Analysis 4: Building Reuse

Introduction

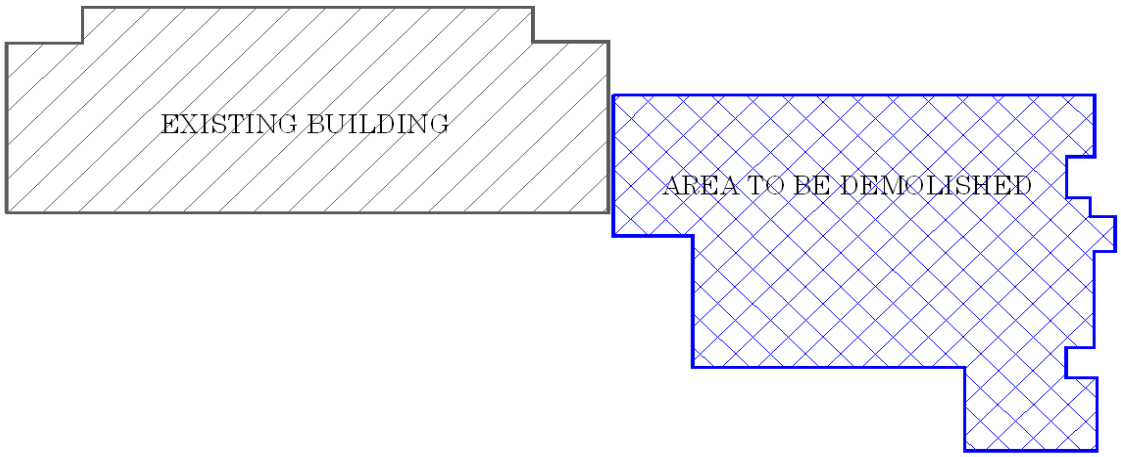
The existing Pasadena Elementary School was built in 1954 and has clearly outlived its original construction. Current codes and program requirements are no longer met and it was clear that action of some sort needed to be taken. After careful analysis and conversation it was decided that the original building be demolished and a brand new building be constructed on another part of the existing site. In the demolished building's place new multi-purpose sports fields are to be constructed.

Reusing buildings contribute to major savings in construction waste costs and also reduces a negative impact on the environment caused by demolition. There could have been major savings if the choice was made to renovate the existing school. Although some demolition and a possible new addition would be required, reuse of the building's structure could have saved time, money and materials in the construction process.

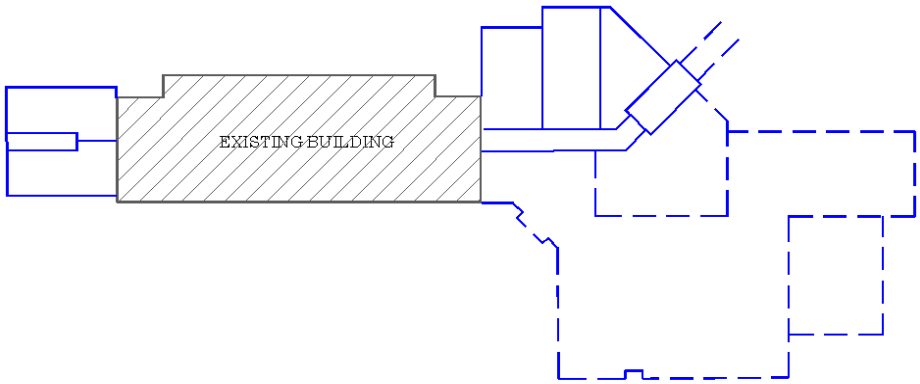
A feasibility study was performed in 2001 to go through all of the possibilities that could have been chosen to construct a new elementary school. Existing conditions of the building were examined and 4 proposals were given to the school board. The school board then decided in the current project of completely replacing the building. The following is an analysis of what the savings could have been had the school board chosen to renovate the original structure.

The major concern of this choice was the fact that relocation of the occupants would be necessary due to the disruption of the construction to the learning environment. In addition a great amount of sitework would be needed due to traffic flow issues and poor flow of egress.

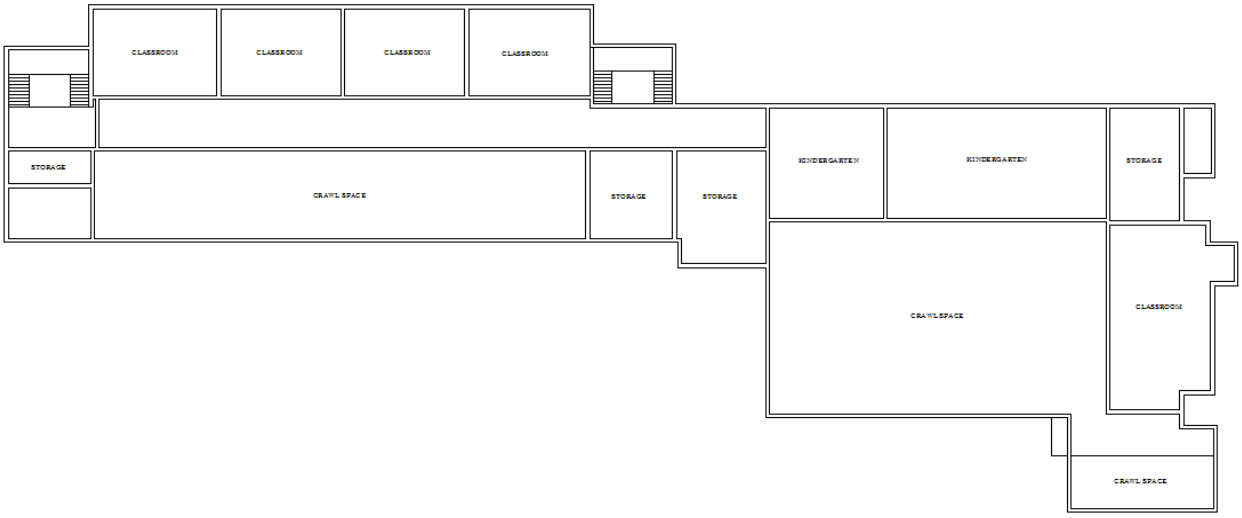
During the feasibility study the architect came up with a proposal for what could have been the elementary school had they chosen the renovation option. Notice on the next page both the existing building including the area to be demolished and the proposed new addition followed by the original floorplans of the building.



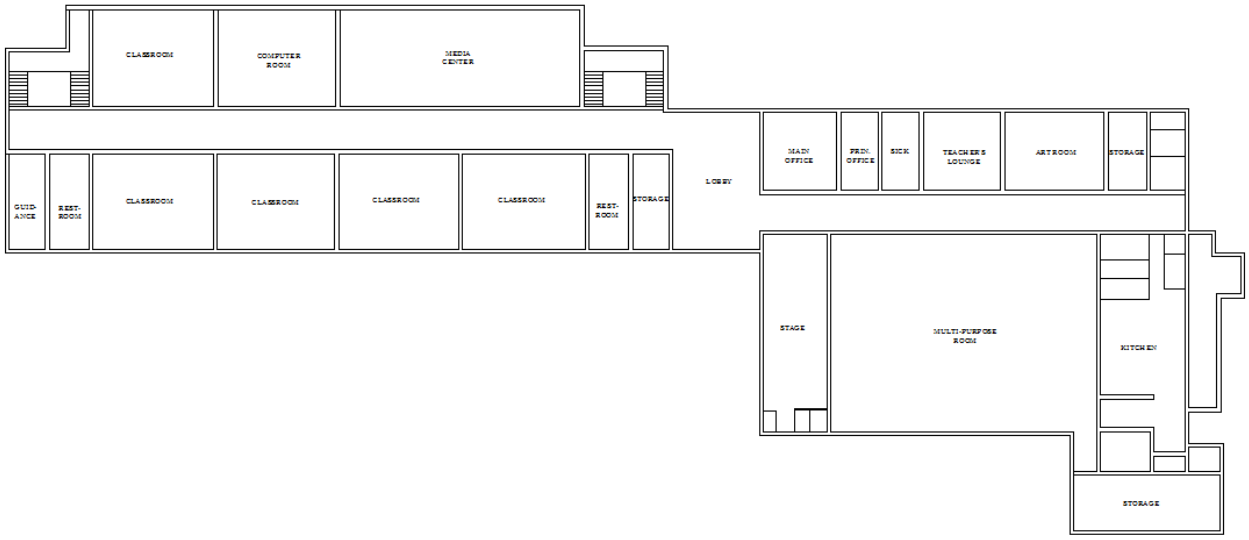
Existing Building Layout



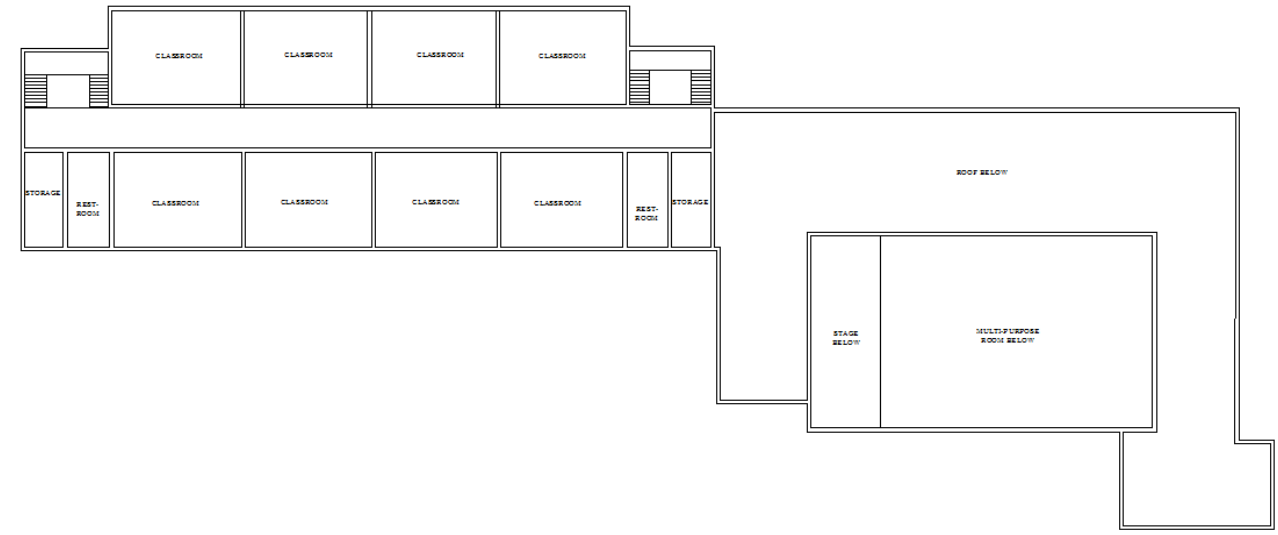
Proposed Addition Layout



Existing Lower Level



Existing First Level



Existing Second Level

Only cost of demolition and new materials was considered when the school board made their decision in 2001. The following analysis will take all factors into consideration to determine if the current and implemented plan for Pasadena Elementary School was the correct one.

Existing Conditions

The following is a summary of the building's systems and their current state previous to the building demolition when the feasibility study was made. Some of the systems would have been useful in a renovation project, but some would need to be replaced.

Building Component	Needs to be Replaced	Partially Needs to be Replaced	Eventually Needs to be Replaced	Does Not Need to be Replaced
Exterior Brickwork		X		
Exterior Precast Sills & Lintels	X			
Windows	X			
Doors	X			
Louvers & Brickvents	X			
Roof		X		
Terrazzo Tile				X
Vinyl Tile	X			
Carpet		X		
SGFT Base				X
Interior Partitions				X
Interior Doors				X

Building Component	Needs to be Replaced	Partially Needs to be Replaced	Eventually Needs to be Replaced	Does Not Need to be Replaced
Ceilings				X
Lockers				X
Casework	X			
Display Boards			X	
Toilet Partitions	X			
Toilet Accessories	X			
Boilers				X
Boiler Accessories				X
Boiler Louvers				X
Steam Condensate System Pump				X
Steam/Steam Condensate Return Piping				X
Mechanical Heating Elements	X			
Air Conditioning System	X			
Exhaust Fans	X			
Ventillation System	X			
Temperature Controls				X
Domestic Water System				X
Sanitary and Stormwater System				X
Underground Oil Tank				X
Cast Iron Piping				X
Copper Piping	X			
Water Heater			X	
Plumbing Systems	X			
Sprinkler System	X			
Electrical Systems	X			
Lighting Systems			X	
Fire Alarm Systems	X			
Intercom System				X
Security System	X			
Data Wiring System				X
Central Cable System	X			
Telephone System				X

Site

The current paving on the project site would need to be demolished and redone. This is due to the fact that it creates difficulty for buses and parents to pick up and drop off the school children and it also does not meet current county codes.

Exterior Brickwork
Brickwork was in good condition with the exception of one panel on the kindergarten wing that was in need of replacement because of cracks due to settlement. Minor repairs were needed all over the building's exterior brickwork.

Exterior Precast Sills & Lintels
All precast concrete sills and lintels need to be replaced. Many of them were cracked and showed signs of water damage. In addition many cracks, chips, etc. were evident throughout. Many of the head joints were allowing water into the building due to missing mortar.

Windows
Both the windows throughout the building and the curtainwall system at the main staircase need to be replaced. Although in decent condition, the windows should be updated due to aging and need for basic maintenance such as sealing and repainting. They are also thermally inefficient. The curtainwall is covered in rust and some of the windows in the systems are broken.

Doors
The steel doors are thermally inefficient and it was suggested that they be replaced with insulated doors although they are in fair condition. Only new hardware and painting is necessary to update them to code standards.

Louvers and Brickvents
They all need to be replaced due to their poor condition.

Roof
The roof was recently replaced and is currently is good condition therefore it does not need to be replaced. However, there is one canopy adjacent to brickwork by the north stair tower that leaks and needs to be replaced.

Interior Flooring
Minor patches are needed in some areas of the terrazzo tile and therefore the tile does not need to be replaced.

Throughout the building the vinyl tile is in poor condition and needs to be replaced.

The carpet in the kindergarten rooms, media center and computer lab are in good condition and therefore do not need to be replaced. However, carpet throughout the rest of the building is in poor condition and does need to be replaced.

Structural glazed facing tile base throughout the building is in good condition.

Interior Partitions
Concrete Masonry Units and Structural Glazed Facing Tile make up the majority of the interior walls and partitions. Although minor patching and repairs are needed, they are in good condition and do not need to be replaced.

Interior Doors
Interior doors were in need of refinishing but do not need to be replaced.

Ceilings
The majority of the ceiling throughout the building consists of 12" x 12" acoustical ceiling tile that was in good condition. In the restroom areas the ceilings are made of gypsum board and are in good condition as well.

Lockers
The lockers were replaced ten years prior and are still in great condition. Therefore, the do not need to be replaced.

Casework
Both the countertops and the casework throughout are in poor condition and are in need of replacement.

Chalkboards
Although aged, the chalkboards are in good condition. They could be left alone at this time and be replaced at a later date.

Toilet Partitions
Some stall doors are missing and therefore need to be replaced.

Toilet Accessories
Toilet accessories throughout the building need to be replaced.

Heating Mechanical Systems
The current boilers (2) in the elementary school were just installed in 1997-1998 and are therefore in good condition. They are estimated to last for 35 more years. They were manufactured by H. B. Smith (Model 350) mills series cast iron sectional type, each having 3 sections. Each burner for each boiler has a combination gas-oil modulating fired and was built by Power Flame (model C2-G0-20A). Repairs may be needed for the blower fan on boiler No. 1 due to a clanging sound observed.

Boiler accessories were only 3-4 years old at the time of inspection and are therefore up to date according to Maryland State Boiler Code CSD-1 standards. Boiler accessories include one low water cut-off, a combination low water cut-off with boiler feed pump control, and a burner cut-off switch used for emergencies that is located at an exit in the boiler room.

Also observed was a masonry stack used for natural draft from each boiler including individual insulated welded steel breeching. There were no induced fans present.

A high and low louver located in an existing window wall supplies combustion air for the boilers, each having a control damper. The Boiler Inspector approved the existing louvers that were installed with the new boilers. It has been recommended that the size be verified because it was observed that they appear to be too small. It was also noted that the lower louver for boiler No. 1 has only been opening partially as the boiler is on high fire.

Ventilation for the boiling room includes four operable windows which open into an area way. There is no positive ventilation for the space.

The pump used for the building steam condensate system was installed in 1997 and is in excellent condition. Steam condensate returns to the boilers through a combination condensate receiver and boiler feed unit. It was manufactured by Domestic Pump Company (Model 75CBM-15-25).

Also installed with the new boilers were the steam and steam condensate return piping along with the valves and accessories and are therefore in good condition as well.

Entrances, administrative offices, the health room, stage, kitchen, faculty lounge, restrooms and storage rooms are supplied heat via steam to fin tube radiation. The equipment was 47 years old at the time of inspection but appears to be in good condition because of lack of moving parts.

The largest space in the building, the multi-purpose room, is supplied each by two heating and ventilating units on each side of the stage. Each unit supplies air on the side at the face of the stage. Return air is collected through wood louvers at the face of the stage that runs into an air plenum that runs underneath the stage. Although in good condition, sprinklers would need to be installed for the return air systems to meet current code requirements due to the stage being combustible.

The classrooms and the Media Center are supplied heat by unit ventilators original to the building that are supplied by steam. They appear to be in good condition.

The insulation on fittings for the steam and steam condensate return piping appears to contain asbestos and therefore needs to be tested. The return piping including the valves, steam traps and accessories are original to the construction of the building. The entire steam system needs to be replaced due to the age of the system and likelihood of the system failing in the near future.

Air Conditioning Mechanical Systems

Only a small section of the existing building has air conditioning. The following areas have window cooling units: Health Room, Teachers Lounge, Administrative Offices, Guidance Offices, Media Center, Computer Rooms, and Meeting Room with server equipment.

In the third floor classrooms there is no air conditioning but they have paddle fans to help circulate air.

The current ventilation system at the 3-story classroom section of the building does not meet National Fire Protection regulations or the current building code. Outside air is brought into the building via classroom unit ventilators. When the classroom temperature is higher than outside air temperature and when heating is not required, the units which have economizer cycles, allow the classrooms to be supplied with 100% outside air. Large grilles are located at the top of each of the stairways and they are connected to a gravity ventilator which is located on the roof. Louvers in the classroom doors allow the air (if supplied by the economizer) to exit the classrooms and travel into the corridor. As it travels down the corridor it is then relieved into the stairways.

Fire dampers need to be installed in some of the ductwork that penetrates two or three floors. This arrangement does not meet current building codes.

In the Multi-Purpose room the pressure and relief grilles are visible and are operating in good condition. The air handling units in the space are similar to the units in the classroom with the exception that they are larger in size.

Exhaust fans ventilate the restroom areas and are in need of replacement. The areas had odors which led to believe that they are not working properly and the air quality does not meet air ventilation codes.

Natural ventilation through windows or a gravity ventilation system ventilates the storage rooms throughout the building. The spaces should be updated to have positive ventilation to agree with current codes. Also, some of the storage areas have been changed for use as offices and they do not have any windows. If the offices were chosen to remain through renovation, the gravity system will not meet code requirements.

Transfer of air from the Multi-Purpose room to the kitchen is required. Currently, the kitchen has a 35 square foot hood and does not have a make-up air unit.

Temperature Controls

Controls appear to be in good condition. Honeywell temperature controls are located throughout the building and are mostly pneumatic. A duplex air compressor with refrigerant air dryer serves the building system and is located in the boiler room. There are four occupied/unoccupied zones: Office Area, Multi-Purpose Room, Classrooms and Convectors.

Wall mounted pneumatic thermostats that control heating elements are located in each classroom by the doors.

Building Utilities

The domestic water system has been changed from a well system to water service connected the county water main. The original well had water treatment equipment and a hydropneumatic tank. Since the utility change the well has been capped off for health code regulations and the original equipment has been removed. The new water service has a main shut-off valve.

The existing sanitary and storm water mains in the building are in fair condition and do not need to be replaced. However, it was suggested that before connecting any new fixtures the mains should be cleaned by high pressure equipment and checked with a video scope to determine any problems that may arise in the future.

Within recent years a 10,000 gallon underground oil tank has been installed and currently meets present underground storage tank code requirements by the Environmental Protection Agency. The only thing that needs to be updated is the oil tank vent pipe is currently 9 feet above grade and the code requires 12 feet.

A natural gas device that currently exists in the building needs to be investigated by BGE.

Plumbing Systems

Most of the plumbing in the building is original to its construction. The cast iron piping that is used for sanitary and storm water is in good condition and does not need to be replaced. However, the copper piping that is used for water needs to be tested for lead due to older systems using lead based solder. If lead is found, the system needs to be replaced.

A water heater with a capacity of 85 gallons and 18 kW was installed in the boiler room for domestic hot water 5 years ago. The Rheem (Model EG18-85A-g) has an expected life of 10 to 15 years and therefore eventually needs to be replaced, but not at this time. A return circulator for hot water has been installed without an expansion tank and a mixing valve of an old age has been installed on the hot water pipe that serves the building's restrooms.

The existing plumbing fixtures do not meet American Disabilities Act code requirements and therefore need to be replaced. The majority of the building's plumbing fixtures are original to construction. The following are the fixture types that are found throughout the building:

- Floor mounted flush valves of vitreous china type with black open front seats serve water closets
- Flush valve type with stall units serve the urinals which do not meet current codes because the seal trap is not visible
- Enamel cast iron wall mounted lavatories are installed in the restrooms. The current faucets are self closing and only have cold water available for spaces that children use. Both cold and hot water are available for adult areas.

- Enamel cast iron drop-in type sinks are located in the classrooms. They are only supplied with cold water with a self closing faucet and a cold water bubbler mounted on the right side.

Fire Protection Systems

Currently the building does not have a fire protection or sprinkler system throughout. Although not necessarily required by present code, if installed a drop in insurance premiums may justify the installation of such a system. Also, updating the building structure may be more costly than installing a sprinkler system.

Electrical Systems

A 50kVa single phase pole mounted transformer that is located on the side of the building supplies the school. Service to the building is run from the pole underground through a CT cabinet that connects to a main fused disconnect switch (600 amps) that is located in the boiler room. 2-400 amp, Square D panelboards are fed by the breaker which serve the lighting and receptacle panelboards throughout the building and the mechanical equipment in the boiler room. There is a 100 amp enclosed circuit breaker for a portable classroom was installed in 1998.

The main disconnect switch for two additional circuit breakers has a service that is tapped ahead that used to feed the old fire alarm panel and the exit light load center.

All electrical systems including panelboards, wiring and equipment are of original building construction and need to be replaced.

No computer power distribution runs throughout the school building.

Lighting Systems

Throughout the school fluorescent 4 foot wrap around fixtures are used. They are surface mounted to the ceiling and have been installed where originally there were incandescent light fixtures.

In small spaces such as restrooms, storage rooms and exterior soffits, incandescent lights are used.

Wall-mounted battery units are used for emergency lighting used throughout the building.

Pendant-mounted incandescent light fixtures and one row of border lights are located on the stage area of the building. Also there are incandescent spot lights used for performances on the stage located in the Multi-Purpose Room. All lights are controlled by wall switches and do not contain dimmers.

Fire Alarm Systems

A 120V system by IBM serves the entire building. Throughout the building there are manual pull stations and bells. There are no parts that are available for this system. Certain aspects f the system

are lacking including visuals throughout the building to meet ADA and National Fire Protection Association criteria.

In the Main Office another fire alarm control panel was installed in 1998 that monitors the portable classroom, duct type smoke detectors and the existing IBM panel.

A digital communicator (Silent Knight) was added in later years for reporting purposes of the fire alarm system.

There is no annunciator panel within the building.

Telecommunication Systems

An intercom system is controlled from the Main Office. Calls can be made separately to each classroom and announcements can be made throughout the school through the system. Each classroom has both a speaker and a call switch. The call switches in the classrooms are difficult to reach due to the switch being located high above the chalkboards.

A separate system serves the Multi-Purpose room and has a wall cabinet with an Altec Lansing amplifier. Also included in the system are wall mounted speakers located on each side of the stage. There are also microphone outlets located at the front of the stage.

A C&K system serves as a security system for the building. The Main Office storage closet is the location of the main control panel. There is a key pad, motion detectors and also door sensors as part of the system as well.

A Cat 5 wiring system serves as the schools data wiring system. Each classroom has two receptacle outlets located at the front of the room. Hub equipment for the system is located in the first floor meeting room and consists of Baynetworks hubs and a Cisco router. This system connects the Computer Rooms, Library, Offices and Classrooms.

There is no central cable system located within the school.

A Lucent telephone system is located in the main office. The same pole located outside that supplies the electrical service supplies the telephone service. A terminal board located in the boiler room is where the wiring runs from the pole into the building.

Scope of Renovation

A simple renovation of the existing building would not be sufficient due to programmatic issues. An addition that would provide more space in the building would be necessary to meet current codes and regulations.

Some major phases of this plan are below:

- Demolition of the existing Cafeteria and Kindergarten wing will be performed.
- An addition will be built alongside the south side of the existing building and this addition will accommodate the following spaces:
    - Art room
    - Computer room
    - Kitchen
    - Stage
    - Offices
- The following new rooms will be added to the addition:
    - Media Center
    - Separate space for Cafeteria and Gymnasium
    - Administrative Spaces
- Another addition on the north end of the building will be used for kindergarten rooms
- A new elevator will be installed
- Restrooms will be updated to meet ADA requirements

Below is a summary of the demolition quantities based on the area of the building.

	Lower Level	**Level 1**	**Level 2**	**Total**
Demolition	12,041	11,681		**23,722**
Renovation	5,566	6,911	8,660	**21,137**
Improvements	1,530	3,578	1,829	**6,937**
Addition	9,196	26,645		**35,841**
Total	**16,292**	**37,134**	**10,489**	**63,915**

As stated earlier, sitework for this renovation project will be a great expense. The majority of the sitework construction includes:

- New parking location including new parent drop-off area
- New bus loop
- New drivable area for kitchen access
- New fire access lane and new waterline fire loop to meet Anne Arundel County Fire Department policy
- New hard and soft surface play areas

Due to the extensive architectural changes of the building new systems for both plumbing and mechanical systems will be required. All of the existing systems will be removed and new systems will be installed. In addition, the boiler room will be relocated due to the addition on the south side

of the building. New boilers with dual temperature chilled/heating water pumps will be installed to serve the entire building.

The new HVAC system will include the following:

- Classrooms: The dual temperature chilled/heating water system will serve all classrooms that are equipped with ducted fan coil units
- Administration Area: The area is served by 3 small air handling units with a Variable Air Volume distribution system. An air cooled condensing unit will allow cooling in the areas.
- Gymnasium, Media and Multi-Purpose Room: Constant volume air handling units connect to the dual temperature chilled/heating water system
- A direct digital control system will serve as the temperature control system for the building. It will allow the operation of the building to be local or remote and will provide economical and energy saving procedures

Abatement of hazardous materials, removal and replacement of systems and new construction is necessary for this plan. The disturbance that the construction would cause would require the students and the faculty to be relocated to another facility during the school year.

Cost Analysis

Below is an estimate of the cost of the renovation plan for the school. The numbers are based on square footage of the building and therefore are not completely accurate but area close estimate. Note that the total of $10,657,890 includes demolition and abatement and is less than the current building's project total of $14,042,006.

	Area (sq. ft.)	Unit Price ($/sq. ft.)	Total
Architectural/Engineering Fees			$ 810,000
Construction Management Fees			$ 375,000
Site Development			$ 978,655
Selective Demolition	23,722	$ 4.00	$ 94,888
Renovation	21,137	$ 60.00	$ 1,268,220
Modernization	6,937	$ 100.00	$ 693,700
New Construction	35,841	$ 150.00	$ 5,376,150
Contingency			$ 680,000
Inspection Fees			$ 42,500
Building Technology			$ 200,000
Abatement	46,259	$ 3.00	$ 138,777
Estimated Total			**$ 10,657,890**

The original building was 45,296 square feet. If the proposed renovation would have happened, only 23,735 square feet would have had to be demolished. Savings in cost of the demolition contractor would have been $217,942.

Schedule Analysis

The schedule could have been reduced due to the fact that the multi-purpose sports fields could have been in progress at the same time the building was in construction. Obviously with this major change the sequence of the project would have differed dramatically.

The construction of the sports fields would have taken place over a five and a half month period of time or 121 man days. In the original schedule, the construction of the fields does overlap with the asbestos abatement and the demolition phase of the project. However, the abatement and demolition phases are finished before the construction of the fields and in the final 3 months of the project only the construction of the fields is taking place. Therefore, this 3 month period of time could be saved by the new schedule proposal.

Below are some of the key dates to the original schedule. Turn to Appendix B for the complete original schedule.

	Start Date	**Completion Date**
Project Start Date	05 September 2006	
Sitework	05 September 2006	
Concrete	06 October 2006	
Masonry	13 November 2006	
Mechanical & Plumbing	21 November 2006	
Electrical	22 November 2006	
General Works	15 January 2007	
Structural Steel	01 March 2007	
Windows	30 March 2007	
Sprinkler	16 April 2007	
Technical Wiring	14 May 2007	
Kitchen Equipment	15 May 2007	
Playground Equipment	19 July 2007	
Casework	20 July 2007	
Abatement	21 January 2008	
Demolition	21 February 2008	07 April 2008
Phase II Sitework (Sports Fields)	21 January 2008	07 July 2008

Below are some of the key dates to the proposed new schedule.

	Start Date	Completion Date
Project Start Date	05 September 2006	
Abatement	05 September 2006	05 October 2006
Demolition	06 October 2006	31 October 2006

Below is a breakdown of where the above dates were generated from based on durations and rates from the original schedule. It was assumed that the same construction workers would work at the same rate.

	Duration	Sq. Footage	Rate
Abatement			
Original Schedule	22	45,296	2059 sf/day
Proposed Schedule	23	46,259	
Demolition			
Original Schedule	33	45,296	1373 sf/day
Proposed Schedule	18	23,722	

Conclusions

There could have been a great amount of savings if the Anne Arundel County would have chosen to renovate the original school building. This decision would have saved many new materials that were used but did not need to be.

The existing building would have caused a tremendous amount of waste that went to landfills for disposal. Some of this waste could have been avoided if the entire building was not demolished. The section of the building that would have had to be demolished could have been recycled which was not in the original construction waste management plan.

The original building, although out of date with many code standards, was still in good condition and the structure could have been reused. Many updates to the building have recently been performed such as a new roof system and the boilers were recently purchased.

Also, it would not have been more expensive or would not have taken more time than the project's current plan of demolishing the existing building and building a new one. In fact, it was found that the schedule could have been reduced.

The major inconvenience that would have come with this option would have been the necessity of relocating the school's occupants for the course of at least one school year. However, this small inconvenience would have been worth the savings of construction waste and unnecessary new materials that have a negative impact on our environment.