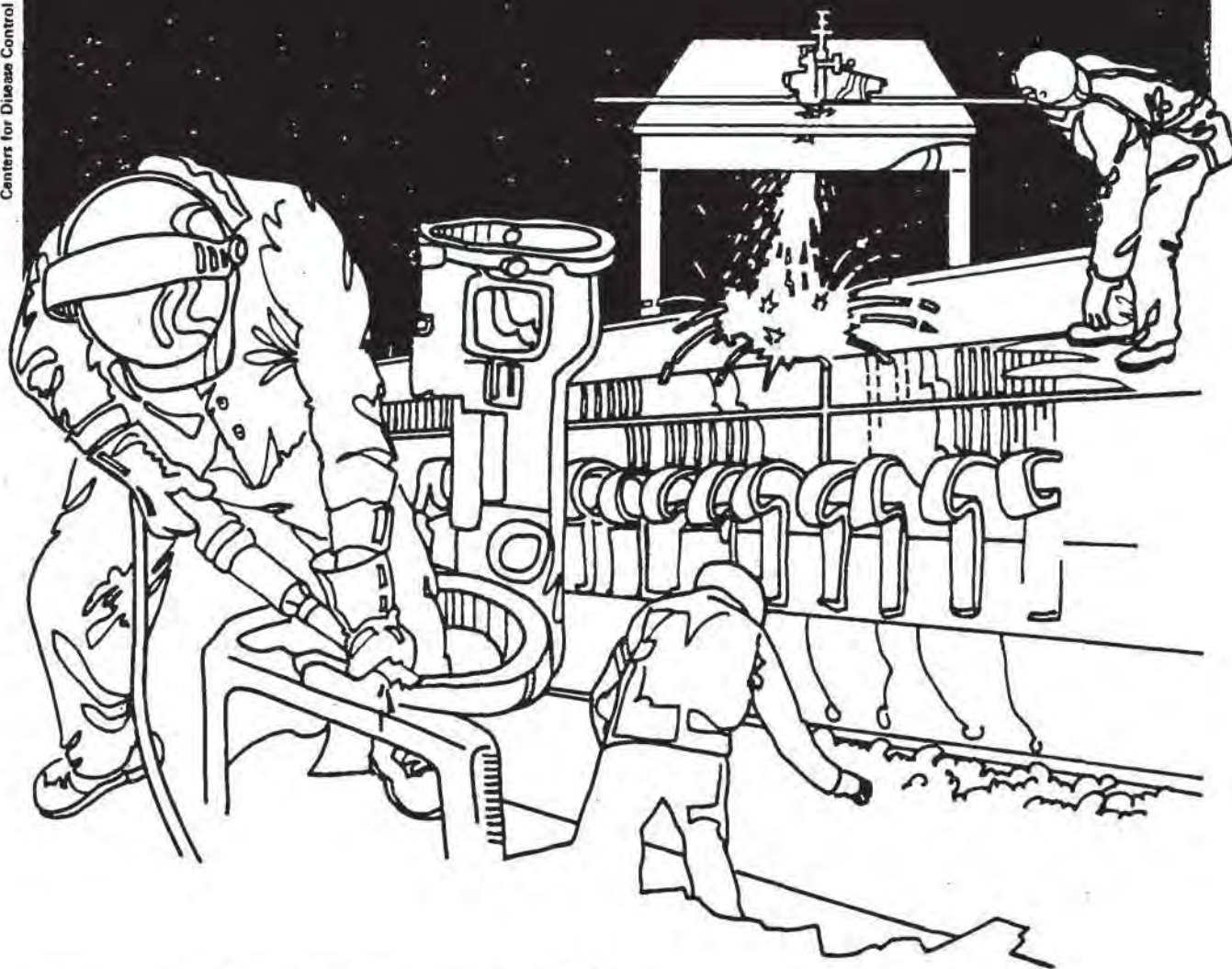


# NIOSH



## Health Hazard Evaluation Report

HETA 82-294-1458  
ALHAMBRA PLAZA  
CLIFTON, NEW JERSEY

## PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 82-294-1458  
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ALHAMBRA PLAZA  
CLIFTON, NEW JERSEY

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## I. SUMMARY

In July 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate complaints of headache, nasal and eye irritation in an office building, Alhambra Plaza, Clifton, New Jersey. Staff from the Occupational Health Program of the New Jersey State Department of Health performed the investigation under a cooperative agreement with NIOSH. The ventilation system was reviewed by the industrial hygienist. The occupational physician interviewed most of the occupants and distributed a questionnaire for the occupants to fill out.

There was a high level of irritative symptoms among the occupants. Almost a third of the respondents complained of at least two of the three most common symptoms (headache, eye irritation and sore throat) being associated with work. Almost half of the occupants felt there was a problem with the building air. The cases appeared to be clustered at three of the building corner offices. The building ventilation system was observed to remove a low volume of exhaust air with no provision for delivering fresh outside air. The ventilation system did not meet the recommended guidelines issued by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The ASHRAE guidelines recommend that 20 cubic feet per minute of outside air be delivered for each office occupant.

On the basis of the observed deficiencies in the supply of fresh outdoor air and the symptoms reported in the health questionnaires, we conclude that there is a health hazard for employees at this facility. Recommendations to modify the ventilation system to alleviate this problem are included in Section VI of this report.

KEYWORDS: SIC 8011, 8021, 6611, (Offices of Physicians), (Offices of Dentists), (Combinations of Real Estate, Insurance, Loans, Law Offices), indoor air pollution, tight building syndrome, ventilation.



## II. INTRODUCTION

On July 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the owners of Alhambra Plaza in Clifton, New Jersey. In the preceding months a number of the occupants of this office building had been experiencing symptoms at work such as nausea, headache and irritated mucosal membranes. The New Jersey State Department of Health (NJSDH), under a cooperative agreement with NIOSH, investigated the problem. On July 19, an occupational physician and industrial hygienist visited the building. During the building walkthrough, the hygienist evaluated the ventilation system and the physician assessed the health status of the occupants through questionnaire and interview.

This report summarizes the findings of that visit and makes recommendations for changes in the ventilation system.

## III. BACKGROUND

Alhambra Plaza is a two-story office building constructed in 1976. Each floor contains approximately 9,000 square feet of office space. There are 15 businesses in the building occupying spaces which range from 780 to 4,575 square feet (average 1,425 sq. ft.) and employing from 1 to 15 employees (average 5 employees). The basement contains two offices with three employees. The total number of occupants in the building is approximately 80.

Various commercial and professional businesses rent space in the building. Many of these offices require public access to clients, customers and patients who come in to conduct business or receive services.

In response to the discomfort reported by building employees, the building owners requested in July, 1982, that NIOSH conduct a Health Hazard Evaluation.

## IV. METHODS OF EVALUATION

At the time of the site visit, a medical symptoms questionnaire was distributed to the occupants. This self-administered questionnaire was based on questionnaires used in other building-related investigations and amended with some particular information provided by the building's office manager. The physician reviewed the questionnaires returned and interviewed a number of the building occupants.

The industrial hygienist surveyed the offices for possible sources of contamination and inspected the heating ventilation and air conditioning (HVAC) system. The flow of air from exhaust and supply ducts on the roof was measured with an Anor Velometer. This instrument contains a spring loaded vane which moves in response to changes in air velocity. Carbon monoxide concentrations were monitored with a calibrated direct reading carbon monoxide indicator. (Mine Safety Appliance Model 70) This instrument contains a cell which converts carbon monoxide to carbon dioxide thus causing a change in electrical conductivity. This electrical signal is then amplified and results can be read on the face of the meter. Carbon monoxide was measured in order to determine whether the workplace air was contaminated by cigarette smoke.

## V. EVALUATION CRITERIA

Carbon monoxide is an odorless, colorless gas produced by inefficient combustion processes. Exposure to carbon monoxide decreases the ability of the blood to carry oxygen to the tissues. Breathing carbon monoxide may cause headache, nausea, dizziness, weakness, and, at higher concentrations, unconsciousness and death. Exposure to this gas may aggravate artery and heart disease and may cause chest pain in those with pre-existing heart disease. NIOSH has recommended that occupational exposure to carbon monoxide should not exceed 35 parts per million (ppm) averaged over a full work week, and that peak exposures should not exceed 200 ppm.

The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) has recommended that office environments should receive 20 cubic feet per minute (CFM) of fresh (i. e., clean) outdoor air for each occupant. In offices where no smoking is permitted, a lesser amount of outdoor air is acceptable, 5 CFM per person. However, since smoking is allowed in the offices of Alhambra Plaza, the appropriate standard is 20 cfm of outdoor air per person.

### Medical Evaluation

Of the 62 questionnaires distributed, 53 were filled out, for a response rate of 85%. There were approximately an additional twenty people who were not in the building on the day of the site visit. Table 1 summarizes the descriptive characteristics of the occupants who responded. There were twice as many women as men in the building. The women were younger (average age 28 years) than the men (average age 43 years). Forty percent of the occupants were smokers and 21% had a history of allergies. There were 30 questionnaires returned from the first floor and 23 from the second floor. The non-respondents and absent occupants were fairly equally divided between the two floors except for one office having closed the site visit day. Slightly more smokers worked on the second floor. The responses from the basement occupants were combined with the first floor responses for the analysis.

Table 1

#### Medical Questionnaires Results

Questionnaires Administered	62
Questionnaires Returned	53
Response Rate	85%
	<u>Number</u> <u>Average Age</u> <u>Smokers</u> <u>Allergy History</u>
Males	18      43      8      4
Females	<u>35</u> <u>28</u> <u>12</u> <u>7</u>
Total	53      33      20      11

Almost half of the respondents felt there was a problem with the building's air; over 25% of the respondents thought the building air had become worse over the past six months. The occupants identified a range of irritative symptoms which they associated with work (Table 2). Thirty to forty percent of the occupants complained of headache, sore throat, and eye irritation. At least twenty percent of the occupants also complained of nausea, fatigue, increased thirst, dizziness and, nasal congestion or irritation. Any other symptoms were reported worse at work by fewer than ten percent of the respondents.

Table 2

Most Common Symptoms Worse at Work (N = 53)

<u>Symptom</u>	<u>Responses (#)</u>
Eye Irritation	40% (21)
Headaches	34% (18)
Sore Throat	32% (17)
Sick to Stomach	25% (13)
Nasal Congestion	23% (12)
Increased Thirst	23% (12)
Dizziness	21% (11)

Less than 10% of all employees responded positively to each of the other symptoms listed on the questionnaire.

A case was defined as an individual who reported being bothered at work by at least two of the three most common symptoms: headache, sore throat and eye irritation. Sixteen people satisfied these criteria and were identified as cases, for an attack rate of 30%.

Table 3 compares cases with non-cases. The average age of the cases is the same as all the non-cases. The attack rate was similar for the first and second floors (30%). There were fewer smokers and people with allergy history among the cases compared to non-cases. There were proportionally more symptomatic women than men (not statistically significant). It has been hypothesized there are more symptomatic cases within the more clerical job categories. The questionnaire did not provide adequate job information to determine whether the attack rate decreased among those with supervisory positions.

Table 3

Comparison of Cases with Non-Cases

	<u>Cases (#)</u>	<u>Non-Cases (#)</u>
Males	25% (4)	32% (12)
Females	75% (12)	68% (25)
Smokers	31% (5)	41% (15)
History of allergies	13% (2)	24% (9)
<u>Office location</u>		
Corner	94% (15)	59% (22)
Central	6% (1)	41% (15)
*p .05 (chi-square)		
<u>Average Age</u>		
Males	43 yrs.	43 yrs.
Females	30 yrs.	27 yrs.
<u>Total</u>	16	37

The cases appear to cluster in corner offices (see figure 1). One corner office was closed the day of the site visit, so no responses were obtained.

Two of the three corner offices without cases had questionnaire response rates of 40% and 50%. One corner office with one case had four of six occupants responding. The lower response rates in three corner offices may have resulted in reduced case-finding or may reflect a lower level of people with symptoms in those offices. There was only one case found in the five centrally located offices. Fourteen cases were clustered in three corner offices, two first floor offices and one second floor office. Comparing the number of cases to non-cases in the corner and central offices, there are significantly more cases in the corner offices.

### Industrial Hygiene Evaluation

The investigation of the building heating, ventilating and air conditioning system (HVAC) was limited by the fact that no design specifications or diagrams of the ventilation system currently exist. The only currently available information about the system was obtained from a representative of Dynamic Air Balancing Company who services the HVAC system at Albambra Plaza. According to this representative the second floor of the building receives fresh air from two goose neck intake ducts on the roof, but the first floor receives no direct supply of fresh air.

During the site visit nine air conditioning units were observed on the roof. These function as heat exchangers, but provide no fresh air. (Eight of these units have a capacity of one-half horsepower and one has a capacity of one-quarter horsepower.) Air flow measurements made with an Alnor Velometer indicated that no air flow was detectable at either of the two goose neck ducts which supply fresh air to the second floor. One roof vent was observed to be exhausting air at a rate of 827 linear feet per minute. The area of the exhaust opening was 1.64 square feet, making the total air flow exhausted 1,360 cubic feet per minute. It could not be determined from visual inspection which parts of the building were being serviced by this exhaust vent. Furthermore, no active sources of supply air were observed and all windows are sealed. Supply air presumably enters the building passively as the three doors on the first floor are opened.

Carbon monoxide measurements were made to evaluate potential contamination from smokers who work in the building. An MSA Model 70 carbon monoxide indicator was used to monitor carbon monoxide concentrations. The minimum concentration detectable by the MSA model 70 is 2 parts per million. Measurements taken at several sites on both floors including offices where smokers were present, indicated no detectable carbon monoxide.

The building was surveyed for possible chemical contamination. One office contained photographic chemicals. Another office had grinding and polishing machinery without separate ventilation that may be a source of respirable dust. There were copier machines throughout the building. There was no consistent association between symptomatic people and possible office exposures.



## V. DISCUSSION AND CONCLUSIONS

Many building investigations have found industrial hygiene measures of possible environmental chemicals to be low or not detectable despite a high level of building occupant discomfort. This may be because there is no single contaminant to be measured. It is also possible that current analytic methods are not available for some exposures (e.g. detergents).

Experience of public health investigators and environmental consultants have found that many of building associated problems are found in buildings whose ventilation systems use a high proportion of recirculated air. The American Society of Heating, Refrigerating, and Air Conditioner Engineers (ASHRAE) has issued a standard for acceptable indoor air quality which states that the recommended minimum for fresh make up air is now 20 cfm/person. A level of 5 cfm/person is allowable only for areas where there is no smoking. Several building investigations have found that when the percentage of fresh supply is increased from 5 cfm/person to 20-30 cfm/person the occupants' symptoms (headache, fatigue, and mucosal membrane irritation) are found to be reduced.

The fact that the building ventilation system had no active fresh air intake presents a distinct problem. There is some direct exhaust but air intake is provided only through passive sources, such as opening of doors on the first floor.

The clustering of cases in corner offices suggests that these may be particular problems with the building ventilation system in these areas.

## VI. RECOMMENDATIONS

1. It is recommended that the building ventilation system be modified so that at least 20 CFM of clean outdoor air is supplied for each building occupant.
2. The outdoor air supply should be evenly distributed to all work areas to ensure that all work areas meet the recommended criteria of 20 CFM per person.
3. Smoking should be restricted to areas with adequate air flow. Separate nonsmoking work areas should be created for those areas with ventilation less than 20 CFM per person.
4. Repeat the questionnaire to assess improvement in symptoms following changes in the ventilation system.

VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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1. Alhambra Plaza
2. New Jersey State Department of Health
3. NIOSH, Region II
4. OSHA, Region II

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