Spaul Environmental, Inc.

A professional team of engineers, industrial hygienists, safety experts, physicians, and health scientists

Environmental and Medical Monitoring
EPA/OSHA Compliance
Hazardous Waste Control
Indoor Air Quality Evaluations

Safety Evaluations
Training
Expert Testimony
Hazard Communication

30 March 1993

Ms. Judith Hunt, Director
Risk Management and Safety Department
School Board of Broward County
1320 Southwest Fourth Street
Ft. Lauderdale, FL 33312

RE: Cooper City High School

Dear Ms. Hunt:

On 25 March 1993 Dr. Wil A. Spaul, a Certified Industrial Hygienist, conducted an inspection of the air handler systems in Cooper City High School. The areas where allergies and "Tight Building Syndrome" complaints were reported were the areas that were inspected during this initial inspection. Additionally, "gas" odors were also reported. Excessive microbial growths were observed in the condensation pans for the roof mounted units.

The carbon dioxide levels in the 100 wing were excessive, which indicates that inadequate outdoor air flow is being pulled into these air handler units. It appears that the flow for the return air fans exceeds the flow for the supply fans, and instead of pulling outdoor make-up air into the air handlers, air conditioned air is being blown out the outdoor make-up air intakes. The outdoor air dampers were open in these roof mounted air handlers, but the air flow was out of the air intake rather than into the unit. The net effect is that "Tight Building" conditions are created.

Also the chilled water temperatures at the chiller plant were 48.0 and 48.1 °F. For the roof mounted air handlers that had functional thermometers (most were broken), the chilled water temperatures ranged from 49.4 to 52 °F. At this elevated chilled water temperature, inadequate dehumidification will occur and surface molds can be anticipated.

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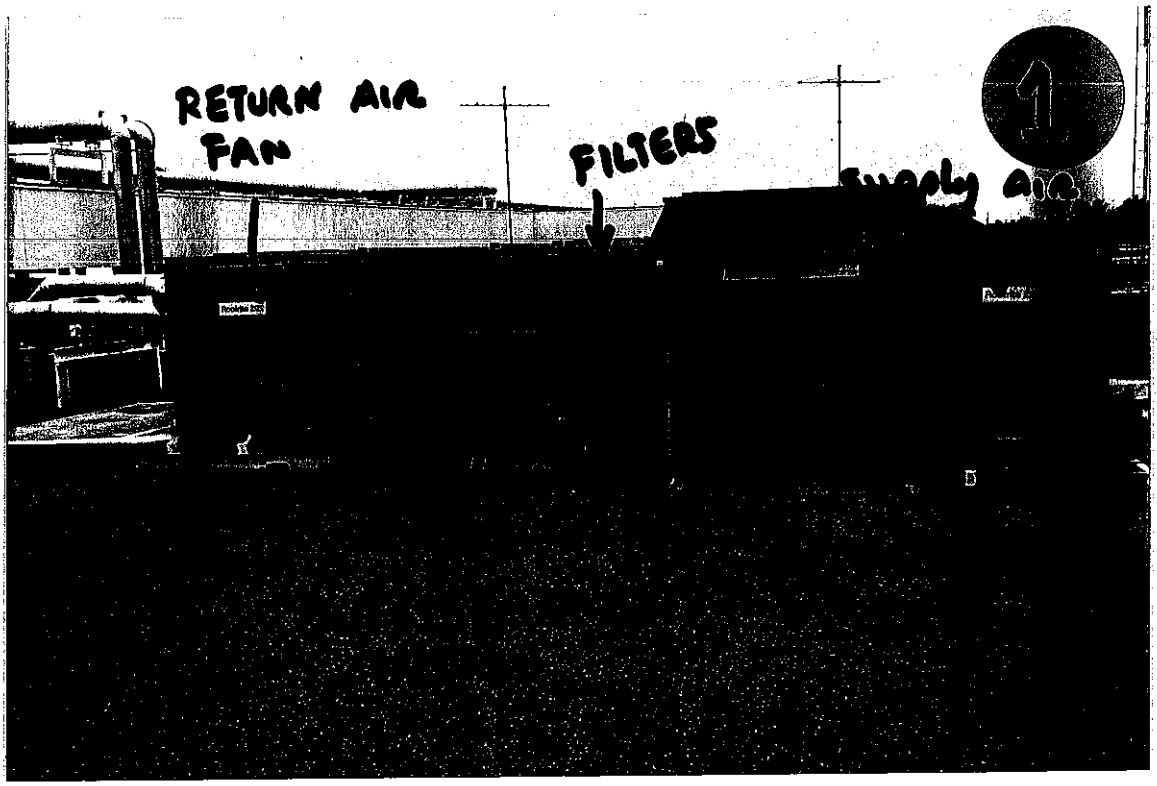
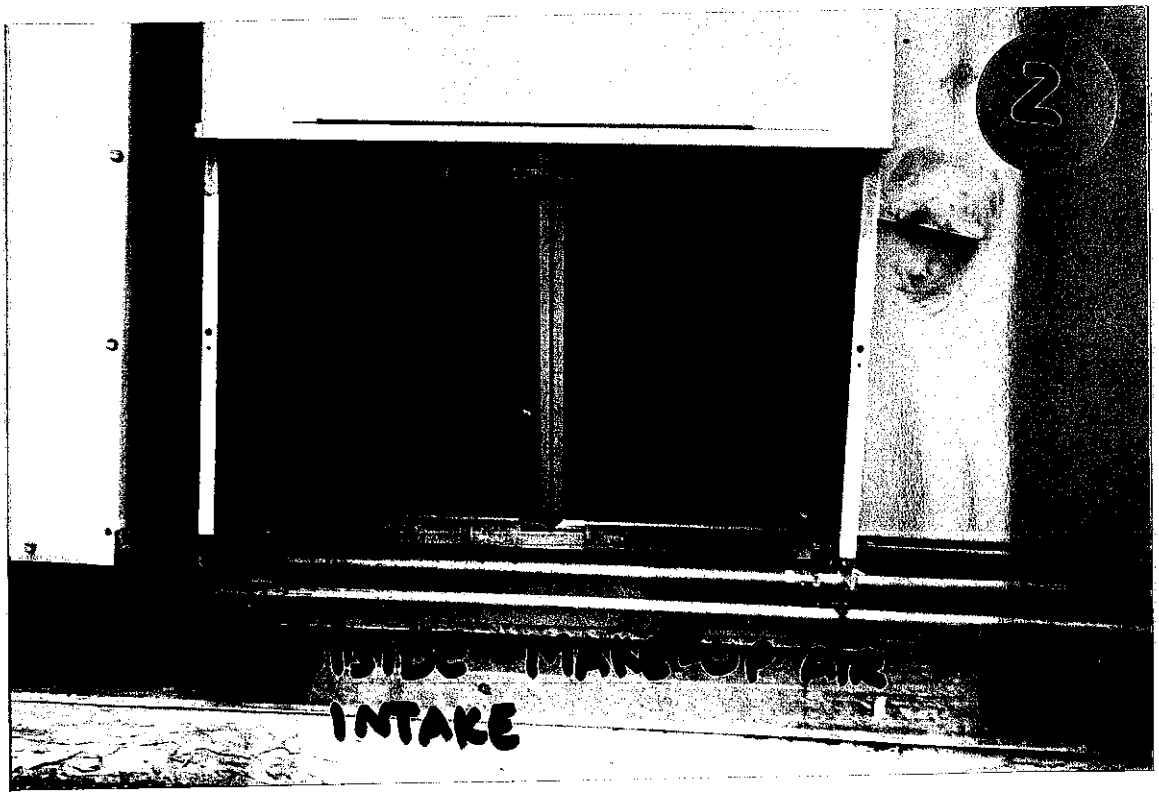
PHOTOGRAPHIC DOCUMENTATION:

Photograph 1: Roof Mounted Air Handler Unit

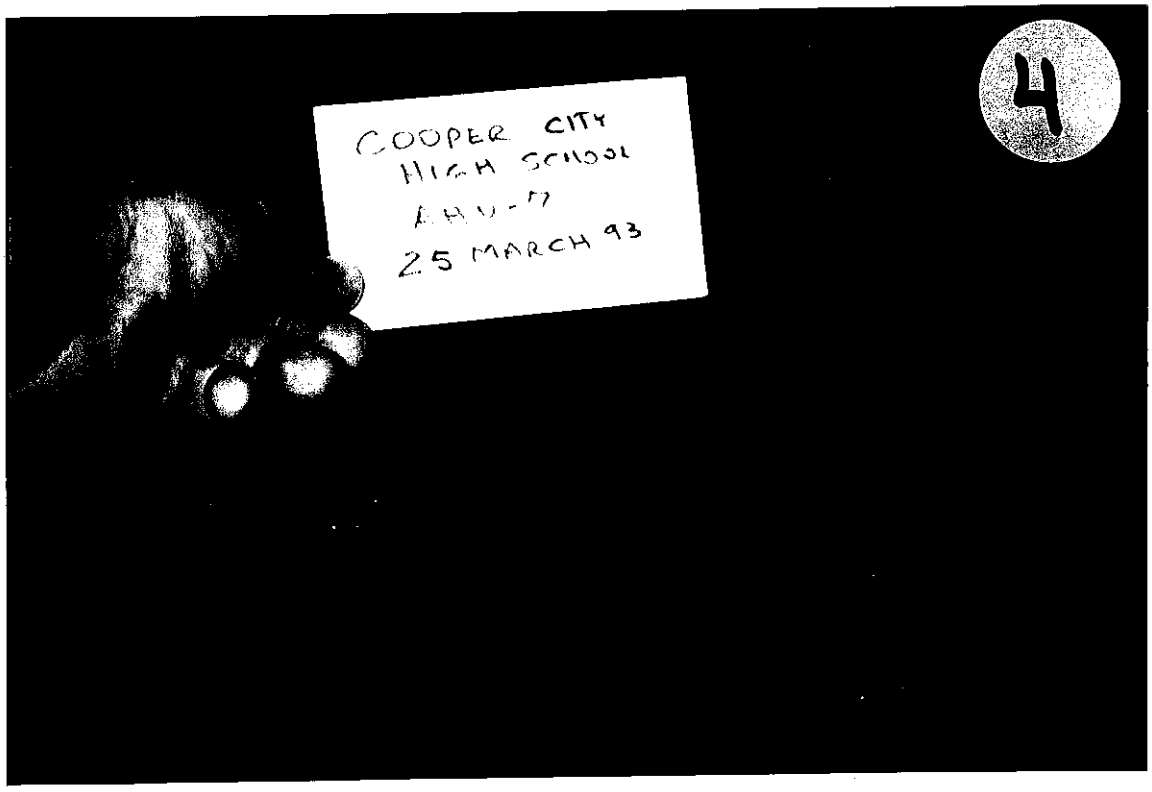


Photograph 2: Close-up Of Make-up Air Intake

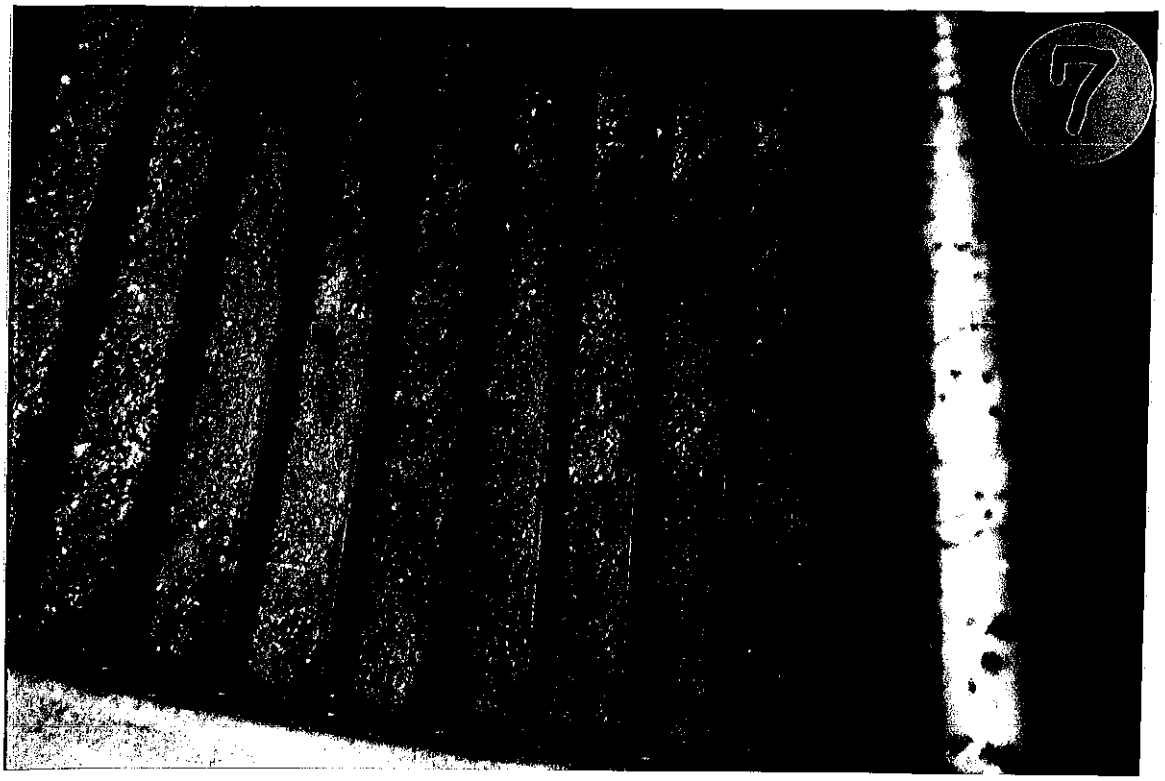


Photograph 3: Return Air Dampers And Make-up Air Dampers Both Wide Open

Photographs 4 & 5: Thick Bioslime Blanket In Each Condensation Pan



Photographs 6 & 7: Mold Growths Starting On Fan Blades



CARBON DIOXIDE MEASUREMENTS:

Location	Time (am)	CO2 (ppm)	# Students
100 Wing Corridor by Room 150	11:15	1855	none
Room 150	11:20	2000+	24
Room 142	11:25	1651	32
Room 149	11:35	2000+	24
Room 137	11:40	1680	28
Room 176A	11:45	1921	23
Room 179	11:50	1938	18
Room 158	11:55	1801	30

The following observations were noted:

AHU-7:

- Coils were very clean;
- Fan unit was just starting to have mold growths on blades;
- Insulation in fan chamber was clean and foil covered;
- Outside air damper was open but was drawing very little air into the unit;
- Excessive microbial slime layer in condensation pan;
- Broken chilled water thermometers.

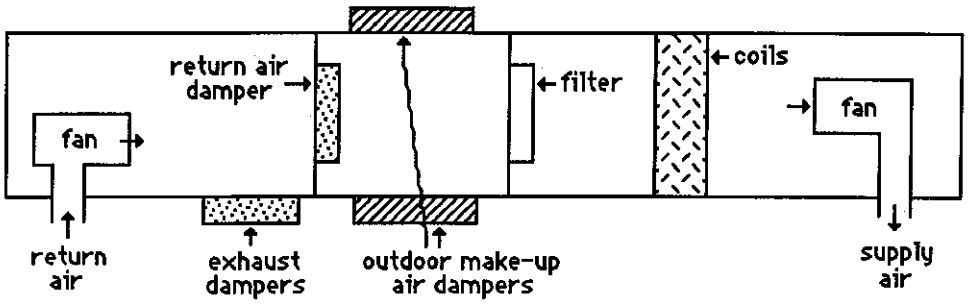
AHU-1:

- Same conditions as AHU-7, but more mold growths on fan and in condensation pan;
- Outside air intake dampers are open, but not pulling any air.

AHU-8:

- Outside air intake closed about one half;
- Same conditions as in above units
- 51°F supply water temperature to coils.

Air Handler Diagram:



NOTES:

1. Exhaust air dampers were closed.
2. Return air dampers were fully open.
3. Outdoor make-up air damper fully open.
4. Since the exhaust dampers are closed and the return air dampers are wide open, there is no drafting of outdoor air into these units. Actually, on some units cold air was felt coming out of the outdoor make-up air intakes.

Sewer Odors:

- Sewer exhaust stacks were very close (<3 feet) from the air intakes on some units; the proximity of these sewer exhaust stacks to the air handler air intakes are the probable cause of these sewer odors. At the time of this survey, extension pipes were being added to these stacks, which should take care of most of these problems. If the problem reoccurs, there is the chance of possible eddy currents entraining the odors. Should this problem occur, make a note of the area where the complaint is occurring, the air handler that serves that zone, and the direction of the wind. With that information, a roof inspection for the most likely exhaust stack should be conducted.

SUMMARY:

1. There is an inadequate flow of outdoor air into these classrooms as a result of excessive return air inside the air handler. Even though the outdoor air dampers were open, very little outdoor air was pulled into these units because the exhaust air damper was closed and the return air damper was wide open. This reduced air flow can result in "tight building" conditions, which are often associated with frequent headaches, eye and nose burning, excessive tiredness, difficulty thinking, dizziness, symptom onset about mid-morning or later, and symptom relief with a few hours away from the building. Additionally, since there is inadequate flushing of the building, odors tend to remain longer than would be expected within the building.

2. From the amount of microbial growths that were present inside the air handlers (on the fan blades and in the condensation pan), it is not surprising that allergy complaints are occurring in this building.

3. After about a week to ten days after these systems have been cleaned, allergy symptom relief should be observed. The "tight building" symptoms should be eliminated within a day or two after adequate outdoor airflows are provided.

4. The "gas" odor is probably due to the proximity of the outdoor air intakes and the sewer stack pipes. Extensions to the sewer pipe

stacks were being installed at the time of this survey.

RECOMMENDATIONS:

1. Thoroughly inspect and clean the inside of all air handlers for this school. This procedure should include the use of a foaming coil cleaner with a thorough rinse. The condensation pans should be thoroughly flushed. The microbial growth sites in these units were the fan blades and condensation pans.

2. Measure the make-up air flow and ensure that at least 15 CFM per person of outdoor air is being provided to each classroom. If 15 CFM per person of outdoor air flow is not possible, contact a Florida Licensed Mechanical Engineer to provide an evaluation on alternative methods to get an adequate outdoor air flow. The exhaust air damper will need to be opened, and the return air damper will need to be partially closed.

3. Upgrade the return air filter to at least a medium removal efficiency filter (50%) and seal the edges around the filter in the return air intake where return air is by-passing the filter.

4. Check the building pressurization to ensure that the buildings are maintained under a slight positive pressure relative to outdoors.

5. The chilled water system should be operated at less than 44°F to ensure that proper dehumidification is being provided by the air handlers. The broken thermometers on the chilled water lines at the air handlers should be replaced.

6. In order to achieve successful resolution of an indoor air quality problem, there are two major aspects that must be addressed. These two aspects are the "engineering solution" for the cause of the problems, and the "people aspect". Often the engineering aspect is much easier to solve than the "people aspect" of the solution. The "people aspect" involves a deconditioning of beliefs that there are problems in the building, and is usually accomplished by keeping the employees informed about the problems, the engineering solutions to be utilized, and the time frames for anticipated resolution of the problem. It is recommended that the "people aspect" of this solution

start promptly, and involve a series of meetings with employees who have expressed a concern. It will be important to point out to the employees that the "building is not sick", just that some routine maintenance activities and minor design changes need to be completed. Dr. Spaul can be available during this meeting to assist you in this effort.

7. The coils and inside of the air handler units should be thoroughly cleaned at least once a year, and more often if needed. The coils should be inspected from both sides of the coils for evidence of discoloration (darker color) or accumulated debris. During the heating phases, this color change will not be as obvious as during the cooling phases, during which time condensation water will be on the coils. A thorough coil cleaning with a non-acidic, foaming coil cleaner (e.g., Trane Alkaline Foam Coil Cleaner or equivalent) should be used, and then followed by a pressure rinse from the filter side through the coil to the condensation pan. The foaming process should continue until the foam is clean and white. A self-rinsing coil solution is acceptable only as a periodic maintenance chemical, but should not be used exclusive of the annual foaming coil cleaner. Be sure to thoroughly rinse the coils and condensation pan at the end of the coil cleaning process and then put the air handler into operation for several hours to flush out any odors before the building occupants return to work.

8. All air handler cleaning procedures should be performed at a time that the building occupants will be away from the building. Be sure to notify and remind the building's occupants prior to the cleaning and request that they keep away from the building during the times of the cleaning. All personnel who are involved in the cleaning should use appropriate personal protection during the cleaning and disinfecting process. Please refer to the manufacturer's MSDS for health and safety information about a particular chemical, and feel free to contact Dr. Spaul if you have any questions regarding the health and safety aspects of the cleaning procedures.

9. The make-up air flow should comply with ASHRAE STD 62-1989 for an office and classroom; i.e., 20 and 15 cfm of outdoor air per person ***continuously*** supplied, respectively. It is recommended that the outdoor air flows to each air handler be measured to ensure

that this minimum flow of outdoor air is continuously supplied. It will be necessary for the air handlers that supply these areas to be measured at least at two of the following: the return air flow; the total air handler output; the outdoor make-up air flow. The purpose of measuring at least two of the above flows is to determine the percentage of supply air that is outdoor air. It is important that this percentage be calculated from actual flow measurements. This percentage is then multiplied by the minimum flow at the register of concern to obtain the cfm of outdoor air flow for that site. If your test and balance firm conducts these measurements have them provide a copy of all raw data and field measurements and a written description of their procedures. It is also recommended that a timed air damper be installed on the make-up air vents to the large air handler units, so that these outdoor air ducts are closed when the zones that are supplied by that air handler are not occupied.

10. After the decontamination process of the air handlers has been completed, a detailed follow-up inspection should be conducted to ensure that these units have been properly decontaminated.

11. In your contract with the mechanical contractor (if you want to use an outside contractor), be sure to include at a minimum the following items. If you do the work in-house, you should also ensure that the following OSHA requirements are also met. If you have any questions about any of these, please call Dr. Spaul.

a) The contractor's employees shall wear at least a half-mask NIOSH approved respirator that is equipped with a combination HEPA filter and charcoal canister during the decontamination process. The contractor shall comply with the OSHA respirator regulations (29 CFR 1910.134).

b) The air handler shall be "locked out of service" during the decontamination, and the contractor shall provide the lock. The contractor should comply with OSHA "lockout regulations" (29 CFR 1910.147).

c) The contractor shall ensure that his employees have been trained on the potential health effects of biological agents that can occur inside an air handler, and on the effects of the chemicals used inside the air handler. The contractor shall comply with the OSHA

Hazard Communication program with respect to training his employees about the hazards to which his employees may be exposed (29 CFR 1910.1200).

d) A copy of the MSDS for each chemical used during the decontamination process shall be supplied to you at least 5 working days prior to use on your property.

e) The air handler units should be put into full and continuous operation for at least six hours prior to people re-entering the space that is supplied by the air handler. This will require that the work be performed between Friday night and Sunday afternoon, or over a holiday period. The outdoor air flow should be wide open during this building flushing period. Be sure to re-set these outdoor dampers.

f) Any damage to the air handler or building that is caused by the contractor shall be repaired by the contractor at his expense.

12. The condensation pans should be frequently (monthly) inspected, washed, and flushed, if necessary. The condensation drain lines should be purged to ensure that the line drains freely. The use of biocidal strips in the condensation pan can be an effective way to minimize microbial growth in the condensation pan. Biocidal tablets are not recommended since they can be corrosive and as they dissolve, they may plug the condensation drain line and result in an overflowed pan.

13. The HVAC worker should remove the panels to the air handlers to provide full access for inspecting and cleaning of each unit. Thoroughness in cleaning the units and sealing the frayed fiberglass areas is extremely important.

14. Only a HEPA filtered vacuum cleaner is recommended for cleaning these air handlers, ducts and un-coated (no foil) fiberglass insulation. Any other type of vacuum cleaner will allow the fiberglass fibers and microorganisms to be discharged into the exhaust air, and breathed by the service worker and building occupants.

15. A licensed mechanical engineer (not mechanical contractor) should conduct an evaluation of the exhaust air flows to ensure that

the building is being properly "flushed", yet at the same time keeping the building under a positive pressure relative to the outdoors.

16. All areas where frayed, torn, or loose fiberglass insulation are observed should be either sealed or replaced. Even small amounts of fiberglass insulation can result in serious and ongoing health-related complaints - until the source is removed.

At your soonest convenience, Dr. Spaul recommends that the meeting with the building occupants be initiated.

It has been a pleasure to have been able to assist you with this project. Please do not hesitate to contact me if you have any questions about this report.

Sincerely,

Wil A. Spaul, President
PhD, MPH, MSCE
Certified Industrial Hygienist

Adjunct Associate Professor of Indoor Air Quality
College of Public Health
University of South Florida - Tampa