	TERRAZZO, PRECAST	445	44	200	10	14274				1000
70	Base, 6" high, straight	T Mstz	70	.114	LF.	12.10	5.10		17.20	21
00	Cove		60	133		13,20	5.95		19.15	23.50
10	8" high, struight	14	60	.133	No.	11.80	5.95	SHEE	17,75	22 20 50
00	Cove For white coment, add	+	50	.160		17.35 .46	7.15		24.50	29.50
00	For 16 ga. zinc toe strip, add					1.81			1.81	1.99
00	Curbs, 4" x 4" high	1 Mstz	40	.200		33.50	8.90		42.40	49.50
00	8" x 8" high	1 140/5	30	.267	-	38.50	11.90		50.40	60
100	Stair treads, 1-1/2" thick, non-slip, three line pattern	2 Morz	70	.229		41	10.20		51.20	60
00	Nasing and two lines	4. Iffant	70	229		41	10.20		51.20	60
00	2" thick treads, stroight		60	267		46.50	11.90		58.40	69
00	Curved		50	.320		61	14.25		75.25	88
00	Stair risers, 1" thick, to 6" high, straight sections		60	.267		11.10	11.90		23	30
00	Cove		50	.320		15.80	14.25		30.05	38.50
00	Curved, 1" thick, to 6" high, vertical		48	.333		21.50	14.85		36.35	45.50
00	Cove		38	.421	mbo	41	18.80		59.80	73
00	Stair fread and riser, single piece, straight, smooth surface		60	.267		52,50	13.90		64.40	75.50
00	Non skid surface		40	.400		68	17.85		85.85	102
00	Curved tread and riser, smooth surface		40	.400		74	17.85		91.85	108
00	Non skid surface		32	.500	200	93	22.50		115.50	135
00	Stair stringers, notched, 1" thick		25	.640		30	28.50		58.50	75
00	2" thick		22	.727		35.50	32.50		68	87
00	Stair landings, structural, non-slip, 1-1/2" thick		85	.188	S.E.	33	8.40		41.40	48.50
00	3" thick	*	75	.213		46.50	9.50		56	65.50
00	Wainscot, 12" x 12" x 1" files	1 Mstz		.667		7.10	29.50		36.60	52
00	16" x 16" x 1-1/2" sles	, M.	8	1	9	14,25	44.50		58.75	81.50
96	6 23 – Resinous Matrix Terrazzo Floor	ring								
66	23.13 Polyacrylate Mod. Cementitious Terrazzo	Fir.								
	POLYACRYLATE MODIFIED CEMENTITIOUS TERRAZZO FLOORIN									
50	Polyacrylete, 1/4" frick, grante clips	0-6	735	.065	S.E.	3.52	2.58	.09	6.19	7.90
70	Recycled porceloin		480	.100		4.54	3,95	.13	8.62	11.20
90	3/8" thick, granite chips		620	.077		4.61	3.06	_10	7.77	9.80
1	Recycled porcelain		480	.100	w	6.45	3.95	.13	10.53	13,30
66	23.16 Epoxy-Resin Terrazzo Flooring									
0	EPOXY-RESIN TERRAZZO FLOORING									
N)	Egoxy torrazzo, 1/4" thick, chemical resistant, granite chips	1-3	200	.080	S.E.	6	3.28	1.55	10.83	13.15
30	Racycled posselale		150	.107		9.10	4.37	2.07	15.54	18,75
00	Epoxy terruzzo, 1/4" thick, granite chips		200	.080		5.15	3.28	1.55	9.98	12.25
0	Average		175	.091		5.45	3.75	1.77	10.97	13,50
0	Recycled porceloin		150	.107		5.75	4.37	2.07	12.19	15.05
0	Epoxy terrazza, 3/8" thick, marble chips		200	.080		5.75	3.28	1.55	10.58	12.90

0000	91 Painting										
ע עו	1 23 - Interior Painting		-	Daily	Labor-	-		2016 Ba	on Courts		Total
9 91	23.52 Miscellaneous, Interior		Gew	Output	Hours	Unit	Material	Labor	Equipment	Total	Incl O&P
400	Paint, 1 cost		I Pord	350	.023	S.E.	.11	.92	adodonaro	1.03	1.5
450	2 coats			400	.020		.21	.81		1.02	1.4
900	Balustrades, primer coat, all base, brushwork	- pd = 1		520	.015		.06	.62		.68	1.0
150	Point, 1 cout			520	.015	mbu	.11	.62		.73	13
700	2 coots			325	.025		.21	.99		1.20	13
900	Trusses and wood frames, primer coat, all base, brushwork			800	.010		.06	.40		.46	
950	Sproy			1200	.007		.07	.27		.34	
000	Paint 1 coat, brushwork		T	750	.011		.11	.43		.54	1
200	Spray	100		1200	.007		.12	.27		.39	
220	Paint 2 coots, brushwork			500	.016		.21	.65		.86	1.3
240	Sproy			600	.013		.24	.54		.78	13
260	Stain, brushwork, wipe aff		di	600	.013	m to	.09	_54		.63	3
280	Varnisk, 3 coats, brushwork			275	.029		.26	1,17		1.43	2.0
350	For latex priest, deduct			2000	arrest.		10%	27.00		5000	22
-	23.62 Electrostatic Painting					_	300				
6000hb	ELECTROSTATIC PAINTING	_						_	-	-	
100	la shop										
200	2222										
	Flat surfaces (lockers, casework, elevator doors, etc.)	The last		200	010			2.24		-0.76	
000	One coat		Pord.	200	.040	S.E.	.57	1.61		2.18	3.1
00	Two coats			120	.067		.82	2.69		3.51	4.5
000	Irregular surfaces (furniture, door frames, etc.)			100	ara	12.5		0.15		0.70	
00	One coaf		Pord	150	.053	S.E.	.57	2.15		2.72	3.
00	Two coats			100	.080		.82	3.23		4.05	5.7
100	On site										
100	Flut surfaces (lockers, casework, elevator doors, atc.)			-	7747474					10000000	
00	One coat		Pont	150	.053	S.F.	.57	2.15		2.72	3.5
00	Two coats		10	100	.080		.82	3.23		4.05	53
200	irregular surfaces (furniture, door frames, etc.)		-	0.733	100	100					
100	One coat		Pord	115	.070	S.F.	.57	2.81		3.38	4.8
100	Two coots			70	.114		.82	4.61		5.43	7.8
000	Anti-microbial coating, hospital application		Ÿ.	150	.053	Ţ.	.06	2.15		2.21	3.3
91	23.72 Walls and Ceilings, Interior										
10	WALLS AND CEILINGS, INTERIOR	R099100-10									
00	Concrete, drywall or plaster, latex, primer or sealer coat	R099100-20									
00	Smooth finish, brushwork	27270 (1750)	Pord	1150	.007	S.E.	.06	.28		.34	3
40	Roller			1350	.006		.06	.24		.30	
80	Spray		1	2750	.003		.05	.12		.17	.2
00	Sand finish, brushwork			975	.008		.06	.33		.39	3
40	Roller			1150	.007		.06	.28		.34	
80	Spray			2275	.004		.05	.14		.19	1
00	Paint 1 cost, smooth finish, brushwork			1200	.007		.07	.27		.34	1
40	Roller			1300	.006		.07	25		.32	1
80	Spray			2275	.004		.06	.14		.20	3
00	Sand finish, brushwork			1050	.008		.06	.31		.37	1
10	Roller	T		1600	.005		.07	.20		.27	
30	Sproy			2100	.004		.02	.15		.17	
00	Paint 2 coats, smooth finish, brushwork			680	.012		.14	.47		.61	1
40	Roller			800	.010		.14	.40		.54	
30	Sproy	-		1625	.005		.13	.20		.33	
10	Sand finish, brushwork			605	.013		14	.53		.55	
10	Roller			1020	.008		14	.32		.46	
10	Spiny			1700	.005		.13	.32			1
Part I	Shai		-	1700	1003		.13	-17		.32	4

	91 Painting			l.							
09 9	11 23 - Interior Painting								10	100	
	02 70 Well- and Callings Interior		Person	Daily	Lobor	Unit	Material	2016 Be		Total	Total Incl C&
	23.72 Walls and Ceilings, Interior Point 3 coots, smooth finish, brushwork		Crew 1 Pord	Output 510	Hours .016	S.F.	.21	Lubor .63	Equipment	.84	1.
200	Roller		1.1980	650	.012	J.F.	.21	.50		.71	- 1
280	Spray		-11	1625	.005		,19	.20		.39	
300	Sand finish, brushwark			454	.018		.30	.71		1.01	I.
340	Rollin		200	680	.012	20	.31	.47		.78	1
380	Sproy			1133	.007		.27	.28		.55	1
600	Glaze coefing, 2 coats, spray, clear			1200	.007		.49	.27		76	
64D	Multicolor			1200	.007		.97	.27		1.24	1
660	Painting walls, complete, including surface grep, primer &		-					-			
670	2 coats finish, on drywall or plaster, with roller		1 Pord	325	.025	S.E.	.21	.99		1.20	1
700	For all base point, add		. +		1452	1	10%	Contr.			
800	For ceiling installations, add							25%			
2000	Masonry or concrete block, primer/sealer, latex point					100					
2100	Primor, smooth finish, brushwork		1 Pord	1000	.008	S.E.	.11	.32		.43	- 5
2110	Roller			1750	.007		.11	.28		.39	
180	Sproy			2400	.003		.10	.13		.23	
2200	Send finish, brushwork			850	.009		.11	.38		.49	
2210	Roller			975	.008		.11	.33		.44	
2280	Sproy			2050	.004		.10	.16		.26	
2400	Finish coat, smooth finish, brush			1100	.007		.08	.29		.37	
2410	Roller		ota .	1300	.006	isdai	.08	.25		.33	
2480	Sproy			2400	.003		.07	.13		.20	
2500	Sond finish, brushwork			950	.008		.08	.34		.42	
2510	Roller			1090	.007		80.	.30		.38	
2580	Spray			2040	.004		.07	.16		.23	15
2800	Primer plus one finish coat, smooth brush			525	.015		.30	.61		.91	1
2810	Roller			615	.013		.19	.53		.72	1
2880	Spray			1200	.007		,17	.27		.44	3
7900	Sand finish, brushwork			450	.018		.19	72		.91	1
2910	Roller			515	.016		.19	.63		.82	1
2980	Spray			1025	.008		.37	.31		.48	
3200	Primer plus 2 finish coats, smooth, brush			355	.023		.27	.91		1.18	1.
3210	Roler		П	415	.019		.27	.78		1.05	1
3280	Sproy			800	.010		.24	.40		.64	1
3300	Sand finish, brushwork			305	.026		.27	1.06		1.33	1
3310	Roller			350	.023		.27	.92		1,19	1
3380	Sproy		111	675	.012	-1	.24	.48		72	
3600	Glaze coating, 3 coats, spray, clear			900	.009		.70	.36		1.06	1
3620	Multicolar			900	.009		1.14	.36		1.50	1
4000	Block filler, 1 coot, brushwork			425	,019		.12	.76		.88	1
4100	Silicone, water repellent, 2 coats, spray		+	2000	.004		.37	.16		.53	2
4120	For oil base paint, add						10%				
8200	For work 8' - 15' H, add							10%			
8300	For work over 15" H, add							20%			
8400	For light textured surfaces, add							10%			
8410	Heavy textured, add							25%			
09 9	1 23.74 Walls and Ceilings, Interior, Zero VOC L	atex									
0010	WALLS AND CEILINGS, INTERIOR, ZERO VOC LATEX	POLICE TO SERVICE TO S	10 8								
0100	Concrete, dry wall or plaster, latex, primer or sealer coat										
0200	Smooth finish, brushwork	G	1 Pord	1150	.007	S.E	.07	.28		.35	
0240	Rolet	G		1350		-	.06	.24		.30	
0280	Spray	G			_003		.05	.12		_17	1
SEOU.	opiny	120	4	44.40	1000	*	100	17.6		1000	1 10

10 51 Lockers 10 51 13 - Metal Lockers Daily Labor 2016 Bare Costs Tatal 1051 13.10 Lockers Ind 0&P Crew Output Hours Unit Material Total Equipment 0011 LOCKERS steel, baked enamel, pre-assembled Single tier box locker, 12" x 15" x 72" 1 Shee 20 .400 231 23 254 289 18" x 15" x 72" 20 .400 245 23 268 305 0120 12" x 18" x 72" 20 400 235 23 258 293 0130 18" x 18" x 72" 20 400 285 23 308 350 0140 6410 Double tier, 12" x 15" x 36" 30 .267 233 15.25 248.25 280 0420 18" x 15" x 36" 30 .267 235 15.25 250.25 283 0430 12" x 18" x 36" 30 .267 265 15.25 280.25 315 18" x 18" x 36" 30 267 225 15.25 240.25 0440 272 320 360 0500 Two person, 18" x 15" x 72" 20 400 297 23 23 353 395 0510 38" x 18" x 72" 20 .400 330 Duplex, 15" x 15" x 72" 20 .400 335 23 358 405 0520 .400 370 23 393 445 0530 20 15" x 21" x 72" 5 fier box lockers, unassembled 30 .267 Opng. 46 15.25 61.25 74 9600 24 333 50 19.10 69.10 84 0700 Set up. 36 222 37 12.70 49.70 60.50 6 tier box lockers, unassembled 6900 30 44 15.25 59.25 71.50 1000 267 Sat up 277 338 400 7.50 1.067 61 1100 Wire meshed waxdrobe, floor mid., open front versity type En. Te-person locker unit with dathing rack 2400 72" wide x 15" deep x 72" high 495 30.50 525.50 585 2500 15 .533 2550 18" deep 15 .533 650 30.50 680.50 760 3000 Wall mounted lockers, 4 person, with coat bar 363 3100 48" wide x 18" deep x 12" high 1 Shee 20 .400 En. 340 23 405 3250 Rack w/24 wire mesh baskets. 1.50 5.333 Set 410 305 715 915 360 365 725 955 3260 30 baskets 1.25 6.400 480 8270 36 baskets 95 8,421 470 950 3280 42 baskets 100 10 455 575 1,030 1,375 For built-in lack with 2 keys, add En. 13.75 13.75 15.10 3600 For hanger rods, add 2 2 2.20 For number plate kit, 100 plates #1 - #100, add 1 Shee 2 82 115 197 265 3650 4 For locker base, closed front panel 90 .089 7.20 5.10 12.30 15.70 3700 3718 End panel, holted 36 222 9.30 12.70 22 29.50 3800 For sloping top, 12" wide 24 .333 32.50 19.10 51.60 65 15" wide 24 .333 54.60 68 3810 35.50 19,10 18" wide 333 35.50 19.10 54.60 3820 24 68 Sloping top end panel, 12" deep 3550 72 12.20 6.35 18.55 23 15" deep 72 .111 12.20 6.35 18.55 23 3860 18" deep 72 .111 12.20 6.35 18.55 23 3870 3900 For finish end panels, steel, 60" high, 15" deep 12 .667 36 38 74 98 3910 72" high, 12" deep 12 667 29 38 67 90.50 12 .867 43.50 38 81.50 107 3920 18" deep For "ready to assemble" lockers, 5000 75% 5010 Add to lobor 5020 Deduct from material 20% Heavy duty for detention facility, tamper proof, 14 ga. welded steel, solid 6000 24" W x 24" D x 74" H, single fier 1 Shee 18 Ea. 525 25.50 550.50 615 6100 444 540.50 605 6110 Double tier 18 444 515 25.50 625 Triple tier 18 530 25.50 555.50

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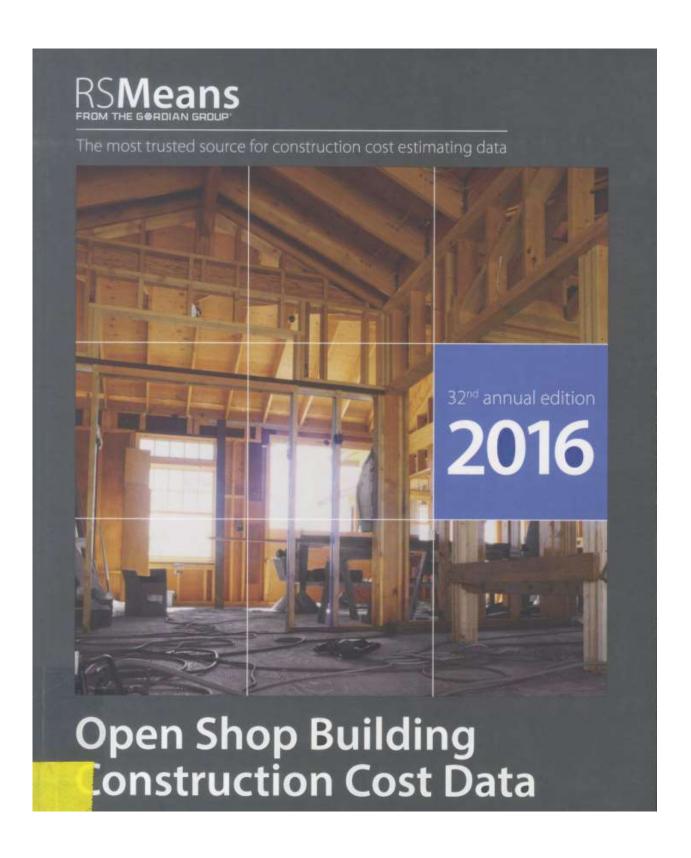
6120

123	4 16 - Restaurant Furniture									- Marie
10 54	16.70 Booths	Crew		Labor- Hours	Unit	Material	2016 Bo Labor	re Costs Equipment	Total	Total Incl 08
3000	Fixed seating, one piece plastic chair and	Cien	output	HUUIS	OIIII	Muteriul	LUDUI	edaibinein	TUTUI	mici ue
3010	plastic faminate table top									
3100	Two seat, 24" x 24" table, minimum	T F-7	30	1.067	Ea.	810	46		856 T	17
120	Modimum	19	26	1.231	T	1,150	53		1,203	1,3
3200	Four seat, 24" x 48" table, minimum		28	1,143		805	49.50		854.50	1
220	Moximum		24	1.333		1,375	57.50		1,432.50	1,
300	Six seat, 24" x 76" table, minimum	1000	26	1.231	-	1,450	-53		1,503	1,
320	Maximum		22	1,455		2,000	63		2,063	2,2
400	Eight seat, 24" x 102" table, minimum		20	1.600		1,950	69		2,019	2
420	Maximum		18	1,778		2,525	77		2,602	2,
000	Free standing, wood fiber care with		- NATIONAL PROPERTY.	2015(0)-00(0)	-	263656	93.50		775.530	- 76
010	plastic laminate face, single booth									
100	24" wide	2 Corp	38	.421	Eo.	385	20.50		405.50	174
150	48" wide	177	34	.471	T	465	23		488	1.0
200	60° wide		30	533	-	570	26		596	19
300	Double booth, 24" wide		32	.500		570	24		594	100
350	46" wide		28	.571		760	27.50		787.50	
400	60" wide		26	.615		955	30		985	1,
600	Uphoistered seat and back		(000)	171.15	-	1000	1		144	79
650	Foursome, single booth, minimum	2 Carp	38	.421	En.	435	20.50		455.50	7
700	Meximum	1 00	30	.533	7	1,650	26		1,676	13
800	Double booth, minimum		32	.500		955	24		979	1)
850	Maximum		26	.615	+	2,550	30		2,580	23
300	Mount in floor, wood fiber core with	- 7	20.	1010	-70	2,350	-50		2,300	4,0
010	plastic luminate face, single booth									
050	24" wide	F-7	30	1.067	Et.	310	46		356	- 1
100	48" wide	- Cr	28	1.143	Land	395	49.50		444.50	5
150	60" wide		26	1.231		570	53		623	3
200	Double booth, 24" wide		26	1.231		500	53		553	6
250	48" wide		24	1.333		640	57.50		697.50	7
300	60" wide	- Lud	22	1.455	-	910	63		973	1,1
	55 Detention Furniture									
_	5 13 - Detention Bunks 13.13 Cots		9					1-14		۹
	COTS				-	12.00				
500	Bolted, single, pointed steel	F4	20	7.600	Eo.	340	86	7.35	433.35	
700	Stainless steel	15-1		1.600	W.	985	86	7.35	1,078.35	1.72
2	56 Institutional Furnitu	re			i	33440	**		71010000	
25	6 33 – Classroom Furniture								ratio	ш
	33.10 Furniture, School									
	FURNITURE, SCHOOL									
500	Classroom, movable chair & desk type, minimum				Set				73.50	
600	Moximum				*				155	
000	Choir, molded plastic									
100	Integral tablet arm, minimum				Eq.	105			105	116
150	Махітит					198			198	70
	Desk, single pedestal, top book compartment, minimum					97.50			97.50	

125	6 33 - Classroom Furniture									
			Daily			I WILLIAM STATE	2016 Be	ore Costs		Total
	33.10 Furniture, School	Crew	Output	Hours	Unit	Material	Labor	Equipment	Total	Ind 08?
020	Maximute				En.	189			189	208
950	Side book compertment, minimum					134			134	148
220	Moximum					173			173	190
200	Flip top, minimum					233			233	256
220	Moximum					285			285	315
300	Preschool, moulded plastic chairs, minimum					23,50			23.50	25.5
20	Maximum					61			61	67
800	Tables, plastic laminate top, 24" wide, 36" long					64			64	70
120	48" long					68.50			68.50	75.5
800	607 long					133			133	147
902	30" wide, 48" long					98.50			98.50	108
20	60" long					146			146	160
40	72" long					171			171	188
W0	36" wide, 36" long					134			134	147
20	60" long					189			189	208
40	72" long					229			229	252
100	Round, 36" diam,					102			102	112
200	42" dem.					120			120	132
30	48" dism.					133			133	146
10	60" diam.		-	-	- 9	183			183	201
-	6 43 - Dormitory Furniture									
	43.10 Dormitory Furnishings									
	DORMITORY FURNISHINGS									
00	Bookcose, two shelf				En.	219			219	240
00	Bunkable bed, twin, minimum					395			395	430
20	Moximum					585			585	645
00	Chest, four drawer, minimum					345			345	380
200	Maximum				v	715			715	785
50	Built-in, minimum	2 Corp	13	1,231	L.F.	123	59.50		182.50	228
50	Maximum		10	1.600		228	77.50		305.50	370
00	Desk top, built-in, laminated plastic, 24" deep, minimum		50	.320		45	15.50		60.50	73.5
00	Maximum		40	.400		134	19.40		153.40	178
50	30" deep, minimum		50	.320		57.50	15.50		73	87
50	Maximum		40	400		251	19.40		270.40	305
50	Dressing unit, built-in, minimum		12	1.333		185	64.50		249.50	305
50	Maximum		8	2	*	555	97		652	760
00	Desk, single pedestal				Ea.	530			530	580
00	Hutch/bookcase, with light					265			265	292
00	Ladder					120			120	132
00	Minor, with frame					120			120	132
30	Nightstand					286			286	315
10	Wall unit, open shelving					480			480	525
00	Wardrobe				*	545			545	595
00	Rule of thumb: total cost for furniture, minimum				Student				2,525	2,800
50	Maximum		-						4,850	5,350
_	6 51 – Library Furniture							ELL		
56	51.10 Library Furnishings									
0 1	LIBRARY FURNISHINGS									
0	Attendant desk, 36" x 62" x 29" high	1 Corp	16	,500	Eu.	1,875	24		1,899	2,100
0	Book display, "A" frame display, both sides, 42" x 42" x 60" high		16	.500		1,275	24		1,299	1,425
0	Table with bulletin board, 42" x 24" x 49" high	-	16	.500	1	760	24		784	870
0	Book trucks, descending platform,				17					

Appendix G

Open Shop Building Construction Cost Data



5 3	1 23.50 Roof Decking		Crew	Delly Output	Lobor- Hours	Unit	Material	2016 Bare (Lobor Fo	esh usprient	Total
810	ROOF DECKING		1.2520.	120071	21000					
015	Made from recycled materials									
100	Open type, 1-1/2" deep, Type 8, wide rib, galv., 22 ga., under 50 sq.	G	14	4500	.007	SE	2.07	.29	:03	2.39
200	50-500 squares	G		4900	.007		1.61	.24	.03	1.90
400	Over 500 squares	[4]		5100	.005		1,49	.25	.03	1,77
600	20 gs., under 50 squares	G		3865	.008		2.42	.33	.04	2.79
650	50-500 squeres	G		4170	.008		1.94	.31	.04	2.29
700	Over 500 squares	G		4300	.007		1.74	.30	,03	2.07
900	18 ge., under 50 squares	G		3800	.008		3.12	.34	.04	3.50
950	50-500 squares	[6]		4100	300.		2.49	.32	.04	2.85
990	Over 500 vquores	G		4300	.007		7.24	.30	.03	2.57
050	16 gp., under 50 squares	G		3700	.009		4.21	.35	.04	4.60
060	50-500 squares	G		4000	.008		3.37	.32	.04	3.73
100	Over 500 squares	G		4200	.008		3.03	.31	.04	3.38
200	3" desp, Type N, 22 ga., under 50 squares	0		3600	.009		3.04	.36	.04	3.44
250	50-500 squares	G		3800	.008		2.43	.34	.04	2.51
260	over 500 squares	G		4000	.088		2.17	.32	.04	2.55
300	20 ga., under 50 squores	G		3400	009		3.28	.38	.04	3,70
350	50-500 states	G		3600	.009		2.63	.36	.04	300
360	over 500 squares	[G]		3800	.008		2.36	,34	.04	7.74
400	18 gs., under 50 squares	G		3200	.010		4.25	.40	.05	4.70
450	50-500 squares	G		3400	.009		3.40	.38	.04	3.92
460 500	ower 500 squares 16 gs., under 50 squares	G		3000	.011		3.06 5.60	.36	.05	3.46
550	50-500 spores	G	-	3290	.010		4.49	.40	.05	4.94
560	even 500 squares	G		3400	1000		4.04	.38	.04	4.46
780	4-1/2" deep, Type J, 20 go., over 50 squares	G		2700	D12		3.68	.48	.05	4.21
1800	18 gr.	[G]		2460	013		4.85	.57	.06	5.44
900	16 po.	G	Property	2350	.014		6.30	.55	.06	6.91
100	6" doeg, Type H, 18 gs., over 50 squares	G		2000	.016		5.80	.65	.07	6.52
200	16 ps.	G		1930	.017		7.25	.67	.88	8
300	14 m.	G		1860	.017		9.35	.69	.08	10.12
1500	7-1/2" deep, Type H, 18 gp., seer 50 squires	[G]	into	1490	010	100	6.90	.76	.89	7.75
600	16 m.	G		1590	.028		8.60	.81	.09	9.50
700	14 gr.	G	14	1490	2023	-	10.75	.87	10	21.72
008	For pointed instead of gelvanized, deduct						5%			
000	For occustical perforated with fiberglass insulation, add					S.E.	25%			
100	For type F intermediate rib instead of type B wide rib, add	G					25%			
150	For type A narrow rib instead of type B wide rib, add	G				4	25%			
05	31 33 - Steel Form Decking									
5 3	1 33.50 Form Decking									
010	FORM DECKING									- 31
0015	Made from recycled materials									
100	Sich form, seed, 78 go., 9/16" deep, Type OFS, occopied	G	54	4000	.008	5.E.	1.56	.32	.04	157
200	Gelverized	[G]	11-1	4000	.008		1.38	.32	7,4	176
220	24 gs., 1" deep, Type UFTX, vaccated	G		3900	800.		1.50	33	.04	1,17
240	Selverized	G		3900	800.		1.76	.33	.04	2.13
300	24 gs., 1-5/16" deep, Type UFX, uncoated	G		3800	800.		1.59	.34	.04	1.97
400	Gehanized	G		3800	.008		1.87	.34	.04	2.25
1500	22 ga., 1-5/16" deep, uncoated	G		3700	.009		2.02	35	.04	2.41
600	Edwartzed	G		3700	.009		2.06	.35	.04	7.6
700	22 ga., 2" deep, unconted	G		3600	.009		2.62	.36	.04	3.00

	A CHARLES ASSESSMENT OF THE STATE OF THE STA	ALC: N		Dolly	Labor-		V 00 7958	2016 Bare Costs	57/8
	16.10 Roof Deck Insulation		Crew	Output	Hours	linit	Material	Lobor Equipment	Total
	ROOF DECK INSULATION, firstering excluded		1,003						
0016	Asphaltic cover board, fiberglass limit, 1/8" thick		T Rofe	1400	.006	53.	.A7	.18	- 1
0018	1/4° this	122		1400	.006		.94	.18	1
0020	Fiberboon) low dansity, 1/2" thick R1.39	G		1300	.005		.33	.20	
0030	1" thick R2.78	G		1040	.008		.55	.25	-
0080	1-1/2" thick R4.17	G		1840	.008		.84	.25	1
0100	2" flick R5.56	G		1040	.008		1,10	.25	1
0110	Fiberboard high density, 1/2" thick R1.3	G		1300	.006		.30	.20	
0120	1" Haid: R2.5	[G]		1040	.008		.56	.25	3
0138	1-1/2" Hick R3.8	G		1040	.008		.86	.25	3
0200	Fiberglass, 3/4" thick R2.78	[G]		1300	1009		.61	.20	
0400	15/16" thick #3.70	[G]	100	7300	.006		.81	20	1
0460	1-1/16" thick R4.17	G		1300	.006		1.01	.20	1
0600	1-5/16" fikk R5.26	G		1300	.006		1.37	.20	1
0650	2-1/16" thick R8.33	G		1040	.008		1.45	.25	I
0700	2-7/16" Hick R10	G		1040	.008		1.68	.25	1
0800	Sypsum cover board, Rheightss man focus, 1/4" thick			1400	.006		47	.18	
0810	1/2* flick			3300	600		57	.20	
0820	5/8" flick			1200	.007		.61	21	
0830	Printed fibergless red facer, 1/4" thick		100	1400	300.	-	.48	.18	- 3
0840	1/2° tick			1300	.006		.57	20	
0850	5/8" Nick	[et		1200	.007		.60	21	
1650	Perite, 1/2" flux 81.32	G		1365	.006		.26 .37	.19	
1655 1660	3/4" frick R2.08	G		1040	.008	-	.53	.25 .25	
1670	1" fluid: 82.78 1-1,/2" fluid: 84.17	[6]		1040	.008		711	25	î
1680	2" flick R5.56	G		910	.009		1.06	.28	i
1485	21/2" field \$6.67	G		910	.009		1.40	.28	1
1690	Tripered for drainage	G	-	1040	.008	B.E.	1.05	25	1
1700	Polyisocyanurate, 2#/C.F. density, 3/4" thick	G		1950	.004	S.E.	.46	.13	
1705	1" tick	G		1820	.004	1	.47	.34	
1715	1-1/2* fick	G		1625	.005		.64	.16	
1725	2º frid	G	<u>śsiko</u>	1430	.006		. 22	.38	- 1
1735	2-1/2* frick	[G]		1385	.006		1.10	.19	1
1745	3° fick	G		1300	006		1.22	.20	3
1755	31/2° fix	G		1300	.006		1.90	.20	2
1765	Tapered for drainage	G	1	1820	.004	B.E.	.59	.14	1
1900	Extruded Polystyrene		1			1			
1910	15 PSI compressive strength, 1" frick, R5	G	1 Refe	1950	.004	S.E.	.60	.33	19
1920	2" fink, #10	G		1625	.005	1	.78	.16	1
1930	3" mix., R15	(G)		1300	.006		1,56	.20	13
1932	4" filix, 820	G		1300	,006		2.10	.20	2
1934	Topered for distinger	G		1950	.004	B.E.	.62	.33	- 13
1940	25 PSI compansive shangfu, 1° filidi, 85	G		1950	.004	S.E.	.69	13	19
1942	2" mix, #10	[G]		1625	.005	1	1,31	.16	1)
1944	3" fick, R15	G		1300	.006		2	.20	23
1946	4" fisk, #20	G		1300	,006	+	2.76	.20	2
1948	Tapered for drainage	G		1950	.004	B.F.	.61	.13	. 3
1950	40 PSI compressive strength, 1" thick, R5	[G]	distant.	1950	,004	S.E.	53	.13	3
1952	2" fikk, \$10	G G		1625	.005		1.01	16	T,
1954	3" Hid, 115	(G)		1300	.006		1.46	.20	1)
1956	4" thirk, #20	G		1300	.004	-	1,91	.20	2
1958	Tapered for drainage	G		1820	.004	B.E.	.76	.14	3

	51 13 - Built-Up Asphalt Roofing	-	Defly		over 1	Truste i	2016 Barr	Costs	100
	1 13.20 Built-Up Roofing Systems	Crew	produce division	Children College	Unit	Material		Equipment	Total
5010	gions fiber left, (Nype IV), mopped	6-1	19	2.947	54	169	88.50	30.50	285
5400 5400	Un militalia dacks		18	3.111		148	93.50	32	273.5
5800	4 piles giass fiber felt (type IV), excepted On notable decks		21	2.667		229	80.50	27.50	35
		+	20	2.800	*	207	84.50	29	32
NAMED AND	1 13.30 Cants								
0010	CANTS								
0300	Lumber, treated, 4" x 4" cut diagonally Mineral or River, trappared of, 1" x 4" x 48"	7 Rafe		.025	LE	1.80	39		22
0400	3-1/2" x 5-5/0" x 48"		325	025		.30	.79		1.0
-		1.4	325	.025		.48	.79		12
	1 13.40 Felts								
0010	FRUS	200							
0012	Glass Rhared reading fielt, #1.5, not reapped	1 flore		138	54.	10.85	4.43		152
0300	Bose sheet; #80, chansel verted		58	.138		42.50	4,43		46.5
0400	#70, coded	14	58	138		17,80	4.43	-	22.3
0500	Cop. #87, mineral surfaced		58	.138		81	4,43		85.4
0600	Finaling membrane, #65		16	500		10.10	16.05		26.1
0000 2900	Cool for fibered, #15, no mapping		58	.138		18	4.43		22.4
100	Againah falt, #15, 4 sp. per rail, no mapping	-	58	.138	-	5.30	4.43		93
200	#30, 2 sq. per roll Double coated, #33		58	138		10.30	4.43		14,7
400	#40, box shart		SB	.138		11	4,43		15.4
450	Costed and schwarkel		58	138		10.95	4.43		15.1
500	Remd felt, organic, #15, 4 sq. rolls	11	.58	138	45	12	4.43	-	16.4
550	#30, 2 sq. rol		58	.138		13.40	4,43		17.8
700	Add for mapping above felts, per ply, asphalt, 24 lb. per sq.	*	58	.138		26.50	4.43		30.9
800	Cool for mapping, 30 lb. per sq.	6-1	192	.292		11,30	8.80	3.01	22.9
900	Flood root, with englight, 60 lb. per sq.	1919	186	301	-	18.85	9.05	3.11	31.0
000	With cook tot, 75 lb, per sq.		60 56	1730		28 47	28 30	9.65 10.35	65.6
-	13.50 Walkways for Built-Up Roofs		30	-	-	76	30	18.20	87.3
1010	WALKWAYS FOR BUILT-UP ROOFS			-			_		
1020	Asphalt imprograted, 3" x 6" x 1/2" flick	1 Rote	400	.020	SE	1.79	- 11		-71-4
1100	3' x 3' x 2/4" flox	1 Marc	400	.020	3E	5.15	.64		2.4
1300	Concrete portio blocks, 2" flick, network	100	115	.070		3.37	2.03		57
1400	Colors	1	115	.070		3.73	2.03		5.6
0333		_	111	28.8	Ť.	4.7.0	6,002		5.7
17/	EQ Madified Disaminare M	papered to	NP-PH	PET.	THE R		-	_	-
44	52 Modified Bituminous M	emo	rall	e k	(0)0	ring			
	2 13 - Atactic-Polypropylene-Modified I	Bitumii	nous	Men	nbra	ne Roof	ing		
	13.10 APP Modified Bituminous Membrane								
	APP MODIFIED BITUMINOUS MEMBRANE R075213	30							
070	Rose steet, #15 glass fiber felt, noiled to deck	1 Kolc		138	54.	11.85	4,43		16.2
030	Spot mapped to deck	6-1	295	190		16.40	5.70	1,96	24.0
040	Fully respond to deck		192	.292		22	8.80	3.01	33.0
058	#15 organic felt, nailed to deck.	1 Roft	58	.138		6.30	4,43		10.7
060	Spot magged to disck	5-1	295	.190		10.85	5.70	1,96	18.5
370	Felly mapped to deck		192	292	*	16.40	8.80	3.01	28.2
100	APP mod., smooth suif, cap sheet, poly, reinf., herched, 160 mile	6-5	2100	.019	5.5.	.74	.56	.09	1,35
150	170 mb		2100	.019		75	.56	.09	1,4
200	Sronule surface cop sheet, poly, west, teached, 180 mile		2000	.020		.93	.59	10	1,67
250	Smooth surface flashing, terched, 160 mile		1260	.032		74	.93	15	1.83
300	170 mis		1260	.032		25	.93	15	1.63

177	52 Modified Bituminous I 52 13 – Atactic-Polypropylene-Modifie	d Bitumi	nous	Me	mbra	ane Roo	fing			
	BE CONTRACTOR TO SECURIS SECURIS AND ADDRESS OF THE SECURIS SE			Lober		7.55.000	2016 Bare	Costs	Section 1	Total
075	213.10 APP Modified Bituminous Membrane	Crew	Output		Unit	Material		quipment	Total	Ind D&P
顯	Granule surface fleshing, torched, 180 miles	6-5	1260	.032	S.E.	.93	.93	.15	2.01	2.9
M	Fibrated always um conting	1 Rafe	11003350	.002	*	.08	.07		.15	.2
760	Sem her widing		205	.039	LE	.08	1.25		1.33	2.4
97.	52 16 - Styrene-Butadiene-Styrene Mod	dified Bit	tumi	nous	Me	mbrane	Roofing			
17.5	16.10 SBS Modified Bituminous Membrane									
iii	585 MODIFIED BITUMINOUS MEMBRANE	- 10	144							1111
	Mel bit ring, SBS med, gran surf cap sheet, poly seinf									
160	120 to 149 mls tick	51	2000	3728	SÆ	1.27	.84	29	2.40	3.2
15	150 to 160 min		2000	028		1.71	.84	.29	2.64	3,7
世	For reflective granules, add					31	79	28	1.78	2.5
UCO	Smooth surface cop sheet, mapped, 145 mils	61	2100	.027		.80	.80	.28	1.88	2.6
	Lightweight bose sheet, fiberglass reinforced, 35 to 47 mil	17	2100	.027		27	.80	28	1.35	2.1
赶	Haavyweight base/ply sheet, reinforced, 87 to 120 mil thick	14	2100	.027		.88	.80	28	1.96	2.7
601 600	Grosdeted walkpad, 180 – 220 mili	1366	400	020	and and	137	.64	.20	2,41	3.7
	Smooth surface flashing, 145 mils	5-1	1260	044		.80	1.34	.46	2.60	3.1
77	150 mile	31	1260	048		.50	1.34	46	2.30	
KS.				.544		.70		000000		3.5
100	Service surface fitables, 150 mile	7.7	1240				1.34	46	2.50	3.7
000	160 mis	7	1260	.044		32	1.34	46	2.52	3.3
700	Electroneit; croftolt primer	1 Rofc	1000000	.003		.16	.10		.26	1
DE	Roofing asphalt, 30 lb. per square	6-1	19000	10007711		.14	.09	.03	.26	.2
120	Cold poxess odnesive, 20 – 30 rels thick	1 Rofc	750	.011	100	.23	.34		.57	
HS)	Self-adhering vapor retarder, 30 to 45 m/s thick	65	2150	.019	4	1	.55	.09	1.64	2.5
	Sean hear welding	Roo		.039	LE	82.	1,25		1.33	2.4
7	53 Elastomeric Membrane	Roo			I.E.	80.	1,25		1.33	2.4
7	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R	Roo			[.E	82.	1,25		1.33	2.4
7 5	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing	Roo			[5	. 80.	1.25		1.33	2.4
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing CHLOROSULFONATED POLYETHYLENE ROOFING	Roo			I.E.	. 80.	1,25		1.33	2.4
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing CHLOROSULFONATED POLYETHYLENE ROOFING CHSconstructed polyethylene (CSPE)	ROO	fing	3			Outre:			
7 53 7 53 7 53 7 53 7 53 7 53 7 53 7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonated Polyethylene Roofing OHLOROSULFONATED POLYETHYLENE ROOFING Official formula polyethylene (CSPE) 45 min, heat webbel samm, plans attentioners	Roo	fing	1343	SE SE	251	33,50	5.50	290	345
7 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing OHLOROSULFONATED POLYETHYLENE ROOFING Official formation polyethylene (CSPE) 45 mil., heart welded searm, plans affectment Heat welded searm, plans affectment and believed	ROO	fing	1.143		251 240	33.50 45	7.45	290 312.45	345 375
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing OHLOROSULFONATED POLYETHYLENE ROOFING Oferoulforated polyethylene (ISPE) 45 mil. hert welded searm, plans attechment Heet welded searm, plans attechment and believed 60 mils, heat welded searns, plans attechment	ROO	35 26 35	1.343 1.538 1.143		251 240 325	33,50 45 33,50	7.45 5.50	290 312.45 364	345 375 430
7 5 53 10 20 20 20 20 20 20 20 20 20 20 20 20 20	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing CHLOROSULFONATED POLYETHYLENE ROOFING Chlorosulforated polyethylene (CSPE) 45 mil. heat welded searm, plans attentionent and beforded 60 mils, heat welded searm, plans attentionent and beforded Heat welded searms, plans attentionent and beforded Heat welded searms, plans attentionent and beforded	Roo loofing	35 26 35 26	1.143 1.538 1.143 1.538		251 240	33.50 45	7.45	290 312.45	345 375
7 5 5 3 7 5 3 7 5 7 5 7 5	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing CHLOROSULFONATED POLYETHYLENE ROOFING CHSoulfonated polyethylene (CSPE) 45 mil, heat welded searn, plans attachment Heat welded searn, plans attachment and believed 60 mils, heat welded searn, plans attachment and believed Heat welded searns, plans attachment and believed 3 23 - Ethylene-Propylene-Diene-Mon	Rootoofing	35 26 35 26	1.143 1.538 1.143 1.538		251 240 325	33,50 45 33,50	7.45 5.50	290 312.45 364	345 375 430
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing CHLOROSULFONATED POLYETHYLENE ROOFING Chlorosulforated polyethylene (CSPE) 45 mil. heat welded searm, plans attentionent and beforded 60 mils, heat welded searm, plans attentionent and beforded Heat welded searms, plans attentionent and beforded Heat welded searms, plans attentionent and beforded	Rootoofing	35 26 35 26	1.143 1.538 1.143 1.538		251 240 325	33,50 45 33,50	7.45 5.50	290 312.45 364	375 430
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing CHLOROSULFONATED POLYETHYLENE ROOFING CHSoulfonated polyethylene (CSPE) 45 mil, heat welded searn, plans attachment Heat welded searn, plans attachment and believed 60 mils, heat welded searn, plans attachment and believed Heat welded searns, plans attachment and believed 3 23 - Ethylene-Propylene-Diene-Mon	Rootoofing	35 26 35 26	1.143 1.538 1.143 1.538		251 240 325	33,50 45 33,50	7.45 5.50	290 312.45 364	345 375 430
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing Ottorosulfonated Polyethylene Roofing Ottorosulfonated Polyethylene Roofing Ottorosulfonated polyethylene Roofing Ottorosulfonated polyethylene (CSPE) 45 mit, heat welded seams, plans attoriosest and believed feet welded seams, plans attoriosest and believed 60 mit, heat welded seams, plans attoriosest and believed Heat welded seams, plans attoriosest and believed 3 23 - Ethylene-Propylene-Diene-Monomer Roofin 23.20 Ethylene-Propylene-Diene-Monomer Roofin	Rootoofing	35 26 35 26	1.143 1.538 1.143 1.538		251 240 325	33,50 45 33,50	7.45 5.50	290 312.45 364	345 375 430
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing OtloRosulfonated Polyethylene Roofing OtloRosulfonated Polyethylene Roofing Oflosulforated polyethylene (ISPE) 45 mil. heat welded searm, plans attechment Heat welded searm, plans attechment and believed 60 mils, heat welded searm, plans attechment and believed Heat welded searm, plans attechment and believed 3 23 - Ethylene-Propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPOM) Etylene-propylene-diene-transmet (EPOM), 45 mils, 0.7m pd	Rootoofing	35 24 35 24 offin	1.143 1.538 1.143 1.538	St	251 240 325 335	33,50 45 33,50	7.45 5.50 7.45	290 312.45 364 387.45	345 375 430
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing Officialforated Polyethylene Roofing Officialforated polyethylene Roofing Officialforated polyethylene (CSPE) 45 mil. heat welded seams, plans attachment and ballacted 60 mils, heat welded seams, plans attachment and ballacted 60 mils, heat welded seams, plans attachment and ballacted 3 23 - Ethylene-Propylene-Diene-Monomer Roofing THYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-dienetrammer (EPCM), 45 mils, 0.7d pd Leosebald & hallpred with stame (30 pd)	Roo toofing	35. 24. offin	1,143 1,538 1,143 1,538 9		251 240 325	33,50 45 33,50 45	7.45 5.50 7.45	290 312.45 364 387.45	345 375 430 460
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing OHLOROSULFONATED POLYETHYLENE ROOFING Official formed polyethylene (CSPE) 45 mil. heat welded seams, plans attentionent and befored 60 mils, heat welded seams, plans attentionent and befored Heat welded seams, plans attentionent and befored 3 23 - Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Heaterscale & ballyzed with states (10 pel) Mechanically etherled	Roo toofing	35 26 35 24 offin	1,143 1,538 1,143 1,538 9	St.	251 240 325 335 335	33,50 45 33,50 45	7.45 5.50 7.45	290 312.45 364 387.45	345 375 430 460
7 53	53 Elastomeric Membrane 316 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing 60 mile, heat welded seams, plans attachment and beliested 60 mile, heat welded seams, plans attachment and beliested Heat welded seams, plans attachment and beliested 3 23 - Ethylene-Propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPOM) Ethylene-propylene-diene-transmer (EPOM), 45 mile, 0.2% pd Leosehald & believed with states (10 pdf) Machanachy otherhad Fully scheed with otherwe	Roo toofing	35. 24. offin	1,143 1,538 1,143 1,538 9	St	251 240 325 335	33,50 45 33,50 45	7.45 5.50 7.45	290 312.45 364 387.45	345 375 430 460
7 5 5 3 10 10 10 10 10 10 10 10 10 10 10 10 10	53 Elastomeric Membrane 316 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing 60 mile, heat welded seams, plans attachment and believed 60 mile, heat welded seams, plans attachment and believed Heat welded seams, plans attachment and believed 3 23 — Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-propylene-diene-transmer (EPDM), 45 mile, 0.78 pd Leose-bid & believed with states (10 pdf) Machanachy ethories 60 mile, 0.40 pdf	Roo toofing	35 26 35 26 offin	1.143 1.538 1.143 1.538 9	\$4 \$4	251 260 325 335 83.50 78.50 111	33,50 45 33,50 45 23 33,50 45	7.45 5.50 7.45 3.79 5.50 7.45	290 312.45 364 387.45 110.29 117.50 163.45	345 375 430 460 139 354 213
7 53 10 10 10 10 10 10 10 10 10 10 10 10 10	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing 60 mile, heat welded seams, plans attechment and beliested 60 mile, heat welded seams, plans attechment and beliested 60 mile, heat welded seams, plans attechment and beliested 62 mile, plans - Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-propylene-diene-tenomer (EPOM), 45 mile, 0.76 pd Leose-bid & believed with stone (10 pd) Machanically offerhed Fully schemed with adversive 60 mile, 0.40 pd Leose-bid & heliosted with stone (10 pd)	Roo toofing	35 26 35 26 offin	1.143 1.538 1.143 1.538 9 784	St.	251 260 325 335 335 83.50 78.50 111	33,50 45 33,50 45 23 33,50 45	7.45 5.50 7.45 3.79 5.90 7.45 3.77	290 312.45 364 387.45 110.29 117.50 163.45	345 375 430 460 139 354 213
7 53	53 Elastomeric Membrane 316 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated polyethylene Roofing Chlorosulfonated polyethylene (CSPE) 45 mile, heart welded seams, plans attachment and believed 60 mile, heart welded seams, plans attachment and believed 80 mile, heart welded seams, plans attachment and believed 83 23 - Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-Propylene-Diene-Monomer Roofing Ethylene-propylene-diene-teamer (EPDN), 45 mile, 0.26 pd Leose-bid & trailingand with stone (10 psf) Mechanically otherhol Nechanically otherhol Nechanically otherhol	Roo toofing	35 26 35 24 ofin	1.143 1.538 1.143 1.538 9 784 1.143	\$4 \$4	251 260 325 335 83.50 78.50 111 95 89	33,50 45 33,50 45 23 33,50 45 23 33,50	7.45 5.50 7.45 3.79 5.50 7.45 3.79 5.50	290 312.45 364 387.45 110.29 117.50 163.45 121.79 128	345 375 430 460 139 354 213
7 53 10 10 10 10 10 10 10 10 10 10 10 10 10	53 Elastomeric Membrane 316 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated polyethylene (CSPE) 45 mil., heat welded seams, plans attachment and believed 60 mils, heat welded seams, plans attachment and believed 80 mils, heat welded seams, plans attachment and believed 83 23 - Ethylene-Propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-diene-teammer (EPDM), 45 mils, 0.75 pd Leccelaid & believed with states (10 psf) Mechanically ottached Fully achieved with otherine 60 mils, 0.40 psf Leccelaid & Indianted with states (10 psf) Mechanically ottached Fully achieved with achieve Fully achieved with achieve Fully achieved with achieve Fully achieved with achieve	Roo toofing	35 26 35 26 offin	1.143 1.538 1.143 1.538 9 784	\$4 \$4	251 260 325 335 335 83.50 78.50 111 95 89	33,50 45 33,50 45 23 33,50 45	7.45 5.50 7.45 3.79 5.90 7.45 3.77	290 312.45 364 387.45 110.29 117.50 163.45 121.79 128 174.45	345 375 430 460 334 213 152 166 225
7 53 10 10 10 10 10 10 10 10 10 10 10 10 10	53 Elastomeric Membrane 316 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated polyethylene (CSPE) 45 min, hear welded seams, plans attendment Heat welded seams, plans attendment and believed 60 min, hear welded seams, plans attendment and believed 323 - Ethylene-Propylene-Diene-Monomer Roofing CHLYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-diene-teammer (EPCM), 45 min, 0,70 pd Leose-half & believed with states (30 psf) Machanically othered Fully achieved with otherine 60 min, 0,40 psf Leose-half & Indianted with states (10 psf) Mechanically othered Fully achieved with achieve 45 min, 2,70 psf, membrane ecty	Roo toofing	35 26 35 24 ofin	1.143 1.538 1.143 1.538 9 784 1.143	\$4 \$4	251 280 325 335 335 83.50 78.50 111 95 89 122 50	33,50 45 33,50 45 23 33,50 45 23 33,50	7.45 5.50 7.45 3.79 5.50 7.45 3.79 5.50	290 312.45 364 387.45 110.29 117.50 163.45 121.79 128 174.45 50	345 375 430 460 139 354 213 152 166 225 35
7 5 5 3 10 10 10 10 10 10 10 10 10 10 10 10 10	53 Elastomeric Membrane 316 - Chlorosulfonate-Polyethylene R 16.10 Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated polyethylene (CPE) 45 min, heat welded seams, plans attachment and behasted 60 min, heat welded seams, plans attachment and behasted 80 min, heat welded seams, plans attachment and behasted 923 - Ethylene-Propylene-Diene-Monomer Roofing CHLYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-dameterammer (EPCM), 45 min, 0.70 pd Leose-ball & believed with stame (30 psf) Mechanically othered Fully achieved with achieve 60 min, 0.40 psf Leose-ball & Indianted with stame (10 psf) Mechanically attached Filip athread with achieve 45 mil, .78 psf, membrane only 60 mil, .40 psf, membrane only 60 mil, .40 psf, membrane only	Roo toofing	35 26 35 24 ofin	1.143 1.538 1.143 1.538 9 784 1.143	St. St. St.	251 280 325 335 335 83.50 78.50 111 95 87 122 50 39.50	33,50 45 33,50 45 23 33,50 45 23 33,50	7.45 5.50 7.45 3.79 5.50 7.45 3.79 5.50	290 312.45 364 387.45 110.29 117.50 163.45 121.79 128 174.45 50 59.50	345 375 430 460 139 354 213 152 166 225 55 65,5
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene 8 16.10 Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated polyethylene Roofing Chlorosulfonated polyethylene (CPE) 45 min, heat welded seams, plans attendment Heat welded seams, plans attendment and believed 60 min, heat welded seams, plans attendment and believed 823 - Ethylene-Propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-damentamaner (EPDM), 45 mils, 0.7d pd Leose-laid & hallowed with stone (10 pd) Mechanically ottached Fully athered with adhesive 60 min, 0.40 pd Leose-laid & hallowed with stone (10 pd) Mechanically ottached Fully athered with adhesive 45 mil, .78 pd, membrane only 50 mil, .40 pd, membrane only 50 mil .40 pd, membrane only	Roo toofing	35 26 35 24 ofin	1.143 1.538 1.143 1.538 9 784 1.143	\$4 \$4	251 280 325 335 335 83.50 78.50 111 95 87 122 50 57.50 43.50	33,50 45 33,50 45 23 33,50 45 23 33,50	7.45 5.50 7.45 3.79 5.50 7.45 3.79 5.50	290 312.45 364 387.45 110.29 117.50 163.45 121.79 128 174.45 50 59.50 43.50	345 375 430 460 139 354 213 152 166 225 55 65,1 48
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene 9 16.10 Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated polyethylene (CPE) 45 mil, heat welded seams, plans attendment Heat welded seams, plans attendment Heat welded seams, plans attendment and believed 50 mil, heat welded seams, plans attendment and believed 3 23 - Ethylene-Propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-diene-monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-diene-transmer (EPCM), 45 mils, 0.2m pd Leose-laid & heliosted with state (10 pd) Mechanically attended Fully adhered with adhesive 60 mil, 0.40 pd Leose-laid & heliosted with state (10 pd) Mechanically attended Fully athresed with adhesive 45 mil, .78 pd, manthane only 60 mil, .40 pd, membrane only 60 mil, .40 pd, membrane only 50 mil .40 pd, membrane only	Roo toofing	35 26 35 24 ofin	1.143 1.538 1.143 1.538 9 784 1.143	St. St. St.	251 280 325 335 335 83.50 78.50 111 95 89 122 50 537.50 43.50 2.43	33,50 45 33,50 45 23 33,50 45 23 33,50	7.45 5.50 7.45 3.79 5.50 7.45 3.79 5.50	290 312.45 364 387.45 110.29 117.50 163.45 121.79 128 174.45 50 59.50 43.50 3.43	345 375 430 460 139 354 213 152 166 225 55 65.5 48
7 53	53 Elastomeric Membrane 3 16 - Chlorosulfonate-Polyethylene 8 16.10 Chlorosulfonated Polyethylene Roofing Chlorosulfonated Polyethylene Roofing Chlorosulfonated polyethylene Roofing Chlorosulfonated polyethylene (CPE) 45 min, heat welded seams, plans attendment Heat welded seams, plans attendment and believed 60 min, heat welded seams, plans attendment and believed 823 - Ethylene-Propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-Diene-Monomer Roofing CHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM) Ethylene-propylene-damentamaner (EPDM), 45 mils, 0.7d pd Leose-laid & hallowed with stone (10 pd) Mechanically ottached Fully athered with adhesive 60 min, 0.40 pd Leose-laid & hallowed with stone (10 pd) Mechanically ottached Fully athered with adhesive 45 mil, .78 pd, membrane only 50 mil, .40 pd, membrane only 50 mil .40 pd, membrane only	Roo toofing	35 26 35 24 ofin	1.143 1.538 1.143 1.538 9 784 1.143	St. St. St.	251 280 325 335 335 83.50 78.50 111 95 87 122 50 57.50 43.50	33,50 45 33,50 45 23 33,50 45 23 33,50	7.45 5.50 7.45 3.79 5.50 7.45 3.79 5.50	290 312.45 364 387.45 110.29 117.50 163.45 121.79 128 174.45 50 59.50 43.50	345 375 430 460 139 354 213 152 166 225 55 65,48

Appendix H

Interior Finishes SIP Schedule Pods C-D

Interior Finishes SIPS- State College Area High School Pods C-D																																																							
	Floor								J	luly									August															Sept	emb	er											00	tob	er						
Building		Zone	Week			Wee			Week 2		We	eek	3	٧	Veel	k 4		W	eek	5		Wee	k 6		We	Week 7		Week 8		\	Week 9		\	Wee	k 10	We		ek 11		Wee	k 12	2	We	eek:	13	V	Vee	k 14		We	ek 1	5	We	ek 1	.6
			1	2 3	4	5	1 2	3	4	5 1	2	3 4	ŀ 5	1	2 3	4	5	1 2	3	4 5	1	2 3	4	5 1	2	3 4	5 1	2 3	3 4 .	5 1	2 3	4	5 1	2 3	4 !	5 1	2 3	3 4	5 1	2	3 4	5	1 2	3	4 5	1	2 3	4	5 1	2	3 4	5	1 2	3 4	Į 5
Pod C	1	1	1	4	2	3		4	5		5	6	7		8	9)	10	1:	L	12	13	14	1 :	15								Ш																						
Pod C	1	2			1	2		3	4		5	5	6		7	8	3	9	10)	11	12	13	3 :	14	15																													
Pod C	1	3				1		2	3		4	5	5		6	7	7	8	9		10	11	12	2 :	13	14	15																												
Pod D	1	1						1	2		3	4	5		5	6	5	7	8		9	10	1:	L Z	12	13	14	15																											
Pod D	1	2							1		2	3	4		5	5	;	6	7		8	9	10) [11	12	13	14	15																										\prod
Pod D	1	3									1	2	3		4	5	,	5	6		7	8	9		10	11	12	13	14	15	5																								\prod
Pod C	2	1										1	2		3	4	1	5	5		6	7	8		9	10	11	12	13	14	1 1	L5																							\prod
Pod C	2	2											1		2	3	3	4	5		5	6	7		8	9	10	11	12	13	3 1	L4	15																						П
Pod C	2	3													1	2		3	4		5	5	6		7	8	9	10	11	12	2 1	L3	14	15																					\prod
Pod D	2	1														1		2	3		4	5	5		6	7	8	9	10	11	1	L2	13	14	15																				П
Pod D	2	2																1	2		3	4	5		5	6	7	8	9	10) 1	l1	12	13	14	15	5																		П
Pod D	2	3																	1		2	3	4		5	5	6	7	8	9	1	LO	11	12	13	14	4	15																	\prod
Pod C	3	1											\prod								1	2	3		4	5	5	6	7	8		9	10	11	12	13	3	14	15																\prod
Pod C	3	2											\sqcap									1	2		3	4	5	5	6	7		8	9	10	11	12	2 :	13	14	15														T	\prod
Pod C	3	3											\sqcap										1		2	3	4	5	5	6		7	8	9	10	1:	1 :	12	13	14	1	5												T	\prod
Pod D	3	1	П								\prod		\sqcap												1	2	3	4	5	5		6	7	8	9	10	0	11	12	13	1	4	15	П		П							\top	\top	\sqcap
Pod D	3	2	П								\prod		\sqcap													1	2	3	4	5		5	6	7	8	9		10	11	12	1	.3	14	15		П							\top	\top	\sqcap
Pod D	3	3	ΠŢ			İ					\prod		\sqcap														1	2	3	4		5	5	6	7	8		9	10	11	1	2	13	14	. 1	L5								\top	\sqcap