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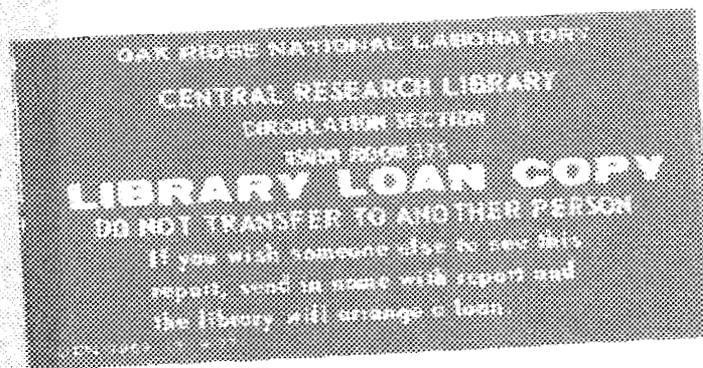


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## Occupant Evaluation of Commercial Office Lighting: Volume II, Preliminary Data Analysis

Robert W. Marans  
Marilyn A. Brown



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Occupant Evaluation of Commercial Office Lighting:  
Volume II, Preliminary Data Analysis

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## EDITOR'S FOREWORD

Electric lighting accounts for an estimated one-third of the energy used in commercial buildings. Along with recent advances in building envelope and equipment R&D, lighting research offers major untapped opportunities for energy savings.

Lighting energy standards and design guidelines are important determinants of energy use in buildings. Because of inadequate empirical data and analysis, these standards and guidelines have historically been based primarily upon professional judgment. Thus, there is little assurance that recommended lighting values provide higher user satisfaction and comfort, while requiring the lowest possible energy use.

In 1984, the U.S. Department of Energy initiated a major research project involving occupant evaluations of commercial office lighting. The central aim of this effort was to explore possible causal factors that are associated with successful lighting design, with particular interest in the relationship between connected lighting power load and subjective measures of lighting quality. In so doing, it was hoped that the project would provide an objective measurement base and analysis from which to assess lighting standards as well as results which will allow the building industry to make lighting system design decisions that are both energy efficient and effective. In 1986, the New York State Energy Research and Development Authority joined DOE in cosponsoring this research, enabling an expansion of the database and additional analyses.

This is the third in a series of four reports describing the project. The titles and authors of these reports are:

- "Occupant Evaluation of Commercial Office Lighting: Volume 1, Methodology and Bibliography," by Gary Gillette;
- "Occupant Evaluation of Commercial Office Lighting: Volume 2, Preliminary Data Analysis," by Robert W. Marans;
- "Occupant Evaluation of Commercial Office Lighting: Volume 3, Data Archive and Database Management System," by Gary Gillette; and
- "Occupant Evaluation of Commercial Office Lighting: Volume 4, Project Summary," by Earle Kennett.

While substantial individual efforts have been made by these authors, it is important to note the considerable involvement of technical review committee members representing the professional, industrial, and research communities (see Acknowledgments).



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Harrison Fraker	American Institute of Architects
Harry Mahler	American Institute of Architects
Dan Nall	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
Fred Pearson	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
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Marilyn Brown	Oak Ridge National Laboratory
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Comments on this report were provided by several of the above individuals, and by Lance McCold of Oak Ridge National Laboratory. Their input is appreciated.



## ABSTRACT

This report presents the preliminary results of a post-occupancy evaluation of office lighting environments. It explores the relationship between quantitative measures of lighting in occupied environments and qualitative measures related to occupant satisfaction.

The report analyzes several types of data from more than 1,000 occupied work stations: 1) subjective data on attitudes and ratings of selected lighting and other characteristics, 2) photometric and other direct environmental data, including illuminances, luminances, and contrast conditions, 3) indirect environmental measures obtained from the architectural drawings and the work station photographs, and 4) descriptive characteristics of the occupants. The work stations were sampled from thirteen office buildings located in various cities in the United States.

Many tentative findings emerged from the analysis, including the following:

- Within the range of values examined here, there is a tendency for lighting satisfaction to decrease as lighting power density increases.
- Occupants who described their work station spaces as bright also tended to be satisfied with their work station lighting.
- Occupants who were most bothered by bright lights and glare were most likely to express dissatisfaction with the lighting at their work stations.
- There is no relationship between work-related activities of employees and indicators of lighting quality.

More research is needed before firm conclusions can be drawn and before guidance regarding lighting standards and other policy issues can be derived.



## 1. INTRODUCTION

This report presents selected findings from a post-occupancy evaluation of office lighting environments. The evaluation was undertaken to begin to define the visual environment and to explore several relationships:

- the relationship between selected quantitative measures of lighting in occupied environments and qualitative measures related to occupant satisfaction, and
- the relationship between the quality of the lighted environment and the energy required to produce it.

As part of the post-occupancy evaluation, field measurements and occupant responses were collected from more than 1200 work stations in thirteen office buildings located in various cities of the United States. The resulting database contains four types of data:

- subjective data on attitudes and ratings of selected lighting and other characteristics,
- photometric and other direct environmental data, including illuminances, luminances, and contrast conditions,
- indirect environmental measures obtained from architectural drawings and work station photographs, and
- descriptive characteristics of occupants.

A companion report describes the procedures used to collect these data (Gillette, 1986), and a second report discusses the data archive (Gillette, 1987). This report presents selected findings from a preliminary data analysis.

The selected findings are based on information contained in two sets of tables shown in Appendix A. The first set (Table Set A) covers descriptive data on samples of occupied work stations in each of 13

office buildings.<sup>1</sup> The remaining sets (Table Sets B through L) show simple bivariate relationships among selected variables for the total sample of work stations.

In Table Set A, the variables cover several work station characteristics, photometric and other lighting conditions, environmental characteristics, lighting power density, and selected occupant responses. The occupant responses were identified as key outcomes to be examined as an initial step in fulfilling the goals and objectives of the research project.<sup>2</sup> They include:

- work station lighting satisfaction,
- preference for improved lighting,
- lighting quality for the building,
- ratings of the amount of light for work,
- lighting evaluations for specific tasks,
- problems with bright lights and glare,
- visual quality of the work station, and
- preferences for more daylight and a better view.<sup>3</sup>

Table Sets B through L show the degree to which selected outcomes are associated with photometric and other lighting conditions, work-related activities of building occupants, and the occupants' evaluations of work station attributes.<sup>4</sup>

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1. Procedures used to sample work stations within the 13 buildings are outlined in Marans (1985) and Gillette (1986).

2. Identification of the key outcomes and their relative importance was made during the meetings of the Technical Review Committee on May 23, 1985 in Washington, D.C. and on July 24, 1985 in Detroit.

3. Items used to measure outcomes and other variables are presented in forms and questionnaires reproduced in Gillette (1986). Copies of the questionnaires and information regarding the construction of scales are available from the author at the College of Architecture and Urban Planning, University of Michigan, Ann Arbor, Michigan 48109.

4. The key figures in the tables are either percentages or mean values and were calculated using numerical weights. The weights reflect different sampling fractions used in selecting work stations in each building and differences in building response rates. In some buildings

The analysis presented in this report is preliminary in that it is limited to a description of the study variables and an examination of bivariate relationships. It represents an initial step toward understanding lighting and lighting quality in 13 office buildings. Bivariate relationships do not imply causal linkages among variables, but simply indicate the degree to which an association exists between one variable and another.

---

where the number of occupied work stations was small (less than 88), questionnaires were distributed to all occupants. Other buildings containing a large number of occupied work stations necessitated the selection of a sample of work stations. The building sampling fractions ( $n/N$ ) vary depending on the total number of occupied work stations ( $N$ ) and the designated sample size ( $n$ ); the fractions range from 1:1.8 to 1:7.7. Response rates among buildings vary from 77 percent to 97 percent with an average of 89 percent of all workers who received questionnaires responding.

Other figures shown in the tables include the actual sample size (in parentheses), which is the number of work stations represented by the percentage or mean, and several statistical measures of association. These are:

- Tau B - a measure of association used with ordinal variables. It measures the extent to which an increase in the value of one variable is accompanied by an increase in the value of another variable.
- Cramer's V - a measure of association based on the chi-square test. A value of 0 represents complete independence between two variables (one of which is nominal); a value of 1 indicates dependence.
- Eta - a measure of association used to test the correlation between two variables.

Additionally, chi-square ( $X^2$ ) tests of significance are presented. The test hypothesizes that there is no relationship between the two variables. A high chi-square value generally connotes a relationship; that is, the hypothesis of no relationship is rejected. The chi-square value is accompanied by a probability value showing the significance level of the relationship. Probability values of less than .10 are considered significant. The measures of association and the chi-square test of significance have been calculated using unweighted data.

This preliminary analysis also suggests paths to be followed in subsequent stages of the research. It can be used to posit models describing how various conditions influence lighting quality. Such models could then be tested using the rich dataset produced by the study, but this is beyond the scope of the current report.

The tentative findings discussed below were highlighted during a workshop held in Washington, D.C. on October 22-23, 1986, and discussed by several workshop participants in subsequent meetings.

## 2. SUBJECTIVE LIGHTING QUALITY--ITS MEASUREMENT, VARIABILITY, AND OVERALL RATING

Subjective lighting quality refers to the responses of building users or occupants to the lighting in their buildings. In the context of this research, three types of responses were used to define subjective lighting quality at the work station. The first is referred to as "lighting satisfaction" and reflects answers to the question, "Overall, how satisfied are you with the lighting at your office or work space?" The second response reflects the importance of "improved lighting" when occupants were asked to indicate their preferences for office improvements. The third response covers the occupants' ratings of the "amount of light for the work you do" at the work station.

Among the building occupants sampled in this study, lighting satisfaction at work stations varies greatly. Whereas two thirds (65%) of the office workers expressed some level of satisfaction with the lighting at their work stations, nearly one-quarter (23.7%) said they were dissatisfied. Work station lighting satisfaction also varied among workers across the 13 buildings. For example, in four buildings, more than three-quarters of the workers were satisfied with their work station lighting; in one building, less than half (44.9%) expressed satisfaction (see Table A-7).

When presented with a list of ten possible office improvements and asked to select four, about half (51%) of the workers selected lighting as one improvement to their work stations (see Table A-7). From the four improvements selected, workers were then asked to select one they would most prefer. Of the workers selecting improved lighting, nearly

one in four mentioned it as the most preferred improvement (115 workers out of 492 workers).

There were mixed ratings on the quantity or amount of lighting and light for performing specific tasks at the work station (see Table A-8). About six in 10 office workers said the amount of light for their work was "good" or "excellent," and only one in four gave high marks to their lighting for reading and writing. Among those who used a CRT, more than one-quarter (28%) rated the lighting for their work as "poor" or "not very good." Similarly, 24.5% of the typists gave "poor" or "not very good" ratings for lighting for typing, as did 23.1% of those who drafted. Table A-8 shows quantity of lighting ratings and lighting assessments for specific tasks among occupants in the 13 buildings.

### 3. CORRELATES OF SUBJECTIVE LIGHTING QUALITY

#### 3.1 ENERGY USE AND LIGHTING

Energy use as reflected by lighting power density (LPD) is related to two indicators of subjective lighting quality (see Table L-1). As LPD values increase, there is a tendency for lighting satisfaction to decrease ( $\eta=.17$ ,  $p<.00$ ). This relationship is also shown in Figure 1. Similarly, ratings of the amount of light for work diminish as LPD values increase ( $\eta=.17$ ,  $p<.00$ ).

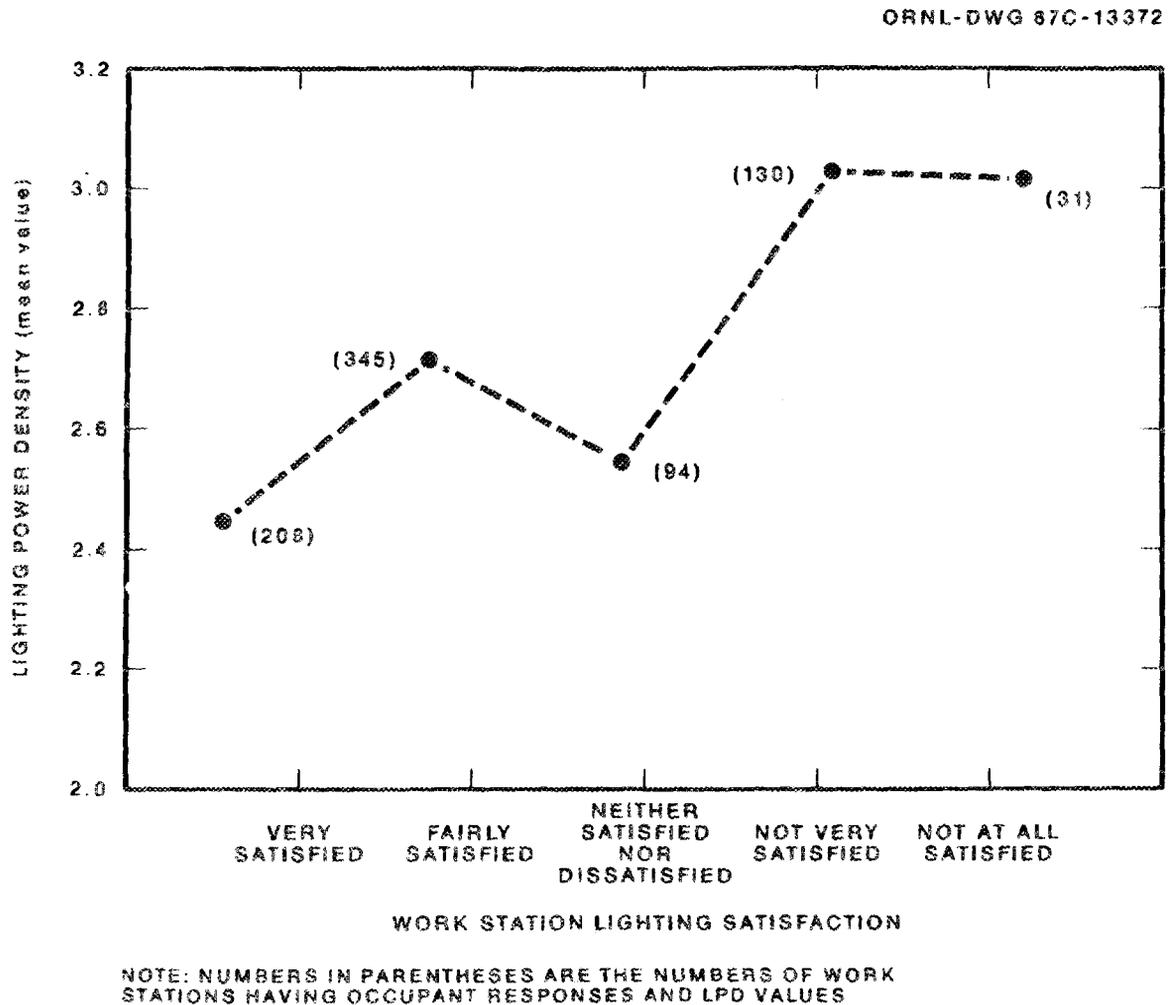


Figure 1.

In the first three buildings, lighting quality as viewed by a team of design experts is also associated with LPD ( $\eta=.19$ ,  $p<.00$ ). That is, higher LPD values are likely to be found at those work stations assessed by experts as having poor quality lighting.

Finally, relationships exist between work station LPD values and measures of illuminance ( $\eta=.19$ ,  $p<.00$ ) and luminance ( $\eta=.25$ ,  $p<.00$ ) at the primary task location (Table I-2). The non-linear relationships (Figures 2 and 3) between lighting power density and the quantity of light in work stations is a surprising finding that merits further analysis.

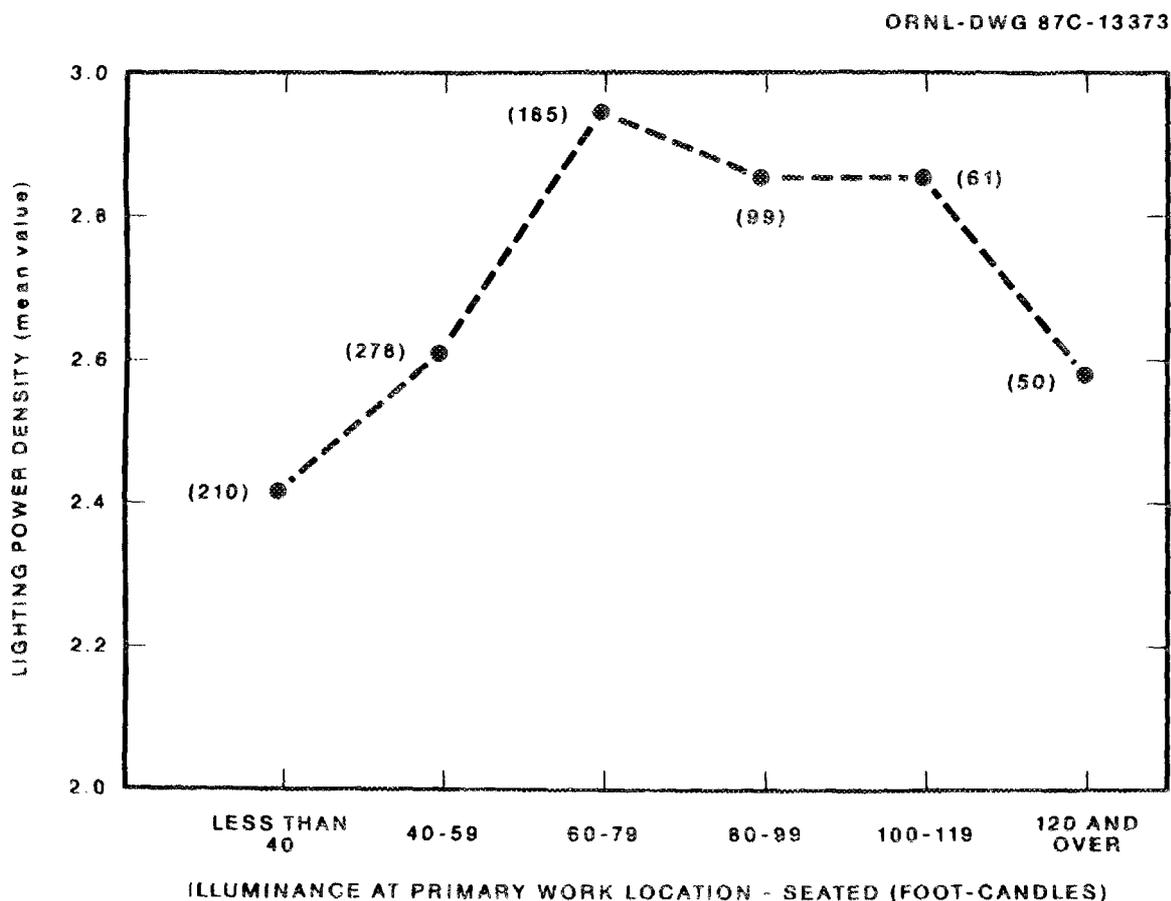


Figure 2.

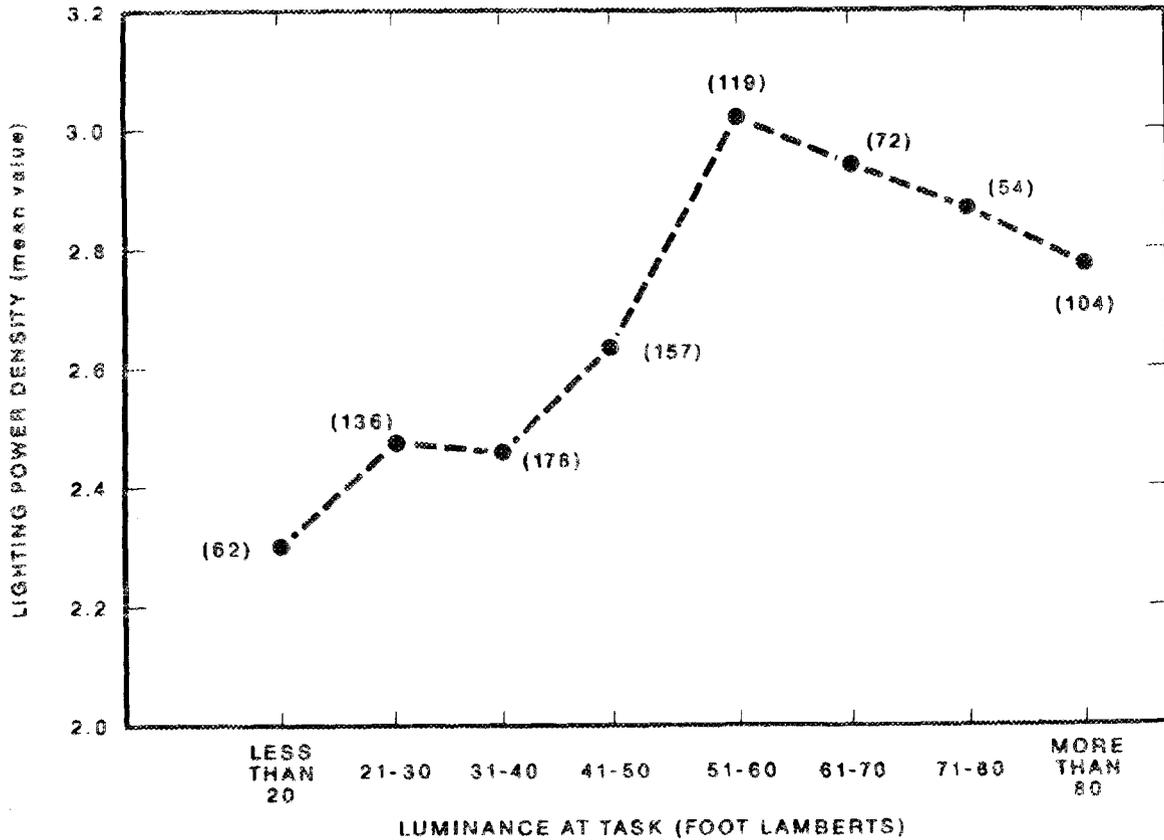


Figure 3.

### 3.2 PERCEPTIONS OF LIGHTING CONDITIONS AND SUBJECTIVE LIGHTING QUALITY

The degree to which work station spaces are described as bright or dim is strongly associated with subjective lighting quality. More than 80% of the building occupants who said their work stations were bright were satisfied with the lighting available to them. In contrast, only 15% of those who described their work station as dim expressed satisfaction (see Table B-5). Similar findings are seen when other indicators of lighting quality are examined vis-a-vis perceptions of brightness (see Table C-5 and E-5 and Figures 4 and 5).

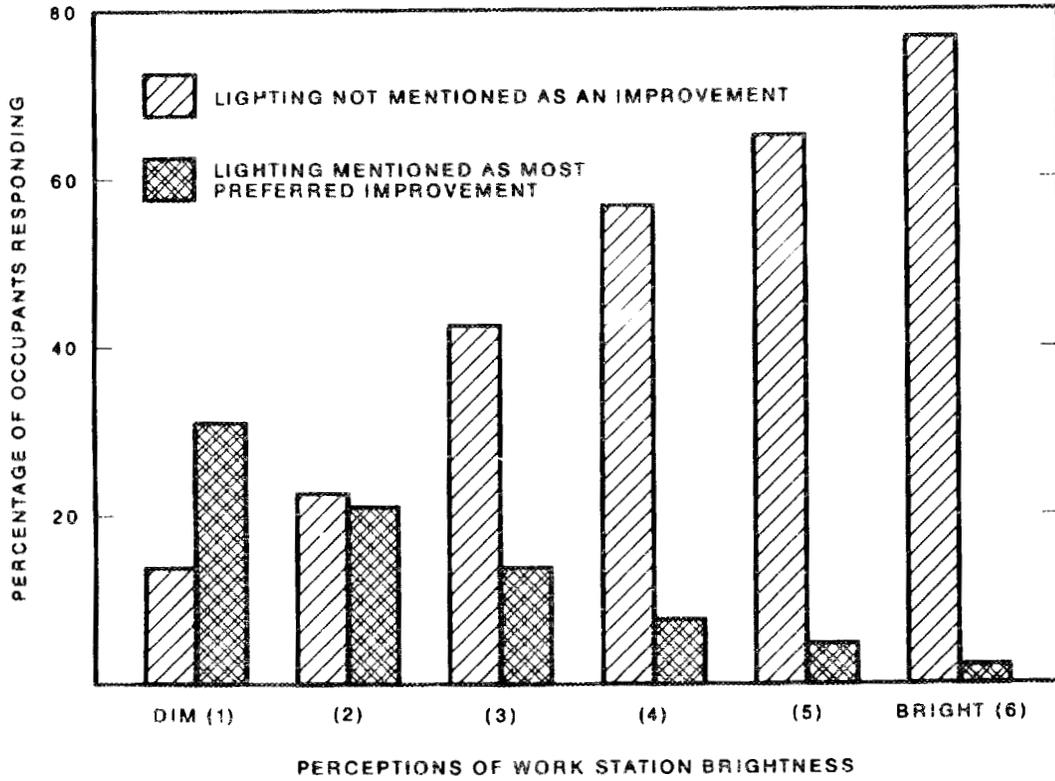


Figure 4.

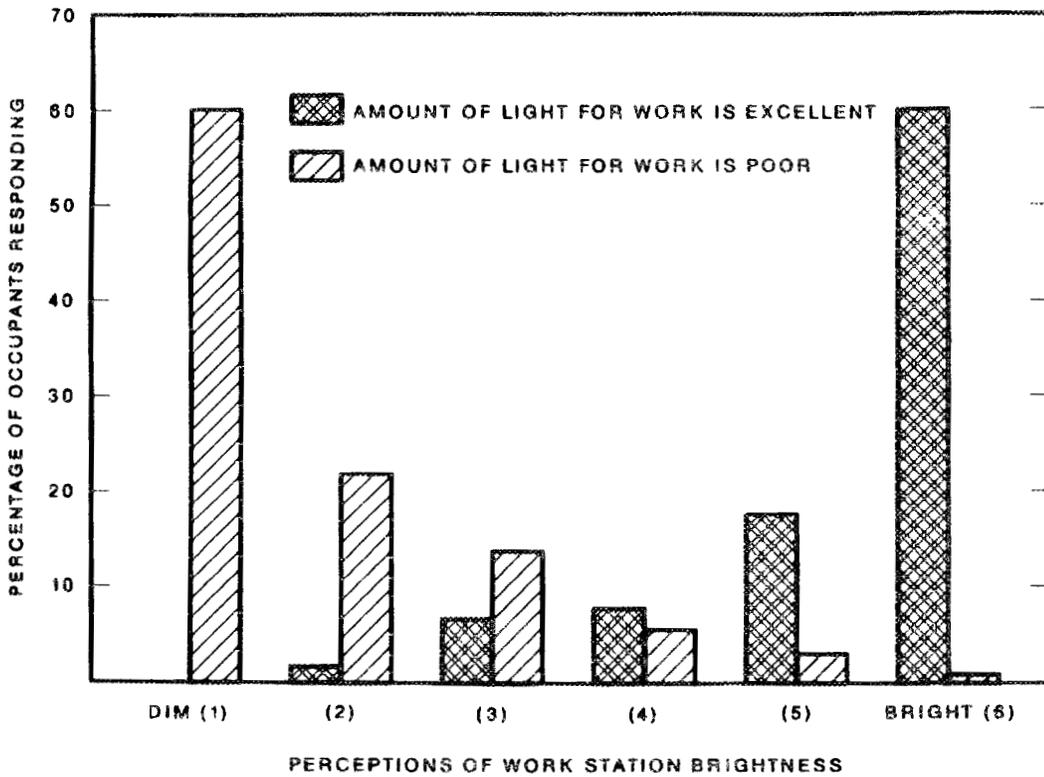


Figure 5.

Occupants' evaluations of brightness and glare conditions are also strongly related to their assessments of lighting quality. Workers who were most bothered by bright lights, reflected glare, and glare from various light sources were most likely to express dissatisfaction with lighting at their work stations and most likely to want their lighting improved. Of the various sources of glare influencing lighting satisfaction at the work station, the problem of reflected glare is most strongly associated with dissatisfaction ( $\text{Tau } B = .34$ ). For example, among workers bothered by reflected glare, more than half (53.7%) were dissatisfied with their work station lighting; only one in eight (12.5%) who were not bothered by reflected glare were dissatisfied with the lighting. The problem of glare from sunlight is also related to work station lighting satisfaction, but compared to glare from electric light sources, its impact is fairly weak ( $\text{Tau } B = .09$ ).

### 3.3 LIGHTING CONDITIONS AND REFLECTED GLARE PROBLEMS

Although the relationship is statistically insignificant, there is a tendency for higher levels of illumination at the primary work location to be associated with reflected glare (see Table I-1). The mean illuminance with body shadow at the primary work surface was 62 footcandles for workers who said that reflected glare is not a problem. For workers who said reflected glare is very bothersome, work surfaces averaged 74 footcandles. Relationships between the reflected glare problems at work stations and the measures of illuminance at the primary and secondary work surfaces in those work stations are shown in Figure 6.

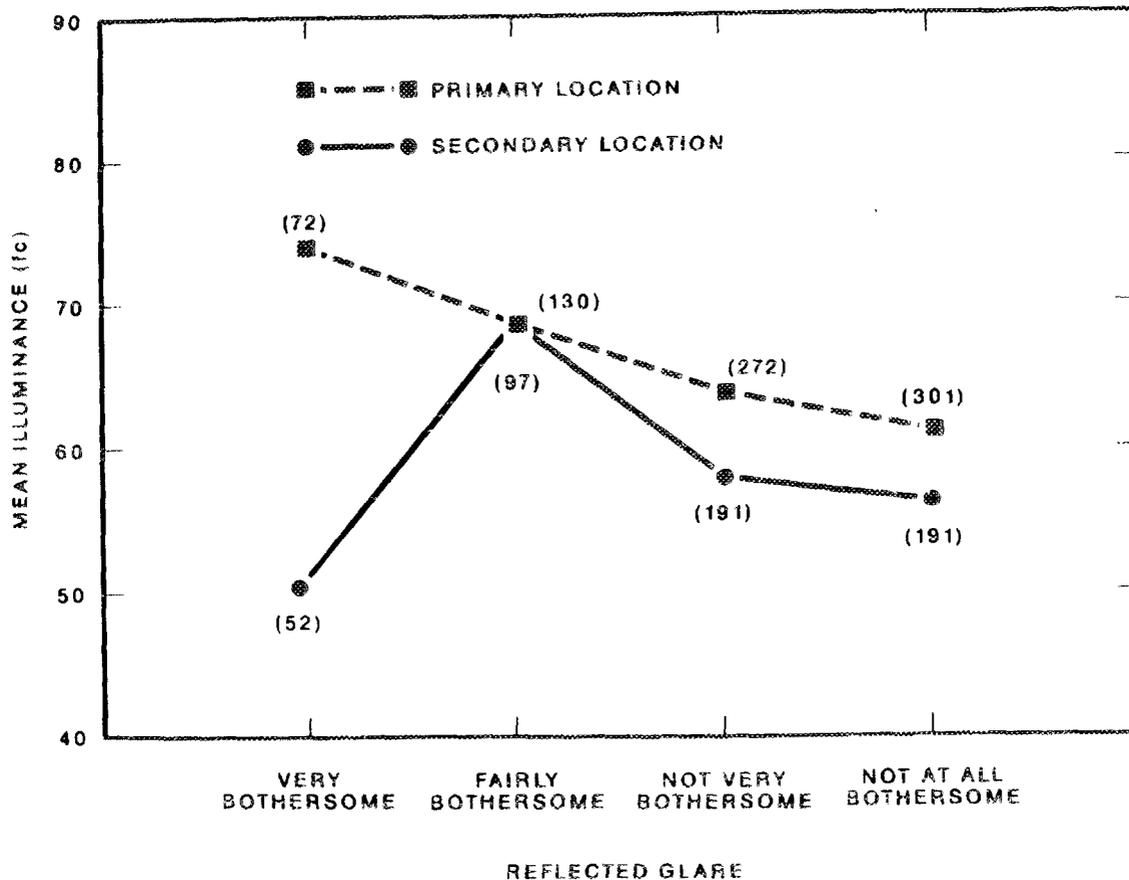


Figure 6.

A moderately significant relationship exists between the luminance on the task and reflected glare. Workers who were not bothered by reflected glare had, on average, 48 footlamberts at their work surfaces, whereas those who were very bothered averaged 56 footlamberts at their work surfaces. The data also reveal weak but significant relationships between the reflected glare problem and task luminance ratios ( $\eta^2=.09$ ,  $p<.02$ ) and minimum values of the contrast rendition factor ( $\eta^2=.12$ ,  $p<.01$ ).

Whereas reflected glare is not significantly related to the type of lighting system at work stations, differences in responses are observed

for workers associated with particular systems (see Table I-2). For instance, nearly half (44.7%) of those at work stations with a direct fluorescent surface mounted system said they were "very bothered" or "fairly bothered" by reflected glare. In contrast, less than one in four workers (22.3%) having high intensity discharge (HID), pendant-mounted, indirect system were "very bothered" or "fairly bothered" by reflected glare.

### 3.4 WORK TASKS AND SUBJECTIVE LIGHTING QUALITY

There are no relationships between work-related activities of employees and indicators of lighting quality (Table E-1). Neither the amount of time spent in a building nor the proportion of that time spent at the work station have any bearing on the workers' lighting satisfaction, preference for improved lighting, or how they feel about the amount of light for their work. Nor does the predominant task performed by workers significantly influence their feelings about work station lighting quality. Office workers who spend most of their time at a CRT expressed the same level of satisfaction as those engaged in other tasks (reading, writing, typing, and drafting) (see Table B-3). Similarly, the amount of time a person devotes to a particular task is unrelated to lighting satisfaction. On the other hand, the amount of time that workers devote to reading, writing, and typing is associated with their ratings for the amount of light for work (Table E-3). These contradictory findings suggest that the influence of work-related activities on indicators of lighting quality warrants further exploration for workers operating under various lighting and other environmental conditions.

### 3.5 LIGHTING CONDITIONS AND SUBJECTIVE LIGHTING QUALITY

Although there is a tendency for lower levels of illumination to be associated with higher levels of subjective lighting quality at the work station, the data indicate that quantitative lighting measures are not significantly related to work station lighting satisfaction and preferences for improved lighting (Tables B-1 and C-1). Neither the illuminances nor the task luminance ratio at the work station are related to these indicators of lighting quality. Similarly, the distance between the work station and the nearest window is unrelated to lighting satisfaction and the preference for improved lighting. On the other hand, ratings of the amount of light for work are associated with the task luminance ratio and with the illuminance at the primary work surface (Table E-1). The latter relationship is shown in Figure 7.

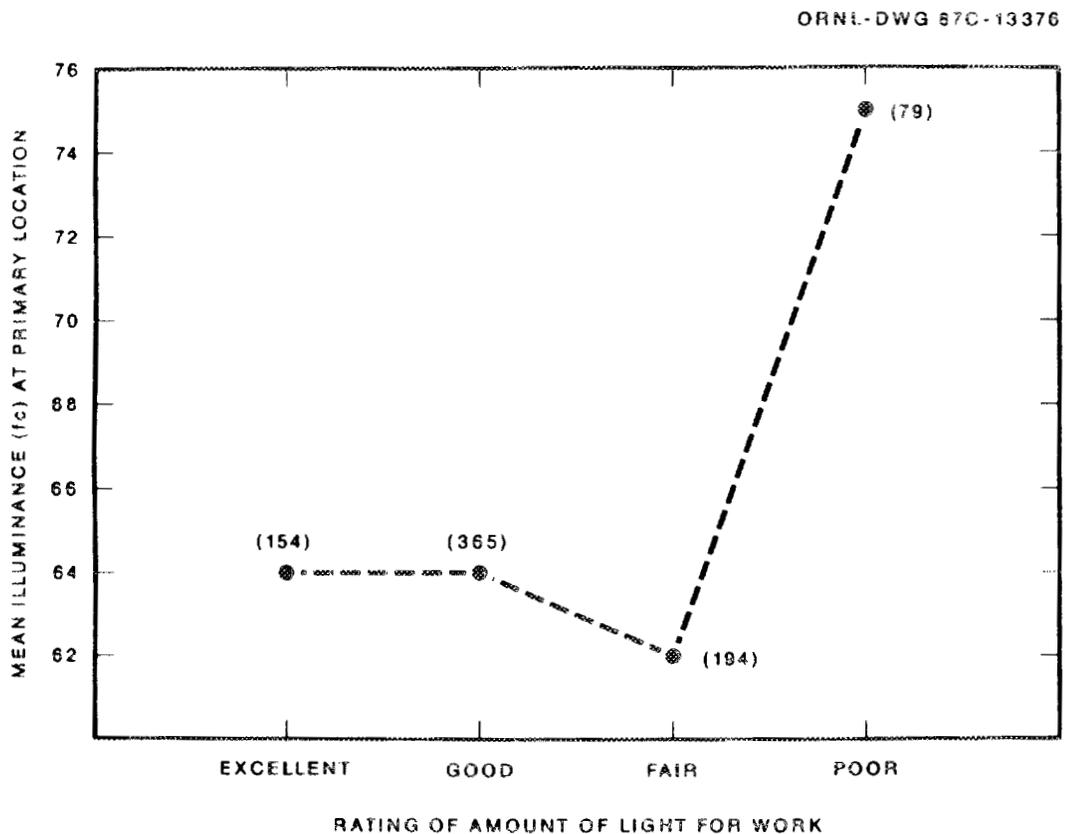


Figure 7.

The type of ambient lighting system is also related to subjective lighting quality. For instance, nearly three-quarters of the building occupants working under direct-recessed florescent lighting fixtures with louvers were satisfied with their work station lighting; 14% were dissatisfied. Those occupants having an indirect furniture-mounted system expressed lower levels of satisfaction, with more than one-third (36%) reporting dissatisfaction with their work station lighting, and just 56% reporting satisfaction (see Table B-2).

The data suggest that dissatisfaction with work station lighting is somewhat lower for workers in the spaces having direct-recessed fluorescent lighting with louvers than it is for workers with the same lighting system having lenses. In buildings with the former, about 14% were dissatisfied whereas 26% of the workers in buildings where the system has lenses expressed dissatisfaction with their work station lighting.

Workers with supplemental task lighting at their work stations tended to rate their lighting unfavorably and were inclined to want better lighting (see Tables B-2, C-2, and E-2). A significant proportion of these work stations had furniture-integrated lighting systems (Table A-4).

### 3.6 LIGHTING CONTROLS AND SUBJECTIVE LIGHTING QUALITY

With respect to lighting controls, workers who can turn their lights on and off were more likely to rate the quality of work station lighting poorly than those who can't manipulate their lighting in this manner (see Table B-4). On the other hand, workers who are able to control the quantity or amount of light and window blinds tend to be

more satisfied with their work station than those who lack such controls.

There is no relationship between work station lighting satisfaction and workers' ability to control the direction of light at their work stations. However, workers' feelings about their ability to adjust the amount and direction of light is strongly related to lighting quality (see Tables B-4, B-5, E-4, E-5). As workers' ratings of their ability to alter the amount and direction of light improve, so does their satisfaction with lighting at the work station (Tau B =.33).

### 3.7 PERCEPTIONS OF LIGHTING CONDITIONS AND VISUAL QUALITY

The visual quality of the work station is related to, but distinct from, its lighting quality. In the context of this study, it is measured by the degree to which work stations were considered attractive, pleasant, interesting, spacious, and comfortable by their occupants.

Bivariate analyses indicate that the workers' view of the outdoors from their office (e.g., whether or not they can see the sky from a sitting position) and the occupants' assessment of their view are associated with visual quality. For example, workers who can see outdoors while sitting at their desks were more likely to assess visual quality favorably than those who can't see outdoors or who have to stand up to see (Table F-3). Similarly, workers who thought their view was attractive and rated it "excellent" were most likely to feel the visual quality of their work station was high (Tables F-4 and F-5). Proximity to a window is also associated with visual quality although the relationship is weak ( $p < .08$ ). As seen in Figure 8, ratings of

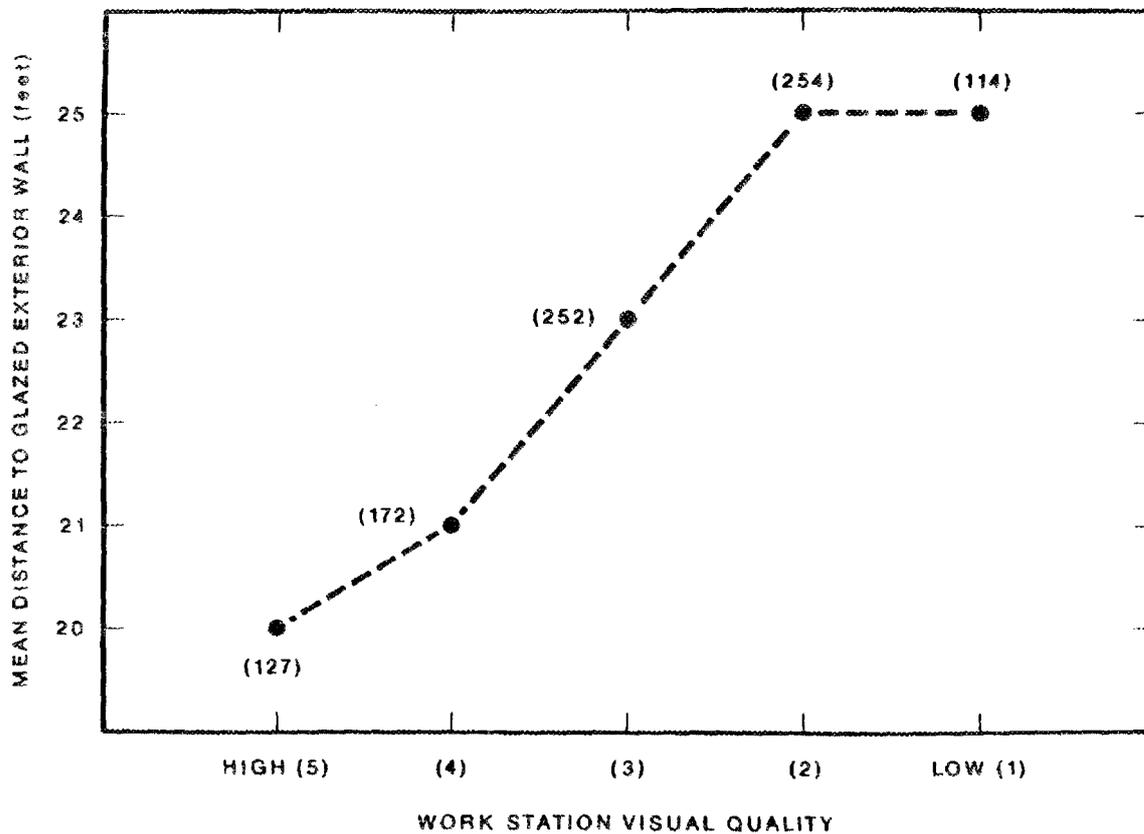


Figure 8.

visual quality diminish as the average distance to a glazed exterior wall increases.

Visual quality is correlated with perceptions of work station brightness. Whereas workers who described their work stations as dim tended to give those spaces low ratings on visual quality, workers describing their work stations as bright were most likely to report high visual quality (see Table F-4).

Peoples' perceptions and evaluations of other work station conditions were also related to visual quality. Tables F-4 and F-5 indicate that problems of glare and bright lights are associated with low levels of visual quality. Similarly, poor visual quality and harsh

lighting tend to go hand in hand. Among other factors influencing visual quality are the occupants' evaluations of the furnishings at their work stations and the color of walls and partitions (Table F-5).

### 3.8 LIGHTING QUALITY--BUILDINGS AND WORK STATIONS

Workers' feelings about the overall quality of lighting in their office buildings are strongly associated with their feelings about lighting at their work stations. As shown in Figure 9, a high proportion of workers who gave low ratings to building lighting quality said they were "not at all satisfied" with lighting at their work stations. At the same time, those giving high ratings to the quality of building lighting were most likely to be very satisfied with work

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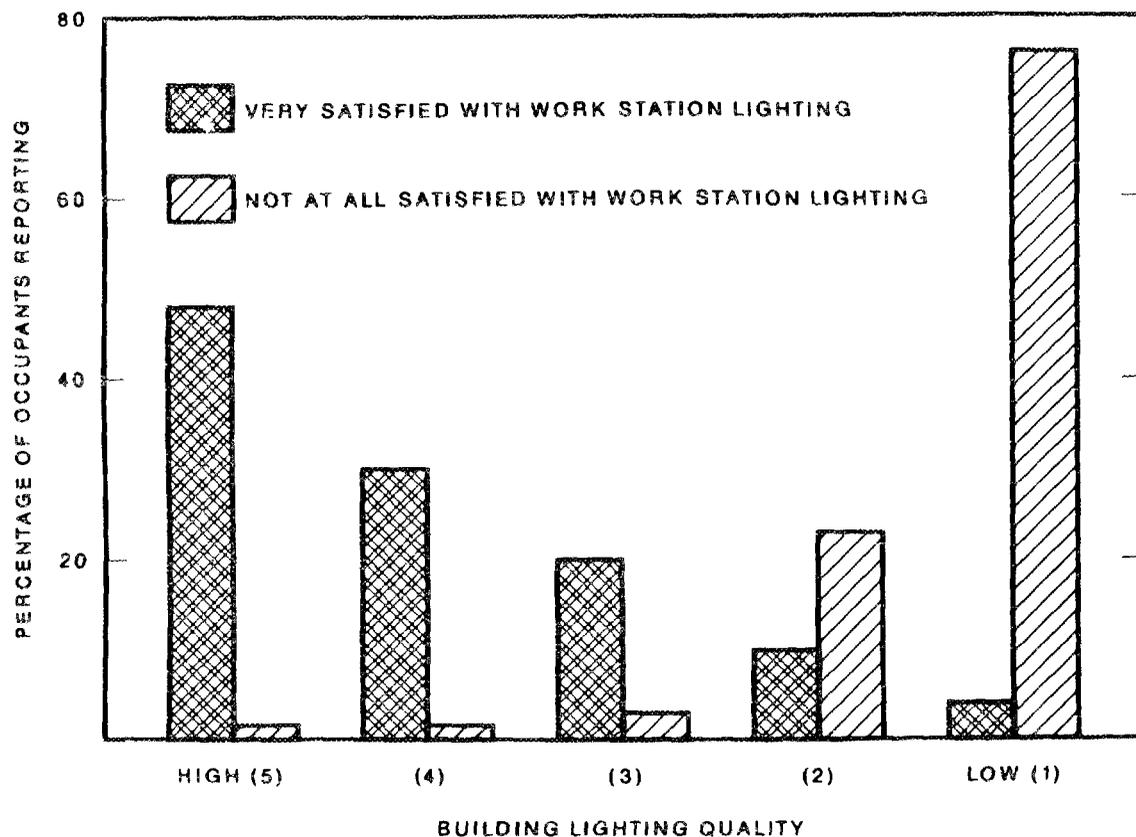


Figure 9.

station lighting. Workers who rated their building lighting quality as high were least likely to report glare and bright lights as problematic and most likely to say their office had soft lighting (Table D-1).

Finally, ratings of lighting in the cafeterias and lobbies of buildings are strongly associated with the overall lighting quality in the building (Table D-2).



#### 4. CONCLUSIONS AND FUTURE WORK

The findings presented here are preliminary in nature. They provide only tentative suggestions about relationships between lighting and environmental conditions on the one hand, and various assessments and perceptions of office workers, on the other hand. Consequently, the findings are not intended to be used to guide policies such as the revision of lighting standards. Rather, they provide a starting point for a longer-term research effort that could ultimately provide the necessary information for guiding both practice and policy.

Among the questions to be explored in subsequent work are the following:

- What is the relative importance of specific lighting attributes in determining the lighting quality of work spaces? Given the limited resources available to the designer, how should she or he best manipulate lighting elements so as to maximize lighting quality?
- What is the role of lighting in the overall quality of the work station? Compared with thermal comfort, space privacy, outside views, and other factors, where does lighting fit? While we can readily acknowledge that lighting design is important, the question of how lighting stacks up relative to these other work station conditions needs to be addressed.

Finally, there are questions about the representativeness of the data examined here.

- How representative are these 13 buildings of commercial office space in the U.S.?
- How typical are the occupants and the organizations occupying these 13 buildings?

These questions need to be addressed before we can draw firm conclusions from this preliminary data analysis and before guidelines can be developed for use by lighting designers, space planners, and policy makers.



## 5. REFERENCES

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## APPENDIX A

Evaluating Lighting Quality: Selected Tables

<u>TABLE SERIES</u>	<u>TITLE</u>	<u>NUMBER OF TABLES</u>
A	Building Comparisons	9
B	Work Station Lighting Satisfaction	6
C	Preference for Improved Lighting	6
D	Building Lighting Quality	2
E	Rating of Amount of Lighting for Work	5
F	Work Station Visual Quality (Occupants)	5
G	Work Station Visual Quality (Experts)	3
H	Evaluation of Lighting for Reading/Writing	3
I	Reflected Glare Problems	2
J	Evaluation of Lighting for CRT Use	2
K	Building Interior Quality	1
L	Work Station Lighting Power Density	2

Table A-1

SELECTED WORKSTATION CHARACTERISTICS (1), BY BUILDING  
(percentage distribution)

Characteristic	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Current Workstation</u>														
Conventional, private office	19.4	14.8	17.2	11.1	41.9	12.0	--	72.0	78.6	100.0	1.3	60.0	2.5	18.8
Open office with partitions	76.9	80.8	82.8	86.7	12.8	82.0	97.5	28.0	--	--	92.4	30.0	96.2	81.2
Open office w/o partitions	3.7	4.4	--	2.2	45.3	6.0	2.5	--	21.4	--	6.3	10.0	1.3	--
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of workstations	1206	183	180	180	86	50	80	50	28	50	80	80	79	80
<u>Previous Workstation<sup>a</sup></u>														
Conventional, private office	19.3	15.1	17.2	15.3	9.3	38.4	8.1	40.0	40.9	42.0	39.6	27.0	17.7	12.1
Conventional, shared office	9.1	13.2	6.7	4.3	16.0	5.1	1.4	25.0	13.6	21.1	10.4	17.6	3.2	22.4
Open office with partitions	40.8	50.3	56.5	45.4	25.3	38.5	35.1	17.5	4.5	5.3	25.0	21.6	63.0	32.8
Open office w/o partitions	20.6	10.7	9.8	27.0	41.4	15.4	41.9	7.5	27.3	5.3	16.7	28.4	14.5	22.4
Other	10.2	10.7	9.8	8.0	8.0	2.6	13.5	10.0	13.6	26.3	8.3	5.4	1.6	10.3
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	1015	159	163	163	75	39	74	40	22	38	48	74	62	58
<u>Workstation View</u>														
Sky seen from standing/sitting position	61.7	63.8	59.0	75.4	45.7	34.9	60.8	87.5	68.0	91.2	8.3	83.7	68.1	44.9
Outdoors seen from standing/sitting positions, but no sky	3.9	8.0	--	3.3	--	7.0	--	--	--	2.9	12.5	--	2.1	--
Sky seen from standing position only	15.3	18.1	31.3	13.1	6.3	--	34.8	4.2	--	--	--	--	--	--
Outdoors seen from standing position only, but no sky	3.3	8.0	0.7	4.1	--	14.0	2.2	--	--	--	--	--	--	--
Outdoors not seen, but workstation is affected by daylight	0.8	0.7	--	--	4.2	--	2.2	--	--	5.9	--	2.0	--	--
Workstation is unaffected by daylight	15.0	1.4	9.0	4.1	43.8	44.1	--	8.3	32.0	--	79.2	14.3	29.8	55.1
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of workstations	841	138	144	122	48	43	46	48	25	34	48	49	47	49

<sup>a</sup> Previous workstation is based on occupant responses to the question, "Before you moved to your present office or workspace, did you work in a: \_\_\_\_\_."

Table A-2

SELECTED WORKSTATION CHARACTERISTICS (2), BY BUILDING  
(mean characteristic)

Characteristic	Building Number													
	All Buildings	1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Amount of Work Space (square feet)</u>														
Mean	87	82	98	82	75	98	74	105	132	81	87	121	126	73
S.D.	51	58	32	52	65	71	28	61	60	34	57	54	46	45
Range	14-472	15-472	39-209	30-426	14-221	24-384	33-204	19-272	36-288	33-196	25-366	33-226	52-285	45-272
<u>Workstation Density (workers per 400 sq. ft.)</u>														
Mean	4.4	4.8	4.6	4.5	3.4	4.9	6.1	2.3	1.3	1.5	4.4	1.8	3.4	4.4
S.D.	2.3	2.7	2.1	2.0	2.6	1.9	2.0	1.6	0.6	0.6	1.7	1.0	1.0	1.6
Range	1-12	1-12	1-9	1-11	1-8	1-8	1-9	1-7	1-3	1-3	1-9	1-5	1-6	1-7
Number of workstations	1197	183	180	180	86	50	80	50	28	50	80	65	79	80
<u>Percent Adjacent to Glazed Exterior Wall (feet)</u>														
Number of workstations	1206	183	160	180	86	50	80	50	28	50	80	80	79	80
<u>Distance to Nearest Glazed Exterior Wall (feet)<sup>a</sup></u>														
Mean	23	20	39	19	11	22	39	8	9	6	16	8	16	17
S.D.	20	15	30	15	6	15	20	3	1	6	8	3	10	10
Range	2-135	3-70	9-135	4-66	3-28	6-60	5-90	2-20	6-12	3-6	5-32	4-22	6-34	4-10
Number of workstations	1048	177	161	173	31	41	80	49	20	50	49	63	79	75

<sup>a</sup> Distances from open offices with and without partitions are straight-line measures from the center of the workstation to the nearest glazed exterior wall (or window). Measurements were not made from interior offices unaffected by daylighting.

Table A-3

Revised 1-22-87

WORKSTATION LIGHTING CONDITIONS, BY BUILDING  
(mean condition)

Occupants' Evaluation	Building Number													
	All Buildings	1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Illuminance - Seated: Primary Location(fc)<sup>a</sup></u>														
Mean	65	54	66	74	44	65	74	55	71	62	60	74	68	54
S.D.	32	24	25	37	29	58	24	22	30	31	29	42	32	24
Range	13-401	14-157	26-152	13-191	18-183	19-401	32-120	15-134	29-128	27-167	17-128	28-236	26-155	14-132
Number of Workstations	896	149	140	139	51	46	49	48	28	50	51	50	49	49
<u>Illuminance - Vacant: Primary Location(fc)<sup>b</sup></u>														
Mean	72	61	73	77	49	86	113	--	--	76	61	83	75	62
S.D.	38	24	25	36	32	118	30	--	--	32	28	43	31	26
Range	15-713	21-167	33-153	15-193	22-187	23-773	70-162	--	--	37-187	17-128	29-238	26-157	18-135
Number of workstations	784	149	140	139	51	46	11	--	--	50	51	49	49	49
<u>Illuminance - Seated: Secondary Location(fc)<sup>a</sup></u>														
Mean	59	54	62	58	27	50	75	49	74	75	54	69	63	43
S.D.	38	31	23	41	12	32	32	19	27	38	85	47	32	24
Range	4-520	11-266	14-150	9-157	18-44	6-167	34-167	21-117	32-123	30-163	11-520	24-251	25-149	4-100
Number of workstations	589	99	127	95	4	25	30	30	9	22	34	27	42	45
<u>Illuminance - Vacant: Secondary Location(fc)<sup>b</sup></u>														
Mean	63	59	59	61	33	54	115	--	--	82	55	75	67	47
S.D.	39	31	24	40	10	30	19	--	--	39	85	48	32	26
Range	4-540	18-263	25-152	13-157	24-46	13-159	98-132	--	--	34-173	13-520	26-251	30-150	4-99
Number of workstations	524	99	127	95	4	25	4	--	--	22	34	27	42	45
<u>Minimum CRF<sup>d</sup></u>														
Mean	89	88	87	86	87	93	86	--	--	97	90	95	93	87
S.D.	9	7	6	6	9	10	11	--	--	10	14	5	5	10
Range	10-104	68-96	57-97	69-96	67-104	60-103	65-102	--	--	69-104	10-103	83-104	81-102	49-103
<u>Minimum Luminance Contrast<sup>c</sup></u>														
Mean	85	87	86	85	79	85	79	--	--	89	84	86	85	79
S.D.	7	7	6	6	10	10	10	--	--	9	7	4	5	9
Range	45-96	67-95	56-96	68-95	47-95	54-94	59-92	--	--	63-95	58-94	76-95	74-93	45-94
Number of workstations	1645	57	120	130	50	43	12	--	--	50	46	43	47	47
<u>Task Luminance Ratio<sup>e</sup></u>														
Mean	3.4	4.5	2.7	3.1	5.3	5.9	1.4	3.0	4.4	1.5	3.9	3.1	7.8	5.1
S.D.	3.7	5.0	4.3	1.3	5.2	4.7	.2	2.6	4.2	1.3	2.4	2.5	4.2	6.6
Range	.6-45	.8-31	.9-35	.6-13	.9-21	.9-16	1-1.83	.7-11	1-21	1-8	.8-13	.7-13	.8-19	.9-45
Number of workstations	896	149	142	139	51	46	48	48	24	50	51	50	49	49
<u>Ceiling Luminance Ratio<sup>f</sup></u>														
Mean	48	63	51	13	21	77	--	--	--	91	38	68	141	84
S.D.	58	66	45	26	32	49	--	--	--	65	72	47	44	46
Range	.9-455	1.3-447	3.1-292	1.7-222	.9-165	.9-188	--	--	--	8-454	1.3-455	13-213	50-253	1.9-174

Table A-3 (continued)

Documents' Evaluation	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Number of workstations	763	134	144	142	50	46	--	--	--	49	51	80	48	49
<u>Field Luminance Ratio<sup>d</sup></u>														
Mean	82	122	60	45	49	148	20	--	--	272	53	80	270	186
S.D.	179	209	57	82	81	143	63	--	--	440	106	113	378	270
Range	0-2850	0-1571	0-343	0-654	0-384	0-790	0-287	--	--	0-2950	0-625	0-527	0-1820	0-970
Number of workstations	1215	183	181	180	90	50	82	--	--	50	80	82	78	80
<u>Maximum Outside Luminance<sup>h</sup></u>														
Mean	591	726	658	347	926	1577	428	1187	1023	508	428	690	148	321
S.D.	708	819	625	344	430	2085	292	788	1801	346	578	641	157	241
Range	1-8400	16-5860	16-2330	1-1270	102-2380	142-2000	90-1400	216-3800	140-8400	1-1300	3-1800	24-4040	13-510	36-930
Number of workstations	541	95	65	76	28	21	30	41	19	50	12	46	35	23

<sup>a</sup> Illuminance with body shadow taken at primary/secondary task surface.

<sup>b</sup> Illuminance without body shadow taken at primary/secondary task surface.

<sup>c</sup> Minimum of luminance contrast measures taken at 45°, 90° and 135° with 25° viewing angle.

<sup>d</sup> Minimum contrast rendition factor at 45°, 90° and 135° with 25° viewing angle.

<sup>e</sup> Ratio of the primary task luminance to the luminance of the immediate surround luminance (Also referred to as the near surround luminance ratio)

<sup>f</sup> Ratio of the maximum of either the luminance of the brightest light source or brightest ceiling area in field of view to the luminance of the ceiling between luminaires.

<sup>g</sup> Ratio of the maximum to minimum of the following luminances: ceiling between luminaires, brightest light source in field of view, brightest ceiling area in field of view, wall at eye level looking straight ahead, wall at eye level looking 90° to the left and wall at eye level looking 90° to the right (also referred to as far surround luminance ratio).

<sup>h</sup> Maximum luminance of sky or external building as seen from eye level when seated.

Table A-4  
 TYPES OF AMBIENT AND SUPPLEMENTAL TASK LIGHTING SYSTEMS, BY BUILDING  
 (percentage distribution)

Type of System	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
<b>Ambient Lighting</b>														
IF-FM	24.2	--	--	64.7	--	--	--	--	--	--	--	--	--	--
IF-FM with other	3.9	--	--	15.3	--	--	--	--	--	--	90.2	--	--	--
IF-P alone														
and with other	12.8	--	--	14.0	--	--	100.0	--	--	--	--	--	--	--
DIF-P	3.1	0.7	20.0	--	--	--	--	--	--	--	2.0	--	--	6.1
DIF-P with other	5.6	24.2	--	4.0	--	--	--	--	--	--	--	--	--	--
DRFL(lo)	11.2	10.1	35.4	--	--	--	--	--	--	--	--	--	--	--
DRFL(lo) with FW	4.4	8.1	19.3	--	--	--	--	--	3.7	--	--	--	100.0	93.9
DRFL(lo) with DIF-P,														
alone and with other	9.9	32.1	25.3	--	--	--	--	--	--	--	--	--	--	--
DRFL(io) with other	4.4	22.8	--	--	--	--	--	--	--	--	--	--	--	--
DRFL(ie), alone														
and with other	9.5	--	--	--	--	82.9	--	--	96.3	100.0	--	--	--	--
DRFL(ie), continuous	2.6	--	--	--	--	--	--	--	--	--	--	53.7	--	--
DFL-SM, alone														
and with other	3.0	--	--	--	--	--	--	100.0	--	--	--	--	--	--
HID-PI, alone														
and with other	1.1	--	--	--	90.5	4.9	--	--	--	--	--	--	--	--
Other	4.3	--	--	--	--	--	--	--	--	--	7.8	46.3	--	--
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of workstations	937	149	150	150	42	41	49	47	27	50	51	82	50	49
<b>Supplemental Task Lighting<sup>b</sup></b>														
No supplemental task lighting														
FI-primary location only	36.1	27.5	60.4	10.1	70.6	55.8	42.9	89.1	80.0	83.7	2.0	94.0	33.3	4.3
FI-secondary location only	27.6	34.2	12.1	46.3	19.6	18.6	--	--	--	--	57.1	--	33.3	38.3
FI-both locations	8.5	12.1	9.4	10.7	--	4.7	--	--	--	--	12.2	--	16.7	19.1
FM-primary location only	4.7	5.4	--	11.4	--	--	--	--	--	--	--	--	2.1	23.4
FS-primary location only	5.1	2.0	4.0	1.3	--	--	34.7	10.9	4.0	--	4.1	2.0	--	4.3
FM/FS-primary; FI-secondary	5.1	1.3	0.7	--	9.8	18.6	22.4	--	12.0	12.2	6.1	4.0	2.1	4.3
FI-primary; FM/FS-secondary	5.3	9.4	6.7	5.4	--	--	--	--	--	--	10.2	--	2.1	4.3
Other	6.2	6.7	6.0	13.4	--	--	--	--	--	--	4.1	--	2.1	4.3
Total	1.4	1.3	0.7	1.3	--	2.3	--	--	4.0	4.1	4.1	--	8.3	2.1
Number of workstations	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	904	149	149	149	51	43	49	46	25	49	49	50	48	47

<sup>a</sup>Ambient Lighting

<u>IF-FM</u>	Indirect fluorescent-furniture mounted
<u>IF-FM with other</u>	Indirect fluorescent-furniture mounted in combination with high intensity discharge (HID), recessed incandescent or surface mounted/pendant incandescent
<u>IF-P alone or with other</u>	Indirect fluorescent-pendant alone or in combination with IF-FM
<u>DIF-P</u>	Direct/indirect fluorescent-pendant
<u>DIF-P with other</u>	Direct/indirect fluorescent-pendant in combination with either direct/indirect wall mounted, indirect fluorescent, furniture mounted, or indirect fluorescent furniture mounted and HID
<u>DRFL(1o)</u>	Direct recessed fluorescent with either 2'x4', 1'x4' or 9"x4' louvers
<u>DRFL(1o) with FWW</u>	Direct recessed fluorescent with louvers along with fluorescent wall washer
<u>DRFL(1o) with DIF-P, alone and with other</u>	Direct recessed fluorescent with louvers and direct/indirect fluorescent-pendant, alone and in combination with FWW, with direct/indirect wall mounted, or with recessed incandescent
<u>DRFL(1o) with other</u>	Direct recessed fluorescent with louvers and direct/indirect wall mounted or direct/indirect wall mounted and fluorescent wall washer
<u>DRFL(1e) alone, and with other</u>	Direct recessed fluorescent with 2'x4' lens, alone and in combination with 2'x2' or 1'x4' lens
<u>DRFL(1e) continuous</u>	Direct recessed fluorescent continuous 1" lens
<u>DFL-SM, alone and with other</u>	Direct fluorescent surface mounted, alone and in combination with direct recessed fluorescent (1o)
<u>HID-PI, alone and with other</u>	High intensity discharge-pendant mounted indirect alone and in combination with recessed incandescent or direct recessed fluorescent (1e)
<u>Other</u>	Recessed incandescent and HID; recessed incandescent with fluorescent wall washer; recessed incandescent with direct recessed fluorescent; recessed incandescent with surface mounted or pendant incandescent; surface mounted or pendant incandescent with HID free standing indirect; HID free standing indirect; perimeter ceiling wash; direct/indirect wall mounted alone and with fluorescent wall washer, surface mounted fluorescent

<sup>b</sup>Supplemental Task Lighting

<u>FI</u>	Furniture integrated
<u>FM/FS</u>	Furniture mounted or free standing

Table A-5

AMBIENT ENVIRONMENTAL CHARACTERISTICS, BY BUILDING  
(mean characteristic)

Characteristic	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Noise Intensity(dBA)</u>														
Mean	44.7	47	44	47	45	47	50	44	46	38	47	48	45	46
S.D.	9.1	3.3	2.6	3.1	5.5	4.8	1.6	8.1	4.5	5.0	4.0	3.8	2.0	8.2
Range	0-74	42-57	39-57	42-60	32-60	35-65	47-54	0-60	40-56	31-49	33-54	42-62	42-53	0-55
Number of Respondents	915	149	149	149	51	45	49	48	25	50	51	50	49	49
<u>Temperature (Dry Bulb)</u>														
Mean	74	76	76	76	75	--	74	71	74	74	76	74	74	72
S.D.	7.5	1.6	1.3	1.3	3.3	--	1.9	11	2.7	2.9	2.7	1.9	1.8	10.8
Range	0-82	71-81	73-80	73-79	71-79	--	70-77	0-78	70-82	67-80	69-81	70-80	69-77	0-77
Number of Respondents	915	149	149	149	51	--	49	48	25	50	51	50	49	49

Table A-6

WORKSTATION LIGHTING POWER DENSITY, BY BUILDING  
(mean density)

Characteristic	Building Number													
	All Buildings	1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Lighting Power Density</u> <sup>a</sup>														
Mean	2.6	2.5	2.3	3.0	2.2	2.3	3.2	3.4	2.9	2.2	3.3	2.1	2.4	2.4
S.O.	0.9	0.5	2.1	1.0	0.8	0.6	0.4	1.4	1.0	0.7	0.8	0.1	0.5	0.8
Range	.4-9.7	.4-7.5	.9-4.2	1.1-7.1	1.4-6.4	1.4-4.2	2.6-4.3	1.6-9.7	1.3-5.4	1.5-4.6	1.9-5.6	2.0-2.7	1.9-4.0	.7-4.6
Number of workstations	904	146	150	150	50	46	45	47	25	50	48	49	49	48

<sup>a</sup> Watts per square foot of workstation task lighting and ambient lighting.

Table A-7

GENERAL LIGHTING EVALUATION, BY BUILDING  
(percentage distribution)

Occupants' Evaluation	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Workstation Lighting Satisfaction</u>														
Not at all satisfied	5.0	2.4	2.4	10.2	--	2.4	2.6	--	--	9.8	8.2	1.3	1.6	1.7
Not very satisfied	18.7	12.7	16.9	21.7	7.7	26.2	18.2	14.6	8.3	24.4	36.7	12.0	4.7	10.0
Neutral	11.3	15.8	8.4	9.6	7.7	11.9	11.7	9.8	16.7	12.2	10.2	13.3	14.3	10.0
Fairly satisfied	40.4	35.2	40.4	38.0	41.0	50.0	49.3	48.8	54.2	31.6	36.7	53.4	49.2	41.6
Very satisfied	24.6	33.9	31.9	20.5	43.6	9.5	18.2	26.8	20.8	22.0	8.2	20.0	30.2	36.7
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	1047	165	166	166	78	42	77	41	24	41	49	75	63	60
<u>Preference for Better Lighting</u>														
Not mentioned as improvement	49.0	50.3	55.6	31.8	74.7	62.8	51.4	68.3	52.2	64.3	46.8	55.5	70.0	58.7
Mentioned but not as most preferred	39.1	40.7	34.8	44.2	23.9	34.9	36.8	26.8	39.1	35.7	46.8	40.3	26.7	31.0
Mentioned as most preferred improvement	11.9	9.0	9.6	24.0	1.4	2.3	11.8	4.9	8.7	--	6.4	4.2	3.3	10.3
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	967	145	135	154	71	43	76	41	23	42	47	72	60	58
<u>Lighting Quality of Building<sup>a</sup></u>														
(1) Low	18.1	12.0	12.5	23.4	15.4	20.9	10.4	9.8	25.0	45.2	32.8	14.7	10.8	3.3
(2)	24.6	17.4	20.8	28.6	12.8	44.1	28.5	17.1	29.1	31.0	26.5	29.3	15.4	20.0
(3)	20.6	22.8	25.6	15.2	16.7	14.0	23.4	36.5	25.0	16.7	12.2	30.7	23.1	23.3
(4)	21.3	24.5	22.6	19.3	25.6	16.3	18.2	26.8	16.7	7.1	26.5	21.3	29.2	28.3
(5) High	15.4	23.3	18.5	13.5	29.5	4.7	19.5	9.8	4.2	--	2.0	4.0	21.5	25.0
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	1060	167	168	171	78	43	77	41	24	42	49	75	65	60

<sup>a</sup> Index consisting of occupants' ratings of the degree to which building lighting is attractive and building spaces are well lit, and the ratings of lighting in conference rooms, corridors and hallways, and restrooms.

Table A-8

EVALUATION OF WORKSTATION LIGHTING  
FOR PERFORMING WORK, BY BUILDING  
(percentage distribution)

Occupants' Evaluation	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Rating of Amount of Light for Work</u>														
Poor	13.1	5.4	13.1	21.8	2.6	7.1	9.1	2.4	--	15.0	23.4	6.9	6.7	8.3
Fair	27.2	25.3	18.5	30.6	18.2	35.7	33.8	19.5	20.0	32.5	36.1	22.2	10.0	18.3
Good	41.7	48.2	48.8	33.5	45.4	42.9	36.3	56.1	70.0	37.5	36.2	47.3	63.3	41.7
Excellent	18.0	21.1	19.6	14.1	33.8	14.3	20.8	22.0	10.0	15.0	4.3	23.6	20.0	31.7
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	1040	166	168	170	77	42	77	41	20	40	47	72	60	60
<u>Lighting Evaluation for Reading/Writing</u>														
(1) Poor	7.2	4.6	5.1	13.1	1.4	2.4	1.4	--	--	16.7	10.6	2.9	3.3	3.5
(2)	12.2	7.9	10.8	13.1	6.8	29.3	13.0	16.2	5.6	16.7	17.0	10.1	3.3	8.8
(3)	16.1	13.2	12.0	18.1	4.1	9.8	20.3	10.8	27.8	21.4	25.5	11.6	8.2	14.1
(4)	38.9	43.4	42.4	34.4	47.3	39.0	37.8	40.6	49.9	21.4	40.5	49.3	52.4	33.1
(5) Excellent	25.6	30.9	29.7	21.3	40.4	19.5	27.5	32.4	16.7	23.8	6.4	26.1	32.8	40.5
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	985	152	158	160	74	41	69	37	18	42	47	69	61	57
<u>Lighting Evaluation for CRT use</u>														
Poor	10.4	7.4	8.7	13.5	2.1	15.0	10.4	5.4	--	7.1	26.3	3.1	5.9	9.6
Not very good	17.6	17.6	7.5	20.2	6.3	15.0	17.9	24.3	12.5	35.8	31.6	15.6	11.8	7.7
Neutral	23.6	16.7	22.5	30.4	10.4	25.0	26.9	16.2	37.5	21.4	15.8	21.9	32.3	28.8
Pretty good	34.6	39.8	41.3	29.2	50.0	25.0	35.8	40.6	50.0	14.3	15.8	50.0	32.4	30.8
Excellent	13.8	18.5	20.0	6.7	31.2	20.0	9.0	13.5	0.0	21.4	10.5	9.4	17.6	23.1
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	608	108	80	89	48	20	67	37	8	14	19	32	34	52
<u>Lighting Evaluation for Typing</u>														
Poor	6.9	2.3	9.4	10.0	3.1	7.7	2.5	--	--	16.7	10.5	--	--	12.5
Not very good	17.6	15.9	3.1	22.5	6.3	19.2	15.0	14.3	5.6	20.0	42.1	10.0	--	6.3
Neutral	18.6	22.7	15.6	20.0	12.5	19.2	20.0	14.3	22.2	20.0	10.5	20.0	27.3	6.3
Pretty good	36.4	34.1	40.6	32.5	40.6	42.4	42.5	35.7	44.4	23.3	31.6	46.7	54.5	43.7
Excellent	20.5	25.0	31.3	15.0	37.5	11.5	20.0	35.7	27.8	20.0	5.3	23.3	18.2	31.2
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	352	44	32	40	32	26	40	14	18	30	19	30	11	16
<u>Lighting Evaluation for Drafting/Drawing</u>														
Poor	8.5	4.5	20.0	7.7	4.8	--	--	--	--	12.5	--	--	9.1	9.4
Not very good	14.6	9.1	20.0	15.4	--	40.0	9.1	--	--	25.0	11.1	30.0	9.1	9.4
Neutral	25.4	27.3	17.8	26.9	9.5	40.0	45.4	16.7	50.0	25.0	33.3	--	18.2	21.9
Pretty good	32.4	40.9	33.3	30.8	33.3	20.0	27.3	33.3	50.0	--	44.5	60.0	18.2	31.2
Excellent	19.1	18.2	8.9	19.2	52.4	--	18.2	50.0	0.0	37.5	11.1	10.0	45.4	28.1
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	208	22	45	26	21	5	11	6	2	8	9	10	11	32

Table A-8 (continued)

Occupants' Evaluation	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
<b>Lighting Evaluation</b>														
<u>For filing</u>														
Poor	6.9	6.0	4.6	13.3	2.3	--	--	--	--	20.0	3.8	3.1	3.7	--
Not very good	10.2	6.0	4.6	15.8	4.5	21.1	4.0	7.7	12.5	6.7	19.2	12.5	14.8	--
Neutral	22.2	13.4	26.2	19.7	13.6	31.6	28.0	15.4	25.0	20.0	38.5	18.8	--	32.1
Pretty good	41.3	50.7	41.5	36.7	50.1	31.6	52.0	30.8	37.5	20.0	30.8	56.2	55.6	32.1
Excellent	19.4	23.9	23.1	14.5	29.5	15.7	16.0	46.1	25.0	33.3	7.7	9.4	25.8	35.8
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	445	67	65	76	44	19	25	13	8	15	26	32	27	28
<b>Reflected Glare</b>														
<u>Very bothersome</u>	10.1	6.7	6.6	13.7	4.0	12.2	13.3	17.1	5.0	10.0	6.3	8.1	8.3	16.7
Fairly bothersome	18.2	16.0	13.3	21.7	6.7	19.8	26.7	26.8	20.0	7.8	18.8	20.3	11.7	16.7
Not very bothersome	38.1	39.9	42.1	28.6	32.0	29.3	34.7	39.0	30.0	35.0	33.3	36.5	28.3	36.6
Not at all bothersome	36.5	37.4	38.0	36.0	57.3	48.7	25.3	17.1	45.0	47.5	41.8	35.1	51.7	30.0
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	1024	163	166	161	75	41	75	41	20	40	48	74	60	60
<b>Bright Lights -</b>														
<u>Bothersome</u>	4.5	5.1	3.2	3.3	2.7	12.2	2.7	7.7	--	13.9	2.1	5.6	1.7	8.6
Very bothersome	9.6	4.4	5.7	6.6	5.4	19.5	12.2	17.9	23.9	19.4	16.7	18.1	20.3	12.1
Fairly bothersome	31.7	32.9	34.4	26.3	18.9	19.5	44.6	23.1	33.3	18.4	28.2	37.5	32.2	39.6
Not very bothersome	54.2	57.6	56.7	53.8	73.0	48.8	40.5	51.3	42.8	47.3	52.0	38.8	45.8	39.7
Not at all bothersome	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Total	989	158	157	152	74	41	74	39	21	36	48	72	59	58
Number of respondents														
<b>Reflected Glare From CRT - Bothersome</b>														
<u>Very bothersome</u>	19.0	19.4	9.4	9.1	11.9	5.6	31.7	27.0	--	20.0	13.3	20.8	13.3	28.9
Fairly bothersome	32.8	21.4	31.2	32.7	23.8	38.8	49.2	29.8	33.4	40.0	26.7	37.6	23.3	26.7
Not very bothersome	23.7	30.6	28.1	20.0	33.3	27.8	15.9	21.6	33.3	--	20.0	20.8	26.7	33.3
Not at all bothersome	24.5	28.6	31.3	38.2	31.0	27.8	3.2	21.6	33.3	40.0	40.0	20.8	36.7	11.1
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	502	98	64	55	42	18	63	37	6	5	15	24	30	45

Table A-9

WORKSTATION VISUAL QUALITY, BY BUILDING  
(percentage distribution)

Occupants' Evaluation	All Buildings	Building Number												
		1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Visual Quality</u>														
(1) Low	13.8	12.0	14.3	5.3	10.3	39.5	11.7	17.1	8.3	33.3	36.7	12.0	4.6	5.0
(2)	26.0	21.0	30.3	25.1	21.8	32.6	23.4	36.6	37.5	38.1	20.4	35.9	38.5	13.3
(3)	27.1	26.8	29.2	29.8	23.1	18.6	28.6	34.1	33.3	14.3	18.4	22.7	33.9	36.7
(4)	19.0	22.2	17.3	19.9	24.4	9.3	19.5	7.3	16.7	11.9	20.4	18.7	9.2	25.0
(5) High	14.1	18.0	8.9	19.9	20.5	--	16.9	4.9	4.2	2.4	4.1	10.7	13.8	20.0
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	1060	167	168	171	78	43	77	41	24	42	49	75	65	60
<u>Preference for Better View Outside</u>														
Not mentioned as improvement	52.3	48.9	43.5	45.1	37.0	53.5	66.6	90.2	95.7	45.2	43.7	82.8	68.3	57.1
Mentioned but not as most preferred	38.7	38.8	49.3	43.1	47.9	37.2	30.7	7.3	4.3	35.7	52.1	14.3	30.0	30.4
Mentioned as most preferred improvement	9.0	12.3	7.2	11.8	15.1	9.3	2.7	2.5	--	19.1	4.2	2.9	1.7	12.5
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	952	139	138	144	73	43	75	41	23	42	48	70	60	56
<u>Preference for More Daylight</u>														
Not mentioned as improvement	73.0	76.1	60.2	59.6	67.5	90.7	92.1	85.0	91.3	87.8	63.8	87.1	81.3	76.8
Mentioned but not as most preferred	24.9	23.1	36.8	36.9	31.1	9.3	6.6	12.5	8.7	12.2	31.9	12.9	15.3	21.4
Mentioned as most preferred improvement	2.1	0.8	3.0	3.5	1.4	--	1.3	2.5	--	--	4.3	--	3.4	1.8
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of respondents	933	130	133	141	74	43	76	40	23	41	47	70	59	56

<sup>a</sup> Index consisting of occupants' ratings on the degree of workstation attractiveness, spaciousness, pleasantness, comfort, and interest.

Table B-1

WORKSTATION LIGHTING SATISFACTION, BY LIGHTING CONDITIONS AT WORKSTATION  
(mean condition)

Lighting Condition	Workstation Lighting Satisfaction					Eta Coefficient
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
Illuminance - Seated: Primary Location (fc)	63(207)	64(337)	64( 93)	69(129)	67( 29)	.00 n.s.
Illuminance - Unseated: Primary location (fc)	69(187)	73(285)	70( 81)	74(114)	73( 28)	.00 n.s.
Illuminance - Seated: Secondary Location (fc)	59(135)	59(229)	53( 65)	58( 92)	90( 17)	.10 n.s.
Illuminance - Unseated: Secondary Location (fc)	62(124)	64(198)	57( 58)	61( 83)	97( 16)	.10 n.s.
Distance to Glazed Exterior Wall(feet)	22(241)	23(380)	25( 99)	24(148)	26( 36)	.00 n.s.
Task Luminance Ratio	3.6(207)	3.2(338)	4.1( 92)	2.9(130)	3.0( 28)	.07 n.s.

Table B-2

WORKSTATION LIGHTING SATISFACTION, BY AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS  
(percentage distribution)

Type of System	Workstation Lighting Satisfaction					Total (number of respondents)
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
<u>Ambient Lighting<sup>a</sup></u>						
IF-FM	15.2	39.3	8.0	25.5	12.0	100(125)
IF-FM with other	13.6	45.5	9.1	27.3	4.5	100( 22)
IF-P alone and with other	28.0	42.2	12.7	12.9	4.2	100( 72)
DIF-P	27.6	41.4	13.8	17.2	--	100( 29)
DIF-P with other	36.2	27.6	13.0	23.2	--	100( 37)
DRFL (1o)	25.2	48.7	10.5	13.0	2.6	100(142)
DRFL (1o) with FWW	42.7	32.1	12.3	10.6	2.3	100( 40)
DRFL (1o) with DIF-P, alone and with other	35.1	36.3	12.2	12.1	4.3	100( 77)
DRFL (1o) with other	35.7	39.3	17.9	7.1	--	100( 28)
DRFL (1e), alone and with other	19.4	41.0	10.0	22.1	7.5	100( 95)
DRFL (1e), continuous	17.5	50.0	12.5	17.5	2.5	100( 40)
DFL-SM, alone and with other	23.7	50.0	10.5	15.8	--	100( 38)
HID-PI, alone and with other	36.6	42.3	14.1	7.0	--	100( 34)
Other	17.8	48.0	14.5	19.6	--	100( 54)
						Tau B=.08
						Cramer's V=.19
						$\chi^2=85.22$ (p<.00)
<u>Supplemental Task Lighting<sup>b</sup></u>						
No task lighting	32.3	42.0	12.2	10.2	3.3	100(352)
FI-primary location	24.2	41.7	11.2	15.9	7.0	100(189)
FI-secondary location	23.2	42.9	10.2	19.1	4.6	100( 64)
FI-both locations	33.6	28.3	8.1	26.1	3.9	100( 36)
FM-primary location only	7.9	47.0	19.8	25.3	--	100( 32)
FS-primary location only	15.1	34.9	6.8	36.9	6.3	100( 43)
FM/FS-primary; FI-secondary	15.2	57.6	9.9	12.1	5.2	100( 34)
FI-primary; FM/FS-secondary	11.8	28.3	9.4	43.7	6.8	100( 44)
Other	13.6	34.1	1.9	37.1	13.3	100( 10)
						Tau B=.16
						Cramer's V=.14
						$\chi^2= 65.8$ (p<.00)

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL (1o)=Direct Recessed Fluorescent with Louvers; DRFL=Direct Recessed Fluorescent with lens; FWW=Fluorescent Wall Washer; DFL-SM=Direct Fluorescent-Surface Mounted; HID-PI=High Intensity Discharge-Pendant Mounted/Indirect

<sup>b</sup> FI=Furniture Integrated; FM=Furniture Mounted; FS=Free Standing

Table B-3

WORKSTATION LIGHTING SATISFACTION, BY WORK-RELATED ACTIVITIES OF OCCUPANTS  
(percentage distribution)

Work-Related Activities	Workstation Lighting Satisfaction					Total (number of respondents)
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
<u>Hours/Week at Building</u>						
Less than 25 hours	36.3	33.7	9.7	14.0	6.3	100( 80)
26-32 hours	24.1	43.4	7.7	21.3	3.5	100(126)
33-42 hours	21.9	44.4	11.9	17.3	4.5	100(499)
More than 42 hours	26.2	35.2	12.4	20.7	5.5	100(324)
						Tau B = .04 $X^2 = 15.6$ (p < .21)
<u>Proportion of Time in Building at Workstation</u>						
About 1/4 time or less	35.9	24.1	16.9	23.1	--	100( 42)
About 1/2 time	26.4	40.2	12.0	15.8	5.6	100(170)
Between 2/3 and 3/4 time	24.3	41.8	12.6	16.4	4.9	100(415)
Nearly all the time	23.2	41.1	9.0	21.4	5.3	100(396)
						Tau B = .01 $X^2 = 16.63$ (p < .17)
<u>Amount of Reading and Writing</u>						
Limited reading/writing	27.1	42.0	11.1	16.8	3.0	100(308)
Extensive reading, limited writing	27.9	39.3	7.8	20.7	4.3	100(200)
Extensive writing, limited reading	25.3	36.2	16.6	14.2	7.7	100( 97)
Moderate reading/writing	20.0	40.5	14.0	21.4	4.1	100(239)
Extensive reading/writing	18.5	49.8	10.8	15.3	5.6	100( 87)
Very extensive reading/writing	29.2	32.4	2.1	24.6	11.7	100( 60)
						Tau B = .05 Cramer's V = .08 $X^2 = 25.96$ (p < .17)
<u>Hours/Day at CRT</u>						
Not part of job	27.6	38.1	10.5	19.7	4.1	100(325)
Less than 2 hours	22.5	41.5	10.4	18.3	7.3	100(257)
2-4 hours	20.7	44.8	5.4	24.6	4.5	100(156)
4-6 hours	24.0	44.6	15.4	12.2	2.8	100( 82)
More than 6 hours	21.4	34.9	16.7	19.8	7.2	100( 87)
						Tau B = .05 $X^2 = 22.38$ (p < .13)

Table B-3 (continued)

Work-Related Activities	Workstation Lighting Satisfaction					Total (number of respondents)
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
<u>Hours/Day Typing</u>						
Not part of job	26.1	39.5	9.8	19.8	4.8	100(580)
Less than 2 hours	23.9	39.0	10.7	22.4	4.0	100(166)
2-4 hours	25.3	53.7	6.5	13.4	1.1	100( 57)
4-6 hours	18.9	44.1	16.2	12.1	8.7	100( 33)
More than 6 hours	--	38.3	37.8	13.8	10.1	100( 12)
						Tau B=.03
						$\chi^2=23.44$ (p<.10)
<u>Hours/Day Drafting</u>						
Not part of job	25.9	40.1	10.8	18.8	4.4	100(681)
Less than 2 hours	19.8	41.1	9.0	23.9	6.2	100( 89)
2-4 hours	18.7	38.2	13.6	22.9	6.6	100( 36)
4-6 hours	29.8	48.5	7.2	14.5	--	100( 14)
More than 6 hours	9.1	53.5	13.4	17.8	6.2	100( 23)
						Tau B=.04
						$\chi^2=7.42$ (p<.96)
<u>Predominant Task</u>						
Reading/writing	24.8	39.0	13.0	18.1	5.1	100(279)
Reading only	31.2	38.0	8.3	19.4	3.1	100(207)
Writing only, write and file	24.1	39.8	13.9	13.2	9.0	100( 87)
Typing only, type and other	15.3	47.8	14.4	15.1	7.4	100( 70)
CRT only, CRT and other	21.6	42.8	11.7	19.7	4.2	100(293)
Drafting, drafting and other	21.4	44.4	7.4	20.4	6.4	100( 59)
No predominant task	28.9	31.3	10.7	26.1	3.0	100( 39)
						Tau B=.02
						Cramer's V=.08
						$\chi^2=26.05$ (p<.35)

Table B-4

WORKSTATION LIGHTING SATISFACTION, BY ABILITY TO CONTROL LIGHTING  
(percentage distribution)

Lighting Controls	Workstation Lighting Satisfaction					Total (number of respondents)
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
<u>Ability to Turn Lights On/Off</u>						100(296)
No	25.9	47.9	11.5	12.9	1.8	100(732)
Yes	23.8	38.0	11.4	20.6	6.2	Tau B = .06 X <sup>2</sup> = 12.9 (p < .01)
<u>Ability to Control Amount of Light</u>						100(581)
No	23.8	36.8	12.1	21.3	6.0	100(130)
Yes	25.4	45.2	7.1	15.7	6.6	Tau B = .05 X <sup>2</sup> = 5.96 (p < .02)
<u>Ability to Control Direction of Light</u>						100(610)
No	25.2	36.2	11.8	20.3	6.5	100(115)
Yes	18.0	47.0	9.6	21.7	3.7	Tau B = .03 X <sup>2</sup> = 3.89 (p < .42)
<u>Ability to Control Blinds</u>						100(267)
No	17.3	45.1	11.5	19.3	6.8	100(392)
Yes	29.0	40.1	12.4	14.0	4.5	Tau B = .10 X <sup>2</sup> = 8.88 (p < .06)

Table B-5

WORKSTATION LIGHTING SATISFACTION, BY OCCUPANTS' EVALUATION OF LIGHTING CONDITIONS  
(percentage distribution)

Occupants' Evaluation	Workstation Lighting Satisfaction					Total (number of respondents)
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
<u>Ability to Adjust Light on Work</u>						
(1) Poor	15.1	34.1	13.9	27.7	9.2	100(498)
(2)	17.9	42.6	10.4	26.7	2.4	100(119)
(3)	23.6	50.2	13.3	10.5	2.4	100(174)
(4)	32.1	59.0	5.8	3.1	--	100( 89)
(5)	47.3	41.8	7.8	3.1	--	100(116)
(6) Excellent	70.2	27.5	--	2.3	--	100( 51)
						Tau B = .33 $X^2 = 215.2(p < .00)$
<u>Reflected Glare</u>						
Not at all bothersome	43.4	37.6	6.5	10.3	2.2	100(451)
Not very bothersome	21.0	48.5	12.8	15.9	1.8	100(340)
Fairly bothersome	7.7	38.6	17.2	31.0	5.5	100(137)
Very bothersome	4.8	27.0	14.5	32.9	20.8	100( 74)
						Tau B = .34 $X^2 = 209.38(p < .00)$
<u>Glare from Ceiling Lights</u>						
Not at all bothersome	37.9	37.8	7.8	13.0	3.5	100(451)
Not very bothersome	18.5	48.8	14.9	15.0	2.8	100(340)
Fairly bothersome	11.0	41.0	14.8	31.6	1.6	100(137)
Very bothersome	3.4	27.9	9.2	40.3	19.2	100( 74)
						Tau B = .30 $X^2 = 186.54(p < .00)$
<u>Glare from Task Lights<sup>a</sup></u>						
Not at all bothersome	32.8	37.8	7.9	17.8	3.7	100(150)
Not very bothersome	17.0	48.2	13.9	19.2	1.7	100(125)
Fairly bothersome	3.7	40.9	10.7	42.2	2.5	100( 55)
Very bothersome	7.9	21.5	14.3	33.3	23.0	100( 25)
						Tau B = .23 $X^2 = 74.93(p < .00)$

Table B-5 (continued)

Occupants' Evaluation	Workstation Lighting Satisfaction					Total (number of respondents)
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
<u>Glare from Sunlight</u>						
Not at all bothersome	30.6	35.9	9.1	19.0	5.4	100(532)
Not very bothersome	22.9	45.6	15.3	13.3	2.9	100(284)
Fairly bothersome	16.5	51.6	9.0	21.8	1.1	100(112)
Very bothersome	11.5	39.4	15.6	25.1	8.4	100(66)
						Tau B = .09 $\chi^2 = 38.28 (p < .00)$
<u>Reflected Glare from CRT</u>						
Not at all bothersome	40.3	39.4	3.3	15.7	1.3	100(126)
Not very bothersome	24.9	42.4	14.4	14.2	4.1	100(128)
Fairly bothersome	16.9	41.5	11.1	23.7	6.8	100(154)
Very bothersome	11.9	40.0	11.5	24.4	12.2	100(91)
						Tau B = .23 $\chi^2 = 51.77 (p < .00)$
<u>Bright Lights</u>						
Not at all bothersome	34.1	37.7	8.9	15.5	3.8	100(523)
Not very bothersome	18.3	48.6	14.1	17.6	1.4	100(306)
Fairly bothersome	9.7	41.6	12.2	30.7	5.8	100(106)
Very bothersome	7.8	34.1	15.1	25.7	16.3	100(45)
						Tau B = .22 $\chi^2 = 96.48 (p < .00)$
<u>Workstation Brightness</u>						
(1) Dim	--	14.9	10.7	48.1	26.3	100(87)
(2)	1.5	22.0	23.9	44.3	8.3	100(101)
(3)	11.6	42.8	18.4	24.0	3.2	100(184)
(4)	14.6	61.0	11.8	10.0	2.6	100(180)
(5)	32.4	53.1	6.1	7.9	0.5	100(280)
(6) Bright	64.3	26.5	3.4	5.3	0.5	100(195)
						Tau B = .48 $\chi^2 = 492.95 (p < .00)$

<sup>a</sup> Data are reported for respondents who have a task lamp at the workstation.

Table B-6

WORKSTATION LIGHTING SATISFACTION, BY SELECTED WORKSTATION CHARACTERISTICS  
(percentage distribution)

Workstation Characteristic	Workstation Lighting Satisfaction					Total (number of respondents)
	Very Satisfied	Fairly Satisfied	Neither Satisfied nor Dissatisfied	Not Very Satisfied	Not at All Satisfied	
<u>Workstation View</u>						
Sky seen from standing/ sitting position	28.0	40.4	10.2	17.4	4.0	100(458)
Outdoors seen from standing/ sitting position, but no sky	20.7	44.1	14.9	20.3	--	100( 24)
Sky seen from standing position only	17.0	47.3	12.7	19.2	3.8	100( 99)
Outdoors seen from standing position only but no sky	20.2	41.5	11.8	20.3	6.2	100( 22)
Workstation is unaffected by daylight	19.2	39.6	13.7	23.3	4.2	100(139)
						Tau B=.07 Cramer's V=.06 X <sup>2</sup> =12.12 (p<.91)

Table C-1

PREFERENCE FOR IMPROVED LIGHTING, BY LIGHTING CONDITIONS AT WORKSTATION  
(mean condition)

Lighting Condition	Preference for Improved Lighting			Eta Coefficient
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
Illuminance - Seated: Primary Location (fc)	65(399)	64(263)	72( 71)	.03 n.s.
Illuminance - Unseated: Primary location (fc)	72(342)	71(230)	77( 62)	.00 n.s.
Illuminance - Seated: Secondary Location (fc)	57(260)	62(187)	53( 49)	.00 n.s.
Illuminance - Unseated: Secondary Location (fc)	61(227)	65(165)	58( 46)	.00 n.s.
Distance to Glazed Exterior Wall (feet)	23(440)	23(310)	23( 84)	.00 n.s.
Task Luminance Ratio	3.1(398)	3.4(264)	3.2( 71)	.00 n.s.

Table C-2

PREFERENCE FOR IMPROVED LIGHTING, BY AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS  
(percentage distribution)

Type of System	Preference for Improved Lighting			Total (number of respondents)
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
<u>Ambient Lighting<sup>a</sup></u>				
IF-FM	37.5	46.2	16.3	100( 117)
IF-FM with other	22.7	45.5	31.8	100( 22)
IF-P alone and with other	53.4	30.2	16.4	100( 68)
DIF-P	54.0	38.9	7.1	100( 28)
DIF-P with other	35.7	48.0	16.3	100( 31)
DRFL(1o)	53.8	34.7	11.5	100( 128)
DRFL(1o) with FWW	72.1	22.8	5.1	100( 36)
DRFL(1o) with DIF-P, alone and with other	58.2	36.0	5.8	100( 63)
DRFL(1o) with other	43.5	43.5	13.0	100( 23)
DRFL(1e), alone and with other	64.4	35.0	0.6	100( 95)
DRFL(1e), continuous	51.3	43.6	5.1	100( 39)
DFL-SM, alone and with other	68.4	26.3	5.3	100( 38)
HID-PI, alone and with other	64.4	27.1	8.5	100( 28)
Other	49.8	41.2	8.9	100( 52)
				Tau B= .14 Cramer's V= .20 $\chi^2=61.53$ (p<.00)
<u>Supplemental Task Lighting<sup>D</sup></u>				
No task lighting	62.8	30.8	6.4	100(322)
FI-primary location	49.8	38.8	11.4	100( 176)
FI-secondary location	47.3	43.3	9.4	100( 54)
FI-both locations	42.0	33.9	24.1	100( 34)
FM-primary location	35.3	36.7	28.0	100( 31)
FS-primary location	44.8	46.8	8.4	100( 44)
FM/FS-primary; FI-secondary	30.7	52.3	17.0	100( 27)
FI-primary; FM/FS-secondary	24.2	53.0	22.8	100( 44)
Other	41.7	37.7	20.6	100( 9)
				Tau B= .20 Cramer's V= .20 $\chi^2=59.36$ (p<.00)

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL (1o)=Direct Recessed Fluorescent with Louvers; DRFL=Direct Recessed Fluorescent with lens; FWW=Fluorescent Wall Washer; DFL-SM=Direct Fluorescent-Surface Mounted; HID-PI=High Intensity Discharge-Pendant Mounted/Indirect

<sup>D</sup> FI=Furniture Integrated; FM=Furniture Mounted; FS=Free Standing

Table C-3

PREFERENCE FOR IMPROVED LIGHTING, BY WORK-RELATED ACTIVITIES OF OCCUPANTS  
(percentage distribution)

Work-Related Activities	Preference for Improved Lighting			Total (number of respondents)
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
<u>Hours/Week at Building</u>				
Less than 25 hours	58.3	32.7	9.0	100( 73)
26-32 hours	60.7	33.3	6.0	100(116)
33-40 hours	46.0	41.0	13.0	100(464)
More than 40 hours	47.4	36.9	13.7	100(297)
				Tau B=.05 X <sup>2</sup> =6.98 (p<.32)
<u>Proportion of Time in Building at Workstation</u>				
About 1/4 time or less	58.5	36.9	4.6	100( 36)
About 1/2 time	52.2	33.4	14.4	100(159)
Between 2/3 and 3/4 time	48.0	42.0	10.0	100(378)
Nearly all the time	47.7	38.9	13.4	100(367)
				Tau B=.02 X <sup>2</sup> =4.76 (p<.58)
<u>Amount of Reading and Writing</u>				
Limited reading/writing	49.2	38.7	12.1	100(287)
Extensive reading, limited writing	54.0	37.6	8.4	100(179)
Extensive reading, extensive writing	41.6	42.7	15.7	100( 87)
Moderate reading/writing	51.2	36.6	12.2	100(220)
Extensive reading/writing	50.3	44.6	5.1	100( 80)
Very extensive reading/writing	34.7	45.4	19.9	100( 57)
				Tau B=.01 Cramer's V=.08 X <sup>2</sup> =12.66 (p<.24)
<u>Hours/Day at CRT</u>				
Not part of job	50.4	36.2	13.4	100(292)
Less than 2 hours	46.7	43.4	9.9	100(234)
2-4 hours	47.2	40.5	12.3	100(151)
4-6 hours	54.2	38.3	7.5	100( 78)
More than 6 hours	43.1	40.9	16.0	100( 80)
				Tau B=.03 X <sup>2</sup> =4.62 (p<.80)

Table C-3 (continued)

Work-Related Activities	Preference for Improved Lighting			Total (number of respondents)
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
<u>Hours/Day Typing</u>				
Not part of job	48.3	38.4	13.3	100(527)
Less than 2 hours	51.9	40.2	7.9	100(154)
2-4 hours	53.6	39.9	6.5	100( 55)
4-6 hours	55.9	34.5	9.6	100( 30)
More than 6 hours	32.6	44.7	22.7	100( 11)
				Tau B = .03 $\chi^2 = 7.09$ (p < .53)
<u>Hours/Day Drafting</u>				
Not part of job	50.0	38.4	11.6	100(628)
Less than 2 hours	44.6	43.1	12.3	100( 80)
2-4 hours	47.8	33.1	19.1	100( 33)
4-6 hours	53.2	39.0	7.8	100( 13)
More than 6 hours	39.6	28.3	32.1	100( 18)
				Tau B = .05 $\chi^2 = 8.09$ (p < .43)
<u>Predominant Task</u>				
Reading/writing	50.3	37.6	12.1	100(255)
Reading only	53.8	35.8	10.4	100(184)
Writing only, write and file	43.9	41.1	15.0	100( 79)
Typing only, type and other	46.1	44.2	9.7	100( 64)
CRT only, CRT and other	46.5	42.4	11.1	100(279)
Drafting, drafting and other	49.6	28.0	22.4	100( 52)
No predominant task	46.1	46.0	7.9	100( 37)
				Tau B = .03 Cramer's V = .07 $\chi^2 = 9.35$ (p < .67)

Table C-4

PREFERENCE FOR IMPROVED LIGHTING, BY ABILITY TO CONTROL LIGHTING  
(percentage distribution)

Lighting Controls	Preference for Improved Lighting			Total (number of respondents)
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
<u>Ability to Turn Lights On/Off</u>				
No	57.5	35.4	7.1	100(274)
Yes	46.7	40.3	13.0	100(677)
				Tau B = .08 $\chi^2 = 8.30$ (p < .02)
<u>Ability to Control Amount of Light</u>				
No	45.6	41.0	13.4	100(542)
Yes	52.0	39.6	8.4	100(116)
				Tau B = .04 $\chi^2 = 1.41$ (p < .50)
<u>Ability to Control Direction of Light</u>				
No	46.0	41.1	12.9	100(567)
Yes	51.4	35.7	12.9	100(105)
				Tau B = .01 $\chi^2 = .82$ (p < .67)
<u>Ability to Control Blinds</u>				
No	44.8	45.2	10.0	100(246)
Yes	51.3	36.7	12.0	100(368)
				Tau B = .06 $\chi^2 = 3.09$ (p < .21)

Table C-5

PREFERENCE FOR IMPROVED LIGHTING, BY OCCUPANTS' EVALUATION OF LIGHTING CONDITIONS  
(percentage distribution)

Occupants' Evaluation	Preference for Improved Lighting			Total (number of respondents)
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
<u>Ability to Adjust Light on Work</u>				
(1) Poor				
(2)	36.7	46.2	17.1	
(3)	46.5	41.2	12.3	100(469)
(4)	47.7	43.6	8.7	100(113)
(5)	69.2	28.8	2.0	100(159)
(6) Excellent	80.5	15.1	4.4	100( 84)
	83.6	14.1	2.3	100(103)
				100( 39)
<u>Reflected Glare</u>				
Not at all bothersome	64.4	30.1		Tau B=.24 $X^2=87.85 (p<.00)$
Not very bothersome	53.4	38.3	5.5	100(342)
Fairly bothersome	30.2	51.0	8.3	100(331)
Very bothersome	27.5	42.7	18.8	100(170)
			29.8	100( 97)
<u>Glare from Ceiling Lights</u>				
Not at all bothersome	61.0	30.0		Tau B=.28 $X^2=104.48 (p<.00)$
Not very bothersome	48.5	42.0	9.0	100(401)
Fairly bothersome	36.9	52.7	9.5	100(317)
Very bothersome	25.1	52.1	10.4	100(135)
			22.8	100( 74)
<u>Glare from Task Lights<sup>a</sup></u>				
Not at all bothersome	50.1	38.0		Tau B=.24 $X^2=77.70 (p<.00)$
Not very bothersome	47.9	41.8	11.9	100(132)
Fairly bothersome	32.9	47.4	10.3	100(121)
Very bothersome	13.3	50.5	19.7	100( 56)
			36.2	100( 26)
				Tau B=.17 $X^2=25.07 (p<.00)$

Table C-5 (continued)

Occupants' Evaluation	Preference for Improved Lighting			Total (number of respondents)
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
<u>Glare from Sunlight</u>				100(476)
Not at all bothersome	48.1	38.0	13.9	100(271)
Not very bothersome	55.8	35.3	8.9	100(109)
Fairly bothersome	47.7	46.3	6.0	100( 66)
Very bothersome	44.8	40.2	15.0	
				Tau B = .01 $\chi^2 = 7.82$ (p < .25)
<u>Reflected Glare from CRT</u>				100(114)
Not at all bothersome	68.2	31.7	5.1	100(122)
Not very bothersome	57.9	36.0	6.1	100(148)
Fairly bothersome	39.1	47.0	13.9	100( 90)
Very bothersome	46.0	41.7	12.3	
				Tau B = .16 $\chi^2 = 18.71$ (p < .01)
<u>Bright Lights</u>				100(471)
Not at all bothersome	55.3	34.1	10.6	100(289)
Not very bothersome	49.6	40.3	10.1	100(105)
Fairly bothersome	40.7	54.1	5.2	100( 45)
Very bothersome	27.6	52.8	19.6	
				Tau B = .14 $\chi^2 = 35.71$ (p < .00)
<u>Workstation Brightness</u>				100( 87)
(1) Dim	13.9	54.9	31.2	100(100)
(2)	20.8	55.9	22.3	100(176)
(3)	42.0	43.3	14.7	100(171)
(4)	57.1	40.5	8.4	100(254)
(5)	63.9	30.6	5.5	100(166)
(6) Bright	76.9	21.3	1.8	
				Tau B = .32 $\chi^2 = 156.24$ (p < .00)

<sup>a</sup> Data are reported for respondents who have a task lamp at the workstation.

Table C-6

PREFERENCE FOR IMPROVED LIGHTING, BY SELECTED WORKSTATION CHARACTERISTICS  
(percentage distribution)

Workstation Characteristic	Preference for Improved Lighting			Total (number of respondents)
	Not Mentioned As Improvement	Mentioned But Not Most Preferred	Mentioned As Most Preferred	
Sky seen from standing/sitting position	49.1	38.6	12.3	100(417)
Outdoors seen from standing/sitting position, but no sky	43.4	43.9	12.7	100( 22)
Sky seen from standing position only	48.5	39.2	12.3	100( 92)
Outdoors seen from standing position only but no sky	49.0	44.6	6.4	100( 21)
Workstation is unaffected by daylight	55.1	37.3	7.6	100(132)

Tau B=.05  
Cramer's V=.07  
 $X^2=7.55$  (p<.67)

Table D-1

BUILDING LIGHTING QUALITY AS VIEWED BY OCCUPANTS, BY EVALUATION OF WORKSTATION CHARACTERISTICS  
(percentage distribution)

Occupants' Evaluation	Building Lighting Quality					Total (number of respondents)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Workstation Lighting Satisfaction</u>						100(280)
Very satisfied	46.0	28.2	16.4	8.6	0.8	100(439)
Fairly satisfied	9.6	27.0	28.3	27.9	7.2	100(119)
Neither satisfied nor dissatisfied	1.8	12.1	25.9	40.5	19.7	100(170)
Not very satisfied	10.3	10.4	11.9	31.0	46.4	100( 39)
Not at all satisfied	--	--	1.8	21.3	76.9	
						Tau B = .53 X <sup>2</sup> = 542.42 (p < .00)
<u>Reflected Glare</u>						100(394)
Not at all bothersome	26.8	23.5	18.9	19.9	10.9	100(361)
Not very bothersome	11.8	27.7	20.8	25.6	14.1	100(171)
Fairly bothersome	4.9	14.4	25.6	28.8	26.3	100( 98)
Very bothersome	5.8	7.8	17.7	35.0	33.7	
						Tau B = .24 X <sup>2</sup> = 99.40 (p < .00)
<u>Glare from Ceiling Lights</u>						100(457)
Not at all bothersome	24.4	23.4	16.8	22.9	12.5	100(343)
Not very bothersome	10.0	24.1	25.8	23.4	16.7	100(137)
Fairly bothersome	6.0	17.9	23.2	30.6	22.3	100( 75)
Very bothersome	4.9	9.1	15.0	35.3	35.7	
						Tau B = .23 X <sup>2</sup> = 56.16 (p < .00)
<u>Glare from Task Lights<sup>a</sup></u>						100(154)
Not at all bothersome	16.9	25.9	12.6	25.4	15.2	100(127)
Not very bothersome	7.2	33.1	20.7	26.7	12.3	100( 56)
Fairly bothersome	1.8	16.4	17.6	26.8	37.4	100( 26)
Very bothersome	5.4	12.5	15.4	38.1	28.6	
						Tau B = .14 X <sup>2</sup> = 35.84 (p < .00)
<u>Glare from Sunlight</u>						100(537)
Not at all bothersome	19.3	21.6	18.0	23.3	17.8	100(286)
Not very bothersome	11.5	23.7	24.2	24.9	15.7	100(113)
Fairly bothersome	15.4	19.6	26.9	26.0	12.1	100( 67)
Very bothersome	10.1	15.0	19.3	35.7	19.9	
						Tau B = .07 X <sup>2</sup> = 24.73 (p < .02)

Table D-1 (continued)

Occupants' Evaluation	Building Lighting Quality					Total (number of respondents)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Bright Lights</u>						
Not at all bothersome	21.3	25.0	17.1	23.0	13.6	100(530)
Not very bothersome	8.2	22.1	27.0	27.6	15.1	100(307)
Fairly bothersome	11.6	14.2	21.7	22.2	30.3	100(106)
Very bothersome	10.9	7.2	18.0	42.3	21.6	100(46)
						Tau B = .18 $\chi^2 = 62.18$ (p < .00)
<u>View Outside</u>						
Excellent	17.9	21.7	19.2	28.2	13.0	100(208)
Good	18.6	21.0	29.3	19.6	11.5	100(171)
Fair	16.1	27.3	18.4	24.3	13.9	100(199)
Poor	13.1	19.0	19.0	26.2	22.7	100(456)
						Tau B = .06 $\chi^2 = 30.15$ (p < .00)
<u>Harsh/Soft Lighting</u>						
(1)Harsh	4.4	13.1	12.7	25.7	44.1	100(131)
(2)	10.9	20.4	21.3	34.9	12.5	100(87)
(3)	7.2	16.5	26.0	29.8	20.5	100(283)
(4)	9.4	26.8	30.8	23.0	10.0	100(190)
(5)	21.4	33.2	16.5	19.7	9.2	100(215)
(6)Soft	43.2	11.2	12.9	15.8	16.9	100(128)
						Tau B = .28 $\chi^2 = 239.59$ (p < .00)
<u>Workstation Visual Quality</u>						
(1)Low	3.5	12.8	10.9	26.4	46.4	100(143)
(2)	4.6	17.4	21.9	31.8	24.3	100(288)
(3)	7.3	27.3	23.8	29.4	12.2	100(291)
(4)	22.9	27.7	24.6	17.5	7.3	100(195)
(5)High	52.2	16.7	16.2	10.3	4.6	100(143)
						Tau B = .38 $\chi^2 = 332.15$ (p < .00)
<u>Building Interior Quality</u> <sup>b</sup>						
(1)Low	1.2	11.0	9.1	22.8	55.9	100(143)
(2)	3.7	12.2	22.8	38.0	23.3	100(295)
(3)	5.5	26.4	25.9	27.6	14.6	100(212)
(4)	20.2	30.1	25.2	16.8	7.7	100(257)
(5)High	52.7	23.4	10.7	12.1	1.0	100(153)
						Tau B = .45 $\chi^2 = 428.19$ (p < .00)

<sup>a</sup> Data are reported for respondents who have a task lamp at the workstation.

<sup>b</sup> Index consisting of occupants' ratings of the degree to which interiors are well designed and spaces are stimulating, and ratings of the way offices and work spaces are arranged and the way they look.

Table D-2

BUILDING LIGHTING QUALITY AS VIEWED BY OCCUPANTS, BY EVALUATION OF BUILDING CHARACTERISTICS  
(percentage distribution)

Occupants' Evaluation	Building Lighting Quality					Total (number of respondents)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Lobby Lighting</u>						
Excellent	34.8	22.6	15.7	17.2	9.7	100(314)
Good	7.4	24.2	26.4	27.2	14.9	100(444)
Neutral	2.7	10.4	20.3	34.7	31.8	100(182)
Not good/poor	1.5	16.2	16.2	17.5	48.6	100( 85)
						Tau B=.35 $X^2=251.3$ (p<.00)
<u>Cafeteria Lighting</u>						
Excellent	34.3	27.5	17.2	13.1	7.9	100(338)
Good	7.5	22.2	27.6	25.5	17.2	100(387)
Neutral	5.3	13.8	19.0	34.0	27.9	100(158)
Not good/poor	3.4	7.0	13.8	37.3	38.5	100( 67)
						Tau B=.37 $X^2=227.6$ (p<.00)

Table E-1

RATING OF AMOUNT OF LIGHTING FOR WORK, BY LIGHTING CONDITIONS AT WORKSTATION  
(mean condition)

Lighting Condition	Amount of Light for Work is:				Eta Coefficient
	Excellent	Good	Fair	Poor	
Illuminance - Seated: Primary Location (fc)	64(154)	64(365)	62(194)	75( 79)	.07 (p<.06)
Illuminance - Unseated: Primary location (fc)	71(138)	70(315)	70(166)	80( 76)	.00 n.s.
Illuminance - Seated: Secondary Location (fc)	58( 99)	59(241)	57(138)	64( 59)	.00 n.s.
Illuminance - Unseated: Secondary Location (fc)	63( 93)	64(210)	58(121)	68( 56)	.00 n.s.
Distance to Glazed Exterior Wall (feet)	22(178)	23(406)	24(216)	25(100)	.03 n.s.
Task Luminance Ratio	4.4(154)	3.0(364)	3.4(194)	3.0( 80)	.11 (p<.00)

Table E-2

RATING OF AMOUNT OF LIGHTING FOR WORK, BY AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS  
(percentage distribution)

Type of System	Amount of Light for Work is:				Total (number of respondents)
	Excellent	Good	Fair	Poor	
<u>Ambient Lighting<sup>a</sup></u>					
IF-FM	8.7	37.8	29.9	23.6	100( 127)
IF-FM with other	13.0	26.1	34.8	26.1	100( 23)
IF-P alone and with other	23.2	37.0	32.8	7.0	100( 72)
DIF-P	16.5	43.9	26.4	13.2	100( 30)
DIF-P with other	31.1	24.1	35.4	9.4	100( 37)
DRFL (lo)	17.2	53.8	18.5	10.5	100( 141)
DRFL (lo) with FWW	33.8	43.4	15.9	7.0	100( 40)
DRFL (lo) with DIF-P, alone and with other	20.3	53.2	20.1	6.4	100( 78)
DRFL (lo) with other	20.7	58.6	13.8	6.9	100( 29)
DRFL (le), alone and with other	15.2	39.9	32.9	12.0	100( 90)
DRFL (le), continuous	23.1	43.6	25.6	7.7	100( 39)
DFL-SM, alone and with other	18.4	57.9	21.1	2.6	100( 38)
HID-PI, alone and with other	31.9	43.5	17.4	7.2	100( 33)
Other	17.6	47.8	31.5	3.1	100( 51)
Tau B=.13 Cramer's V=.19 X <sup>2</sup> =88.73 (p<.00)					
<u>Supplemental Task Lighting<sup>b</sup></u>					
No task lighting	26.1	46.8	20.2	6.9	100(346)
FI-primary location	15.4	44.1	25.5	15.0	100( 190)
FI-secondary location	19.6	50.7	23.7	6.0	100( 64)
FI-both locations	12.3	39.9	25.5	22.3	100( 36)
FM-primary location	4.1	46.1	33.1	16.7	100( 32)
FS-primary location	10.4	26.7	51.4	11.5	100( 45)
FM/FS-primary; FI-secondary	10.8	45.2	29.0	15.0	100( 34)
FI-primary; FM/FS-secondary	8.7	21.5	39.2	30.6	100( 45)
Other	10.3	25.8	34.7	29.2	100( 10)
Tau B=.21 Cramer's V=.18 X <sup>2</sup> =75.02 (p<.00)					

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL (lo)=Direct Recessed Fluorescent with Louvers; DRFL=Direct Recessed Fluorescent with lens; FWW=Fluorescent Wall Washer; DFL-SM=Direct Fluorescent-Surface Mounted; HID-PI=High Intensity Discharge-Pendant Mounted/Indirect

<sup>b</sup> FI=Furniture Integrated; FM=Furniture Mounted, FS=Free Standing

Table E-3

RATING OF AMOUNT OF LIGHTING FOR WORK, BY WORK-RELATED ACTIVITIES OF OCCUPANTS  
(percentage distribution)

Work-Related Activities	Amount of Light for Work is:				Total (number of respondents)
	Excellent	Good	Fair	Poor	
<u>Hours/Week at Building</u>					
Less than 25 hours	30.1	32.7	25.7	11.5	100( 79)
26-32 hours	17.2	54.0	19.6	9.2	100(128)
33-40 hours	18.0	40.5	28.6	12.9	100(496)
More than 40 hours	15.9	41.8	27.7	14.6	100(321)
					Tau B = .07
					$\chi^2 = 12.38$ (p < .19)
<u>Proportion of Time in Building at Workstation</u>					
About 1/4 time or less	41.6	26.1	26.1	6.2	100( 41)
About 1/2 time	15.9	49.6	21.8	12.7	100(169)
Between 2/3 and 3/4 time	17.5	43.2	26.7	12.6	100(408)
Nearly all the time	17.3	39.3	29.9	13.5	100(392)
					Tau B = .04
					$\chi^2 = 13.44$ (p < .14)
<u>Amount of Reading and Writing</u>					
Limited reading/writing	21.9	41.5	24.1	12.5	100(306)
Extensive reading, limited writing	23.5	41.7	26.2	8.6	100(195)
Extensive writing, limited reading	13.4	37.5	36.6	12.5	100( 96)
Moderate reading/writing	14.8	43.3	27.8	14.1	100(236)
Extensive reading/writing	7.7	49.9	27.0	15.0	100( 88)
Very extensive reading/writing	16.1	38.2	23.2	22.5	100( 60)
					Tau B = .07
					$\chi^2 = 23.77$ (p < .07)
<u>Hours/Day at CRT</u>					
Not part of job	19.6	41.2	25.3	13.9	100(318)
Less than 2 hours	15.5	43.0	29.3	12.2	100(254)
2-4 hours	14.6	41.7	26.2	17.5	100(158)
4-6 hours	17.6	44.5	30.9	7.0	100( 81)
More than 6 hours	18.9	38.9	32.4	9.8	100( 86)
					Tau B = .04
					$\chi^2 = 10.25$ (p < .60)
<u>Hours/Day Typing</u>					
Not part of job	17.7	43.7	26.3	12.3	100(572)
Less than 2 hours	18.2	39.1	31.4	11.3	100(166)
2-4 hours	25.0	28.2	37.0	9.8	100( 54)
4-6 hours	13.5	38.8	35.7	12.0	100( 33)
More than 6 hours	--	28.1	58.1	13.8	100( 12)
					Tau B = .06
					$\chi^2 = 19.36$ (p < .08)

Table E-3 (continued)

Work-Related Activities	Amount of Light for Work is:				Total (number of respondents)
	Excellent	Good	Fair	Poor	
<u>Hours/Day Drafting</u>					
Not part of job	19.1	42.2	27.3	11.4	100(671)
Less than 2 hours	15.6	43.1	29.9	11.4	100( 88)
2-4 hours	14.8	42.1	21.8	21.3	100( 36)
4-6 hours	11.5	44.3	22.1	22.1	100( 13)
More than 6 hours	--	48.0	36.8	15.2	100( 23)
					Tau B=.05 X <sup>2</sup> =11.08 (p<.52)
<u>Predominant Task</u>					
Reading/writing	18.5	43.0	24.6	13.9	100(274)
Reading only	22.0	44.1	23.8	10.1	100(202)
Writing only, write and file	13.1	39.1	34.4	13.4	100( 86)
Typing only, type and other	10.3	36.4	40.8	12.5	100( 68)
CRT only, CRT and other	18.4	41.8	28.2	11.6	100(293)
Drafting, drafting and other	17.4	39.7	20.9	22.0	100( 58)
No predominant task	13.3	44.3	27.6	14.8	100( 39)
					Tau B=.04 Cramer's V=.08 X <sup>2</sup> =19.37 (p<.37)

Table E-4

RATING OF AMOUNT OF LIGHTING FOR WORK, BY ABILITY TO CONTROL LIGHTING  
(percentage distribution)

Lighting Controls	Amount of Light for Work is:				Total (number of respondents)
	Excellent	Good	Fair	Poor	
<u>Ability to Turn Lights On/Off</u>					
No	19.1	50.6	24.2	6.1	100(292)
Yes	17.4	38.6	29.0	15.0	100(729)
					Tau B=.07 $\chi^2=12.59$ (p<.01)
<u>Ability to Control Amount of Light</u>					
No	16.4	38.0	29.7	15.9	100(580)
Yes	22.4	43.1	25.6	8.9	100(130)
					Tau B=.09 $\chi^2=6.94$ (p<.07)
<u>Ability to Control Direction of Light</u>					
No	17.9	38.0	28.2	15.9	100(608)
Yes	15.7	42.3	32.5	9.5	100(116)
					Tau B=.03 $\chi^2=4.33$ (p<.23)
<u>Ability to Control Blinds</u>					
No	14.7	42.7	27.3	15.3	100(265)
Yes	21.7	43.0	26.0	9.3	100(391)
					Tau B=.10 $\chi^2=9.27$ (p<.03)

Table E-5

RATING OF AMOUNT OF LIGHTING FOR WORK, BY EVALUATION OF LIGHTING CONDITIONS  
(percentage distribution)

Occupants' Evaluation	Amount of Light for Work is:				Total (number of respondents)
	Excellent	Good	Fair	Poor	
<u>Ability to Adjust Light on Work</u>					
(1) Poor	11.0	31.7	33.4	23.8	100(490)
(2)	10.3	44.2	37.6	7.9	100(119)
(3)	13.7	57.1	24.6	4.5	100(176)
(4)	27.5	48.3	23.9	0.3	100( 88)
(5)	32.4	59.2	8.0	0.4	100(116)
(6) Excellent	67.1	28.3	2.2	2.3	100( 51)
					$\tau_B = .33$ $\chi^2 = 232.0 (p < .00)$
<u>Reflected Glare</u>					
Not at all bothersome	33.0	42.2	17.3	7.5	100(388)
Not very bothersome	12.9	54.0	25.2	7.9	100(357)
Fairly bothersome	4.8	31.3	44.7	19.2	100(169)
Very bothersome	9.1	18.0	35.2	37.7	100( 97)
					$\tau_B = .33$ $\chi^2 = 189.81 (p < .00)$
<u>Glare from Ceiling Lights<sup>a</sup></u>					
Not at all bothersome	29.1	40.7	21.1	9.1	100(452)
Not very bothersome	11.4	52.2	26.1	10.3	100(338)
Fairly bothersome	6.0	37.3	40.1	16.6	100(134)
Very bothersome	7.0	17.9	40.1	35.0	100( 74)
					$\tau_B = .28$ $\chi^2 = 145.46 (p < .00)$
<u>Glare from Task Lights</u>					
Not at all bothersome	19.7	41.7	25.0	13.6	100(154)
Not very bothersome	8.6	50.7	33.5	7.2	100(124)
Fairly bothersome	3.2	31.3	39.5	26.0	100( 55)
Very bothersome	7.6	6.6	38.4	47.4	100( 26)
					$\tau_B = .21$ $\chi^2 = 57.74 (p < .00)$
<u>Glare from Sunlight</u>					
Not at all bothersome	21.7	39.1	23.9	15.3	100(528)
Not very bothersome	16.5	50.1	23.6	9.8	100(283)
Fairly bothersome	17.0	42.1	32.1	8.8	100(112)
Very bothersome	9.4	32.7	43.1	14.8	100( 67)
					$\tau_B = .07$ $\chi^2 = 23.44 (p < .01)$

Table E-5 (continued)

Occupants' Evaluation	Amount of Light for Work is:				Total (number of respondents)
	Excellent	Good	Fair	Poor	
<u>Bright Lights</u>					
Not at all bothersome	25.4	40.0	22.9	11.7	100(524)
Not very bothersome	11.6	54.3	28.5	8.6	100(304)
Fairly bothersome	6.1	36.5	42.6	14.8	100(102)
Very bothersome	11.8	25.4	34.6	28.2	100( 45)
					Tau B = .19
					$\chi^2 = 80.11$ (p < .00)
<u>Workstation Brightness</u>					
(1) Dim	--	10.3	29.8	59.9	100( 88)
(2)	1.3	8.7	67.7	22.3	100(103)
(3)	6.1	42.7	37.5	13.7	100(183)
(4)	7.3	61.2	26.8	4.7	100(178)
(5)	18.1	64.8	14.4	2.7	100(279)
(6) Bright	61.0	29.6	7.9	1.5	100(193)
					Tau B = .54
					$\chi^2 = 654.42$ (p < .00)
<u>Reflected Glare from CRT</u>					
Not at all bothersome	28.2	47.6	15.1	9.1	100(128)
Not very bothersome	21.3	47.6	19.6	11.5	100(128)
Fairly bothersome	13.3	38.4	34.7	13.6	100(152)
Very bothersome	9.4	36.6	34.3	19.7	100( 90)
					Tau B = .22
					$\chi^2 = 37.49$ (p < .00)

<sup>a</sup> Data are reported for respondents who have a task lamp at the workstation.

Table F-1

WORKSTATION VISUAL QUALITY AS VIEWED BY OCCUPANTS, BY LIGHTING CONDITIONS AT WORKSTATION  
(mean condition)

Lighting Condition	Workstation Visual Quality					Eta Coefficient
	(5)High	(4)	(3)	(2)	(1)Low	
Illuminance - Seated: Primary Location (fc)	62(108)	65(147)	65(219)	66(214)	66(117)	.00 n.s.
Illuminance - Unseated: Primary Location (fc)	67(100)	70(131)	72(187)	75(183)	74(104)	.02 n.s.
Illuminance - Seated: Secondary Location (fc)	51( 83)	56( 97)	58(151)	64(133)	67( 81)	.07 n.s.
Illuminance - Unseated: Secondary Location (fc)	55( 78)	61( 89)	63(135)	66(113)	71( 71)	.06 n.s.
Distance to Glazed Exterior Wall (feet)	20(127)	21(172)	23(254)	25(254)	25(114)	.07 (p<.08)
Task Luminance Ratio	4.1(108)	3.4(147)	3.4(220)	3.1(212)	3.0(118)	.00 n.s.
Ceiling Luminance Ratio	38( 96)	53(127)	41(185)	55(177)	51(103)	.03 n.s.
Field Luminance Ratio	94(143)	80(195)	66(291)	101(288)	86(143)	.02 n.s.
Brightest Luminance (fL)	596( 74)	734(105)	612(175)	731(171)	645(104)	.09 (p<.07)
Maximum Outdoor Luminance (fL)	614( 79)	491( 94)	569(141)	593(113)	630( 58)	.00 n.s.

Table F-2

WORKSTATION VISUAL QUALITY AS VIEWED BY OCCUPANTS, BY AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS  
(percentage distribution)

Type of System	Workstation Visual Quality					Total (number of respondents)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Ambient Lighting<sup>a</sup></u>						
IF-FM	13.4	19.5	29.0	23.4	14.7	100(128)
IF-FM with other	13.0	26.1	21.7	34.9	4.3	100( 23)
IF-P alone and with other	23.6	24.2	25.9	16.3	10.0	100( 72)
DIF-P	6.6	16.5	34.0	29.7	13.2	100( 30)
DIF-P with other	26.7	25.9	36.2	7.8	3.4	100( 37)
DRFL (lo)	11.2	14.0	31.7	28.8	14.3	100(144)
DRFL (lo) with FWW	12.3	19.2	35.1	28.1	5.3	100( 40)
DRFL (lo) with DIF-P, alone & with other	15.7	21.9	19.0	26.6	16.8	100( 78)
DRFL (lo) with other	27.6	10.3	31.0	24.1	6.9	100( 29)
DRFL (lo), alone and with other	1.9	11.5	16.7	36.8	33.1	100( 96)
DRFL (lo), continuous	7.5	20.0	22.5	35.0	15.0	100( 40)
DFL-SM, alone and with other	5.3	7.9	31.6	39.4	15.8	100( 38)
HID-PI, alone and with other	19.7	22.5	19.7	26.8	11.3	100( 34)
Other	19.7	11.7	25.3	25.4	17.9	100( 54)
						Tau B=.10 Cramer's V=.17 $\chi^2=95.12$ (p<.00)
<u>Supplemental Task Lighting<sup>b</sup></u>						
No task lighting	15.9	21.1	23.3	25.0	14.6	100(354)
FI-primary location	14.8	17.3	29.4	27.9	10.7	100(194)
FI-secondary location	19.9	17.6	30.8	20.1	11.7	100( 64)
FI-both locations	12.8	26.4	21.0	30.1	9.7	100( 36)
FM-primary location	3.8	17.8	27.0	27.0	24.4	100( 32)
FS-primary location	9.9	6.1	31.3	34.6	18.1	100( 46)
FM/FS-primary; FI-secondary	22.7	12.9	38.4	18.4	7.6	100( 34)
FI-primary; FM/FS-secondary	7.8	24.9	30.4	18.2	18.8	100( 45)
Other	20.5	1.9	26.8	5.2	45.5	100( 10)
						Tau B=.02 Cramer's V=.11 $\chi^2=41.76$ (p<.12)

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL (lo)=Direct Recessed Fluorescent with Louvers; DRFL=Direct Recessed Fluorescent with lens; FWW=Fluorescent Wall Washer; DFL-SM=Direct Fluorescent-Surface Mounted; HID-PI=High Intensity Discharge-Pendant Mounted/Indirect

<sup>b</sup> FI=Furniture Integrated; FM=Furniture Mounted; FS=Free Standing

Table F-3

WORKSTATION VISUAL QUALITY AS VIEWED BY OCCUPANTS, BY WORKSTATION CHARACTERISTICS  
(percentage distribution)

Workstation Characteristic	Workstation Visual Quality					Total (number of observations)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Workstation View</u>						
Sky seen from standing/ sitting position	19.3	18.9	30.2	20.9	10.7	100(465)
Outdoors seen from standing/ sitting positions, but no sky	14.9	26.0	29.6	27.4	2.1	100( 24)
Sky seen from standing position only	7.2	16.7	24.2	35.2	16.7	100(102)
Outdoors seen from standing position only but no sky	6.2	15.6	22.6	36.4	19.3	100( 22)
Workstation in unaffected by daylight	7.5	16.4	21.8	25.8	28.5	100(139)
						Tau B=.15 Cramer's V=.12 $\chi^2=40.46$ (p<.01)
<u>Amount of Personalization</u>						
None	11.9	8.8	33.1	32.6	13.6	100( 71)
One item	16.2	16.5	17.4	29.7	20.2	100(208)
Two items	14.6	18.9	30.1	23.3	13.1	100(275)
Three items	14.1	21.6	30.3	22.3	11.7	100(196)
Four items or more	12.8	27.7	29.3	20.5	9.7	100( 62)
						Tau B=.09 $\chi^2=29.41$ (p<.02)

Table F-4

WORKSTATION VISUAL QUALITY AS VIEWED BY OCCUPANTS, BY EVALUATION OF LIGHTING CONDITIONS  
(percentage distribution)

Occupants' Evaluation	Workstation Visual Quality					Total (number of respondents)
	(5) High	(4)	(3)	(2)	(1) Low	
<u>Reflected Glare</u>						
Not at all bothersome	23.7	20.3	24.2	22.2	9.6	100(394)
Not very bothersome	9.5	19.9	30.1	26.3	14.2	100(361)
Fairly bothersome	8.0	18.0	27.3	28.5	18.2	100(171)
Very bothersome	8.4	13.4	23.0	32.5	22.7	100( 98)
						$T_{\text{au}} B = .16$ $X^2 = 54.78 (p < .00)$
<u>Glare from Ceiling Lights</u>						
Not at all bothersome	21.5	19.9	26.0	23.8	8.8	100(457)
Not very bothersome	9.1	18.1	31.8	27.4	13.6	100(343)
Fairly bothersome	6.6	20.7	19.8	28.9	24.0	100(137)
Very bothersome	8.7	18.8	16.0	27.3	29.2	100( 75)
						$T_{\text{au}} B = .18$ $X^2 = 70.28 (p < .00)$
<u>Glare from Task Lights<sup>a</sup></u>						
Not at all bothersome	18.0	22.8	24.7	26.2	8.3	100( 70)
Not very bothersome	8.8	16.2	36.9	24.4	13.7	100( 69)
Fairly bothersome	11.8	5.3	27.6	30.5	24.8	100( 29)
Very bothersome	3.3	11.6	29.6	17.2	38.3	100( 15)
						$T_{\text{au}} B = .25$ $X^2 = 29.11 (p < .02)$
<u>Glare from Sunlight</u>						
Not at all bothersome	17.5	16.7	26.7	25.7	13.4	100(537)
Not very bothersome	9.8	21.8	28.2	26.1	14.1	100(286)
Fairly bothersome	16.5	22.7	20.7	28.4	11.8	100(113)
Very bothersome	6.7	19.5	32.0	24.7	17.1	100( 67)
						$T_{\text{au}} B = .04$ $X^2 = 18.08 (p < .12)$
<u>Bright Lights</u>						
Not at all bothersome	18.7	19.2	27.2	24.2	10.7	100(530)
Not very bothersome	9.6	17.5	29.7	28.4	14.8	100(307)
Fairly bothersome	7.8	21.3	20.0	27.1	23.8	100(106)
Very bothersome	9.1	27.1	20.2	17.7	25.9	100( 46)
						$T_{\text{au}} B = .13$ $X^2 = 37.37 (p < .00)$

Table F-4 (continued)

Occupants' Evaluation	Workstation Visual Quality					Total (number of respondents)
	(5) High	(4)	(3)	(2)	(1) Low	
<u>Workstation Brightness</u>						
(1) Dim	2.5	12.2	15.4	36.9	33.0	100( 88)
(2)	1.3	5.4	30.1	36.3	26.9	100(103)
(3)	2.5	12.7	25.2	39.9	19.7	100(186)
(4)	12.1	15.7	34.0	31.0	7.2	100(181)
(5)	14.4	30.9	31.7	16.4	6.6	100(283)
(6) Bright	43.6	26.2	13.9	10.9	5.4	100(196)
						$\tau_B = .38$ $\chi^2 = 312.98 (p < .00)$
<u>Location of Ceiling Lights</u>						
Poor	7.5	9.6	28.1	32.1	22.7	100(160)
Fair	6.9	20.2	26.9	28.9	17.1	100(236)
Good	8.8	23.5	29.7	27.3	10.7	100(428)
Excellent	42.3	20.4	20.5	9.6	7.2	100(188)
						$\tau_B = .26$ $\chi^2 = 169.04 (p < .00)$
<u>Harsh/Soft Lighting</u>						
(1) Harsh	7.1	10.4	22.7	29.8	30.0	100(131)
(2)	4.7	16.6	29.0	36.5	13.2	100( 87)
(3)	4.5	15.3	24.7	35.5	20.0	100(283)
(4)	9.2	24.1	34.1	21.5	11.1	100(190)
(5)	17.2	26.5	31.4	19.8	5.1	100(215)
(6) Soft	47.5	17.1	12.4	14.3	8.7	100(128)
						$\tau_B = .32$ $\chi^2 = 288.7 (p < .00)$
<u>Workstation View</u>						
(1) Unattractive	6.3	12.4	18.4	24.4	38.5	100(141)
(2)	4.8	11.3	22.6	37.8	23.5	100( 39)
(3)	0.9	18.5	28.6	45.5	6.5	100( 35)
(4)	16.8	21.8	22.0	30.0	9.4	100( 68)
(5)	6.4	16.9	36.6	35.5	4.6	100( 58)
(6)	8.5	24.1	28.2	18.5	20.7	100( 77)
(7) Attractive	25.6	22.2	25.3	20.0	6.9	100(117)
						$\tau_B = .25$ $\chi^2 = 106.98 (p < .00)$

<sup>a</sup> Data are reported for respondents who have a task lamp at the workstation.

Table F-5  
 WORKSTATION VISUAL QUALITY AS VIEWED BY OCCUPANTS, BY EVALUATION OF WORKSTATION CHARACTERISTICS  
 (percentage distribution)

Occupants' Evaluation	Workstation Visual Quality					Total (number of respondents)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Furniture Materials</u>						
Poor	--	5.2	17.8	35.8	41.2	100(44)
Fair	2.6	11.2	14.3	40.2	31.6	100(183)
Good	8.0	19.0	31.8	29.3	11.9	100(566)
Excellent	36.1	25.6	25.0	9.4	3.9	100(255)
Tau B = .40 X <sup>2</sup> = 281.23 (p < .00)						
<u>Color of Walls/Partitions</u>						
Poor	1.8	5.4	20.1	33.9	38.8	100(141)
Fair	7.0	14.4	24.4	36.4	17.8	100(319)
Good	12.3	24.9	33.2	21.9	7.7	100(445)
Excellent	44.8	23.0	19.8	9.2	3.2	100(137)
Tau B = .40 X <sup>2</sup> = 315.13 (p < .00)						
<u>Furniture Style</u>						
Poor	2.0	6.7	9.9	33.6	47.8	100(93)
Fair	2.6	13.5	24.8	35.9	23.2	100(266)
Good	13.6	21.9	32.0	24.8	7.7	100(526)
Excellent	38.7	23.7	22.7	11.1	3.8	100(163)
Tau B = .38 X <sup>2</sup> = 280.04 (p < .00)						
<u>Furniture Quality</u>						
(5)High	33.8	22.0	23.0	10.4	4.8	100(172)
(4)	13.6	24.1	33.4	21.2	7.7	100(420)
(3)	5.2	14.7	25.9	39.2	15.0	100(299)
(2)	1.6	8.4	16.9	32.9	40.2	100(130)
(1)Low	--	8.0	10.6	33.9	47.5	100(39)
Tau B = .38 X <sup>2</sup> = 299.2 (p < .00)						
<u>Outside View</u>						
Poor	9.2	15.8	26.7	29.9	18.4	100(456)
Fair	13.2	24.0	27.0	25.1	10.7	100(199)
Good	20.8	24.4	28.5	18.7	7.6	100(171)
Excellent	22.4	19.4	27.5	23.3	7.4	100(208)
Tau B = .15 X <sup>2</sup> = 43.08 (p < .00)						

Table G-1

WORKSTATION VISUAL QUALITY AS VIEWED BY DESIGN EXPERTS, BY AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS\*  
(percentage distribution)

Type of System	Workstation Visual Quality					Total (number of observations)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Ambient Lighting</u> <sup>a</sup>						
IF-FM	1.0	7.2	24.7	32.0	35.1	100( 97)
IF-FM with other	--	--	13.1	21.7	65.2	100( 23)
IF-P alone and with other	28.6	23.8	19.0	19.1	9.5	100( 21)
DIF-P	16.1	16.1	35.5	25.8	6.5	100( 31)
DIF-P with other	59.5	16.7	9.5	9.5	4.8	100( 42)
DRFL	7.4	22.1	29.4	27.9	13.2	100( 68)
DRFL with FWW	26.8	43.9	19.5	4.9	4.9	100( 41)
DRFL with DIF-P, alone and with other	27.9	18.6	19.8	22.1	11.6	100( 86)
DRFL with other	14.7	26.5	20.6	23.5	14.7	100( 34)
Other	16.7	--	--	50.0	33.3	100( 6)
						Tau B = .22 Cramer's V = .32 $\chi^2 = 182.30$ (p < .00)
<u>Supplemental Task Lighting</u> <sup>b</sup>						
No task lighting	20.5	30.2	25.3	15.8	8.2	100(146)
FI-primary location	13.1	13.1	24.1	23.4	26.3	100(137)
FI-secondary location	31.3	10.4	22.9	25.0	10.4	100( 48)
FI-both locations	8.0	8.0	12.0	40.0	32.0	100( 25)
FM/FS-primary location	15.4	38.5	7.6	38.5	--	100( 13)
FM/FS-secondary location	40.0	20.0	--	40.0	--	100( 5)
FM/FS-primary; FI-secondary	28.1	6.3	21.8	18.8	25.0	100( 32)
FI-primary; FM/FS-secondary	12.2	12.2	14.6	26.8	34.2	100( 41)
						Tau B = .15 Cramer's V = .21 $\chi^2 = 75.45$ (p < .00)

\* Figures based on data from three buildings examined by experts.

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL=Direct Recessed Fluorescent with Louvers; FWW=Fluorescent Wall Washer

<sup>b</sup> FI=Furniture Integrated; FM=Furniture Mounted; FS=Free Standing

Table G-2

WORKSTATION VISUAL QUALITY AS VIEWED BY DESIGN EXPERTS, BY WORKSTATION CHARACTERISTICS\*  
(percentage distribution)

Workstation Characteristic	Workstation Visual Quality					Total (number of observations)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Workstation View</u>						
Sky seen from standing/ sitting position	26.8	19.6	23.0	20.0	10.6	100(265)
Outdoors seen from standing/ sitting positions, but no sky	6.7	6.7	26.7	26.7	33.2	100( 15)
Sky seen from standing position only	5.8	17.4	23.3	29.1	24.4	100( 86)
Outdoors seen from standing position only but no sky	--	17.6	23.5	11.8	47.1	100( 17)
Workstation in unaffected by daylight	10.0	35.0	10.0	25.0	20.0	100( 20)
						Tau B=.23 Cramer's V=.18 $\chi^2=54.89$ (p<.00)
<u>Amount of Personalization</u>						
No items	6.7	10.0	6.7	30.0	46.6	100( 30)
One item	6.9	9.2	24.1	27.6	32.2	100( 87)
Two items	18.1	20.5	21.6	22.3	17.5	100(166)
Three items	23.4	23.4	23.4	22.7	7.1	100(128)
Four items or more	41.7	19.4	25.0	5.6	8.3	100( 36)
						Tau B=.29 $\chi^2=76.34$ (p<.00)

\* Figures based on data from three buildings examined by experts.

Table G-3

WORKSTATION VISUAL QUALITY AS VIEWED BY DESIGN EXPERTS, BY EXPERT ASSESSMENTS OF WORKSTATION CHARACTERISTICS  
(percentage distribution)

Experts' Assessment	Workstation Visual Quality					Total (number of observations)
	(5)High	(4)	(3)	(2)	(1)Low	
<u>Visual Privacy</u>						
(1)Not at all private	11.3	11.3	21.7	25.5	30.2	100(106)
(2)	6.9	15.8	25.5	28.0	22.8	100(129)
(3)	25.3	28.1	20.2	19.3	6.1	100(114)
(4)Very private	70.0	20.0	5.0	2.5	2.5	100(40)
						Tau B=.35 $X^2=129.60$ (p<.00)
<u>Speech Privacy</u>						
(1)Not at all private	12.4	11.4	21.0	24.7	30.5	100(105)
(2)	9.6	15.5	26.7	29.1	18.1	100(251)
(3)	39.4	38.1	12.7	5.6	4.2	100(71)
(4)Very private	61.8	18.2	--	--	--	100(22)
						Tau B=.35 $X^2=145.40$ (p<.00)
<u>Noise Level</u>						
(1)Very noisy	62.8	14.3	8.6	8.6	5.7	100(35)
(2)	21.7	27.8	21.7	19.0	9.8	100(184)
(3)	8.6	11.5	25.3	27.8	26.8	100(198)
(4)Very quiet	12.5	9.4	15.5	31.3	31.3	100(32)
						Tau B=.33 $X^2=97.54$ (p<.00)
<u>Orderliness</u>						
(1)Neat	24.2	24.2	20.3	17.6	13.7	100(227)
(2)	11.0	13.9	26.6	28.8	19.7	100(173)
(3)Messy	18.4	6.2	12.2	26.5	36.7	100(49)
						Tau B=.22 $X^2=41.21$ (p<.00)
<u>Spaciousness</u>						
(1)Not at all spacious	--	2.5	10.0	40.0	47.5	100(40)
(2)	6.0	8.0	24.0	33.3	28.7	100(150)
(3)	19.3	28.0	25.5	16.5	9.6	100(218)
(4)Very spacious	78.1	19.5	--	2.4	--	100(41)
						Tau B=.50 $X^2=205.35$ (p<.00)

Table H-1

RATING OF LIGHTING FOR READING AND WRITING, BY AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS  
(percentage distribution)

Type of System	Rating of Lighting for Reading/Writing					Total (number of respondents)
	Excellent	Pretty Good	Neutral	Not Very Good	Poor	
<u>Ambient Lighting<sup>a</sup></u>						
IF-FM	14.2	39.2	16.6	14.1	15.9	100(120)
IF-FM with other	20.0	20.0	40.0	15.0	5.0	100( 20)
IF-P alone and with other	34.6	30.7	21.2	9.1	4.4	100( 68)
DIF-P	22.2	44.5	11.1	14.8	7.4	100( 27)
DIF-P with other	29.3	28.3	22.1	12.3	8.0	100( 36)
DRFL(1o)	29.3	48.7	7.4	10.8	3.8	100(135)
DRFL(1o) with FWW	37.1	39.5	8.0	10.5	4.9	100( 38)
DRFL(1o) with DIF-P, alone and with other	29.7	44.4	15.6	5.6	4.7	100( 71)
DRFL(1o) with other	30.8	53.8	15.4	--	--	100( 26)
DRFL(1e), alone and with other	23.6	27.5	17.5	18.7	12.6	100( 89)
DRFL(1e), continuous	30.6	41.6	13.9	11.1	2.8	100( 36)
DFL-SM, alone and with other	29.4	44.2	8.8	17.6	--	100( 34)
HID-PI, alone and with other	35.8	53.7	3.0	7.5	--	100( 32)
Other	23.6	56.0	10.4	8.5	1.5	100( 52)
						Tau B=.09 Cramer's V=.18 X <sup>2</sup> =98.21 (p<.00)
<u>Supplemental Task Lighting<sup>b</sup></u>						
No task lighting	31.3	40.7	13.2	8.5	6.3	100(327)
FI-primary location	23.3	42.6	14.4	11.0	8.7	100(181)
FI-secondary location	25.9	41.4	18.1	8.1	6.5	100( 61)
FI-both locations	30.0	24.3	19.9	21.6	4.0	100( 35)
FM-primary location	17.3	31.8	34.9	9.8	6.2	100( 29)
FS-primary location	18.6	32.3	16.2	22.7	10.2	100( 43)
FM/FS-primary; FI-secondary	34.8	24.5	20.4	8.8	11.5	100( 32)
FI-primary; FM/FS-secondary	10.7	43.0	16.8	16.3	13.2	100( 41)
Other	13.6	35.9	21.3	29.2	--	100( 10)
						Tau B=.12 Cramer's V=.12 X <sup>2</sup> =43.47 (p<.09)

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL (1o)=Direct Recessed Fluorescent with Louvers; DRFL=Direct Recessed Fluorescent with lens; FWW=Fluorescent Wall Washer; DFL-SM=Direct Fluorescent-Surface Mounted; HID-PI=High Intensity Discharge-Pendant Mounted/Indirect

<sup>b</sup> FI=Furniture Integrated; FM=Furniture Mounted; FS=Free Standing

Table H-2

RATING OF LIGHTING FOR READING AND WRITING, BY WORK-RELATED ACTIVITIES OF OCCUPANTS  
(percentage distribution)

Work-Related Activities	Rating of Lighting for Reading/Writing					Total (number of respondents)
	Excellent	Pretty Good	Neutral	Not Very Good	Poor	
<u>Amount of Reading and Writing</u>						100(280)
Limited reading/writing	32.3	36.8	17.0	10.2	3.8	
Extensive reading, limited writing	25.6	35.6	19.7	12.9	6.2	100(191)
Extensive writing, limited reading	23.9	36.9	20.9	10.5	7.8	100( 95)
Moderate reading/writing	20.5	42.2	14.7	16.3	6.3	100(239)
Extensive reading/writing	19.9	47.8	9.6	11.7	11.0	100( 87)
Very extensive reading/writing	26.9	38.7	9.1	8.8	16.5	100( 59)
						Tau B = .07 Cramer's V = .09 $\chi^2 = 32.43$ (p < .04)
<u>Hours/Day Reading</u>						100( 24)
Not part of job	41.4	20.6	26.7	3.7	7.6	100(351)
Less than 2 hours	29.6	37.9	16.6	10.8	5.1	100(396)
2-4 hours	22.8	41.1	16.3	13.2	6.6	100(121)
4-6 hours	21.4	41.5	11.4	13.1	12.6	100( 78)
More than 6 hours	27.0	33.3	17.2	14.0	8.5	
						Tau B = .07 $\chi^2 = 16.84$ (p < .40)
<u>Hours/Day Writing</u>						100( 36)
Not part of job	19.1	42.3	34.7	3.9	--	100(433)
Less than 2 hours	29.9	36.4	16.9	12.0	4.8	100(365)
2-4 hours	21.7	42.5	13.3	15.6	6.9	100( 78)
4-6 hours	21.8	38.9	15.2	8.0	16.1	100( 49)
More than 6 hours	26.3	41.0	15.7	3.4	13.6	
						Tau B = .05 $\chi^2 = 33.79$ (p < .01)

Table H-3

RATING OF LIGHTING FOR READING AND WRITING, BY OCCUPANTS' EVALUATION OF LIGHTING CONDITIONS  
(percentage distribution)

Occupants' Evaluation	Rating of Lighting for Reading/Writing					Total (number of respondents)
	Excellent	Pretty Good	Neutral	Not Very Good	Poor	
<u>Reflected Glare</u>						100(363)
Not at all bothersome	40.6	37.7	11.5	5.9	4.2	100(344)
Not very bothersome	23.9	46.3	18.3	8.3	3.2	100(159)
Fairly bothersome	11.3	37.2	19.6	21.8	10.1	100( 83)
Very bothersome	8.4	23.0	18.3	30.1	20.2	
						Tau B=.30 $\chi^2=159.25$ (p<.00)
<u>Glare from Ceiling Lights</u>						100(423)
Not at all bothersome	36.8	37.3	14.3	6.5	5.1	100(327)
Not very bothersome	22.1	45.7	18.5	9.8	3.9	100(126)
Fairly bothersome	12.2	38.1	18.1	26.0	5.6	100( 72)
Very bothersome	4.7	28.9	14.9	26.2	25.3	
						Tau B=.29 $\chi^2=161.33$ (p<.00)
<u>Glare from Task Lights<sup>a</sup></u>						100(143)
Not at all bothersome	36.4	31.6	19.3	8.1	4.6	100(123)
Not very bothersome	17.5	51.5	18.8	9.4	2.8	100( 56)
Fairly bothersome	5.6	32.3	16.0	32.6	13.5	100( 25)
Very bothersome	9.7	18.3	15.3	31.2	25.5	
						Tau B=.26 $\chi^2=75.31$ (p<.00)
<u>Glare from Sunlight</u>						100(500)
Not at all bothersome	29.2	37.4	14.3	12.8	6.3	100(273)
Not very bothersome	25.6	40.8	17.8	8.4	7.4	100(104)
Fairly bothersome	25.7	44.1	10.6	17.2	2.4	100( 63)
Very bothersome	11.5	40.2	26.8	13.4	8.1	
						Tau B=.07 $\chi^2=22.95$ (p<.03)
<u>Bright Lights</u>						100(495)
Not at all bothersome	34.9	35.8	14.8	10.1	4.4	100(291)
Not very bothersome	19.2	48.2	19.7	10.5	2.4	100(100)
Fairly bothersome	12.4	37.4	9.4	23.7	17.1	100( 43)
Very bothersome	8.2	29.9	22.3	19.8	19.8	
						Tau B=.21 $\chi^2=98.53$ (p<.00)

<sup>a</sup> Data are reported for respondents who have a task lamp at the workstation.

Table I-1

REFLECTED GLARE PROBLEM, BY LIGHTING CONDITIONS AT WORKSTATION  
(mean condition)

Lighting Condition	Glare Reflected From Work Surface is:				Eta Coefficient
	Not at All Bothersome	Not Very Bothersome	Fairly Bothersome	Very Bothersome	
Illuminance - Seated: Primary Location (fc)	62(301)	64(273)	69(130)	74( 72)	.06 n.s.
Illuminance - Unseated: Primary Location (fc)	68(275)	73(240)	74(101)	82( 63)	.02 n.s.
Illuminance - Seated: Secondary Location (fc)	57(191)	58(191)	69( 97)	50( 52)	.08 (p<.08)
Illuminance - Unseated: Secondary Location (fc)	61(176)	62(172)	74( 78)	55( 47)	.10 (p<.04)
Minimum CRF	90(219)	88(200)	89( 83)	86( 52)	.12 (p<.01)
Luminance on Task(fL)	48(301)	51(273)	54(129)	56( 73)	.07 (p<.06)
Task Luminance Ratio	3.8(301)	3.0(273)	3.0(129)	3.6( 73)	.09 (p<.02)
Field Luminance Ratio	102(394)	77(361)	65(171)	94( 98)	.05 n.s.
Ceiling Luminance Ratio	49(268)	50(230)	40(101)	50( 64)	.00 n.s.
Distance to Glazed Exterior Wall(feet)	21(334)	24(312)	25(152)	25( 85)	.04 n.s.

Table I-2

REFLECTED GLARE PROBLEM, BY TYPES OF AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS  
(percentage distribution)

Type of System	Glare Reflected From Work Surface is:				Total (Number of respondents)
	Not at All Bothering	Not Very Bothering	Fairly Bothering	Very Bothering	
<u>Ambient Lighting</u> <sup>a</sup>					
IF-FM	36.6	32.5	19.2	11.7	100(120)
IF-FM with other	26.1	30.4	26.1	17.4	100( 23)
IF-P alone or with other	36.0	30.0	26.7	7.3	100( 69)
DIF-P	29.7	43.9	19.8	6.6	100( 30)
DIF-P with other	50.9	29.3	14.6	5.2	100( 37)
DRFL (lo)	35.5	42.2	12.5	9.8	100(139)
DRFL (lo) with FWW	38.1	42.1	17.5	2.3	100( 40)
DRFL (lo) with DIF-P, alone and with other	35.3	41.9	11.4	11.3	100( 76)
DRFL (lo) with other	44.5	44.4	11.1	--	100( 27)
DRFL (le), alone and with other	49.0	33.2	8.9	8.9	100( 90)
DRFL (le), continuous	41.1	28.2	25.6	5.1	100( 39)
DFL-SM, alone and with other	15.8	39.5	26.3	18.4	100( 38)
HID-PI, alone and with other	53.8	23.9	11.9	10.4	100( 32)
Other	30.3	40.3	18.0	11.4	100( 53)
Tau B=.02 Cramer's V=.14 X <sup>2</sup> =51.01 (p<.10)					
<u>Supplemental Task Lighting</u> <sup>b</sup>					
No task lighting	40.0	36.5	15.3	8.2	100(340)
FI-primary location	41.2	32.7	16.4	9.7	100(183)
FI-secondary location	41.3	38.4	11.4	8.9	100( 64)
FI-both locations	21.8	38.9	24.5	14.8	100( 35)
FM-primary location	31.8	39.7	24.7	3.8	100( 32)
FS-primary location	29.1	28.7	28.1	14.1	100( 44)
FM/FS-primary; FI-secondary	38.2	35.9	19.7	6.2	100( 34)
FI-primary; FM/FS-secondary	25.7	38.5	20.3	15.5	100( 44)
Other	44.5	9.9	40.4	5.2	100( 10)
Tau B=.08 Cramer's V=.11 X <sup>2</sup> =28.73 (p<.23)					

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL (lo)=Direct Recessed Fluorescent with Louvers; DRFL=Direct Recessed Fluorescent with lens; FWW=Fluorescent Wall Washer; DFL-SM=Direct Fluorescent-Surface Mounted; HID-PI=High Intensity Discharge-Pendant Mounted/Indirect

<sup>b</sup> FI=Furniture Integrated; FM=Furniture Mounted; FS=Free Standing

Table J-1

RATING OF LIGHTING FOR CRT USE, BY AMBIENT AND SUPPLEMENTAL LIGHTING SYSTEMS  
(percentage distribution)

Type of System	Rating of Lighting for CRT Use <sup>a</sup>					Total (number of respondents)
	Excellent	Pretty Good	Neutral	Not Very Good	Poor	
<u>Ambient Lighting<sup>a</sup></u>						
IF-FM	8.7	30.6	13.0	21.7	26.0	100( 23)
IF-FM with other	16.7	16.7	33.3	33.3	--	100( 6)
IF-P alone or with other	9.3	34.5	27.1	17.5	11.6	100( 36)
DIF-P	23.1	46.1	--	15.4	15.4	100( 13)
DIF-P with other	15.4	25.6	30.9	28.1	--	100( 12)
DRFL (1o)	22.6	42.8	15.9	13.1	5.6	100( 59)
DRFL (1o) with FWW	51.4	13.6	10.6	13.6	10.6	100( 8)
DRFL (1o) with DIF-P, alone and with other	19.3	26.2	20.6	26.2	7.7	100( 27)
DRFL (1o) with other	16.7	41.6	16.7	25.0	--	100( 12)
DRFL (1e), alone and with other	--	41.6	25.1	33.3	--	100( 9)
DRFL (1e), continuous	--	33.3	16.7	50.0	--	100( 6)
DFL-SM, alone and with other	12.0	36.0	12.0	32.0	8.0	100( 25)
HID-PI, alone and with other	16.0	64.0	--	20.0	--	100( 11)
Other	7.0	17.4	--	41.3	34.3	100( 5)
						Tau B=.05 Cramer's V=.24 X <sup>2</sup> =57.74 (p<.28)
<u>Supplemental Task Lighting<sup>c</sup></u>						
No task lighting	16.2	43.5	13.0	19.9	7.4	100( 108)
FI-primary location	24.4	34.2	7.4	24.0	10.0	100( 47)
FI-secondary location	18.1	20.5	27.6	21.4	12.4	100( 20)
FI-both locations	18.4	30.3	25.2	17.6	8.5	100( 20)
FM-primary location	6.6	39.6	37.8	6.6	19.4	100( 16)
FS-primary location	6.9	17.6	29.8	32.7	13.0	100( 21)
FM/FS-primary; FI-secondary	18.1	27.5	36.3	--	18.1	100( 6)
FI-primary; FM/FS-secondary	--	21.9	31.4	27.5	19.2	100( 11)
Other	--	59.4	--	40.6	--	100( 4)
						Tau B=.15 Cramer's V=.19 X <sup>2</sup> =36.53 (p<.27)

<sup>a</sup> Data are reported for respondents who have a CRT at the workstation.

<sup>a</sup> IF-FM=Indirect Fluorescent-Furniture Mounted; IF-P=Indirect Fluorescent-Pendant; DIF-P=Direct/Indirect Fluorescent-Pendant; DRFL (1o)=Direct Recessed Fluorescent with Louvers; DRFL=Direct Recessed Fluorescent with lens; FWW=Fluorescent Wall Washer; DFL-SM=Direct Fluorescent-Surface Mounted; HID-PI=High Intensity Discharge-Pendant Mounted/Indirect

<sup>c</sup> FI=Furniture Integrated; FM=Furniture Mounted; FS=Free Standing

Table J-2

RATING OF LIGHTING FOR CRT USE, BY OCCUPANTS' EVALUATION OF LIGHTING CONDITIONS  
(percentage distribution)

Occupants' Evaluation	Rating of Lighting for CRT Use <sup>a</sup>					Total (number of respondents)
	Excellent	Pretty Good	Neutral	Not Very Good	Poor	
<u>Reflected Glare</u>						
Not at all bothersome	28.3	28.3	21.5	15.6	6.3	100( 78)
Not very bothersome	11.5	46.4	19.0	16.6	6.5	100( 92)
Fairly bothersome	1.0	31.2	18.9	32.2	16.7	100( 55)
Very bothersome	13.5	15.5	17.6	31.5	21.9	100( 30)
						Tau B=.31 X <sup>2</sup> =51.46 (p<.00)
<u>Glare from Ceiling Lights</u>						
Not at all bothersome	21.9	29.1	24.6	13.7	10.7	100( 89)
Not very bothersome	15.7	40.1	19.8	19.8	4.6	100( 90)
Fairly bothersome	1.1	37.5	10.0	40.4	11.0	100( 47)
Very bothersome	5.2	25.6	18.1	26.9	24.2	100( 28)
						Tau B=.25 X <sup>2</sup> =41.31 (p<.00)
<u>Glare from Task Lights</u> <sup>b</sup>						
Not at all bothersome	21.9	33.7	22.3	15.6	6.5	100( 85)
Not very bothersome	8.7	30.9	31.3	20.9	8.2	100( 81)
Fairly/Very bothersome	3.2	33.1	24.4	17.8	21.5	100( 48)
						Tau B=.21 X <sup>2</sup> =27.26 (p<.04)
<u>Glare from Sunlight</u>						
Not at all bothersome	22.7	32.7	13.7	20.7	10.2	100(122)
Not very bothersome	12.0	37.8	20.7	18.2	11.3	100( 60)
Fairly bothersome	8.7	38.4	15.5	33.1	4.3	100( 37)
Very bothersome	3.8	17.7	45.7	11.4	21.4	100( 30)
						Tau B=.20 X <sup>2</sup> =34.41 (p<.00)
<u>Bright Lights</u>						
Not at all bothersome	17.1	38.9	19.2	16.8	8.0	100(113)
Not very bothersome	16.4	28.7	24.1	22.4	8.4	100( 84)
Fairly bothersome	11.1	27.7	17.4	29.4	14.4	100( 31)
Very bothersome	9.4	34.2	14.0	30.4	11.9	100( 15)
						Tau B=.17 X <sup>2</sup> =13.33 (p<.35)
<u>Glare from Above or Behind CRT Screen</u>						
Not at all bothersome	37.6	33.4	15.8	9.1	4.1	100( 56)
Not very bothersome	18.4	49.0	19.8	6.0	6.8	100( 58)
Fairly bothersome	2.4	35.7	25.1	31.9	4.9	100( 71)
Very bothersome	5.6	19.2	12.1	32.7	30.4	100( 53)
						Tau B=.41 X <sup>2</sup> =76.85 (p<.00)

<sup>a</sup> Data are reported for respondents who have a CRT at the workstation.

<sup>b</sup> Data are reported for respondents who have a task lamp at the workstation.

Table K-1

BUILDING INTERIOR QUALITY, BY SELECTED WORKSTATION CHARACTERISTICS  
(percentage distribution)

Workstation Characteristic	Building Interior Quality					Total (number of respondents)
	(1)Low	(2)	(3)	(4)	(5)High	
<u>Workstation View</u>						
Sky seen from standing/ sitting position	10.4	24.9	21.4	24.6	18.5	100(465)
Outdoors seen from standing/ sitting position, but no sky	7.4	23.4	19.9	39.7	9.6	100( 24)
Sky seen from standing position only	14.9	25.1	26.0	23.1	10.9	100(102)
Outdoors seen from standing position only but no sky	2.4	27.0	28.6	24.9	17.1	100( 22)
Workstation is unaffected by daylight	17.0	36.1	18.1	15.4	13.3	100(139)

Tau B=.07  
Cramer's V=.08  
 $\chi^2=20.01$  (p<.46)

Table L-1

WORKSTATION LIGHTING POWER DENSITY,  
BY EVALUATIONS OF LIGHTING AND VISUAL QUALITY  
(mean density)

Evaluation	Lighting Power Density	Eta Coefficient
<u>Workstation Lighting Satisfaction</u>		.17 (p<.00)
Very Satisfied	2.44(208)	
Fairly Satisfied	2.72(343)	
Neither Satisfied nor Dissatisfied	2.56( 94)	
Not Very Satisfied	3.03(130)	
Not At All Satisfied	3.01( 31)	
<u>Preference for Improved Lighting</u>		.10(p<.01)
Not Mentioned as Improvement	2.61(399)	
Mentioned But Not as Most Improved	2.86(271)	
Mentioned as Most Preferred Improvement	2.77( 73)	
<u>Workstation Lighting Quality (Experts)<sup>a</sup></u>		.19 (p<.00)
(1) Low	2.84( 91)	
(2)	2.72( 67)	
(3)	2.57(135)	
(4) High	2.36(153)	
<u>Rating of Amount of Light for Work</u>		.17 (p<.00)
Excellent	2.45(155)	
Good	2.62(365)	
Fair	2.87(200)	
Poor	3.02( 84)	
<u>Rating of Lighting for Reading and Writing</u>		.07 n.s.
Excellent	2.61(207)	
Pretty Good	2.65(313)	
Neutral	2.70(108)	
Not Very Good	2.89( 86)	
Poor	2.87( 46)	

Table L-1 (continued)

Evaluation	Lighting Power Density	Eta Coefficient
<u>Workstation Visual Quality (Occupants)</u>		.04 n.s.
(1) Low	2.86( 11)	
(2)	2.75(217)	
(3)	2.74(222)	
(4)	2.61(149)	
(5) High	2.49(110)	
<u>Workstation Visual Quality (Experts)<sup>a</sup></u>		.34 (p<.00)
(1) Low	3.15( 75)	
(2)	2.74( 89)	
(3)	2.49(128)	
(4)	2.24( 87)	
(5) High	2.31( 67)	

<sup>a</sup> Figures based on data from three buildings (A, B, and C) examined by experts.

Table L-2  
WORKSTATION LIGHTING POWER DENSITY, BY  
LIGHTING CONDITIONS AT WORKSTATION  
(mean density)

Light Condition	Lighting Power Density	Eta Coefficient
<u>Illuminance-Seated</u>		
<u>Primary Location (fc)</u>		
		.19(p<.00)
Less than 40	2.40(210)	
40-59	2.59(278)	
60-79	2.92(185)	
80-99	2.83( 99)	
100-119	2.81( 61)	
120 or more	2.56( 50)	
<u>Illuminance-Seated</u>		
<u>Secondary Location (fc)</u>		
		.09(p<.08)
Less than 40	2.71(183)	
40-59	2.62(176)	
60-79	2.62(109)	
80-99	3.08( 55)	
100-119	2.88( 24)	
120 or more	2.81( 34)	
<u>Luminance at Task (fL)</u>		
		.25(p<.00)
Less than 20	2.30( 62)	
21-40	2.46(314)	
41-50	2.61(157)	
51-60	3.01(119)	
61-70	2.93( 72)	
71 or more	2.80( 54)	
81 or more	2.77(104)	



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