

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
DIVISION OF RESPIRATORY DISEASE STUDIES

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Health Services Administration Building
Hyattsville, MD

I. SUMMARY

In October, 1980, the Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health, was requested to lend technical assistance to the Special Studies Branch, Chronic Disease Division, Center for Environmental Health, Centers for Disease Control, to investigate a problem of upper and lower respiratory symptoms and eye irritation in office workers at the Health Services Administration, U.S. Department of Health and Human Services, Hyattsville, Maryland. The survey was conducted on November 10, 11, 12, 1980, and consisted of environmental sampling for various gases, fumes, vapors, particulates and viable organisms; and a medical study consisting of pre- and post-shift spirometry, chest radiograph, and a short questionnaire. All persons who worked on the basement/ground floor of the building (where complaints predominated) and those from other floors of the office building who previously had indicated work-related symptoms to the CDC investigators or who had supplied a sample of serum for anti-fungal antibody titer analysis were invited to participate.

The environmental sampling found levels of carbon monoxide, sulfur dioxide, nitrogen dioxide, formaldehyde and respirable particulates well below the survey criteria. There are no standards to which one could compare airborne fungus concentrations. However, the concentrations of colony-forming units/cubic meter on the basement/ground floor samples were not statistically different from the samples obtained from the other floors.

The humidity on different floors on different days varied greatly with some excess relative humidities and temperatures. Chest radiographs and pulmonary function results produced no clear pattern of disease. Thus the etiology of the symptoms has not been conclusively determined. We recommend, however, that ventilation systems be routinely cleaned, maintained and operated to reduce temperature and relative humidity and the chance of airborne fungal contamination.

II. INTRODUCTION AND BACKGROUND

In October, 1980, the Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health, received a request for technical assistance from the Special Studies Branch, Chronic Disease Division, Center for Environmental Health, Centers for Disease Control to investigate a problem of upper and lower respiratory symptoms in office workers at the Health Services Administration Offices, U.S. Department of Health and Human Services, Hyattsville, Maryland. Complaints of work-related chest tightness, shortness of breath, cough and eye-nose-throat irritation had begun to develop around November, 1979, at a time when many employees moved to offices in the basement/ground floor. These complaints persisted through the summer of 1980 at which time the Special Studies Branch initiated an investigation.

The HSA building is a modern, 10-story office building, typical of the 1970-vintage office buildings that have gone up in the Washington, DC suburbs. It is located on a site with two other office buildings of similar design. The building is owned and operated by a private company and leased by the General Services Administration for use by other government agencies. Since the energy crisis of 1973, the operators of this building have attempted to decrease energy consumption by reducing the circulation of air and the introduction of outside "fresh" air. A ventilation expert hired by the CDC recommended better ventilation to reduce build-up of gases, vapors and humidity, as well as routine maintenance of vents and carpets to minimize fungal growth.

The CDC initiated its investigation with a questionnaire designed to elicit a broad range of symptoms, and some fungus samples were taken from various wet and mildewed surfaces of the building particularly on the ground floor. The questionnaire detected the variety of symptoms noted above and the fungal sampling produced Aspergillus niger. The CDC then asked employees to provide serum for antibody titer to Aspergillus. (The entire CDC protocol and results will be included by the project officer at CDC). In addition to some positive high titers, there were reports of interstitial pneumonias and granulomatous pulmonary disease in some workers. With this background, CDC requested NIOSH to survey employees to detect subclinical pulmonary disease.

III. MATERIALS AND METHODS

A. Environmental

The following gases, vapors, fumes, particulates and viable organisms were measured using area sampling techniques and direct reading instruments: carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), formaldehyde, organic vapors, respirable particles and fungi.

It was decided that ambient air samples be taken in locations (Appendix A) where the most health complaints originated in order to determine if there were unknown toxic chemicals present, or an exceptional number of colony forming units of fungi in the air, as the cause of the health complaints. A majority of the sampling locations were within rooms on the ground/basement and first floors. Also sampling locations (controls) were established on the fifth floor in an area in which no complaints had been received.

On November 10, 1980, a normal workday, a series of instantaneous general area ("grab") samples were taken throughout the day, beginning at 7:30 a.m. on the ground floor and working up to the first and fifth floors, finishing around 5:00 p.m. Grab samples were obtained at each sampling site once in the morning and once in the afternoon allowing for two samples per station per shift. On November 11, 1980, (a holiday, no employees present) sampling began at 10:00 a.m. on the ground floor and progressed to the fifth floor, finishing around 2:30 p.m. with each station being sampled only once. Sampling was conducted on this day -- a day on which the HVAC system supposedly would not be functioning (although it turned out that it was) -- in order to compare to the usual working day. In addition to the grab samples, full shift stationary charcoal tube samples were taken for analysis for organic vapors on both days.

An Ecolyzer* Model 2100 was used to monitor for CO, an Ecolyzer Model 7100 for NO₂, the Interscan Model 1248 for SO₂, a Piezobalance Respirable Aerosol Mass Monitor Model 3500 for respirable particles, and Draeger Detector tubes for formaldehyde. Temperature and relative humidity measurements were obtained with a Bendix battery powered psychrometer.

Thirty charcoal tube samples were obtained for analysis for organic vapors (methylene chloride, perchloroethylene, toluene, benzene and methylethyl ketone) using Dupont Constant Flow Samplers at approximately 50cc/min for 6-8 hours. The primary reason for analysis for these substances was that a print shop utilizing compounds containing these chemicals is located in two rooms on the ground/basement floor. The samples were submitted to the NIOSH laboratory in Cincinnati, Ohio for analysis by gas chromatography and mass spectrometry.

Two Andersen six stage viable samplers were used to collect airborne fungi in the "suspect" and "control" offices. Each site was sampled once per shift on November 10 and 11, 1980. The stages of the samplers were cleaned with Micro Liquid lab cleaner prior to use, and swabbed with 70%

*Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

ethanol during the loading and unloading of the plastic petri dishes containing 45 mls of agar. Duplicate samples were taken for 5 and 20 minute intervals on Rose Bengal Streptomycin (RBS) agar and Sabourad (SAB) agar containing 100 units per milliliter penicillin and 100 milligrams per milliliter streptomycin. Duplicate samples using the two media were collected for comparison of the media with respect to the number of colonies developing. The sampled plates were incubated at 25°C and colonies counted on November 14, 1980 and again on November 17, 1980. For comparison, the number of colony forming units per cubic meter (CFU/M³) was computed as follows: (1)

$$\frac{\text{Total number of colonies from six stages of samples}}{\text{Total sampling time in minutes (1 ACFM)}} = \text{mean number of viable particles per cubic foot of air sampled}$$

$$\frac{\text{Mean number of viable particles}}{\text{ft}^3} \times \frac{35.31 \text{ ft}^3}{\text{M}^3} = \frac{\text{colony forming units}}{\text{M}^3}$$

The ventilation system was not evaluated during this survey because the system had been surveyed by a private contractor in September, 1980. A copy of the report is attached (Appendix B).

B. Medical

The study population included all individuals who worked in offices on the ground/basement floor, and persons from other floors who had stated that they had experienced work-related cough, shortness of breath or chest tightness. This latter information was gathered either on the CDC questionnaire or by a verbal question at the time when blood was drawn for serology. Thus, the sample was not random nor representative of the 1500+ employees of the HSA. In total 146 people were sent letters asking their participation in the study. No controls were selected at this time; the two federal office buildings with similar structural design located next to the study site were earmarked for future control sites, if necessary. The participating employees were studied on the first day back to work after at least one day off work. The study took place during the week of November 10, 1980, during which Tuesday was a holiday. Thus half the people were studied on Monday (after the full weekend off) and half on Wednesday (after Tuesday off). Employees from the same office area were alternately assigned to Monday or Wednesday, to avoid a potential bias relating to the day of examination.

There are no established standards for exposure to airborne fungi to which our findings could be compared. Thus we made internal comparisons between the areas with suspected high prevalences of symptoms (rooms in the basement/ground floors) and other floors. The five minute colony samples were used for comparison only if the counts in the 20 minute samples were excessive, e.g., greater than 300 colonies on any given plate. Otherwise the 20 minute samples were used to compare the different areas. Comparison was performed by the two-tailed t-test (assuming equality of variances) with the degrees of freedom being two less than the total number of samples taken. Rejection of the null hypothesis that the mean numbers of colony forming units/M³ in the "suspect" and comparison areas are equal occurred at the .05 level.

B. Medical

Pulmonary Function Tests - For each set of five forced expiratory maneuvers, spirometry results were deemed unsatisfactory if the two largest values of Forced Vital Capacity (FVC) were not within 5% of each other. In technically satisfactory procedures, the largest FVC and Forced Expiratory Volume in the first second (FEV₁) were used to calculate the appropriate ratios for obstruction and restriction, and for calculating over-shift changes in pulmonary function.

Obstruction - based upon the pre-shift spirometry values, a person was deemed obstructed if his or her FEV₁/FVC ratio was $\leq 69\%$.

Restriction - based upon pre-shift spirometry values, a person was deemed restricted if his or her FVC/FVC-predicted ratio was $< 80\%$. The predicted values used in this comparison are those of Knudson *et al.* (5) For blacks the FVC was decreased by 10% before comparison to the predicted value due to black-white anthropomorphic differences. (6, 7, 8, 9)

Over-shift-decrement in FEV₁ - A person was deemed to have a biologically-significant decrement in FEV₁ if the decrement was $\geq 10\%$.

Radiographs - the chest radiographs were read clinically by a radiologist consultant at West Virginia University Hospital. Although the radiologist made note of any abnormality he detected, for the purposes of this study only infiltrates and granulomas will be reported.

V. RESULTS AND DISCUSSIONS

A. Environmental

As illustrated in Tables 1 and 2, several direct reading measurements for CO, SO₂, NO₂, formaldehyde, and respirable particles were obtained at various locations throughout the work area. There were no detectable concentrations observed for NO₂, SO₂ and formaldehyde. The minimal

readable levels for these substances utilizing the instruments previously described were 0.01 parts per million (PPM), 0.1 ppm, and 0.5 ppm respectively.

The results for CO varied from less than 1 ppm to 6 ppm which is less than 20 percent of the NIOSH recommended environmental criteria of 35 ppm (10) of CO as an occupational exposure. The levels of CO found in the working areas were also less than the criteria of 9 ppm (11) for the outside ambient air as established by the Environmental Protection Agency. It was an observation of the surveyor that the levels of CO appeared to be proportional to the amount of cigarette smoke present at the various sampling sites and times.

Respirable particles measurements were all less than 0.2 milligrams of particulate material per cubic meter of air (mg/M^3) and typically ranged from $<.01$ to $0.15 \text{ mg}/\text{M}^3$. These levels are much less than the occupational exposure criteria of $5 \text{ mg}/\text{M}^3$ for respirable (nuisance) particulates.

Long term charcoal tube samples for organic vapors were obtained at the locations listed in Tables 1 and 2 except for the outside area. All results were below the lower limit of quantitation which ranged from 0.1 mg/sample for toluene and benzene to 0.6 mg/sample for methylethyl ketone.

An extremely wide range of relative humidity and temperature measurements were recorded in the areas surveyed. On November 10th, a normal workday, the measurements ranged from 30% - 100% relative humidity and the dry-bulb temperature ranged from 68°F - 83°F . On November 11, a holiday and a time when the HVAC system was supposedly shut off, the range of dry-bulb temperature readings was 63°F - 80°F with humidity measurements ranging from 5% - 41% except for rooms G31, G37, B59 and B67 which had readings of 95-100%. Studies have shown that when relative humidities of 60% and dry-bulb temperatures of 65°F are reached, employees begin experiencing discomfort. (12)

Table 3, Results of Airborne Sampling (Viable Organisms) indicates the total number of colony forming units for each sampling site. The efficiency of the two media, RBS and SAB, were compared with respect to the number of colonies collected on each media. It was determined that the SAB agar did not collect the fungi as efficiently as the RBS agar ($\alpha = 0.05$, $p < .025$). Also it was determined that the numbers of fungi collected during the 5 minute sampling time did not fall into the optimum range for counting (30-300 colonies/plate). However, we believe that the 5 minute sampling time should be used whenever high colony counts are expected.

Therefore, based upon the combined results of the 20 minute samples on both days, collected on RBS, it was found that the mean CFU/M^3 on the basement/ground floor was not statistically significantly different from the mean CFU/M^3 on the other floors ($t = 1.18$; $d.f. = 15$, $\alpha = .05$, $p = .20$).

The predominant genera observed were Alternaria, Aspergillus, Cladosporium, Epicoccum, and Penicillium. Other less frequently observed genera included Aureobasidium, Cephalosporium, Fusarium, Ostracoderma, Paecilomyces and Scopulariopsis as well as a few colonies that could not be identified because of lack of sporulation. No attempt was made to quantify individual genera as this would require isolation and microscopic study of hundreds of isolates.

B. Medical Results

Basic demographic information is shown in Table 4. The participation rate was 111/146 = 75%. The participation rate for the basement/ground floor was 71%. Both rates were lower than expected given the interest in the problem and the high probability for self-selection.

One question was asked regarding symptoms: "Have you developed chest tightness since the beginning of the shift?" Nineteen/108 (18%) of the participants responded affirmatively, which is not unexpected given the selection of the group. For the basement/ground floor workers only 14/84 (17%) responded affirmatively. 11 of the 14 were smokers. There was no significant difference in the chest tightness rate between smokers and non-smokers on this floor.

The radiographic findings are found in Table 5. The percentage of individuals with granulomas was 3/99 (3.3%) and infiltrates 1/99 (1%).

The pulmonary function results are shown in Table 6. Only 2/102 (2%) had evidence of restriction, 6/102 (6%) evidence of obstruction and 1/102 (1%) showed a decrement in FEV₁ over the shift of $\geq 10\%$. This particular person stated she had worked "all over" the building, and only a small fraction of her exposure could be ascribed to the basement/ground floor.

The mean of the over-the-shift change in FEV₁ in the 19 persons who stated that they had developed chest tightness since the beginning of the shift was compared to the mean for all other employees. Those with this symptom had a mean (+ standard deviation) decrement of 1.4% + 3.3%, and those without this symptom had a decrement of 1.2% + 7.1%. These values were not statistically significant (t = 0.1, d.f. = 105).

C. Medical Discussion

The initial complaints of the office workers ranged from eye irritation to headache to chest tightness related to work. There was also a report of granulomatous disease in at least one worker. Thus it was unclear whether the workers were affected by agents causing direct irritation, type 1 (atopic) hypersensitivity responses or Type III hypersensitivity responses. The latter, hypersensitivity pneumonitis, in its full-blown form, is a well-documented disease in pigeon breeders, farmers and mushroom workers. (13) Classically it presents as malaise, cough, fever

Prior to the study the participants were sent a letter instructing them not to smoke within one hour before arriving at work, and to report directly to the study site before going to their office. When they arrived at the study site, they were asked if they had smoked in the past hour and if they had yet been to their office. They were also asked if they had worked the previous day. In addition, we asked for basic demographic information (Appendix C).

Pre-shift spirometry was done on each participant, using Ohio 840 waterless spirometer, attached to an oscilloscope for instantaneous check on the quality of flow-volume curves. Each person performed at least five maximum expiratory maneuvers to the satisfaction of the technicians. The maneuvers were recorded on tape and edited and analyzed in the laboratory in Morgantown. Each subject was asked to obtain a chest x-ray at the NIOSH mobile trailer adjacent to the office building. PA and lateral chest films were taken on all individuals who consented to the x-ray examinations.

The workers were then re-examined approximately six hours after they had conducted their usual business at work. At that time they were asked questions about their work day (Appendix C) and were asked to perform five forced spirometry maneuvers.

IV. EVALUATION CRITERIA

A. Environmental

The primary sources of environmental evaluation criteria considered in this report are: a) NIOSH Criteria Documents with recommended standards for occupational exposure; b) American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's) with supporting documentation; and c) Federal Occupational Health Standards as promulgated by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor (29 CFR 1910.1000).

Occupational health exposure limits for individual substances are generally established at levels that can be tolerated by a worker occupationally exposed during an 8 or 10 hour workday, 40 hour workweek without adverse effects.

For the primary substances monitored during this study, the environmental criteria are listed below:

Table of Environmental Criteria

<u>Substance</u>	<u>NIOSH (2)</u>	<u>Exposure Level</u>	
		<u>ACGIH (3)</u>	<u>OSHA (4)</u>
Carbon Monoxide	35ppm	50ppm	50ppm
Nitrogen Dioxide	1ppm*	5ppm*	5ppm
Sulfur Dioxide	0.5ppm	2ppm	5ppm
Formaldehyde	1ppm*	2ppm*	3ppm 10ppm*
Respirable particles	--	5mg/M ³	5mg/M ³
Fungi	No established criteria		
Benzene	1ppm*	10ppm	10ppm 50ppm*
Toluene	100ppm 200ppm*	100ppm 150ppm*	200ppm 500ppm*
Methylene chloride	75ppm 500ppm*	200ppm	500ppm 2000ppm*
Perchloroethylene	50ppm 100ppm*	100ppm	100ppm 300ppm*
Methyl ethyl ketone	200ppm	200ppm	200ppm

ppm - Parts per million
 mg/M³ - Milligrams per cubic meter
 * - Maximum Ceiling Limit

and leukocytosis 4-6 hours (or even later) after exposure to the offending agent. In the last decade there have been reports of this disease in offices with poor ventilation or poorly-maintained equipment. (14, 15, 16) In one report, Banaszak et al (14) suggest that there may be more insidious forms of this syndrome which would be difficult to detect on a survey, and suggest that persons with any respiratory complaints associated with their work environment (excluding obvious causes) may be exhibiting milder forms of the syndrome.

The medical data were very equivocal. Subjectively there was a rather large percentage of individuals who noted chest tightness developing over the shift. It is difficult to interpret what this proportion means, especially in light of the lack of a statistical difference in the decrements in FEV_1 in the symptomatic and non-symptomatic groups of workers. In the basement/ground floor roughly the same percentage had the same symptom. Even though all workers on the ground/basement floor were requested to participate, only 71% did. We do not know whether the non-participants were primarily those who had mentioned symptoms on the previous CDC questionnaire or whether they were primarily non-symptomatic people. Had all ground floor employees participated without an increase in people experiencing chest tightness then the proportion would have been 12%, still a rather large figure.

Similarly, the dichotomized pulmonary function data and x-ray findings were so equivocal as to be essentially random; positive findings were so few that no patterns could be detected.

That there was no difference in the colony-forming unit/ M^3 count between the ground/basement floor and other floors also makes it difficult to conclude that airborne fungi were responsible for the symptoms. The number of samples we used to apply the t-test ($n=17$) was sufficient enough for us to detect a difference of 100 CFU/ M^3 with a power of 80%, setting our α level at .05. In truth we do not know whether a difference of 100 is what we wish to detect. Prior experience by NIOSH investigators in the Laboratory Investigations Branch, DRDS, has shown that presumably "clean" buildings will provide colony counts around 50-100 CFU/ M^3 . "Clean" buildings include the NIOSH laboratory and a control building for a previous Health Hazard Evaluation. In this previous Health Hazard Evaluation the "study" office (in which three employees were ill, possibly with hypersensitivity pneumonitis), the fungal growth approached 10,000 CFU/ M^3 . Thus, it may be that levels of contamination at this magnitude are needed before one can expect hypersensitivity disease. Thus, our lack of statistically significant difference in the study may also suggest a lack of a biologically significant difference.

Prior to this study there had been noted a large amount of water condensation on false ceilings and in the carpeting of some offices. Much of this problem had been ameliorated by the repair of ventilation drain lines and use of portable dehumidifiers. We could speculate that perhaps prior to these modifications airborne fungi counts could have reached much higher levels.

VI. CONCLUSION AND RECOMMENDATIONS

This health evaluation confirmed the high level of symptoms just reported by the CDC investigation, but failed to detect any substantiating objective pulmonary signs or any possibly etiology. The only objective measurement which could point to a cause for discomfort in the office workers is the high relative humidity in certain areas of the building.

Therefore we recommended only that the ventilation systems be properly maintained so as to discourage possible growth of fungi and other microorganisms and provide a comfortable work environment based on the latest guidelines by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (12)

VII. ACKNOWLEDGEMENTS

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VIII. REFERENCES

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TABLE I
RESULTS OF AIRBORNE SAMPLING
HEALTH RESOURCES ADMINISTRATION CENTER BUILDING
HYATTSVILLE, MARYLAND

November 10, 1980

Location (Room) (Appendix A)	Time of Sampling	Respirable Particles (mg/m ³) (1) (MDL(2) = .01mg/m ³)	Carbon Monoxide (PPM) (3) (MDL=1PPM)	Nitrogen Dioxide (PPM) (MDL=.01PPM)	Sulfur Dioxide (PPM) (MDL=0.1PPM)	Formaldehyde (PPM) (MDL=0.5PPM)	WB (4) (°F)	DB (5) (°F)	RH (6) (%)
G 15/17 Point A	7:30AM	.03	2	ND (7)	ND	ND	59	77	35
	1:00PM	.10	2	ND	ND	ND	58	78	30
G 15/17 Point B	7:40AM	.03	3	ND	ND	ND	59	77	35
	1:35PM	.04	2	ND	ND	ND	58	78	30
G 15/17 Point C	7:55AM	.03	3	ND	ND	ND	59	77	35
	2:00PM	.04	1	ND	ND	ND	69	79	60
G20	8:10AM	.10	4	ND	ND	ND	56	69	41
	3:50PM	.07	1	ND	ND	ND	68	73	75
G23	8:20AM	.03	6	ND	ND	ND	57	73	35
	2:35PM	.07	1	ND	ND	ND	68	74	70
31	8:30AM	.01	5	ND	ND	ND	57	73	35
	2:50PM	.03	1	ND	ND	ND	73	75	90
G37	8:40AM	.12	5	ND	ND	ND	59	76	36
	3:00PM	.04	ND	ND	ND	ND	77	78	95
B59	9:50AM	.11	4	ND	ND	ND	65	75	60
	3:15PM	.04	ND	ND	ND	ND	56	76	30
B67	9:00AM	.15	5	ND	ND	ND	67	68	95
	3:25PM	.07	1	ND	ND	ND	57	75	33

TABLE 2
RESULTS OF AIRBORNE SAMPLING
HEALTH RESOURCES ADMINISTRATION CENTER BUILDING
HYATTSVILLE, MARYLAND

November 11, 1980

Location (Room) (Appendix A)	Time of Sampling	Respirable Particles (mg/m ³) (1) (MDL (2)=.01mg/m ³)	Carbon Monoxide (PPM) (3) (MDL=1PPM)	Nitrogen Dioxide (PPM) (MDL=.01PPM)	Sulfur Dioxide (PPM) (MDL=0.1PPM)	Formaldehyde (PPM) (MDL=0.5PPM)	WB (4) (°F)	DB (5) (°F)	RH (6) (%)
G15/17 Point A	10:05AM	.01	ND	ND(7)	ND	ND	51	73	20
G15/17 Point B	10:20AM	.01	ND	ND	ND	ND	52	73	20
G15/17 Point C	10:25AM	.01	ND	ND	ND	ND	53	74	20
G20	10:35AM	.01	ND	ND	ND	ND	41	63	5
G23	10:45AM	.01	ND	ND	ND	ND	61	75	41
G31	11:45AM	.01	ND	ND	ND	ND	74	75	95
G37	11:55AM	.01	ND	ND	ND	ND	76	77	95
B59	12:10PM	.01	ND	ND	ND	ND	75	76	95
B67	12:20PM	.01	ND	ND	ND	ND	74	74	100
B66	1:34PM	.01	ND	ND	ND	ND	54	77	20
1-43	1:55PM	.01	ND	ND	ND	ND	57	60	20
1-57	2:00PM	.01	ND	ND	ND	ND	57	80	20
1-39	2:10PM	.01	ND	ND	ND	ND	54	78	18

TABLE 2 (Continued)

5-30	2:20PM	.01	ND	ND	ND	ND	52	68	30
Outside (Ground Level)	2:15PM	.04	ND	ND	ND	ND	37	47	30

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- (1) mg/m³ - milligrams per cubic meter
 - (2) MDL - Minimum Detectable Level
 - (3) PPM - Parts Per Million
 - (4) WB - Wet Bulb
 - (5) DB - Dry Bulb
 - (6) RH - Relative Humidity
 - (7) ND - None Detected

TABLE 3
 RESULTS OF AIRBORNE SAMPLING
 (VIABLE ORGANISMS - FUNGI)
 HEALTH RESOURCES ADMINISTRATION CENTER BUILDING
 HYATTSVILLE, MARYLAND

November 10 and 11, 1980

Location (Room) (Appendix A)	Agar	Monday		Tuesday	
		5 min ⁽¹⁾ (CFU/M ³) (2)	20 min (CFU/M ³)	5 min (CFU/M ³)	20 min (CFU/M ³)
B66	SAB ⁽³⁾	120	56	56	70
	RBS ⁽⁴⁾	63	61	49	85
G40	SAB	459	218	Room locked - unable to sample	
	RBS	324	268		
G23	SAB	219	151	204	120
	RBS	176	198	162	116
G37	SAB	No sample	127	148	98
	RBS	120	187	146	139
G 15/17 Point B	SAB	233	95	190	129
	RBS	225	218	148	116
G 15/17 Point A	SAB	No sample	115	169	113
	RBS	No sample	123	92	120
G20	SAB	226	178	162	146
	RBS	522	223	169	134
5-30	SAB	7	88	106	85
	RBS	85	64	92	85
5-50	SAB	85	99	254	208
	RBS	120	131	282	176

(1) Min - minutes

(2) CFU/M³ - Colony Forming Units per cubic meter

(3) SAB - Sabourad Agar

(4) RBS - Rose Bengal Streptomycin Agar

TABLE 4

BASIC INFORMATION ON WORKERS STUDIED AT
HRA BUILDING, HYATTSVILLE, MD, 1980

ASKED TO PARTICIPATE	=	146	
ACTUAL PARTICIPANTS	=	110	76%
NUMBER OF GROUND/BASEMENT FLOOR EMPLOYEES	=	118	
NUMBER OF PARTICIPANTS	=	84	(71%)

SEX

FEMALES	64/110	=	58%
MALES	47/110	=	42%

RACE

BLACK	27/110	=	24%
OTHERS	84/110	=	76%

SMOKING STATUS

SMOKED ON DATE OF STUDY	37/110	=	34%
DID NOT SMOKE	72/110	=	65%
UNKNOWN	2/110	=	1%

TABLE 5

RADIOGRAPHIC FINDINGS IN HEALTH RESOURCES ADMINISTRATION
OFFICE WORKERS, HYATTSVILLE, 1980

PERCENT OF RESPONDENTS X-RAYED	99/110	=	90%
PERCENT WITH ABNORMAL FILMS	15/99	=	15%
PERCENT GRANULOMAS	3/99	=	3.0%
PERCENT INFILTRATES	1/99	=	1.0%

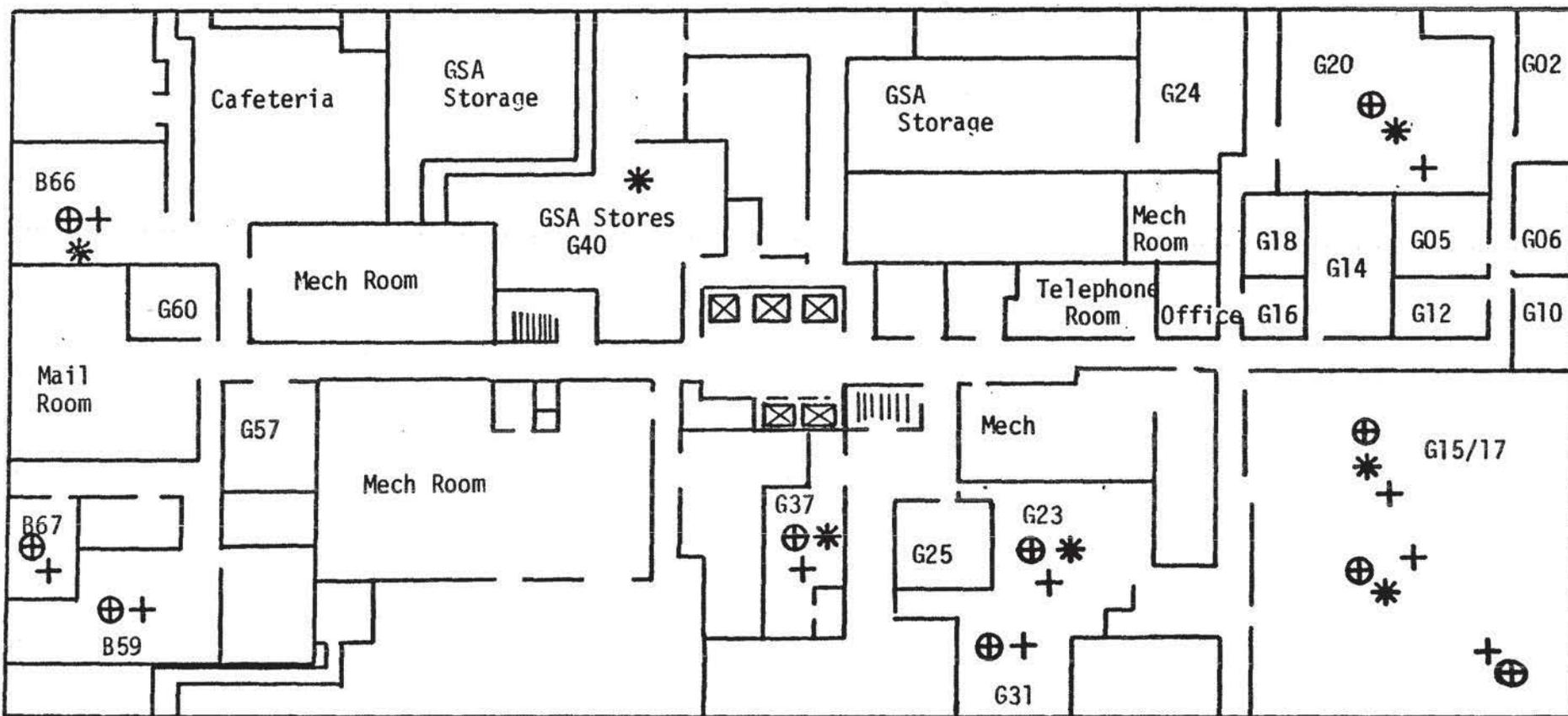
TABLE 6

PULMONARY FUNCTION FINDINGS IN
HEALTH RESOURCES ADMINISTRATION OFFICE WORKERS
HYATTSVILLE, MD, 1980

PERCENT OF PARTICIPANTS WITH TECHNICALLY SATISFACTORY PRE- AND POST-SHIFT PFTs	102/111 = 91.9%
PERCENT RESTRICTED (BASED ON PRE-SHIFT FVC/FVC-PREDICTED < 80%	2/102 = 2.0%
PERCENT OBSTRUCTED (BASED ON BEFORE SHIFT FEV ₁ /FVC ≤ 69%	6/102 = 5.9%
PERCENT WITH OVER-SHIFT DECREMENT IN FEV ₁ ≥10%	1/102 = 1.0%

APPENDIX A

Sampling Locations
 Health Resources Administration Center Building
 Hyattsville, Maryland
 November 10 and 11, 1980



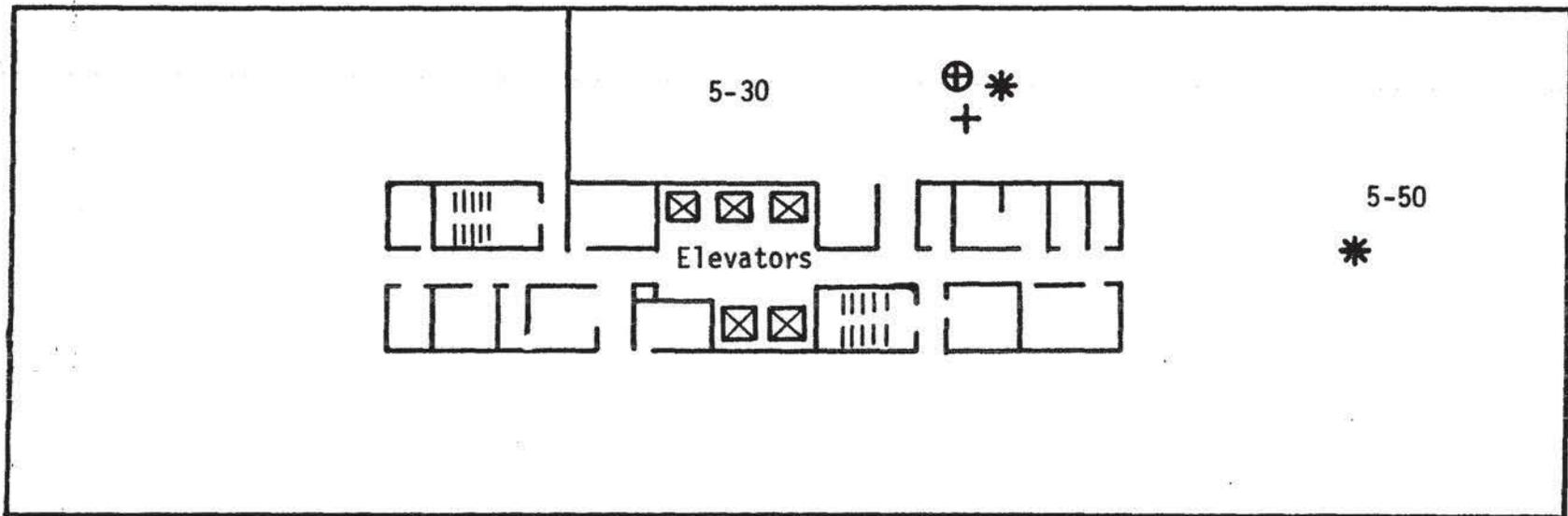
Ground Floor

SYMBOLS:

- ⊕ - Instantaneous (grab) sampling site
- + - Full shift charcoal tube sampling sites
- * - Fungi sampling sites



APPENDIX A



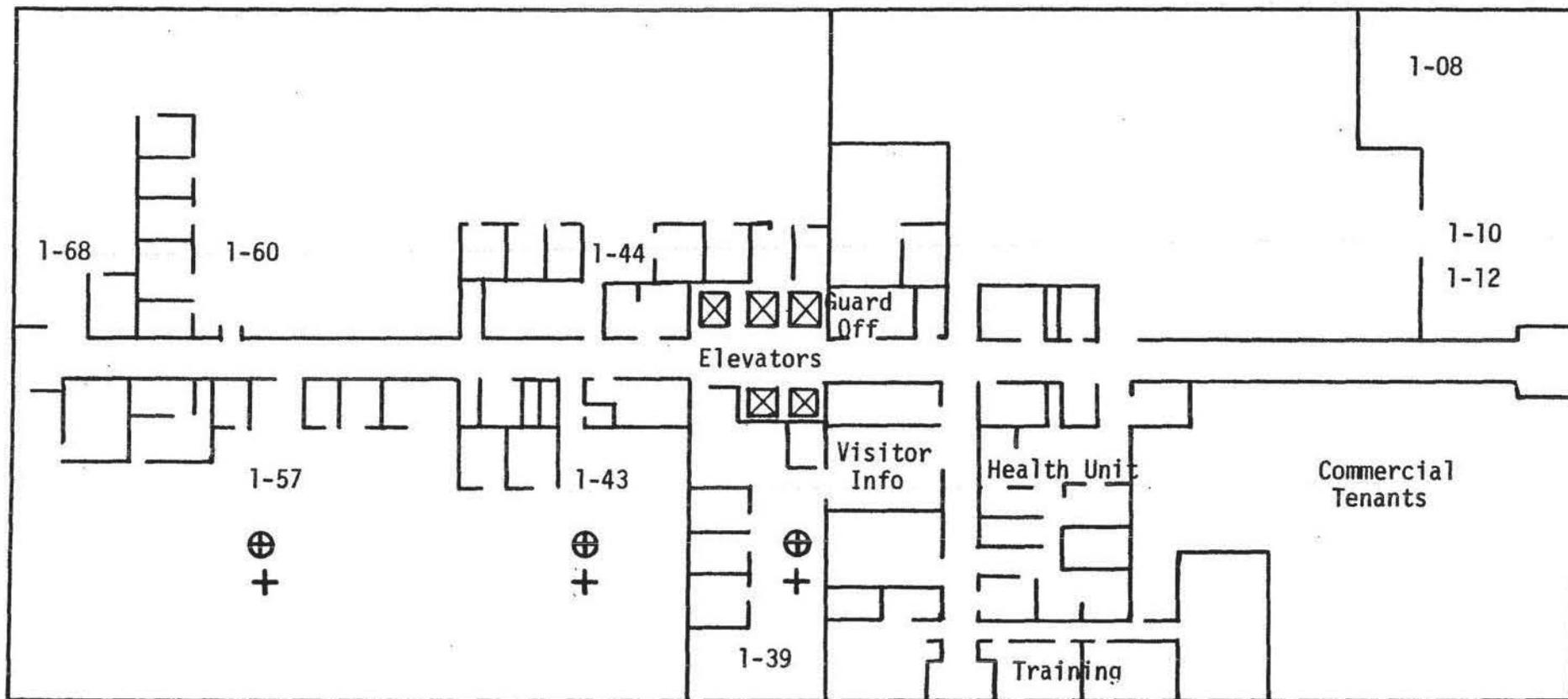
SYMBOLS:

Fifth Floor

- ⊕ - Instantaneous (grab) sampling sites
- + - Full shift charcoal tube sampling sites
- * - Fungi sampling sites



APPENDIX A



First Floor

SYMBOLS:

- ⊕ - Instantaneous (grab) sampling sites
- + - Full shift charcoal tube sampling sites





October 31, 1980

Dr. Alex Kelter, M.D.
Special Studies Branch
Chronic Diseases Division
EPI
CDC
Atlanta, Georgia 30333

Dear Alex:

I visited the Center Building (HRA), the Presidential Building, and the Agricultural Building, (all in the same complex), on October 28, 29, 1980, and made comparative studies on October 30, 1980, to determine similarities and differences in the Heating Ventilating Air Conditioning (HVAC) systems in each building. I also took additional swab samples at the Center Building in the same locations as I had taken them previously plus a few extra locations. These samples will be mailed to you by HRA people on October 29, 1980, so you can use them as you deem appropriate.

Briefly, the air conditioning systems in all of the above mentioned buildings will be described to indicate the variances. The description for each building is as follows:

A) Center Building (HRA - Federal Building #2)
The HVAC systems for this building are comprised of center core air handling units with only one coil which is furnished either with chilled water or hot water depending on desired room conditions. (two pipe system) Chilled water is furnished by slow recovery absorption chillers. The air supply system is through sheet metal ducts to terminal ceiling grilles or diffusers. Return air is taken from various spaces back through ceiling grilles, and the entire ceiling acts as a return plenum. The perimeter of the building has fan coil units under the windows. These units only have one common coil for chilled or hot water. There are a few scattered heat pumps in various locations. The HVAC system as a whole with its problems are described in detail in my previous report to Dr. Falk.

Dr. Alex Kelter, M.D.

October 31, 1980

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B) Presidential Building

The HVAC systems for this building are comprised of central core air handling units. Cooling is achieved by utilizing evaporator coils (cooling coils) in these units and supplying refrigerant directly to those coils from a condensing unit. Heating is accomplished by an electric coil in the unit. No circulating hot water or chilled water is used to effect cooling or heating. The air supply system is through sheet metal ducts to terminal ceiling grilles or diffusers. Return air is taken from various spaces back through the same supply diffuser, and the entire ceiling acts as a return plenum.

The perimeter of the building utilizes heat pumps, i.e., each under window unit has its own self-contained refrigerant cycle (compressor, condenser and evaporator). Heating is accomplished by reversing the cooling cycle internally in the unit. From the second floor down, heat pumps supply all the air to and from all the areas.

C) Agricultural Building (Federal Building #1)

The HVAC systems for this building are comprised of central core air handling units with a separate heating and cooling coil (four pipe system). Chilled water is supplied to the cooling coil, and hot water is supplied to the heating coil depending upon room requirements. Chilled water is furnished by electrically operated centrifugal chillers with a rapid recovery rate. The air supply system is through sheet metal ducts into pressurized ceiling plenums. These pressurized ceilings have lighting troffers (lights with slots on the perimeter) which distribute the air to the room areas. The corridors have wall mounted return air grilles, and each office has a door grille so that air is returned to the air handling units through the door grilles into the corridors and then back to the central units. The perimeter of the building utilizes fan coil units similar to the units in the Center Building.

Differences or similarities in the HVAC systems for each building may be summarized as follows using Building "A" as the base system:

"A" Building

1. Slow acting absorption chiller.
2. Central core air handling units with one coil for utilizing either hot or chilled water.
3. Perimeter fan coil units with one coil using either hot or chilled water.

4. Ducted supply air system to ceiling diffuses in various areas.
5. Ceiling plenum return air system from areas.
6. Very few heat pumps.
7. Steam Boilers to operate absorption chillers.
8. Steam Boilers furnish steam to heat exchangers to provide hot water for heating building.

"B" Building (system compared item for item as in numbered sequence for "A" Building)

1. No chiller at all but separate compressors that furnish refrigerant directly to cooling coil. Coil will therefore operate at proper temperature while system is running. In "A" Building, chilled water temperature can be raised causing loss of humidity control. Loss of humidity control occurs in this system also, but entire unit must be shut off to do so.
2. Central core air handling units but with electric heat and direct expansion (direct refrigerant) cooling in an evaporator coil.
3. Perimeter heat pump units using their own self-contained refrigerant cycle for heating or cooling.
4. Ducted supply air system similar to the "A" Building.
5. Ceiling return air plenums similar to "A" Building except air is returned through special diffusers that also supply the air to the areas.
6. Many heat pumps throughout building.
7. No Steam Boiler for operation of absorption chillers as there are no chillers.
8. No heat exchangers as heat is either electric or from reverse cycle heat pumps.

"C" Building (system compared item for item as in numbered sequence for "A" Building)

1. Electrically operated centrifugal chillers with rapid recovery after shut down.
2. Central core air handling units but with a separate chilled water and hot water coil; not just one common coil as in "A" Building.
3. Perimeter fan coil units similar to "A" Building.
4. Ducted supply air directly from above the ceiling area through slots in lighting troffers.
5. Return air is returned through door grilles into corridors then into central wall return grilles in the corridors back to the air handling units.

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October 31, 1980
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6. Very few heat pumps.
7. Steam Boiler but no requirement to furnish steam to centrifugal chillers as chillers are electrically operated.
8. Heat exchangers to furnish hot water to central core air handling units and perimeter fan coil units.

The important features that could alter direct controlled comparisons are as follows relative to Building "A":

Building "B" - Items 1, 2 & 3.

Building "C" - Items 1, 2, 3 & 4.

The apparent common methodology is basically the same for each building in that all HVAC systems are shut down in the late afternoon and placed in operation in the early morning. All are shut down on weekends and holidays. The outside air make-up to the large air handling units for all buildings are at a very minimum setting of 10% or less. Although the three buildings have rather dissimilar HVAC systems, it is recommended that Building "C" (Agricultural Building) be considered for a control. I believe this building will provide a reasonable comparison assuming people in this building are not experiencing symptoms of a comparable nature to the Center (HRA) Building.

I know several people in GSA, and they are going to contact me on other buildings which could be used as controls.

The entire HVAC operation in all buildings is rather chaotic as a direct result of U. S. Government energy policies for conserving energy and also monetary savings with little or no regard for overall human well being. Irrespective of ideas for providing sliding doors to reduce untreated outdoor air from entering the building (or buildings), small portable dehumidifiers, additional heating methods, etc., the underlying problems of air pollution, high humidities and fungal growth in the building (or buildings) will not be alleviated or improved until direct and specific action is taken to revise the rigid energy requirements as set forth by U. S. Governmental regulations. There is a great potential for both short and long term human discomfort and human health hazards.

Sincerely,

W. Rhodes
Wallace W. Rhodes, Jr., Ph.D., P.E.

WWR, Jr.:ks

Attachment

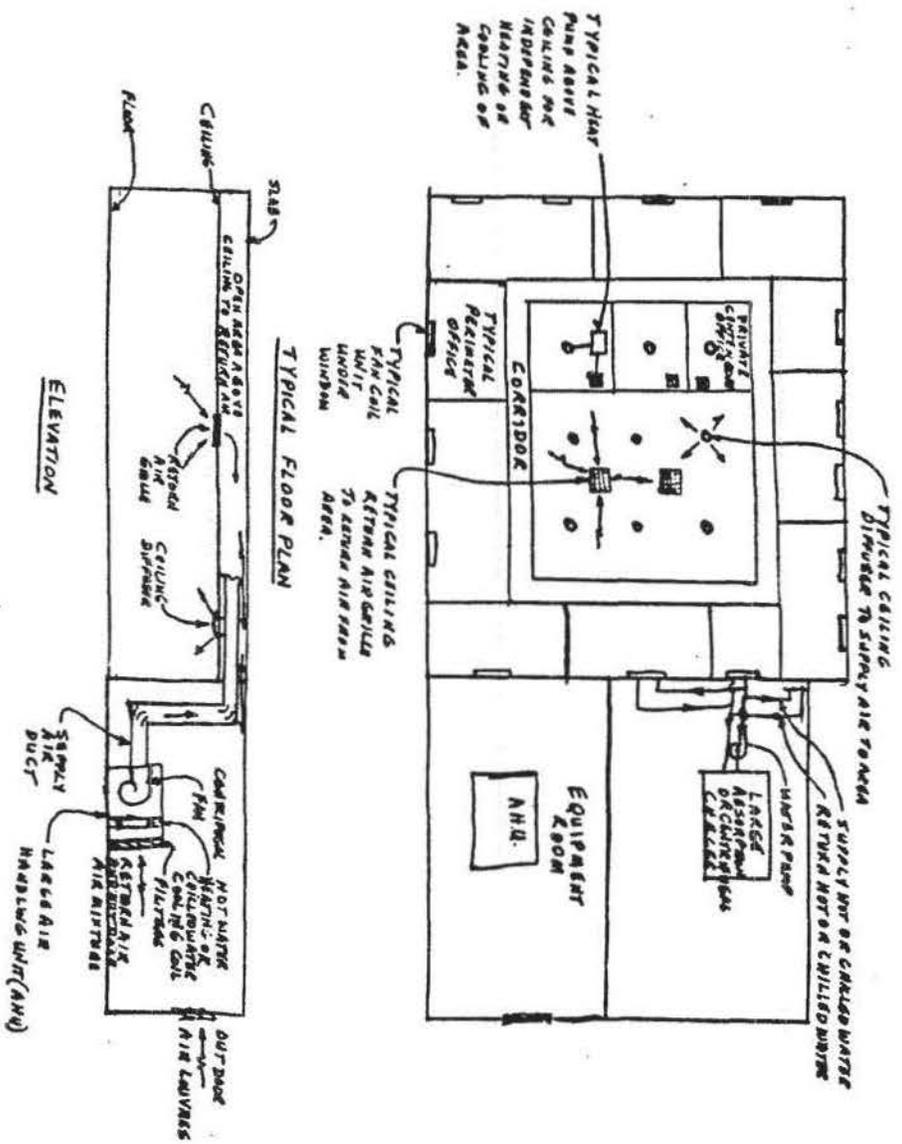
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Attachment

Buildings in Washington, D. C. that have similar HVAC systems as compared to the Center (HRA) Building in Hyattsville, Maryland. Mr. Leonard Carter, Engineering Foreman, in charge of HVAC systems for the Forrestal Field Office GSA (telephone (202) 755-3308) called me on October 31, 1980 at 3:00 p.m. and indicated that two GSA operated buildings would be applicable for a comparative study. The two buildings are as follows:

1) Department of Transportation, Federal Aviation Administration, 800 Independence Avenue, Washington, D.C. is a 10 story building that has a central core air handling system, perimeter fan coil units and centrifugal chillers;

2) N.A.S.A. Building, 600 Independence Avenue, Washington, D.C., is a 6 story building and the HVAC is similar to the building as described above.

For coordinations, contact Mr. John Conners, Building Manager, General Services Administration at (202) 755-9768.



TYPICAL
HVAC SYSTEM
FOR HRA BLDG.
& SIMILAR BLDGS.

WWRhodes
11/2/80

APPENDIX C

DATE OF INTERVIEW: - -
 MO DAY YR

A. SUBJECT IDENTIFICATION

LAST NAME:
 FIRST NAME: MIDDLE INITIAL:
 ADDRESS:
 CITY:
 STATE: ZIP CODE:

PERSONAL DATA

1. TELEPHONE: - -
 Area code
2. RACE/ETHNIC CODE:

1.	American Indian or Alaskan Native
2.	Asian or Pacific Islander
3.	Black, not of Hispanic Origin
4.	Hispanic
5.	White, not of Hispanic Origin
6.	Other

 3. Height
 cm. (without heels)
 Weight
 kg
4. SEX: 1. Male 2. Female
5. What is your date of birth? (month/day/year) - - Age
 years
6. What is the last grade of school you completed? (State number of years 01 - 19)
 ELEMENTARY = 01 - 08 SECONDARY = 09 - 12 COLLEGE = 13 (1 year)
 14 (2 years)
 15 (3 years)
 16 (4 years)
 17 (5 years)
 18 (6 years)
 19 (7 or more years)

7. Under federal law, people participating in our surveys DO NOT have to tell us their social security number. However it is very useful and helps us to follow-up studies. May I have your social security number?

REFUSAL: 2 NOT AVAILABLE
 SOCIAL SECURITY NUMBER:

NAME _____
Last First

ID NUMBER _____

PRE-SHIFT QUESTIONNAIRE

1. Have you smoked within the past hour? Yes
 No
2. Have you been to your area of work today? Yes
 No
3. Did you work yesterday? Yes
 No

POST-SHIFT QUESTIONNAIRE

1. How many cigarettes did you smoke during the shift today?
2. Have you smoked within the past hour? Yes
 No
3. Did you wear a respirator during the shift? Yes
 No
4. Have you used any lung medications or inhalers today? Yes
 No
5. Have you developed chest tightness since the beginning of this shift? Yes
 No
6. Did you work your regular job today?
(if NO, ask question 7) Yes
 No
7. Where did you work today and what percentage of time?
