

State College Area High School



Technical Report Part 1

Senior Thesis

Bryce Burkentine

Construction Management

Project Location: State College, PA

Advisor: Chimay Anumba

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Technical Report One

Bryce Burkentine | Construction | Dr. Anumba | State College Area High School | State College, PA | September 16th, 2015

Executive Summary

The State College Area High School is a two building project around 1 million square feet. The project is located on Westerly Parkway in State College, PA. The South Building consists of new construction and renovation, while the North Building will be demolished and rebuilt. The South Building is starting construction in September 2015 on the 4 pods. School will be in session in the existing part of the South Building while the pods are being constructed. Once the 4 pods are complete in the beginning of June 2016, the renovation will begin during the summer of 2017 and finish at the end of August 2017, just in time for the students to occupy the whole South Building for the school year. The project will be LEED Gold Certified with solar array systems, green roof systems, and integrated MEP systems. The construction manager, Massaro, is the right hand of the owner in which Massaro will not hold any contracts but will manage the project and trades. State College Area High School has four main goals from this \$117 million project, which include: improving outdated facilities, foster a secure, healthy, and nurturing environment, strengthen relationships, and provide rigorous programs and more personalized learning for every student. This is not just a new high school but a school to be modeled from for years to come.

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Client Information

The State College Area High School was finally approved for construction after almost a decade. The State College Area High School has four main goals they are trying to accomplish which include, improving outdated facilities, strengthen relationships, foster a secure, healthy, and nurturing environment, and provide rigorous programs and more personalized learning for every student. Right now children cross the street, sometimes more than five times a day, which is very dangerous. Having a centralized building where the student stays in all day long is needed to provide a safe and focused learning experience. The project will support flexible learning spaces that take full advantage of student-teacher relationships to boost student growth and achievement. The most important item to the board members during construction is to provide a safe and learnable environment.

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 and deals with the trades without holding any contracts with the trades. 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.

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Building System

Structural System

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 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.

Mechanical System

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.

Electrical System

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.

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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.

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 11th – 12th grades and the South building serves 9th – 10th 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.

Site Logistics Plan

This project is an existing school already therefore having construction in progress concurrently while school is in session means site logistics is top priority. The project is broken up into 4 pods which will be construction with a mobile crane. The site logistic plan shows new construction in progress while the existing portion of the South building is still accessible by buses and students. While the South building is occupied and the safety is Massaro's number one concern, there will be an emergency student area outside in case of a fire or some hazard within the school. There will be a bus lane that wraps around the South building for buses to drop students off. As construction goes from pod1 to pod 4 there will be a mobile crane that will be able to assist in the erection of steel joists and concrete slabs. Waste water management is a very important topic of discussion which will be address with retention ponds to contain the water.

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Summary Schedule

Phase 1 will consist of new construction in the South parking lot, while classes are in the existing South Building from October 2015 to June 2017. Phase 2 there will be 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 Evaluation

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.

Actual Project Cost	
Total Project Cost	\$ 101,235,000.00
Project Cost/SF	\$ 207.36
Total Construction Costs	\$ 75,655,000.00
Construction Cost/SF	\$ 154.97

RS Means Construction Costs	
Total Project Cost	\$ 103,281,318.94
Project Cost/SF	\$ 211.56
Total Construction Costs	\$ 93,046,233.28
Construction Cost/SF	\$ 190.59

RS Means Building Systems Costs		
System	%	\$
Substructure	4.20%	\$ 3,904,037.76
Shell- Superstructure	15.00%	\$ 13,942,992.00
Shell- Exterior Enclosure	15.80%	\$ 14,686,618.24
Shell- Roofing	4.50%	\$ 4,182,897.60
Interiors	20.20%	\$ 18,776,562.56
Concealing	0.50%	\$ 464,766.40
Plumbing	5.30%	\$ 4,926,523.84
HVAC	18.00%	\$ 16,731,590.40
Fire Protection	2.20%	\$ 2,044,972.16
Electrical	12.10%	\$ 11,247,346.88
Equipment & Furnishings	2.30%	\$ 2,137,925.44
Special Construction	0.00%	\$ -
Total		\$ 93,046,233.28

Actual Systems Costs		
System	%	\$
Substructure	7.31%	\$ 5,531,000.00
Shell- Superstructure	10.43%	\$ 7,890,000.00
Shell- Exterior Enclosure	12.67%	\$ 9,584,000.00
Shell- Roofing	3.61%	\$ 2,730,000.00
Interiors	19.57%	\$ 14,803,000.00
Concealing	0.19%	\$ 144,000.00
Plumbing	5.64%	\$ 4,269,000.00
HVAC	15.99%	\$ 12,098,000.00
Fire Protection	1.73%	\$ 1,307,000.00
Electrical	14.09%	\$ 10,660,000.00
Equipment & Furnishings	7.69%	\$ 5,820,000.00
Special Construction	1.08%	\$ 819,000.00
Total		\$ 75,655,000.00

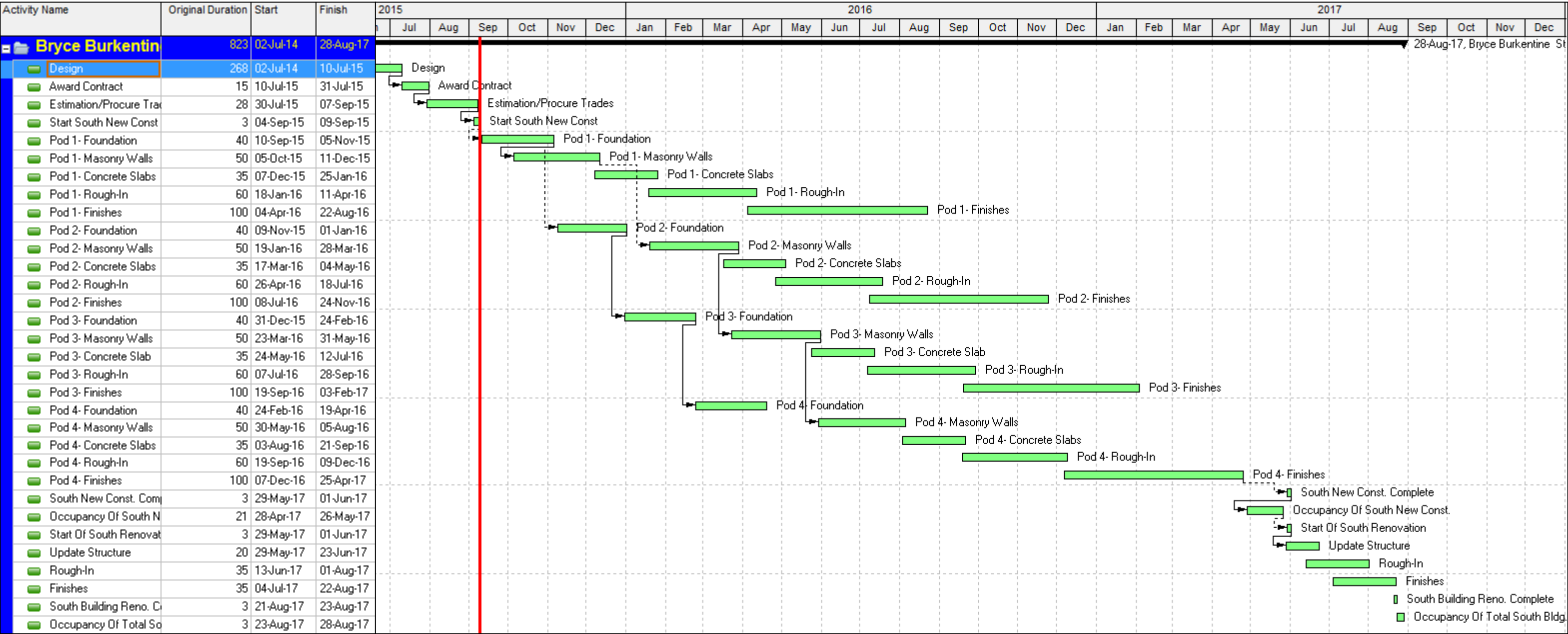
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Appendix

- A. Summary Schedule
- B. Summary Estimate
- C. Existing Conditions Site Plan
- D. Project Delivery System
- E. Staffing Plan
- F. Updated Presentation Slides
- G. RS Means Data Sheets

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A. Summary Schedule



Technical Report One

B. Summary Estimate

Building Parameters	
Gross Area (ft ²)	488200
Perimeter (ft)	3900
Story Height (ft)	16

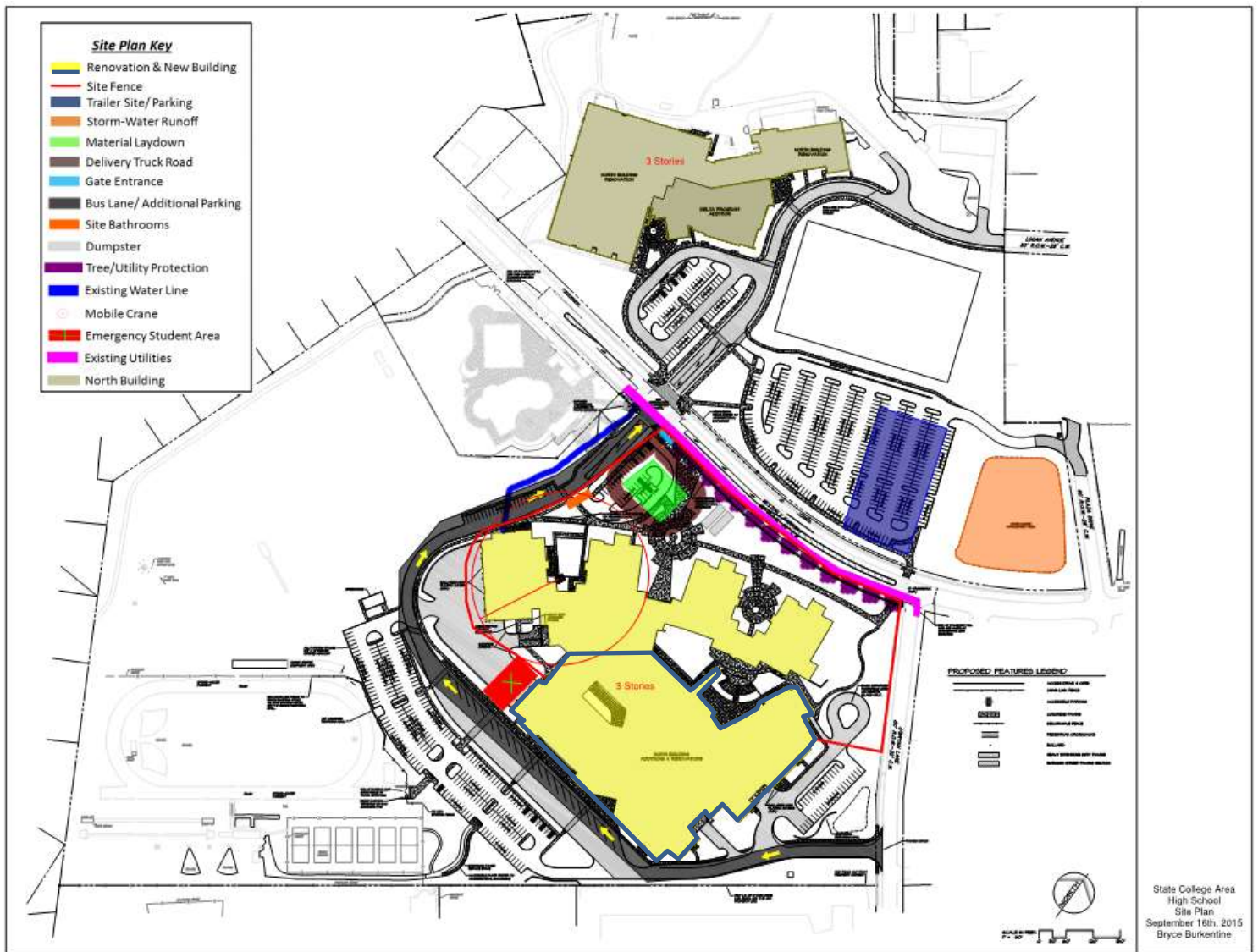
Adjusted Square Foot Value		
Cost Adjustments	Adjustment Value	Adjusted SF Cost
Base SF Cost	n/a	\$ 169.00
Perimeter Adjustment	1	\$ 30.0000
Story Ht. Adjustment	1.9	\$ 30.40
Bsmt Adjustment		\$ -
	SF Cost	\$ 229.40

RS Means Building Systems Costs			
System	%	\$/SF	\$
Substructure	4.2	\$ 9.63	\$ 4,703,709.36
Shell- Superstructure	15	\$ 34.41	\$ 16,798,962.00
Shell- Exterior Enclosure	15.8	\$ 36.25	\$ 17,694,906.64
Shell- Roofing	4.5	\$ 10.32	\$ 5,039,688.60
Interiors	20.2	\$ 46.34	\$ 22,622,602.16
Conceyng	0.5	\$ 1.15	\$ 559,965.40
Plumbing	5.3	\$ 12.16	\$ 5,935,633.24
HVAC	18	\$ 41.29	\$ 20,158,754.40
Fire Protection	2.2	\$ 5.05	\$ 2,463,847.76
Electrical	12.1	\$ 27.76	\$ 13,551,162.68
Equipment & Furnishings	2.3	\$ 5.28	\$ 2,575,840.84
Special Construction	0	\$ -	\$ -
Total			\$ 112,105,073.08

Total Building Costs		
Building Cost		\$ 112,105,073.08
General Requirements	3%	\$ 3,363,152.19
Architectural Fees	7%	\$ 7,847,355.12
Contingency	1%	\$ 1,121,050.73
Grand Total		\$ 124,436,631.12

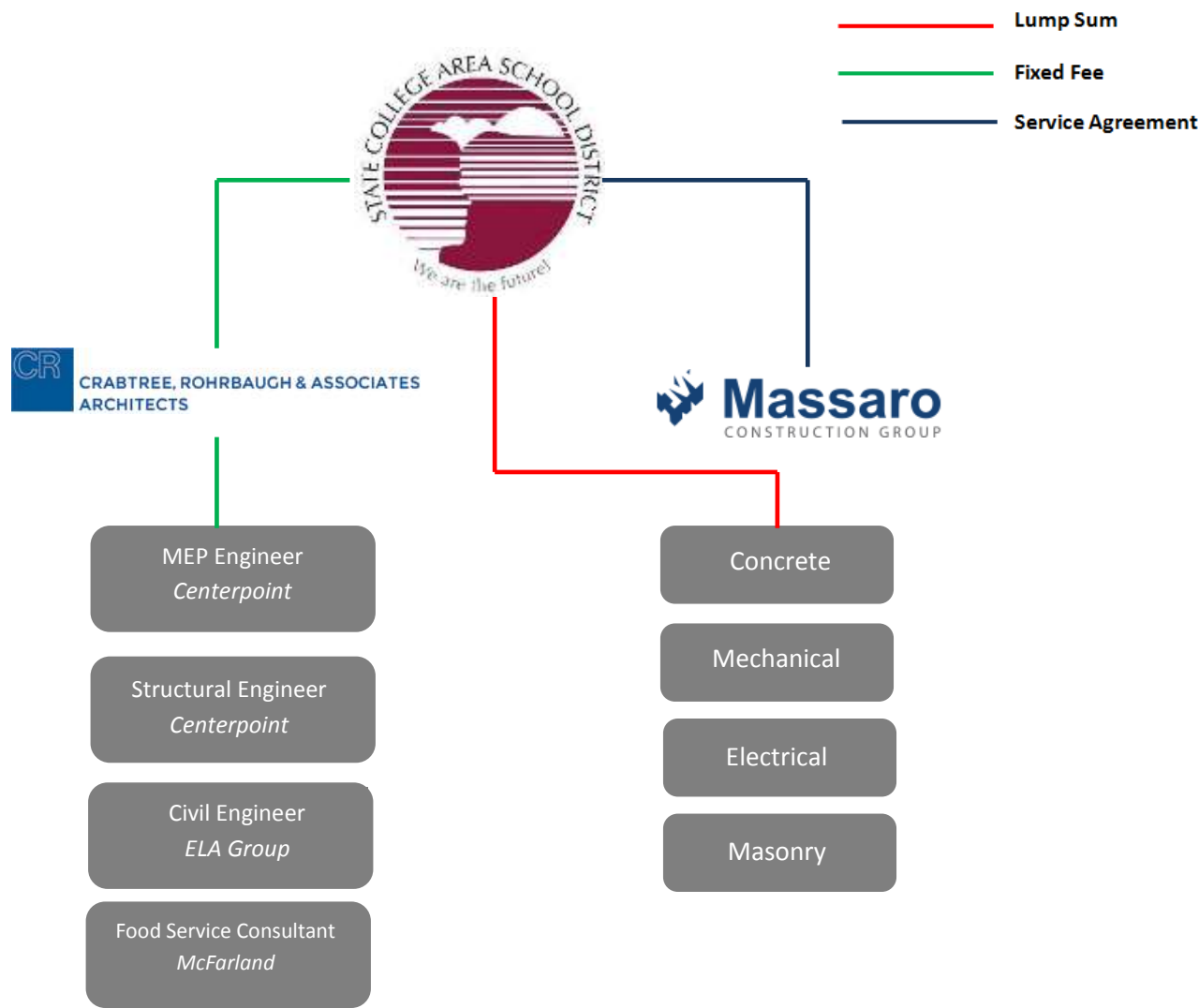
Technical Report One

C. Existing Conditions Site Plan



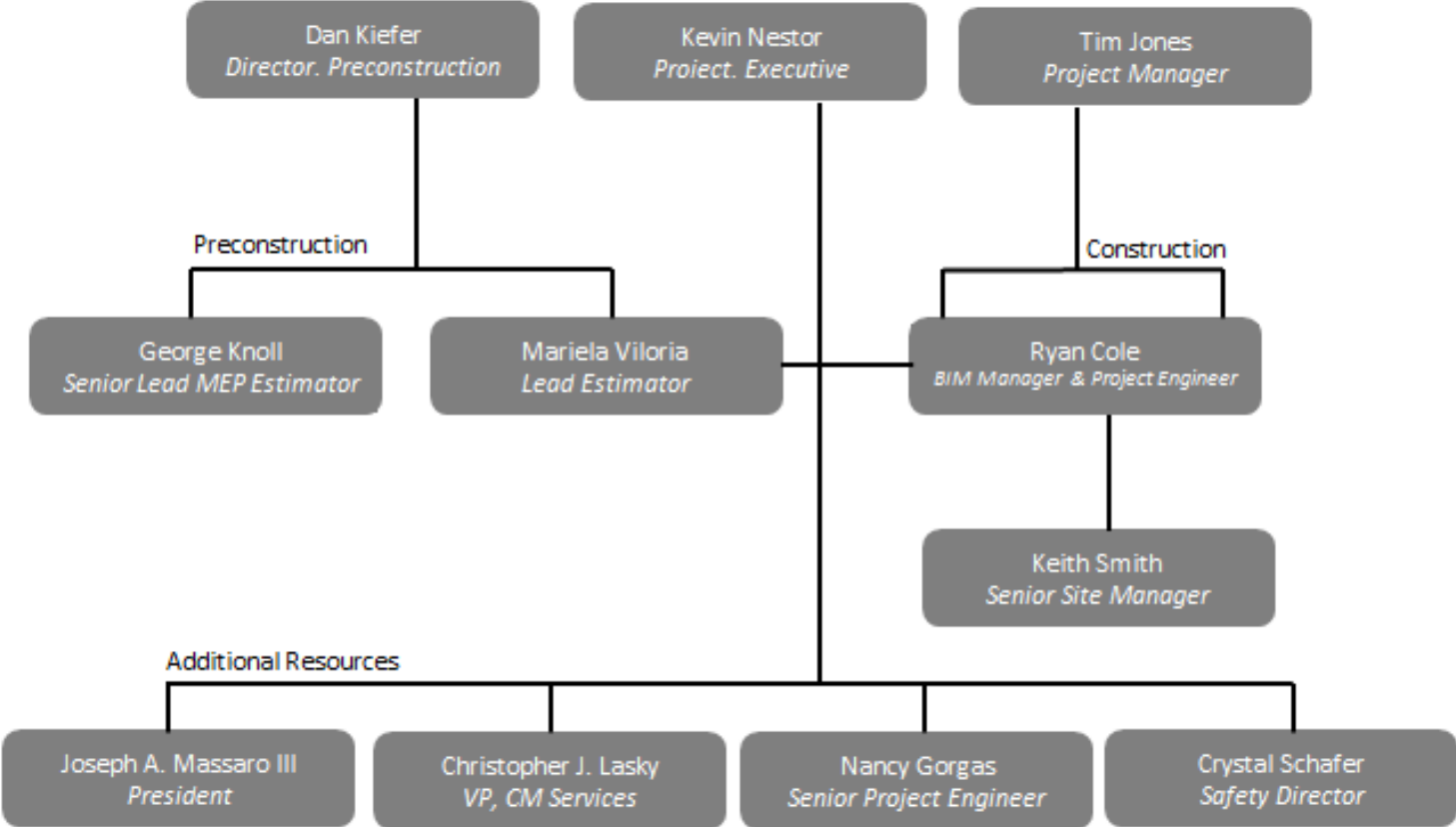
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D. Project Delivery System



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E. Staffing Plan



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F. Updated Presentation Slides

Client Information

4-Goals:

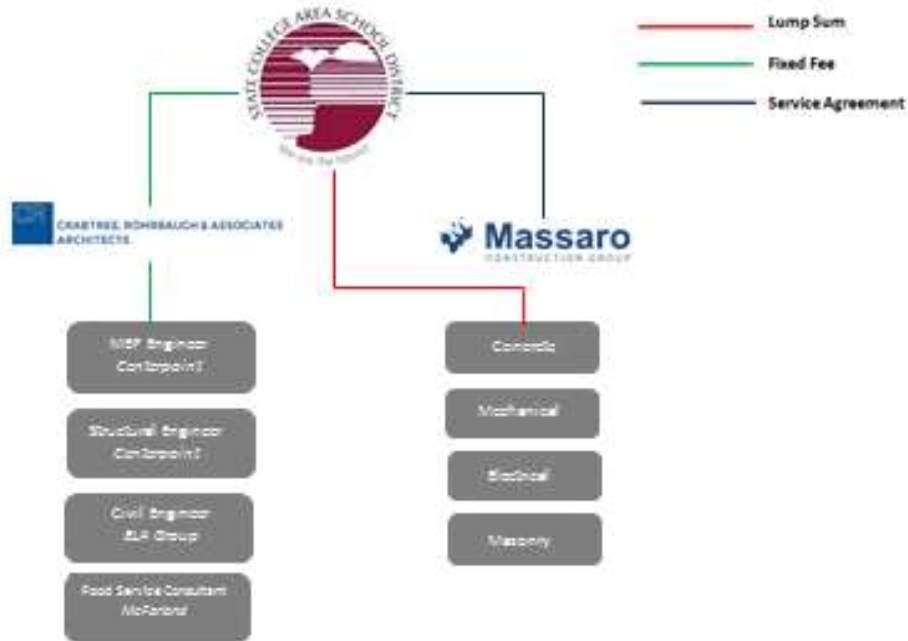


Notes:

- Explain the four goals and explain how this project will not just be a new school but a school to model for years to come
- The south building will be under construction while students continue to attend the school. Safety will be the top priority throughout the course of the project
- South Building will be finish by the beginning of the school year 2017 and North Building will be finished in August 2018
- Meeting clients expectations will be the completion of the phases on time and the safety of the students

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Project Delivery

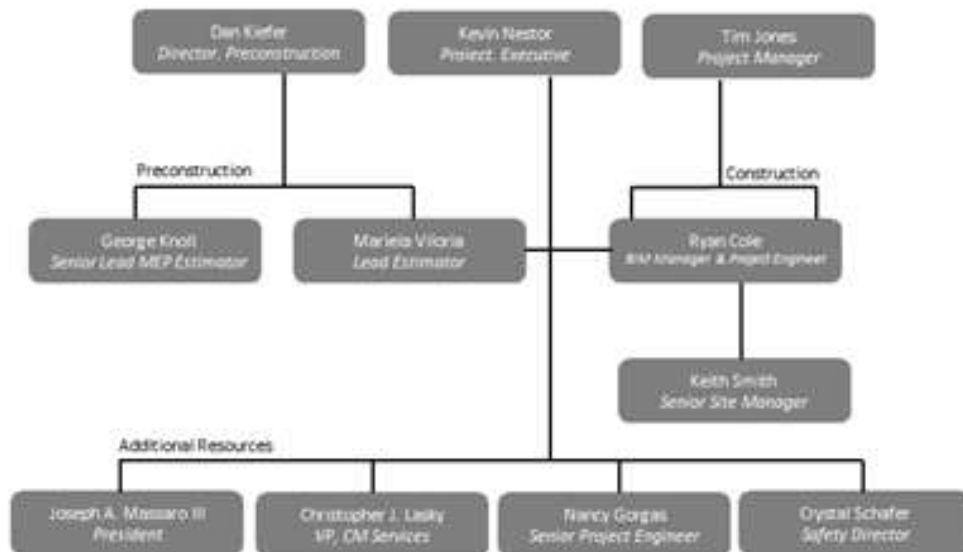


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Project Team

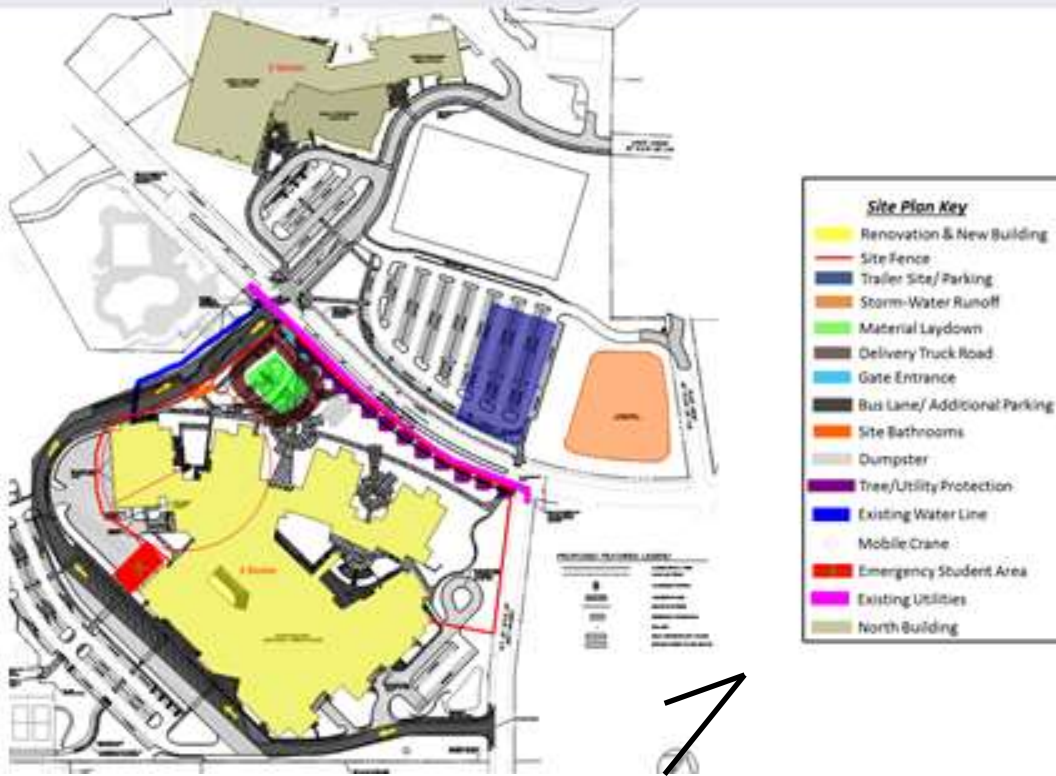


Notes:

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- 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
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Existing Conditions & Site Logistics

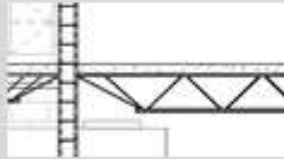
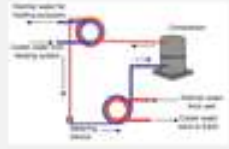



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- Waste water management is a very important topic of discussion which will be address with retention ponds to contain the water.

Technical Report One

Building Systems

System	Specifications	Diagrams/Photos
Structure System	<ul style="list-style-type: none"> • Load Bearing Masonry Walls • Steel Joists Supporting Floor • Composited Decking With Cast-In-Place Concrete 	
Mechanical System	<ul style="list-style-type: none"> • Individual Water Source Heat Pumps Per Classroom • Rooftop Units For Common Areas • Hot Water Return System 	
Electrical System	<ul style="list-style-type: none"> • Two New Electrical Systems • 400A, 480V, 3-Phase, 4-Wire • Occupancy Sensors, Day-Light Harvesting, Time On/Off Control 	

Notes:

- Structure- 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 first floor –slab on grade. Elevated slabs will concrete over a composite metal deck with fiber reinforcement. Elevated floors will be supported by steel joists bearing on masonry walls. The steel joists are K and LH Series fabricated.
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Technical Report One

Building Systems

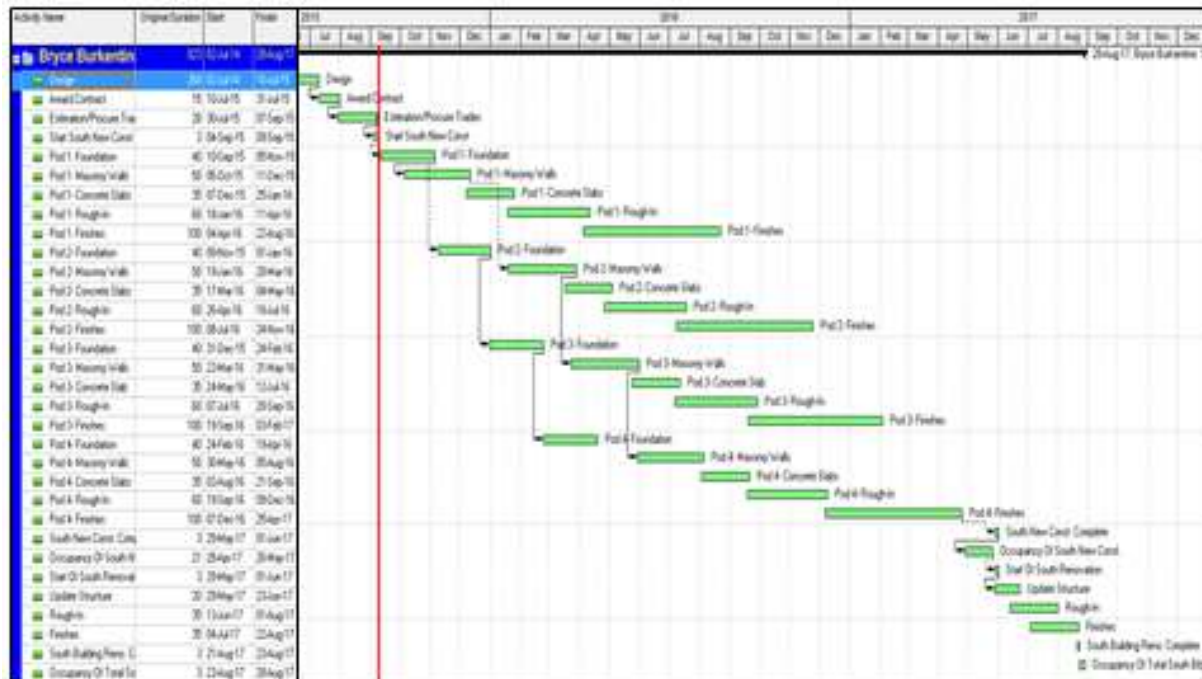
System	Specifications	Diagrams/Photos
Building Façade System	<ul style="list-style-type: none">Aluminum StorefrontManufactured Brick MaterialSunshades	
Sustainability System	<ul style="list-style-type: none">Green Roof SystemSolar Array SystemIncreased R-Values- Perimeter Walls and RoofHigh Performance Building Systems	 <small>Images: Crabtree, Kohnsavage & Associates, Google</small>

Notes:

- Building Façade System- The façade 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.
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Technical Report One

Project Schedule



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Technical Report One

Cost Evaluation

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Total Construction Costs	\$ 93,046,233.28
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Electrical	\$ 11,247,346.88	\$ 10,660,000.00
Equipment & Furnishings	\$ 2,137,925.44	\$ 5,820,000.00
Special Construction	\$ -	\$ 819,000.00
Total	\$ 93,046,233.28	\$ 75,655,000.00

Notes:

- Total Project costs \$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.
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Technical Report One

G. RS Means Data Sheets

COMMERCIAL/INDUSTRIAL/
INSTITUTIONAL

M.570

School, High, 2-3 Story

Costs per square foot of floor area

Exterior Wall	S.F. Area	50000	70000	90000	110000	130000	150000	170000	190000	210000
	L.F. Perimeter	850	1140	1420	1700	1980	2280	2560	2840	3120
Face Brick with Concrete Block Back-up	Steel Frame	176.75	174.10	172.35	171.25	170.45	170.20	169.80	169.45	169.15
	R/Conc. Frame	182.15	178.40	176.10	174.60	173.55	173.15	172.50	172.10	171.65
Decorative Concrete Block	Steel Frame	172.50	169.05	167.00	165.60	164.65	164.20	163.65	163.25	162.90
	R/Conc. Frame	173.05	169.55	167.55	166.15	165.15	164.75	164.20	163.80	163.40
Limestone with Concrete Block Back-up	Steel Frame	190.95	186.70	184.05	182.35	181.15	180.70	179.95	179.45	178.95
	R/Conc. Frame	198.50	194.25	191.55	189.85	188.65	188.25	187.50	186.95	186.50
Perimeter Adj., Add or Deduct	Per 100 L.F.	4.25	3.00	2.35	1.95	1.70	1.45	1.20	1.10	1.00
Story Hgt. Adj., Add or Deduct	Per 1 Ft.	2.10	2.00	2.00	1.95	1.95	1.95	1.90	1.90	1.90
For Basement, add \$35.25 per square foot of basement area										

The above costs were calculated using the basic specifications shown on the facing page. These costs should be adjusted where necessary for design alternatives and owner's requirements. Reported completed project costs, for this type of structure, range from \$104.15 to \$245.35 per S.F.

Common additives

Description	Unit	\$ Cost	Description	Unit	\$ Cost
Bleachers, Telescoping, manual			Kitchen Equipment		
To 15 tier	Seat	137 - 190	Broiler	Ea.	4050
16-20 tier	Seat	281 - 345	Cooler, 6 ft. long, reach-in	Ea.	4175
21-30 tier	Seat	299 - 390	Dishwasher, 10-12 racks per hr.	Ea.	4275
For power operation, add	Seat	55 - 86	Food warmer, counter, 1.2 KW	Ea.	735
Canals Hardwood	Ea.	975 - 2350	Freezer, 44 C.F., reach-in	Ea.	5175
Clock System			Lockers, Steel, single tier, 60" or 72"	Opng.	221 - 370
20 room	Ea.	19,900	2 tier, 60" or 72" total	Opng.	120 - 165
50 room	Ea.	46,800	5 tier, box lockers	Opng.	77 - 86.50
Elevators, Hydraulic passenger, 2 stops			Locker bench, lam. maple top only	L.F.	34
1500# capacity	Ea.	65,700	Pedestals, steel pipe	Ea.	76
2500# capacity	Ea.	68,800	Seating		
Emergency lighting, 25 watt, battery operated			Auditorium chair, all veneer	Ea.	310
Lead battery	Ea.	330	Veneer back, padded seat	Ea.	320
Nickel cadmium	Ea.	780	Upholstered, spring seat	Ea.	320
Flagpoles, Complete			Classroom, movable chair & desk	Set	81 - 171
Aluminum, 20' high	Ea.	1850	Lecture hall, pedestal type	Ea.	263 - 630
40' high	Ea.	4200	Sound System		
Fiberglass, 23' high	Ea.	1325	Amplifier, 250 watts	Ea.	2050
39'-5" high	Ea.	3450	Speaker, ceiling or wall	Ea.	213
			Trumpet	Ea.	410

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Important: See the Reference Section for Location Factors

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Model costs calculated for a 2 story building
with 15' story height and 130,000 square feet
of floor area

School, High, 2-3 Story

			Unit	Unit Cost	Cost Per S.F.	% Of Sub-Total
A. SUBSTRUCTURE						
1010	Standard Foundations	Poured concrete, strip and spread footings	S.F. Ground	2.62	1.31	
1020	Special Foundations	N/A	—	—	—	
1030	Slab on Grade	4" reinforced concrete with vapor barrier and granular base	S.F. Slab	5.44	2.72	4.2%
2010	Basement Excavation	Site preparation for slab and trench for foundation wall and footing	S.F. Ground	.18	.12	
2020	Basement Walls	4' foundation wall	L.F. Wall	84	1.27	
B. SHELL						
B10 Superstructure						
1010	Floor Construction	Concrete slab without drop panel, concrete columns	S.F. Floor	23.32	11.66	15.0%
1020	Roof Construction	Concrete slab without drop panel	S.F. Roof	15.50	7.75	
B20 Exterior Enclosure						
2010	Exterior Walls	Face brick with concrete block backup 75% of wall	S.F. Wall	33.44	11.46	
2020	Exterior Windows	Window wall 25% of wall	Each	74	8.49	15.8%
2030	Exterior Doors	Metal and glass	Each	2256	.51	
B30 Roofing						
3010	Roof Coverings	Single-ply membrane and standing seam metal; polyisocyanurate insulation	S.E. Roof	11.68	5.84	4.5%
3020	Roof Openings	Roof hatches	S.E. Roof	.10	.05	
C. INTERIORS						
1010	Partitions	Concrete block 25 S.F. Floor/L.F. Partition	S.F. Partition	13.04	6.26	
1020	Interior Doors	Single leaf kalamain fire doors 700 S.F. Floor/Door	Each	1157	1.65	
1030	Fittings	Taller partitions, chalkboards	S.F. Floor	1.30	1.30	
2010	Stair Construction	Concrete filled metal pan	Flight	11,600	.54	20.2%
3010	Wall Finishes	75% paint, 15% glazed coating, 10% ceramic tile	S.F. Surface	3.58	3.44	
3020	Floor Finishes	70% vinyl composition tile, 20% carpet, 10% terrazzo	S.F. Floor	5.97	5.97	
3030	Ceiling Finishes	Mineral fiber tile on concealed zee bars	S.F. Ceiling	7.03	7.03	
D. SERVICES						
D10 Conveying						
1010	Elevators & Lifts	One hydraulic passenger elevator	Each	83,200	.64	0.5%
1020	Escalators & Moving Walks	N/A	—	—	—	
D20 Plumbing						
2010	Plumbing Fixtures	Kitchen, bathroom and service fixtures; supply and drainage 1 Fixture/860 S.F. Floor	Each	4343	5.05	
2020	Domestic Water Distribution	Gas fired water heater	S.F. Floor	1.09	1.09	5.3%
2040	Rain Water Drainage	Roof drains	S.F. Roof	1.52	.76	
D30 HVAC						
3010	Energy Supply	Oil fired hot water, wall fin radiation	S.F. Floor	5.28	5.28	
3020	Heat Generating Systems	N/A	—	—	—	
3030	Cooling Generating Systems	Chilled water, cooling tower systems	S.F. Floor	18.05	18.05	18.0%
3050	Terminal & Package Units	N/A	—	—	—	
3090	Other HVAC Sys. & Equipment	N/A	—	—	—	
D40 Fire Protection						
4010	Sprinklers	Sprinklers, light hazard	S.F. Floor	2.57	2.57	
4020	Standpipes	Standpipe, wet, Class II	S.F. Floor	.34	.34	2.2%
D50 Electrical						
5010	Electrical Service/Distribution	2000 ampere service, panel board and feeders	S.F. Floor	1.07	1.07	
5020	Lighting & Branch Wiring	High efficiency fluorescent fixtures, receptacles, switches, A.C. and misc. power	S.F. Floor	10.09	10.09	
5030	Communications & Security	Addressable alarm systems, internet wiring, communications systems and emergency lighting	S.F. Floor	4.09	4.09	12.1%
5090	Other Electrical Systems	Emergency generator, 250 kW	S.F. Floor	.44	.44	
E. EQUIPMENT & FURNISHINGS						
1010	Commercial Equipment	N/A	—	—	—	
1020	Institutional Equipment	Laboratory casework and counters	S.F. Floor	1.97	1.97	2.3%
1030	Vehicular Equipment	N/A	—	—	—	
1090	Other Equipment	Built-in athletic equipment, bleachers and scoreboard	S.F. Floor	.96	.96	
F. SPECIAL CONSTRUCTION						
1020	Integrated Construction	N/A	—	—	—	
1040	Special Facilities	N/A	—	—	—	0.0%
G. BUILDING SITEWORK N/A						
Sub-Total				129.77	100%	
CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%)				25%	32.43	
ARCHITECT FEES				7%	11.35	
Total Building Cost				173.55		

For customer support on your Square Foot Cost Data, call 877.694.8329.

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