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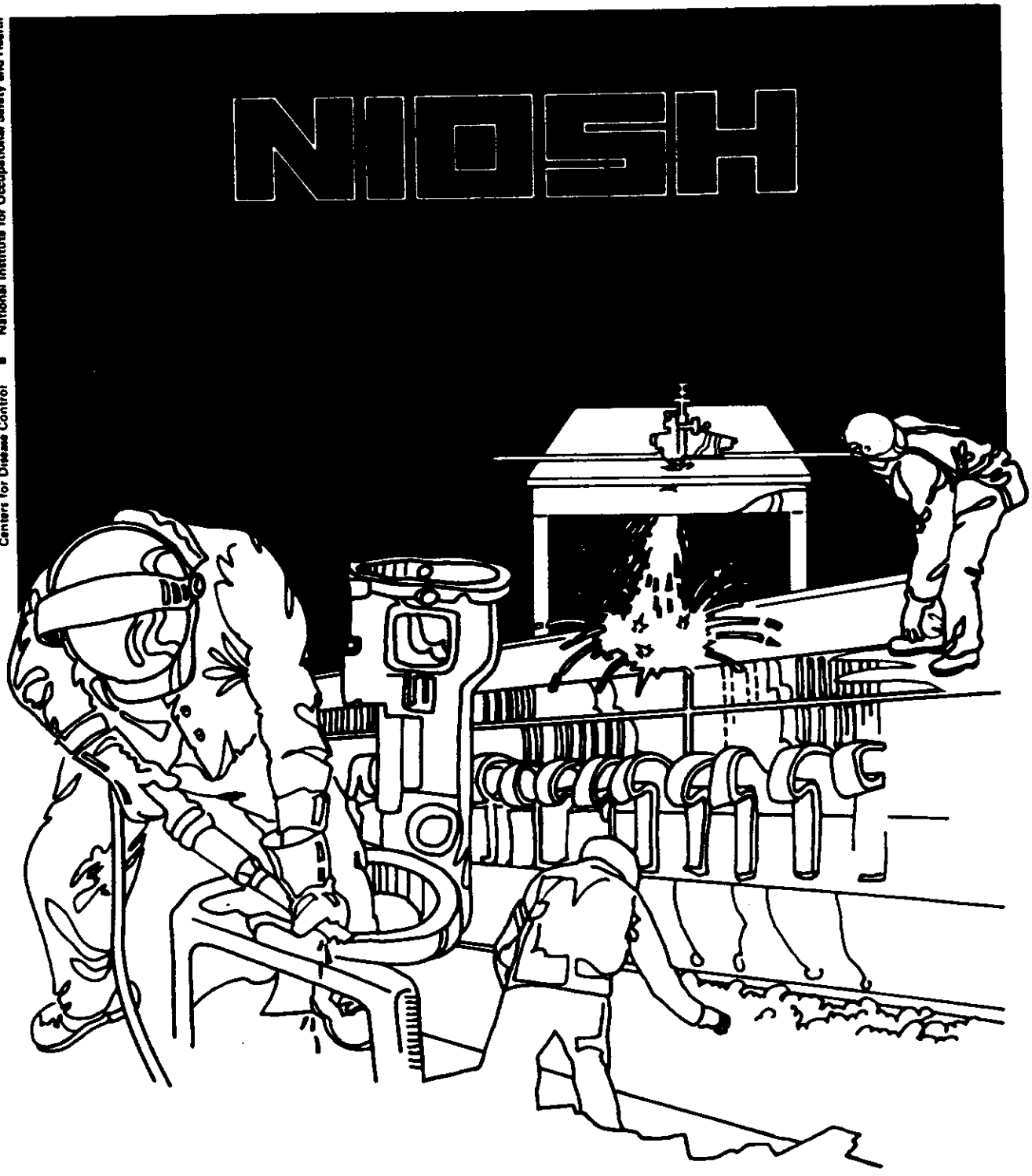
NIOSH



Health Hazard Evaluation Report

HETA 88-364-2102 - VOL. I
LIBRARY OF CONGRESS
MADISON BUILDING
WASHINGTON, D.C.

INDOOR AIR QUALITY AND WORK ENVIRONMENT STUDY

Library of Congress
Madison Building

Volume I:

Results of Employee Survey

National Institute for Occupational Safety and Health

U.S. Environmental Protection Agency

John B. Pierce Foundation Laboratory at Yale University

National Institute of Standards and Technology

Westat, Inc.

HETA 88-364-2102
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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 and 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.

TECHNICAL TEAMS

This study of indoor air quality and work environment was conducted by three technical teams representing multiple organizations. It was jointly developed and carried out at the Library of Congress' Madison Building and EPA headquarters under the auspices of these teams working independently of both management and unions at both the Library of Congress and EPA.

Overall project coordination was provided by two technical team leaders: Lawrence Fine at NIOSH and Kevin Teichman at EPA.

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We wish to thank Linda Nainis and her staff at the Georgetown University Library for assisting in the pretest. The input received was most helpful.

We appreciate the thoughtful reviews of the questionnaire and the drafts of this report by Dennis Roth of CREA (Congressional Research Employee Association), Mary Ann Joyce of AFSCME (American Federation State, County, and Municipal Employees) Local 2910, Martez Baker of AFSCME Local 2477, and those who worked with them. We also thank James Trew, Director, Integrated Support Services, Rhoda Cantor, Associate Librarian for Management, and Gerald Garvey and Stephen Bush of the Library of Congress for their considered reviews.

We also appreciate the contributions of numerous Westat staff without whose efforts this project could not have succeeded. In particular, we wish to acknowledge Frankie Robinson, Field Director; Lenora Bohren, Deputy Field Director; William Devlin, Systems Analyst; Janice Machado, Grethel Hoffmaister and Nita Lemanski, Research Analysts; and Douglas Duncan, Helen Powell and Sharon Beausejour, Programmers.

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EXECUTIVE SUMMARY

1. Background

In recent years, employees in the Madison Building of the Library of Congress (LOC) in Washington, D.C. have expressed their concerns about air quality and work environment discomforts. Because of the difficulties usually encountered in determining the exact causes of such concerns about the building environment, a systematic study was undertaken to assess the nature and spatial distribution of employee health symptom and comfort concerns in an attempt to determine if associations exist between employee responses and specific workplace conditions. This evaluation of the Madison Building has been performed by a team of researchers from the National Institute for Occupational Safety and Health (NIOSH), the Environmental Protection Agency (EPA), the John B. Pierce Foundation at Yale University, the National Institute of Standards and Technology (NIST), and Westat, Inc., a health consulting firm.

This is the first of three reports that investigate the perceived and actual quality of indoor air and work environment at the Madison Building of the LOC. This report documents the design of the study and the results of the detailed questionnaire survey of all Madison Building employees conducted in February 1989. This report presents only a descriptive summary of the survey data. Results of the environmental monitoring will be presented in Volume II; multivariate analyses of all the study results will be presented in Volume III.

The research effort at the Library of Congress was integrated with a parallel study of three headquarters buildings at the Environmental Protection Agency (EPA) in Washington, D.C. Both the LOC and EPA surveys made use of similar study designs and survey instruments, although separate reports have been prepared for each agency. While certain features of the study are specific to the particular buildings involved, the survey was designed to be applicable to any building suspected of environmental problems.

2. Study Design

Because of the lack of systematic information on employee health that could be used in this study, and because of the spatial variability of ventilation, thermal factors, and other conditions that influence health and comfort, it was decided to conduct a complete survey of all Madison Building employees. A self-administered questionnaire was distributed in February 1989, asking for information about health symptoms and comfort concerns, along with data on background health and demographic characteristics. Among the topics covered in the questionnaire were:

- Location of workstation (to detect associations between the survey and monitoring data);
- Description of workstation; both current and changes over the last year;
- Amount of time spent at workstation;
- Health symptoms experienced while in building, both in the previous week and last year;
- Other health effects and risk factors: contact lenses and eyeglasses wear, smoking, allergies, asthma, etc.;
- Eye, nose, throat, or respiratory irritation from tobacco smoke or other chemicals during last year;
- Comfort issues: temperature, humidity, air movement, noise, dust, light, odors, and furniture during last year;
- Job characteristics, including job satisfaction and job stresses;
- Education, job pay plan and grade, and job classification.

To increase participation in the survey, both management and unions were given the opportunity to review the draft questionnaire and their endorsements were communicated to all employees prior to the survey. Stringent measures were taken to ensure the confidentiality of all responses.

Findings from the employee survey were used to rank all rooms in the building using a health symptom index and a comfort index, and then to select approximately 100 locations within the building for environmental monitoring and physical measurements. Environmental monitoring

was conducted three weeks after the employee survey. All locations were monitored for temperature, relative humidity, carbon dioxide, and biological contaminants. A subset of locations was also sampled for nicotine, particles, formaldehyde and other aldehydes, other volatile organic compounds (VOCs), and pesticides. In addition, ventilation parameters were measured.

While the monitoring was in process, a supplemental questionnaire was administered to all employees near the environmental equipment. This provided a basis of comparison between air measurements and employee experiences on the same day.

3. Results of the Employee Survey

The overall response rate for the survey questionnaire was 90 percent, with 2,845 of 3,176 Madison Building employees completing the survey. More than 1200 employees also took the opportunity to make additional comments in the "essay" portion provided at the end of the survey.

Key results are reported below, first for health symptoms, then for comfort issues. It is important to note that the health symptoms and comfort issues reported in this survey are self-reported by the respondents, and have not been verified by a physician's diagnosis as part of this study. No attempt is made in this report to associate health or comfort outcomes with possible risk factors in the building. These analyses will be the focus of Volume III.

Health Symptoms

Employees were asked to report whether each of 32 health symptoms occurred during the past year "never," "rarely," "sometimes," "often," or "always." To focus the findings of this report, a "positive" symptom (sometimes referred to, in epidemiologic terms, as a "case") is defined here as one that was reported to have occurred "often" or "always" and usually gets better when away from work in the Madison Building. This allows the focus to be on symptoms that are recurring rather than occasional and that appear to be connected in some way to the building.

The proportion of Madison Building employees reporting positive work-related symptoms, as defined above, is presented in Exhibit ES-1. The most commonly reported work-related symptoms among Madison Building employees were:

- contact lens problems (31% of contact lens wearers)
- sleepiness or drowsiness (25%)
- sore eyes (23%)
- fatigue (21%)
- dry eyes (21%)
- stuffy nose (21%)
- headache (16%)
- burning eyes (13%)
- sneezing (13%)
- tension or nervousness (12%)

It is noted that most of these symptoms, most notably headache, fatigue, and symptoms associated with mucous membrane irritation, have often been reported in published evaluations of indoor air quality.

The prevalences of work-related symptoms (reported to occur often or always in past year and get better when away from work) can be viewed another way, as in Exhibit ES-2, which groups the symptoms into three categories and presents the results by floor.

1. Indoor Air Quality Symptoms, typically associated with acute discomfort, such as headache, runny nose, stuffy nose/sinus congestion, dry, itching, or tearing eyes, burning eyes, dry throat, fatigue, and sleepiness;

2. Respiratory or Flu-like Symptoms, which may be manifested in clinically defined illnesses that may require prolonged recovery times after leaving the building. Such symptoms include cough, wheezing, shortness of breath, chest tightness, fever, and aching muscles or joints; and

3. Ergonomic Symptoms, which include back pain or stiffness, and pain or numbness in the shoulder, neck, hands, or wrists.

The predominant type of symptoms which occurred among employees in the Madison Building are those that may be associated with poor indoor air quality. As this exhibit shows, and as is borne out by other findings, the highest proportions of employees reporting positive indoor air related symptoms are those on the 4th floor. Respiratory and flu-like symptoms occurred among relatively few persons and did not vary across floors. Although the 4th and 5th floors

Exhibit ES-1: Percent of Respondents* Reporting Symptoms "Often" or "Always" in the Past Year and that Got Better Upon Leaving Work, at Madison Building

Symptoms	Often/Always and Got Better Upon Leaving Work
Headache	16%
Nausea	1%
Runny nose	10%
Stuffy nose	21%
Sneezing	13%
Cough	5%
Wheezing	2%
Shortness of breath	2%
Chest tightness	2%
Dry, itchy eyes	21%
Sore, strained eyes	23%
Blurry vision	6%
Burning eyes	13%
Sore throat	3%
Hoarseness	3%
Dry throat	10%
Fatigue/tiredness	21%
Sleepiness	25%
Chills	9%
Fever	1%
Aching muscles/joints	7%
Problems with contacts**	31%
Difficulty remembering	2%
Dizziness/lightheadedness	4%
Feeling depressed	7%
Tension/nervousness	12%
Difficulty concentrating	7%
Dry skin	8%
Pain-upper back	10%
Pain-lower back	9%
Pain-shoulder/neck	8%
Pain-hand/wrist	3%

*Total number of respondents equals 2,750 (excluding persons for whom "floor" was missing).

**These percentages are based upon only the people who wear contact lenses at work, "sometimes, often or always" (Part II, Question 1a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

Exhibit ES-2: Percent of Respondents Reporting Symptoms "Often" or "Always" in Past Year and that Got Better Upon Leaving Work, by Group of Symptoms, at Madison Building

SYMPTOMS	TOTAL (N=2,750*)	FLOOR							
		6th (N=267)	5th (N=712)	4th (N=457)	3rd (N=284)	2nd (N=386)	1st (N=115)	Grd. (N=409)	Sub-Grd. (N=120)
Indoor Air Quality Symptoms									
Headache	16%	18%	16%	20%	14%	19%	12%	14%	13%
Runny Nose	10%	11%	11%	14%	6%	9%	11%	8%	9%
Stuffy Nose	21%	23%	20%	25%	14%	22%	25%	18%	19%
Dry Eyes	21%	19%	24%	24%	18%	20%	14%	18%	14%
Burning Eyes	13%	9%	16%	14%	10%	11%	13%	11%	7%
Dry Throat	10%	10%	11%	13%	5%	9%	14%	10%	10%
Fatigue	21%	17%	23%	27%	13%	24%	13%	21%	14%
Sleepiness	25%	20%	27%	32%	25%	25%	20%	20%	21%
Respiratory or Flu-like Symptoms									
Cough	5%	3%	7%	7%	3%	5%	4%	4%	6%
Wheezing	2%	2%	1%	3%	1%	1%	4%	2%	3%
Shortness of Breath	2%	1%	2%	2%	1%	2%	4%	2%	3%
Chest Tightness	2%	3%	3%	2%	0%	1%	2%	1%	2%
Fever	1%	0%	1%	1%	1%	0%	1%	1%	1%
Aching Muscles/Joints	7%	5%	7%	8%	5%	7%	6%	6%	7%
Ergonomic Symptoms									
Pain-Upper Back	10%	7%	12%	10%	10%	11%	9%	9%	4%
Pain-Lower Back	9%	7%	10%	10%	10%	8%	5%	9%	6%
Pain-Shoulders	8%	6%	10%	8%	9%	8%	7%	6%	4%
Pain-Hands/Wrists	3%	3%	5%	4%	3%	3%	2%	2%	3%

*Excluding persons for whom "floor" was missing.

Reference: Part II, Question 7.

report the highest symptom rates for these symptoms, the differences are small. Similarly, the differences across floors for ergonomic symptoms of the upper body were relatively small.

Defining a "positive" symptom as one that is reported to have occurred often or always may represent a conservative estimate of symptoms experienced by respondents. Employees may experience symptoms only "sometimes" that are nevertheless related to the building. (For example, persons may be sensitive to paint fumes but may only "sometimes" be exposed to a new paint near their workstations.) Therefore, it may be useful to consider the prevalence of symptoms reported by respondents sometimes, often, or always in the past year. For comparison to the building-wide prevalences of symptoms (reported to occur "often" or "always") presented in Exhibit ES-1, Exhibit ES-3 is provided, which shows the proportion of employees reporting symptoms "sometimes," "often," or "always" last year that usually got better when away from work. In addition, it is recognized that certain symptoms that may be building-related do not improve upon leaving work (e.g., muscle pains, delayed hypersensitivity reactions, and immune responses). The main body of the report includes exhibits that eliminate the "got better upon leaving work" criterion.

Almost half (44%) of the respondents in the building reported that a symptom or symptoms reduced their ability to work at least some of the time. Approximately one third (35%) of workers reported that in the past year their symptoms had caused them to stay home from work or leave work early sometimes or often.

Seventy percent of workers associated one or more of their symptoms with their work in the Madison Building, ranging from 78% on the 4th floor to 64% on both the 1st and ground floors. Of those employees reporting that they "often" or "always" experienced symptoms, the percentage who reported that their symptoms improved when they left the building generally ranged between 60 and 85 percent. Most respondents (67%) stated that in the past year their symptoms had stayed the same.

Almost half (41%) of Madison Building employees reported more frequent infections since beginning work in the building, with the highest proportion on the 4th floor (49%). More than one third (37%) of building respondents reported that their infections tend to last longer, again with the highest proportion being among employees on the 4th floor (44%).

Exhibit ES-3: Percent of Respondents* Reporting Symptoms "Sometimes," "Often" or "Always" in the Past Year and that Got Better Upon Leaving Work, at Madison Building

Symptoms	Sometimes/ Often/Always and Got Better Upon Leaving Work
Headache	44%
Nausea	11%
Runny nose	24%
Stuffy nose	36%
Sneezing	31%
Cough	18%
Wheezing	7%
Shortness of breath	10%
Chest tightness	9%
Dry, itchy eyes	43%
Sore, strained eyes	47%
Blurry vision	18%
Burning eyes	30%
Sore throat	14%
Hoarseness	10%
Dry throat	26%
Fatigue/tiredness	43%
Sleepiness	52%
Chills	23%
Fever	4%
Aching muscles/joints	16%
Problems with contacts**	53%
Difficulty remembering	9%
Dizziness/lightheadedness	17%
Feeling depressed	22%
Tension/nervousness	34%
Difficulty concentrating	27%
Dry skin	15%
Pain-upper back	22%
Pain-lower back	22%
Pain-shoulder/neck	20%
Pain-hand/wrist	9%

*Total number of respondents equals 2,750 (excluding persons for whom "floor" was missing).

**These percentages are based upon only the people who wear contact lenses at work "sometimes, often or always" (Part II, Question 1a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

Of nine possible sources of eye, nose, throat, or respiratory irritation mentioned, those reported most often were tobacco smoke, paint, cleaning fumes (from carpets, etc.), "other" fumes, and other chemicals such as glues and adhesives. One-third (33%) of respondents throughout the Madison Building reported that they consider themselves especially sensitive to the irritants mentioned.

Comfort Issues

Approximately two thirds (65%) of respondents reported that they were generally satisfied with their physical workstations (chair comfort, lighting), although this may be because respondents have some ability to adjust these factors. For example, desk lamps are used regularly by 33% of respondents. Dissatisfaction with other building-related variables was also reported. Overall, 43% of respondents often or always wanted to adjust air movement, 39% wanted to adjust the temperature, and 26% wanted to adjust the humidity in their immediate environment. Second floor employees reported the most dissatisfaction with the air movement and humidity in their work environment, while 4th floor employees most often expressed the desire to adjust the temperature (Exhibit ES-4).

Throughout the Madison Building, respondents reported the air to be often or always too dry, rather than too humid, with too little as opposed to too much air movement. Overall, these reported percentages were 25% as opposed to eight percent, and 40% as opposed to 12%, respectively. The desire to adjust temperature was seasonally dependent, with respondents wanting to adjust temperature more during winter and summer. Almost two thirds of respondents wanted to adjust the temperature during winter months.

Almost half of the respondents (46%) reported that, during the past year, the environment at their workstation was often or always too stuffy, and almost one quarter (23%) of the respondents reported it being too dusty, often or always in the past year.

This report also outlines the findings of the survey regarding respondents background characteristics, including demographic characteristics, health factors not related to the building, job satisfaction and sources of stress, and the physical work environments in which employees work.

Exhibit ES-4: Percent Reporting "Often" or "Always" Wanting to Adjust Environmental Comfort Last Year, by Madison Building Floor

SYMPTOM	TOTAL (N=2,750*)	FLOOR							
		6th (N=267)	5th (N=712)	4th (N=457)	3rd (N=284)	2nd (N=386)	1st (N=115)	Grd. (N=409)	Sub-Grd. (N=120)
Adjust Air Movement	43%	47%	43%	47%	39%	49%	38%	40%	31%
Adjust Temperature	39%	44%	39%	45%	33%	41%	37%	36%	33%
Adjust Humidity	26%	27%	28%	28%	23%	30%	25%	22%	13%

*Excluding persons for whom "floor" was missing.

Reference: Part III, Questions 1c, 1f and 1i.

These factors will be used in the Volume III analyses as background variables to help explain patterns of health symptoms and comfort problems. These analyses will provide a more detailed context in which to understand the differential health and comfort problems experienced by different types of employees, and employees in different areas of the building. The analyses will thus help to determine to what extent the health symptoms and comfort concerns described in this report can be attributed to building conditions and to what extent they can be attributed to other independent factors.

1. INTRODUCTION

1.1 Background

The quality of the air and the work environment in office buildings has become an increasingly important issue in recent years. Workers in numerous modern, apparently well-designed office buildings have suffered ailments and discomforts that appear to be related to working in the buildings, whether from unacceptable indoor air quality, job characteristics, or other factors. Health concerns of workers in office buildings fall into several categories, including symptoms associated with indoor air quality, comfort concerns, and ergonomic symptoms. Indoor air quality symptoms refer to a complex mix of occupant reported symptoms associated with acute discomfort (e.g., headache, fatigue, stuffy nose, sinus congestion, eye irritation, sore throat) that improve while away from work. Comfort issues include concerns about air movement, temperature, humidity, odors, and physical comfort considerations (e.g., lighting, noise). Back pain/stiffness or pain/numbness in shoulders or hands are examples of symptoms associated with ergonomic stresses (repetitive motion or awkward postures).

Building related illnesses, another important potential health problem among office workers, are diseases that are caused by specific building-related etiologic factors. For example, hypersensitivity pneumonitis can be caused by bioaerosols produced by microbial contamination of ventilation systems, water-damaged rugs, furniture, or ceilings. This respiratory illness is characterized by infiltrates seen on chest x-rays and non-specific symptoms (fever, muscles aches, cough, and shortness of breath). Other building related illnesses include toxic effects of overexposure to chemical agents such as carbon monoxide (initial symptoms of headache and nausea) and dermatitis caused by fibrous glass which wears from ventilation duct linings. These symptoms can, of course, often occur for reasons unrelated to working in the building. Essential to the proper diagnosis of individuals with building related illnesses are physician evaluation and the measurement of environmental contaminants.

Since first occupying the building in 1980, employees in the Madison Building of the Library of Congress in Washington, D.C. have expressed their concerns about indoor air quality and work environment discomforts. In response to these concerns, the Library of Congress

requested the National Institute for Occupational Safety and Health (NIOSH) and the Environmental Protection Agency (EPA) to undertake a systematic study of the nature and geographic distribution of the employees' health symptoms and comfort concerns, and to attempt to determine if associations exist between employee responses and specific workplace conditions. This study has been done in cooperation with investigators from the John B. Pierce Foundation at Yale University. In addition, the National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) has been conducting a long-term investigation of ventilation and air quality at the Madison Building. Westat, Inc., a health statistics consulting firm, was brought into the study to conduct the questionnaire survey, assist with preliminary data analysis, and coordinate the organizations involved in the research.

This research effort was integrated with a parallel study at the U.S. Environmental Protection Agency headquarters where employees were also reporting physical symptoms and discomforts that they attributed to the buildings in which they worked. Both the Library of Congress and EPA surveys made use of similar study designs and survey instruments, although separate reports are being prepared for each agency. While certain details are specific to the particular buildings involved, the survey design is applicable to a comprehensive study of any building suspected of environmental problems.

This report documents the first part of an extensive investigation of the indoor air quality and work environment at the Madison Building. Specifically, this report documents the design of the study and the results of the detailed survey of all Madison Building employees conducted in February 1989. This report presents only a descriptive summary of the survey data. Results of the environmental monitoring and analyses of the entire study will be presented in subsequent reports.

1.2 Study Objectives

The goal of this study is to characterize the extent of building-related health, comfort, and environmental problems at the LOC Madison Building and to suggest remedies.

1. Survey the nature, magnitude and spatial distribution of acute health symptoms and comfort concerns.

2. Characterize selected physical, chemical and biological aspects of the building in selected locations during the survey period.

3. Generate hypotheses from any associations observed between acute health and comfort effects and environmental factors while taking into account factors that would confound or modify such associations.

4. Identify areas not in compliance with standards or guidelines.

To fulfill Objective 1, a survey of all Library of Congress employees in the Madison Building was conducted. To fulfill Objective 2, environmental monitoring was conducted for the following pollutants:

- nicotine;
- respirable particles (<2.5 microns);
- formaldehyde and other aldehydes;
- other volatile organic compounds (VOCs);
- pesticides;
- viable organisms (bacteria and fungi); and
- non-viable organisms (pollen and fungal spores).

Monitoring was also conducted for comfort related factors: carbon dioxide, temperature, humidity, and air flow, as well as other ventilation parameters. At the time of the environmental monitoring, a second questionnaire was administered to persons working in the vicinity of the monitoring stations in order to assess health and comfort concerns on the day of the survey. Objectives 3 and 4 will be fulfilled by an integrated analysis of all these bodies of data.

1.3 Study Reports

This report is the first of three reports documenting the study. This report addresses Objective 1; it presents detailed results of the questionnaire survey, including information about work-station design, health and comfort concerns, and potential related factors. Volume II will address Objective 2 and will report on environmental monitoring data collected. Volume III will address Objectives 3 and 4. It will present a statistical investigation of the interrelationships among employees' responses, the environmental monitoring data, identified risk factors, and confounding factors.

This report is organized as follows. Chapter 2 presents a summary of the overall study design. Chapter 3 explains the survey methodology. Chapter 4 summarizes the environmental monitoring methodology. Finally, the results of the survey are presented in Chapter 5. A series of appendices contains the questionnaires used in the surveys and additional data tables.

2. STUDY DESIGN

This chapter presents an overview of the study design developed and implemented at the Library of Congress Madison Building. Section 2.1 provides a brief description of the Madison Building; Section 2.2 examines certain important issues that shaped the design of the study; Section 2.3 presents the conceptual design of the study and its major components. For a detailed discussion of the study design, see Chapters 3 and 4.

2.1 Library of Congress Madison Building

The Library of Congress is housed in three buildings in Washington, D.C.: the Adams Building, the Jefferson Building, and the Madison Building. The Madison Building, completed in 1980, has a total area of approximately 1.5 million square feet of functional space, located on nine floors. Approximately 3200 of the Library's employees work in the Madison Building, in a variety of departments, including the Copyright Office and Congressional Research Service.

2.2 Design Issues

The study objectives required a survey of employees to systematically collect information about their reactions to their work environments and environmental monitoring to ascertain the levels of environmental contaminants in the air and to characterize ventilation parameters. Further, the objectives required that the survey and monitoring be conducted in a manner that would permit the detection of associations between the two sets of data at common locations. At the same time, there were several constraining factors and ancillary objectives present that influenced the ultimate study design. These influences are summarized here.

Inadequate Prior Data. Limited records are maintained by the Library of Congress Safety Office regarding employee health and discomfort complaints. However, there was little or no usable information on employee health or comfort problems that could be used as part of this study. Therefore, it was deemed necessary to design and conduct a survey of employees.

Need for Complete Enumeration. Ventilation, thermal factors and other conditions that influence health and comfort have great spatial variability. They can change sharply in a few feet. Consequently, a sample of employees may miss significant problems. This suggested that a complete enumeration be conducted with all of the approximately 3,200 Madison Building employees included in the survey.

Maximize Participation. There were a number of concerns about the employees' reactions to the survey. It was felt that the employees with complaints would be more likely to respond than those without complaints. It was necessary to approach the employees in a manner that encouraged participation by all employees.

Need for Confidentiality. The survey required the collection of sensitive data, and also required that respondents' workstation locations be identified. These factors generated a number of concerns about the privacy of employees' responses and, consequently, the participation rate. Assurances were provided to the unions that management would not be able to see any individual's data.

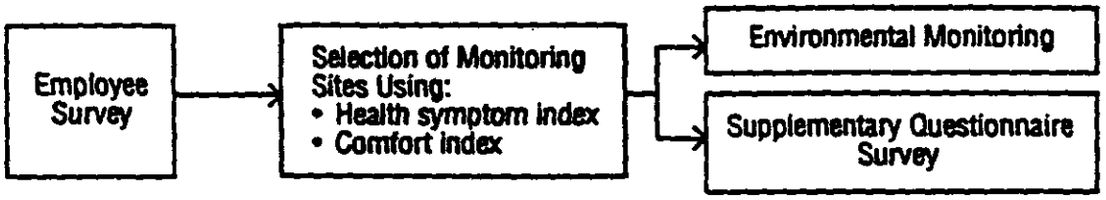
Limited Resources. Available resources did not allow for telephone or in-person interviewing; it was therefore decided to design the questionnaire for self-administration. This, in turn, required minimizing: respondent burden, potential for misunderstanding questions, effects of memory lapses, and potential for refusing to answer sensitive questions.

Also, since the number of sites that could be monitored was limited by the availability of resources and environmental monitoring equipment, it was decided to conduct the employee survey first, and to use the results to guide the selection of monitoring sites. To increase the ability to detect associations between survey information and environmental monitoring data, a second survey limited to employees in the vicinity of the monitoring equipment was also planned.

2.3 Conceptual Study Design

In view of these considerations, it was decided that the study objectives could be achieved most efficiently through the multi-pronged approach diagrammed in Exhibit 2-1 and outlined below.

Exhibit 2-1: Conceptual Design



Employee Survey

A survey of all employees of the Madison Building (excluding workers employed by contractors) was conducted during the week of February 27, 1989 using a self-administered questionnaire. The survey collected information about employees' health symptoms and comfort concerns, along with a number of possible risk factors and confounding factors. It thus yielded a comprehensive and detailed data base concerning Madison Building employee reactions to their workplace environment. The specific topics covered by the questionnaire included:

- Location of workstation (to enable the detection of associations between the survey and monitoring data);
- Description of workstation; both current and changes over the last year;
- Amount of time spent at workstation;
- Health symptoms experienced while in building, both in the previous week and last year;
- Other health effects and risk factors: contact lens and eyeglasses wear, smoking, allergies, asthma, etc.;
- Eye, nose, throat, or respiratory irritation from tobacco smoke or other chemicals during last year;
- Comfort issues: temperature, humidity, air movement, noise, dust, light, odors, and furniture during last year;
- Job characteristics, including job satisfaction and job stresses; and
- Education, job pay plan and grade, and job classification.

During the questionnaire's development, extensive reviews and pretests with debriefings were conducted. The pretests took place at a university library and another federal government agency. Pretesting was not conducted with Library of Congress or EPA employees in order to avoid any possible biases in the full-scale survey.

A broad array of techniques designed to enhance the participation rates was employed. Both management and unions were given the opportunity to review the draft questionnaire. Endorsements were secured from top management and union leaders and communicated to all employees prior to the survey. Employees were assured by management, unions, and the research team that their individual responses would not be revealed either to management or union representatives. The questionnaires were distributed to the employees through their supervisors. However, questionnaires were returned in sealed envelopes directly to the contractor, not through labor or management. Those not responding in a timely fashion were prompted with telephone calls. Announcements and reminders were posted throughout the building during the field period.

Selection of Monitoring Sites

Findings from the employee survey were used to select approximately 100 locations for environmental monitoring. Rooms were selected for monitoring using a protocol developed for this purpose. (A detailed description of the protocol is given in Section 4.1.) Briefly, a health symptom index was computed for each employee from the questionnaire responses, and a standardized mean symptom score was then computed for each room in the building. Similarly, a comfort index was computed for each employee from the questionnaire responses and a standardized mean comfort score was then computed for each room in the building.

Rooms were independently ranked according to the standardized health and comfort indices. Rooms were selected for environmental monitoring, starting with the rooms with the highest values for both indices and the lowest values for both indices. In the selection of rooms, greater priority was given to the health symptom index over the comfort index; and lesser priority was given to rooms with only one occupant.

Environmental Monitoring and Supplemental Survey

The monitoring was conducted three weeks after the employee survey. All locations were monitored for temperature, relative humidity, and carbon dioxide. A subset of locations included measurements of nicotine, biological contaminants, particles, formaldehyde and other aldehydes, other volatile organic compounds (VOCs), and pesticides. In addition, ventilation parameters were measured. See Chapter 4 for a detailed description of the monitoring.

A supplemental questionnaire was administered to all employees near the environmental equipment while the monitoring was on-going. "Near" was defined to include those within 25 feet of the monitoring carts, with no intervening walls. The supplemental questionnaire was, in large part, adapted from the portion of the original survey that collected information on employees' activities, health symptoms, comfort, and psychological state, in this case, on the same day as the monitoring.

3. COMPREHENSIVE SURVEY METHODOLOGY

This chapter describes in detail the methodology employed in the survey of Madison Building employees. The development of the questionnaire is described in Section 3.1. Section 3.2 describes the content of the questionnaire. Section 3.3 reviews the techniques used to maximize the participation rates and the results achieved. Section 3.4 describes the administration and collection of the questionnaires, and Section 3.5 describes the data preparation process.

3.1 Development of the Employee Questionnaire

This section briefly describes the development of the survey questionnaire. A preliminary draft questionnaire was initially developed to explore associations between health symptoms and comfort concerns, and the work environment and indoor air quality for the Madison Building of the Library of Congress. The first draft of the questionnaire was 36 pages long and took 60 to 75 minutes to administer. Since overly long questionnaires tend to have lower response rates, it was decided to reduce the average administration time to no more than 30 minutes.

From October 1988 through January 1989, the draft questionnaire was thoroughly reviewed by experts in each subject area, and representatives of the Library of Congress management and unions. All comments were studied by the Survey Design Team, which led to numerous revisions to the questionnaire. The final questionnaire was 20 pages long and met the goal of a 30-minute administration time.

The revision process began by prioritizing questions according to their relevance to the objectives of the study. Each question in the preliminary draft questionnaire was assigned a priority rating. Only those questions with the higher ratings remained in the questionnaire. Some questions that may not appear to be related to air quality and work environment were retained. These were questions that explore confounding factors, i.e. explanations for health symptoms other than indoor air quality.

A series of pretests and focus groups was designed and conducted to test and refine the questions, to explore the reliability of specific questions and the questionnaire design, to discuss confidentiality issues, and to test the administration procedure. For the first pretest, a library setting was sought. The pretest was conducted at George Washington University Law Library in November 1988. Volunteers from all job categories were asked to complete the questionnaire during the morning and participate in a focus group discussion of the questionnaire in the early afternoon. The focus group reviewed each question, the time required to fill out the questionnaire, and the problems of filling out a questionnaire at one's workstation.

The second and third pretests were conducted in December 1988 at the Department of Energy in order to test the relevance of the questions and procedure in a federal agency. These pretests involved two different groups of volunteers, separated by grade level in order to foster a more open discussion. Many of the comments and suggestions made by the pretest group were incorporated into the final questionnaire, completed in January 1989. Appendix A contains the final questionnaire.

3.2 Content of the Questionnaire

The questionnaire is divided into five sections. The first three sections address the primary focus of this report: the spatial distribution of health symptoms and comfort complaints throughout the Madison Building. Part IV is a section on job characteristics that addresses potential confounders such as job satisfaction and looks for indicators of stress in work and non-work activities. Part V includes demographic and other miscellaneous questions. Highlights of the contents of each part of the questionnaire are presented below.

Part I. Description of Workstation

Potential Risk Factors

Previous studies of office workers' health complaints have identified certain risk factors associated with the workstation. Among these are textiles, which may collect dust or emit organic gases, partitions, which may emit formaldehyde and other organics; and office equipment,

such as copying machines, which may emit solvents or fumes from graphic processes.[1] Large amounts of paper have been shown to be a risk factor in previous indoor air studies.[2] Questions 7, 8, 9, and 11 collect information about these and other suspected or potential risk factors. Question 10, dealing with fans, air filters, heaters, and desk lamps, is included to determine how many people have brought such additional equipment to work to adjust the comfort factors in their workstation. Question 12, on water leaks, is included because many investigations have identified humid conditions or water leaks as breeding grounds for molds, fungi, and bacteria that could cause building-related illnesses.

Exposure

Part I includes questions that characterize the potential exposure of Madison Building employees to adverse environmental conditions while at their workstations (desk, office, cubicle, or primary work place). The workstation attributes explored include the following.

- Depending on the design, construction, maintenance, and evolution of the work space and the heating, ventilating, and air conditioning (HVAC) system, the type of physical space (Question 1a) has been found to be critical to the indoor air quality of a particular space.
- Changes in workstation space configuration (Question 11f) were examined.
- The type of space and space sharing information (Question 1) was collected for comparison to information on comfort in Part III, especially Question 1.
- The determination of temporal employment characteristics for each employee (Questions 3, 4, 5, and 6) were made.
- Data on exposure (Question 9), or remediation (Question 10), from specific equipment were solicited.

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[1]Wallace, L.A., Pellizzari, E., Leaderer, B., Zelon, H., Sheldon, L. (1987). "Emissions of volatile organic compounds from building materials and consumer products," Atmos. Environ. 21:385-393.

[2]Skov, P. and Valbjorn, O. (1987) "Sick Building Syndrome in the Office Environment, the Danish Town Hall Study," Indoor Air '87 Vol. 2, pages 439-443, Institute for Water, Soil and Air Hygiene, Berlin.

Part II. Information About Health and Well-being

In order to explore the primary question of the geographic distribution of health symptoms and comfort complaints, health outcomes possibly associated with working in an indoor environment, as well as potential risk factors or confounders associated with the work environment, must be explored.

Health Outcomes

Information was sought on the occurrence of a number of symptoms that have been reported by workers in previous evaluations of health effects of indoor air quality. Symptoms included were those related to nasal and mucous membrane irritation, respiratory effects, and other non-specific symptoms such as headache, fatigue, memory problems, tension, and depression (Question 7).

Information was sought on several specific potential health hazards associated with the work environment such as the use of video display terminals (VDTs) and postural strains due to poorly designed workstations. Eye strain (Question 7, parts j, k, l, and m) and possible cumulative trauma disorders or strains (Question 7, parts cc through ff) assess the effects of these potential hazards.

Information was sought on the chronic occurrence of these symptoms by asking employees how often they experienced each symptom during the past year on a scale from "never" to "always" (Question 7). To provide an estimate of more recent symptom occurrence, employees were asked how many days each symptom occurred in the week immediately preceding the survey. This information was indicative of a point prevalence in the winter season and was also used to select specific areas within the building for environmental monitoring. Finally, information was obtained in Question 7 on whether each symptom changes when a person is not at work. As a general rule for most symptoms, if the symptom is related to the work environment, it would be expected to improve when not at work. Some exceptions to this general rule include muscle pains, which tend to get worse several hours after the irritating activity; delayed hypersensitivity reactions; and immune responses that can be triggered by apparently small amounts of substances encountered at home or at work.

The frequency of symptom occurrence was asked for each symptom (Question 7). The severity of these symptoms,was assessed by asking the employees if any of these symptoms reduced their ability to work (Question 8) or caused them to miss work (Question 9).

Information was sought on the increased susceptibility of the employee to respiratory illnesses such as bronchitis and pneumonia (Question 13) or other infections (Questions 12 and 17) as a possible concern related to the indoor work environment. Questions regarding asthma (Questions 15 and 16) were asked both to investigate the possibility of its occurrence as a result of the indoor environment and because, if present before employment in the building, it may be a risk factor for the occurrence of a number of symptoms included in the questionnaire.

A series of questions was included on irritation caused by a variety of fumes (Questions 19 and 20) because of a number of previous reports in the Madison Building as well as from other work environments.

Information was sought on changes in the occurrence of symptoms in different seasons due to changes in environmental factors, such as ventilation, temperature, and humidity (Question 10). This information can also be related to individual perceptions (obtained in Part III of the questionnaire) of these environmental factors.

Other Related Health Factors

Information was sought on a number of characteristics that can affect responses to the questions regarding health symptoms. Questions regarding the wearing of contact lenses and glasses (Questions 1 and 2) are used in the analysis of the questions regarding eye irritation and eye strain. Information was sought on the smoking of tobacco products (Questions 3 through 6) to help analyze health outcomes such as those related to the respiratory system and mucous membrane irritation. Information was sought on employees with eczema (Question 14) and allergies to pollens or animals (Question 18). These individuals may be more likely to experience an allergic type response to some environmental factors. Finally, information was sought on age (Question 21) and gender (Question 22) since previous studies have shown that the occurrence of

certain symptoms or the tendency to report the occurrence of symptoms may be related to age or gender.[3]

Part III. Information About Present Workstation

Indoor air quality attributes, such as air movement, temperature, humidity, stuffiness, odors, and dustiness, are the focus of many complaints about indoor air quality. Each of these physical comfort issues has been identified as a likely contributing source for many of the health symptoms mentioned in Part II, such as mucous membrane irritation, respiratory irritation, headache, and fatigue.

Air Quality Outcomes

- Questions 1, 2, 3 profile the complaints and perceived performance of the heating, ventilation, and air-conditioning (HVAC) systems. The distributions of odors, for example, may help identify possible sources and HVAC solutions.
- Employees were asked how often they wanted to adjust air movement (Question 1c), temperature (Question 1f), or humidity (Question 1i). These questions contribute to analyzing the acceptability of the workstation. The responses may be helpful in identifying mitigation measures.

Physical Comfort Outcomes

- Information on noise and quiet (Question 1k and 1l) was collected for its potential relationship with health outcomes such as headache, fatigue, etc. (Part II), and job satisfaction (Part IV), and as a portion of the overall assessment of the physical environment.
- Information on lighting (Questions 4, 5, and 6) relates to eye health (Part II), equipment use (Part I), and was used as a portion of the overall assessment of the physical environment.
- Access to daylight (Question 6) and the necessity and frequency of taking fresh air breaks (Question 9), are believed to be related to well being (Part II) and

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[3] Op Cit.

stress management (Part IV). Question 9 was also part of the evaluation of the HVAC system;

- Information on the physical comfort of furniture (Questions 7 and 8) was collected to see what role workstation design and ergonomics may play in the association of symptoms and comfort complaints, particularly eye and muscular health (Part II) and job acceptability (Part IV);

- Information was sought on the overall assessment of the physical environment (Questions 10, 11, 12, and 13) including possible daily changes in the physical environment.

Part IV. Characteristics of the Job

Job characteristics address issues which could possibly create stress. Stress is defined as "a disturbing imbalance between the job and the individual."[4] The work factors which can cause stress are called job stressors. Job stressors are work conditions that produce an acute affective, physiological, or behavioral response. Stressors are important to an assessment of the work environment because they are capable of producing symptoms that are similar to those associated with poor indoor air quality and therefore serve as potential confounders in this study. Questions in this section are combined to form indices of commonly occurring job stressors:

- Job satisfaction: job stressors are often found to be highly related to reports of job satisfaction. A measure of global satisfaction was included to provide a rough index of overall job stress level (Question 1, parts a, b, c, and d). Specific aspects of satisfaction are assessed in Questions 2 and 3.

- Role conflict and role ambiguity are two of the most ubiquitous stressors found in modern work environments. Role conflict (Question 4, parts a, b, and c) occurs when behaviors demanded by an individual's roles in an organization are incompatible. Role ambiguity (Question 6, parts h, i, j, and k) refers to a lack of certainty regarding expected role behaviors.

- Job control (Question 5, parts a, b, c, and d) has been associated with psychological and physical health complaints. This scale assesses control over workload, resources needed to do the job, policies and procedures at work, and workstation surroundings.

- Quantitative workload (Question 6, parts a, b, c, and d) refers to the amount of work an individual has to do and the pace at which the individual must work.

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[4]Sauter, S.L., Chapman, L.J., and Knutson, S.J. (1985). Improving VDT Work: Causes and Control of Health Concerns in VDT Use, Lawrence, KS.

Quantitative workload is one of the most commonly assessed job stressors in the occupational stress literature and has been linked to a variety of health complaints.

- Underutilization of abilities (Question 6, parts e, f, and g) measures the extent to which workers are required to use skills and knowledge in completing their work. Underutilization of abilities is a highly prevalent stressor thought to produce a variety of health complaints.

- External stressors (Question 7) form an index of overall non-work demands. These are important to assess because non-work demands can increase the level and nature of work demands and vice versa. Work and non-work demands may interact to increase symptom reporting.

Job stressors act as confounders which complicate a determination of the cause of indoor air quality complaints. The particular questions and scales used in this section have already been validated in previous job stress studies and were chosen because of their reliability of measuring work and non-work stressors.[5,6,7]

Part V. Concluding Questions

This section addresses basic demographic issues such as living and financial arrangements; job, pay and educational classifications; and workstation location identified by room number and telephone number. Demographic issues such as job classification or education help explain clustering of responses. Information about room number and phone number was sought so that responses could be related to environmental monitoring. Part V concludes with an opportunity for the respondent to tell us anything else that concerns him or her about air quality or environmental health in the building. There were two major reasons for including this question. First, the questionnaire may have left out an important factor in health or environmental considerations. If enough respondents mention the same factor, then it both merits attention and

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[5]Caplan, R.D., Cobb, S. French, J.R.P. Jr., Van Harrison, R. and Pinneau, S.R. (1975). Job demands and worker health. HEW Publication No. (NIOSH) 75-160.

[6]Quinn, R.P. and Staines, G.L. (1979). The 1977 Quality of Employment Survey, Institute for Social Research, University of Michigan, Ann Arbor, Michigan.

[7]Quinn, R.P. and Shepard, L.J. (1974). The 1972-73 Quality of Employment Survey: Descriptive statistics with comparison data from the 1969-70 Survey of Working Conditions. Ann Arbor: Survey Research Center.

may be important to include in future building studies. Second, an essay question gives respondents an opportunity to express any strong feelings or opinions that cannot be expressed within the structure of the questionnaire. Respondents were assured of the confidentiality of their responses to Part V, as well as to the entire survey.

3.3 Maximizing Respondent Participation

A comprehensive plan was developed and implemented to maximize responses to the questionnaire:

- endorsement was secured from management and union leaders and communicated to all employees prior to the survey;
- management and unions leaders reviewed a draft questionnaire and made comments;
- all employees were notified of the survey a few days before the distribution of the questionnaires;
- questionnaires were distributed through the supervisors;
- the questionnaires were tracked to ensure that every employee received one;
- confidential return of the questionnaires to the health statistics contractor was accomplished by the use of questionnaire return boxes to be maintained and collected only by contractor employees;
- a hot line was provided for all employees for questions regarding the questionnaire or its confidentiality;
- telephone calls were made to prompt non-participants to return their questionnaires; and
- reminders of the survey due dates were posted in designated locations in the building.

The plan assured that the questionnaire was approved by both management and the unions with the qualification that maximum precautions be taken to ensure confidentiality of the participants' responses. With this assurance, management and unions agreed to communicate their endorsement to all Madison Building personnel. As part of this effort, a letter was sent to all employees from the Librarian of Congress and the presidents of the unions encouraging all

employees to participate in the voluntary survey and assuring them that their responses would be confidential. A second letter was sent from the Librarian of Congress to the supervisors explaining the nature of the survey, the contractor's role in the survey, and the procedure they were to follow in distributing the questionnaires to their staff. A third letter, included with the questionnaires, was sent to all employees from the study researchers, introducing themselves and explaining the nature of the questionnaire and the procedure to be followed in filling out and returning the questionnaire. Included in the letter was the contractor's phone number that the respondents could use for any questions they might have regarding the questionnaire or its confidentiality.

Confidentiality was built into the protocols for the distribution, return, and review of the questionnaire. The questionnaire was delivered by the supervisors in sealed envelopes to each employee with the assurance that neither they nor Library of Congress (LOC) management would see the employee's responses. Once completed, the questionnaires would be returned by the respondents in special sealed envelopes to questionnaire return boxes located on each floor. The only identifying information on the questionnaire was an employee identification number to be used by the contractor in tracking and analyzing the data. This number and its association with an LOC employee was known only to the contractor and was used to keep track of questionnaire returns and to coordinate employee health concerns and environmental monitoring. The questionnaire return boxes were maintained and collected by the contractor. The questionnaires were taken to the contractor's facilities in Rockville, Maryland to be processed.

In order to encourage maximum participation, telephone prompts were made on Wednesday and Thursday of the survey week. The telephone prompts asked the employees:

- If they had received a copy of the questionnaire;
- If they were in the process of completing the questionnaire;
- If they planned to fill out the questionnaire;
- If they did not plan to fill out the questionnaire, why not;
- If they did plan to fill out the questionnaire, they were reminded to fill it out and return it to the questionnaire return boxes by 3:00 pm on Friday; and
- If they had already filled out the questionnaire, they were reminded to return it to the questionnaire return boxes by 3:00 pm on Friday. Also, notices were

posted in designated locations in the building during the survey week reminding the participants to return their questionnaires by 3:00 pm on Friday.

Response Rate

A total of 3176 questionnaires was delivered to Library of Congress employees in the Madison Building. Of these, 2845 were completed and returned, resulting in a response rate of 89.6%. Another 23 questionnaires were returned by the employees, but were not used in any analyses because they provided insufficient information (11 were blank; 12 had removed bar code label). Further breakdown of the response rate by demographic groups (age, gender, job category) is not possible, as records containing this information about non-respondents were not available to study investigators.

3.4 Employee Survey Field Protocol

This section presents the selection criterion for respondents and the protocols used by the field team in administering the survey.

The list of employees to be surveyed (the "frame") included all full-time employees located in the Madison Building of the Library of Congress. The frame intentionally excluded contractor employees. The Library of Congress management supplied a data tape of personnel that included information on the building assignment and supervisor. With this information, two labels were generated for each respondent. One label listed the respondent's name, office number and supervisor, the other was a six digit ID with a bar code.

The questionnaire was designed to be self-administered. Contractor field staff distributed the questionnaires to LOC supervisors and collected the completed questionnaires form return station boxes. The field staff were responsible for the following tasks:

- Setting up the return stations boxes in designated locations, exits and elevator lobbies;
- Transferring return stations boxes to the contractor;
- Ensuring that envelopes containing completed questionnaires were not opened until they reached the contractor;
- Monitoring the return station boxes and locations in the building;
- Removing full boxes to designated area;
- Reporting any problems, missing return station boxes, vandalism to return station boxes, etc.; and
- Referring respondents with questions to the Field Operations Manager and returning completed questionnaires to questionnaire return station boxes.

The field staff distributed the questionnaire packets to the LOC supervisors on February 3. The survey began on February 6, when the LOC supervisors distributed the questionnaire packets to their staff.

Each packet contained the following:

- The questionnaire;
- Two letters, one explaining the purpose of the study, the second explaining the procedures to follow when the questionnaire was completed; and
- An envelope used by the respondent when returning the completed questionnaire to the return station box to ensure confidentiality and privacy.

If there were problems with the distribution of the packets, the LOC supervisors contacted the field supervisors for assistance. Few problems occurred; most were the result of respondents relocated to another building, retired, recent hires or in some cases on annual or sick leave. Where needed, the field staff distributed copies of the questionnaire to respondents who did not receive one or misplaced the first copy. While the LOC supervisors distributed the questionnaire packets, the field staff set up questionnaire return station boxes in all the elevator

lobbies throughout the building. There were approximately 60 return station locations in the Madison Building. The return station boxes remained in the elevator lobbies for the duration of the survey period and were monitored every hour by the field staff.

The monitoring was done to prevent vandalism and to identify any station that was at least half-filled with questionnaires. The quantity in the return station box was determined by lifting the station and gently shaking it. When a return station box was found to be at least half-filled, it was removed and replaced with an empty return station box. The half-filled return station boxes were taken to the field office, opened, and consolidated with the contents of other boxes. At the end of the day the filled return station boxes were transported to the contractor. Under no circumstances were the return station boxes or the completed questionnaires handled by anyone other than contractor personnel. Once at the contractor's offices, the return station boxes were opened, the sealed envelopes were removed and opened, and the questionnaires were processed through receipt control.

3.5 Data Preparation

Receipt control for questionnaires received at the contractor's headquarters was done by passing a bar code reader over the bar code on the front of the questionnaire. In a few cases where the respondent had altered, removed, or damaged the existing bar code, it was necessary to type in the correct ID number assigned to the respondent. After 50 ID numbers had been entered, a batch sheet was printed. The batch sheet had the batch ID number, the date, the code reader's initials, and a listing of all the ID numbers in that batch. The batch sheet was then attached to the questionnaires and the completed batch was sent to Key Entry for keying. The questionnaires were then keyed and 100 percent verified.

Coding and editing were accomplished by the use of COED, a computer software system developed by the contractor for preparing and analyzing data for survey research studies using predesigned survey forms. After the data were key entered, an edit report was generated for each batch keyed. The coding staff reviewed the edit report, corrected any errors, and submitted the corrections to key entry to update the data files. This cycle of review was completed three times. At various stages in the editing, the coding staff found responses that were not among the response options provided in the questionnaire. In these instances, they would fill out a problem

card for the supervisor, which the supervisor would review and assign a code. The file was then updated with the new code. The problem cards were filed by question number, making it possible to identify which questions answered with a faulty response. If a "faulty" response was received often enough that it appeared to be a standard response, then it was added to the list of acceptable responses.

A review of the database resulted in finding and resolving various editing problems. This review indicated that there were 11 respondents whose symptom matrix was blank. That is, the respondent did not answer any part of Question 7 in Part II of the questionnaire. All 11 questionnaires were reviewed. It was discovered that these respondents had also failed to answer substantial parts of the questionnaire. It was decided to delete these 11 cases from the database.

In Question 4b, Part I (number of hours spent in building during a typical day), there were instances where the respondent indicated a response that was outside of an acceptable range. A formula was created to make the response fall within the acceptable range. Specifically, when the reported hours exceeded 16, the reported hours were divided by five, under the assumption that the respondent had interpreted the question to be about hours per week instead of hours per day. The same problem was found to occur with Question 5, 9a, 9b, 9e, and had similar resolutions.

If a respondent reported having worked in the building before it was built (Question 3a, 4a Part I), the response was changed to be no longer than the building's age.

In Question 7, Part II, there were instances when the respondent did not answer the first question for a particular symptom, but did go on and answer the second question for that symptom. In each case, we imputed the response to the first part of the question as "rarely." Also, if the respondent answered "never" to the last year part, but for the last week indicated one or more days, the response to last year was changed to "rarely." If a respondent failed to answer some symptoms in Question 7 Part II, but responded to others, the missing items were coded as "never."

For Question 5a in Part III there were instances when the respondent indicated "never," but went on to 5b and checked a response. For these cases, the response at 5a was changed to "sometimes."

4. ENVIRONMENTAL MONITORING METHODOLOGY

This chapter summarizes the environmental monitoring research component of the indoor air quality study at the Library of Congress Madison Building. The summary includes a discussion of the methods used to select the monitoring sites (Section 4.1); the environmental monitoring design (Section 4.2); the methods followed in the evaluation of the Madison Building ventilation system (Section 4.3); and the supplemental employee questionnaire administered in conjunction with the monitoring (Section 4.4). The monitoring methodology will be presented in greater detail in Volume II of the study report. Volume II will also report on the monitoring data.

4.1 Selection of Environmental Monitoring Sites

During the week after the administration of the comprehensive survey, a preliminary analysis of the questionnaires was performed to rank each room within the Madison Building by prevalence of health symptoms and thermal comfort complaints. Rooms with a high prevalence and those with a low prevalence of symptom and thermal comfort complaints were then provisionally selected for environmental monitoring.

The specifics entailed in this selection protocol are presented below, first for health symptoms and then for thermal comfort.

Health Symptom Scores

a. Even though all employees were included in the survey, the data used for site selection were limited to employees who reported working at their workstations four or more hours a day, on average.

b. Symptoms were counted as positive if the following three criteria were met:

   1. reported to occur at least "often" in the past year;

   2. reported to occur at least 1 day in the past week; and

   3. reported to get better when away from work.

c. Of the 32 symptoms listed in the questionnaire, 19 were grouped into the following categories:

Nasal: runny nose, stuffy nose/sinus congestion, sneezing.

Respiratory: cough, wheezing or whistling in chest, shortness of breath, chest tightness.

Mucous Membrane: dry, itching, or tearing eyes, sore/strained eyes, burning eyes, sore throat, hoarseness, dry throat, problems with contact lenses.

Non-Specific: headache, unusual fatigue or tiredness, dizziness/ lightheadedness, difficulty concentrating, difficulty remembering things.

d. For each of the four symptom categories, if any symptom was positive (from b. above), then the symptom score for that category equaled 1. If no symptom within the category was positive, then the symptom score was 0.

e. The total symptom score for each individual was calculated by summing the scores of each of the four symptom categories. The possible range of scores then was from 0 (no symptom category) to 4 (all symptom categories).

f. For each room in the building, the mean health symptom score was calculated by summing the total symptom scores and dividing the total by the number of respondents in the room.

Thermal Comfort Scores

a. A comfort score was computed for each of the four thermal comfort factors (temperature, air movement, humidity, and stuffiness). A score of 1 was given if there was "too much" or "too little" of the factor "often" or "always" in the previous week, with a score of 0 otherwise. These were added to obtain a "last week" thermal comfort score that ranged from 0 (no factors) to 4 (all thermal comfort factors).

b. A "last year" score was calculated by giving a 1 if any of the four factors occurred "too much" or "too little" "often" or "always" in the last year, and 0 otherwise.

c. The "last year" and "last week" scores were added to obtain a thermal comfort scale with values from 0 to 5.

Combined Scores

a. Two z scores were then calculated, one for the mean symptom scores in each room, and one for the mean thermal comfort scores in each room:

$$z_i = \frac{(X_i - \bar{X})\,(n_i)^{1/2}}{s_i}$$

where:

X_i = mean symptom or comfort score for Room i

$\bar{X}$ = overall mean symptom or comfort score (all rooms)

n_i = number of eligible respondents in Room i

s_i = sample standard deviation of individual scores in Room i

If n_i equaled 1, the building-wide standard error estimate was substituted for s_i in the denominator. Similarly, if the variance of the mean score was 0, i.e., all persons in a given room had the same score, s_i was set equal to 0.35 (which is half the standard deviation if half the people had the same score and the other half had a score a unit above or below that score).

b. The health symptom and comfort z scores for the approximately 300 rooms in the building were ranked in order of magnitude.

c. Approximately 50 rooms with the highest symptom prevalences (z scores above +1.5) and 40 rooms with the lowest symptom prevalences (z scores below -1.0) were chosen. To maximize the environmental monitoring resources available, single person offices were not eligible for selection.

d. Each room chosen in this manner was visited by a team of industrial hygienists to assess its appropriateness for sampling. One or two sites within each room, depending on its size and layout, were selected and marked for sampling.

In addition to the sites chosen in the manner described above, some sites were selected in two other manners:

(1) In order to be responsive to the persons who work in the Madison Building and have particular concerns about certain areas of the building, representatives of management and each of the three unions were asked to provide a list of sites where employees were thought to have experienced problems (either health or comfort related). These sites were compared with the list generated by analysis of the survey questionnaire, and, if a site reported by management or unions

was not included in that list, every effort was made to perform environmental monitoring. The results of monitoring done at those locations are reported separately.

(2) As stated above, single-person offices were not eligible to be selected for environmental monitoring. However, because they are an area of concern for employees, a list of such offices was requested from union representatives, and environmental sampling was performed at seven 1-person and three 2-person offices. The results from these locations will be reported separately from the results of sites chosen in the selection procedure reported above.

4.2 Environmental Monitoring Research Design

Of the rooms identified and prioritized using the initial employee survey results, three types of monitoring sites were identified:

- temporal sites, at which direct, instantaneous measurements were collected at one or more points in time;
- integrated sites, at which an integrated sample was collected over an entire workday, in addition to the temporal measurements; and
- two fixed sites, one indoor and one outdoor, at which both integrated and temporal measurements were made each workday throughout the entire week.

A total of about 100 temporal and 50 integrated sampling sites were identified, with the integrated sites also being temporal sites. Sample collection occurred during normal employee working hours (between 7:00 am and 5:00 pm) during the week of February 27-March 3, 1989. On a typical day, samples were collected at the fixed indoor, fixed outdoor, up to 10 integrated indoor, and up to 20 temporal indoor monitoring locations.

Environmental monitoring at the LOC was conducted by investigators from NIOSH, EPA, the John B. Pierce Foundation of Yale University (Yale), and NIST. Each agency was responsible for an important aspect of the comprehensive study plan. Exhibit 4-1 summarizes, by participating agency, the environmental parameters monitored and the analytical methods used to evaluate them.

Exhibit 4-1: Environmental Monitoring Methodology, Madison Building Evaluation

AGENCY	ANALYTE	SAMPLE COLLECTION	ANALYTICAL METHOD
NIOSH	VOCs*	Triple-bed solid sorbent	GC-MSD*
	Carbon dioxide	Direct measurement	Infrared analyzer
	Respirable particles	Direct measurement	Scattered infrared light beam
	Temperature (°F), relative humidity	Direct measurement	Psychrometer
	Viable microbiological agents	Impaction onto agar	Incubation, colony count
	Non-viable microbiological agents	Impaction onto greased tape	Spore count
EPA	VOCs*	Evacuated canister	GC-MS*, FID*
	Respirable particles	Dichotomous sampler	Gravimetric
	Aldehydes	Coated silica gel	HPLC*
	Pesticides	Poly-urefoam cartridge	GC-ED*
YALE	Nicotine	Coated filter (passive)	GC-nitrogen specific detector
NIST	Sulfur hexafluoride (ventilation decay study)	Automatic sampler	GC-ECD*
	Carbon dioxide	Direct measurement	Infrared analyzer
	Carbon monoxide	Direct measurement	Infrared analyzer

VOCs, volatile organic compounds
GC, gas chromatography
MSD, mass selective detector
MS, mass spectrometry
FID, flame ionization detector
ED, electrochemical detector
HPLC, high pressure liquid chromatography
ECD, electron capture detector

NIOSH: The NIOSH effort was divided into three categories: (1) the direct measurement of carbon dioxide (CO_2), respirable and total particles, and temperature and relative humidity, (2) viable and non-viable microbiological agent sampling, and (3) volatile organic compounds (VOC) and formaldehyde air sampling.

(1) Temporal measurements of carbon dioxide, respirable particles, and wet- and dry-bulb temperatures (used to calculate relative humidity) were made at each temporal and fixed site four times daily (early morning, late morning, early afternoon, and late afternoon).

(2) Samples for viable microbiological agents (fungi, thermophylic actinomycetes, and other bacteria) were collected using a single-stage impactor. The collected particles were impacted onto a growth media. The viable particles were then grown on the media, under appropriate temperature conditions, to a size where they could be counted. Non-viable samples (fungal spores) were collected using a spore trap. Water samples were collected from the reservoirs of both steam and water-spray HVAC humidification systems. These samples were serially diluted, plated onto growth media and incubated under appropriate temperature conditions to a size where they could be counted.

The viable bioaerosol sampling protocol called for collecting duplicate five-minute samples for fungi, thermophylic actinomycetes, and other bacteria at each designated sample site. On Monday through Thursday, two high symptom and one low symptom areas were sampled twice, once in the morning and again in the afternoon. Five sampling sites from Monday had repeat sampling conducted on Friday. A control sample from outside the building was collected on each of the five sampling days.

The non-viable sampling protocol called for the collection of four 24-hour samples on Monday through Thursday. Sample locations were chosen from the sites identified from the questionnaire results.

The protocol also called for the collection of water samples from the HVAC humidification systems serving the sampled areas.

(3) The VOC sampling and analysis method used by NIOSH was an experimental procedure. Only preliminary evaluation work had been performed with this method and the full range of the method had not yet been explored. Results obtained with this methodology were considered to be tentative at the time of the survey. Samples were collected for a 6- to 8-hour time period on multiple-bed solid sorbent tubes (commercially available) and analyzed using a thermal desorber system, interfaced with a gas chromatograph equipped with a mass selective detector (GC-MSD).

The formaldehyde air samples were collected using a formaldehyde passive monitor (commercially available). The monitors were exposed for

The formaldehyde air samples were collected using a formaldehyde passive monitor (commercially available). The monitors were exposed for approximately 24 hours. These devices sampled for formaldehyde by diffusion and were analyzed, using a proprietary solution, on site. The amount of formaldehyde present on the badge is determined by the length of stain produced by the proprietary developing solution.

The protocol for the NIOSH VOC sampling called for collection of five samples per day. These samples were paired with the EPA VOC samples (canister method). Samples were collected in both high and low symptom areas. Formaldehyde samples were collected at all sites monitored by EPA for VOCs.

EPA: The EPA conducted integrated air sampling for volatile organic compounds (VOC), respirable particles, pesticides, and aldehydes. VOC and respirable particle samples were collected at each location using evacuated SUMMA polished canisters and preweighed 37 mm Teflon filter media respectively. Aldehyde and pesticide samples were collected daily at selected (>2) indoor locations using 2,4-dinitrophenylhydrazine coated silica gel and poly-urefoam (PUF) cartridges, respectively.

Gravimetric sample analysis follows standard EPA procedures. VOC samples were initially analyzed for 25 targeted compounds by GC/mass spectroscopy followed by GC/flame ionization detection for total non-methane VOC. Pesticide and aldehyde samples will be analyzed by GC/electrochemical detection and high pressure liquid chromatography, respectively.

Yale: The Yale investigators measured for vapor phase nicotine at all LOC sampling locations. Integrated nicotine samples were collected over the entire five day sampling period using a recently developed passive monitor containing sodium bisulfite-coated filter media. Sample nicotine analysis was conducted by GC with a nitrogen-selective detector.

NIST: As part of its on-going study of the ventilation system of the Madison Building, NIST made measurements of local air exchange rates at 59 of the sampling locations. Further description of the NIST study and measurements made as part of the environmental monitoring is presented in Section 4.3.

4.3 Evaluation of Madison Building Ventilation System

Two separate evaluations of the Madison Building ventilation system were used as part of this study: one performed by the National Institute of Standards and Technology (NIST), as part of an on-going study, the other performed by NIOSH investigators.

NIST: NIST is conducting a long-term study of ventilation and air quality in the Madison Building of the LOC under the sponsorship of the U.S. Department of Energy. This investigation began in late 1988 and is scheduled to last approximately one year. During the 5-day period of cooperative study, NIST made measurements of whole building air exchange rates, local air exchange characteristics, and carbon dioxide levels. Measurements of whole building air exchange rates and carbon dioxide levels were also made before and after this period, providing a baseline for comparing the data collected during the week of intensive measurements.

Whole building air exchange rates were measured using tracer gas decay techniques. In the tracer gas technique, a harmless and nonreactive tracer gas (sulfur hexafluoride) is released into a building and mixed thoroughly with the interior air. Once the tracer gas concentration is spatially uniform within the building, the concentration decay is monitored over time using GC-electron capture detection.

Measurements of local air exchange characteristics were performed at 59 of the locations within the occupied space that were monitored during the week of cooperative testing. These local evaluations included measurements of local decay rates and measurements of the mean local age of air. Additionally, CO_2 and carbon monoxide (CO) concentrations in the building were measured in the eight return shafts in conjunction with the tracer gas decay tests using an automated infrared detection measurement system. Two-hour averages of CO_2 concentrations were also measured at the 59 locations tested in the evaluations of local ventilation, during these local tests.

NIOSH: The NIOSH evaluation was directed at observing and recording operational parameters of the ventilation systems supplying areas of the Madison Building where environmental monitoring was being conducted. The methods used for evaluating the ventilation system at the Madison Building were first to record daily the operational parameters from the control panel gauges for the air handling units supplying air to the survey sites for that day. As

part of this operation, the pressure drop across the filters, the position of the outside air damper, and whether the humidification system was operating was checked on the relevant units. Second, the building systems management computer was set to print out data received from sensors on the air handling units at one-half hour intervals throughout the time of the survey each day. Third, a copy of the maintenance log was obtained daily. Fourth, thermostats from survey sites were randomly selected for inspection for calibration, settings, and operation. Fifth, the air flow patterns in the hallways and at the doorways on each floor were visualized using smoke tubes and recorded. Sixth, three spaces were fogged using non-toxic smoke to show air flow patterns within the spaces.

In addition to the evaluations performed by NIST and NIOSH, another data source will be used to assess the representativeness of the thermal conditions in the Madison Building during the week of the environmental monitoring. Building engineers in the office of the Architect of the Capitol (AOC) maintain approximately 100 fixed temperature and humidity sensors within the building. Hourly logs of these data were obtained from the AOC over a period of one month, extending from the week of the employee survey through the week of the environmental monitoring. These data will be analyzed to detect trends in temperature and humidity over this time period.

4.4 Supplemental Questionnaire

A short follow-up questionnaire was designed to be administered to individuals near the environmental monitoring stations on the day of testing. The purpose of the questionnaire was to assess health and comfort status during the same period the environmental parameters were measured. The questionnaire is provided in Appendix B.

The supplemental questionnaire is comprised of four sections:

1. **Description of Workstation:** These questions assess the amount of time an individual has been in the building and at his or her workstation on the day of testing, as well as the amount of time spent at tasks such as photocopying and working at video display terminals. In order to help interpret some of the environmental measurements, individuals were also asked about the use of certain chemicals and processes in their work area.

2. **Information about Workstation Conditions:** These questions from the original questionnaire were slightly modified to assess an individual's perception of air movement, temperature, humidity, noise, and levels of stuffiness and dustiness. These perceptions were obtained from respondents separately for the morning and afternoon in order to be correlated with environmental parameters measured throughout the day. Individuals were also asked about their perception of a variety of odors at their workstation during the day.

3. **Information about Health:** Individuals were asked to report on the occurrence of the same 32 health symptoms included on the original questionnaire. For each symptom, respondents were asked if it began before arriving at work, during the morning at work, or during the afternoon at work. This information was used both to assess the degree to which the symptom was directly work-related and to compare with environmental parameters measured throughout the day.

4. **Mood:** A list of mood states was presented and respondents were asked to report if they felt each mood from "not at all" to "extremely." The 24 items were selected from the Profile of Mood States to assess fatigue, vigor, and tension, states that could be affected by quality of indoor air and other working conditions.[1]

Administration of the Supplemental Questionnaire

One or two interviewers were assigned to each environmental monitoring cart. At each of the sites sampled by the cart, the interviewer identified all workers eligible for administration of the supplemental questionnaire. A worker was eligible for the study if he or she met the following criteria:

1. workstation was within 25 feet (distance between structural columns) of the sampling station;

2. workstation was in an area not separated from the sampling station by a wall or other ceiling to floor barrier.

During the morning of the monitoring, the persons to receive the second questionnaire were identified and asked to participate in this phase of the study. They were given a brief written description of the study and a request to participate. They were told that their area was to be monitored that day and that the survey staff would return about 1:00 pm to distribute

[1]McNair, D.M., Lorr, M. and Droppleman, L.F. (1971), "Profile of Mood States," P.O.M.S. San Diego, CA: Education and Industrial Testing Service.

questionnaires that would record how they felt that day. Those individuals who were not at their desks in the morning were left a copy of the notice. For individuals who were not at their desks when the survey staff returned in the afternoon, a questionnaire was left with instructions, with the completed form to be left on their desks in the accompanying sealed envelopes. These questionnaires were picked up around three in the afternoon. As many trips as were necessary were made to the workstations to collect all the questionnaires, whether completed or not, by the end of the day. If a questionnaire was not collected from any individual, the reason was noted on the log. Also recorded was the workstation configuration, e.g., partitions (1/2 or 3/4) or open space. The questionnaires were then sent to the contractor for processing. Approximately 800 supplemental questionnaires were completed and collected.

Individuals were requested to provide their names on the front cover of the questionnaire, so that information from the supplemental questionnaire could be linked to the responses from the original questionnaire. As with all other personal information gathered in this study, confidentiality of these questionnaires was assured and maintained.

Survey Data Preparation

When the questionnaires were received by the contractor, the names on the covers were matched with a list of all employees containing their names, workstation locations and the identification numbers assigned in the main survey. When a match was found, a label with a bar code for the ID was attached to the top of the inside first page. The cover with the name was then detached from the questionnaire. Receipt control was completed by reading the bar code on the questionnaire, in the same manner described in Section 3.5.

The questionnaires were keyed by the contractor, and were 100 percent verified to minimize key entry errors. The coding and editing was accomplished in a manner similar to the main questionnaire. (See Section 3.5.) The data file was reviewed and edited to identify and resolve data errors. With this short, pre-coded questionnaire, the only possible data problems were out-of-range codes.

5. EMPLOYEE SURVEY RESULTS

This chapter describes the findings of the employee survey conducted at the Madison Building of the Library of Congress (LOC). The primary focus of the chapter is on the health symptoms reported in the survey (Section 5.2) and problems of comfort with the work environment (Section 5.3).

Following this presentation, Section 5.4 then summarizes the data collected in the survey on four sets of "background" variables -- (a) the demographics of the respondents (age, gender, education, etc.), (b) certain health characteristics (such as the use of corrective lenses, medical history of asthma, etc.), (c) job satisfaction and sources of stress, and (d) the physical elements of employees' workstations. Each of these background characteristics could prove important in understanding or explaining the survey data and will be used in analyses to be conducted and reported in Volume III. Finally, Section 5.5 summarizes the responses received to the "essay question" at the end of the employee questionnaire; here, respondents had the opportunity to describe building conditions and their experiences in their own words. To focus attention on the main findings, only selected exhibits are presented in this chapter. Additional exhibits referred to in this chapter are included in Appendix C.

A primary objective of the study was to determine the locational variation of health symptoms, comfort parameters, and odors within the Madison Building. In this report, these descriptive analyses are presented by floor of the Madison Building. Because of the relatively small number of persons employed on the Basement and Sub-basement, these two floors have been combined and are referred to as the Sub-ground. It is recognized that not all floors have the same ventilation systems, environmental conditions, or types of employees or job classifications. More complete consideration of these potential risk factors will be provided in Volume III.

5.1 Note on Data Presentation

No attempt is made in this chapter to explore associations between health or comfort outcomes and environmental or other possible risk factors in the building. The data are presented below without accompanying analyses or conclusions about the causes of symptoms experienced.

In addition, it is important to note that the health symptoms and comfort concerns reported in the survey are self-reported by the respondents, and have not been verified by a physician's diagnosis as part of this study.

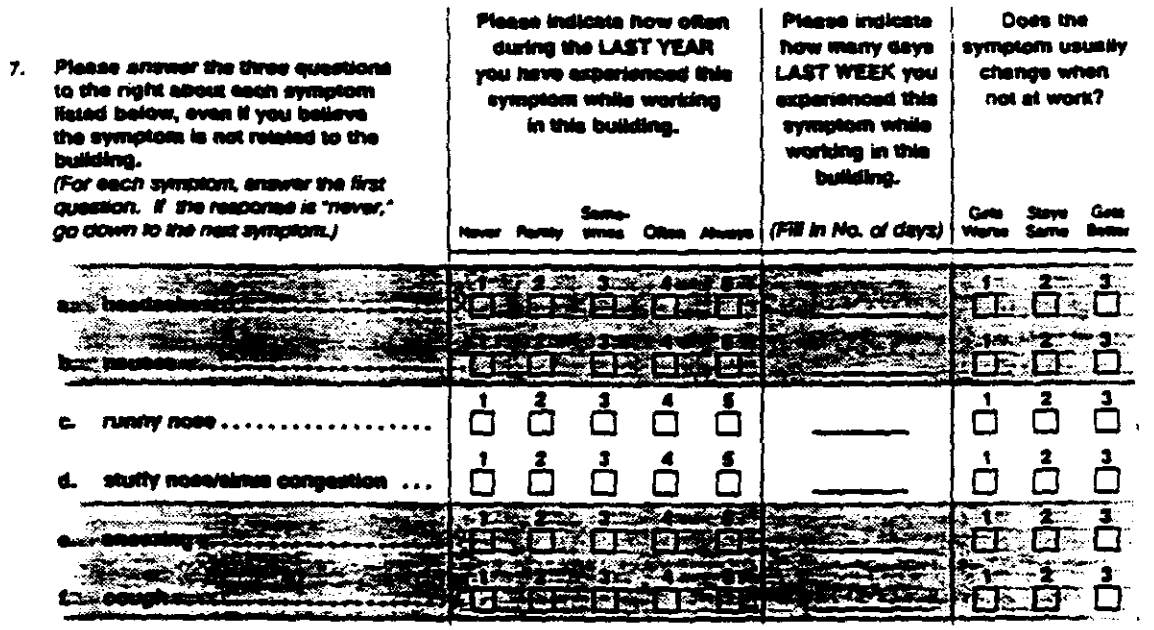
In addition, we cannot comment on the degree to which the findings are "significant" compared to other buildings. At present, there are no expected or "normal" rates of symptoms from other buildings with which to compare these observed prevalences. Other studies reported in the literature tend to report findings from buildings which were known to have problems; therefore, their symptom rates are probably higher than the general population of office workers. Another impediment to the use of reports found in the literature as good comparative data is the fact that few studies use the same definition of a positive symptom; thus findings from different studies can rarely be compared.

The primary reason for this approach is to avoid speculating on the causes of occupant concerns or the significance of the results presented until a complete analysis can be conducted. Multivariate analyses of associations are complex and require a lengthy and more detailed set of calculations. Volume III of this study will present such analyses (including environmental monitoring results).

In order to assess the distribution of symptoms within the Madison Building, floor-specific symptom prevalences were calculated; a chi-square test was then performed. The chi-square test provides a mechanism for deciding when differences in symptom prevalence across floors exceed the amount of variability that would be expected by chance. It is recognized that the group studied was not a sample, but a census of the entire population. Statistical tests could therefore be considered to be unwarranted. However, we consider the population under study to be a sample in time; that is, as people enter and leave the workforce over time, differences in symptom prevalences might be observed, in the absence of any changes in environmental conditions. Thus, it is appropriate to perform such tests on this "sample." The probability level of 0.05 is considered to be the level of statistical significance.

5.2 Health Symptoms

In order to identify health outcomes that might be related to conditions in the Madison Building, major emphasis is given here to a series of questions on 32 health symptoms that comes from Part II, Question 7 of the questionnaire (excerpted below). Respondents were asked to report how often they experienced each of 32 health symptoms in the past year, how many days they had experienced the symptom in the previous week, and whether the symptom typically changes when not at work.



7. Please answer the three questions to the right about each symptom listed below, even if you believe the symptom is not related to the building. (For each symptom, answer the first question. If the response is "never," go down to the next symptom.)	Please indicate how often during the LAST YEAR you have experienced this symptom while working in this building. Never	Rarely	Sometimes	Often	Always	Please indicate how many days LAST WEEK you experienced this symptom while working in this building. (Fill in No. of days)	Does the symptom usually change when not at work? Gets Worse	Stays Same	Gets Better
a. headache	1	2	3	4	5		1	2	3
b. [illegible]	1	2	3	4	5		1	2	3
c. runny nose	1	2	3	4	5	____	1	2	3
d. stuffy nose/sinus congestion	1	2	3	4	5	____	1	2	3
e. sneezing	1	2	3	4	5		1	2	3
f. cough	1	2	3	4	5		1	2	3

It should be remembered that responses to these questions are based on self-perceptions of health and environmental conditions, which might not be verified by independent professional health experts or environmental scientists. In other words, like responses in other surveys, they are subject to the same types of limitations of human reporting due to faulty memory and incomplete recall. At the same time, these are the types of perceptions that affect the way employees interpret their work environment and function in that environment. Respondents are, in other words, in an ideal position to report on their work environment and how it may affect their health and comfort.

5.2.1 Major Health Symptoms Experienced Last Year

Employees were asked to report whether they had experienced a symptom during the past year "never," "rarely," "sometimes," "often," or "always." Because most of the 32 symptoms are experienced by most people at some time, a symptom was considered in the following tables only if it was reported to have occurred either often or always in the past year. The proportion of Madison Building employees reporting these symptoms "often" or "always" in the past year is presented in Exhibit 5-1. (The complete tabulation of responses to this question is shown in Appendix C, Exhibit C-1.)

Most of the symptoms reported, if work-related, would be expected to improve when away from work. Therefore, to obtain a more focused perspective of health symptom problems, a symptom that was reported "often" or "always" in the past year (referred to as a "positive symptom" or, in epidemiologic terms, a "case") was considered to be potentially work-related if it was reported to improve when the employee was away from work in the Madison Building (referred to as a "work-related positive symptom"). The criterion of "gets better when away from work" has also been used as an approximation of "work-related" in previous studies.[1,2]

The proportion of Madison Building employees reporting work-related positive symptoms, as defined above, is also presented in Exhibit 5-1. The most commonly reported work-related symptoms among Madison Building employees were problems (irritation) from contact lenses (31% of contact lens wearers), sleepiness (24%), sore eyes (23%), fatigue (21%), dry eyes (21%), stuffy nose (21%), headache (16%), burning eyes (13%), sneezing (13%), and tension (12%). It can be noted that most of these symptoms, most notably headache, fatigue, and those associated with mucous membrane irritation, have often been reported in published evaluations of indoor air quality.

The prevalences of positive work-related symptoms are presented by floor in Exhibit 5-2. The difference across floors in the prevalence of symptoms was statistically significant (chi-

[1]Finnigan, J.J., et al. "The Sick Building Syndrome: Prevalence Studies", British Medical Journal, 8 Dec 1984, pages 1573-1575.

[2]Skov, P., Valbjorn, O., and Pedersen, V., "Influence of Personal Characteristics, Job-related Factors and Psychosocial Factors on the Sick Building Syndrome", Scandinavian Journal of Work Environment and Health, 1989, 15; 286-295.

Exhibit 5-1: Percent of Respondents* Reporting Symptoms "Often" or "Always" in the Past Year, at Madison Building

Symptoms	Often/Always in Past Year	Often/Always and Got Better Upon Leaving Work
Headache	21%	16%
Nausea	2%	1%
Runny nose	18%	10%
Stuffy nose	34%	21%
Sneezing	18%	13%
Cough	10%	5%
Wheezing	4%	2%
Shortness of breath	4%	2%
Chest tightness	3%	2%
Dry, itchy eyes	26%	21%
Sore, strained eyes	27%	23%
Blurry vision	9%	6%
Burning eyes	16%	13%
Sore throat	6%	3%
Hoarseness	4%	3%
Dry throat	15%	10%
Fatigue/tiredness	27%	21%
Sleepiness	30%	25%
Chills	11%	9%
Fever	1%	1%
Aching muscles/joints	14%	7%
Problems with contacts**	38%	31%
Difficulty remembering	6%	2%
Dizziness/lightheadedness	4%	4%
Feeling depressed	11%	7%
Tension/nervousness	15%	12%
Difficulty concentrating	9%	7%
Dry skin	23%	8%
Pain-upper back	15%	10%
Pain-lower back	16%	9%
Pain-shoulder/neck	13%	8%
Pain-hand/wrist	7%	3%

*Total number of respondents equals 2,750 (excluding persons for whom "floor" was missing).

**These percentages are based upon only the people who wear contact lenses at work "sometimes, often or always" (Part II, Question 1a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

Exhibit 5-2: Percent of Respondents Reporting Symptoms "Often" or "Always" in Past Year and that Got Better Upon Leaving Work, by Madison Building Floor

SYMPTOM	TOTAL (N=2,750*)	FLOOR								p value**
		6th (N=267)	5th (N=712)	4th (N=457)	3rd (N=284)	2nd (N=386)	1st (N=115)	Grd. (N=409)	Sub-Grd. (N=120)	
Headache	16%	18%	16%	20%	14%	19%	12%	14%	13%	0.10
Nausea	1%	1%	2%	1%	1%	2%	2%	2%	2%	0.69
Runny nose	10%	11%	11%	14%	6%	9%	11%	8%	9%	0.20
Stuffy nose	21%	23%	20%	25%	14%	22%	25%	18%	19%	0.02
Sneezing	13%	9%	16%	14%	7%	11%	16%	11%	14%	0.02
Cough	5%	3%	7%	7%	3%	5%	4%	4%	6%	0.09
Wheezing	2%	2%	1%	3%	1%	1%	4%	2%	3%	0.48
Shortness of breath	2%	1%	2%	2%	1%	2%	4%	2%	3%	0.83
Chest tightness	2%	3%	3%	2%	0%	1%	2%	1%	2%	0.06
Dry, itchy eyes	21%	19%	24%	24%	18%	20%	14%	18%	14%	0.03
Sore, strained eyes	23%	19%	29%	26%	21%	23%	15%	21%	9%	<0.001
Blurry vision	6%	5%	8%	6%	5%	8%	6%	4%	4%	0.25
Burning eyes	13%	9%	16%	14%	10%	11%	13%	11%	7%	0.008
Sore throat	3%	3%	4%	4%	2%	3%	2%	4%	1%	0.42
Hoarseness	3%	3%	2%	4%	1%	3%	3%	4%	2%	0.53
Dry throat	10%	10%	11%	13%	5%	9%	14%	10%	10%	0.04
Fatigue/tiredness	21%	17%	23%	27%	13%	24%	13%	21%	14%	<0.001
Sleepiness	25%	20%	27%	32%	25%	25%	20%	20%	21%	0.002
Chills	9%	6%	9%	12%	4%	8%	10%	10%	6%	0.006
Fever	1%	0%	1%	1%	1%	0%	1%	1%	1%	0.89
Aching muscles/joints	7%	5%	7%	8%	5%	7%	6%	6%	7%	0.75
Problems with contacts***	31%	31%	31%	43%	21%	36%	18%	29%	0%	0.05
Difficulty remembering	2%	1%	3%	4%	2%	2%	3%	2%	1%	0.13
Dizziness/lightheadedness	4%	4%	4%	5%	4%	2%	4%	3%	3%	0.49
Feeling depressed	7%	7%	9%	9%	5%	5%	7%	8%	6%	0.21
Tension/nervousness	12%	12%	16%	11%	10%	10%	9%	11%	7%	0.01
Difficulty concentrating	7%	5%	7%	9%	4%	6%	7%	7%	6%	0.20
Dry skin	8%	9%	7%	12%	5%	9%	8%	7%	10%	0.07
Pain-upper back	10%	7%	12%	10%	10%	11%	9%	9%	4%	0.04
Pain-lower back	9%	7%	10%	10%	10%	8%	5%	9%	6%	0.36
Pain-shoulder/neck	8%	6%	10%	8%	9%	8%	7%	6%	4%	0.05
Pain-hand/wrist	3%	3%	5%	4%	3%	3%	2%	2%	3%	0.29

*Excluding persons for whom "floor" was missing.

**Chi Square test for overall difference across floors.

***These percentages are based upon only the people who wear contact lenses at work "sometimes, often or always" (Part II, Question 1a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

square; $p<0.05$) for 13 of the 32 symptoms. These included problems with contact lenses, sleepiness, sore eyes, fatigue, dry eyes, stuffy nose, burning eyes, sneezing, tension, dry throat, upper back pain, chills, shoulder or neck pain.

It is, of course, possible that employees may suffer building-related symptoms that persist, or even first appear, after the employee leaves work. Some symptoms, most notably pain in the back, neck, shoulders, hands or wrists, and symptoms possibly associated with delayed hypersensitivity reactions, such as wheezing and shortness of breath, even if work-related, may be expected not to improve when away from the building. In addition, some individuals may develop an immune response after exposure to certain chemicals encountered at work. Subsequent exposure to even small amounts of these substances, whether at work or not, can then trigger an allergic response. Such symptoms might, therefore, not be expected to improve when away from work among this group of individuals.

Furthermore, employees may experience symptoms only "sometimes" that are nevertheless related to the building. (For example, persons may be sensitive to paint fumes but may only "sometimes" be exposed to a new paint near their workstations.) For comparison to the building-wide prevalences of symptoms (reported to occur "often" or "always") presented in Exhibit 5-1, Exhibit 5-3 is provided, which shows the proportion of employees reporting symptoms "sometimes," "often," or "always" last year. This exhibit also provides the proportion of employees who had symptoms "sometimes," "often," or "always" last year that got better when away from work.

The prevalences of work-related symptoms (reported to occur often or always in past year and gets better when away from work) can be viewed another way, as in Exhibit 5-4, which groups the symptoms into three categories:

1. Indoor Air Quality Symptoms, typically associated with acute discomfort, such as headache, runny nose, stuffy nose/sinus congestion, dry, itching, or tearing eyes, burning eyes, dry throat, fatigue, and sleepiness;

2. Respiratory or Flu-like Symptoms, which may be manifested in clinically defined illnesses that may require prolonged recovery times after leaving the building. Such symptoms include cough, wheezing, shortness of breath, chest tightness, fever, and aching muscles or joints; and

3. Ergonomic Symptoms, which include back pain or stiffness, and pain or numbness in the shoulder, neck, hands, or wrists.

Exhibit 5-3: Percent of Respondents* Reporting Symptoms "Sometimes," "Often" or "Always" in the Past Year, at Madison Building

Symptoms	Sometimes/ Often/Always in Past Year	Sometimes/ Often/Always and Got Better Upon Leaving Work
Headache	64%	44%
Nausea	16%	11%
Runny nose	55%	24%
Stuffy nose	69%	36%
Sneezing	58%	31%
Cough	43%	18%
Wheezing	14%	7%
Shortness of breath	17%	10%
Chest tightness	14%	9%
Dry, itchy eyes	58%	43%
Sore, strained eyes	61%	47%
Blurry vision	27%	18%
Burning eyes	40%	30%
Sore throat	34%	14%
Hoarseness	20%	10%
Dry throat	41%	26%
Fatigue/tiredness	61%	43%
Sleepiness	70%	52%
Chills	31%	23%
Fever	9%	4%
Aching muscles/joints	40%	16%
Problems with contacts**	72%	53%
Difficulty remembering	28%	9%
Dizziness/lightheadedness	24%	17%
Feeling depressed	39%	22%
Tension/nervousness	49%	34%
Difficulty concentrating	41%	27%
Dry skin	48%	15%
Pain-upper back	38%	22%
Pain-lower back	44%	22%
Pain-shoulder/neck	36%	20%
Pain-hand/wrist	21%	9%

*Total number of respondents equals 2,750 (excluding persons for whom "floor" was missing).

**These percentages are based upon only the people who wear contact lenses at work "sometimes, often or always" (Part II, Question 1a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

Exhibit 5-4: Variation in Distribution of Reports of Positive Symptoms*, by Madison Building Floor

SYMPTOMS	TOTAL (N=2,750**)	FLOOR							
		6th (N=267)	5th (N=712)	4th (N=457)	3rd (N=284)	2nd (N=386)	1st (N=115)	Grd. (N=409)	Sub-Grd. (N=120)
Indoor Air Quality Symptoms									
Headache	16%	1.8%	-0.1%	3.2%	-2.4%	2.4%	-4.2%	-2.5%	-3.7%
Runny Nose	10%	0.9%	1.3%	3.8%	-3.6%	-0.6%	0.6%	-2.0%	-0.8%
Stuffy Nose	21%	2.1%	-0.4%	4.2%	-6.6%	1.0%	4.9%	-2.4%	-2.0%
Dry Eyes	21%	-1.3%	3.3%	2.9%	-2.4%	-0.7%	-6.6%	-2.2%	-7.1%
Burning Eyes	13%	-3.2%	3.7%	1.6%	-2.6%	-1.2%	0.4%	-1.7%	-5.8%
Dry Throat	10%	0.0%	0.8%	2.5%	-5.3%	-0.9%	3.6%	-0.6%	-0.1%
Fatigue	21%	-4.4%	2.4%	5.6%	-7.7%	2.7%	-7.9%	-0.4%	-6.5%
Sleepiness	25%	-5.1%	1.7%	7.1%	0.0%	-0.2%	-5.0%	-4.7%	-3.8%
AVERAGE		-1.2%	1.6%	3.9%	-3.9%	0.3%	-1.8%	-2.1%	-3.7%
Respiratory or Flu-like Symptoms									
Cough	5%	-1.6%	1.5%	1.6%	-2.2%	-0.3%	-0.6%	-1.5%	1.0%
Wheezing	2%	-0.3%	-0.4%	1.1%	-0.4%	-0.5%	1.7%	-0.3%	-0.1%
Shortness of Breath	2%	-0.8%	0.2%	-0.4%	-0.5%	-0.1%	1.6%	0.1%	0.6%
Chest Tightness	2%	1.1%	1.2%	0.1%	-1.6%	-0.6%	-0.2%	-0.9%	-0.2%
Fever	1%	-0.3%	0.0%	0.4%	0.0%	-0.4%	0.2%	-0.2%	0.1%
Aching Muscles/Joints	7%	-1.6%	0.3%	1.5%	-1.5%	0.4%	-0.4%	-0.3%	0.2%
AVERAGE		-0.6%	0.5%	0.7%	-1.0%	-0.3%	0.4%	-0.5%	0.3%
Ergonomic Symptoms									
Pain-Upper Back	10%	-3.3%	2.5%	-0.2%	0.4%	1.3%	-1.1%	-0.9%	-5.6%
Pain-Lower Back	9%	-2.2%	1.0%	1.7%	0.9%	-1.1%	-3.4%	-0.2%	-2.7%
Pain-Shoulders	8%	-2.0%	2.3%	-0.1%	0.9%	-0.2%	-1.2%	-2.6%	-3.8%
Pain-Hands/Wrists	3%	-0.2%	1.5%	0.3%	-0.4%	-0.6%	-1.5%	-1.2%	-0.6%
AVERAGE		-1.9%	1.8%	0.4%	0.4%	-0.2%	-1.8%	-1.2%	-3.2%

*A positive symptom is defined as having been reported to occur "often"or "always" in the past year and reported to get better when away from work in the building.

**Excluding persons for whom "floor" was missing.

Reference: Part II, Question 7.

For each of these symptom groups, the floor-specific prevalence of each symptom was compared with the overall building prevalence and the differences were averaged. For example, if a floor reported a positive two percent variation for headaches, that would mean that respondents on that floor experienced a rate of headaches 2 percent greater than the building as a whole, namely 16 percent plus 2 percent, equaling 18 percent. Negative percents indicate a lower than building average percent of persons reporting work-related symptom (occurring "often" or "always"), while positive percentages indicate a higher than average level. (Note that the rows do not sum to zero because of different numbers of respondents on each floor.)

For the symptoms often associated with poor indoor air quality, the only two floors for which this average difference was substantially greater than 0 (floor-specific prevalences were greater than the building prevalence) were the 4th (mean difference = +3.9) and the 5th floors (mean difference = +1.6).

Respiratory or flu-like symptoms occurred among relatively few persons and did not vary across floors. Similarly, the differences across floors for ergonomic symptoms were smaller than those noted for symptoms associated with poor indoor air quality.

The results presented in Exhibit 5-4 must be interpreted with great caution. At this stage, any observed differences in symptom prevalence across floors cannot be attributed to any environmental factors. A more complete analysis, which will be reported in Volume III, will attempt to assess relationships between health outcomes and environmental measurements, taking into account a variety of other workplace and personal characteristics that may also be associated with health symptoms.

Most people (56%), when asked in which season or seasons they were most bothered by health symptoms, reported that there was no seasonal relationship (Exhibit C-2). Approximately one third (31%) reported the winter as the worst season, with the other three seasons being mentioned considerably less often (spring 13%, summer 9%, and fall 11%). (Percentages add to greater than 100 since respondents were allowed to check as many seasons as were applicable.)

5.2.2 Other Health Symptoms Experienced Last Year

In addition to the list of 32 symptoms, additional questions were asked of employees about certain clusters of symptoms. Almost one-third of respondents (31%) reported repeated episodes of flu-like symptoms (wheezing, cough, shortness of breath, fever, chills, aching muscles or joints) over the past year. There was a statistically significant difference in proportions reporting this complex of symptoms across floors (chi-square = 14.0; p = 0.05), with proportions ranging from 36% on the 4th floor to 26% on the 1st floor. Approximately 21% of employees reported chest illnesses during the past year that have kept them from working. However, there was no difference in the proportions across floors.

Seventeen percent of employees reported having had episodes of wheezing (without fever, chills, or sore throat) in the past year. Of the 255 (9%) (building occupants who reported that a physician had diagnosed them as having had asthma, 40 (19%) reported that it had been diagnosed since working in the Madison Building. Eighty-four individuals report having had an asthma attack within the past year (33% of persons with physician-diagnosed asthma, 30% of all building respondents).

5.2.3 Health Symptoms Experienced Last Week

Respondents were asked to report the number of days during the past week they experienced each of the same 32 symptoms while working in the Madison Building. The number of individuals who had experienced work-related symptoms on at least one day during the past week was estimated by summing the responses for 1 day up to 5 days (plus a few instances reporting up to 7 days) and who also reported that the symptom usually gets better when away from work. The proportions of employees who experienced work-related symptoms at least 1 day during the past week are presented in Exhibit 5-5. These proportions are somewhat higher than those seen among individuals reporting symptoms during the past year (Exhibit 5-1); however, because the past year's symptoms must have occurred "often" or "always," this is not surprising. Of note is the general agreement in the relative ranking of these symptoms. Again, the most predominant are those symptoms relating to mucous membrane irritation, headaches, and lethargy.

Exhibit 5-5: Percent of Respondents* Reporting Symptoms One or More Days and That Got Better Upon Leaving Work in the Past Week, at Madison Building**

Symptoms	Reported Symptom One or More Days and Got Better Upon Leaving Work
Headache	42%
Nausea	10%
Runny nose	21%
Stuffy nose	32%
Sneezing	31%
Cough	17%
Wheezing	5%
Shortness of breath	8%
Chest tightness	7%
Dry, itchy eyes	37%
Sore, strained eyes	42%
Blurry vision	16%
Burning eyes	27%
Sore throat	11%
Hoarseness	8%
Dry throat	22%
Fatigue/tiredness	40%
Sleepiness	51%
Chills	21%
Fever	4%
Aching muscles/joints	14%
Problems with contacts***	42%
Difficulty remembering	8%
Dizziness/lightheadedness	15%
Feeling depressed	20%
Tension/nervousness	31%
Difficulty concentrating	25%
Dry skin	13%
Pain-upper back	13%
Pain-lower back	18%
Pain-shoulder/neck	17%
Pain-hand/wrist	8%

*Total number of respondents equals 2,750 (excluding persons for whom "floor" was missing).

**This exhibit, which includes the criterion that the symptoms usually get better when away from work, cannot be compared directly to Exhibit 5-8 (also Exhibit ES-5) in the EPA report (Volume I: Employee Survey), which does not include this criterion. Relaxing this criterion would increase the numbers shown in this Exhibit; incorporating this criterion in the EPA report would decrease the numbers presented in Exhibit 5-8 of the EPA report.

***These percentages are based upon only the people who wear contact lenses at work "sometimes, often or always" (Part II, Question 1.a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

5.2.4 Effects of Health Symptoms on Work

Madison Building employees were asked to assess the effects of their symptoms on their work. Among people reporting the occurrence of any symptom (rarely to always) in the past year, almost half (44%) reported that the symptom or symptoms reduced their ability to work at least some of the time (including 8% who reported that the symptoms reduced the ability to work often or always) (Exhibit 5-6). There was a significant difference in reported proportions across floors in the building (chi-square=25.5; $p<0.0001$), with the highest proportions reporting that their symptoms reduce their ability to work being on the 4th and 5th floors (48% each) and the lowest proportions being on the 1st (31%) and 6th (36%) floors.

Approximately one-third (32%) of workers reported that in the past year their symptoms had caused them to stay home from work or leave work early "sometimes," and another 3% who "often" missed work due to their symptoms. The symptoms reported most often which resulted in employees staying home or leaving work were headache, stuffy nose, fatigue, chills, fever, and cough. Again, there was a statistically significant difference in the proportions reporting across floors (chi-square=25.8; $p=0.0005$). The sub-ground floors had the highest proportion, with 42% reporting that they leave work early or stay home at least sometimes because of their symptoms. However, this was reported by only 23% of respondents on the 3rd floor.

5.2.5 Perceived Association of Symptoms with Madison Building

Employees were asked whether (a) they associated their health symptoms with conditions in the building; (b) felt that the conditions had improved over the past year; and (c) had experienced more or fewer infections, or longer or shorter periods of infection, since working in the building.

Seventy percent of workers associated their symptoms with their work in the Madison Building (Exhibit 5-7), ranging from 78% on the 4th floor to 64% on both the 1st and ground floors (chi-square=28.8; $p=0.0002$). Most employees (67%) stated that in the past year their symptoms had stayed the same, 27% had become worse, and only 6% had improved (Exhibit 5-7). There was no significant difference in these percentages across floors in the Madison Building.

Exhibit 5-6: Number and Percentage of Responding Employees Indicating Impact of Symptoms on Ability to Work Last Year, at Madison Building

	NUMBER	PERCENT RESPONDING				
		NEVER	RARELY	SOMETIMES	OFTEN	ALWAYS
Symptoms Reduced Ability to Work	2,764	26%	31%	36%	7%	1%
Symptoms Resulted In Staying Home or Leaving Work Early	2,730	39%	27%	32%	3%	*

*'Always' was not a possible answer in Question 9.

Reference: Part II, Questions 8 and 9.

Exhibit 5-7: Percentage of Responding Employees Associating Symptoms with Building Last Year, at Madison Building

	MADISON BUILDING
Percent Associating Symptoms with Building	70%
Symptoms Improved over the Last Year	6%
Symptoms Became Worse over the Last Year	27%
Symptoms Remained the Same	67%
Employees Responding	2,689

Reference: Part II, Question 11.

More than half (54%) of respondents reported that they have experienced no change in the frequency of infections since working in the Madison Building. However, 41% reported more frequent infections since beginning work in the building, while only 5% reported less frequent infections (Exhibit 5-8). There was a statistically significant difference across floors (chi-square=26.0; p=0.0004) in the proportion of persons reporting more infections since working in the Madison Building. The floor with the highest proportion was the 4th (49%), with the lowest proportion reported among employees on the 5th and ground floors (38% each).

Similarly, more than half (60%) of respondents reported that there has been no change in the time infections tend to last (Exhibit 5-8). Only 4% reported that infections tend to be shorter since working in the Madison Building, whereas 37% reported that they last longer. Again, the difference in proportions was statistically significant across floors (chi-square=18.6; p=0.009), with the highest proportion reported among employees of the 4th floor (44%) and the lowest among those on the 1st floor (27%).

Another view of the association between symptoms and work in the Madison Building is provided in Exhibit 5-9. A relatively high percentage of workers reporting a symptom which occurred often or always in the past year also reported that the symptom usually improved when away from work. Most symptoms were reported by more than 60% of respondents to get better when away from work, with a range of 36% (dry skin) to 87% (fever).

5.2.6 Potential Sources of Irritation

Respondents were asked about the occurrence of eye, nose, throat, or respiratory irritation from nine possible sources on a continuum of "never," "rarely," "sometimes," "often," or "always." Exhibit 5-10 displays the percent reporting that they experienced irritation "sometimes," "often," or "always." Noted by more than 10% of the respondents were tobacco (17%), paint (13%), cleaning fumes (from carpets, drapes, etc.) (12%), "other" fumes (11%), and other chemicals such as glues and adhesives (11%). As would be expected, relatively few respondents reported irritation "often" or "always"; all nine sources of irritation were reported "often" or "always" by fewer than 3% of respondents, with the exception of tobacco smoke, from which 7% reported that they often or always experienced eye, nose, throat, or respiratory irritation. One-

Exhibit 5-8: Percentage of Responding Employees Reporting Changes in Frequency and Duration of Infections Since Beginning Work, at Madison Building

	MADISON BUILDING RESPONDENTS
Percent Who Report Having Infections:	
More Frequently	41%
Less Frequently	5%
Same Frequency	54%
Employees Responding	2,765
Percent Whose Infections Reportedly:	
Last Longer	37%
Are Shorter	4%
Are Unchanged	60%
Employees Responding	2,724

Reference: Part II, Question 17.

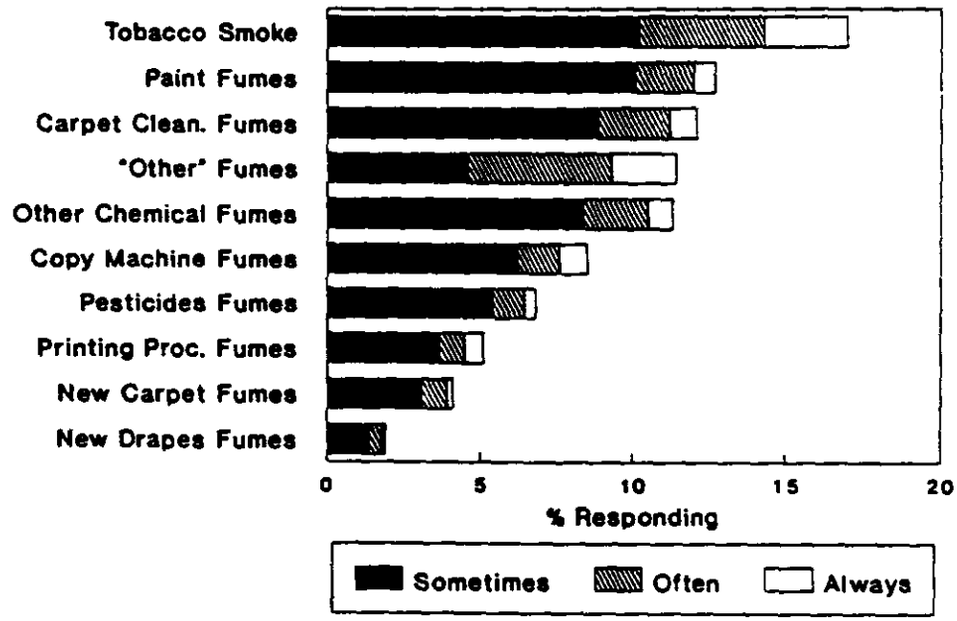
Exhibit 5-9: Percent of Respondents Whose Symptoms Got Better Upon Leaving Work, Among Those Who Have Symptoms "Often" or "Always," by Madison Building Floor

SYMPTOMS	TOTAL	FLOOR							
		6th	5th	4th	3rd	2nd	1st	Grd.	Sub-Grd.
Headache	79%	80%	82%	82%	80%	80%	74%	75%	65%
Nausea	74%	64%	80%	50%	100%	91%	59%	88%	100%
Runny nose	60%	63%	62%	72%	42%	60%	71%	59%	57%
Stuffy nose	63%	69%	61%	69%	50%	65%	71%	58%	56%
Sneezing	74%	65%	76%	75%	56%	75%	82%	78%	74%
Cough	57%	40%	71%	63%	42%	55%	39%	45%	58%
Wheezing	50%	56%	38%	76%	67%	57%	51%	41%	22%
Shortness of breath	56%	37%	57%	45%	67%	62%	57%	80%	37%
Chest tightness	66%	67%	76%	91%	27%	72%	40%	59%	33%
Dry, itchy eyes	82%	82%	83%	85%	75%	80%	73%	85%	70%
Sore, strained eyes	85%	80%	88%	85%	79%	91%	85%	86%	61%
Blurry vision	69%	67%	72%	71%	71%	81%	77%	58%	62%
Burning eyes	86%	78%	90%	83%	78%	83%	94%	81%	72%
Sore throat	56%	43%	73%	53%	39%	53%	28%	68%	19%
Hoarseness	68%	87%	65%	76%	44%	76%	59%	78%	50%
Dry throat	77%	84%	78%	83%	54%	73%	73%	78%	85%
Fatigue/tiredness	78%	68%	79%	82%	73%	83%	65%	80%	61%
Sleepiness	84%	83%	85%	87%	87%	83%	79%	82%	70%
Chills	84%	89%	87%	93%	79%	94%	85%	87%	47%
Fever	86%	100%	100%	85%	100%	60%	53%	100%	100%
Aching muscles/joints	49%	56%	46%	56%	44%	59%	41%	44%	44%
Problems with contacts*	84%	88%	94%	91%	67%	86%	57%	80%	0%
Difficulty remembering	39%	19%	45%	49%	42%	33%	33%	34%	17%
Dizziness/lightheadedness	78%	90%	77%	73%	93%	81%	62%	93%	46%
Feeling depressed	70%	75%	73%	67%	61%	77%	67%	70%	46%
Tension/nervousness	81%	81%	85%	80%	61%	88%	77%	77%	67%
Difficulty concentrating	81%	85%	79%	83%	70%	100%	72%	80%	64%
Dry skin	36%	43%	30%	45%	25%	43%	32%	42%	52%
Pain-upper back	68%	49%	70%	55%	69%	77%	67%	74%	56%
Pain-lower back	56%	47%	57%	62%	55%	55%	34%	61%	43%
Pain-shoulder/neck	63%	50%	65%	63%	69%	62%	40%	23%	31%
Pain-hand/wrist	47%	43%	52%	51%	37%	52%	40%	33%	43%

*These percentages are based upon only the people who wear contact lenses at work "sometimes, often or always" (Part II, Question 1a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

Exhibit 5-10: Percent of Responding Employees Attributing Eye, Nose, Throat or Respiratory Irritation to Various Causes at Workstation Last Year, at Madison Building



Reference: Part II, Question 19.

third (33%) of respondents throughout the Madison Building reported that they consider themselves especially sensitive to the irritants listed in Exhibit 5-10.

There was no statistically significant difference in the prevalence of reports of irritation from either new carpeting or new drapes and furniture across floors in the building. There was, however, for each of the other possible sources of irritation, a difference in reported prevalences across floors, although there was no one floor which had consistently higher reporting rates.

5.3 Comfort Issues

This section reports on the comfort experienced by respondents working in the Madison Building. Two aspects of comfort are dealt with separately -- comfort associated with indoor air quality (e.g., how one feels about the temperature, stuffiness, odor, etc.), and comfort related to the physical environment (as in the ergonomics of the workstation, the comfort of the chairs, etc.).

Air Quality Comfort

A complete tabulation of responses to questions on air movement, temperature, humidity, noise, and dust is presented in Exhibit C-3. An extract of key comfort concerns is displayed in Exhibit 5-11, which shows that 43% of respondents often or always wanted to adjust air movement in the building. The floor-to-floor differences in proportions was statistically significant (chi-square=21.1; p=0.003), ranging from 49% (2nd floor) to 31% (sub-ground). Overall, 39% often or always wanted to adjust the temperature. Again, there was a statistically significant (chi-square = 17.4; p=0.01) difference across floors, with the highest percent (45%) with a desire to adjust the temperature on the 4th floor, and the lowest among workers on the third and sub-ground floors (33% each). Approximately one quarter (26%) reported that they often or always wanted to adjust the humidity. As with the desire to adjust air movement, the highest proportion wishing to adjust humidity was on the 2nd floor (30%) and the lowest proportion on the sub-ground floors (13%)(chi-square = 19.6; p=0.006).

Exhibit 5-11: Percent Reporting "Often" or "Always" Wanting to Adjust Environmental Comfort Last Year, by Madison Building Floor

SYMPTOM	TOTAL (N=2,750*)	FLOOR								p value**
		6th (N=267)	5th (N=712)	4th (N=457)	3rd (N=284)	2nd (N=386)	1st (N=115)	Grd. (N=409)	Sub-Grd. (N=120)	
Adjust Air Movement	43%	47%	43%	47%	39%	49%	38%	40%	31%	0.004
Adjust Temperature	39%	44%	39%	45%	33%	41%	37%	36%	33%	0.01
Adjust Humidity	26%	27%	28%	28%	23%	30%	25%	22%	13%	0.006

*Excluding persons for whom "floor" was missing.

**Chi Square test for overall difference across floors.

Reference: Part III, Questions 1c, 1f and 1i.

Overall, 12% of respondents reported that during the past year, there was often or always too much air movement, whereas 40% reported too little air movement. As seen in Exhibit 5-12, the difference across floors for each proportion was statistically significant. Not surprisingly, the 6th floor had both the highest proportion reporting too little air movement and the lowest reporting too much air movement. Similarly, the 1st floor had the lowest proportion with too little air movement and the highest with too much air movement.

Throughout the Madison Building, 16% of respondents reported that the environment at their workstation was too hot (often or always during the past year), with a statistically significant difference across floors; the 6th floor reported the highest proportion (25%) and the sub-ground floors the lowest (8%) (see Exhibit 5-12). One quarter (25%) reported that it was too cold; however, there was no difference across floors.

Only 8% of respondents reported that their workstation environment was often or always too humid during the past year, with no differences across floors. However, 25% of respondents reported it being too dry, ranging from 31% of the 5th floor occupants to 14% of the occupants of the sub-ground floors ($p < 0.0001$) (Exhibit 5-12).

Almost half of the respondents (46%) reported that, during the past year, the environment at their workstation was often or always too stuffy, with the highest proportion reporting on the 2nd floor (51%) and the lowest on the 1st floor (29%) ($p < 0.0001$) (Exhibit 5-12). In addition, almost one quarter (23%) of the respondents reported it being too dusty, often or always in the past year. Again, there was a statistically significant difference across floors ($p < 0.0001$), ranging from 30% on the 5th floor to 12% on the 3rd floor.

Respondents were asked to report in which seasons they would most like to adjust the physical conditions (air movement, temperature, humidity, and odors) around their workstations. As seen in Exhibit C-4, most persons reported winter (up to 64%) and summer (up to 48%), with considerably fewer reporting spring and fall. Overall, most people reported the desire to adjust temperature, followed by air movement, humidity, and odors.

The meaning of odors and odor frequencies that are reported at workstations varies greatly. For example, body odor, an element included in air quality standards, does not usually reflect public health problems, although it may be disruptive in an office. On the other hand,

Exhibit 5-12: Percent Reporting Positive Responses to Comfort Questions*, at Madison Building

SYMPTOM	TOTAL (N=2,750**)	FLOOR								p value***
		6th (N=267)	5th (N=712)	4th (N=457)	3rd (N=284)	2nd (N=386)	1st (N=115)	Grd. (N=409)	Sub-Grd. (N=120)	
AIR MOVEMENT:										
Too much air movement	12%	6%	12%	14%	7%	11%	16%	15%	14%	0.002
Too little air movement	40%	46%	44%	38%	40%	45%	28%	33%	29%	<0.0001
TEMPERATURE:										
Too hot	16%	25%	20%	17%	12%	15%	9%	12%	8%	<0.0001
Too cold	26%	21%	25%	28%	25%	27%	33%	27%	28%	0.31
HUMIDITY:										
Too humid	8%	5%	6%	10%	8%	8%	6%	9%	8%	0.28
Too dry	25%	29%	31%	27%	18%	28%	21%	19%	14%	<0.0001
Too stuffy	46%	49%	48%	45%	44%	51%	30%	37%	30%	<0.0001
Too dusty	23%	21%	30%	26%	12%	21%	21%	21%	28%	<0.0001

*A positive response is defined as having been reported to occur "often" or "always" in the past year.

**Excluding persons for whom "floor" was missing.

***Chi Square test for overall difference across floors.

Reference: Part III, Questions 1a, 1b, 1d, 1e, 1g, 1h, 1j, and 1m.

noting the odor of diesel or other vehicles even rarely may signal a public health problem especially since some of the harmful combustion gases (for example, carbon monoxide) are odorless. Respondents were asked about the presence of a number of odors in their environment. Exhibit 5-13 displays the percent of respondents reporting that they notice the odor "sometimes," "often," or "always." Almost half the respondents (45%) reported food odors other than fishy smells. This is more than double all other odors, with the exception of cosmetic odors (39%). Tobacco smoke (22%), musty/damp basement smells (18%), and body odor (17%) are the other most commonly reported odors.

Employees were asked how often they took fresh air breaks. One quarter (25%) of respondents reported that they usually did not go outside for fresh air in the course of a week. Half (48%) of respondents reported that they take fresh air breaks one to four times per week, and 27% reported that they take fresh air breaks five or more times per week.

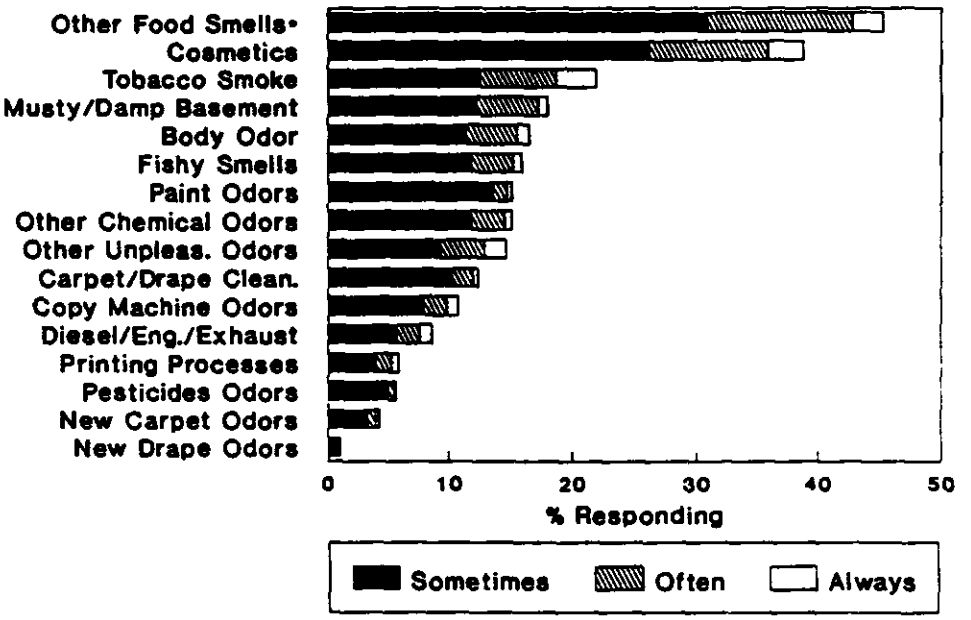
Physical Comfort

Ergonomic issues encompass general workstation comfort, chair comfort, and lighting. Overall, two-thirds (65%) of respondents reported that they are "very" or "somewhat" satisfied with the physical environment in the Madison Building both over last year and for last week (Exhibit 5-14). Most respondents (79%) reported that their physical environment stayed the same over the past year, while 9% reported that conditions had improved and 12% reported that conditions had become worse over the past year. Again, most (74%) reported that conditions tend to remain about the same on a typical day. However, 5 times as many reported that conditions become worse than reported improvement (22% vs. 4%).

Almost two-thirds of respondents reported that their chair (61%) and workstations (69%) are "reasonably comfortable." The rest of the respondents reported that their chairs and workstations are somewhat or very uncomfortable.

The overall rating of lighting levels was high (Exhibit C-5), with 51% reporting lighting was "just right" and only 10% combined reporting it was "much too dim" or "much too bright." In addition, about one-fifth (21%) reported that they experienced glare often or always, with 60% reporting glare at least sometimes.

Exhibit 5-13: Percent Reporting Odors at Workstation During Past Year, at Madison Building



*Food smells other than "fishy smells"

Reference: Part III, Question 2.

Exhibit 5-14: Degree of Satisfaction with Physical Workstation Environment Last Year and Last Week, at Madison Building

	EMPLOYEES RESPONDING	PERCENT RESPONDING			
		VERY SATISFIED	SOMEWHAT SATISFIED	NOT TOO SATISFIED	NOT AT ALL SATISFIED
Last Year	2,824	13%	52%	28%	7%
Last Week	2,803	16%	53%	25%	6%

Reference: Part III, Questions 10 and 11.

5.4 Employee Characteristics

This section outlines the findings of the survey in terms of background characteristics of respondents, including demographics, health factors not related to the building, job satisfaction and sources of stress, and the physical work environment in which the employees work.

The factors described in this section will be used in Volume III to help explain patterns of health symptoms and comfort problems. They are expected to provide more detailed insights into differential health and comfort problems experienced by different types of employees or employees in different areas within the building. For example, it may be possible to draw conclusions that certain symptoms are found disproportionately among employees working in particular types of workstations or subject to particular types of job stress. Or, for example, people with pre-dispositions to allergies, or people who smoke may experience heightened reactions to their indoor air irritants; they may also experience health symptoms independent of the effects of potential indoor air pollution at the Madison Building. It is important to control for these background factors by conducting multivariate analyses, in order to determine to what extent health and comfort symptoms can be attributed to building conditions and to what extent they can be attributed to other independent factors.

5.4.1 Demographics

The demographic background factors included in the questionnaire involved respondents' age, gender, educational status, and professional category.

Overall in the Madison Building, 53% of the survey respondents were female and 47% male. The age of respondents ranged from 16 to 79, with almost half of respondents over the age of 45 (Exhibit C-6).

Almost half of the respondents (42%) hold graduate degrees (Exhibit C-7). A similar number (38%) reported professional job categories, with technical, managerial, and administrative positions each reported by 15-20% of employees (Exhibit C-8).

5.4.2 General Health Characteristics

Several questions were asked to assess factors which can affect responses to the questions regarding health symptoms. These included medical history, the use of corrective lenses, and smoking history.

Medical History: Some individuals may have a pre-disposition to allergies, often exhibited by the presence of eczema or allergies to pollens or animals. Approximately 8% of respondents reported having had eczema, while almost half reported an allergy to either pollens or animals.

Persons with asthma may report more respiratory symptoms than those without such a condition. Most (81%) of the 255 persons reporting physician-diagnosed asthma stated that it was diagnosed in a year before starting work in the Madison Building. Such pre-existing asthma can be a risk factor for the development of symptoms in the building. Individuals who have developed asthma since working in the building may also be at additional risk for other symptoms.

Corrective Lenses: Two-thirds (66%) of employees wear eyeglasses for close-up work. Twenty percent of the employees wear contact lenses. Of those who ever wear contact lenses, approximately 12% never wear them at work. Reasons given for this include the fact the air in the building is too dry to wear them comfortably, as well as a number of non-work-related reasons.

Smoking History: More than half (59%) of the Madison Building employees report that they have never smoked tobacco products, with another 25% describing themselves as former smokers. Of the current smokers (17%), most (70%) report that they never smoke at their workstations, whereas 80% of the current smokers smoke elsewhere in the building. (Current LOC policy permits smoking in designated lounges, but prohibits smoking at workstations, except where permission is granted on petition to the Librarian of Congress. These cases would involve some private offices and common work areas where there is both a consensus of the employees and adequate ventilation.)

5.4.3 Job Satisfaction and Stress

Various types of stress are capable of producing health symptoms that are similar to those associated with poor indoor air quality and may therefore influence the results. A series of questions was asked of employees designed to assess aspects of job satisfaction, and sources of work-related and external stressors. A preliminary description of the distribution of these factors is presented in this report. An analysis of the relationships between these stressors and reported health symptoms and comfort concerns will be presented in Volume III.

Responses to items in Part IV (Characteristics of Your Job) of the questionnaire are found in Exhibits C-9 and C-10. Employees at the Madison Building appear to be generally satisfied with their jobs, with nearly 84% reporting that they are either "somewhat" or "very" satisfied and only 16% reporting that they are "not too" or "not at all" satisfied (Exhibit 5-15). Similarly, there is also the suggestion of a moderate level of satisfaction with salary. Over 71% of respondents reported being either "somewhat" or "very" satisfied with their salary. However, employees are generally not satisfied with their opportunities for advancement at the Library. Nearly 52% of the respondents indicated that they were "not too" or "not at all" satisfied with advancement opportunities.

Responses to Questions 4 and 6 (Exhibit C-9) suggest that work roles at the Madison Building are generally well defined. For example, nearly 87% of the respondents reported that they are "fairly often" or "very often" clear on what their job responsibilities are (item 6h) and nearly 66% indicated that they "rarely or never" get conflicting orders from those in a good position to see that their tasks are completed (item 4b).

Responses to items in Question 6 indicate that many Madison Building employees feel that their skills are being underutilized and that many employees feel that they have a heavy workload. For example, nearly 29% of the respondents indicated that they are only "rarely" or "occasionally" given a chance to do the things that they do best (item 6f) and nearly 70% indicated that there is "fairly" or "very" often a great deal to be done (item 6d).

Home and other outside responsibilities can also contribute to stress. Responses to items in Question 7 (Exhibit C-10) indicate that 40% of the respondents have children at home,

Exhibit 5-15: Satisfaction with Specific Characteristics of Job, at Madison Building

	EMPLOYEES RESPONDING	PERCENT RESPONDING			
		VERY SATISFIED	SOMEWHAT SATISFIED	NOT TOO SATISFIED	NOT AT ALL SATISFIED
Satisfaction with Job	2,805	38%	46%	12%	4%
Satisfaction with Salary	2,795	25%	47%	19%	10%
Satisfaction with Opportunity for Advancement	2,789	16%	32%	29%	23%

Reference: Part IV, Questions 1a, 2 and 3.

24% have major responsibility for childcare, and 68% reported major responsibility for housecleaning duties. One third (33%) of respondents reported a regular commitment of five or more hours per week outside of their jobs.

5.4.4 Workstation Environment

Information on the physical elements of the work environment and length of employee exposures come from answers to Part I of the questionnaire.

- Type of Office Space: As seen in Exhibit 5-16, the most prevalent type of workstation, identified by 45% of the respondents, is that of a cubicle with mid-height partitions. Most of the workstation spaces are occupied by one occupant (69%) and those shared with one other person amount to another 10%. Many of these single-occupant spaces are mid-height partitioned cubicles so the sense of privacy and control that often comes with non-shared space will likely differ within this category. The importance of visual access to a window has been reported in other indoor air quality surveys; about a quarter (23%) of those responding in the Madison Building can see out a window from their workstations.

- Workstation furnishings and equipment: Types of furniture and equipment are reported in Exhibit C-11. New carpet and its installation has been the focus of some other indoor air quality studies. In the Madison Building, only 6% of the respondents indicated that there was new carpet within 15 feet of their workstations. Half the respondents reported fabric-covered partitions, another reservoir for dust, within 15 feet of their workstations. Not surprising in a library, 88% reported metal bookshelves/cases and 19% reported wood or composition bookcases. The partitions and the shelves are part of the dustiness potential in the Madison Building and will be included in later analyses.

- Fans, Heaters, Lamps: Information on the regular use of portable fans, air filters, heaters, and desk lamps gives a good indication of the degree to which employees are dissatisfied enough with their work environments to ameliorate the conditions (see Exhibit C-12). A third of the respondents report using desklamps, but fan (7%), air filter (3%), heater (3%), and humidifier (2%) use is much lower.

- Workstation and Computers: An important element in evaluating indoor air quality and work environment conditions is the notion of exposure -- for example, the number of hours during the workday a person uses a particular machine, chemical, or work posture. Descriptive statistics for some of these important situations are shown in Exhibit 5-17. Respondents have worked a mean of 13.6 years for the Library of Congress and 6.5 years in the Madison Building. Half of the respondents have worked 12.6 years for the LOC, 7.1 years in the Madison Building, and 3.8 years at their current workstation.

Exhibit 5-16: Description of Current Workstation, at Madison Building

WORKSTATION CHARACTER	MADISON BUILDING Percent Respondents
Type of Space:	
Enclosed office with door	22%
Cubicle with floor to ceiling partitions and no door	11%
Cubicle with mid-height partitions	45%
Open office area	17%
Stacks	1%
Loading dock,...print shops	1%
Work all around building	2%
Employees Responding	2,744
Type of Space Sharing:	
Single Occupant	70%
Shared with one other person	10%
Shared with two or more other persons	20%
Employees Responding	2,736

Reference: Part I, Question 1a and 1b.

Exhibit 5-17: History and Characterization of Respondents' Workplace, at Madison Building

	MADISON BUILDING	
	Mean	Median
Years of Service with LOC	13.6 yrs	12.6 yrs
Years Working in Building	6.5 yrs	7.1 yrs
Years at Current Workstation	4.9 yrs	3.8 yrs
Hours/Week in Building	39.4 hrs	40.0 hrs
Hours/Day at Workstation	6.7 hrs	7.0 hrs
Hours/Day with Computer	3.3 hrs	2.0 hrs
Hours/Day with Photocopy Machine	1.0 hrs	1.0 hrs
Hours/Day with Photographic Developing/Processing	0.1 hrs	0.0 hrs
Hours/Day with Printing Processing	0.3 hrs	0.0 hrs
Hours/Day with Other Chemicals	0.5 hrs	0.0 hrs

Reference: Part I, Questions 2, 3a, 4a, 3b, 4b, 9a, 9b, 9c, 9d, and 9e, respectively.

Although there was a wide range in the number of hours spent at one's workstation, half reported that they spend at least 7 hours at their workstation on a typical day, and 95% spend at least 4 hours a day at their workstation. As one would expect, exposure to computers is highly variable, with approximately half the respondents reporting that they use computers two hours or less on a typical day, and about 10% reporting their use more than 7 hours a day. Most employees reported limited use of photocopiers (1 hour a day or less), although 18% reported that a photocopier was located within 15 feet of their workstation. Few respondents reported working in the vicinity of photographic or printing processing or other chemicals such as glues and cleansers.

5.5 Essay Question

The final question on the questionnaire asked respondents for additional comments about "environmental or health matters in the Madison Building." Of the persons that responded to the survey, 1244 (44%) took the opportunity to write a response. The open-ended essay question allows an opportunity for those being surveyed to add topics to the discussion of indoor air quality and work environment at the Madison Building, especially topics that may have been overlooked in the questionnaire. In addition, it allows for emphasis, especially strong feelings and beliefs, that may not be clear or possible in the pre-coded earlier questions.

The persons who answered this portion of the survey are self-selected and the resulting response profiles can be said only to reflect those who choose to answer, not in any way a profile of persons in the whole building. It is also not possible to assume that the responses necessarily represent the topics about which the respondent feels most strongly about, since some topics may have been covered adequately in the main questionnaire. (However, in a number of cases, the respondent explicitly identified his or her major concern or highest priority recommendation.) Therefore, these responses should be interpreted on their own merit, as anecdotal accounts and suggestions offered by a substantial subgroup of building occupants.

The essays were read and the various topics discussed by respondents were recorded and grouped into common categories and summarized. The topics and the number of items reported here reflect the answers given but they also reflect the interests in indoor air quality and the work environment of the overall study. For example, a hypothetical sentence such as "For me, the worst part of the environment at work is the air, it's just too stuffy; I get headaches and feel

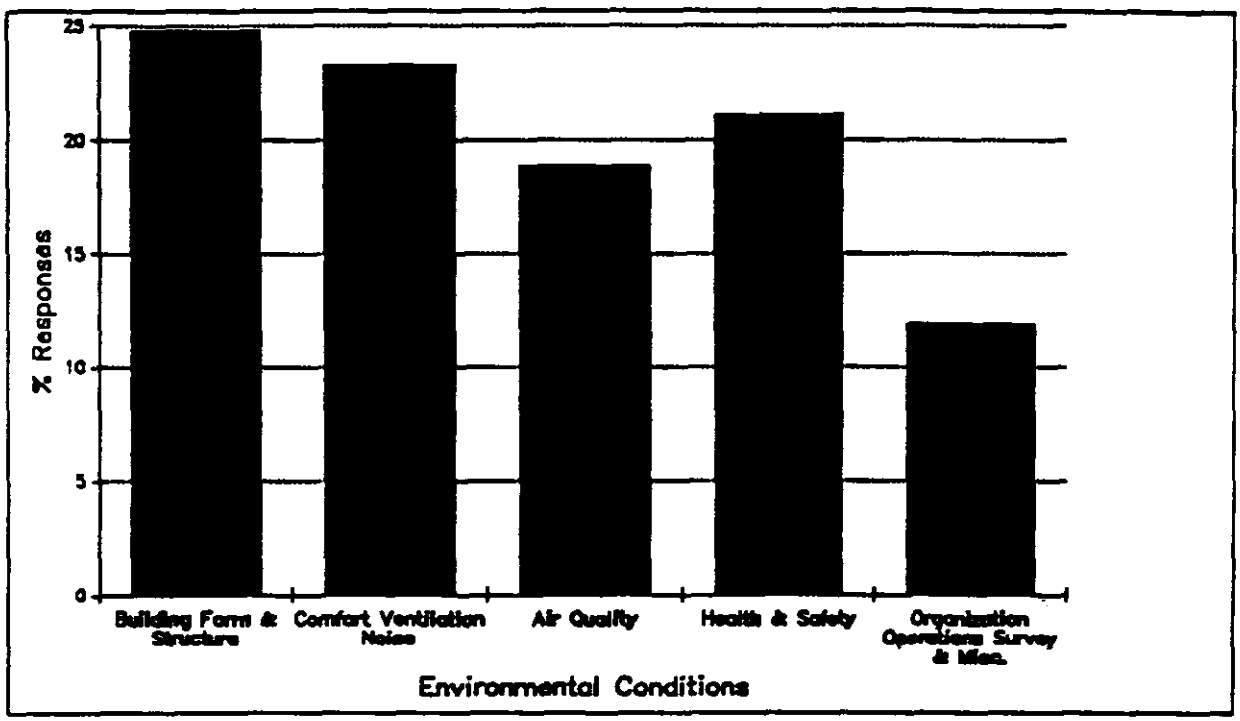
drowsy every afternoon because of it" could be scored in several ways. For this report, such a sentence would have been recorded as 1) "air stuffy worst" and 2) "symptom = headache drowsy daily" for a total of two items. A sentence such as this would have contributed one score to the health and safety column and one score to the environmental conditions column. If the person had added "and too hot" after "stuffy" in this example sentence, there still would have been only two scores. However, if the person had added an additional sentence, or more, about the temperature, then an additional score for "temperature" would have been added. By this scoring method, more than three thousand items were recorded from these essays for an average of 2.8 items per essay. Exhibit 5-18 illustrates the percentages by summary topic of the various categories.

Building Form and Structure

Approximately one quarter of the responses were related to the form and structure of the building itself. The items that make up this summary category include: windows, lighting, workstations, and water in the Madison Building (Exhibit 5-19a). Approximately 8% of the all comments were about the building itself, which included mention of the building in general, the "environment" of the building, the heating, ventilating and air conditioning system (HVAC system), doors, and flooring. Comments about the building itself that were positive in nature ("acceptable" and "fine") were reported 1.4 times more often than negative comments ("unacceptable" and "problems"). However, comments about the building environment were approximately 4 times more often negative ("ugly," "sterile," "hostile") than positive ("OK," "cheerful"). A number of comments were made about the HVAC system questioning its capacity, design, maintenance, and operating hours. Several persons commented that doors in the building are too heavy for them. Comments about the flooring reflected both a concern for the slippery-when-wet marble floors and the need to clean the carpets, with a few persons troubled by the color of the carpet in one of the public areas.

More than 5% of the total comments were about windows, including whether one had visual access to them, the fact that they become obscured by banners draped over them, and desires that they open. If a single comment was made about windows, then it was coded as "window" with an additional note such as "lack" or "needed." However, if there were additional comments about the need for windows, the lack of natural light, or the role windows play in knowing about the weather or in mental health, then the item was coded "windowlessness."

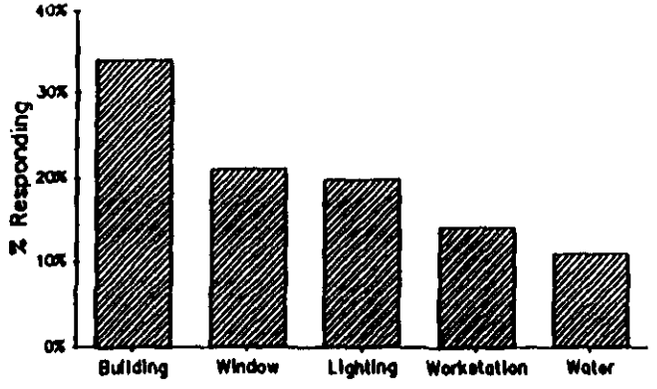
Exhibit 5-18: Percent of Responses* by Summary Topic for the Essay Question



*Total of 3,081 responses.

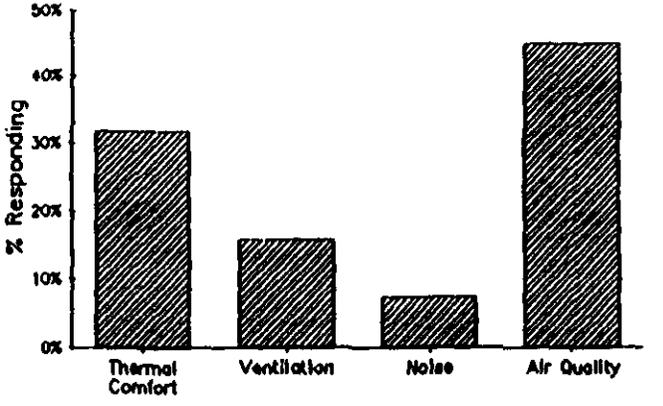
Reference: Part V, Question 6.

Exhibit 5-19a: Percent Responses to the Essay Question: Building Form and Structure



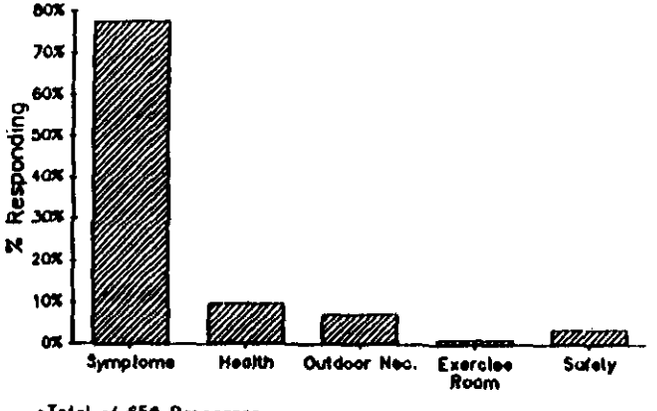
•Total of 757 Responses.

Exhibit 5-19b: Percent Responses to the Essay Question: Environmental Conditions



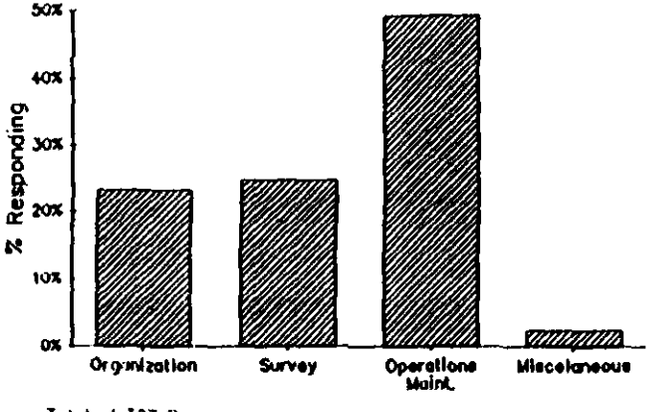
•Total of 1,301 Responses.

Exhibit 5-19c: Percent Responses to the Essay Question: Health and Safety



•Total of 658 Responses.

Exhibit 5-19d: Percent Responses to the Essay Question: Organization, Operations, Survey, Misc.



•Total of 367 Responses.

Windowlessness was one of the largest single categories of comment; about 1 in 10 writers scored in this category.

Comments about lighting accounted for about 5% of the total comments, about a quarter of which included the mention of glare. About a third of them included a reference to some symptom, such as eye strain or headache, which they associated with the lighting. At least 40% of the lighting comments were negative comments about fluorescent lighting.

Four percent of the total comments referred to the physical attributes of the workstation, including chairs, desks and other furniture, equipment, and computers. Eighty-five percent of the chair comments were negative; the other 15% were happy, if not ecstatic, because they had, or had on order, ergonomically appropriate chairs. Furniture, equipment and computer comments were likewise dominated by mention of ergonomic problems associated with workstation situations. Negative comments about the workstation ("crowded," "cave-like," "inappropriate") were approximately 20 times more common than positive comments, such as "comfortable."

Three percent of the total comments addressed "water" in the building. Of these, 14% were references to water supply/drain leaks; the rest were about the taste, temperature, clarity and safety of the drinking water in the Madison Building.

Environmental Conditions

Approximately 42% of the total responses pertained to environmental conditions in the Madison Building. The categories that make up this topic include thermal comfort (temperature and humidity), ventilation, noise, and air quality (Exhibit 5-19b). Comments on the temperature accounted for nearly 12% of the overall comments. Approximately 3 times more comments were made that the temperature is "cool" or "too cold" than "warm" or "too hot." In addition, about a quarter of the comments on temperature indicated that the temperature varied; a few considered that the temperature varied from cool to too cold, with even commenting that it varied from too cold to too hot either by time, from room to room, or even within 5 to 10 feet in the same room. Some writers observed that correcting the temperature in one place often led to problems in another usually nearby place. Several comments were made about the practical aspect

of the variance in temperature -- that it was difficult to predict the temperature in the building and thus how one should dress for work.

With only about 2% of the total comments, humidity, by itself, was not a large item. Of those comments where it was possible to tell the direction of the comment (that is, toward too humid or too dry), 63% reported that it was "dry," "too dry," or "low" in contract to those 37% that reported it "damp" or "too humid."

Ventilation is reported in a variety of ways in an open-ended question. Comments were categorized as drafty, air circulation, air flow and air movement, then summarized as ventilation. Almost all of the comments about ventilation (93%) were negative. About 23% of these comments were complaints about draftiness. Within those comments, about 15% mentioned a specific symptom, usually neck, shoulder, or back muscle problems, or colds, which they associated with sitting in a draft. Several indicated that they had to tape over the supply vents in order to solve the problem of drafty conditions.

Three percent of the total comments referred to noise, a quarter of which mentioned vacuuming and cleaning. (These comments specifically about the noise from cleaning are in addition to the other comments discussed later regarding cleaning in the Madison Building.) Noise from the book-conveyor system, computer, printers, copy machines, and the HVAC system together were identified by 29% of the noise comments. A few writers indicated that noise was their principal environmental problem; one suggested that it was too quiet in the Madison Building. A few indicated symptoms they associated with noise or their level of discontent with this aspect of environmental conditions. In most entries it was difficult to judge the importance of this topic to the writers.

Air quality, accounting for 19% of the total comments, covers a wide range of subjects, including air freshness, its "lack" of quality, that it is stuffy/stagnant/stale/heavy, or that there are noticeable odors. Comments about smoking are also included here in air quality. Negative comments about the air being stuffy, stagnant, stale or heavy accounted for 18% of the air quality summary. Approximately 8 times more negative reports about air quality ("bad," "disgraceful," "poor") were made than positive comments ("comfortable," "better," "no complaints"). A number of comments were made that the air quality varied within an office, from day to by day, or from morning to afternoon. Although dust and dirty will be featured later in the cleaning

category, dusty air was mentioned by a few writers (only 1% of this category). More than one third (37%) of the air quality comments pertained to odors. Twenty-seven percent of the odor comments mentioned food, cooking or cafeteria odors; 23% mentioned diesel or auto exhaust smells. Also noticed were odors of pesticides, chemicals, paint, solvents, perfume, mold, dust, equipment (such as copiers), and trash, as well as fishy, wet-dog, and tobacco smoke odors.

About 3% of the comments overall were addressed to the problems and issues of smoking. Writers supporting existing or extended smoking bans exceeded smokers' comments by 6 to 1. About 10% of the smoking comments included a reference to health symptoms that the writer experienced when tobacco smoke is encountered.

Health and Safety Matters

Although mention of health symptoms dominate this category, other matters included in this category include comments about health policy/risk issues, the needs to go outside the building during the day, a plea for an on-site exercise space, and safety/security comments (Exhibit 5-19c). More than three quarters (78%) of the health and safety comments pertained to the occurrence of symptoms. Of those, 22% listed multiple symptoms. Noted in more than 15% of the essays were references to sleepy, drowsy and/or fatigued conditions; headache was mentioned in almost 15% of the health symptom comments. Sixty-four percent of the symptom comments included some explicit note that they believed their condition was linked to work exposure, to the building, or that their symptoms were relieved or lower away from the building. Fewer than 1% of the symptom comments indicated explicitly that the problems listed were the same or worse away from the Madison Building.

Seven percent of the health and safety comments indicated that it was necessary to go outside on a regular basis, many stating that they do so to overcome fatigue and/or drowsiness. Almost 2% of this summary indicated that some exercise facility would be a rewarding addition to the Madison Building.

The health issues, worries and concerns that were not symptom related were put into a category "health." Here writers raised, for the most part, public health questions about the building, its use, its users, about specific rooms or laboratories, exposures to particular situations,

like computers, or solvents, or pesticides in the cafeteria, or exposures to more general and widespread conditions, like paper dust. This category accounted for 10% of the health and safety summary.

The last category in this summary is that of safety and security, which contributed almost 4% of the comments. These items are directed to specific or potential accident hazards throughout the building, including items such as missing lamps, specific fire hazards, and dangers of cuts from the sharp corners of the shelving.

Organization, Operations, Survey, and Miscellaneous

This summary topic includes the comments about the organization, its maintenance program, the survey, and a small (a total of nine entries) miscellaneous category (Exhibit 5-19d). About 23% of these comments were about the organization: job, management, staff, and the bureaucracy of large organizations. More than half (58%) of this sub-category referred to "the job." Within the job sub-category, nearly a quarter mentioned stress and pressure. However, even more (31%) mentioned the job in a very positive way ("satisfaction," "love," "great," "enjoy"), but these essays also contained negative statements about the building or physical environment ("unsatisfactory," "loathe," "poor," "put-up-with").

About a quarter (26%) of the comments about the organization referred to management, including management attitudes, policies, communication, responsiveness and responsibilities. A few of these could be classed as cynical, a few were about management style, a few were about policies. Overall, such comments were less than 1% of the overall total--even when the comments about bureaucracy and dealing with other federal organizations are included.

One category where policy decisions and operational consequences is clearly in evidence were those comments coded to cleaning and housekeeping conditions. About half (49%) of this summary topic were comments about cleanliness, dust, dirt, the status of the restrooms and the cafeteria, and the impact of the daytime cleaning operation. There were a few rare positive comments about these matters, but for the most part, the comments were unambiguously negative, directed to cleaning frequency and schedule, technique, technology, and especially directed toward

the impact of the vacuuming noise on business phone calls, the disruption caused by the cleaning, and a general disgust with this aspect of the environment.

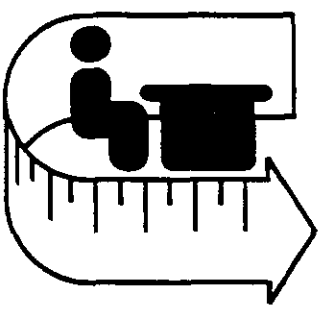
Lastly, there were comments coded as to being directed toward the survey itself, including explanations about why some survey answers were filled in as they were and suggested improvements. Indications of appreciation for the survey efforts tallied about a quarter of the comments about the survey, which was approximately 3 times the number of negative comments and/or notes from the doubters.

Appendix A

Employee Questionnaire

INDOOR AIR QUALITY AND WORK ENVIRONMENT SURVEY

MADISON BUILDING, LIBRARY OF CONGRESS



We are investigating the air quality and work environment in the Madison Building. We need information about your work environment and how it affects you. This information is not available anywhere else. Therefore, we must rely on your answers to this survey, along with monitoring of environmental conditions in the Madison Building, to clearly analyze the situation. We need your participation, regardless of how satisfied you are with the air quality or your work environment.

Attach Label Here

DO NOT PUT YOUR NAME ON YOUR QUESTIONNAIRE OR THE RETURN ENVELOPE PROVIDED. PLEASE PUT YOUR COMPLETED QUESTIONNAIRE IN THE RETURN ENVELOPE. SEAL IT AND TAKE IT TO ONE OF THE RETURN BOXES NEAR THE ELEVATORS AND BUILDING EXITS.

PLEASE READ BEFORE COMPLETING QUESTIONNAIRE

Many questions in the questionnaire concern either last week or last year. By "LAST YEAR" we mean the 12-month period ending today. If you have worked in the Madison Building for less than one year, answer the "LAST YEAR" questions only for the part of the year that you worked in the Madison Building.

Please report your ACTUAL EXPERIENCES LAST WEEK even if last week was unusual for you. By "LAST WEEK" we mean any or all days worked from last Monday through Friday.

CONFIDENTIALITY

To protect your privacy, the identification for your questionnaire is the bar-code label on the cover. The bar-code cannot be read by Library of Congress computers or staff. Additionally, the survey forms will be gathered by staff from Westat, Inc., an independent survey research firm, and processed away from the Madison Building. Your name and other information necessary for the survey and analysis that might identify you, such as your room and telephone number, will not be disclosed to individuals, unions, or management of the Library of Congress. Reports of the survey will not give your name, nor will data be presented in such a way that you, or anyone else, could be identified.

STUDY SPONSORS AND ORGANIZATION

The study has been developed and is being conducted by the National Institute for Occupational Safety and Health (NIOSH), the Environmental Protection Agency (EPA), the John B. Pierce Foundation Laboratory at Yale University, and Westat, Inc. It is being supported by funds from NIOSH, EPA, the Library of Congress, and the Department of Energy.

PART I. DESCRIPTION OF YOUR WORKSTATION

This section asks you to describe your workstation. Your answers to these questions will help us to construct a picture of your work surroundings.

By WORKSTATION we mean your desk, office, cubicle, or place that is your primary work area. This description is obvious for many people, but more difficult for those whose jobs require them to move about the building. If you do move about the building, your workstation is the specific location where you spend more time than any other single location. If your workstation has been relocated, use the location where you are now.

1. **There are many different types of workstations. Please check the categories that best describe the space in which your current workstation is located.**

   a. **Type of space** *(Check one)*

   1. ☐ Enclosed office with door
   2. ☐ Cubicle with floor to ceiling bookcases or partitions and no door
   3. ☐ Cubicle surrounded by mid-height bookcases or partitions
   4. ☐ Open office area
   5. ☐ Stacks
   6. ☐ Loading dock, laboratory, copy center, or print shops
   7. ☐ Work all around the building
   8. ☐ Other (specify) _____

   _____

   b. **Type of space sharing** *(Check one)*

   1. ☐ Single occupant
   2. ☐ Shared with one other person
   3. ☐ Shared with two or more other persons
   4. ☐ Other *(describe)* _____

   _____

2. **How many years of service do you have with the Library of Congress?** *(Enter number of months if less than one year.)*

   _____ years _____ months

3. a. **How many years have you been working in the Madison Building?** *(Enter number of months if less than one year.)*

   _____ years _____ months

   b. **During a typical week, how many hours do you spend in this building?**

   _____ hours per week

4. a. **How many years have you worked at your current workstation?** *(Enter number of months if less than one year.)*

   _____ years _____ months

   b. **During an average workday, how many hours do you spend at your workstation?**

   _____ hours per day

5. **How many days did you work in the Madison Building last week?**

   _____ days last week

6. **What time do you usually:**

		AM	PM
a.	Arrive at work ____:____	☐	☐
b.	Leave work ____:____	☐	☐
c.	Varies *(describe)* _____		

_____

7. **Which of the following items are presently located within 15 feet of your workstation?** *(Check "no" or "yes" for each item.)*

		No 1	Yes 2
a.	Metal desk	☐	☐
b.	Wood or composition desk	☐	☐
c.	Metal bookshelves or bookcases	☐	☐
d.	Wood or composition bookshelves or bookcases	☐	☐
e.	File cabinet(s)	☐	☐
f.	Other metal furniture	☐	☐
g.	Other wood or composition furniture	☐	☐
h.	Fabric-covered partitions	☐	☐
i.	Portable humidifier	☐	☐
j.	Laser printer	☐	☐
k.	Photocopy machine	☐	☐
l.	Live plants	☐	☐

8. **Is there carpeting on most or all of the floor at your workstation?**

1. ☐ No
2. ☐ Yes

9. **During a typical day LAST WEEK, how much time did you spend working with each of the following items?** *(If you worked with an item at all, but less than 1 hour, enter 1 hour per day.)*

		Hours per day
a.	Computer or word processor with screen/keyboard	____
b.	Photocopy machine	____
c.	Photographic developing and processing	____
d.	Printing processing (press, binding materials, etc.)	____
e.	Other chemicals such as glues, adhesives, cleansers, white out, rubber cement, pesticides, etc.	____

NOTE: If you have worked in the Madison Building for less than a year, answer the following questions for the part of the year that you worked in the Madison Building.

10. **Were any of the following items regularly used at your workstation during the LAST YEAR:** *(Check "no" or "yes" for each item.)*

		No 1	Yes 2
a.	Portable fan	☐	☐
b.	Portable air filter, or cleaner, or negative-ion generator	☐	☐
c.	Portable heater	☐	☐
d.	Desk lamp	☐	☐

11. **During the LAST YEAR (and since you've been in your current workstation) have any of the following changes taken place within 15 feet of your current workstation?** *(Check "no" or "yes" for each item.)*

		No	Yes
		1	2
a.	New carpeting	☐	☐
b.	New drapes or curtains	☐	☐
c.	New furniture	☐	☐
d.	New equipment, such as a computer	☐	☐
e.	Walls painted	☐	☐
f.	Rearranged walls	☐	☐

12. **At any time during the LAST YEAR, have you noticed evidence of new or continuing water leaks from the ceiling, floors, walls, or pipes near your workstation?**

1. ☐ No
2. ☐ Yes

PART II. INFORMATION ABOUT YOUR HEALTH AND WELL-BEING

This section asks questions about the status of your health and well-being. Your answers to these questions will help us construct a profile of the health status of the employees in the Madison Building. Please answer all the questions even if you don't associate these health conditions with your work.

1. a. Do you wear contact lenses?

1. ☐ Never ⟶ *Go to Q.2*
2. ☐ Sometimes
3. ☐ Often
4. ☐ Always

b. Do you wear contact lenses at work?

1. ☐ Never
2. ☐ Sometimes ⟶ *Go to Q.2*
3. ☐ Often ⟶ *Go to Q.2*
4. ☐ Always ⟶ *Go to Q.2*

c. If never worn at work, why?

_____

_____

_____

2. During work, how often do you wear eyeglasses (NOT including contacts) for close-up work?

1. ☐ Never
2. ☐ Sometimes
3. ☐ Often
4. ☐ Always

3. Which of the following best describes your history of smoking tobacco products such as cigarettes, cigars or pipes?

1. ☐ Never smoked ⟶ *Go to Q.7*
2. ☐ Former smoker ⟶ *Go to Q.7*
3. ☐ Current smoker

4. Do you smoke tobacco products at your workstation?

1. ☐ Never
2. ☐ Sometimes
3. ☐ Often

5. Do you smoke tobacco products elsewhere at work?

1. ☐ Never
2. ☐ Sometimes
3. ☐ Often

6. In a typical 24 hour day, how many CIGARETTES do you usually smoke?

1 ☐ None
2. ☐ 1 to 5
3. ☐ 6 to 10
4. ☐ 11 to 20
5. ☐ 21 to 30
6. ☐ 31 or more

7. **Please answer the three questions to the right about each symptom listed below, even if you believe the symptom is not related to the Madison Building.**
(For each symptom, answer the first question. If the response is "never," go down to the next symptom.)

	Please indicate how often during the LAST YEAR you have experienced this symptom while working in the Madison Building.					**Please indicate how many days LAST WEEK you experienced this symptom while working in the Madison Building.**	**Does the symptom usually change when not at work?**		
	Never	Rarely	Some-times	Often	Always	*(Fill in No. of days)*	Gets Worse	Stays Same	Gets Better
a. **headache**	1	2	3	4	5	____	1	2	3
b. **nausea**	1	2	3	4	5	____	1	2	3
c. **runny nose**	1	2	3	4	5	____	1	2	3
d. **stuffy nose/sinus congestion**	1	2	3	4	5	____	1	2	3
e. **sneezing**	1	2	3	4	5	____	1	2	3
f. **cough**	1	2	3	4	5	____	1	2	3
g. **wheezing or whistling in chest**	1	2	3	4	5	____	1	2	3
h. **shortness of breath**	1	2	3	4	5	____	1	2	3
i. **chest tightness**	1	2	3	4	5	____	1	2	3
j. **dry, itching, or tearing eyes**	1	2	3	4	5	____	1	2	3
k. **sore/strained eyes**	1	2	3	4	5	____	1	2	3
l. **blurry/double vision**	1	2	3	4	5	____	1	2	3
m. **burning eyes**	1	2	3	4	5	____	1	2	3
n. **sore throat**	1	2	3	4	5	____	1	2	3
o. **hoarseness**	1	2	3	4	5	____	1	2	3
p. **dry throat**	1	2	3	4	5	____	1	2	3
q. **unusual fatigue or tiredness**	1	2	3	4	5	____	1	2	3
r. **sleepiness or drowsiness**	1	2	3	4	5	____	1	2	3

7. *(continued)*

(For each symptom, answer the first question. If the response is "never," go down to the next symptom.)	Please indicate how often during the LAST YEAR you have experienced this symptom while working in the Madison Building.					Please indicate how many days LAST WEEK you experienced this symptom while working in the Madison Building.	Does the symptom usually change when not at work?		
	Never	Rarely	Some-times	Often	Always	*(Fill in No. of days)*	Gets Worse	Stays Same	Gets Better
s. chills	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
t. fever	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
u. aching muscles or joints	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
v. problems with contact lenses	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
w. difficulty remembering things	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
x. dizziness/lightheadedness	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
y. feeling depressed	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
z. tension or nervousness	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
aa. difficulty concentrating	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
bb. dry or itchy skin	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
cc. pain or stiffness in upper back	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
dd. pain or stiffness in lower back	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
ee. pain or numbness in shoulder/neck	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐
ff. pain or numbness in hands or wrists	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	____	1 ☐	2 ☐	3 ☐

NOTE: **The next four questions (Questions 8-11) refer to your symptoms described in Question 7. If you reported that you never experienced any of these symptoms, go to Question 12.**

8. **How often during the LAST YEAR have any of your symptoms reduced your ability to work in the Madison Building?**

   1. ☐ Never
   2. ☐ Rarely
   3. ☐ Sometimes
   4. ☐ Often
   5. ☐ Always

9. a. **Have any of your symptoms caused you to stay home from work or leave work early during the LAST YEAR?**

   1. ☐ Never → *Go to Q.10*
   2. ☐ Rarely
   3. ☐ Sometimes
   4. ☐ Often

   b. **Which symptoms?**

   _____

   _____

   _____

10. **In which season(s) are you bothered more by the symptoms you reported in Question 7?** *(Check all that apply.)*

    1. ☐ Winter
    2. ☐ Spring
    3. ☐ Summer
    4. ☐ Fall
    5. ☐ No relation to seasons

11. a. **Do you associate any of the symptoms you reported in Question 7 with your work in the Madison Building?**

    1. ☐ No → *Go to Q.12*
    2. ☐ Yes

    b. **Have these symptoms:**

    1. ☐ improved over the last year
    2. ☐ become worse over the last year
    3. ☐ stayed the same

12. **During the LAST YEAR, have you had an illness in which you had repeated episodes of THREE OR MORE of the following symptoms at the same time: wheezing, cough, shortness of breath, fever, chills, aching joints/muscles?**

    1. ☐ No
    2. ☐ Yes

13. **During the LAST YEAR, have you had any chest illnesses, such as bronchitis or pneumonia, that have kept you off work, indoors at home, or in bed?**

    1. ☐ No
    2. ☐ Yes

14. **Has a physician ever told you that you have, or had, eczema?**

    1. ☐ No
    2. ☐ Yes

15. **During the LAST YEAR, have you had any episodes of wheezing (whistling in the chest) WITHOUT fever, or chills, or sore throat?**

    1. ☐ No
    2. ☐ Yes

16. a. **Has a physician ever told you that you have, or had, asthma?**

1. ☐ No ⟶ *Go to Q.17*
2. ☐ Yes

b. **In what year was it first diagnosed?**

19 _____

c. **Have you had an asthma attack during the LAST YEAR?**

1. ☐ No
2. ☐ Yes

17. **Comparing your health since working in the Madison Building with your health before you began to work in the Madison Building . . .**

a. **. . . do you have infections (e.g., colds, flu, bronchitis, etc.) . . .**

1. ☐ more frequently?
2. ☐ less frequently?
3. ☐ with the same frequency?

b. **. . . do your infections (e.g., colds, flu, bronchitis, etc.) tend to . . .**

1. ☐ last longer?
2. ☐ last a shorter amount of time?
3. ☐ last about the same amount of time?

18. **Do you believe you are or may be allergic to any of the following?** *(Check "no" or "yes" for each item.)*

		No 1	Yes 2
a.	pollen or plants	☐	☐
b.	animals	☐	☐
c.	dust	☐	☐
d.	molds	☐	☐
e.	Other *(specify)*	☐	☐

_____

19. **During the LAST YEAR, how often do you believe you have experienced EYE, NOSE, THROAT, OR RESPIRATORY IRRITATION at your workstation from:**

	ALWAYS 1	OFTEN 2	SOMETIMES 3	RARELY 4	NEVER 5
a. Tobacco smoke . . .	☐	☐	☐	☐	☐
b. Fumes from a photocopying machine	☐	☐	☐	☐	☐
c. Fumes from printing processing (press, binding materials, etc.)	☐	☐	☐	☐	☐
d. Fumes from other chemicals such as adhesives, glues, cleansers, white out, rubber cement, etc.	☐	☐	☐	☐	☐
e. Fumes from pesticides	☐	☐	☐	☐	☐
f. Fumes from new carpeting	☐	☐	☐	☐	☐
g. Fumes from new drapes, curtains, or furniture	☐	☐	☐	☐	☐
h. Fumes from paint	☐	☐	☐	☐	☐
i. Fumes from cleaning of carpets, drapes, or other furnishings	☐	☐	☐	☐	☐
j. Other *(specify)* . . . . _____	☐	☐	☐	☐	☐

20. Do you consider yourself especially sensitive to any of the items in Question19?

1. ☐ No
2. ☐ Yes

21. How old are you?

_____ years

22. Are you:

1. ☐ Male
2. ☐ Female

PART III. INFORMATION ABOUT YOUR PRESENT WORK ENVIRONMENT

This section asks you to report specific responses to the physical environment at your present workstation. You or a co-worker may have altered your work environment with a portable fan, heater, humidifier, etc. If so, please tell us how your work environment would have been without this equipment.

1. At your present workstation, HOW OFTEN . . . *(Please check one box for last year and one box for last week.)*	. . . during the LAST YEAR					. . . during the LAST WEEK				
	Never	Rarely	Some-times	Often	Always	Never	Rarely	Some-times	Often	Always
a. was there too much air movement?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
b. was there too little air movement?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
c. did you want to adjust the air movement?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
d. was the temperature too hot?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
e. was the temperature too cold?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
f. did you want to adjust the temperature?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
g. was it too humid? . . .	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
h. was it too dry?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
i. did you want to adjust the humidity?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
j. was the air too stuffy?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
k. was it too noisy?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
l. was it too quiet?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
m. was the work area too dusty?	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

2. During the LAST YEAR, how often, if at all, have you noticed any of these types of ODORS at your present workstation? *(Check one box for each item.)*

	NEVER	RARELY	SOMETIMES	OFTEN	ALWAYS
a. Body odor	1	2	3	4	5
b. Cosmetics, such as perfume or after-shave	1	2	3	4	5
c. Tobacco smoke	1	2	3	4	5
d. Fishy smells	1	2	3	4	5
e. Other food smells	1	2	3	4	5
f. Musty or damp basement smells	1	2	3	4	5
g. Odors from new carpet	1	2	3	4	5
h. Odors from new drapes or curtains	1	2	3	4	5
i. Odors from diesel or other engine exhaust	1	2	3	4	5
j. Odors from a photocopying machine	1	2	3	4	5
k. Odors from printing processing (press, binding materials, etc.)	1	2	3	4	5

2. *(continued)*

	NEVER	RARELY	SOMETIMES	OFTEN	ALWAYS
l. Odors from other chemicals such as adhesives, glues, cleansers, white out, rubber cement, etc.	1	2	3	4	5
m. Odors from pesticides	1	2	3	4	5
n. Odors from cleaning of carpets, drapes, or other furnishings	1	2	3	4	5
o. Odors from paint	1	2	3	4	5
p. Other unpleasant odors *(describe)* _____	1	2	3	4	5

3. In which seasons would you most like to adjust the physical conditions around your workstation? *(Check all that apply)*

	None	Winter	Spring	Summer	Fall
a. Air movement	1	2	3	4	5
b. Temperature	1	2	3	4	5
c. Humidity	1	2	3	4	5
d. Odors	1	2	3	4	5

4. **Please rate the lighting at your workstation.**

1. ☐ Much too dim
2. ☐ A little too dim
3. ☐ Just right
4. ☐ A little too bright
5. ☐ Much too bright

5. a. **Do you experience a reflection or "glare" in your field of vision when at your workstation?**

1. ☐ Never → *Go to Q.6*
2. ☐ Sometimes
3. ☐ Often
4. ☐ Always

b. **Where does the reflection or glare come from?** *(Check all that apply)*

1. ☐ Window, sunlight, outside reflection
2. ☐ Overhead fluorescent lights
3. ☐ Video display screen and/or reflections when looking at screen
4. ☐ Desk lamp
5. ☐ Other *(specify)* _____

6. **Can you see out an outside window from your workstation?**

1. ☐ No
2. ☐ Yes

7. a. **How comfortable is the chair at your workstation?**

1. ☐ Reasonably comfortable
2. ☐ Somewhat uncomfortable
3. ☐ Very uncomfortable
4. ☐ Don't have one specific chair → *Go to Q.8*

b. **Is your chair easily adjustable?**

1. ☐ No
2. ☐ Yes
3. ☐ Not adjustable

8. **How comfortable is the current set-up of your desk or work table (that is, height and general arrangement of the table, chair, and equipment you work with)?**

1. ☐ Reasonably comfortable
2. ☐ Somewhat uncomfortable
3. ☐ Very uncomfortable
4. ☐ Don't have one specific desk or work table

9. a. **During the LAST YEAR, how many times per week did you go outdoors, weather permitting, during work hours (for lunch, break, or other reasons)?**

____ time(s) per week → If zero, go to Q.10

b. **How many of these times did you go outdoors primarily to get some fresh air?**

____ time(s) per week for fresh air

NOTE: **The next four questions concern the overall physical environment at your workstation, that is, the air quality, temperature, light, noise, odor, etc.**

10. **During the LAST WEEK, how satisfied were you with the physical environment at your workstation?**

    1. ☐ Very satisfied
    2. ☐ Somewhat satisfied
    3. ☐ Not too satisfied
    4. ☐ Not at all satisfied

11. **During the LAST YEAR, how satisfied were you with the overall physical environment at your workstation?**

    1. ☐ Very satisfied
    2. ☐ Somewhat satisfied
    3. ☐ Not too satisfied
    4. ☐ Not at all satisfied

12. **During the LAST YEAR, has the overall physical environment in the vicinity of your workstation:**

    1. ☐ improved
    2. ☐ become worse
    3. ☐ stayed the same

13. **During a typical work day, does the overall physical environment in the vicinity of your workstation:**

    1. ☐ improve during the day
    2. ☐ become worse during the day
    3. ☐ stay the same

PART IV. CHARACTERISTICS OF YOUR JOB

This section asks you to describe your job in terms of specific qualities. In order to gain a better understanding of your work environment, we would like to know how you feel about your job situation. As stated before, your responses will be kept confidential.

1. **We would like you to think about the TYPE OF WORK YOU DO IN YOUR JOB.** *(Check one box for each statement)*

   a. **All in all, how satisfied are you with your job?**

   1. ☐ Very satisfied
   2. ☐ Somewhat satisfied
   3. ☐ Not too satisfied
   4. ☐ Not at all satisfied

   b. **Knowing what you know now, if you had to decide again whether to take the job you now have, what would you decide? Would you . . .**

   1. ☐ Decide without hesitation to take the same job
   2. ☐ Have some second thoughts
   3. ☐ Decide definitely not to take the same job

   c. **If you were free right now to go into any type of job you wanted, what would your choice be? Would you . . .**

   1. ☐ Take the same job
   2. ☐ Take a different job
   3. ☐ Not want to work

   d. **If a friend of yours told you he/she was interested in working in a job like yours, what would you tell him/her? Would you . . .**

   1. ☐ Strongly recommend it
   2. ☐ Have doubts about recommending it
   3. ☐ Advise against it

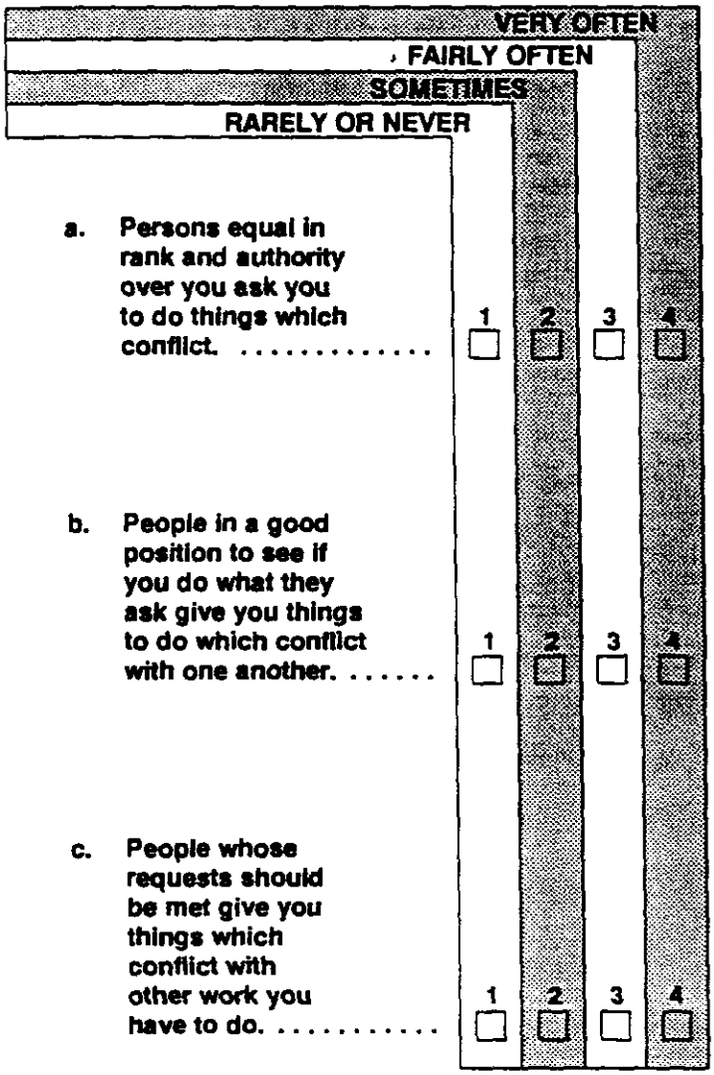
2. **How satisfied are you with your salary?**

   1. ☐ Very satisfied
   2. ☐ Somewhat satisfied
   3. ☐ Not too satisfied
   4. ☐ Not at all satisfied

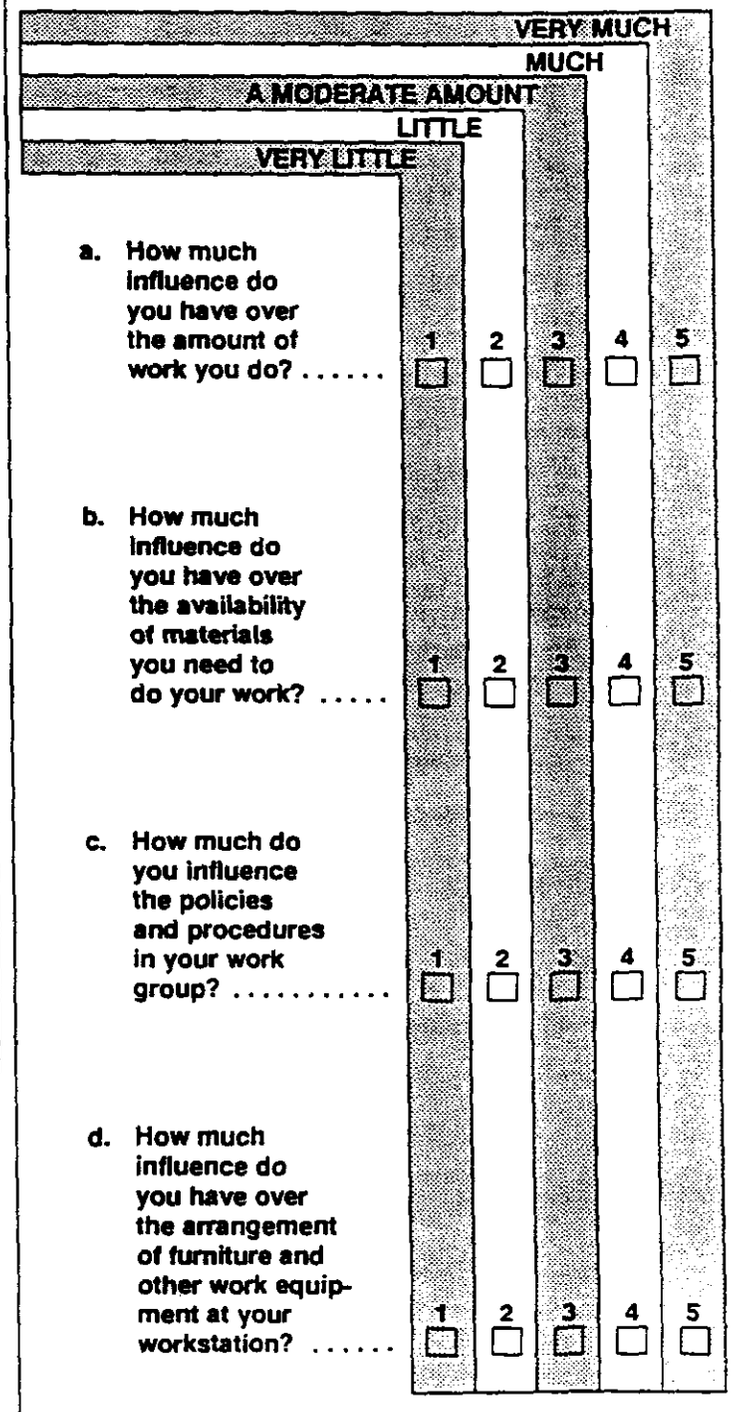
3. **How satisfied are you with your opportunity for advancement at the Library of Congress?**

   1. ☐ Very satisfied
   2. ☐ Somewhat satisfied
   3. ☐ Not too satisfied
   4. ☐ Not at all satisfied

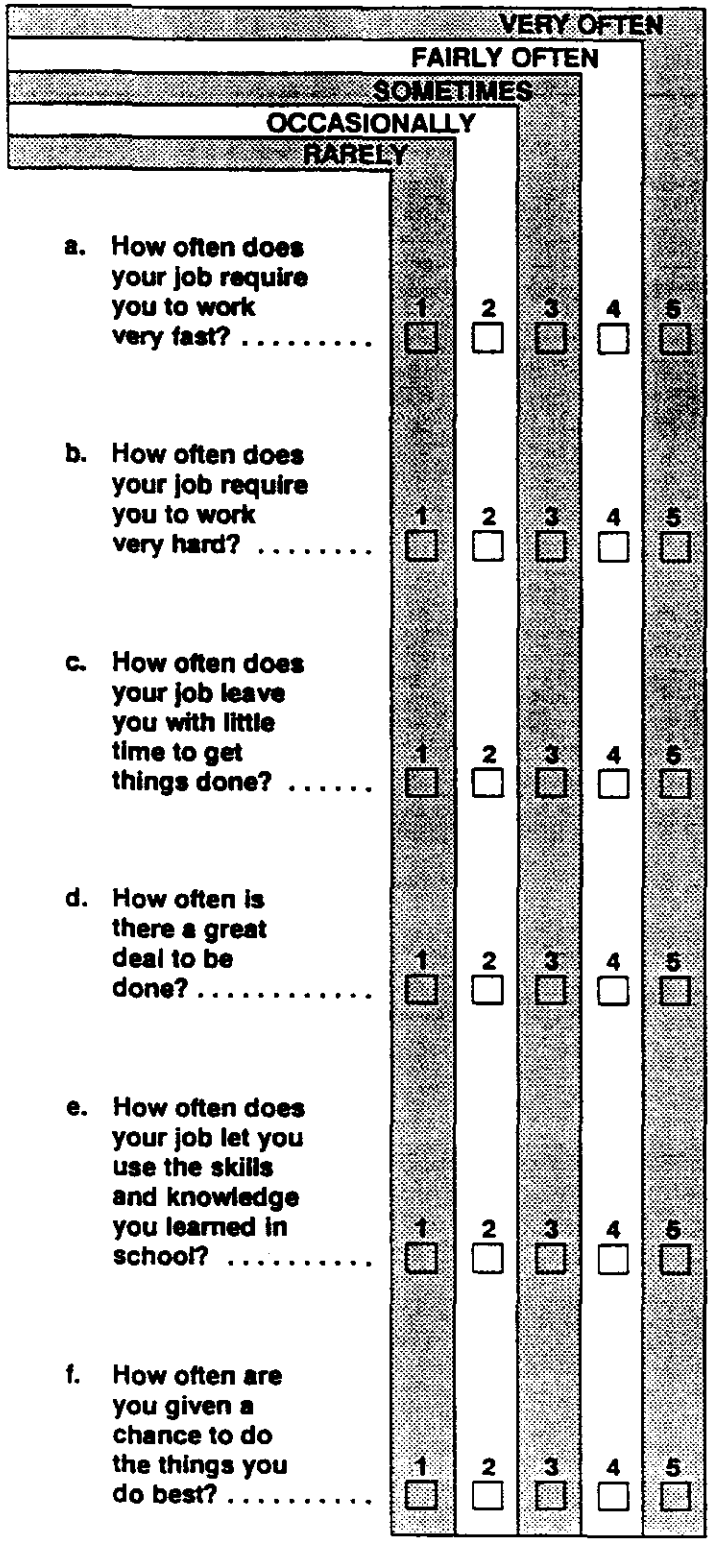
4. **Conflicts can occur in any job. For example, someone may ask you to do work in a way which is different from what you think is best, or you may find that it is diffcult to satisfy everyone. HOW OFTEN do you face problems in your work like the ones listed below?** *(Check one box for each statement)*

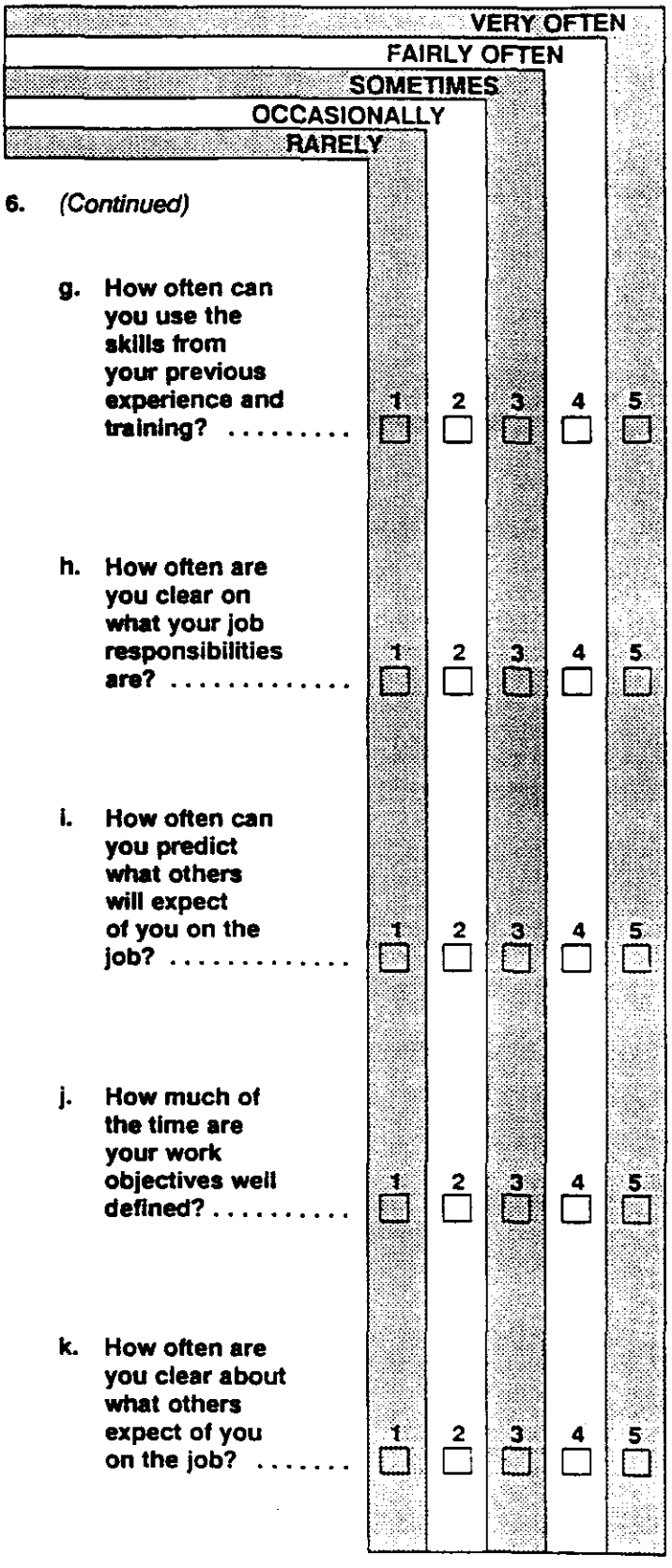


5. **The next series of questions asks HOW MUCH influence you now have in each of several areas at work. By influence we mean the degree to which you control what is done by others and have freedom to determine what you do yourself.** *(Check one box for each question)*



6. **The next series of questions asks HOW OFTEN certain things happen at your job.** *(Check one box for each question)*





7. **In order to better understand your responsibilities outside your normal working day, the next series of questions deals with other significant aspects of your life.** *(Check "no" or "yes" for each question)*

	No 1	Yes 2
a. **Do you have children at home?**	☐	☐
b. **Do you have major responsibility for childcare duties?**	☐	☐
c. **Do you have major responsibility for housecleaning duties?**	☐	☐
d. **Do you have major responsibility for the care of an elderly or disabled person on a regular basis?**	☐	☐
e. **Are you taking courses for credit toward a degree or a diploma?**	☐	☐
f. **Do you have a regular commitment of five hours or more per week, paid or unpaid, outside of this job?** *(Include volunteer work, charitable work, second job, etc.)*	☐	☐

PART V. CONCLUDING QUESTIONS

This section concludes this survey. Your answers to these questions, like your answers to the previous questions, will be kept confidential. This information is needed for statistical purposes.

1. **What day of the week did you complete this survey?**

   1. ☐ Monday
   2. ☐ Tuesday
   3. ☐ Wednesday
   4. ☐ Thursday
   5. ☐ Friday

2. **Which of the following best describes your current living and financial arrangements?**

   1. ☐ Live alone, sole provider of rent/mortgage, utilities, food, and other living expenses.
   2. ☐ Live alone, but receive assistance from one or more others in paying rent/mortgage, utilities, food, and other living expenses.
   3. ☐ Live with one or more other persons, but sole provider of rent/mortgage, utilities, food, and other living expenses.
   4. ☐ Live with one or more other persons who help to pay rent/mortgage, utilities, food, and other living expenses.

3. **What is the highest grade you completed in school?**

   1. ☐ 8th grade or less
   2. ☐ 9th, 10th, or 11th grade
   3. ☐ High school graduate
   4. ☐ 2 years of college or Associate Degree
   5. ☐ Bachelor's or technical degree
   6. ☐ Some graduate work
   7. ☐ Graduate or professional degree

4. a. **What is your pay plan and grade (e.g., GS-5, GM-14, SES-2, WG-2, etc.)?**

   _____

   b. **Which of the following best describes your job duties and responsibilities?** *(If more than one applies, check the ONE box for the job duties on which you spend the most time.)*

   1. ☐ Managerial (such as administrator, manager, etc.)
   2. ☐ Professional (such as engineer, scientist, lawyer, etc.)
   3. ☐ Technical (such as technician, programmer, etc.)
   4. ☐ Administrative Support (such as clerical, computer operator, etc.)
   5. ☐ Service (such as health services, food preparation, janitorial, etc.)
   6. ☐ Craftsman (such as mechanic, repairer, etc.)
   7. ☐ Operator or laborer
   8. ☐ *Other (specify)* _____

      _____

The following information is needed so that your workstation can be located within the Madison Building. This is necessary so that we can relate your responses to the air measurements that will be taken in a few weeks. As with the rest of the questions in this survey, this information will be kept confidential. Please tell us:

5. a. **Your room number**

   _____

   b. **Your workstation telephone number (your direct or private number, not your "section" or "division" number.)**

   _____

6. **Is there anything else you would like to tell us about environmental or health matters in the Madison Building? If so, please use this space provided for that purpose.**

Please put your completed questionnaire in the return envelope provided. Seal it and take it to one of the return boxes located near the elevators and building exits.

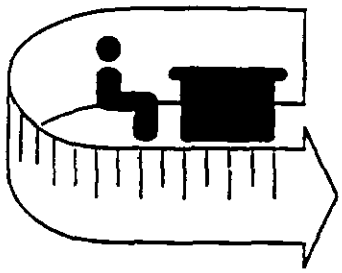
PLEASE READ THE NEXT PAGE

In a few weeks we plan to conduct air measurements in the Madison Building. At that time people whose workstations are close to the air measurement locations will be asked a few additional questions. You may be recontacted at that time.

Thank you very much for your time and patience in filling out this questionnaire.

Appendix B

Supplemental Questionnaire



INDOOR AIR QUALITY AND WORK ENVIRONMENT FOLLOWUP SURVEY

THE MADISON BUILDING STUDY

Measurements of a variety of environmental conditions are being taken in your work area throughout the day TODAY. To help determine how these measurements relate to your comfort and health, please complete the attached questionnaire. Your participation in this part of the evaluation of the Madison Building is, of course, voluntary.

Your completed questionnaire will be collected by and analyzed by NIOSH, Yale and Westat investigators and WILL NOT BE SEEN BY LIBRARY OF CONGRESS MANAGEMENT OR UNION REPRESENTATIVES.

So that we may combine your responses to this questionnaire with the questionnaire distributed three weeks ago, we need you to print your name below. As soon as we have matched your questionnaires, we will remove this cover sheet and save this questionnaire without your name on it. At that time, we will also remove your name from the final combined data file.

YOUR FULL NAME: _____
(please print) **FIRST** **MIDDLE** **LAST**

Please complete this questionnaire even if you did not complete the questionnaire distributed previously.

After you complete this questionnaire, please place it in the attached envelope and seal it. A study investigator will collect it from you.

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY.

Date: ____/____/____

Cart No. _____

Location: ____ ____ ____ ____

(To be completed by investigators)

INDOOR AIR QUALITY AND WORK ENVIRONMENT STUDY

I. **Your answers to the following questions will allow a better interpretation of the environmental measurements taken TODAY in the area around your workstation.**

1. **Did you complete and return the green-covered Indoor Air Quality and Work Environment questionnaire distributed during the week of February 6, 1989?**

   1. ☐ No
   2. ☐ Yes

2. **Have you been in the Madison Building at least 4 hours yet TODAY?**

   1. ☐ No
   2. ☐ Yes

3. **How many hours (to the nearest 1/2 hour) have you spent <u>at your workstation</u> TODAY?** *(Enter 0 if you have not been at your workstation today.)*

   _____ hours this morning (before 12:00 noon)

   _____ hours this afternoon (between 12:00 noon and time you complete this questionnaire)

4. **Since you arrived at work TODAY, have you gone outside (for lunch, break, or other reason)?**

   1. ☐ No
   2. ☐ Yes

5. **How many hours (to the nearest 1/2 hour) have you spent TODAY working at a photocopy machine?**

   _____ hours

6. **How many hours (to the nearest 1/2 hour) have you spent TODAY working at a video display terminal?**

   _____ hours

7. **During the day TODAY, have you or anyone else performed any of the following activities at or near your workstation?** *(Check "no" or "yes" for each item.)*

		No 1	Yes 2
a.	Smoked tobacco	☐	☐
b.	Used a humidifier	☐	☐
c.	Used a cleanser, glue, white out, or other strong-smelling chemical	☐	☐
d.	Used a computer or word processor	☐	☐
e.	Used a printer	☐	☐

II. **For the following, please check the response that best describes your work environment TODAY . . .**
(Please check one box for this morning and one box for this afternoon.)

	This MORNING	This AFTERNOON
1. **Has the AIR MOVEMENT been:**	1. ☐ too much 2. ☐ too little 3. ☐ just right	1. ☐ too much 2. ☐ too little 3. ☐ just right
2. **Has the TEMPERATURE been:**	1. ☐ too hot 2. ☐ too cold 3. ☐ just right	1. ☐ too hot 2. ☐ too cold 3. ☐ just right
3. **Has the HUMIDITY been:**	1. ☐ too humid 2. ☐ too dry 3. ☐ just right	1. ☐ too humid 2. ☐ too dry 3. ☐ just right
4. **Has the NOISE LEVEL been:**	1. ☐ too loud 2. ☐ too quiet 3. ☐ just right	1. ☐ too loud 2. ☐ too quiet 3. ☐ just right
5. **Has the air been TOO STUFFY?**	1. ☐ No 2. ☐ Yes	1. ☐ No 2. ☐ Yes
6. **Has your work area been TOO DUSTY?**	1. ☐ No 2. ☐ Yes	1. ☐ No 2. ☐ Yes

7. a. **Would you like to adjust any of the above conditions?**

1. ☐ No ⟶ *Go to Q.8*
2. ☐ Yes

b. **If yes, which condition(s) would you adjust?**

_____

_____

_____

8. **Have you noticed any of these types of ODORS at your workstation TODAY?** *(Check one box for each item.)*

	No 1	Yes 2
a. Body odor	☐	☐
b. Cosmetics, such as perfume or after-shave	☐	☐
c. Tobacco smoke	☐	☐
d. Fishy smells	☐	☐
e. Other food smells	☐	☐
f. Musty or damp basement smells	☐	☐
g. Odors from new carpet	☐	☐
h. Odors from new drapes or curtains	☐	☐
i. Odors from diesel or other engine exhaust	☐	☐
j. Odors from a photo-copying machine	☐	☐
k. Odors from printing processing (press, binding materials, etc.)	☐	☐
l. Odors from other chemicals such as adhesives, glues, cleansers, white out, rubber cement, pesticides, etc.	☐	☐
m. Odors from pesticides	☐	☐
n. Odors from cleaning of carpets, drapes, or other furnishings	☐	☐
o. Odors from paint	☐	☐
p. Other unpleasant odors *(describe)* _____	☐	☐

9. **How would you judge the overall air quality in the Madison Building TODAY?**

1. ☐ Excellent
2. ☐ Good
3. ☐ Fair
4. ☐ Poor

III. **Have you experienced any of the following symptoms while at work in the Madison Building TODAY?** *(For each symptom, answer "no" or "yes." If your response is "no," go down to the next symptom.)*

	NO	YES	IF YES, when did this symptom begin? BEFORE ARRIVING AT WORK	THIS MORNING AT WORK	THIS AFTERNOON AT WORK
a. headache	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
b. nausea	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
c. runny nose	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
d. stuffy nose/sinus congestion	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
e. sneezing	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
f. cough	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
g. wheezing or whistling in chest	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
h. shortness of breath	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
i. chest tightness	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
j. burning lungs	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
k. dry, itching, or tearing eyes	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
l. sore/strained eyes	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
m. blurry/double vision	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
n. burning eyes	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
o. sore throat	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
p. hoarseness	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
q. dry throat	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
r. unusual fatigue or tiredness	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
s. sleepiness or drowsiness	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
t. chills	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
u. fever	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
v. aching muscles or joints	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
w. problems with contact lenses	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
x. difficulty remembering things	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
y. dizziness/lightheadedness	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
z. feeling depressed	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
aa. tension or nervousness	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
bb. difficulty concentrating	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
cc. dry or itchy skin	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
dd. pain or stiffness in upper back	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
ee. pain or stiffness in lower back	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
ff. pain or numbness in shoulder/neck	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐
gg. pain or numbness in hands or wrists	1. ☐	2. ☐	1. ☐	2. ☐	3. ☐

IV. **The quality of indoor air and other working conditions may influence the way a person feels. For each of the following, please indicate how you have been feeling TODAY.** *(Check one box for each item.)*

	Not at all	A little	Moderately	Quite a lot	Extremely
a. worn out	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
b. listless	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
c. lively	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
d. active	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
e. on edge	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
f. shaky	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
g. energetic	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
h. tense	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
i. relaxed	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
j. uneasy	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
k. restless	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
l. fatigued	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
m. nervous	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
n. cheerful	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
o. exhausted	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
p. anxious	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
q. sluggish	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
r. panicky	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
s. weary	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
t. alert	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
u. full of pep	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
v. carefree	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
w. vigorous	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
x. bushed	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐

V. **What time is it now?**

____:____ PM

Thank you for your time and patience in filling out this questionnaire. Your answers to this questionnaire, like the previous questionnaire, will be kept confidential.

Appendix C

Selected Data Tables from Employee Survey

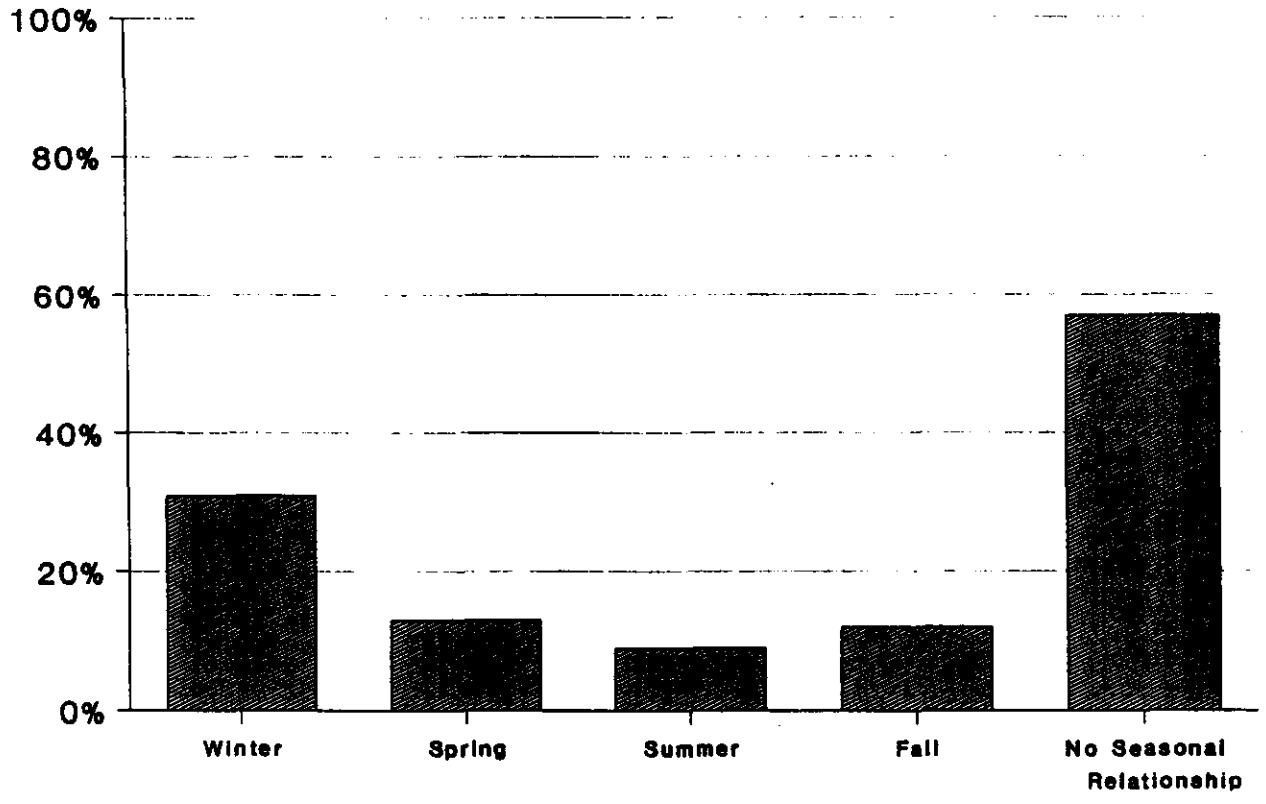
Exhibit C-1: Frequency Distribution of Symptoms Reported Last Year, at Madison Building

SYMPTOMS	NEVER	RARELY	SOMETIMES	OFTEN	ALWAYS	TOTAL REPORTING
a. Headache	11%	25%	43%	19%	2%	2,838
b. Nausea	52%	32%	14%	2%	0%	2,817
c. Runny nose	17%	29%	37%	15%	3%	2,823
d. Stuffy nose	13%	19%	35%	26%	8%	2,831
e. Sneezing	12%	30%	41%	15%	3%	2,832
f. Cough	17%	40%	34%	8%	2%	2,821
g. Wheezing	67%	20%	10%	3%	1%	2,817
h. Shortness of breath	64%	20%	13%	3%	1%	2,822
i. Chest tightness	66%	20%	11%	3%	0%	2,820
j. Dry, itchy eyes	25%	17%	32%	21%	5%	2,823
k. Sore, strained eyes	21%	18%	33%	22%	5%	2,824
l. Blurry vision	54%	19%	18%	7%	2%	2,814
m. Burning eyes	38%	21%	25%	13%	3%	2,822
n. Sore throat	27%	39%	29%	5%	1%	2,826
o. Hoarseness	47%	32%	16%	3%	1%	2,822
p. Dry throat	33%	26%	27%	12%	3%	2,823
q. Fatigue/tiredness	19%	19%	34%	20%	7%	2,826
r. Sleepiness	11%	19%	40%	23%	7%	2,831
s. Chills	44%	25%	20%	8%	3%	2,826
t. Fever	56%	35%	8%	1%	0%	2,814
u. Aching muscles/joints	35%	25%	26%	10%	4%	2,821
v. Problems with contacts*	11%	17%	34%	29%	9%	494
w. Difficulty remembering	48%	24%	22%	5%	1%	2,811
x. Dizziness/lightheadedness	49%	27%	19%	4%	0%	2,818
y. Feeling depressed	35%	27%	28%	9%	2%	2,824
z. Tension/nervousness	27%	24%	34%	12%	3%	2,817
aa. Difficulty concentrating	30%	29%	32%	7%	2%	2,818
bb. Dry skin	37%	16%	25%	16%	7%	2,815
cc. Pain-upper back	42%	20%	23%	11%	4%	2,812
dd. Pain-lower back	35%	21%	28%	12%	4%	2,816
ee. Pain-shoulder/neck	46%	19%	22%	10%	3%	2,815
ff. Pain-hand/wrist	61%	18%	13%	5%	2%	2,813

*These percentages are based upon only the people who wear contact lenses at work "sometimes, often, or always" (Part II, Question 1a) as opposed to all respondents in the building.

Reference: Part II, Question 7.

Exhibit C-2: Percent Reporting Season(s) Most Bothered by Symptoms



Reference: Part II, question 10.

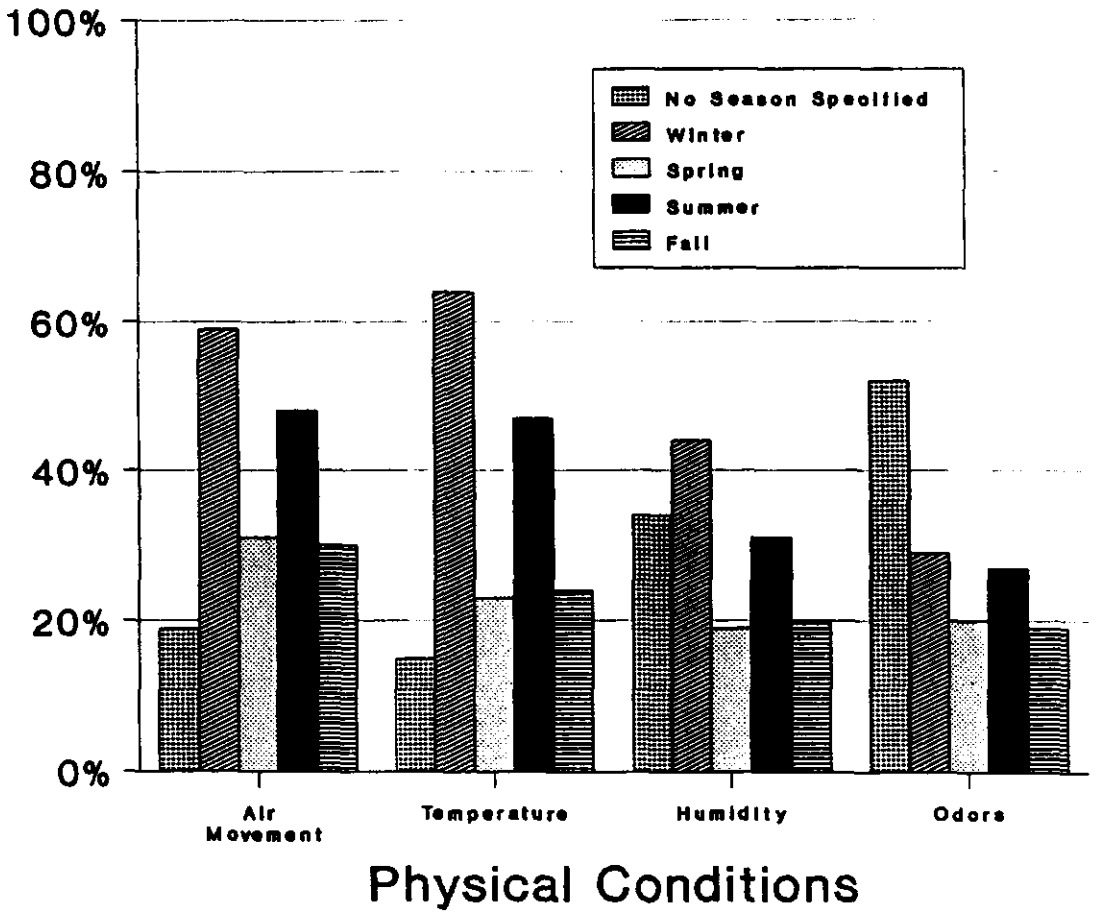
Exhibit C-3: Physical Environment of Workstation Last Year, at Madison Building

	Never		Rarely		Sometimes		Often		Always	
	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.
Too Much Air Movement	1,251	45%	673	24%	497	18%	226	8%	116	4%
Too Little Air Movement	463	17%	450	16%	751	27%	682	25%	406	15%
Adjust the Air Movement	416	15%	284	10%	864	31%	756	27%	432	16%
Temperature Too Hot	725	26%	718	26%	874	32%	371	13%	86	3%
Temperature Too Cold	449	16%	605	22%	984	35%	545	20%	210	8%
Adjust the Temperature	290	10%	339	12%	1,054	38%	720	26%	372	13%
Too Humid	1,322	48%	763	28%	453	16%	156	6%	57	2%
Too Dry	692	25%	563	20%	808	29%	463	17%	240	9%
Adjust the Humidity	759	28%	456	17%	819	30%	434	16%	272	10%
Air Too Stuffy	394	14%	399	14%	751	27%	719	26%	518	19%
Too Noisy	728	26%	834	30%	716	26%	346	12%	151	5%
Too Quiet	1,764	64%	693	25%	203	7%	67	2%	27	1%
Work Area Too Dusty	684	25%	696	25%	746	27%	375	13%	285	10%

Resp. - Number of Employees Responding.
%Resp. - Percentage of Employees Responding.

Reference: Part III, Question 1.

Exhibit C-4: Percent Wanting to Adjust Physical Conditions by Season, at Madison Building



Reference: Part III, question 3.

Exhibit C-5: Employee Rating of Lighting at Workstation, at Madison Building

	PERCENT RESPONDING
Much Too Dim	4%
A Little Too Dim	22%
Just Right	51%
A Little Too Bright	17%
Much Too Bright	6%
Employees Responding	2,795

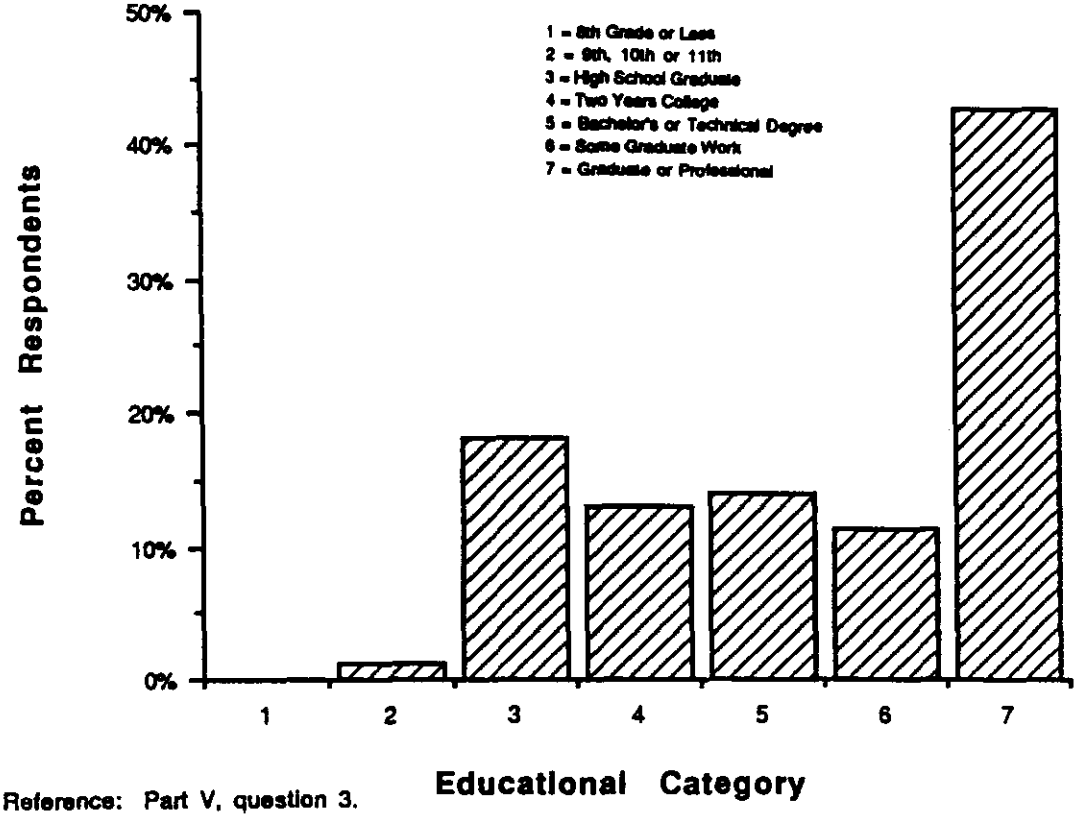
Reference: Part III, Question 4.

Exhibit C-6: Age and Gender Distribution, Madison Building

	RESPONDENTS	
	Male	Female
Employees Responding	1,318	1,466
Percent 24 years or younger	2%	8%
Percent 25 - 34 years	14%	18%
Percent 35 - 44 years	38%	38%
Percent 45 - 54 years	31%	21%
Percent 55 - 64 years	13%	10%
Percent 65 years and older	2%	3%

Reference: Part II, Questions 21 and 22.

Exhibit C-7: Education Distribution, at Madison Building



Reference: Part V, question 3.

Note:
2,811 Persons Answered this Question.

Exhibit C-8: Distribution of Job Categories, at Madison Building

Reference: Part V, Question 4b.

Note:
2,770 Persons Answered the Question.

Exhibit C-9a: Frequency Distribution of the Components of the Role Conflict Scale

Conflicting tasks from Persons:	Rarely		Sometimes		Fairly Often		Very Often		Total
	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	Responding
Equal in rank	1,742	62%	815	29%	165	6%	73	3%	2,795
In position of authority	1,826	66%	733	26%	153	5%	71	3%	2,783
Whose requests should be met	1,281	46%	1,036	37%	333	12%	134	5%	2,784

Reference: Part IV, Questions 4a-4c.

Exhibit C-9b: Frequency Distribution of the Components of the Job Control Scale

How Much Influence Do You Have in the Following Areas:	Very Little		Little		A Moderate Amount		Much		Very Much		Total
	#Resp.	%Resp.	#Resp.	%Resp.	#Resp.	%Resp.	#Resp.	%Resp.	#Resp.	%Resp.	Responding
Over Amount of Work You Do	420	15%	348	12%	817	29%	665	24%	555	20%	2,805
Over Availability of Materials	400	14%	446	16%	882	32%	686	25%	385	14%	2,799
Over Policies in Work Group	743	27%	633	23%	813	29%	372	13%	237	8%	2,798
Over Layout/Design Workstation	974	35%	470	17%	539	19%	430	15%	393	14%	2,806

Reference: Part IV, Questions 5a-5d.

Exhibit C-9c: Frequency Distribution of the Components of the Quantitative Workload Scale

	Rarely		Occasionally		Sometimes		Fairly Often		Very Often		Total
	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	Responding
Required to Work Very Fast	239	9%	546	19%	782	28%	755	27%	489	17%	2,811
Required to Work Very Hard	154	5%	328	12%	718	26%	929	33%	679	24%	2,808
Little Time to Get Things Done	442	16%	488	17%	792	28%	629	22%	450	16%	2,801
Often Have Lot to Do	84	3%	252	9%	520	18%	896	32%	1,059	38%	2,811

Reference: Part IV, Questions 6a-6d.

Exhibit C-9d: Frequency Distribution of the Components of the Underutilization of Abilities Scale

	Rarely		Ocasionally		Sometimes		Fairly Often		Very Often		Total
	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	Responding
Use Skills Learned in School	417	15%	391	14%	558	20%	728	26%	714	25%	2,808
Allowed to do Things You do Best	406	15%	402	14%	673	24%	808	29%	507	18%	2,796
Use Skills from Past Experience	353	13%	347	13%	534	19%	843	30%	694	25%	2,771

Reference: Part IV, Questions 6e-6g.

Exhibit C-9e: Frequency Distribution of the Components of the Role Ambiguity Scale

	Rarely		Occasionally		Sometimes		Fairly Often		Very Often		Total
	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	# Resp.	%Resp.	Responding
Clear on Job Responsibilities	62	2%	108	4%	275	10%	1,022	37%	1,306	47%	2,773
Predict what Others Expect of You	142	5%	141	5%	422	15%	1,122	41%	937	34%	2,764
Work Objectives Well Defined	149	5%	194	7%	553	20%	1,119	41%	740	27%	2,755
Clear on Others Expectations of You	114	4%	167	6%	443	16%	1,129	41%	912	33%	2,765

Reference: Part IV, Questions 6h-6k.

Exhibit C-10: Frequency Distribution of the Components of the External Stress Scale, at Madison Building

	NO		YES		TOTAL RESPONDING
	N	%	N	%	N
Children at home	1,692	60%	1,119	40%	2,811
Major Responsibility for Childcare	2,134	76%	675	24%	2,809
Major Housecleaning Responsibilities	893	32%	1,909	68%	2,802
Regular Care for Elderly Person	2,629	94%	179	6%	2,808
Taking Courses toward Degree/Diploma	2,503	89%	302	11%	2,805
Regular Commitment Outside Job	1,868	67%	936	33%	2,804

Reference: Part IV, Questions 7a - 7f.

Exhibit C-11: Types of Furniture, Equipment and Changes Within 15 Feet of Workstation, at Madison Building

	No		Yes		Total
	# Resp.	% Resp.	# Resp.	% Resp.	Responding
Metal Desk	679	25%	2,006	75%	2,685
Wood or Composition Desk	1,302	51%	1,243	49%	2,545
Metal Bookshelves or Bookcases	327	12%	2,411	88%	2,738
Wood or Composition Bookcases	1,967	81%	461	19%	2,428
File Cabinet(s)	718	27%	1,961	73%	2,679
Other Metal Furniture	846	33%	1,742	67%	2,588
Other Wood Furniture	1,236	49%	1,274	51%	2,510
Fabric-covered Partitions	1,323	51%	1,258	49%	2,581
Portable Humidifier	2,404	98%	58	2%	2,462
Laser Printer	1,967	78%	542	22%	2,509
Photocopy Machine	1,983	79%	540	21%	2,523
Live Plants	802	30%	1,872	70%	2,674
Carpeting	220	8%	2,571	92%	2,791
New Carpeting	2,456	94%	149	6%	2,605
New Drapes/Curtains	2,579	99%	14	1%	2,593
New Furniture	2,105	81%	491	19%	2,596
New Equipment	1,315	50%	1,310	50%	2,625
Walls Painted	2,145	83%	449	17%	2,594
Rearranged Walls	2,273	88%	322	12%	2,595
New/Continuing Water Leaks	2,273	86%	379	14%	2,652

Reference: Part I, Questions 7, 8, 11 and 12.

Exhibit C-12: Items Used Regularly at Workstation Last Year, at Madison Building

	No		Yes		Total
	#Resp.	%Resp.	#Resp.	%Resp.	Responding
Portable Fan	2,182	93%	175	7%	2,357
Portable Air Filter	2,265	97%	78	3%	2,343
Portable Heater	2,278	97%	68	3%	2,346
Desk Lamp	1,584	67%	774	33%	2,358

Reference: Part I, Question 10.

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