



DAMIANO BARILE ENGINEERS, P.C.

MECHANICAL ELECTRICAL CONSULTANTS

77 TARRYTOWN ROAD WHITE PLAINS, NY 10607

PHONE: 914.328.6060 FAX: 914.328.9304 EMAIL: GENERAL@DAMIANOBARILE.COM

September 18, 2015

Mr. Scott Hillje
Mr. Andrew Claar
KSQ Architects, PC
235 Main Street Suite 410
White Plains, New York 10601

RE: CROTON-HARMON UNION FREE SCHOOL DISTRICT
VENTILATION EVALUATION

Dear Mr. Hillje and Mr. Claar,

As per your request we have performed specific tasks pertaining to ventilation evaluation of the Croton-Harmon Union Free School District's three school buildings. They are as follows:

1. Perform a visual inspection of ventilation systems in each building.
2. Write a report detailing the type of systems, estimated age and code compliance of each system. Note that older systems may not be up to current codes, however per NY State Education Department if they are functioning as originally designed, they are considered compliant.
3. Make recommendations to bring all systems up to current code. We will prioritize recommendations based on apparent functionality, useful life expectancy and health and life safety.
4. Provide probable construction costs for each recommendation.



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September 18, 2015

RE: CROTON-HARMON UFSD
5 YEAR CAPITAL PLAN
ENGINEERING SERVICES
VENTILATION EVALUATION

Exclusions:

1. Identification of any asbestos, lead or other carcinogenic material.
2. Performance of any air quality monitoring, mold identification or infiltration identification.
3. Testing of specific components of the equipment such as dampers, motors, filters, coils, controls, etc. We will be reviewing systems as a whole.

If the District decides to move forward with any of our recommendations to replace or upgrade some of the systems, we will be suggesting a separate project to refurbish existing equipment to remain. Technicians and Air Balancers will be required to check the functionality of every component and measure actual air flows as every register, diffuser, intakes and outlets.

Our findings, opinions, interpretations and recommendations are on the following pages.

Please let us know if we can be of further assistance.

Very truly yours,

Paul J. Gallagher, PE
Vice President



CARRIE E. TOMPKINS ELEMENTARY SCHOOL:



Figure 1: CET Elementary School

Original Building (1954):

Classrooms in the 1954 portion of the building are served by floor mounted unit ventilators (UV) that introduce outdoor air and recirculate room air. Exhaust air is transferred through the classroom coat closets into the corridors below the corridor ceilings. It then exits the building by non-powered gravity vents in the roof.

Although this type of system conformed to the current NYS code at the time of original construction, this does not conform to current code mainly because it would allow for smoke to transfer into a means of egress in the event of a fire in the classroom.

The unit ventilators were replaced in approximately 2003 and are within their estimated useful life of 20 years per the ASHRAE Applications Handbook.

Recommendations: 1954 Wing Classrooms

Provide powered exhaust from occupied spaces, ducted in corridor ceilings to new fans on roof.



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Figure 2: Typical 1954 wing UV



Figure 3: 1954 Wing Classroom - Corridor Air Transfer Grille



Figure 4: Typical 1954 Wing – Gravity Roof Outlet



Some additional spaces of interest in the 1954 wing include Room 4 where the transfer air grille is blocked off.

Room 5 was converted into a small group instruction space off a classroom space without modification of the existing Perimeter Terminal Air Conditioners (PTAC). It is unlikely that this system presently provides required outdoor air, however it is scheduled for a ventilation system upgrade in the summer of 2015.

Similarly, Room 6 has two PTAC's and is also schedule for a ventilation upgrade in 2015.

Rooms 13, 14, 15, 16, and 17 were the subject of evaluation by various agencies and experts in the 2014 - 2015 school year and are scheduled for ventilation upgrades in 2015.

Rooms 2 and 3 have UV's but no visible exhaust.

Recommendations: 1954 Wing

Provide powered exhaust from rooms 2, 3, and 4, deducted in corridor ceiling to new fan roof.

The Nurses Room and Nurses Exam Room each have a PTAC unit with no visible exhaust except through the Nurses Bathroom. It is unlikely these spaces have compliant outdoor air or exhaust.

Recommendations: Nurses Suite

Upgrade system to achieve code compliant outdoor air and dedicated exhaust.



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The General Administration Offices and Principal's Office areas are all served by a roof mounted HVAC unit that was installed roughly 15 years ago and is functioning without any reported problems.



Figure 5: Administration Roof Top Unit

The Library was formerly the Cafeteria and is now served by two gas fired rooftop units that were installed in 2010. The adjacent Reference Room, Librarian's Office, Story Room and Computer Rooms are also served by one of these units. Each space has different usages, occupancies, cooling loads and outdoor air requirements. Occupants have complained of discomfort in some of these spaces.



Figure 6: Two Library Roof Top Units



Figure 7: Library Duct Distribution



Figure 8: Reference Room Branch Duct



Figure 9: Computer Room



Recommendations: Library

Modify the Library system by cutting off and redirecting the branch ductwork to the other spaces so these serve the library only. Provide dedicated HV systems for the Reference Room. The Librarian's Office, Story Room and Computer Room with the proper outdoor air and heating/cooling capacities.

The gymnasium is served by two air handling units in an interior mechanical equipment room adjacent to the gym. The supply and return air are both on the same side of the gym with relief air from two trough the wall propeller fans. At the time of our inspection the air handlers were on but the relief air fans were not. Air distribution in the space is not optimal and the air handlers are well past their useful life.



Figure 10: Gymnasium Air Handler



Figure 11: Gymnasium Corner Air Relief Fan



Figure 12: Gymnasium Supply Air Outlet and Corner Return Grille

Recommendations: Gymnasium

Replace old Gym HV units and provide ducted supply air distribution at the ceiling of the Gym with low returns. Eliminate the hard to service propeller fans and incorporate new exhaust fans on the roof or in the mechanical room to relieve air from the return air ducts.

There are two interior Physical Education offices near the gym that are interior spaces with no outdoor air, exhaust, or air conditioning.

The Head Custodian's office near the boiler room is an interior space with no outdoor air, exhaust, or air conditioning.

Recommendations: Physical Education and Custodian Offices

Provide dedicated HVAC systems with proper outdoor air to Gym and Custodian's Offices.



1961 Addition:

The 1961 Wing is served by unit ventilators that are well beyond their useful life. There is no visible exhaust. Ceilings were replaced and it is possible that the exhaust is blocked or obscured. There are large exhaust shafts in the core of the building that suggest that air was transferred into the corridors in a similar fashion as the original building, which does not meet current code.

There are also reported controls problems with the unit ventilators. The outdoor air damper closes when the fan is energized and opens when the fan is de-energized. The opposite should happen and the fan should be on at all times during occupied mode.



Figure 13: 1961 Wing Unit Ventilator



Figure 14: 1961 Wing Corridor Exhaust Transfer Grille



Figure 15: 1961 Wing Exhaust Shaft

The Faculty Room is in this wing which has the same type of ventilation as a typical classroom in this wing. The Lactation Room off of the Faculty Room has an exhaust fan on a toggle switch but no powered ventilation for outdoor air.

Room 213 has an interior space with no powered ventilation or exhaust.

Recommendations: 1961 Wing

Option 1a: (no air conditioning)

Replace existing classroom unit ventilators with new unit ventilators, providing the required quantity of outside ventilation air. Provide ducted exhaust fans for powered relief air.

Option 1b: (with air conditioning)

Replace the existing classroom unit ventilators with new self-contained unit ventilators, providing the required quantity of outside ventilation air. Provide ducted exhaust fans for powered relief air.

Option 2a: (no air conditioning)

Replace existing classroom unit ventilators with new roof mounted energy recovery units (minimum 3) and associated ductwork, providing the required quantity of outside ventilation air and relief/exhaust air. Provide heating coils in ductwork for final air tempering. New ductwork installation will require existing ceiling removal/modifications and soffits in classrooms, structural steel on roof, etc.

Option 2b: (with air conditioning)

Replace existing classroom unit ventilators with new packaged roof mounted air conditioning/energy recovery units (minimum 3) and associated ductwork, providing the required quantity of outdoor ventilation air and relief/exhaust air. Provide heat coils in the ductwork for final air tempering. Provide variable refrigerant flow (VRF) type ductless cooling system throughout for individual classroom zone control. New ductwork installation will require existing ceiling removal/modifications and soffits in classrooms, structural steel on roof, etc.

1997 Addition:

The 1997 addition is primarily served by gas fired rooftop units that were installed in 2010 at the same time the Library units were installed in the 1954 Wing. These spaces include the Cafeteria, Cafeteria Platform, Cafeteria Lobby, Art Room and Music Room. The District retained a copy of the balancing report that was issued at the completion of this work in 2010. The report indicates all outdoor air design quantities were met or exceeded.

There are no reported operational problems in any of these spaces.



Figure 16: Cafeteria and Cafeteria Platform Units



Figure 17: Cafeteria Lobby and Music Room Units



Figure 18: Music Room Unit



2003 Addition:

Ventilation air enters the classrooms in the 2003 wing through unit ventilators, is transferred into open ceiling plenums, and then vented by gravity through roof hoods. There is no powered classroom exhaust in this wing.



Figure 19: 2003 Wing Unit Ventilator



Figure 20: Typical 2003 Wing Roof Relief Hoods

Recommendation: 2003 Addition

Provide powered exhaust from occupied spaces ducted in corridor ceilings to new fans on roof.

Building Corridors Throughout: (District Wide)

New York State Education (NYSED) now requires that all Corridors be provided with powered ventilation air. Fan coils units with outdoor air connections should be added to all corridors. Exhaust could be achieved by providing transfer ducts from corridors into toilet rooms, using toilet exhaust fans for two purposes.

Co2 Sensor Monitoring: (District Wide)

Although NYSED does not allow using Co2 Sensors for reducing outdoor air in classrooms below minimum per code, the District could decide to install Co2 Sensors in classrooms and other important areas to monitor Co2 levels. This would allow the District to ensure all occupants are receiving proper outdoor air and to act quickly if it is determined that they are not.



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EXECUTIVE SUMMARY

Explanation of Notes:

- A: Ventilation system does not meet any Code past or present.
- B: System is not functional.
- C: Ventilation system met current Code at time of construction, although does not meet current Code.
- D: System is nearing or past the end of its useful life, however is still functioning.
- E: Upgrade current system to more energy efficient, quiet central system.
- F: Add air conditioning where not required.

CARRIE E. TOMPKINS ELEMENTARY SCHOOL

SPACE	DESCRIPTION	NOTE	LEVEL	ESTIMATED PROBABLE COST	ARCHITECTURAL ASSOCIATED COST
1954 Building	Provide Ducted Powered Exhaust	C	2	\$150,000.00	\$100,000.00
Nurses Office and Exam Room	Upgrade to Required Outdoor Air and Powered Exhaust	C	1	\$60,000.00	\$20,000.00
Librarian's Office	Provide Dedicated HVAC Unit	C	2	\$15,000.00	\$2,000.00
Computer Room	Provide Dedicated HVAC Unit	C	2	\$75,000.00 *	\$7,500.00
Reference Room	Provide Dedicated HVAC Unit	C	2	\$75,000.00 *	\$7,500.00
Story Room	Provide Dedicated HVAC Unit	C	2	\$75,000.00 *	\$7,500.00
Gymnasium	Replace Old HV Units, Powered Exhaust Fans and Improve Distribution	D	2	\$400,000.00	\$15,000.00



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SPACE	DESCRIPTION	NOTE	LEVEL	ESTIMATED PROBABLE COST	ARCHITECTURAL ASSOCIATED COST
Gym Offices	Provide Outdoor Air, Powered Exhaust and Air Conditioning	C	1	\$20,000.00	\$2500.00
Head Custodian Office	Provide Outdoor Air, Powered Exhaust and Air Conditioning	C	1	\$20,000.00	\$5,000.00
1961 Addition	Replace Unit Ventilators and Provide Powered Exhaust	B	1	\$475,000.00	\$100,000.00
1961 Addition	Replace Unit Ventilators with UVAC's and Provide Powered Exhaust	F	3	\$625,000.00 *	\$125,000.00
1961 Addition	Replace Unit Ventilators with Roof Energy Recovery Units	B	3	\$525,000.00	\$175,000.00
1961 Addition	Replace Unit Ventilators with Roof Air Conditioning type ERU's and VRF in Classrooms	F	3	\$925,000.00 *	\$225,000.00
Lactation Room	Provide Outdoor Air, Powered Exhaust and Air Conditioning	A	1	\$20,000.00	\$5,000.00
Room 213	Provide Outdoor Air, Powered Exhaust and Air Conditioning	A	1	\$20,000.00	\$2,500.00
2003 Addition	Provide Ducted Powered Exhaust	C	2	\$90,000.00	\$20,000.00
Corridors	Provide Powered Ventilation Throughout	C	1	\$300,000.00	\$75,000.00
CO2	Add CO2 Sensors for Monitoring *(Assume 80 total)	-	4	\$40,000.00	\$0.00

* Electrical Service Upgrade Not Included. To Be Determined With Actual Usage and Utility Company. (Approximate probable cost: \$200,000.00)

Note: Costs do not include soft costs and escalation.



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CROTON HARMON PIERRE VAN CORTLAND MIDDLE SCHOOL



Figure 21: Pierre Van Cortland Middle School

Original Building (1939):

Second Floor:

Note that there is no "First Floor" in the original building because the new addition has a lower floor that is identified as First Floor.

With some exceptions, typical classroom spaces in the original building have unit ventilators with exhaust being removed through the back coat closets. Air is then ducted up through the attic to a number of roof mounted exhaust fans that are beyond their useful life. There is no indication that there are fire dampers at any of the floor to floor penetrations.



Figure 22: Typical Classroom Unit Ventilator



Figure 23: Typical Classroom Closet Exhaust Register



The Home and Careers Room is served by an air handling unit in the boiler room and an exhaust fan in the adjacent storage room. Exhaust is ducted down over each cooking range and is not rated for commercial use. Faculty Dining and adjacent closets are also served by this air handler. This system does not have air conditioning, and serves some interior spaces, which is code compliant unless any of these interior spaces are student occupied.



Figure 24: Home and Careers Air Handler



Figure 25: Home and Careers Exhaust Ductwork



There is no visible outdoor air or exhaust air in the Classroom Room 224 or Faculty Room 223. The adjacent Custodian's Office 221 has exhaust but no powered outdoor air.



Figure 26: Music Keyboarding Room 224 Radiators

The Nurses Office is served by a basement fan coil unit with fresh air that was installed in 2001.

There are a number of exhaust fans on the flat roof section. Some were recently replaced but four are beyond their useful life.

Recommendation: Second Floor

Provide four new exhaust fans on roof. Add ventilation to Classroom 224, Faculty 223 and Custodian's Office 221.



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Third Floor:

Health Room 319 appears to have been formerly a stage that was walled off from the gymnasium. There is no ventilation or air conditioning in this student occupied interior space.

There is no visible exhaust in Office 315, Office 315A, or Room 310 which is adjacent to 8th Grade Classroom 311. There is no visible ventilation in the Guidance area which includes rooms 307, 308, and 309.

The gymnasium is ventilated by an attic mounted utility set supply fan which appears to be original to the building. Although it is well past its expected useful life, this fan is of very solid construction, quiet, and well maintained.



Figure 27: Gym Supply Fan



Figure 28: Gymnasium

Recommendations: Third Floor

Add ventilation and air conditioning to Health Room 319. Add ventilation to the Guidance area rooms 307, 308 and 309. Replace gym supply fan.



Fourth Floor:

Conference Room 416 has exhaust but no supply or outdoor ventilation air.

Recommendations: Fourth Floor

Provide roof mounted heating and ventilating unit for Conference Room 416.

New Addition (2004)

Classrooms in the new addition are served predominantly by floor mounted unit ventilators and plenum ceilings for exhaust. This equipment is well within its useful life.



Figure 29: Typical 2004 Addition Classroom Unit Ventilator

The Music Suite, Gymnasium, Administration Area, Stage Platform, and Library are all served by air handling units located in the Second Floor Mechanical Room. They are all well within their useful life.

Recommendations: 2004 Addition

None.



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- E: Upgrade current system to more energy efficient, quiet central system.
- F: Add air conditioning where not required.

PIERRE VAN CORTLAND MIDDLE SCHOOL

SPACE	DESCRIPTION	NOTE	LEVEL	ESTIMATED PROBABLE COST	ARCHITECTURAL ASSOCIATED COST
1939 Building	Replace Ducted Powered Exhaust Fans	D	2	\$75,000.00	\$0.00
1939 Building	Provide Fire Dampers in Classroom Exhaust Shafts	C	1	\$45,000.00	\$80,000.00
1939 Building	Provide Powered Ventilation to Rooms 221, 223, and 224	A	1	\$150,000.00	\$30,000.00
1939 Building	Provide Powered Ventilation to Rooms 319, 307,308 and 309	A	1	\$200,000.00	\$45,000.00
1939 Building	Replace Gym Exhaust Fan	D	2	\$60,000.00	\$0.00
Corridors	Provide Powered Ventilation Throughout	C	1	\$150,000.00	\$75,000.00
C02 Sensors	Add C02 Sensors for Monitoring *(Assume 80 total)	-	4	\$40,000.00	\$0.00

* Electrical Service Upgrade Not Included. To Be Determined With Actual Usage and Utility Company. (Approximate probable cost: \$200,000.00)

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CROTON HARMON HIGH SCHOOL



Figure 30: Croton Harmon High School

Original Building (1924):

(Areas not included in any recent renovation)

Typical classroom spaces in the original building have unit ventilators with no visible signs of exhaust. Some of the older doors into the corridors have louvers on them which suggest that at one time air was transferred from the classrooms into the corridors and out of the building by gravity shafts. That system is no longer used and there is no powered exhaust. This is also the case for the three science rooms on the top floor, which are required to have dedicated powered exhaust. (Rooms 310, 311, and 312)



Figure 31: Original Building Typical Unit Ventilator

Community Room 113 receives outdoor air from a failing floor mounted air handler in the adjacent room 107D. A replacement system was designed with air conditioning added in 2015. This portion of the project was bid as an alternate and it is unknown if this system will be upgraded.

The TV Studio 120 had a new system designed and is scheduled for construction in the summer of 2015.

The following areas on the first floor and second floor of the original 1924 building have no visible powered ventilation or exhaust: Darkroom 102A, Classroom 103, Special Ed 105, Special Ed 105A, Classroom 105E, Office 105C and Office 105D, Classroom 200A, Office 200E, Office 200G and Office 200H, ESL 206, Office 206A, Resource 211, Resource 212, and Computer 213.

Classroom 200A, Special Ed 105 and 105A are interior student occupied areas which also requires air conditioning per NYSED.

Rooms 214, 215, 216, 217, and 218 had unit ventilators replaced in approximately 2003. Relief air is transferred into the corridors then through relief vents in the roof. There is no powered exhaust. Air transferred into a corridor is currently non-conforming because in the event of a fire smoke could be transferred into a means of egress.



Figure 32: Room 214 Unit Ventilator



Figure 33: Air Transfer Grille into Corridor

Recommendations: Original Building

Provide powered exhaust to all areas that do not have it. It may be possible to re-use some of the original relief shafts, but fire dampers will need to be added from floor to floor. Ducted exhaust would need to be provided from the shafts on the top floor to roof mounted exhaust fans.

Provide powered ventilation and exhaust to areas that don't have it. Ceiling or floor mounted energy recovery units (ERU's) are well suited for Special Ed 105 and surrounding offices and classroom 200 and surrounding offices. Interior spaces would also be equipped with ductless split air conditioners.

Rooms 206, 211 and 213 could have dedicated ceiling mounted energy recovery units for each space with intake and exhaust ducts to the roof or through the walls.



Provide ducted powered exhaust in rooms 214 through 218 with an exhaust fan on roof.

Provide dedicated powered exhaust to Science Rooms 310, 311 and 312.

1960's Main Gym Addition:

The Main gym is served by two roof mounted air handling units located on the adjacent lower roof that supply and return air on one side of the gym. They were installed in 2003. Air is exhausted through two wall mounted propeller exhaust fans above the bleachers on the opposite side of the room. The air distribution in this space is not ideal but there is still remaining useful life in the equipment. Revised ductwork for better air flow could be considered in the future when the equipment is at the end of its useful life.



Figure 34: 1960's Gym High Supply Air and Low Return Outlets

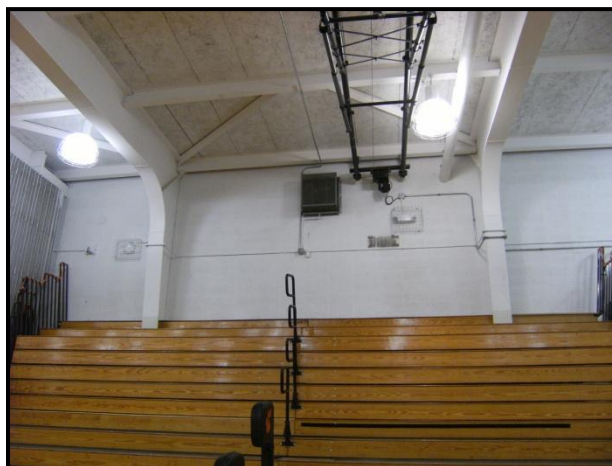


Figure 35: 1960's Gym Wall Exhaust Fan



1970's Addition:

The first floor of the 1970's Addition is now the Custodian's Office, Interior Conference Room, Storage and the Music/Choral Room. The Custodian's Office and Conference Room have no powered ventilation and no visible exhaust.

There are also two interior offices across the hall that have air outlets but it is unclear if the original system has been abandoned. If these spaces are ever student occupied, NYSED requires air conditioning as well as powered ventilation.

The Music/Choral Room only has one unit ventilator that is sized for a typical classroom, and is too small to provide required outdoor air for a fully occupied room, and there is no visible exhaust in the space.



Figure 36: Music/Choral Room Unit Ventilator

The second floor of the 1970's addition now has science rooms that were renovated in 2010. Outside air is provided by ceiling mounted unit ventilators and powered exhaust is achieved by roof mounted exhaust fans.

Recommendations: 1970's Addition

Provide powered ventilation and exhaust in Custodian's Office. Provide ductless split air conditioning systems with outdoor air capability and exhaust fans for interior offices and small group instruction areas.

Provide an ERU for the Music/Choral room outside of the space to minimize equipment sound.

1996 Renovation:

The Faculty Room, Conference Room 116 and adjacent New Media Rooms all receive outdoor air through ducted overhead systems from an air handler in an adjacent mechanical room that was installed in 1996. Powered exhaust is through a wall mounted exhaust fan on the exterior wall. This system is beyond its useful life.



Recommendation: 1996 Renovation Replace this system in kind.

2003 Additions and Alterations:

Most of the remainder of the building was built or renovated in 2003.

Areas in the front addition such as the Library, Main Office, Tech Office, In School Suspension, and Athletic Director's Office receive heating, ventilating and air conditioning by a multi-zone air handler in the second floor mechanical room.

The Guidance area 107 and adjacent offices and Art Room 104 and 104A receive outdoor air through ceiling mounted unit ventilators installed in 2003. There is no powered exhaust. Air is relieved through gravity dampers and louvers in the wall above the ceiling.

The Auditorium receives outdoor air through a second floor mechanical equipment room air handler with a condensing unit on an adjacent roof installed in 2013. There is a ducted distribution system in the ceiling of the auditorium with return grills in the back of the space and exhaust fans on the roof of the stage.

The dressing rooms below the stage are scheduled to receive new heating and ventilating equipment in the summer of 2015.



Figure 37: Auditorium Ceiling Diffusers



Figure 38: Auditorium Condensing Unit

The Cafeteria/Study Hall and Auxiliary Gym are served by an air handler in an adjacent mechanical equipment room that provides outdoor air. Air is relieved by a non-powered relief vent on the roof.

The Gym Locker Rooms are served by an air handler in the same mechanical room that provides outdoor air, but the locker rooms have ducted powered exhaust fans on the roof.

Classrooms 120 through 124 and 220 through 224 have unit ventilators for outdoor air and a roof mounted exhaust fan for powered exhaust.

Recommendations: 2003 Additions and Alterations

Provide powered exhaust in Guidance area, Art area, Cafeteria/Study Hall and Auxiliary Gym. Gravity vents could be replaced with roof mounted powered exhaust fans.



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CROTON HARMON HIGH SCHOOL

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1924 Building	Provide Ducted Powered Exhaust	C	1	\$150,000.00	\$75,000.00
1924 Building	Provide Required Outdoor Air and Ducted Powered Exhaust	A	1	\$225,000.00	\$50,000.00
1924 Building	Provide Dedicated Powered Exhaust to Science Rooms	A	1	\$40,000.00	\$25,000.00
1924 Building	Provide Ducted Powered Exhaust in Rooms 214 thru 218	C	2	\$55,000.00	\$30,000.00
1970's Addition	Provide Energy Recovery Unit in Custodian's Office and Conference Room	C	1	\$45,000.00	\$5,000.00
1970's Addition	Provide AC and exhaust to SGI and Offices	C	1	\$30,000.00	\$10,000.00
1970's Addition	Provide Energy Recovery Unit to Choral/ Music Room	C	1	\$150,000.00	\$20,000.00
1996 Renovation	Replace HVAC Unit in Conference Room & Faculty Room	D	2	\$75,000.00	\$2,500.00
2003 Adds & Alts	Provide Powered Exhaust in Guidance, Art, Study/Cafe and Aux Gym	C	2	\$75,000.00	\$5,000.00
Corridors	Provide Ventilation Throughout	C	1	\$300,000.00	\$80,000.00
C02 Sensors	Add C02 Sensors for Monitoring *(Assume 80 total)	-	4	\$40,000.00	\$0.00

* Electrical Service Upgrade Not Included. To Be Determined With Actual Usage and Utility Company. (Approximate probable cost: \$200,000.00) **Note: Costs do not include soft costs and escalation.