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Occupant Evaluation of Commercial Office Lighting: Volume 1, Methodology and Bibliography

Gary Gillette
Marilyn A. Brown

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OCCUPANT EVALUATION OF COMMERCIAL OFFICE LIGHTING: VOLUME 1, METHODOLOGY AND BIBLIOGRAPHY

Gary Gillette, P.E.
Project Manager

American Institute of Architects Foundation
1735 New York Avenue, N.W.
Washington, D.C. 20006

Marilyn A. Brown, Editor

Energy Division
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37831

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EDITOR'S FOREWARD

Electric lighting accounts for an estimated one-third of energy use 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 high 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 the 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 first in a series of four reports describing the project. The titles and principal 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, Basic Statistical Analysis" by Robert W. Marans
- "Occupant Evaluation of Commercial Office Lighting: Volume 3, Data Base Archive" by Gary Gillette
- "Occupant Evaluation of Commercial Office Lighting: Volume 4, Design Conclusions and Research Recommendations" by Earle Kennett and Lance McCold.

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 the Acknowledgments).

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The Technical Review Committee provided professional input and helped define much of the direction. The committee members and the organizations they represented are as follows:

Harrison Fraker	American Institute of Architects/Energy Committee
Harry Mahler	American Institute of Architects/Design Committee
Dan Nal	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
Fred Pearson	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
Alton Penz	Building Owners and Managers Association
Howard Brandston	Illuminating Engineering Society
Stephen Margulies	Illuminating Engineering Society
Helen Diemer	International Association of Lighting Designers
Maxine Savitz	Lighting Research Institute
Thomas Schneider	Lighting Research Institute
Richard Vincent	Lighting Research Institute
Harry Lobdell	National Electrical Manufacturers Association
J. W. Griffith	National Fenestration Council
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Marilyn Brown	Oak Ridge National Laboratory
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ABSTRACT

This report documents the forms and procedures developed for a post-occupancy evaluation of office lighting environments. It is the first in a series of four reports. The central aim of the larger project is to explore possible causal factors that are associated with successful lighting design, with particular interest in the relationship between the connected lighting power load and subjective measures of lighting quality. A post-occupancy evaluation procedure was used as the strategy for obtaining the desired data. The procedure involved collecting several different types of data: 1) direct measures of the physical environment, including spatial luminances, illuminances, and contrast conditions; 2) indirect measures such as the amount of space provided for each work station and the connected lighting power load; 3) occupant responses to lighting and other factors of the work station; and 4) a limited number of expert ratings of the lighting conditions. Data from thirteen buildings and 1,217 work stations were collected. These data were built into a database allowing lighting quality to be quantified and explained.

1. BACKGROUND

1.1 RATIONALE FOR THE STUDY

In August of 1982, the Board of Directors of the Illuminating Engineering Society of North America (IES) approved the report, "IES Recommended Procedure for Lighting Power Limit Determination" as an official document of the society. Prepared by the IES Energy Management Committee, this report provides a methodology for determining upper power limits using the Unit Power Density (UPD) procedure. Here specific values of UPD's are given for most lighting tasks experienced in practice. These UPD values are critical factors in the procedure, yet they were established several years ago and developed not from an objective statistical base, but were obtained empirically from professional judgments and committee consensus. Such a technique for obtaining data for standards creates a problem in that it is difficult to defend the selection of one value over another.

More recently, a somewhat related research effort has been under way within the heating, ventilating, and air conditioning community to upgrade Standard 90A-1980 of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) entitled, "Energy Conservation in New Building Design." Under the auspices of the Department of Energy, a special project committee (SPC 41) was established within ASHRAE to recommend revisions and improvements of the existing standard. As this work progressed, lighting surfaced as an important area where revisions were necessary. Reductions of 20 to 25% were suggested for the IES base UPD values. However, these suggested revisions were based on hypothetical lighting systems (computerized simulated scenarios) where the impact on the quality of the visual

environment was never assessed. Although separate arguments can be made in favor of each set of data, there are no definitive measured data to support either claim. In an effort to bridge this gap, a research project was initiated by the American Institute of Architects Foundation (AIAF), a neutral party in the discussion to date. The purpose of the research effort was to begin developing a reference set, an archival database, of information to aid in better understanding the relationship between measures of lighting power density and the quality of the lighting environment.

To avoid the weakness of employing data derived from theoretical lighting environments, a post-occupancy evaluation (POE) strategy was planned for a selected number of occupied office buildings. To overcome the weakness of potential personal bias, and to gain insight into the user and design professional points of view, the environments were evaluated by the occupants and (in the initial study) by an independent expert design team. These multiple impressions were compared with photometric measurements and calculations of in-situ lighting power density. These data have been prepared into a data file suitable for statistical analysis allowing relationships to be explored between both quantitative (photometric) data and qualitative (occupant and expert response) data. Furthermore, a structure was established for archiving these data in an database that eventually can be used by researchers and standards writing organizations.

The project received extensive review from several different communities: professional, industrial, and research. From the professionals, extensive input was received via a Technical Review Committee; lighting

recommendations were made by members of the Illuminating Engineering Society (IES), the International Association of Lighting Designers (IALD), the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), the American Institute of Architects (AIA), and the building management profession (Building Owners and Managers Association International). From the industrial communities, advice was received from the National Electrical Manufacturers Association (NEMA) and the National Fenestration Council (NFC). The research community was represented by the Lighting Research Institute (LRI), the Oak Ridge National Laboratory (ORNL), the U.S. Department of Energy (DOE), and the New York State Energy Research and Development Authority (NYERDA), with additional review being provided by the National Bureau of Standards (NBS) and the Lawrence Berkeley Laboratory (LBL).

1.2 GOALS AND OBJECTIVES

Several goals and objectives were established for the project. As used here, objectives refer to the direction or aim of the research and are distinguished from goals, which are the particular achievements to be reached.

The project had three broad objectives; they were to begin to understand:

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

The specific goals for this phase of such a long-range research effort were as follows:

- To prepare a database of information of calculable, measurable, and subjective aspects of lighting in a statistically sampled number of work stations in a number of occupied office buildings.
- To investigate the feasibility of developing a lighting quality metric for use in occupied office environments.
- To investigate the relationship between lighting power density and other measures of lighting contained in the database.
- To initiate the development of a database to be used by standard writing organizations in establishing lighting energy standards.

1.3 DEFINITIONS AND PROJECT SCOPE

The project was initiated with a review of the research literature concerning lighting qualitative and quantitative issues (see Section 7 for bibliography). This preliminary work also helped in establishing definitions and limits to the overall study. This activity was necessary since such words as lighting quality, satisfaction, and performance have a broad range of possible definitions and interpretations. While it was beyond the scope of this research effort to establish absolute definitions for all such terms, working definitions were developed with the assistance of the Technical Review Committee and the Oxford English Dictionary.

As used in this study, the term "lighting quality metric" refers to a photometrically measurable attribute of the occupied environment that correlates with subjective measures of perceived lighting quality. The purpose here was not to develop such a metric, but rather to explore the feasibility of characterizing lighting environments using one or more photometric descriptors. The refining of a qualitative metric was beyond the scope of this study.

Throughout this study, lighting quality is defined in terms of several subjective measures: occupant satisfaction, perceived ability

to perform visual work, and attractiveness as viewed by occupants. In the initial study of the first three buildings, appropriateness of the lighting system as viewed by an expert team was also included as an additional measure. The subjective measures of lighting quality include individual occupant ratings of several environmental factors and indices created by combining those responses that were strongly correlated to each other statistically, thus, creating new combined measures.

1.4 THE TWO PHASES

There were two phases of work: an initial study of three buildings and an extended study of ten additional buildings. (Figure 1 lists these 13 buildings and the types of data collected from each.) Each phase was initiated with an examination of a pretest building, for a total of 15 buildings studied (13 archived and two test cases). Two points should be made: first, the pretest building data were not included in the database; and second, the unit of analysis was the work station, not the building.

The two phases of research differed in several ways. These will be described throughout the report as pertinent, but the intent was to collect and analyze data on an initial set of three buildings, and then revise the methodology as necessary for the extended set of buildings. An effort was made to ensure that the revisions allowed the data in the extended set to be merged and compared to the data in the initial set of buildings.

Also, in the extended study, due to cost and other constraints, only selected sections of some of the larger buildings were evaluated. The sections, however, always comprised an organizational unit such as a

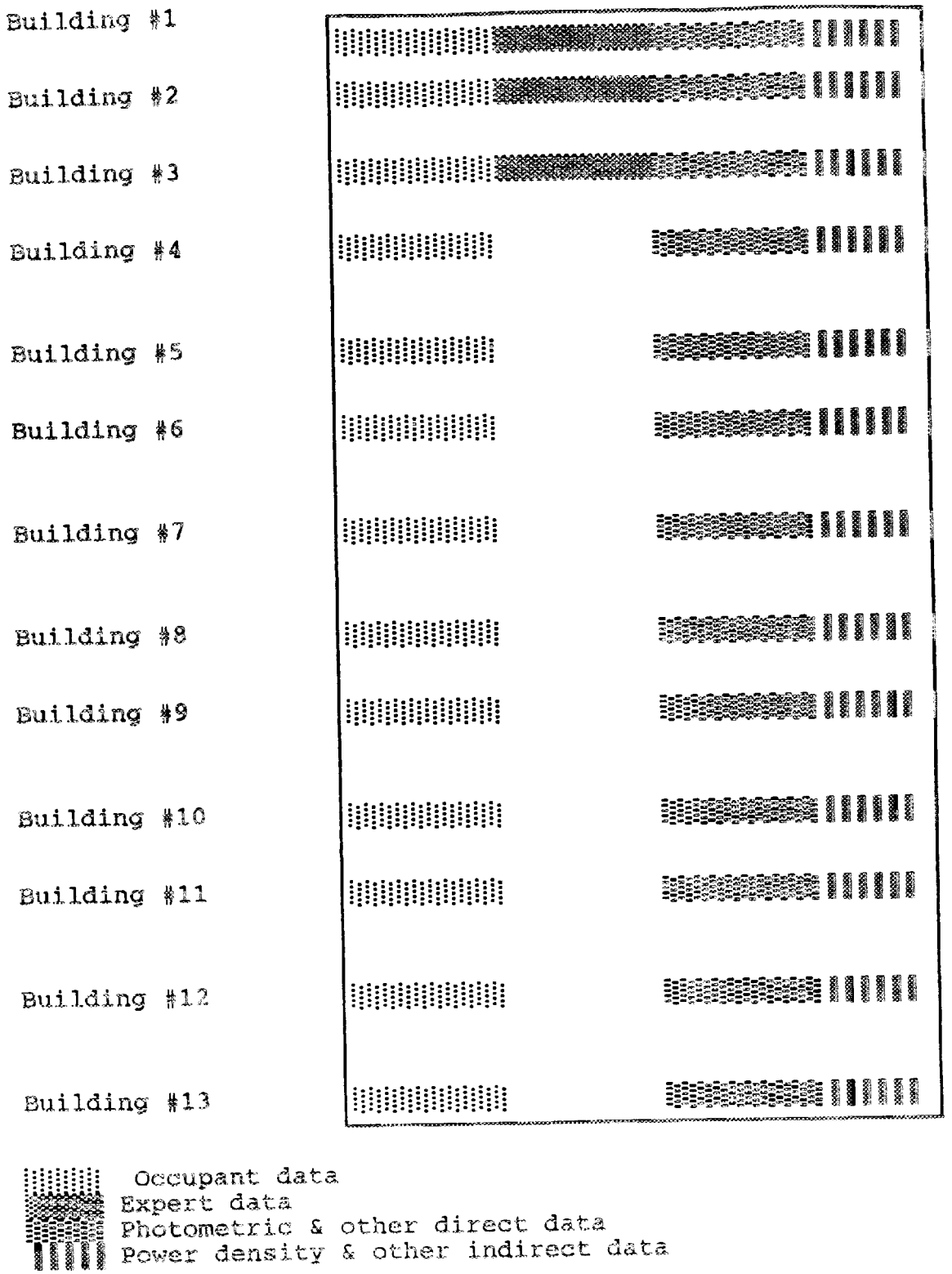

Figure 1. OSIRIS data file design.

division of the corporation or a floor of the building. This allowed statements to be made about the work stations within these entities.

While the focus of this study was on the lighting conditions in work stations, limited expert assessment data were also collected as a part of the initial study using an expert design team. The team consisted of an architect, lighting designer, illuminating engineer, and interior designer. These assessments included expert ratings of the lighting conditions in the work stations as well as in surrounding ancillary spaces and of the building as a whole. Although these latter data were collected for the first three buildings, after reviewing the data the decision was made (largely due to cost) not to have the team as a part of the second phase of the research effort.

2. EXPERIMENTAL DESIGN AND EVALUATION PROCEDURE

2.1 OVERALL PROCEDURE

To reach the project goals, a post-occupancy evaluation procedure was designed, pretested, and executed on a sample of work stations from thirteen office buildings representing a variety of different lighting systems. Data were collected from 1,217 work stations, with combined occupant and direct measurement data for over 900 of these. Random sampling was done using all occupied work stations identified for the building or organizational unit within the building. This sample was used for administering the questionnaires. To improve the occupant response rate and increase the chances of getting occupant responses for the work stations where direct environmental measures were made, the sample of work stations where these questionnaires were made were themselves randomly sampled. The second sampling was necessary to limit the number of direct measurement work stations since these measurements were much more time consuming and costly.

The procedure included soliciting information from occupants via questionnaires and obtaining expert judgments (for the initial buildings) from a team of four experts who walked through the building and evaluated the sampled work stations. These subjective responses were complemented by a series of field measurements of photometric, acoustic, and thermal conditions. Conceptually, the process was to treat the subjective responses as the qualitative measures, and compare the unit power density and the photometric measures against these qualitative measures. A detailed description of the evaluation procedure is given below. An outline of the analysis process can be found in Section 4,

and the strategy used for reaching the four project goals can be found in Section 5. A detailed listing of the data collected has been provided in Appendix A.

The experimental design was aimed at collecting three basic types of data under occupied environmental conditions: subjective impressionistic data, photometric and other direct environmental data, and lighting power density and other indirect environmental data. The direct environmental data refers to measurements made at the site. In contrast, indirect data are those data obtained at least in part using sources such as architectural drawings and photographs. Using the subjective data, dependent variables were developed to describe dimensions of perceived lighting quality. The photometric measures and the power density measures (the independent variables) were compared against these qualitative measures in an effort to identify possible photometric predictors of lighting quality. The relative strengths of these relationships were then examined statistically and inferences were drawn. To control extraneous factors that may also influence the subjective responses, a series of additional measures of thermal comfort and acoustical privacy were made. Also, subjective responses to a number of other (possibly related) aspects of the environment as well as data about the occupant were collected. In this way, the effects of various exogenous variables were controlled.

2.2 PROCEDURE FOR COLLECTING SUBJECTIVE DATA

Initial Study

One of the unique features of the initial study was having occupant and design expert assessments in conjunction with the photometric and

other environmental measurements. To accomplish this, the four-member expert team was organized consisting of individuals with extensive lighting design experience. A two-member technical team was also organized to take the photometric and other environmental measurements. The technicians were to follow behind the expert team taking field measurements immediately after the expert team left the space.

A pretesting exercise was conducted on a nearby building to test out the timing and sequencing of the two teams. The pretest helped identify possible problem areas in the evaluation forms and helped to estimate the time needed for field evaluations at the three selected buildings. Floor plans of the test building were prepared beforehand showing which sample locations would be examined. On the morning of the one-day pretest, the teams were provided with a packet of forms, and after being introduced to the building manager, evaluated 24 work stations. Following the pretest, the teams reviewed their experiences and discussed the problems they encountered. Their reactions were noted by the research team and used in revising the evaluation forms.

In preparation for the field evaluations, visits were made to the candidate buildings selected for evaluation. Checks were made to ensure that each building indeed had the type of lighting system of interest, up-to-date drawings of the work station layout and the lighting plans were available, and that management was willing to cooperate with the team. Drawings were checked to determine if they accurately represented the current spatial arrangement of work stations and if each work station was occupied. Unique numbers were assigned to each work space and a random sampling was done to obtain an initial sample of 180 work stations per buildings. Self administered questionnaires were given to

occupants whose work stations were included in this sample. To account for a non-response rate among building occupants, another random subsample of the original 180 work stations was prepared to obtain 150 work stations per building from which expert assessments, photometric measurements, and other environmental measurements were made. The subsample of 150 work stations allowed the field team to complete their evaluations of work stations and ancillary spaces for each building in one week.

A few weeks before the evaluation teams were to arrive, a form letter, prepared by the project team but distributed by the building management, was given to the occupants informing them of the study. Study participants were told only that the office environment was under investigation, and were not told that lighting was its focus.

A week before the evaluation team arrived, a member of the project staff visited the building site and distributed the questionnaires to the first sample (180 work stations). An envelope with the work station code marked was provided with each questionnaire, and instructions given to seal it inside the envelope once completed. The staff member picked up the envelopes the following day noting those not completed.

When the evaluation teams arrived the following week, their first task was to collect all remaining questionnaires before the teams visited the work stations. This was necessary to control for potential bias once the occupants became aware of the kinds of measurements being made. The four members of the expert team then began their field evaluations of the work stations. They each had identical forms and, without speaking to each other, spent approximately 12 minutes completing the forms for each work station.

In addition to this activity, each team member also had one of four special assignments. The team leader was responsible for directing the team through the building using a map of the sub-sample of 150 work stations. A second team member determined the lamp and ballast wattages of all luminaires in and around the work station (up to within 10 feet) using the luminaire specification form. A third member marked the lamps or luminaires that were out, disconnected, added, or otherwise misrepresented on the drawings (on a reduced copy of the reflected ceiling plans). The fourth member took two specially designed photographs. The first was a 180° non-cropping fish-eye view of the space showing as much of the space as possible. The second was a similar hemispherical photograph of the work stations as viewed at the primary work surface, horizontally looking up and including the image of an occupant when seated. In this way, all luminaires contributing to the illuminance at the primary work surface with body shadow were visible. The camera was also equipped with an internal digital clock which recorded the time and date of each photograph. Photographs were taken after the evaluation forms were completed and before the technical team began taking its measurements.

Extended Study

The second phase methodology was virtually identical to the initial study, but used a slightly streamlined procedure. After reviewing the data on the initial buildings, the research team, together with the Technical review committee, agreed to the following revisions:

- No expert assessments would be made for the remaining buildings

- The number of work stations where direct measures were to be made would be reduced to 50 per building
- A few additional questions were put into the questionnaire, and a few modifications were added to the measurement form.

2.3 PROCEDURE FOR COLLECTING PHOTOMETRIC AND OTHER DIRECT ENVIRONMENTAL DATA

The two member technical team took all the photometric and other direct environmental measurements, including spatial luminances, work surface illuminances, and luminance contrast measurements. Illuminances were measured at both the primary and secondary work surfaces, with and without body shadow. An illuminance photometer was used which had a cosine corrected diffuser and a C.I.E. (Commission Internationale de l'Eclairage) photopic eye response filter. For making the illuminance measurement without body shadow, an adapter/extension cord allowed the detector to be detached from the meter. In this way the technicians were able to hide from the detector. The location of the work surfaces were identified by the occupants using peel-off labels provided in the questionnaire (see Appendix B for the specific instructions given). When the surface was a desk top or similar type surface, the illuminance was measured 0.152m (6 inches) from the front edge and immediately in front of where the occupant normally sits. The body shadow measurement was taken with the technician seated facing upright toward the photometer.

The luminance contrast and contrast rendition factor measurements were made using a Bruel and Kjaer luminance contrast meter with a reference standard calibrated under a sphere environment. The reference standard visual task used black ink on white paper (the Scandinavian

standard) viewed at a 25° angle off normal. Since the instrument maintains a constant viewing point at 400 mm above the work plane, the detector needs only a radial angle to be positioned. Three angles, 45°, 90°, and 135°, were selected. Luminance contrast and the contrast rendition factors were measured for each of the three positions at the primary work surface. In the extended study measures were also made of the minimum contrast and its location.

The thirteen field luminances were measured using a portable 1° spot luminance meter. The luminance of a standard white bond paper and the luminance of the work surface immediately surrounding the paper were measured to determine the near surround luminance ratio. In addition, the following far surround luminances were measured: the luminance of the ceiling between luminaires; the brightest light source in field of view; the brightest ceiling area in field of view; the darkest area in field of view; the wall luminance at eye level straight ahead; 90° to the right; and 90° to the left. The brightest sky luminance in each of the four cardinal directions and its position with respect to the occupant were recorded as viewed from the seated position.

The technical team also took two thermal and an acoustic sound level measurements. Dry bulb and wet bulb temperatures were recorded for each zonal area using a sling psychrometer; a portable sound level meter measured the ambient noise level using an A-weighted decibel scale.

2.4 PROCEDURE FOR COLLECTING LIGHTING POWER DENSITY

The collection of lighting power density data involved obtaining the in-situ lamp and ballast wattages for all luminaires in and around the work station, and assigning floor areas associated with these wattages.

These wattages were for both portable and stationary sources. This activity required knowledge of the actual lamps and ballasts as installed, which often differed substantially from the way the environment was originally designed. Consequently, it became necessary to design a systematic procedure for documenting both the wattages and the areas used to determine the power densities (Watts/square area). The lighting evaluation form (see Appendix A) was used during the field evaluations to record the wattage and number of each type of luminaire. This was done by visual inspection. The lighting system specifications, a ballast catalog, and a portable multimeter assisted the expert team member responsible for collecting this information. Where feasible, spot measurements were made at the panel board of the amperages and the phase-to-ground and phase-to-phase voltages of individual lighting circuits. These data were then used in concert with the updated reflected ceiling plans and the work station photographs, also supplied by one of the experts, to determine the total connected wattage of each defined area.

Two wattages and two associated areas were defined. The first was for the local work station. Here the local area was defined as either the area of the enclosed office or the area bounded by partial wall barriers. In the case of open pool offices or areas without clear personal space boundaries, the centerline between work stations was treated as the boundary line (when less than four feet apart). When no boundary was evident within four feet, a four foot limit was used (see Indirect Environmental Form, Appendix B). The second area, the general zone area, was defined as the area bounded by walls, which for the open plan and open pool offices, was the area of the entire bay, and therefore,

required a determination of the wattage for the bay. Thus, two lighting power densities were obtained, one for the local task lighting, and a second for the general ambient lighting. The unit power density of the space was the combination of the two.

3. DESCRIPTION OF BUILDINGS AND LIGHTING ENVIRONMENTS

3.1 SELECTION CRITERIA

Thirteen buildings were selected for evaluation, three as a part of the initial study, and ten as part of a follow-on study. The selection of the buildings began by first establishing a list of criteria to be used. With the assistance of the Technical Review Committee, the following criteria were developed:

- The building had to be predominately used for office space.
- Although the building need not be owned by the occupant, the office space was to be occupied by a single organization having some control over the lighting decisions made in the building.
- Cooperation was needed from the building owner, the personnel manager, and the design firms involved.
- Up-to-date drawings of work station layouts and the reflected ceiling plan (with specifications) had to be available.
- It was desirable to have the architectural program and the lighting design criteria that were used to design the system.
- A variety of lighting systems and light sources were to be included.

For the initial three buildings, the additional criteria were added:

- The building had to be designed, not necessarily constructed, since 1975.
- Energy conservation was to be an important part of the lighting design solution.
- The quality of the lighting environment was to be viewed in general as being relatively high.

The initial buildings were the "flag ship" buildings: corporate headquarters with professional lighting designers on the design team. The second set of buildings sought to enlarge the database by including different types of lighting systems and light sources, a broader range

of lighting power densities, and a range in the quality of the lighting system (see Table 1).

Candidate buildings were solicited from the organizations represented on the committee, and once finalists were selected, again using the committee, visits were made by the project team to inspect the facilities. If all the criteria were met and no unexpected problems found, the building was selected.

3.2 DESCRIPTION OF SELECTED BUILDINGS

A brief description of the thirteen buildings is given below. The first three buildings are the "flag ship" buildings, and the remaining ten comprise the extended study. Figure 2 shows a matrix of the types of lighting systems included in the study. No statements concerning representativeness can be made from these few buildings. While a variety of lighting systems was sought, many types of systems are not represented in this sample.

Building #1

The first building evaluated was an eight story corporate office building located in Tampa, Florida. It was designed with energy as an important design feature, meaning that stringent requirements were placed on the design team, but at the same time energy did not dominate the design. A professional lighting design firm was retained for the design of the lighting system and, using a target of 2.1 W/ft^2, provided an original design that was estimated not to exceed 2.0 W/ft^2 overall. Although the lighting system almost exclusively used warm white fluorescent sources in the ceiling and cool white sources at the task, a

Table 1. Lighting Systems Studied

Building Number and Location	General lighting			Supplemental task		
	Mount	Lens	Source	Mount	Lens	Source
1. Tampa, Florida	DR DIP	LV LV	WW WW	FM	PL	CW
2. Richmond Virginia	DIP DR	LV LV	WW WW	- -	- -	- -
3. Cincinnati, Ohio	FM	-	WW	FI	PL	WW
4. Asheville, North Carolina	DP FS	- -	MH MH	- -	- -	- -
5. Washington, D.C.	DR	PL	CW	-	-	-
6. Appleton, Wisconsin	ID	-	W	-	-	-
7. Gaithersburg, Maryland	DS	LV	CW	-	-	-
8. New York, New York	DR	PL	WW	-	-	-
9. Ann Arbon, Michigan	DR	PL	CW	-	-	-
10. New York, New York	FM	-	WW	FI	PL	WW
11. Albany, New York	DR	PL	CW	-	-	-
12. New York, New York	DR	LV	WW	FI	PL	WW
13. Hopewell, New Jersey	DR	LV	CW	FI	PL	CW

Note: System code on following pages.

I. Mounting type

DR - Direct recessed ceiling system
DS - Direct surface mounted ceiling system
DP - Direct pendent mounted system
DIP- Direct/indirect pendent mounted system
DIW- Direct/indirect wall mounted wall wash system
ID - Indirect pendent mounted system
FI - Furniture integrated
FM - Indirect furniture mounted system
FS - Indirect free standing system
LS - Luminous ceiling
WM - Wall/partition mounted
CM - Ceiling mounted
O - Other

II. Lens/diffuser type

LV - Parabolic louver
EL - Egg crate louver
SD - CW (cross-wise) LW (length-wise) shielding
WL - Prismatic wraparound lens
PL - Flat prismatic lens
BL - Batwing louver
BD - Batwing diffuser
NC - No control
O - Other

III. Source type

CW - Cool white fluorescent
DCW- Deluxe cool white fluorescent
WW - Warm white fluorescent
DWW- Deluxe warm white fluorescent
DL - Daylight fluorescent
W - White fluorescent
MH - Metal halide
HPS- High pressure sodium
IN - Incandescent
MV - Mercury Vapor
CC - Cold-cathode
O - Other

variety of lighting fixtures and configurations were employed. The building had a mix of enclosed office and open office arrangements and used a professionally designed open office system equipped with sound masking and acoustically treated partial wall barriers. Many of the open offices had furniture mounted task luminaires. A few had free standing task luminaires. The ceiling was fitted with "1x4" fluorescent fixtures with open parabolic louvers and with periodic placement of pendent-mounted and wall-mounted direct/ indirect linear units. The ceiling fixtures were not uniformly distributed over the ceiling area but were concentrated where needed most. The wall mounted fixtures were used extensively to provide perimeter wall wash.

Building #2

The second building, located in a suburban area of Virginia, is a low-rise corporate headquarters with two floors on one side and three on the other side of a strong central spine running the full extent of the building.

Like the first building, it had a good mix of enclosed and open offices. It was also designed by a professional lighting design firm, and used a warm white ceiling system with periodic wall wash. Other than these similarities, however, the lighting system was quite different. Only a few task luminaires were used in this second building. As a result, the warm white ceiling system dominated the environment, particularly in the interior of the building where no supplemental daylight was provided. The majority of the ceiling system had recessed "1x4" fluorescent ceiling units with parabolic louvers evenly distributed in linear rows. The exceptions were bays where linear rows of

pendent mounted direct/indirect fixtures were used. The few cases that had task luminaires were either spaces with warm white fluorescent furniture units or drafting areas with additional swivel type drafting units.

Building #3

The third building was a corporate headquarters that occupied the first eleven floors of a high-rise office building in downtown Cincinnati. Like the two previous buildings, a professional lighting design firm was consulted in the design of the lighting system. Although this system also made use of warm white fluorescent sources, the system was virtually all furniture mounted, and thus, vastly different. The task/ambient system made extensive use of local furniture mounted units for both the task and the ambient light; consequently, the ceiling was virtually void of luminaires. An important attribute of this lighting system was the degree of individual control the occupants had over the amount of light in and around their space, since both the task and the ambient light was controlled at the work station. Lastly, in spaces where insufficient ambient light was provided by the furniture mounted units, free standing metal halide kiosks were added.

Building #4

Located near Asheville, North Carolina, the fourth building was constructed in 1979 and was to be an energy efficient building by using light sources that had a high luminous efficacy. The lighting system used pendent-mounted indirect units with single lamp metal halide sources. These units were suspended 18 inches from the ceiling and were installed throughout the building, with only two exceptions. In an open bay area

on the second floor the pendent mounted units were replaced with free standing indirect metal halide kiosks, and a series of pendent mounted indirect fluorescent units were used in the lobby. Most of the offices evaluated, however, had the pendent mounted metal halide units. These enclosed offices had either one or two units, depending on office size, and only rarely were any task lighting units found.

Building #5

The fifth building was a professional society headquarters located in downtown Washington, D.C. The sampled work stations were taken from three of the eight floors of the building. Only a few of the work stations were enclosed offices; instead, the bulk of the work stations were in an open plan office arrangement. The lighting system used recessed ceiling "2x4" 4-lamp units with cool white fluorescent sources and prismatic lenses. As a result of an earlier delamping scheme, a large fraction of the 4-lamp ceiling units had only two lamps in them. The fixtures were generally distributed uniformly across the ceiling, but were occasionally repositioned to provide additional light in certain areas. A variety of task lighting units, some brought in by the occupants, were used to provide supplemental light.

Building #6

The sixth building was a low-rise office complex located outside of Appleton, Wisconsin. The major feature of this large two-story office is the extensive use of daylighting from both side windows and overhead skylights. Due to time and cost restraints, only the second floor of the over 500,000 square foot office was evaluated. Although the daylight provided a dramatic qualitative element to the space, indirect

high-output white fluorescent units provide most of the work station illumination, with local free standing task units to augment the ambient light. The general lighting system employed linear high-output lamps mounted within the well of the skylight, providing supplemental light along the walls of the skylight. This overhead lighting system was controlled on an automated computer control system which could switch the system to a half-load condition during the summer months. This strategy, however, was not in effect during the evaluation period.

Building #7

This administration building is situated on a research campus in a suburban area outside of Washington, D.C. The thirteen-floor high-rise office building was built in the early 1960's and is a double-loaded corridor with the windows facing either north or south. Three of the thirteen floors (2nd, 3rd, and 8th) were sampled, and from these a sub-sample was drawn to obtain the work stations evaluated. Most of the work stations were in enclosed offices which had two occupants per office. With only a few exceptions the lighting system employed surface mounted "1x4" ceiling units with 2-lamp cool white fluorescent sources and egg-crate louvers with side elements of diffuse glass. The luminaires were arranged in banks of three units each running perpendicular to the windows. Few task lights were used in the building.

Building #8

The spaces evaluated in the eighth building were located on the thirtieth floor of a high-rise federal office building in lower Manhattan. Other than a few secretarial spaces, all the work stations were single enclosed offices with windows overlooking the city. The tenant had only

26 full-time employees; consequently, all work stations were included in the evaluation. The lighting system used recessed ceiling-mounted "2x4" units with prismatic lenses and either two or four warm white fluorescent lamps per unit. A few portable fluorescent desk units were found. Ohter than the fact that the warm white sources were used, the ceiling system was similar to the system in building #5.

Building #9

Located on the campus of the University of Michigan, this building houses both faculty and graduate students. The four-story office building is a double-loaded corridor with perimeter offices and interior offices that face onto an open court area. The sub-sample in this building was the upper two floors containing exclusively enclosed offices that, for the most part, were identical in size. The offices had two recessed ceiling-mounted "2x4" units per office. The fixtures were similar to those found in building #5 and used 2-lamp cool white fluorescent sources in the 4-lamp units. The lighting system in the individual offices was similar to that found in building #8.

Building #10

The offices evaluated in the tenth building are on the 5th, 6th, and 7th floors of a high-rise office building located in midtown Manhattan, New York City. The offices were exclusively open plan cubicles. A task/ambient lighting system, identical to that used in building #3, was installed using the same equipment and light sources. The furniture contained up-light units that washed the ceiling and down-light units that provided task light. The indirect units were 4-lamp fixtures with warm white fluorescent sources and prismatic lenses, and were mounted on

top of the furniture in an up position. The single-lamp task units used either cool white or warm white fluorescent lamps and were positioned directly over the desks. Although prismatic lenses were originally located in the task units, most of these lenses were no longer in place when the field evaluations took place. A few portable task units were also found.

Building #11

The offices evaluated in the eleventh building were located on seven floors of a mid-rise state government office building in Albany, New York. A linear ceiling system was utilized throughout the building with almost no task units used. The continuous 2-lamp fixtures, lamped with cool white fluorescent sources, were recessed into the ceiling and spaces five feet apart to provide even illumination. Because energy conservation was an issue, a delamping scheme similar to that used in buildings #5 and 9 was employed. The offices had approximately a 60/40 mix of enclosed offices to open pool spaces.

Building #12

The corporate offices evaluated in building #12 occupied the 29th floor of a high-rise office building in midtown Manhattan. All but one of the offices included in the evaluation were open plan. The furniture used was the same as that found in buildings #3 and 10, but without the indirect furniture mounted ceiling units. Instead, recessed 9 inch x 4 foot fluorescent units with low brightness parabolic louvers were evenly spaced throughout the space. With the exception of spacing, the ceiling system was similar to the recessed units in the second building. The ambient and the task sources were also similar: warm white sources for

the ambient system and cool white sources (with a few exceptions) for the tasks.

Building #13

The last building was located in Hopewell, New Jersey. It had a task/ambient lighting system similar to building #12, but with cool white fluorescent sources. The ceiling system had "2x4" parabolic units spaced uniformly over the ceiling grid. The open plan office furniture system, with furniture mounted task units, was similar to systems installed in buildings #3, 10, and 12.

4. OUTLINE OF STATISTICAL ANALYSIS PROCESS

4.1 SAMPLING PROCEDURE

Although data were collected from thirteen buildings, the bulk of the data, and consequently the thrust of the analysis, focuses on the work station as the unit of analysis. These work stations were randomly sampled from the population of work stations in each building, and represented work stations with occupants from all levels of management and age group, with the only stipulation being that the space is used as an office.

During preliminary visits to each of the thirteen buildings, similarities in work station layout and furnishings were noted. At the same time, differences were observed in the sizes, locations, and lighting characteristics of the work stations.

For the first three buildings, the decision was made to gather data from a representative sample of 150 work stations in each building in order to achieve variability in both work station characteristics and occupant responses. This number was based largely on the estimate of the number of work stations that could be observed and measured by the evaluation teams during the course of a week. The number was also influenced by the data analysis that was anticipated. In order to account for a nonresponse rate in these first buildings, the decision was made to distribute questionnaires to the occupants in 180 work stations in each building. In other words, a two-stage sampling procedure was employed. A total of 180 work stations were randomly sampled for identifying the work stations where questionnaires were distributed. A second random subsample from these 180 identified 150 work stations where measurements were made.

For the extended set of buildings, the sampling number was reduced to 80 work stations per building where questionnaires were distributed. A subsample of 50 work stations was obtained, where possible, from which both occupant and environmental data were collected. The smaller sample sizes allowed more buildings to be included in the study, thereby increasing the overall variability of lighting conditions studied.

To maintain sampling ratios consistent with the initial set of buildings, care was taken to sample from a proportionately smaller number of work stations. This meant that on occasion the sample of work stations was drawn from a group within the building and not the entire building.

Table 2 describes the number of work stations available for sampling, the number of occupant questionnaires collected, the number of direct environmental measures collected, and other sampling information for the thirteen buildings. Altogether, 1173 questionnaires were distributed of which 964 (82%) were returned. Direct environmental measurements were completed for 916 work stations.

4.2 ANALYSIS PLAN

The analysis plan consists of six basic parts:

- o describing how the various measures are distributed across the sample of work stations;
- o identifying key outcome measures to be examined (dependent variables);
- o identifying possible influencing conditions or predictors (independent variables);
- o developing combined measures for the dependent and independent variables (data reduction);
- o examining bivariate relationships between the independent and dependent variables; and
- o Completing multivariate analyses of selected dependent variables.

Table 2. Sampling distribution of study

	Building	Nws[a]	Nqd[b]	Nqr[c]	Ndm[d]	Sampling interval[e]
1.	Tampa, Florida	916	184	165	149	5.09
2.	Richmond, Virginia	715	180	66	149	3.97
3.	Cincinnati, Ohio	1217	180	166	149	6.76
4.	Asheville, North Carolina	88	84	78	51	1.04
5.	Washington, D.C.	124	48	44	46	2.58
6.	Appleton, Wisconsin	609	79	77	49	7.71
7.	Gaithersburg, Maryland	112	49	41	48	2.29
8.	New York, New York	27	27	26	26	1.00
9.	Ann Arbon, Michigan	242	50	42	50	4.84
10.	New York, New York	352	64	49	51	5.50
11.	Albany, New York	195	79	75	50	2.47
12.	New York, New York	79	79	65	49	1.00
13.	Hopewell, New Jersey	147	77	61	49	1.84
TOTALS		4823	1180	955	916	

[a]Nws = total number of work stations from which the sample was taken.
[b]Nqd = number of questionnaires distributed.
[c]Nqr = number of questionnaires returned.
[d]Ndm = number of work stations with direct measures.
[e]Sampling interval = NWs/Nqd

5. STRATEGY FOR REACHING PROJECT GOALS

A short description is provided below discussing each of the four goals of the project and how each is addressed. It is not the purpose of this report to present findings or conclusions; these will be reported separately in Volumes 2 and 3. The strategy for reaching these goals, however, is an important part of the methodology, and thus, has been included here.

5.1 ADDRESSING GOAL #1: PREPARATION OF A WORKING DATA FILE

Goal #1: To prepare a database of reference information of calculable, measurable, and subjective aspects of lighting in a statistically sampled number of work stations in a series of occupied office buildings.

Data will be compiled into a file that can be processed by statistical software packages. These data will be organized using the individual work station as the unit of analysis (Figure 1). Each of the measured data and occupant response data for the work station will be represented in individual fields within each record, where a record represents a single work station. Thus, one or more attribute of the work station can be compared against other attributes providing a relational data structure. A separate companion report will describe the database design in detail.

5.2 ADDRESSING GOAL #2: THE FEASIBILITY OF A LIGHTING QUALITY METRIC

Goal #2: To investigate the viability of a lighting quality metric using elements of the database.

Lighting quality will be evaluated in terms of occupant and expert ratings of overall lighting satisfaction, occupant ratings of lighting for performing work, occupant ratings of attractiveness of the visual

environment, and for the initial study, expert ratings of the appropriateness of the lighting system. These measures will be compared against a series of possible outcome measures in a univariate, bivariate and multivariate fashion.

5.3 ADDRESSING GOAL #3: COMPARISON OF POWER DENSITY TO OTHER MEASURES

Goal #3: To investigate relationships between unit power density and the measures of lighting contained within the database.

The relational capabilities of the database will be used to explore possible relationships between the lighting power density of a work station and other data collected for the same work station.

5.4 ADDRESSING GOAL #4: ESTABLISHMENT OF A DATABASE

Goal #4: To initiate the development of a database that can eventually be used by standards writing organizations in establishing lighting energy standards.

The database archiving plan is to make the database accessible in two forms. A 9-track ASCII magnetic tape of clean data and a dictionary to supplement the tape will be prepared for use by those wishing to load the data onto their own mainframe computer system. Those using the database in this form would have access to the data directly, but would need to have their own programming support for loading, accessing, and processing the data. The second form of the database will be a PC-based version of the data on diskettes for use under a commercially available database management system (DBMS). Here the data would be protected, meaning that the data can be accessed but not changed. Application software would be provided to access the data and to assist in using the database on the DBMS.

6. CONCLUSIONS AND FUTURE WORK

This research effort has been largely devoted to the development and pretesting of a procedure that can be used for evaluating quantitative and qualitative elements of occupied office lighting systems. The methodology provides a structure for exploring relationships between and among these elements. A detailed description of the database, the statistics and relationships discovered, and conclusions developed from this project will be reported in subsequent volumes of this report. A preliminary review of the data suggests that they are valid for meeting the goals of the study. The univariate distributions have verified a wide range in most of the quantitative and qualitative measures. There is a mix in the age group, sex, use of glasses and contacts, and management level of the occupants. There is also significant variation in most of the quantitative measures with the exception of luminance contrast and contrast rendition factor. It also is clear that the occupants were able to delineate their views about the lighting from their views concerning other factors in the environment.

Since the number and type of building office environments was very limited, it is strongly recommended that for future work, additional buildings and office lighting environments be incorporated into the database. Cost and time restraints required that few of the lighting systems in this study have major daylighting emphasis or control strategies that change with time. Future work is needed to evaluate systems that contain these features.

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APPENDIX A. SUMMARY OF COLLECTED DATA

The following is a summary description of the data collected for each of the work stations included in the study. The data have been organized into five basic groups: 1) subjective measures related to the visual environment, 2) photometric and other direct environmental measures, 3) lighting power density and other indirect measure, 4) descriptive characteristics of the occupants, and 5) other subjective measures not directly related to the visual environment, but measures that may influence it.

1. SUBJECTIVE MEASURES RELATED TO THE VISUAL ENVIRONMENT

The occupant and expert responses to questions related to the visual environment are itemized below. Although the occupants responded to many different types of questions, not just those related to lighting and the visual environment, only those with this particular thrust are included here. Occupant responses to many other non-lighting related questions can be found under item (E).

A. Impressions of Satisfaction

- Rating of overall satisfaction with the lighting at work space.
- Rating of how well building is lit overall.
- Rating of satisfaction with the lighting to perform different tasks.
- Rating of preference for improved light compared to other possible changes.
- Rating of preference for more daylight compared to other possible changes.
- Rating of location of ceiling lights in relation to work area.

- Rating of ability to adjust the direction of the light on work.
- Rating of overall satisfaction with office or work space.
- Rating of overall job satisfaction.

B. Impressions of Performance

- Rating of the amount of light for the work to be done.
- Rating of bothersomeness of reflected glare from work surface.
- Rating of bothersomeness of glare from ceiling lights.
- Rating of bothersomeness of glare from task lights.
- Rating of bothersomeness of glare from sunlight.
- Rating of bothersomeness of flicker off CRT screen.
- Rating of bothersomeness of glare from light above or behind CRT screen.

C. Impressions of Attractiveness

- Rating of the overall lighting attractiveness.
- Rating of the overall building attractiveness.
- Rating of the attractiveness of the main lobby.
- Rating of the "lighting quality" of the main lobby, cafeteria, conference room, corridors/hallways, and rest rooms.
- Rating of the visual environment (semantic scales).

- pleasantness	- space brightness
- spaciousness	- attractiveness
- relaxed atmosphere	- softness of light
- comfortable atmosphere	- interesting atmosphere

D. Impressions of Appropriateness of the Lighting Design

- Rating of the appropriateness of light for the primary task.
- Rating of the appropriateness of light for the secondary task.
- Rating of the position of light source relative to task.
- Rating of opportunity for visual relief.
- Rating of appropriateness of ambient light sources for overall work space.
- Rating of appropriateness of supplementary task light source.

2. PHOTOMETRIC & OTHER DIRECT ENVIRONMENTAL MEASURES

In addition to the subjective measures collected, direct environmental measures were also made at each work station. These measures include photometric, acoustic, and thermal measurements as well as photographs and other descriptive documentation of the space. A description of the measurements is given below:

A. Spatial Illuminances

- Illuminance at primary task surface without body shadow.
- Illuminance at primary task surface with body shadow.
- Illuminance at secondary task surface without body shadow.
- Illuminance at secondary task surface with body shadow.

(Note: Primary and secondary locations are determined by occupant using peel-off labels found on questionnaire.)

B. Spatial Luminances

- Luminance at task--luminance of standardized white paper.

  Located at primary task and viewed at eye level when seated.
- Luminance of surface immediately surrounding task.
- Luminance of ceiling between luminaires.
- Luminance of brightest light source in field of view.
- Luminance of brightest ceiling area in field of view.
- Luminance of darkest area in field of view.
- Luminance of wall at eye level looking straight ahead.
- Luminance of wall at eye level looking 90° to the right.
- Luminance of wall at eye level looking 90° to the left.
- Maximum luminances of sky or eternal building as seen from eye level when seated.

C. Contrast Characteristics of Space

- Luminance contrast at 25° viewing angle normal to edge of desk.
- Luminance contrast at 25° viewing angle at 45° left of normal.
- Luminance contrast at 25° viewing angle at 45° right of normal.
- Contrast rendition factor at 25° viewing angle normal to edge of desk.
- Contrast rendition factor at 25° viewing angle 45° left of normal.
- Contrast rendition factor at 25° viewing angle 45° right of normal.

D. Measures of Room Thermal and Acoustical Comfort

- Dry bulb temperature for each zonal area and each enclosed office.
- Wet bulb temperature for each zonal area and each enclosed office.
- Sound pressure dBA reading for each zonal area and each enclosed office.
- PNC reading for each zonal area and each enclosed office.
- Peak dB at peak Hz for each zonal area and each enclosed office.

E. Photographs

- 180° fish eye photograph of space as viewed from standing upright position looking into space.
- 180° fish eye photograph of space as viewed from horizontal at primary task location looking up.

F. Other Direct Environmental Data

- Outdoor sky conditions at the time photometric measurements were made.
- Type of window glazing and window treatment (if any).
- Height of space divider used in open office (if any).
- Predominant furnishing treatment used (wood, metal, fabric, etc.)
- Predominant wall treatment used (wood, metal, fabric, etc.)
- Type of office chair used (selected from a choice of seven options).
- Record of colors in work station - the three dominant colors were matched to standard color samples under the existing office lighting. These colors can be matched to their Munsell color notation.
- Type of supplemental task lamp, lens/control media, and luminaire.
- Type of light switch used (on/off, none, multiple level).

3. LIGHTING POWER DENSITY AND OTHER INDIRECT ENVIRONMENTAL MEASURES

The particular lighting power data and other indirect measures data are listed below. Both of these types of data are obtained indirectly; that is, they are acquired (at least in part) from the architectural drawings of the building. The lighting power density falls under this category because it is determined by computing the ratio of the connected power load to the work station floor area.

A. Lighting Power Data

- Connected lamp and ballast power load (watts) of localized task lighting.
- Connected lamp and ballast power load (watts) of ambient system in surrounding zone.
- Lighting power density (watts/sq. ft.) of local task lighting.
- Lighting power density (watts/sq. ft.) of ambient surrounding zone.
- Total lighting power density (watts/sq. ft.).

B. Other Indirect Environmental Data

- Area of work station (square feet).
- Area of zone or bay that work station is in (square feet).
- Shortest walking distance from work station to elevator/stairs.
- Straight line distance from work station to nearest window.
- Straight line distance from work station to nearest atrium.

4. DESCRIPTIVE CHARACTERISTICS OF THE OCCUPANT

These additional data were collected on the work station occupants.

- Age of occupant.
- Sex of occupant.
- Whether occupant wore glasses, contacts, or bifocals.
- Whether occupant smoked or worked near someone who did.
- Whether occupant was left or right handed.
- Professional level of occupant.
- How long occupant worked in present building.
- How many hours per day occupant was at building.
- How many days per week was occupant at building.
- How many hours per day was occupant at work space.
- How long has occupant been at present work station.
- Type of office environment occupant was in before moving to present work station.

5. OTHER SUBJECTIVE MEASURES NOT DIRECTLY RELATED TO THE VISUAL ENVIRONMENT

- Rating of convenience in getting to and from work.
- Rating of bothersomeness of various surrounding noises.
- Rating of comfort with heating, ventilation, and cooling system.
- Rating of frequency of health factors such as headaches, dizziness, sleepiness, sore throat, eye irritation, and trouble focusing eyes.
- Rating of the amount of space available to do work.
- Rating of amount of speech privacy.
- Rating of comfort of chair.
- Rating of the amount of surface area available to do work.

(There are several other ratings that are not mentioned here.)

APPENDIX B: QUESTIONNAIRE AND EVALUATION FORMS

1. LETTER TO OCCUPANT
2. OCCUPANT QUESTIONNAIRE
3. EXPERT EVALUATION FORMS
4. PHOTOMETRIC AND OTHER DIRECT ENVIRONMENTAL EVALUATION FORM
5. INDIRECT ENVIRONMENTAL MEASURES FORM
6. LIGHTING SPECIFICATION FORM

Letter to Occupant

THE AMERICAN INSTITUTE OF ARCHITECTS FOUNDATION
1735 NEW YORK AVENUE, NORTHWEST, WASHINGTON, D.C. 20006

Dear Office Occupant:

The American Institute of Architects Foundation, together with the University of Michigan, is in the process of conducting an evaluation of the _____ offices and other office spaces throughout the United States. This project, sponsored by the U.S. Department of Energy and supported by your management, is designed to learn about building energy use and how employees use and feel about their workplace. The information from the evaluation will be helpful to the Department of Energy and, more generally, to architects and space planners who design and plan office buildings elsewhere.

As a part of our work, we would like you to complete a brief questionnaire which will be distributed to you on _____ and collected later that afternoon. Please fill out the questionnaire as carefully as you can, but if there is any question you are unable to answer or don't want to answer, just skip it and go on to the next one. Your responses to the questions will remain anonymous. That is, no one will see your answers except the research team and the results will be tabulated in statistical form representing everyone who works in your office.

During the week after the questionnaires are distributed and completed, a technical team will visit a sample of 50 work stations to measure a few environmental conditions (lighting levels, noise levels, temperature). We estimate that their visit will take no more than 15 minutes. You do not have to be present while the measurements are being made.

We think you will find this study interesting and informative and we appreciate your willingness to cooperate. The overall results will be made available to you through your management. Should you have any questions, please contact or

Very Truly Yours,

Gary Gillette, Project Manager
American Institute of Architects
Research Foundation

Robert W. Marans, Consultant
Institute for Social Research
University of Michigan

Occupant Questionnaire

College of Architecture
and Urban Planning

The University of Michigan
2000 Bonisteel Boulevard
Ann Arbor Michigan 48109
313 764 1340

Space ID

APRL
Architecture and Planning
Research Laboratory

May 2, 1986

Dear Workstation Occupant:

Please fill out this questionnaire as completely as possible. If there is any question you are unable to answer or don't want to answer, just skip it and go on to the next one. All information will be treated as confidential.

Thank you for your cooperation.

1. How long have you worked in the building where you now are employed?

- ☐ LESS THAN 3 MONTHS
- ☐ 3-6 MONTHS
- ☐ MORE THAN 6 MONTHS, LESS THAN 1 YEAR
- ☐ 1-2 YEARS
- ☐ MORE THAN 2 YEARS

2. How do you usually get to and from work? (CHOOSE ONE)

- ☐ OWN CAR
- ☐ SHARE RIDE OR CAR POOL
- ☐ BUS OR OTHER PUBLIC TRANSIT
- ☐ WALK
- ☐ OTHER (SPECIFY) _____

3. Travel to and from this building from my home is:

- ☐ VERY CONVENIENT
- ☐ FAIRLY CONVENIENT
- ☐ NOT VERY CONVENIENT
- ☐ NOT AT ALL CONVENIENT

4. Here are some words used to describe office buildings. Please rate each of the following by placing an X in the box that best describes your feelings about the building you work in. For example, if you think the building is "attractive" put an X next to the word "attractive," if you think the building is "unattractive" put an X next to the word "unattractive," and if you think it is somewhere in between, please put an X where you think it belongs.

ATTRACTIVE	☐	☐	☐	☐	☐	☐	☐	UNATTRACTIVE
GOOD EXTERIOR DESIGN	☐	☐	☐	☐	☐	☐	☐	POOR EXTERIOR DESIGN
WELL MAINTAINED INTERIORS	☐	☐	☐	☐	☐	☐	☐	POORLY MAINTAINED INTERIORS
ATTRACTIVE LIGHTING	☐	☐	☐	☐	☐	☐	☐	UNATTRACTIVE LIGHTING
POORLY DESIGNED INTERIORS	☐	☐	☐	☐	☐	☐	☐	WELL DESIGNED INTERIORS
UNPLEASANT	☐	☐	☐	☐	☐	☐	☐	PLEASANT
POOR SECURITY	☐	☐	☐	☐	☐	☐	☐	GOOD SECURITY
STIMULATING SPACES	☐	☐	☐	☐	☐	☐	☐	UNSTIMULATING SPACES
DIFFICULT TO FIND WAY AROUND	☐	☐	☐	☐	☐	☐	☐	EASY TO FIND WAY AROUND
WELL LIT SPACES	☐	☐	☐	☐	☐	☐	☐	POORLY LIT SPACES
GOOD OVERALL DESIGN	☐	☐	☐	☐	☐	☐	☐	POOR OVERALL DESIGN

If you have specific comments concerning any of the above items, please write them below.

5. For each of the following building spaces, please rate the quality of lighting.

	(1) EXCELLENT	(2) PRETTY GOOD	(3) NEUTRAL	(4) NOT VERY GOOD	(5) POOR	(0) NOT APPLICABLE
MAIN LOBBY						
CAFETERIA/COFFEE SHOP						
CONFERENCE ROOM YOU MOST OFTEN USE						
CORRIDORS AND HALLWAYS						
RESTROOMS						

These questions are about the interior spaces used by your organization. Please rate each of the following:

6. The way offices and other work spaces are arranged in terms of making it easier for employees to get their jobs done well is:

- ☐ EXCELLENT
- ☐ PRETTY GOOD
- ☐ FAIR
- ☐ POOR

7. The way the offices and other work spaces look is:

- ☐ EXCELLENT
- ☐ PRETTY GOOD
- ☐ FAIR
- ☐ POOR

8. How many days each week are you usually at your building?

2 DAYS OR LESS	3-4 DAYS	5 DAYS	MORE THAN 5 DAYS
☐	☐	☐	☐

9. On the average, how many hours a day are you in the building?

1-2 HOURS	3-4 HOURS	5-6 HOURS	7-8 HOURS	MORE THAN 8 HOURS
☐	☐	☐	☐	☐

The following set of questions is about the office or work space where you are now sitting.

10. Approximately how much of your time at the building is spent at your office or work space?

1-2 HOURS	3-4 HOURS	5-6 HOURS	7-8 HOURS	MORE THAN 8 HOURS
☐	☐	☐	☐	☐

11. How long have you occupied the office or work space where you are now sitting?

LESS THAN 3 MONTHS	3 MONTHS TO 1 YEAR	1-2 YEARS	MORE THAN 2 YEARS
☐	☐	☐	☐

13. Before you moved into your present office or work space, did you work in:

- ☐ A PRIVATE, CONVENTIONAL OFFICE
- ☐ A CONVENTIONAL OFFICE SHARED WITH ANOTHER PERSON
- ☐ AN OPEN OFFICE OR CUBICLE WITH PANELS (PARTITIONS)
- ☐ AN OPEN OFFICE WITHOUT PANELS
- ☐ OTHER (SPECIFY) _____

5

13. Which of the following tasks best describes the work you normally do. (CHECK ONLY ONE)

- [ ] READING AND WRITING
- [ ] TYPING
- [ ] USING A WORDPROCESSOR OR COMPUTER TERMINAL
- [ ] DRAFTING OR DRAWING
- [ ] FILING
- [ ] ATTENDING MEETINGS
- [ ] TALKING ON TELEPHONE

14. Here are some specific tasks that people do at work that could be affected by lighting. On a typical day, about how many hours do you spend on each task:

	(1) NOT USUALLY PART OF JOB	(2) LESS THAN 2 HOURS	(3) 2-4 HOURS	(4) MORE THAN 4 LESS THAN 6	(5) 6 HOURS OR MORE
READING					
WRITING (BY HAND)					
USING A TYPEWRITER					
USING A WORD PROCESSOR OR COMPUTER TERMINAL					
DRAFTING/DRAWING					
FILING					

6

15. For each task performed, please rate the lighting available to you:

	(1) EXCELLENT	(2) PRETTY GOOD	(3) NEUTRAL	(4) NOT VERY GOOD	(5) POOR	(0) NOT APPLICABLE
READING						
WRITING (BY HAND)						
USING A TYPEWRITER						
USING A WORD PROCESSOR OR COMPUTER TERMINAL						
DRAFTING/DRAWING						
FILING						

16. How would you describe the amount of light available to you now?

- [ ] MUCH TOO BRIGHT
- [ ] A BIT TOO BRIGHT
- [ ] JUST ABOUT RIGHT
- [ ] A BIT TOO DIM
- [ ] MUCH TOO DIM

17. Overall, how satisfied are you with the lighting at your office or work space?

- [ ] VERY SATISFIED
- [ ] FAIRLY SATISFIED
- [ ] NEITHER SATISFIED NOR DISSATISFIED
- [ ] NOT VERY SATISFIED
- [ ] NOT AT ALL SATISFIED

18. If you work on a word processor/computer terminal (CRT), indicate how bothersome each of the following conditions is for you. If you don't use a word processor/CRT at your work station, skip to question 21.

	(1) NOT AT ALL BOTHERSOME	(2) NOT VERY BOTHERSOME	(3) FAIRLY BOTHERSOME	(4) VERY BOTHERSOME
FLICKERING OF THE SCREEN				
DISTANCE TO THE SCREEN				
ANGLE OF THE SCREEN				
GLARE FROM LIGHT ABOVE OR BEHIND SCREEN				
SIZE OF LETTERING				
DISTANCE TO KEYBOARD				
ANGLE OF KEYBOARD				
HEIGHT OF DESK				
SEATING				
BRIGHTNESS ON SCREEN				

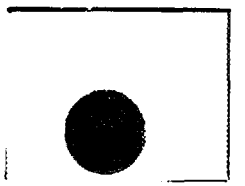
19. Is the word processor/CRT you usually use located in <u>your</u> office or work space?

YES ☐ NO ☐

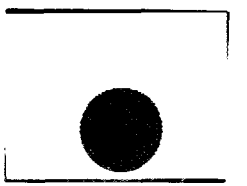
20. Are the keyboard and screen separate units on the word processor/CRT?

YES ☐ NO ☐

21. Next week, technicians will visit your work space in order to make some environmental measurements. In order to help them identify the precise places you work, place the sticker with the RED dot on the work surface you use <u>most</u> of the time. If you use the desk, table, or other flat surface most often, place the sticker on the corner so that it can easily be seen. If you use your typewriter or word processor/CRT most often, place the sticker on the side of it. If you use more than one work surface within your office or work space, use the sticker with the BLUE dot to identify the second most used location.



USE THIS STICKER TO IDENTIFY YOUR PRIMARY WORK PLACE



USE THIS STICKER TO IDENTIFY YOUR SECONDARY WORK PLACE (IF YOU HAVE ONE)

21a. Do you have another office or workstation in the building besides the one where you are now sitting?

YES ☐ NO ☐

21b. Do you share your workstation/desk with someone else?

YES ☐ NO ☐

9

22. Sometimes the arrangements of offices and work stations can be distracting to people in office buildings. Please indicate how bothersome each of the following is to you:

	(1) NOT AT ALL BOTHERSOME	(2) NOT VERY BOTHERSOME	(3) FAIRLY BOTHERSOME	(4) VERY BOTHERSOME
RINGING TELEPHONES				
CONVERSATIONS OF CO-WORKERS				
NOISE FROM PRINTERS COMPUTER TERMINALS				
NOISE FROM OTHER EQUIPMENT (TYPEWRITERS, ETC.)				
NOISE FROM VENTILATING SYSTEM				
NOISES FROM CORRIDORS				
REFLECTED GLARE FROM WORK SURFACES				
GLARE FROM CEILING LIGHTS				
GLARE FROM TASK LIGHTS/LAMPS				
GLARE FROM SUNLIGHT				
BRIGHT LIGHTS				
TOO HOT IN SUMMER				
TOO COLD IN SUMMER				
TOO HOT IN WINTER				
TOO COLD IN WINTER				
DRAFTS				
STUFFY AIR				

10

	(1) NOT AT ALL BOTHERSOME	(2) NOT VERY BOTHERSOME	(3) FAIRLY BOTHERSOME	(4) VERY BOTHERSOME
HEAT FROM SUNLIGHT				
HEAT FROM CEILING LIGHTS				
HEAT FROM TASK LIGHTS/LAMPS				
FREQUENT REARRANGING OF FURNITURE				
PEOPLE WALKING AROUND				
OTHER (SPECIFY) _____ _____				

23. How often have you experienced any of the following symptoms which you think are caused by working in this building?

	(1) NEVER	(2) RARELY	(3) SOMETIMES	(4) ALWAYS
HEADACHE				
DIZZINESS				
SLEEPINESS				
SORE OR IRRITATED THROAT				
NOSE IRRITATION (ITCH OR RUNNING)				
EYE IRRITATION				
TROUBLE FOCUSING EYES				
DIFFICULTY CONCENTRATING				
SKIN DRYNESS, RASH OR ITCHING				
FATIGUE				

24. How many days(times) have you been absent from work due to illness during the last six months?

- ☐ NONE
- ☐ 1-2 TIMES
- ☐ 3-5 TIMES
- ☐ 6-12 TIMES
- ☐ MORE THAN 12 TIMES

25. Here are some words to describe offices and work spaces. Indicate how you feel about your particular office or work space by marking an "X" in the appropriate box for each pair of words.

PLEASANT	☐	☐	☐	☐	☐	☐	☐	UNPLEASANT
BRIGHT	☐	☐	☐	☐	☐	☐	☐	DIM
SPACIOUS	☐	☐	☐	☐	☐	☐	☐	CONFINED
UNATTRACTIVE	☐	☐	☐	☐	☐	☐	☐	ATTRACTIVE
RELAXED ATMOSPHERE	☐	☐	☐	☐	☐	☐	☐	TENSE ATMOSPHERE
SOFT LIGHTING	☐	☐	☐	☐	☐	☐	☐	HARSH LIGHTING
UNCOMFORTABLE	☐	☐	☐	☐	☐	☐	☐	COMFORTABLE
INTERESTING	☐	☐	☐	☐	☐	☐	☐	UNINTERESTING
NOISY	☐	☐	☐	☐	☐	☐	☐	QUIET
ATTRACTIVE VIEW	☐	☐	☐	☐	☐	☐	☐	UNATTRACTIVE VIEW

26. Suppose you could make 4 improvements to your work station. Using the list below, check the 4 changes you would like to make.

- ☐ A. A BETTER VIEW OUTSIDE
- ☐ B. A BETTER OFFICE TEMPERATURE
- ☐ C. MORE PRIVACY
- ☐ D. A CHANGE IN COLOR OF WALLS, FURNISHINGS OR CARPETING
- ☐ E. IMPROVED LIGHTING
- ☐ F. LESS NOISE
- ☐ G. IMPROVED AIR CIRCULATION
- ☐ H. A MOVE CLOSER TO PEOPLE
- ☐ I. MORE DAYLIGHT
- ☐ J. MORE COMFORTABLE FURNISHINGS

27. Of the four changes you selected, which one would you most prefer?

_____

_____

28. Why did you make this choice? _____

_____

_____

29. Here are some other characteristics of work stations in office buildings. Please rate your work place on each of the following:

	(1) EXCELLENT	(2) GOOD	(3) FAIR	(4) POOR
AMOUNT OF SPACE AVAILABLE TO YOU				
MATERIALS USED FOR DESKS TABLES AND CHAIRS				
AMOUNT OF LIGHTING FOR WORK YOU DO				
LOCATION OF CEILING LIGHTS IN RELATION TO WORK AREA				
COLOR OF WALLS AND PARTITIONS				
AMOUNT OF SPACE FOR STORING THINGS				
CONVERSATIONAL PRIVACY (HEARING OTHERS AND BEING HEARD)				
YOUR VIEW OUTSIDE				
ACCESS TO OTHER PEOPLE YOU HAVE TO WORK WITH				
WALL AREA FOR HANGING THINGS (E.G. PICTURES, POSTERS)				
STYLE OF YOUR FURNITURE				
ABILITY TO ADJUST THE AMOUNT OF LIGHT ON YOUR WORK				
VISUAL PRIVACY				
AMOUNT OF SURFACE AREA FOR WORK				
COMFORT OF YOUR CHAIR				
VENTILATION AND AIR CIRCULATION				
HEATING				

	(1) EXCELLENT	(2) GOOD	(3) FAIR	(4) POOR
COOLING				
AIR QUALITY				
ABILITY TO ADJUST THE DIRECTION OF LIGHT ON YOUR WORK				

30. Can you see a window from where you normally work?

YES ☐ NO ☐ → SKIP TO QUESTION 33

31. Can you change the amount of direct sunlight on your work by controlling the drapes or blinds on the windows?

YES ☐ NO ☐

32. Can you change the amount of daylight on your work by controlling the drapes or blinds on the windows?

YES ☐ NO ☐

33. Can you control the temperature at your work space?

YES ☐ NO ☐

34. Can you control the ventilation at your work space?

YES ☐ NO ☐

35. Do you have a task light or lamp at your desk or workspace?

YES ☐ NO ☐

36. Can you turn your lights on and off?

YES ☐ NO ☐ → SKIP TO QUESTION 38

37. Once you turn your lights on, can you control the amount of light on your work surface?

YES ☐ NO ☐

38. Can you control the direction of light on your work surface?

YES ☐ NO ☐

39. Overall, how satisfied are you with your office or work space?

- [ ] VERY SATISFIED
- [ ] FAIRLY SATISFIED
- [ ] NEITHER SATISFIED NOR DISSATISFIED
- [ ] NOT VERY SATISFIED
- [ ] NOT AT ALL SATISFIED

40. These statements are about peoples' jobs. For each one, please indicate how true it is in your job.

	(1) VERY TRUE	(2) SOMEWHAT TRUE	(3) NOT VERY TRUE	(4) NOT AT ALL TRUE
THE WORK IS INTERESTING				
WHENEVER I TALK TO CO-WORKERS, OTHERS CAN HEAR OUR CONVERSATIONS				
MY JOB IS SATISFYING				
MY WORK IS VERY ACCURATE				
I HAVE ACCESS TO THE EQUIPMENT AND MATERIAL I NEED TO GET THE JOB DONE WELL				
MY EYES GET TIRED WHEN I READ FOR MORE THAN ONE HOUR				
MY JOB REQUIRES ME TO REMAIN IN ONE PLACE ALL DAY				
MY JOB REQUIRES A GREAT DEAL OF CONCENTRATION				
I HAVE ENOUGH TIME TO GET MY WORK DONE				
LIGHTING AT MY DESK HINDERS ME FROM DOING MY JOB WELL				
I HAVE THE OPPORTUNITY TO DEVELOP MY OWN SPECIAL ABILITIES				

	(1) VERY TRUE	(2) SOMEWHAT TRUE	(3) NOT VERY TRUE	(4) NOT AT ALL TRUE
MY JOB REQUIRES ME TO WORK VERY FAST				
OTHERS AROUND ME DO AS MUCH WORK AS THEY REASONABLY CAN				
I AM SATISFIED WITH THE QUALITY OF MY WORK				
I HAVE NO PROBLEM WITH MEETING DEADLINES				
PEOPLE I WORK WITH ARE COMPETENT IN DOING THEIR JOBS				

41. Which *of* the following *best* describes your job?

- [ ] MANAGER-ADMINISTRATOR-SUPERVISOR
- [ ] PROFESSIONAL
- [ ] TECHNICIAN
- [ ] SECRETARIAL-CLERICAL
- [ ] PROGRAMMER
- [ ] OTHER (SPECIFY) _____

42. Are you:

- [ ] RIGHT-HANDED
- [ ] LEFT-HANDED

43. Do you wear glasses?

YES ☐ NO ☐

44. Do you wear contact lenses?

YES ☐ NO ☐

45. Do you wear bifocals?

YES ☐ NO ☐

46. Are you:

FEMALE ☐ MALE ☐

47. How old are you?

☐ UNDER 25 ☐ 25-34 ☐ 35-44 ☐ 45-54

☐ 55-64 ☐ 65-74 ☐ 75 OR OVER

48. Today is:

☐ MONDAY ☐ TUESDAY ☐ WEDNESDAY ☐ THURSDAY

☐ FRIDAY ☐ SATURDAY ☐ SUNDAY

49. The sky is now:

☐ SUNNY-CLEAR

☐ SUNNY-PARTLY CLOUDY

☐ HAZY

☐ COMPLETELY OVERCAST

☐ NOT OBSERVABLE

This completes the questionnaire. Thank you for taking the time to complete it. If you have any additional comments about the building and in particular the lighting, feel free to write them down on this page.

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Expert Assessment Form - Work Station

Time is: _____ Date is: _____ Space I.D. _____

Day is: M Tu W Th F Bldg. No: 001

Recorder: _____

1. Daylighting affects the visual environment of the work station:

2 YES 1 NO → SKIP TO NEXT PAGE, ITEM 2

1a. Can you see outdoors while in a sitting position?

1 YES 2 NO

1b. Can you see the sky while in a sitting position?

1 YES 2 NO

1c. Can you see outdoors while standing?

1 YES 2 NO

1d. Can you see the sky while standing?

1 YES 2 NO

1e. Outdoor condition presently is:

1 SUNNY-CLEAR SKY 4 COMPLETELY OVERCAST

2 SUNNY-PARTLY CLOUDY 5 NOT DISCERNABLE

3 HAZY

2. Workstation appears to be:

1 ASSIGNED 2 UNASSIGNED

3. Number of work surface(s) or place(s) at the work station where tasks occur:

1 2 3 OR MORE

3a. Is(Are) the dot(s) visible?

1 YES

2 NO → PLACE A STICKER WITH A RED DOT ON THE WORK SURFACE WHICH APPEARS TO BE USED MOST OFTEN. IF THERE IS A SECOND WORK SURFACE AT THE WORK STATION, PLACE A BLUE DOT ON IT.

IF NO SECONDARY WORK SURFACE, SKIP TO ITEM 6

4. Primary work surface appears to be used for: (CHOOSE ONLY ONE)

1 READING AND WRITING

2 USING A TYPEWRITER

3 USING A WORD PROCESSOR OR CRT

4 DRAFTING

5 OTHER (SPECIFY)_____

6 UNABLE TO DETERMINE

5. Secondary work surface appears to be used for: (CHOOSE ONLY ONE)

1 READING AND WRITING

2 USING A TYPEWRITER

3 USING A WORD PROCESSOR OR CRT

4 DRAFTING

5 OTHER (SPECIFY)_____

6 UNABLE TO DETERMINE

A. RATINGS OF LIGHTING AT TASK LOCATIONS

Lighting at Primary Work Surface
(IF LOCATION IS AT CRT, TURN IT ON)

6. Brightness on task at primary work surface:

1 MUCH TOO BRIGHT	2 SOMEWHAT TOO BRIGHT	3 JUST ABOUT RIGHT	4 SOMEWHAT TOO DIM	5 FAR TOO DIM

7. Amount of discomfort glare due to electric lights reflecting off task:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

8. Amount of disability glare from electric lights:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

9. Amount of discomfort glare due to daylight reflecting off task:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

10. Amount of disability glare from daylight:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

11. Task contrast:

5 EXCELLENT	4 GOOD	3 FAIR	2 POOR	1 BAD

12. Appropriateness of light for the task:

5 VERY APPROPRIATE	4 SOMEWHAT APPROPRIATE	3 NEITHER APPROP. NOR INAPPROP.	2 SOMEWHAT INAPP.	1 VERY INAPP.

13. Position of source relative to task:

5 EXCELLENT	4 GOOD	3 FAIR	2 POOR	1 BAD

14. Opportunity for visual relief:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

15. Opportunity to control amount of light on task:

1 YES	2 NO

16. Opportunity to control direction of light on task:

1 YES	2 NO

17. Direction of light makes task:

1 VERY EASY	2 FAIRLY EASY	3 FAIRLY DIFFICULT	4 VERY DIFFICULT

WORK STATION HAS ONLY ONE TASK LOCATION

1 YES ----> SKIP TO PAGE 7, ITEM 30

2 NO

Lighting at Secondary Work Surface
(IF LOCATION IS AT CRT, TURN IT ON)

18. Brightness on task at secondary work surface:

1 MUCH TOO BRIGHT | 2 SOMEWHAT TOO BRIGHT | 3 JUST ABOUT RIGHT | 4 SOMEWHAT TOO DIM | 5 MUCH TOO DIM

19. Amount of discomfort glare due to electric lights reflecting off task:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

20. Amount of disability glare from electric lights:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

21. Amount of discomfort glare due to daylight reflecting off task:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

22. Amount of disability glare from daylight:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

23. Task contrast:

5 EXCELLENT | 4 GOOD | 3 FAIR | 2 POOR | 1 BAD

24. Appropriateness of light for the task:

5 VERY APPROPRIATE | 4 SOMEWHAT APPROPRIATE | 3 NEITHER APPROP. NOR INAPPROP. | 2 SOMEWHAT INAPP. | 1 VERY INAPP.

25. Position of source relative to task:

5 EXCELLENT | 4 GOOD | 3 FAIR | 2 POOR | 1 BAD

26. Opportunity for visual relief:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

27. Opportunity to control amount of light on task:

1 YES | 2 NO

28. Opportunity to control direction of light on task:

1 YES | 2 NO

29. Direction of light makes task:

1 VERY EASY | 2 FAIRLY EASY | 3 FAIRLY DIFFICULT | 4 VERY DIFFICULT

7

B. IMPRESSIONS OF VISUAL ENVIRONMENT

30. CHEERFUL	7	6	5	4	3	2	1	SOMBER
31. CLEAR	7	6	5	4	3	2	1	HAZY
32. COMFORTABLE	7	6	5	4	3	2	1	UNCOMFORTABLE
33. INTERESTING	7	6	5	4	3	2	1	UNINTERESTING
34. ATTRACTIVE	7	6	5	4	3	2	1	UNATTRACTIVE
35. STIMULATING	7	6	5	4	3	2	1	UNSTIMULATING
36. PLEASANT	7	6	5	4	3	2	1	UNPLEASANT
37. BRIGHT	7	6	5	4	3	2	1	DIM
38. SPACIOUS	7	6	5	4	3	2	1	CONFINED
39. WARM/INTIMATE	7	6	5	4	3	2	1	COLD/NON-INTIMATE
40. RELAXED ATMOS.	7	6	5	4	3	2	1	TENSE ATMOS.

If you can not see outdoors, skip to item 43.

41. ATTRACTIVE VIEW	7	6	5	4	3	2	1	UNATTRACTIVE VIEW
42. INTERESTING VIEW	7	6	5	4	3	2	1	UNINTERESTING VIEW

8

C. RATINGS OF ELECTRIC LIGHT SOURCE(S)

43. Cleanliness of luminaires:

4 VERY CLEAN | 3 FAIRLY CLEAN | 2 FAIRLY DIRTY | 1 VERY DIRTY

44. Brightness of ambient source:

1 MUCH TOO BRIGHT | 2 SOMEWHAT TOO BRIGHT | 3 JUST ABOUT RIGHT | 4 SOMEWHAT TOO DIM | 5 MUCH TOO DIM

45. Brightness of supplementary task source:

1 MUCH TOO BRIGHT | 2 SOMEWHAT TOO BRIGHT | 3 JUST ABOUT RIGHT | 4 SOMEWHAT TOO DIM | 5 MUCH TOO DIM | 8 N/A

46. Color of ambient light source:

1 WARM | 2 NEUTRAL | 3 COOL

47. Appropriateness of ambience source(s) for overall workspace:

5 VERY APPROPRIATE | 4 SOMEWHAT APPROPRIATE | 3 NEITHER APPROP. NOR INAPPROP. | 2 SOMEWHAT INAPP. | 1 VERY INAPP.

48. Appropriateness of supplementary task source:

5 VERY APPROPRIATE | 4 SOMEWHAT APPROPRIATE | 3 NEITHER APPROP. NOR INAPPROP. | 2 SOMEWHAT INAPP. | 1 VERY INAPP. | 8 N/A

49. Total number of luminaires at work station:

1 MORE THAN ENOUGH | 2 JUST ABOUT RIGHT NUMBER | 3 NOT ENOUGH

50. Sounds from luminares:

1 VERY NOTICABLE | 2 SOMEWHAT NOTICABLE | 3 QUIET

D. RATINGS OF WORK STATION ATTRIBUTES

51. Visual privacy:

4 VERY PRIVATE	3 FAIRLY PRIVATE	2 NOT VERY PRIVATE	1 NOT AT ALL PRIVATE

52. Speech privacy:

4 VERY PRIVATE	3 FAIRLY PRIVATE	2 NOT VERY PRIVATE	1 NOT AT ALL PRIVATE

53. Ringing telephones:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

54. Conversations among co-workers:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

55. Sounds from office equipment (typewriters, copy machines, CRTs, printers, etc.):

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

56. Overall noise level at work station:

5 VERY NOISY	4 FAIRLY NOISY	3 NEITHER NOISY NOR QUIET	2 FAIRLY QUIET	1 VERY QUIET

57. Orderliness/tidyness:

1 VERY NEAT	2 FAIRLY NEAT	3 MIXED, SO-SO	4 FAIRLY MESSY	5 VERY MESSY

58. Maintenance:

5 VERY WELL MAINTAINED	4 FAIRLY WELL MAINTAINED	3 MIXED, SO-SO	2 NOT WELL MAINTAINED	1 NOT AT ALL MAINTAINED

59. Amount of space:

4 VERY SPACIOUS	3 FAIRLY SPACIOUS	2 NOT VERY SPACIOUS	1 NOT AT ALL SPACIOUS

60. Amount of personalization:

4 A LOT	3 SOME	2 VERY LITTLE	1 NONE

61. Thermal comfort:

5 VERY WARM	4 SOMEWHAT WARM	3 JUST ABOUT RIGHT	2 SOMEWHAT COOL	1 VERY COOL

62. Attractiveness of colors:

5 VERY ATTRACTIVE	4 FAIRLY ATTRACTIVE	3 NEITHER ATTR. NOR UNATTRACTIVE	2 FAIRLY UNATTRACT.	1 VERY UNATTRACT.

63. Color harmony:

5 EXCELLENT COLOR MIX	4 GOOD COLOR MIX	3 NEUTRAL	2 POOR COLOR MIX	1 BAD COLOR MIX

64. Ability to discriminate among colors <u>within work station</u>:

4 VERY DIFFICULT	3 FAIRLY DIFFICULT	2 FAIRLY EASY	1 VERY EASY

65. Ability to discriminate among colors <u>outside work station</u>:

4 VERY DIFFICULT	3 FAIRLY DIFFICULT	2 FAIRLY EASY	1 VERY EASY

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Expert Assessment Form - Ancillary Space

Time is: _____ Date is: _____ Space I.D. _____

Day is: M Tu W Th F Bldg. No: 001

Type of space: _____ Recorder: _____

1. Daylighting affects the visual environment of the space:

2 YES 1 NO ——→ SKIP TO NEXT PAGE, ITEM 2

1a. Can you see outdoors while in a sitting position?

1 YES 2 NO

1b. Can you see the sky while in a sitting position?

1 YES 2 NO

1c. Can you see outdoors while standing?

1 YES 2 NO

1d. Can you see the sky while standing?

1 YES 2 NO

1e. Outdoor condition presently is:

1 SUNNY-CLEAR SKY 4 COMPLETELY OVERCAST

2 SUNNY-PARTLY CLOUDY 5 NOT DISCERNABLE

3 HAZY

2

2. Space appears to be used primarily for: _____

3. Other activities which appear to take place in the space include:

In the space below, sketch out a plan of the space indicating all light sources including windows and skylights. Note other important space attributes.

A. IMPRESSIONS OF VISUAL ENVIRONMENT

4. CHEERFUL	7	6	5	4	3	2	1	SOMBER
5. CLEAR	7	6	5	4	3	2	1	HAZY
6. COMFORTABLE	7	6	5	4	3	2	1	UNCOMFORTABLE
7. INTERESTING	7	6	5	4	3	2	1	UNINTERESTING
8. ATTRACTIVE	7	6	5	4	3	2	1	UNATTRACTIVE
9. STIMULATING	7	6	5	4	3	2	1	UNSTIMULATING
10. PLEASANT	7	6	5	4	3	2	1	UNPLEASANT
11. BRIGHT	7	6	5	4	3	2	1	DIM
12. SPACIOUS	7	6	5	4	3	2	1	CONFINED
13. WARM/INTIMATE	7	6	5	4	3	2	1	COLD/NON-INTIMATE
14. RELAXED ATMOS.	7	6	5	4	3	2	1	TENSE ATMOS.

If you cannot see outdoors, skip to item 17

15. ATTRACTIVE VIEW	7	6	5	4	3	2	1	UNATTRACTIVE VIEW
16. INTERESTING VIEW	7	6	5	4	3	2	1	UNINTERESTING VIEW

B. RATING OF LIGHTING WITHIN SPACE/ROOM

17. Brightness of space:

1 MUCH TOO BRIGHT | 2 SOMEWHAT TOO BRIGHT | 3 JUST ABOUT RIGHT | 4 SOMEWHAT TOO DIM | 5 MUCH TOO DIM

18. Amount of discomfort glare due to electric lights reflecting off task:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

19. Amount of disability glare from electric lights:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

20. Amount of discomfort glare due to daylight reflecting off task:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

21. Amount of disability glare from daylight:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

22. Opportunity for visual relief:

4 A LOT | 3 SOME | 2 VERY LITTLE | 1 NONE

23. Condition of luminaires within space:

5 EXCELLENT | 4 GOOD | 3 FAIR | 2 POOR | 1 BAD | 0 N.A.

24. Cleanliness of luminaires:

4 VERY CLEAN	3 FAIRLY CLEAN	2 FAIRLY DIRTY	1 VERY DIRTY

25. Brightness of ambient sources:

1 MUCH TOO BRIGHT	2 SOMEWHAT TOO BRIGHT	3 JUST ABOUT RIGHT	4 SOMEWHAT TOO DIM	5 MUCH TOO DIM

26. Color of ambient light sources:

1 WARM	2 NEUTRAL	3 COOL

27. Appropriateness of ambience sources for activities that take place in space:

5 VERY APPROPRIATE	4 SOMEWHAT APPROPRIATE	3 NEITHER APPROP. NOR INAPPROP.	2 SOMEWHAT INAPP.	1 VERY INAPP.

28. Total number of sources within space:

1 MORE THAN ENOUGH	2 JUST ABOUT RIGHT NUMBER	3 NOT ENOUGH

29. Sounds from luminaires:

1 VERY NOTICABLE	2 SOMEWHAT NOTICABLE	3 QUIET

C. RATINGS OF OTHER SPACE ATTRIBUTES

30. Orderliness/tidyness:

1 VERY NEAT	2 FAIRLY NEAT	3 MIXED, SO-SO	4 FAIRLY MESSY	5 VERY MESSY

31. Maintenance:

5 VERY WELL MAINTAINED	4 FAIRLY WELL MAINTAINED	3 MIXED, SO-SO	2 NOT WELL MAINTAINED	1 NOT AT ALL MAINTAINED

32. Amount of space:

4 VERY SPACIOUS	3 FAIRLY SPACIOUS	2 NOT VERY SPACIOUS	1 NOT AT ALL SPACIOUS

33. Thermal comfort:

5 VERY WARM	4 SOMEWHAT WARM	3 JUST ABOUT RIGHT	2 SOMEWHAT COOL	1 VERY COOL

34. Attractiveness of colors:

5 VERY ATTRACTIVE	4 FAIRLY ATTRACTIVE	3 NEITHER ATTR. NOR UNATTRACTIVE	2 FAIRLY UNATTRACT.	1 VERY UNATTRACT.

35. Color harmony:

5 EXCELLENT COLOR MIX	4 GOOD COLOR MIX	3 NEUTRAL	2 POOR COLOR MIX	1 BAD COLOR MIX

36. Ability to discriminate among colors <u>within space</u>:

5 VERY DIFFICULT	4 FAIRLY DIFFICULT	3 MIXED, SO-SO	2 FAIRLY EASY	1 VERY EASY

D. OVERALL ASSESSMENT

37. How would you rate the overall architectural quality of the space/room?

5 EXCELLENT	4 GOOD	3 FAIR	2 POOR	1 BAD

38. How would you rate the overall lighting quality of the space/room?

5 EXCELLENT	4 GOOD	3 FAIR	2 POOR	1 BAD

39. How would you rate the appropriateness of the space/room location relative to other parts of the building?

5 EXCELLENT	4 GOOD	3 FAIR	2 POOR	1 BAD

40. During the assessment period, space was:

1 ALWAYS OCCUPIED	2 OCCUPIED MOST OF TIME	3 OCCUPIED SOME OF TIME	4 UNOCCUPIED

Time is now: _____

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Environmental Measures - Direct

Time is: _____ Date is: _____ Space I.D. _____ 10-26

Day is: 1 MON | 2 TUE | 3 WED | 4 THUR | 5 FRI Bldg. No: _____

Recorder: _____

1. Contrast at PRIMARY task surface: 27-42

_____ C at 90°		_____ R at 90°	
_____ C at 45°		_____ R at 45°	
_____ C at 135°		_____ R at 135°	
_____ C - other		_____ R - other	

43-44

1a. Rating for major lighting system:

1. Daylighting/vertical
2. Daylighting/horizontal
3. Direct ceiling
4. Direct/Indirect
5. Indirect ceiling
6. Indirect free standing
7. Indirect furniture mounted

1b. Rating for lighting source:

1. Fluorescent
2. Incandescent
3. Metal hallide
4. High pressure sodium
5. Low pressure sodium
6. Mercury vapor
7. Other

1c. Number of work surfaces or places where tasks occur: | 1 | 2 | 3 OR MORE | 2

45

1d. Red dot visible: | 1 YES | 2 NO | 46-47

1e. Blue dot visible: | 1 YES | 2 NO |

1f. Illuminance at PRIMARY task surface while SEATED in chair:

_____ fc 48-50

1g. Illuminance at PRIMARY task surface while chair is UNOCCUPIED:

_____ fc 51-53

1h. Illuminance at SECONDARY task surface while SEATED in chair:

_____ fc 54-56

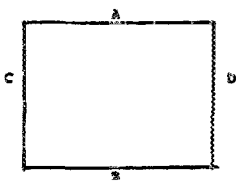
1i. Illuminance at SECONDARY task surface while chair is UNOCCUPIED:

_____ fc 57-59

1j. Luminance at PRIMARY task area: 60-87

fL _____	TASK
fL _____	IMMEDIATE SURROUND OF TASK
fL _____	CEILING BETWEEN LUMINAIRES
fL _____	BRIGHTEST LIGHT SOURCE IN FIELD OF VIEW
fL _____	BRIGHTEST CEILING AREA IN FIELD OF VIEW
fL _____	DARKEST AREA IN FIELD OF VIEW
fL _____	WALL STRAIGHT AHEAD, EYE LEVEL
fL _____	WALL RIGHTS, EYE LEVEL
fL _____	WALL LEFT, EYE LEVEL

1k. WINDOWS IN WORKSTATION 88-107



A: fL _____

B: fL _____

C: fL _____

D: fL _____

2. Does daylight affect the visual environment of the workstation?

[1 YES] [2 NO] → GO TO PAGE 4

From a SITTING position:

3a. Can you see outside:
[1 YES] [2 NO → GO TO 4a]

3b. Can you see the sky:
[1 YES] [2 NO]

3c. The predominant view is:
[1 SKY]
[2 ARCHITECTURAL ELEMENTS]
[3 LANDSCAPE ELEMENTS]
[4 OTHER ELEMENTS]
[5 NOTHING → GO TO 4a]

3d. The type of view is:
[1 NEAR VIEW ONLY]
[2 FAR VIEW ONLY]
[3 MIXED VIEW]

GO TO 4a

From a STANDING position:

4a. Can you see outside:
[1 YES] [2 NO → GO TO 9]

4b. Can you see the sky:
[1 YES] [2 NO]

4c. The predominant view is:
[1 SKY]
[2 ARCHITECTURAL ELEMENTS]
[3 LANDSCAPE ELEMENTS]
[4 OTHER ELEMENTS]
[5 NOTHING → GO TO 5]

4d. The type of view is:
[1 NEAR VIEW ONLY]
[2 FAR VIEW ONLY]
[3 MIXED VIEW]

GO TO 5

5. Outdoor condition: (CHECK ONLY ONE)

1 SUNNY-CLEAR SKY	2 SUNNY-PARTLY CLOUDY	3 HAZY	4 CHAPPARRAL (OVERCAST)	5 NOT DETERMINABLE

6. Type of window covering (CHECK ALL THAT APPLY)

[1 HORIZONTAL BLINDS]
[1 VERTICAL BLINDS]
[1 FABRIC CURTAINS]
[1 SHADES]
[1 OTHER (SPECIFY _____)]
[1 NONE]

7. Window covering is:

[1 IN USE] [2 NOT IN USE] [3 BOTH]

8. Type of window glass:

[1 NEUTRAL] [2 COLORED/TINTED]

108

WORKSTATION SETTING

9. Workstation is in an:

[1 OPEN AREA]

109-124

10a. Type of panels: 135-140
[1 42"-54" PANELS]
[2 60"-66" PANELS]
[3 68"-74" PANELS]
[4 OPEN WITHOUT PANELS]
[5 OTHER: (SPECIFY) _____]

10b. Workstation appears to be:
[1 ASSIGNED]
[2 UNASSIGNED]

10c. The space containing the workstation is:
[2 SHARED] [1 PRIVATE → GO TO PAGE 5]

10d. Number of additional workstations:
[1] [2] [3 OR MORE]

125

10e. Other workstations appear to be:
[1 ASSIGNED]
[2 UNASSIGNED]
[3 BOTH]

126-132

10f. Other workstations are now:
[1 IN USE]
[2 NOT IN USE]
[3 BOTH]

GO TO PAGE 5

[3 ENCLOSED AREA (Conventional office)] 134

11a. Workstation appears to be: 141-146
[1 ASSIGNED]
[2 UNASSIGNED]

11b. This conventional office is:
[2 SHARED] [1 PRIVATE → GO TO PAGE 5]

11c. Type of panels:
[1 OPEN WITH 42"-54" PANELS]
[2 OPEN WITH 60"-66" PANELS]
[3 OPEN WITH 68"-74" PANELS]
[4 OPEN WITHOUT PANELS]
[5 OTHER: (SPECIFY) _____]

11d. Number of additional workstations:
[1] [2] [3 OR MORE]

11e. Other workstations appear to be:
[1 ASSIGNED]
[2 UNASSIGNED]
[3 BOTH]

11f. Other workstations are now:
[1 IN USE]
[2 NOT IN USE]
[3 BOTH]

GO TO PAGE 5

132

133

FURNISHINGS AND COLOR

12. Furnishings are predominantly (CHECK ALL THAT APPLY): 147-150

1 WOOD
1 METAL
1 FABRIC
1 OTHER (SPECIFY) _____

13. Walls are predominantly (CHECK ALL THAT APPLY): 151-159

1 WOOD
1 METAL
1 FABRIC
1 DRY WALL OR PLASTER
1 BRICK OR BLOCK
1 DEMOUNTABLE CEILING HEIGHT PARTITIONS
1 VINYL WALLCOVERING
1 GLASS
1 OTHER (SPECIFY) _____

14. Total number of colors in workstation: [ ][ ] 160-161

15. Dominant colors in workstation: [ ][ ] [ ][ ] [ ][ ] 162-167

16. Type of office chair: [ ] 168

17. Has the workstation occupant: 169-170

a. Taped over or adjusted air diffuser?....	1 YES	2 NO
b. Covered windows with make-shift blinds or screens?.....	1 YES	2 NO

18. Does the workstation have: 171-176

a. Desk or floor plants.....	1 YES	2 NO
b. Pictures or posters on wall.	1 YES	2 NO
c. Pictures or other mementos on desk, credenza or tack surface.....	1 YES	2 NO
d. Radio, tape deck, TV set.....	1 YES	2 NO
e. Fan.....	1 YES	2 NO
f. Space heater.....	1 YES	2 NO

19. CRT/Wordprocessor 177-181

a. Does the workstation have a CRT/Wordprocessor?.....	1 YES	2 NO → GO TO PAGE 7
b. Reflected window light can be seen on screen?.....	1 YES	2 NO
c. Reflected light from electric light sources can be seen on screen?...	1 YES	2 NO
d. Keyboard can be raised and lowered?....	1 YES	2 NO
e. Screen can be raised, lowered, or tilted?.....	1 YES	2 NO

182-189 | 20A PRIMARY | 20B SECONDARY | 190-197 | 7

2 NO	1 YES	Supplemental task lighting at primary/secondary task location?	1 YES	2 NO
GO TO SECONDARY Q20B				

21. Lamp Type

1	FLUORESCENT	1
2	INCANDESCENT	2
3	OTHER: SPECIFY #2 _____ #1 _____	3

22. Fixture Type

1	FURNITURE INTEGRATED	1
2	FURNITURE MOUNTED	2
3	FREE STANDING - MOVEABLE	3
4	WALL MOUNTED	4
5	CEILING MOUNTED	5

23. Direction of Light

1	FIXED	1
2	ADJUSTABLE	2

24. Height Above Task Surface

___ IN	RECORD IN INCHES	___ IN
97	VARIES	97

25. Lamp Color

1	WARM	1
2	WHITE/COOL WHITE	2
3	NONE	3
4	OTHER: SPECIFY #2 _____ #1 _____	4

26. Control of Switching

1	SINGLE	1
2	ON-OFF	2
3	MULTIPLE LEVELS	3

GO TO SECONDARY Q20B

198-202

27. Other free standing lighting fixtures? 1 YES 2 NO → GO TO PAGE 8

28. Number: 1 | 2 | 3 OR MORE

29. Lamp Type(s): (CHECK ALL THAT APPLY)

1	FLUORESCENT
1	INCANDESCENT
1	OTHER (SPECIFY): _____

8

30. INTRUSIVE SOUNDS 203-209

	NONE	VERY LITTLE	SOME	A LOT
a. RINGING TELEPHONES.....	1	2	3	4
b. CONVERSATIONS OF CO-WORKERS...	1	2	3	4
c. PRINTER OR COMPUTER NOISE.....	1	2	3	4
d. OTHER OFFICE EQUIPMENT NOISE..	1	2	3	4
e. VENT SYSTEM NOISE.....	1	2	3	4
f. OUTSIDE NOISE.....	1	2	3	4
g. MUSIC OR INTERCOM.....	1	2	3	4

31. SOUND MASKING: 1 YES | 5 NO 210

32. Temperature: 211-214

_____ °F Dry Bulb

_____ °F Wet Bulb

33. Background Noise Level: 215-216

_____ dBA READING

GUIDELINES

The guidelines which follow should be used in measuring and recording workstation characteristics. Where appropriate, code values should be assigned to the classes of each characteristic. For example, numbers were assigned to each type of workstation: open office with partitions = 1, open office without partitions = 2, conventional office = 3.

1. Type of Workstation

   Using the architectural floor plans of the building (showing furniture layouts) indicate whether the workstation is an:

   a. Open office with partitions. At least one side of the workstation consists of a movable partition (panel) which is four feet in length and at least three feet high but not reaching the ceiling.

   b. Open office without partitions. The workstation is in an open area and has no movable partitions (panels) surrounding it.

   c. Conventional office. An office enclosed completely by ceiling high walls and usually has a door.

2. Workstation Area

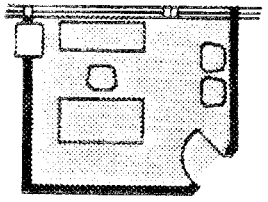
   Determine the area of the workstation in square feet by marking the boundaries of the workstation with a colored pencil and placing an "X" in the center of the workstation space (to be used in other measurements). The measurements of the sides of the workstation can be rounded to the nearest one half foot. Calculate the area and code the figure.

   Consider the following when determining the dimensions of the workstation: (see examples)

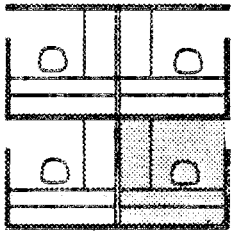
   a. For a conventional private office, the area is equal to the entire enclosed space for that office.

   b. For workstations enclosed by moveable panels, measure the area of the enclosed space.

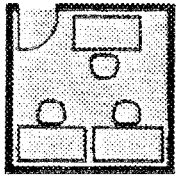
   c. If two or more people occupy a conventional office or a space enclosed by moveable partitions or panels, divide the total enclosed area by the number of people occupying that space.



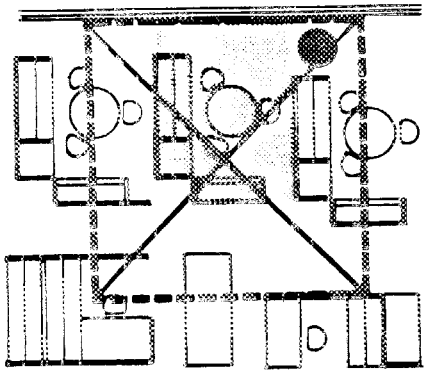
a. CONVENTIONAL PRIVATE OFFICE



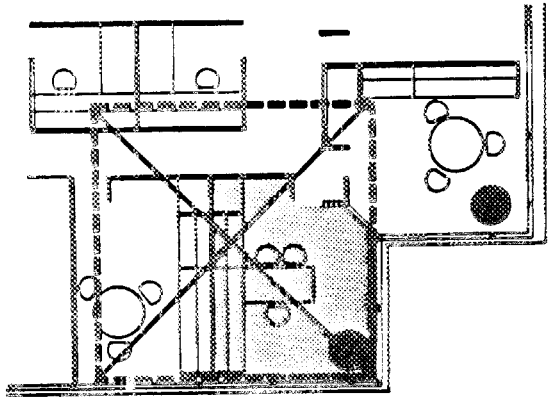
b. WORKSTATION ENCLOSED BY MOVABLE PARTITIONS



c. OFFICE SHARED BY 3 PEOPLE



b-1 DENSITY = 4/400 SQUARE FEET



b-2 DENSITY = 5/400 SQUARE FEET

d. If a primary work surface is not bounded by a panel(s), then measure three feet beyond the primary work surface to form the workstation space. (see f & g)

e. If the workstation is only partially bounded by panels, assume the area is the enclosure of the workstation that is bounded by extensions of the panels and the edge of the furniture.

f. Use the building's structural components as workstation boundaries if they are within 4 feet of the primary work surface and are not intended for other use (e.g. corridor, other workstation).

g. For a workstation that is open without partitions, the area is defined by the primary work surface, contiguous furniture and equipment, and the space three feet beyond the work surface. If there is a wall, partition, bank of files or public traffic corridor within three feet of the primary work surface, then it defines the edge of the workstation.

   If there is another open workstation less than six feet from the edge of the primary work surface, divide the area between the primary work surface and other open workstation to form the edge of the workstation being measured.

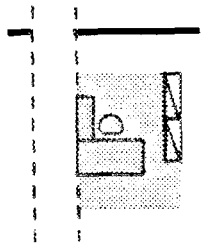
h. Square-off curved edges of workstations before taking measurements.

3. <u>Workstation Density</u>

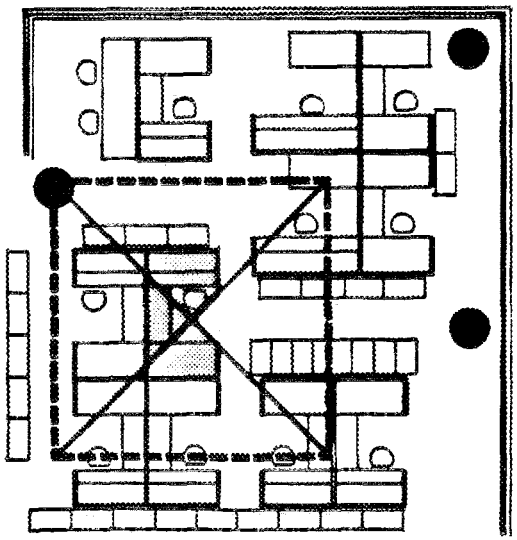
By density we mean the number of workstations per 400 square feet of floor area. Using clear acetate, draw a box 20 feet by 20 feet using the same scale as the architectural drawings. Connect the diagonal corners to form an "X". Place the center of the X on the center of each open office workstation and count the number of workstations (including the one centered on) that fall within the 400 square foot template. If any portion of a work station falls within the 400 square feet, it should be counted.

Consider the following conditions when determining density:

a. For spaces less than 400 square feet bounded by ceiling high walls, count only the workstations within that wall-bound area. For example, a conventional office occupied by one person (one workstation) would have a density of one.



d. and g. OPEN OFFICE WITHOUT PARTITIONS
One edge is on a traffic corridor.



DENSITY = 8/400 SQUARE FEET

b. When a workstation in an open office area is adjacent to or within 10 feet of a ceiling high wall, place the edge of the 20 feet by 20 feet template on the ceiling high wall and center the other direction of the template over the workstation (see example b-1). For a corner workstation, place corner of template on the corner formed by walls (see example b-2).

4. Number of Full Ceiling High Walls Enclosing Workstation

Count the number of ceiling high walls that form the boundaries of the workstation. A conventional private office will have four ceiling high walls. An open office arrangement without partitions will in most cases not have a full ceiling high wall bounding it. If the open office is adjacent to an interior building wall, exterior building wall or atrium wall, one ceiling high wall should be counted.

5. Number of Moveable Partitions (Not Ceiling High)

Count the sides of the workstation space that are enclosed by moveable panels or partitions.* To be considered a partition, the panel must be at least 4 feet in length.

6. Adjacency to Glazed Exterior Wall

Indicate whether or not the workstation is adjacent to a glazed exterior wall of the building. The workstation is considered adjacent if one or more of its edges is formed by a glazed exterior wall(s). Consider guidelines for determining area boundaries of workstations - see Workstation Area.

7. Adjacency to Interior Atrium

Indicate whether or not the workstation is adjacent to an atrium. See Item 6 for definition of adjacency.

8. Adjacency to Non-Glazed Exterior Wall

Indicate whether or not the workstation is adjacent to a non-glazed exterior wall. See Item 6 for definition of adjacency.

* For workstation modules that are not rectangular, the standard number of sides may be greater than 4.

9. Straight-Line View to Glazed Exterior Wall

Using the architectural furniture floor plan of the building, determine whether the workstation (from the center point of the workstation) has an unobstructed view to a glazed exterior wall.

An obstruction would consist of any unglazed ceiling high wall or other opaque structural element such as a column. A glazed interior wall would not obstruct a possible view to a glazed exterior wall. A panel that does not reach the ceiling would not be considered an obstruction.

10. Shortest Distance From Workstation to Glazed Exterior Wall (Straight-Line)

If 9 was "Yes" then measure the straight line distance from the center X of the workstation to the nearest glazed exterior wall. Consider the following where making the measurement:

a. Do not measure through any opaque ceiling-high wall or other obstruction.

b. Measure to the interior edge of the window glass if it is indicated on the drawing. Otherwise, measure to the interior edge of the exterior glazed wall.

c. Moveable open office partitions are not considered obstructions. Measure over them.

11. Straight-Line View to Atrium

To determine whether there is a possible view to the atrium, use the procedure described in Item 9.

12. Shortest Distance From Workstation to Atrium (Straight-Line)

To measure the distance from workstation to atrium, use the procedure and guidelines outlined in Item 10.

13. Functional Distance to Nearest Stair

Measure the distance of the shortest possible route that the workstation occupant can take to the nearest stair. Functional distance is the distance that a person would normally move through the space. A furniture floor plan is necessary for this measurement. Consider the following when taking the measurement:

a. Openings between walls, furniture or other objects must be at least 2 feet wide to be considered a passage to measure through.

b. Use the "X" in the center of the workstation as the point for beginning the distance measurement.

c. Place an "X" on the office area side of the stairwell, 3 feet from the center of the door opening and measure to this point.

d. Mark off the routes from workstations to stairs with colored pencil on the furniture floor plan. This procedure will aid in verifying the measurements later.

14. Functional Distance to Nearest Elevator

Measure the distance of the shortest possible route that the workstation occupant can take to the nearest elevator. An "X" should be placed in the center of an elevator lobby (more than one elevator) or three feet from the center of the elevator opening outside the elevator (one elevator). This "X" is the end point of the measurements. See Item 13 for further considerations in making functional distance measurements.

15. Adjacency to Major Traffic Corridor

Using the architectural/furniture plans, mark the major traffic corridors in colored pencil. Consider the following:

a. Major corridors provide circulation for a floor of the building, so traffic patterns can be easily identified on the floor plans. Notice the route that connects the building core(s) with the office areas.

b. Often, elevators, stairs, toilet rooms and reception areas will be on major traffic corridors.

c. The width of the traffic corridor should be at least three feet. In most cases, it will be larger.

d. To be considered adjacent to a major traffic corridor, a workstation should have one side adjacent to it, or it should open onto the corridor.

16. Type of Ambient (General) Lighting System in Building

An ambient or general lighting system is one that provides uniform illumination to a space. It can be the sole source of illumination for a workstation or can be combined with daylighting or task lighting. However, in the AIAF/UM lighting study, the classification of the ambient lighting system does not take into account daylighting or task lighting characteristics of the workstation. Three attributes of electric lights used to define ambient lighting are directionality, type of light source, and mounting.

In the AIAF/UM study, three directions of ambient lighting were considered: direct, indirect, and direct/indirect. Three types of lamps were also used: incandescent, fluorescent, and high intensity discharge. Finally, seven types of mountings were identified in the workstations under study. These were: recessed, pendant, furniture mounted, surface mounted pendant, free standing, wall mounted, and wall washer. Directionality, lamp type and mounting were combined to define the following classes for the ambient lighting system associated with each workstation.

1. Direct Recessed Fluorescent with Louvers (1'x4')
2. Direct Recessed Fluorescent with Lens (2'x2')
3. Direct Recessed Fluorescent with Lens (2'x4')
4. Direct/Indirect Fluorescent Pendant
5. Indirect Fluorescent - Pendant
6. Indirect Fluorescent - Furniture Mounted
7. Recessed Incandescent
8. Surface Mounted Pendant Incandescent
9. High Intensity Discharge - Free Standing Indirect
10. Direct/Indirect Fluorescent - Wall Mounted
11. Fluorescent Wall-Washer

The presence or absence of each class was noted for an area approximately 10 feet beyond the edges of workstations in open offices. Photographs and lighting plans were used to determine ambient lighting characteristics of all workstations.

Lighting Specification Form

Time is:_____ Date is:_____

Day is: M Tu W Th F S

LIGHTING SPECIFICATION FORM - WORK STATION

Space ID: _____

Bldg No: _____

Recorder: _____

1. Ambient lighting associated with the work station

	luminaire no. 1	luminaire no. 2	luminaire no. 3
a. Luminaire type			
b. Number of luminaires			
c. Lamp specification			
d. Number of lamps per luminaire			
e. Wattage per lamp			
f. Ballast specification			
g. Wattage			

2. Supplemental task lighting:

	luminaire no. 1	luminaire no. 2	luminaire no. 3
a. Luminaire type			
b. Number of luminaires			
c. Lamp specification			
d. Number of lamps per luminaire			
e. Wattage per lamp			
f. Ballast specification			
g. Wattage			

APPENDIX C: THE EVALUATION TEAMS

The experts were:

Name	Profession	Special Task(s)
Henry Kowalewski, AIA	Architect	Team leader
Stephen Squillace, P.E.	Illuminating Engineer	Recorded lamp & ballast wattages
Gary Steffy, IALD, IES	Lighting Designer	Photographer
Ross Maloukis, ASID	Interior Designer	Recorded lamps and fixtures that were out

The technicians were:

Name	Building
Virginia North, University of Michigan	1,2,& 3
Carol Barrett, University of Michigan	1
Pamela O' Connor, University of Michigan	2
Gayl Marans, University of Michigan	3
Doug Holland, National Bureau of Standards	4,5,7,9
Bernard Brasey, National Bureau of Standards	6,8,10,11,12
Belinda Kuo, National Bureau of Standards	13
Gary Gillette, AIA Foundation	4,5,6,7,8,9 10,11,12,13

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