

# Technical Assignment 1

## Construction Project Management



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Pasadena Elementary School  
Technical Assignment 1

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## Executive Summary

This report on *Construction Project Management*, is an overview of Pasadena Elementary School in Pasadena, MD. It covers the project schedule, a summary of the building systems, and an evaluation of the project costs. It also includes a site plan of existing conditions, local conditions of Pasadena, MD, information about the owner, Anne Arundel Public School, and how the project team is organized.

The project does not have a general contractor, instead it has a construction manager at risk with (14) prime contractors for each trade. The project schedule is broken down by bid packages for each contractor. It highlights the milestones of when each of the (14) contracts area awarded.

Each major building system is summarized. The building systems include demolition and asbestos abatement, structural steel, cast in place concrete, mechanical systems and electrical systems. In addition the sprinkler system, masonry, and the support of excavation is also described.

Several project cost evaluations are performed. Most of the estimates were low in comparison with the actual cost of the building. This is due to the fact that included in the actual project cost is demolition and asbestos abatement of the existing elementary school which makes the cost higher.

A site plan in Appendix E shows existing conditions of the site. This plan shows where the old elementary school that is to be demolished is located. It also shows the existing utility lines, roads, parking, flow of traffic and pedestrians, and adjacent properties.

The local soil on the site is soft sand that needed to be compacted by using Rapid Impact Compaction which is a state of the art method. This was done until the existing soil was located (12) feet below the building pad elevation. Then suitable structural soil was backfilled to the proper elevation.

The client of the project is the Anne Arundel County Public Schools. The main concern they expressed about this project was the schedule completion. Since both Phase I and Phase II were going on while school is in progress, dates were very important. The tenants of the building are scheduled to relocate to the newly constructed building over Christmas break 2007.

This project has (14) contractors as stated earlier. They all have lump sum contracts with the owner. An organization chart showing both the project and the Construction Manager's organization is shown in Appendices F & G.

## Project Schedule Summary

A summary of the project schedule is located in Appendix A. The schedule is broken down by different trades summarizing the bid packages for the different contractors. The start date for the project is August 30, 2006 and the completion date is July 7, 2008.

Sitework of the project has the longest activity duration because it includes the general conditions for the project. Also sitework is involved in both phases of the project due to the excavation for the new school building and because of the landscaping and new sports fields in Phase II.

Excavation will begin as soon as the site contract is awarded. This includes preparation for the spread footings. In December 2006 the concrete footings are scheduled to be poured in Area A and is to be followed by Area B and C. This order is similar for all activities. As soon as the footings are poured the exterior walls begin to be constructed. The structural steel (including columns, floor joists and decking) is then to begin to be erected in March 2007 after the bearing plate curing period. After the building is weatherproof, interior work can begin.

## Building Systems Summary

<b>Work Scope</b>	<b>Yes</b>	<b>No</b>
Demolition	X	
Structural	X	
Cast-in-Place Concrete	X	
Precast Concrete		X
Mechanical System	X	
Electrical System	X	
Fire Protection System	X	
Masonry	X	
Curtain Wall		X
Support of Excavation	X	

## **Demolition Required**

Phase I of the project includes the construction of the new elementary school. Phase II consists of demolition of the existing elementary school building including asbestos abatement. After the demolition is complete, sports fields will be constructed where the old elementary school once was.

## **Structural System**

Steel HSS columns are throughout the (2) North wings of the building with bays varying around 30' each. Steel beams support metal roof decking with cast-in-place concrete poured on top. Temporary shoring and bracing with sufficient strength is required until all final connections are made for permanent members. Erection of the structural steel is from the center of the footprint of the building.

## **Cast in Place Concrete**

Cast-in-place concrete for this project consists of mostly the foundation system. After excavation, the spread footings and wall footings were formed and poured. Vertical and horizontal formwork is used as needed.

## **Mechanical System**

The mechanical room is located in the southwest corner of the building. It supports (3) Rooftop Units with Energy Recovery (ERUs) and (3) Air Handling Units (AHUs). There are (6) Ductless Split System Units (DSS). The RAHUs only have a return fan that can supply between 1530-7500 cfm (cubic feet per minute). Outdoor air is supplied at 375-2500 cfm. The ERUs supply and return air between 258 and 454 MBH (Thousand BTUs/hr). All units are supplied with 480 volts at 3 phase power.

## **Electrical System**

There is one main switchboard that runs to panel boards located in (5) electrical closets throughout the building. The system runs on 277/480 V power with a 3 phase 4-wire system.

## **Fire Sprinkler System**

An automatic wet-pipe sprinkler system runs throughout the classrooms, offices, cafeteria seating, auditorium seating, corridors, lobbies and rest rooms at 0.1 GPM/sq. ft. (Gallons per Minute per square foot) over every 1,500 square foot area. In the mechanical room, kitchen food preparation and storage areas water is pumped at 0.15 GPM/sq. ft. over every 1,500 square foot area. The gymnasium and platform is supplied with 0.2 GPM/sq. ft. The system consists of (2) zones.

## **Masonry**

Concrete Masonry Units on the building's exterior must be able to accompany a minimum average net-area compressive strength of 1900 psi (pounds per square inch). Concrete building brick must have a minimum average net-area compressive strength of 2500 psi. Temporary formwork and shoring is used during the installation of reinforced masonry installation.

## **Support of Excavation**

Excavation must be supported by shoring and bracing when it is not possible to slope sides. Sides must be sloped to comply with local codes, ordinances and requirements of authorities having jurisdiction. Drainage ditches outside excavation limits are used to collect water from runoff areas and to avoid intrusion of water in the excavated areas.

## **Project Cost Evaluation**

The following is a summary of project costs broken down in several ways and for specific systems of the building. A more detailed breakdown of costs for Pasadena Elementary School can be found in Appendix B.

Appendix C contains an estimate from using D4Cost 2002 software. When using this software, (7) educational buildings were selected with similar characteristics. Square footage, number of levels, type of education and total project cost were considered. The estimate that was computed from the average of these buildings was **\$ 12,244,072**. This number is much lower than the actual project cost of Pasadena Elementary School which is **\$ 14,042,006**. The reason for the significant difference is that the estimating software does not take into consideration the demolition and asbestos abatement and the additional sitework to build the sports fields for Phase II. Demolition and asbestos

abatement alone in the contract comes to \$ 702,352. This value added to the estimate from D4Cost software is **\$ 12,946,424**. With the cost of the sports fields from Phase II this estimate is closer to the actual cost of the building.

A square footage estimate was also done by using R.S. Means 2007. A detailed breakdown is located in Appendix D. The total cost computed was **\$8,206,947**. This is only about half of the actual cost of the building. Part of the building has a structural system with load bearing walls and the remaining has steel columns. Because of this, both the square footage and perimeter for each section were found and the estimate was completed. A perimeter adjustment was used for the steel frame section of the estimate so an additional \$6034 had to be added to the total. Since this is a square foot estimate I believe that that is why it is so far off from the actual value. It does not take into consideration many features of the building and the construction sequence, including demolition with asbestos abatement and additional sitework.

Actual Building Construction Cost	<b>\$ 10,019,908</b>
Construction Cost/Square Foot	<b>\$ 147.35</b>
Total Project Costs	<b>\$ 14,042,006</b>
Total Costs/Square Foot	<b>\$ 206.50</b>
Structural Steel Cost	<b>\$ 907,921</b>
Structural Steel Cost/Square Foot	<b>\$ 13.35</b>
Mechanical Systems Cost	<b>\$ 2,427,947</b>
Mechanical Systems Cost/Square Foot	<b>\$ 35.71</b>
Fire Protection Systems Cost	<b>\$ 171,045</b>
Fire Protection Systems Cost/Square Foot	<b>\$ 2.52</b>

Electrical Systems Cost	<b>\$ 1,539,838</b>
Electrical Systems Cost/Square Foot	<b>\$ 22.64</b>

## **Site Plan of Existing Conditions**

The Site Plan of existing conditions is located in Appendix E. Take note on the location of the existing elementary school building. Also note all of the existing utilities, parking, fire hydrants, and adjacent properties.

A second aerial photograph is included for a better idea of what the existing site looks like. The trees that are to be removed where the new elementary school will be located are labeled along with the location of the existing and new school buildings.

## **Local Conditions**

The soil of the property contains very loose lands to construct on. Therefore because of this Rapid Impact Compaction had to be used to consolidate the existing sands (12) feet below the building pad elevation. Structural fill was then used to bring the soil up to the building pad elevation. This involved computers on pile drivers telling the operator how hard and how long to compact the soil. This went on all across the building pad area.

## **Client Information**

The owner of the project is Anne Arundel County Public Schools. The existing Pasadena Elementary School was built in 1955. An upgrade was needed due to maintenance reasons, local code, and by the Anne Arundel County Public School Education Specification requirements.

This project has (2) phases that must be scheduled around the school year so it does not interfere with the students at the school. While the new school is being constructed students must be able to go to the existing elementary school without any interruptions. During the Christmas break of 2007 the occupants of the school will transfer to the



newly constructed Pasadena Elementary School. During 2008 demolition and asbestos abatement will be occurring on the existing school that is no longer occupied. Once complete, sitework will begin to construct sports fields for the children. This all must happen without disruption of the new elementary school.

## **Project Delivery System**

This project does not have a general contractor. Instead, it is set up with (14) prime contractors each for a different trade of the scope of the project. Jacobs Facilities Inc. acts as a CM at Risk while handling all of the contracts for the owner. The Architect, Rubeling & Associates has a contract with the owner and also has hired all of the engineers for the project and therefore holds contracts with all of them.

All of the contracts for this project are lump sum and use the AIA Document A101 template. Included in the contracts are performance bonds and insurance certificates prove that the contractor is insured for General Liability, Automobile Liability and Excess/Umbrella Liability.

Because this is a government project it is mandated by law for the lowest responsible bidder to receive the award. This is done through an open, public bid process. The main requirement for bidders is the following: they must have been in business under their current name for a minimum of (3) years and must be able to use 3 previous jobs of similar size and scope as a reference. Usually by using these requirements the lowest bidder will win.

Contractors are actively pursued by the Construction Manager to get a minimum of (3) to (5) bidders for each bid package. If this is not met and (0) to (1) bidders are suspected to submit a bid, it will be suggested to the owner to delay or cancel bidding for that certain package.

An organizational chart is located in Appendix F to show the project's delivery system.

## **Staffing Plan**

There is no General Contractor, only one Construction Manager at Risk on this project. Appendix G shows an organization chart for how Jacobs Facilities is organized on the Pasadena Elementary School project.

# Appendix A

ID	Task Name	Duration	Start	2007												2008											
				Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Award Site Contract	1 day	Wed 8/30/06	◆ Award Site Contract																							
2	Site Work	395 days	Wed 9/6/06	Site Work																							
3	Award Abatement Contract	1 day	Mon 10/1/07	◆ Award Abatement Contract																							
4	Abatement	24 days	Tue 1/15/08	Abatement																							
5	Award Demolition Contract	1 day	Mon 10/1/07	◆ Award Demolition Contract																							
6	Demolition	33 days	Mon 2/18/08	Demolition																							
7	Award Concrete Contract	1 day	Wed 9/6/06	◆ Award Concrete Contract																							
8	Concrete	259 days	Fri 10/6/06	Concrete																							
9	Award Masonry Contract	1 day	Thu 9/14/06	◆ Award Masonry Contract																							
10	Masonry	203 days	Thu 10/26/06	Masonry																							
11	Award Structural Steel Contract	1 day	Thu 9/14/06	◆ Award Structural Steel Contract																							
12	Structural Steel	220 days	Fri 11/17/06	Structural Steel																							
13	Award General Works Contract	1 day	Thu 8/31/06	◆ Award General Works Contract																							
14	General Works	278 days	Fri 11/17/06	General Works																							
15	Award Roofing Contract	1 day	Thu 10/5/06	◆ Award Roofing Contract																							
16	Roofing	108 days	Fri 4/20/07	Roofing																							
17	Award Windows Contract	1 day	Mon 10/23/06	◆ Award Windows Contract																							
18	Windows	222 days	Mon 12/18/06	Windows																							
19	Award Kitchen Equipment Contract	1 day	Thu 10/26/06	◆ Award Kitchen Equipment Contract																							
20	Kitchen Equipment	137 days	Tue 3/6/07	Kitchen Equipment																							
21	Award Casework Contract	1 day	Mon 10/23/06	◆ Award Casework Contract																							
22	Casework	39 days	Thu 8/2/07	Casework																							
23	Award Technical Wiring Contract	1 day	Tue 10/10/06	◆ Award Technical Wiring Contract																							
24	Technical Wiring	40 days	Tue 8/7/07	Technical Wiring																							
25	Award Mechanical & Plumbing Contract	1 day	Fri 9/8/06	◆ Award Mechanical & Plumbing Contract																							
26	Mechanical & Plumbing	273 days	Thu 11/9/06	Mechanical & Plumbing																							
27	Award Sprinklers Contract	1 day	Mon 10/23/06	◆ Award Sprinklers Contract																							
28	Sprinklers	117 days	Tue 5/15/07	Sprinklers																							
29	Award Electrical Contract	1 day	Thu 9/14/06	◆ Award Electrical Contract																							
30	Electrical	208 days	Tue 12/26/06	Electrical																							

Start Date Wed 8/30/06 Finish Date Wed 4/2/08	Task		Milestone	◆	External Tasks	
	Split		Summary		External Milestone	◆
	Progress		Project Summary		Deadline	↓

# Appendix B

<b>Contract</b>	<b>Original Contract Amount</b>	<b>Executed Change Orders</b>	<b>Current Contract Total</b>	<b>Contract Change Directives</b>	<b>Current Encumbered Purchase Order Total</b>	<b>Written But Not Executed Change Orders</b>	<b>Open Proposed Change Orders</b>	<b>Total Contract Exposure</b>
Sitework	\$ 3,394,000	\$ (76,538)	\$ 3,317,462	\$ (20,500)	\$ 3,296,962	\$ -	\$ 22,784	\$ 3,319,746
Abatement	\$ 244,780	\$ -	\$ 244,780	\$ -	\$ 244,780	\$ -	\$ -	\$ 244,780
Demolition	\$ 457,572	\$ -	\$ 457,572	\$ -	\$ 457,572	\$ -	\$ -	\$ 457,572
Concrete	\$ 699,722	\$ (7,593)	\$ 692,129	\$ -	\$ 692,129	\$ -	\$ -	\$ 692,129
Masonry	\$ 1,507,000	\$ -	\$ 1,507,000	\$ -	\$ 1,507,000	\$ -	\$ -	\$ 1,507,000
Structural Steel	\$ 911,000	\$ (284)	\$ 910,716	\$ -	\$ 910,716	\$ -	\$ (2,795)	\$ 907,921
General Works	\$ 1,712,800	\$ 5,120	\$ 1,717,920	\$ -	\$ 1,717,920	\$ 4,684	\$ 4,729	\$ 1,727,333
Roofing	\$ 440,500	\$ -	\$ 440,500	\$ -	\$ 440,500	\$ -	\$ -	\$ 440,500
Windows	\$ 214,000	\$ -	\$ 214,000	\$ -	\$ 214,000	\$ 1,166	\$ -	\$ 215,166
Kitchen	\$ 99,500	\$ -	\$ 99,500	\$ -	\$ 99,500	\$ -	\$ -	\$ 99,500
Casework	\$ 218,760	\$ -	\$ 218,760	\$ -	\$ 218,760	\$ (3,950)	\$ 300	\$ 215,110
Tech Wiring	\$ 64,000	\$ 1,451	\$ 65,451	\$ -	\$ 65,451	\$ 5,777	\$ 5,191	\$ 76,419
Mechanical	\$ 2,411,800	\$ 1,380	\$ 2,413,180	\$ -	\$ 2,413,180	\$ (1,221)	\$ 15,988	\$ 2,427,947
Fire Protection	\$ 171,100	\$ 1,680	\$ 172,780	\$ -	\$ 172,780	\$ (1,735)	\$ -	\$ 171,045
Electrical	\$ 1,530,800	\$ (1,816)	\$ 1,528,984	\$ -	\$ 1,528,984	\$ 5,362	\$ 5,492	\$ 1,539,838
<b>Prime Totals</b>	<b>\$ 14,077,334</b>	<b>\$ (76,600.00)</b>	<b>\$ 14,000,734</b>	<b>\$ (20,500.00)</b>	<b>\$ 13,980,234</b>	<b>\$ 10,083</b>	<b>\$ 51,689</b>	<b>\$ 14,042,006</b>

**Construction Cost = \$ 10,019,908**  
**Construction Cost/Sq. Ft. = \$ 147.35**

\*Includes all contracts except for Sitework, Abatement and Demolition

**Total Project Cost = \$ 14,042,006**  
**Total Project Cost /Sq. Ft. = \$ 206.50**

\*Includes all contracts

**Structural Steel Cost = \$ 907,921**  
**Structural Steel Cost/Sq. Ft. = \$ 13.35**

**Mechanical Cost = \$ 2,427,947**  
**Mechanical Cost/Sq. Ft. = \$ 35.71**

**Fire Protection Cost = \$ 171,045**  
**Fire Protection Cost/Sq. Ft. = \$ 2.52**

**Electrical Cost = \$ 1,539,838**  
**Electrical Cost/Sq. Ft. = \$ 22.64**

# Appendix C

<b>Code</b>	<b>Division Name</b>	<b>%</b>	<b>Sq. Cost</b>	<b>Projected</b>
00	Bidding Requirements	6.91	\$12.45	\$846,324
01	General Requirements	3.67	\$6.61	\$449,460
02	Site Work	10.24	\$18.44	\$1,254,159
03	Concrete	5.15	\$9.27	\$630,276
04	Masonry	12.71	\$22.88	\$1,555,970
05	Metals	8.12	\$14.63	\$994,633
06	Wood & Plastics	2.41	\$4.33	\$294,494
07	Thermal & Moisture Protection	5.79	\$10.42	\$708,741
08	Doors & Windows	3.70	\$6.67	\$453,554
09	Finishes	8.50	\$15.30	\$1,040,696
10	Specialties	1.64	\$2.95	\$200,562
11	Equipment	2.50	\$4.49	\$305,576
12	Furnishings	2.64	\$4.75	\$323,003
13	Special Construction	0.55	\$0.98	\$66,797
14	Conveying Systems	0.26	\$0.46	\$31,475
15	Mechanical	15.72	\$28.31	\$1,925,371
16	Electrical	9.50	\$17.10	\$1,162,980
	<b>Total Building Costs</b>	<b>100.00</b>	<b>\$180.06</b>	<b>\$12,244,072</b>



# Appendix D

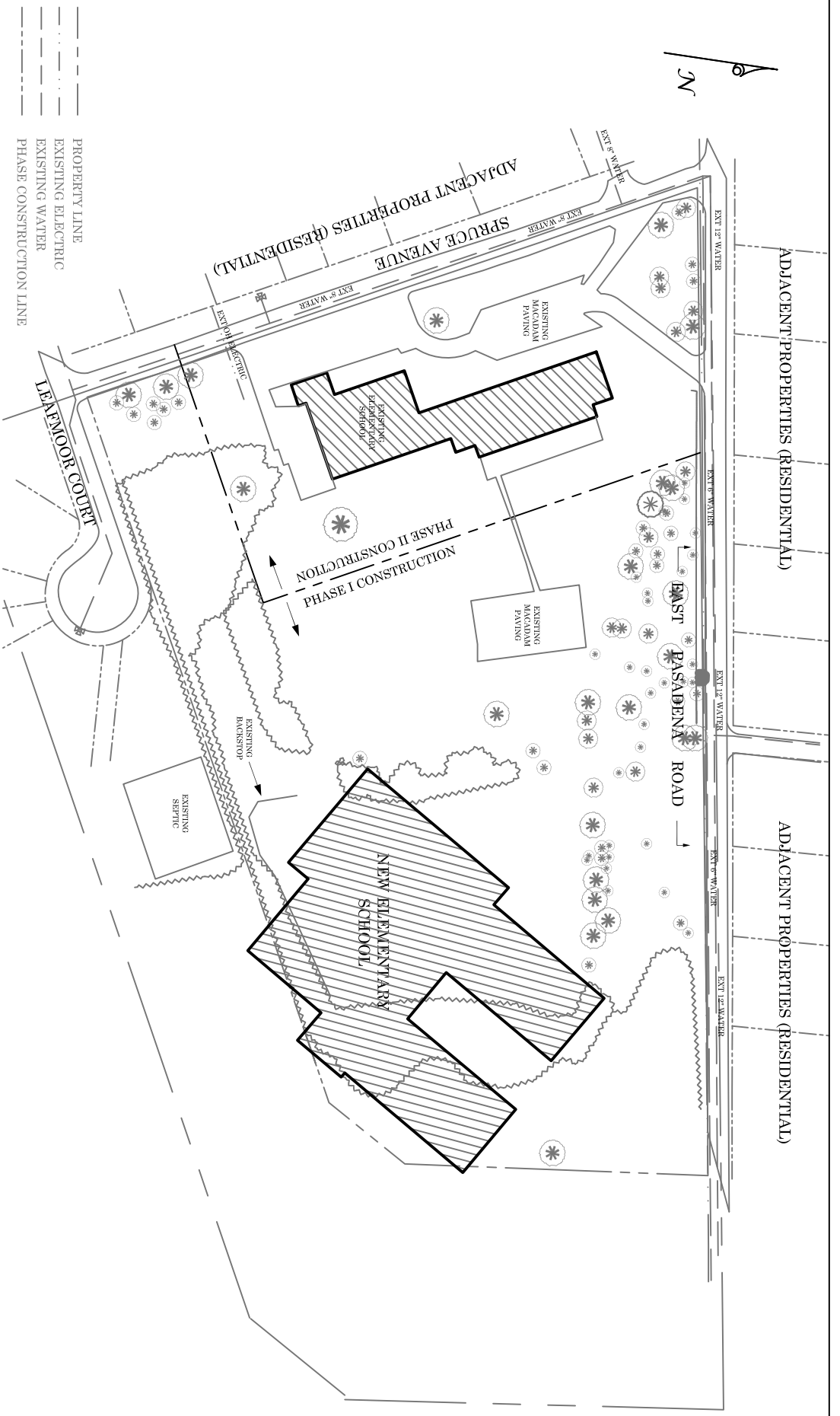
		Bearing Walls			Steel Frame			
Exterior Wall	S.F. Area		20135	25000		45000	47865	50000
	L.F. Perimeter		700	700		922	1234	994
Face Brick with Concrete Block Back-up	Steel Frame				\$ 120.20	\$ 119.74	\$ 119.40	
	Bearing Walls		\$ 122.65	\$ 122.65				
Perimeter Adjustment			\$ -	\$ -	\$ 1.85	\$ 4.89	\$ 1.65	

**Bearing Walls Square Footage = 20315 x \$ 122.65 + \$ - = \$ 2,469,558**  
**Steel Frame Square Footage = 47865 x \$ 119.74 + \$ 6,034.00 = \$ 5,737,389**

**Total Building Estimate = \$ 8,206,947**

\*Indicates numbers found by interpelation and numbers used in estimate

# Appendix E



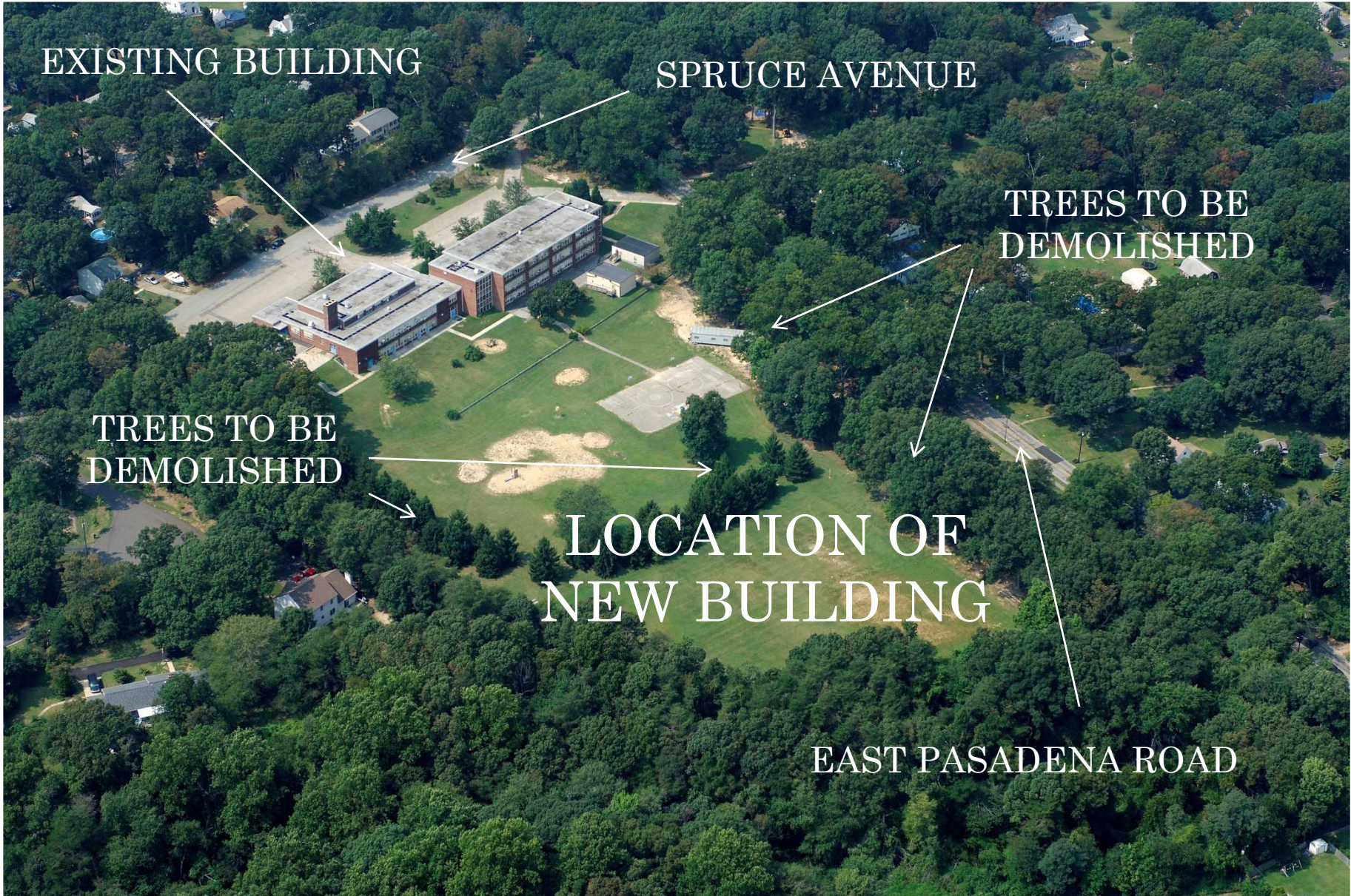
# EXISTING CONDITIONS SITE PLAN

SCALE: 1/28" = 1'

CATHERINE NEIDERER  
 ARCHITECTURAL ENGINEERING  
 SENIOR THESIS PORTFOLIO

PASADENA ELEMENTARY SCHOOL  
 105 SPRUCE AVENUE  
 PASADENA, MD 21122

1 OF 1



EXISTING BUILDING

SPRUCE AVENUE

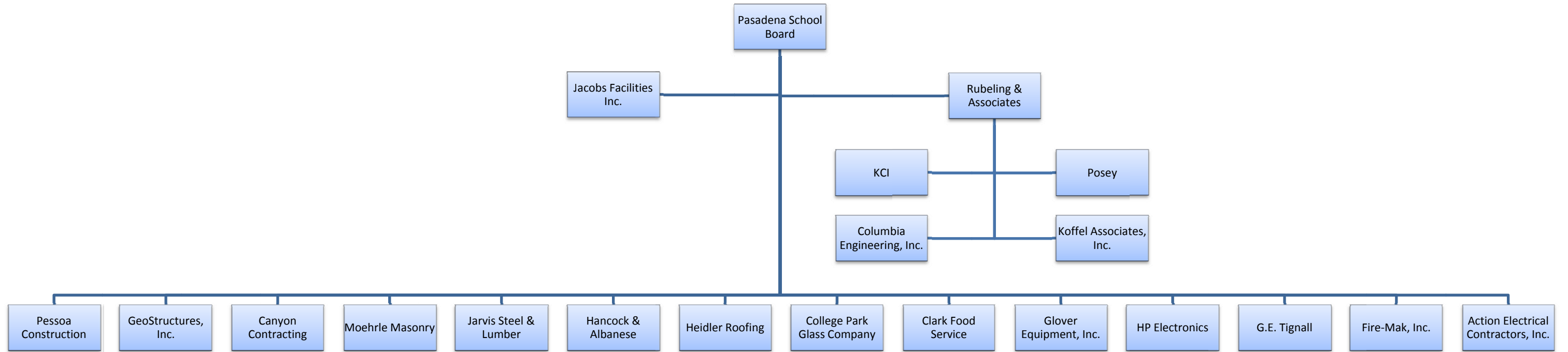
TREES TO BE  
DEMOLISHED

TREES TO BE  
DEMOLISHED

LOCATION OF  
NEW BUILDING

EAST PASADENA ROAD

# Appendix F



# Appendix G



