DAYLIGHTING CONCEPTS FOR UNIVERSITY LIBRARIES AND THEIR INFLUENCES ON USERS' SATISFACTION

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
İZMİR UNIVERSITY OF ECONOMICS

BY

DİDEM KAN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF DESIGN
IN
THE GRADUATE SCHOOL OF SOCIAL SCIENCES

MARCH 2009

Approval of the Graduate School of Social Sciences

.....

Asst. Prof. Dr.Alp Limoncuoğlu

Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Design.

.....

Prof. Dr. Tevfik Balcıoğlu

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Design.

.....

Asst. Prof. Dr. Deniz Hasırcı

Supervisor

Examining Committee Members

Assoc. Prof. Dr. Suat Günhan .....

Asst. Prof. Dr. Deniz Hasırcı .....

Assoc. Prof. Dr. S. İlkim Kaya .....

ABSTRACT

DAYLIGHTING CONCEPTS FOR UNIVERSITY LIBRARIES AND THEIR INFLUENCES ON USERS' SATISFACTION

Kan, Didem

MDes, Department of Design Studies

Supervisor: Asst. Prof. Dr. Deniz Hasırcı

March 2009, 170 pages

The aim of this study is to carry out a thorough investigation on daylighting in university libraries and their influences on users' satisfaction. This study examines users' reactions to the library space with emphasis on the effects of daylight and aims to discuss the effects of daylighting design especially in user-centered university libraries. The study focuses on the influences of daylighting on user's preference and satisfaction. The effects of daylighting on university library users are measured in relation to the 4 processes of environmental psychology, namely, privacy, personal space, territoriality, and crowding. University libraries were chosen, as they are more student-centred and has different type of use during exam periods according to public libraries. In this study, the Main Library of Dundee University (Dundee, Scotland) was chosen as a case study because of receiving the already limited daylight of Dundee effectively into space. As instruments, observations and questionnaires with the library users in this library were used, the statistical values were calculated and potential future activities and design suggestions for designing the university libraries were recommended. The heliodon, artificial sky, lightmeter and physical model were used to measure the amount of daylight in the space. It was found that the relationship between daylight and the 4 processes of environmental psychology should be considered when designing the university libraries to achieve quality spaces that encourage students to make use of libraries to their full extent. It is believed that, this has the potential to support university education.

Keywords: Daylight, users' satisfaction, university library space, 4 processes of environmental psychology.

ÖZET

ÜNİVERSİTE KÜTÜPHANELERİ İÇİN GÜNIŞIĞI KAVRAMLARI VE KULLANICI MEMNUNİYETİNE ETKİLERİ

Kan, Didem

MDes, Tasarım Çalışmaları Bölümü

Danışman: Yrd.Doç.Dr. Deniz Hasırcı

Mart 2009, 170 sayfa

Bu çalışma, üniversite kütüphanelerinde gün ışığının ve gün ışığının kullanıcı memnuniyeti üzerindeki etkisinin derinlemesine araştırılmasını amaçlamaktadır. Kullanıcıların kütüphane mekanına olan tepkilerini gün ışığını da vurgulayarak sınamakta ve özellikle kullanıcı merkezli üniversite kütüphanelerinde gün ışığı tasarımının etkilerini tartışmayı amaçlamaktadır. Çalışma, gün ışığının kullanıcı tercihine ve memnuniyetine olan etkisine odaklanmaktadır. Gün ışığının üniversite kütüphane kullanıcılarına etkileri çevresel psikolojinin dört temel bileşeni olan; mahremiyet, kişisel alan, korunan alan ve kalabalık duygusu kavramları ile ilişkilendirilerek ölçülmüştür. Üniversite kütüphanelerinin seçilme sebebi, halk kütüphanelerine göre daha fazla öğrenci merkezli olmaları ve sınav dönemlerinde farklı kullanım alanlarına cevap vermesidir. Bu çalışmada Dundee Üniversitesi Ana kütüphanesi, hali hazırda sınırlı gün ışığı alabilen bir mekan olması sebebiyle örnek çalışma olarak seçilmiştir. Gözlemler ve bu kütüphanedeki kullanıcılarla yapılan anketler bu çalışmanın enstrumanlarıdır. İstatistiki değerler hesaplanmış, üniversite kütüphaneleri için tasarım önerileri sunulmuş ve gelecekte yapılması olası aktiviteler önerilmiştir. Mekandaki gün ışığı miktarının ölçülmesinde heliodon cihazı, yapay gökyüzü, ışık ölçer ve maket kullanılmıştır. Bununla birlikte bu çalışmanın bir sonucu olarak, öğrencilerin üniversite kütüphanelerini tüm yönleri ile kullanmaya teşvik edici kaliteli mekanlar kazanmak için, üniversite kütüphaneleri tasarlanırken gün ışığı ve çevresel psikolojinin dört temel bileşeni arasındaki ilişkinin göz önüne alınması gerektiği bulunmuş olup bunun üniversite eğitimine katkı potansiyeline sahip olduğuna inanılmaktadır.

Anahtar kelimeler: Gün ışığı, kullanıcı memnuniyeti, üniversite kütüphane mekanı, çevresel psikolojinin dört temel bileşeni.

To My Family

ACKNOWLEDGEMENTS

I would like to give a special thank to my advisor Asst. Prof. Deniz Hasırcı for her guidance and making this research a very good learning experience for me.

I would like to acknowledge Asst. Prof. Markus Wilsing for his continous support in the past two years. To Prof. Mike Press, Jeanette Paul, Hazel White and Tamer Gado in Duncan of Jordanstone College of Art and Design, for their suggestions, comments, valuable discussions and collaborations and I would like to thank my committee members for their ideas, suggestions and participation. I would like to thank my colleagues, my friends and my research participants who took part in my research.

I can never thank enough my family for their endless love and continuous support. Nothing would be possible and meaningful without the constant love and encouragement of Kemal, thanks to him for his unshakable faith in me.

TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

FIGURE

CHAPTER 1

INTRODUCTION

People physiologically and psychologically prefer daylight -mainly through levels of serotonin- over artifical lighting as their primary source of illumination and it affects the satisfaction of people (Ulrich, 2006). This general idea is the beginning point of the study, but especially the study focuses on the role of daylight on efficiency of university library users in relation to "privacy", "personal space", "territoriality", and "crowding". The main research question is, "How does daylight influence satisfaction and preference of university library users considering 4 processes of environmental psychology?".

The first university according to sources was built in Italy, Bologna in the 11st century. Before the establishment of this university, madrasahs were the spaces for high-level education in the Turkish-Islam world. The first madrasah with a library was built by Yıldırım Bayezıd in Bursa between the years 1389 and 1402, and Köprülü Library in Çemberlitaş was known as the first independent library building built in 1661 (Küçükcan, 2007). The architectural plans of these libraries showed that these examples of libraries were seen as a storage space for the books. In time, library spaces changed to answer the users' necessities with the help of technology. Today, these spaces have transformed into spaces which correspond also to users' psychological necessities from just being information center. It is a space where one can reach and share the information and keep the sources of information as well.

Libraries are an indispensable part of universal education and they always find space according to cultural habits and varying conditions of the community. University libraries are the most efficiency expected kind between all other kinds of library (Küçükcan, 2007). The following data shows the statistics regarding use of university libraries by university students in Turkey.

As cited in UNESCO's (2007), statistics on national libraries in Turkey, the total number of books in national libraries was 1.146.000 in 1995, in 1999 it was 1.552.629. Nearly 400.000 books increased from 1995 to 1997. In addition to this, the registered users increased from 24.736 to 27.000 between the years 1995 and 1999 (National Libraries, 2007). Independent Educators Union of Turkey (BES) (2008) prepared a report about the reading habits of Turkish according to the number of registered users and books. While 14% of the total population in Japan, 12% of community in America, 21% of community in England and France read books regularly, only one person of 10000 people reads books in Turkey (Celal, 2008). The report shows that Turkish community -foremost youth- are reading less books by the day. The education system based on exams and the increase of visual items such as television and the internet can be thought to inhibit people from reading.

These statistics can be interpreted as a lack of awareness in general population on the use of publications, information centers and libraries. University students and scholars are the main population groups that retrieve information by the use of internet or other digital tools. They do not read books because information can easily be taken from the internet and easily be saved in digital platforms and easily be removed again. The libraries' role is important in the education of students who are

academically well-rounded and have full access to permanent information, data sources and documentation records in university libraries. Thus, the use of university libraries can encourage students to work in the library not only on exam days, which is usually the case, but also in their free time.

As cited in The Council of Higher Education of the Republic of Turkey (YÖK) (2008) statistics, there are 95 state universities and 36 private universities in Turkey. There are a total of 1.969.086 university students and 79.555 teaching staff in these state and private universities. One of the largest collections in Turkey with its 343.677 books, 32.000 e-books, 1475 journal subscriptions, 24.355 e-journal subscriptions and 13.730 dissertations are in the METU (Middle East Technical University) Library according to the indicators in 2006 which was founded in 1957 in Ankara (Middle East Technical University Library, 2008). In the 21st century, libraries are evaluated with the performance of library use in addition to their collection size. The METU Library is the most used university library, primarily due to space layout and printed and electronic resources in Turkey. In 2005, 350.000 books were borrowed, 770.000 articles were downloaded and 320.000 electronic reference sources were scanned by the users. With its 3 million dollar budget, the METU Library has the first place in all state and private universities in Turkey (Karasözen, 2007). The number of users in METU is 24.236 and borrowed books per person is 14.14 for a year (İzmir University of Economics Strategical Report, 2007). Bilkent University Library was founded in 1986 and is in the list of ten best libraries in Turkey. Its collection has more than 400.000 books, 2.700 printed resources and 30.000 electronic resources. Bilkent University Library has a 3 million dollar collection budget (Hürriyet, 2007). The number of users is 13.963 and the borrowed

books for per person is 17.44 for a year (İzmir University of Economics Strategical Report, 2007).

These figures show that the METU Library and Bilkent University Library users know their information needs and use libraries extensively. This depends on the library's spatial atmosphere in addition to their collection. The METU Library and Bilkent Library are used more by university students because these libraries are not just resource centers of the university but also the exhibition and gathering spaces for university students with the activities in them (See Chapter 3 for spatial organization of these two libraries).

The METU Library and Bilkent University Library can be stated to be examples of the best university libraries in Turkey. The reasons for this might be that firstly, these two libraries have changed the concept of library viewpoint with their exhibition platforms, conference halls, multimedia and projection zones and gathering places. Therefore, the ratio of the use of these libraries are more than the ratio of the use of other universities and also all public libraries in Turkey. Secondly, the METU Library and Bilkent University Library have wide collections and they are the only libraries which have such large budgets.

The formats of knowledge and information have changed, so the value of the physical presence of library space is in the first place for the duration of the library users (Wastawy, 2006).

> "The library is at any one time a meeting place, a learning resource and a comfortable and relaxing public space. The buildings that are well designed and managed offer an array of resources that enable people and groups to establish relationships, carry on conversations, exchange ideas and engage the life of the mind" (Bundy, 2004:4).

If library space is redefined as a design and function, students can use it more for different reasons not just for their studies, and it can turn to be meeting point of the students, and not a place of dissatisfaction.

One of the reasons why university libraries are not used efficiently in Turkey is due to the lack of library culture which is not imposed in the early ages in schools (Küçükcan, 2007). Although all elementary schools have to have a library according to The Republic of Turkey Ministry of National Education (MEB) (2007) law, most university students only find their first meeting opportunities with the libraries in their whole life, when they begin their freshman year. A student who has continued his/her education life without using a library, may be less inclined to use it during university education. With this viewpoint, he/she may not be able to use the full potential of university education (Küçükcan, 2007; Bundy, 2004). Accordingly, the library spatial atmosphere becomes important for satisfying the users and it can encourage them to work in the libraries as well as, borrowing more books and using the library space more effectively.

1.1. Purpose

The aim of this study is to carry out a thorough investigation on daylighting in university libraries and their influences on users' satisfaction.

It is important to realise that daylighting is not only an energy efficiency technology but also an architectural discipline and major factor in users' perception and acceptance of workspaces. This study examines users' reactions to the university library space with emphasis on the effects of daylight and aims to discuss user-centered daylighting design in university libraries. The study focuses on the influences of daylighting on user's preference and satisfaction. The effects of daylighting on university library users will be measured in relation to the social processes of environmental psychology, namely, "privacy", "personal space", "territoriality", and "crowding". Therefore, psychological aspects of daylight is the main consideration in this study.

1.2. Methodology and Hypothesis

The main research question is, "How does daylight influence satisfaction and preference of university library users?". The research question has been aimed at understanding the satisfaction of users considering daylight concepts in university libraries and it has served to guide every step of the research process including the overall design of the research methodology, evaluation process and analysis of the research results. Based on the research question, the following hypotheses were developed:

"Daylight strongly influences the satisfaction and dissatisfaction of the users of university libraries depending on the 4 processes of environmental psychology: privacy, personal space, territoriality, and crowding".

Sub-hypotheses may be stated as such:

- "Perceived comfort of the university library layout (seating plan, circulation area, bookshelves scheme) is related to the seat preference based on 4 processes of environmental psychology".
- "Perceived comfort of the university library layout (seating plan, circulation area, bookshelves scheme) is related to the amount of time spent in the library".
- "The amount of time spent in the university library affects the satisfaction of the users".

"Daylight strongly influences the seat preference of users of university libraries".

- "Window seats are chosen first in the university libraries".
- "The amount of lux (daylight and artificial light) affects seat choice within a university library space".
- "The amount of time spent is influenced by the amount of lux (daylight and artificial light) in university library spaces".
- "The quality of view affects the seat preference in university library spaces".
- "Visual comfort of users of university libraries affects the seat preference of the users".

Charles and Veitch (2002), Galasiu and Veitch (2006), Solomon and Finnegan (1981), and Cuttle (2002) have studied the satisfaction of users in the workplace with a relation to a window, Cheung and Ghung (2007) have investigated the preference of daylight in residential rooms, and also several recent studies have focused on relations between characteristics of an organization’s physical environment and a

variety of people's reactions including performance and satisfaction (Oldham, 1988; Sundstrom et al., 1980). In addition, Wells (1967) and Markus (1967) in the UK, Heerwagen and Heerwagen (1986) in the USA have all mentioned that high percentages of survey respondents prefer to work by daylight. However, there has been no work attempting to show relationships between satisfaction, preference of users and daylight comparatively in terms of the university library. Research on daylight is not well developed as examining influences on environmental influences and satisfaction of the university library users. Therefore, this study examines the role of daylight on satisfaction of university library users in relation to privacy, personal space, territoriality, and crowding.

In this study, the data collection process basically makes use of 2 different instruments: the observation and questionnaire. The physical model, the heliodon, and artificial sky were also added after the pilot studies were completed. After the participants were determined, pilot studies were carried out in the library of İzmir University of Economics (İUE) and library of Duncan of Jordanstone College of Art and Design (DoJ). After the pilot studies, the case study was carried out in the Main Library of Dundee University. The data was collected on site by the author in the pilot study of DoJ Library and in the case of the Main Library of Dundee University, and by 3rd year İUE, Interior Architecture and Environmental Design students in the pilot study of İUE Library. According to the observation and questionnaire with the library users and library staff, the statistical values were calculated and potential future facilities and design suggestions for designing university libraries were recommended.

The Main Library of Dundee University in Scotland was chosen as a case study. It was observed that the main library was a good example for a building that was not only a library or a resource center, but also a gathering place of the university students with its groupwork areas. There were many seating options for every type of study such as teamwork or individual, on the floor or big comfortable sofa, separated computer areas, or wireless access. In addition, it was thought that the design layout was developed according to the intent of delivering the already limited daylight of Dundee effectively into space. Therefore, the Main Library of Dundee University was an appropriate space for testing influences of daylight on users' satisfaction in university libraries.

1.3. Structure

The thesis is composed of five chapters. Chapter 1 is the Introduction chapter which dwells on the purpose, research question and hypotheses, and the methodology of the thesis. It begins with the statistical documents of the use of university libraries and how often university students use the university libraries in Turkey. This data will be beneficial for understanding the aim and future stages of the study.

After the mentioned purpose and methodology of the study, and the research question and hypotheses in the Introduction chapter, Chapter 2 gives insight into the literature on daylight effects on library users' satisfaction in relation to the social processes of environmental psychology, namely, privacy, personal space, territoriality, and crowding. This literature review seeks to identify what is known

about the impact of daylight in those areas and examines the benefits of both window, as outside view and daylight.

Chapter 3 summarizes daylighting design concepts in public and univesity libraries. Libraries are discussed according to their periods and each library was given as an example of using daylight into library space efficiently in their own periods. It discusses how library space affects the satisfaction of library users in it. There are examples of libraries from the 20th century, pre-20th century, and post-20th century. In addition, Lanchester Library, The University of Nevada Lied Library, Minneapolis Central Library, Seattle Public Library, Peckham Library, Santa Monica College Library, the New Library of Alexandria, in addition METU and Bilkent Library and the Turkish National Library are given as example of how library affects the structure of the community.

Chapter 4 states the research methodology which aims to find answers to the research question and recommend the future facilities, research directions, and design suggestions for improving users' satisfaction in university libraries. The research methodology is elaborated including observation, questionnaire, daylight measuring and analysis. It discusses the statistical analysis of the relationships between daylight, seating preference and satisfaction depending on the 4 processes of environmental psychology namely privacy, personal space, territoriality, and crowding. It summarizes the statistical analysis of the results from the data collected in the research.

Chapter 5 derives conclusions from the analysis. The research is summarized and future research directions for researchers and future design guidlines for designers are suggested.

CHAPTER 2
DAYLIGHT AND USERS' SATISFACTION: THE PSYCHOLOGY OF BEHAVIOUR IN INTERIORS

Architectural spaces are designed for human activities and technology. The character of a space affects human emotions and behaviour. Thus, success in design depends on how well the space satisfies the range of human needs of the occupants. Design aims to create solutions to respond to human needs which may appear in the form of physical, technical, social, and functional constraints. Achieving a balance between these factors requires a systematic approach with spatial identity, inspiration and human well-being (Fisher, 2006).

The earliest analysis conducted of the human and interior light relationship were the Hawthore studies that analysed the effects of daylighting on workers' performances in 1924. The researchers involved in these studies hypothesized that increased daylighting would correlate with increased worker production (Kopec, 2006). Since then, there has been several studies regarding this important topic. This study also showed that when the changes were reversed, production continued to rise. Robert Sommer pointed out that there is no simple relationship between single environmental elements and complex human behaviour. He discussed how the relationships of changes in working conditions were tied also to managerial philosophy and the psychological climate of the office environment.

According to his study, if employees trust management and feel that they are understood, changes are seen as indications of positive interest (Isacco, 1985). The Hawthorne study concluded that productivity increases when motivation increases. It was found not to be related to the increased or decreased lighting levels (Egan and Olgyay, 2002). On the other hand, the following are the studies on how daylight and outside view affect users' satisfaction in the workspace.

It is believed that access to a window with enough daylight, and an outside view is beneficial to users and it affects their satisfaction with their workspace (Yıldırım et al., 2007). Research findings have shown a relationship between daylight and psychological effects. For example, research has shown that library users experience an increase in physiological and psychological stress after moving from a place near a window to a place that is far from a window (Yıldırım et al., 2007). A window allows to keep in touch with the changing weather and the time of day. It can also help people in a complex building find their way around (Bell and Burt, 1995). The variation of daylighting within a day, the view of the outside, contact with the changing outdoor scene are all important reasons to receive daylighting into the space.

Kaplan (1993) described two studies on the importance of an outside view in the workplace. The first study showed that occupants with natural views had greater job satisfaction. In the second study, involving 615 employees in office jobs with a view of nature felt less frustrated and more patient, and found their job positively more challenging (Yıldırım et al., 2007). The importance of an outside view is also shown by the work of Young and Berry (1979). They examined people's preferences for an

office with either a real window, providing both a view out and daylight in the office or an artificial window showing a dynamic view of nature but providing very little light into the office. There was very little difference in the preferences for the two window types, implying that it is the view that is dominating the preference (Boyce et al., 2003). However, several surveys have studied that people believe that daylight is superior to artificial light in its effects on people (Veitch and Galasiu, 2006), and so that working by daylight would result in less stress and discomfort than working by artificial light. Thus, daylight was found to be better for psychological comfort (Cheung and Chung, 2007). In Cuttle's research in England and New Zealand, it was investigated that from the sample of participants of 471 office workers who were asked whether they considered windows to be an important feature of a workplace and how important that was and why. 99% of them thought that offices should have windows and 86% considered daylighting to be their preferred source of lighting (Cuttle, 1983).

As cited in Veitch and Galasiu (2006), Heerwagen and Heerwagen (1986) surveyed occupants of an office building in Seattle, USA, in winter and summer. Most of the occupants believed that daylight is better for psychological comfort, for office appearance and pleasantness, and for visual health. Veitch and Gifford (1993) surveyed university students in Canada about their preferences for lighting. Nearly 78% of students thought that daylight was better for working under than artificial light. As cited in Veitch and Galasiu (2006), Wells (1965) interviewed with office workers in the UK to determine the relationship between physical conditions and attitudes of people towards windows, daylighting and artificial lighting. 89% of the

workers believed that the outside view was very important, and 69% believed that it was better for their eyes to work by daylight.

In addition, as cited again in Veitch and Galasiu (2006), Ne'eman and Hopkinson (1970) conducted an experiment with 318 occupants of three buildings in the UK to determine whether there was a minimum in window size that influences people's preference and satisfaction. The experiments were conducted from January to July under various sky conditions. The results showed that the minimum acceptable window width was between 2.2-3.2 m., and the window width was directly proportional with the distance between the participant and the window. Moreover, people's satisfaction was proportionally affected by the window area and was inversely proportional with the number and width of the window (Veitch and Galasiu, 2006).

In addition, Cuttle (1983) mentioned that the larger the windows are, the more desirable according to the perception of the users. On the other hand, Butler and Biner (1989) showed that large windows were not preferred for the majority of spaces. 59 university students were asked to specify their preferred window options for 14 spaces including offices, residential spaces, libraries, lecture halls and education spaces. The results showed that 43% of students preferred large windows, 46% of them preferred medium windows and rest of them preferred small sized windows. Access to an outside view and effects of daylight on task performance were cited by 65% of the students to be the main factors for this survey.

According to Christoffersen et al. (2000), during fall and spring in 20 Danish buildings, people preferred workplaces located near windows. An outside view was the most positive aspect of a window. This study involved 1823 office workers. 70% of them were satisfied with the daylighting conditions in the work environment, 80% were never bothered by glare. Another survey which was done by Rea et al. (1998) in 58 US offices showed that 50% of 800 office workers preferred to seat near a window, and only 8% of them preferred work locations further away from the windows (Veitch and Galasiu, 2006).

> "In a daylighting system, the window can be treated as the light source, so the quality of view can be understood to be the aesthetic of the light source. Therefore, the daylighting performance of an interior can also be affected by the quality of view out" (Cheung and Chung, 2007:8).

Charles and Veitch (2002) studied the satisfaction of users in the workplace as cited in Yıldırım, et al. (2007) with a relation to a window. Their studies showed that proximity to a window was a significant positive predictor of satisfaction in addition to artificial lighting. According to Kaplan's framework, the direct effect of windows on the workplace, having enough daylight and an outside view were all affected their perception of the space. They also investigated that satisfaction would be the greatest in people located in close proximity to a window (Kaplan, 1993).

Several recent studies have focused on relations between an organization of physical environment and a variety of people's reactions including satisfaction (Oldham, 1988; Sundstrom, et al., 1980). As cited in Stone and Irvine (2001), performance, positive mood, and satisfaction would be greater for people working in windowed

offices. Windowed offices also increased perceived daylight within the space and ventilation. On the other hand, windowless offices increased perceived temperature.

In addition, Stone and Irvine (2001) expected that the windowed rooms would enable better performance, positive mood and satisfaction. Hedge (1982) as cited in Stone and Irvine (2001) analysed that windows may affect actual temperature and ventilation, but window preference may be explained by the fact that windows influence one's perception of temperature, ventilation, and mood. Furthermore, people would rather work by daylight than by artificial light (Yıldırım, et al., 2007).

According to research studies, windows are potential sources of stimulation, aesthetic interest, and information about the outside world (time of the day, weather, etc.) are highly influenced. It was hypothesized by Solomon and Finnegan (1981) that American workers in a windowless environment would have unfavourable attitudes toward their jobs than would those with windows. According to their studies, the windowless group were significantly less positive than the windowed groups on job satisfaction, interest value of the job and physical working conditions (visual appearance, lighting, temperature). They rated the physical conditions of their work less pleasant and this feeling might have been a cause of the lowered interest value of the job and lowered job satisfaction.

In the Cheung and Chung (2007) research study, a research was conducted to investigate the subjective preference to daylit environment of a residential room According to this study, it was found that people had different interpretations and criteria of daylight, like daylight glare and lighting levels. Variations may depend on

individual’s age, experience, expectations and mood. Personal lighting preferences are shaped by the number of hours and the time of day we work, personal styles and even our work culture. Individual differences such as age, gender, physical abilities, past experience and education, as well as social factors such as purpose, social role, cultural norms can affect preference (Clements and Croome, 2006).

Researchers have used different instruments to understand the users’ satisfaction in the workspace. Markus (1967) used a questionnaire to determine how satisfied office workers were with their workspaces. Ten environmental factors, including sunshine and view, were presented to employees for a satisfaction analysis. This questionnaire provided an understanding of their workers’ overall satisfaction. In this study, approximately 96% of participants preferred to work under natural light. Furthermore, participants sitting near windows were more content, whereas participants sitting further away from the windows complained more (Edwards and Torcellini, 2002).

Although Markus (1967) measured overall satisfaction of employees with the help of the questionnaire, White et. al. (1988) pointed out that "overall satisfaction" had never been measured directly. It is related with work performance, mood or work satisfaction of people. However, a post-occupancy evaluation which was done by White et al. (1988), focuses on ‘habitability’ of environments. Thus, encourages a consideration of satisfaction as a unique issue that can be measured directly. Post-occupancy evaluations generally try to find answer to these questions: Are people happy with their physical environments or not? Are environment supporting or impeding human activities? Do environment and people match? All these questions are for improving the satisfaction of users in an environment, optimizing the

relationship between people and the environment, and enhancing the function of that space (Dinç, 2007).

Psychological factors, such as satisfaction or dissatisfaction with other factors in the work environment, can have an influence on the strength of response of the occupants to their environments (Clements and Croome, 2006). The following section examines the influences of daylight on satisfaction and involves daylight with relation to visual comfort, psychological health, meaning of space and the 4 processes of environmental psychology, namely, privacy, personal place, territoriality, and crowding.

2.1. Visual Comfort and Daylight

Visual comfort is our feeling of ease or well-being within the visual field (Glossary of Lighting Terms, 2008). Lighting researchers have focused on visibility and as a result, we have an understanding of what is needed to make objects visible. Four variables have the greatest effects: the age of the viewer, task size, task/background contrast and task luminance (Veitch, 2006).

Rea and Ouellette (1991) produced a model of relative visual performance and the model includes the effect of decreasing visual acuity that occurs with age. Certain industrial tasks will require special attention according to the task characteristics. Some details are so small or have such low contrast that increasing the task luminance will not sufficiently increase task visibility. In these cases, magnifiers and directional lighting will be necessary parts of lighting design (Veitch, 2006).

As cited in Boyce et al. (2003), productivity at work can be measured by looking at many different factors. The indoor environment, including lighting conditions, is one of the system factors that influence the productivity of the individual. In 1980, Louis Harris conducted a study for Steelcase Company in which the question researched was "Does office comfort increase productivity?". 1004 employers and 203 managers were interviewed and what they believed was that office comfort affected productivity. Good lighting and a comfortable chair were the highest ranking factors which affected comfort in the minds of participants (Isacco, 1985). In addition, comfort is a pleasant state of physiological, psychological and physical harmony between a human being and the environment according to Slater (1985) and is in close relationship with visual comfort. It means that the ability to move and adjust one’s work position is important in the workplace. In addition, the organisation of the space is an important factor, including desk orientation and circulation orientation (Wilson, 2002).

According to the study of Cheung and Chung (2007) investigates the subjective preference in the daylit environment of a residential room, "general brightness" indicates the perceived overall lighting level of the interior surfaces of the room and "desktop brightness" represents the lighting level on the desk level. "Perceived glare" means the existence of any discomfort or reflecting glare due to the bright sky or direct sunlight and "quality of view" means how pleasant the external view of the window is for the occupants.

The results of this study showed that general brightness and desktop brightness with a good external view was ranked as the most preferred living environment by the occupants. The least preferred environment was a dark general and desktop daylit environment with a bad external view, frequent perceived glare and difficult control of interior shading devices but with energy saving quality. As a result, 24% of the occupants thought that the highest importance factor was "quality of view", 23% of them thought "general brigthness", "impact on energy" was 17%, and "user friendliness of shading control" was 15%. The lowest importance level was found to be "sunlight penetration" (4%). In other words, the results showed that the participants considered "quality of view" and "general brightness" to be more important than other attributes when evaluating a daylit environment (Cheung and Chung, 2007).

In addition, as cited in Veitch and Galasiu (2006), Hopkinson (1970) found that people tolerated daylighting glare better than glare originating from artificial light sources. The participants of this study believed that outside view was affected their judgment about the degree of glare in the space. He mentioned that when a pleasant view is seen from the window, the tolerance for higher glare levels increases. Glare, either directly from light sources in the field of view or by reflection on glossy surfaces, is the less extreme instance of light as a stressor. Discomfort glare is a well-known phenomenon that has a physiological basis (Berman, 1994). Very high luminances in the field of view or very highly non-uniform luminance distributions can cause discomfort (Veitch and Gifford, 1996).

Visual comfort is closely linked to perception, however, perception is much more sophisticated than just producing a feeling of visual discomfort. In a sense, every lighting installation sends a message about the people who designed it and about the place it is located. Observers interpret the message according to context in which it occurs and their own culture, preferences and expectations. According to what the message is, the observer's mood and behaviour can be changed. There would be a situation where the lighting provides poor task visibility, so that visual performance is poor. If the worker is aware of the poor level of performance, it fails to meet his/her expectations (Boyce et al., 2006).

Quite often, the higher illuminance levels improve visibility. 300 lux is acceptable and 70 lux is quite dark for paper-based work (Küçükcan, 2007). Gifford (1997) suggested that a high illuminance can improve office task performance as compared to a very low one. However, Veitch (2006) states that most people spend longer than 15 minutes in their offices. Once they adapt the conditions, illuminance probably does not influence performance, provided the level is adequate for seeing task details. More light is not necessarily better light (Veitch, 2006).

According to the results of Escuyer and Fontoynont (2001) study, for people working on computers, the preferred light levels were between 100-300 lux, while for people working less time on computers, preferred light levels were 300-600 lux. Many occupants chose low electric light levels when daylight was available. The study of Laurentin, et al. (1998) observed 30 French workers who were tested on computer tasks. Results showed that, when seated near the window, 57% of the participants did not add any electrical light, while the rest added between 20 and 450 lux. The

participants perceived 300 lux illuminance level as pleasant under daylight and unpleasant under electric light, but in general the preference showed that they preferred a lower illuminance level under electric light alone than under daylight (Veitch and Galasiu, 2006).

2.2. Psychological Health and Daylight

More recent studies have concentrated on exploring what it means to be a happy worker. Specifically, it has been established that psychological well-being at work, rather than job satisfaction, correlates with measures of job performance. Job satisfaction is a long-term attitude, but psychological well-being is short-term emotional state. For example, if employees feel happiness when they look out of a window or sit in sunshine, that feeling may contribute to their performance on that day or moment while not affecting how they feel about their co-workers or responsibilities in general (Boyce et.al, 2003).

Daylight from windows provides many benefits such as psychological satisfaction, occupant health and improved environmental quality (Cheung and Chung, 2007). Apart from providing daylight, windows have other advantages. For example, in offices, the psychological benefits of windows were found to be greater than the physical benefits on users. One of the psychological benefits of windows is that they facilitate time orientation so that our metabolic rhythms are synchronised with the time of the day or night (McNicholl and Lewis, 1994).

When one considers psychological health in the context of design, we must include both the positive approach, identifying those design attributes that promote health and well-being, as well as the traditional approach, focusing on mental disorders. People who are in good psychological health are considered to have a well-developed self-confidence. They seem better equipped to handle environmental stressors. Poor psychological health seems to be perpetuated by environments in which people are forced to control, such as hospitals, prisons or schools.

> "Our environmental perceptions are also influenced by variables called proceedings, which in turn are affected by our psychological health: Internal proceedings, External proceedings. Internal proceedings are mental processes that help us to represent and explain the world around us. They are the thoughts and feelings that give order to our environments. External proceedings are the thoughts we interact with the physical environment and other individuals" (Kopec, 2006:60).

Stone and Irvine (2001) studied the relationship between psychological health and daylight in schools. They analysed that windows introduce a dynamic element into the environment, and this affects the student's ratings. Moreover, the school staff felt most challenged when performing the managerial task in the windowed room and they were more satisfied with their work when they were performing the task in the windowless room. Collins (1975) found that a lack of windows does not appear to be a problem in dynamic environments. However, when the environment is static, it changes. It has not been found that windows are distractors for managerial tasks. On the other hand, in restorative environments like hospitals and recreation areas they can pose problems because they allow rest and recovery, tend to increase one's ability to ignore distractions (As cited in Kaplan, 1983). Our psychological health

influences the way we perceive and make choices about our environments and cope with environmental stressors (Kopec, 2006).

In the future, research on the psychological effects of daylighting will lead to the development of new workplace daylighting and applications that not only provide physical comfort, but also improve satisfaction, productivity, motivation levels, and work satisfaction of the users (Stone and Irvine, 2001).

2.3. Meaning of Place and Daylight

Meaning of space is defined as an individual's concern for the physical environment as something that is worthy of protection, understanding and enhancement (Gifford, 2007). As cited in Kopec (2006), the meaning of place depends on how individuals conceptualize the world around them. After long experiences in an environment, places can acquire great personal meaning (Gifford, 2007).

Four processes are related to meanings of place: attachment, ideological communication, personal communication, and architectural purpose. "Place attachment" is a personal connection to a site. "Ideological communication" is an abstract concept that a place signifies. "Personal communication" is what the site says about the occupants. "Architectural purpose" is the building's function relative to its form or appearance (Kopec, 2006:61). "Place attachment" is one of the important notion which can be explained in the meaning of place. "It refers to the affective connections linking people to specific places or behaviour settings". It can be also defined as a person's bond with the social and physical environments of a

place (Altman and Low, 1992). When "place attachment" grows, the meaning of place and the meaning of self begin to merge (Gifford, 2007).

As cited in Clemons et al. (2005), Altman and Werner (1985) explained that place attachment and place identity suggest that a bond develops between people and objects or spaces when people attach psychological, social and cultural significance to them. No matter what the space is, an individual adds a personal touch to it, in other words, personalizes it.

Researchers have identified three elements which attach people to a place and affect their well-being. The first element is their personal characteristics and behaviour, and the availability of facilities, the second element is opportunities and resources and the third one is a sense of belonging. The "place identity" issue has two basic functions: "defining who people are and defending or protecting them from settings and properties that threaten who they are and what they want to be" (Kopec, 2006). "Sense of place" involves a kind of psychological distance between self and place, a sense of security, and being at home. It also involves feelings of belonging within the physical and social realms of place (Stewart, 2007). "Sense of place" is a theory that is about the feeling of belonging to an environment and security within it. Steele (1981) described a sense of place as a theory of experience of a person in a particular place or how he or she feels about the place (Clemons et al., 2005). It develops when a level of comfort and feelings of safety are associated with a place which for many people translates to a sense of belonging. There is also research about the effect of daylight on meaning of place.

The effect of daylight on meaning of place can be explained by Oldham and Rotchford (1983) study. They explained that the connection between place darkness and interpersonal contact is less obvious than the linkages involving the other place characteristics. When actual room size is held constant, people consider dark rooms smaller and less spacious than light rooms. This information can be used to bring people together or separate them according to the function of a space.

2.4. The Environment, Social Behaviour, and Daylight

Place characteristics might affect users' reactions through their influence on users' experiences with the environment. For example, employees may experience some offices as crowded because coworkers are in close proximity and have easy access to their personal workspaces. Employees may also have trouble concentrating in such offices. They may find it difficult to avoid interpersonal contact. In addition, since employees in such offices have little protected space and are in close physical proximity to their colleagues, employee's behaviour can be easily monitored by his/her coworkers and supervisor resulting in discomfort and a feeling of lack of privacy (Oldham and Rotchford, 1983).

Other elements of the environment such as noise and crowding are also viewed as stressors, although other social factors can also cause stress, such as job pressures, family discord or moving to a new home. Stress comprises emotional, behavioural and physiological components. Stress will occur if the environmental demands are greater than the person's capabilities or if the person's expectations are greater than the environment supplies (Salvendy, 1997).

In studies investigating the relationship between daylight and social behaviour, results showed that window preference was related to daylight, ventilation, mood, privacy, personal space, view of outside to see others, view of the outside for temporal information, time of the day, and room appearance. Window related factors also include task performance, safety, security, and glare (Butler and Biner, 1989). In addition, findings from studies investigating the effect of daylight showed mainly positive effects on the length of stay, mortality rate, and perceived stress (Dijkstra, et. al, 2006).

Veitch and Newsham (1998) have presented a model for lighting-behaviour research that includes six categories of human needs addressed by lighting. These are "visibility", "task performance", "social behaviour and communication", "mood and comfort", "aesthetic judgments", and "health and safety". The literature documents several psychological processes thought to mediate the relationship between lighting conditions and these behaviours and they can be discussed with other considerations such as energy efficiency, architecture and costs, to produce a model for achieving good-quality lighting in workplaces (Clements and Croome, 2006).

The interrelationship between the environment and social behaviour can be thoroughly analysed under four notions: "privacy", "personal space", "territoriality", and "crowding". In the following section, these four behaviours are explained according to the effects of daylight on them.

2.4.1. Privacy and Daylight

Privacy is important to human beings in managing their social interactions. Privacy does not mean removing oneself from the presence of others. Instead, it involves controlling the amount of contact with others (Pedersen, 1996).

There are three types of privacy: acoustical, visual, and territorial. For example, acoustical privacy is about noisy distractions like ringing phones, overhanging co-workers conversations, office machine, and outside sounds like can traffic and building construction. Visual privacy is about line of sight and deals with motion interruptions like sudden movements, foot traffic, and other visual distractions. Territorial privacy is about negotiating physical space and the natural human inclination to establish spatial boundaries. It can also hinder interaction, relationship building and the development and sharing of new ideas. When one is never in contact with others, information is easily lost and the transfer of knowledge is severely hindered (Hamp, 2008).

Psychological privacy comes from a sense of control over access to oneself or one's group. It includes control over transmission of information about oneself to others and control over input from others (Altman, 1975). This concept of privacy provides that people try to maintain an optimal level of social contact. Too little social contact might produce feelings of isolation, and feelings of being disconnected, and too much might produce crowding. Architectural privacy refers to the visual and acoustic isolation supplied by an environment. Architectural privacy may contribute to

psychological privacy because people in private quarters can control their accessibility to others more easily than in open and visible places (Sundstrom, 1980).

Block and Stokes (1989) mentioned that the issues of task difference are related to open and close plan offices, focusing on desire for privacy, sources of disturbance and effect on productivity. Employees, such as managers, who performing complex tasks, tend to prefer private settings for thinking and concentrating on what they are doing. Evidence for this comes from research on the open plan office, which uses no walls and few partitions and minimizes distances between co-workers whose jobs call for contact with each other (Stone and Irvine, 2001).

Veitch and Kaye (1988) explained that groups of female university students conversing about financial job candidates were louder under low illuminance (400 lux) than high illuminance (1274 lux). The authors speculated that the unusual nature of the dim lighting condition caused louder speech, conversely, students in a brightly lit classroom are usually not expected to speak loudly.

In addition, Maher and von Hippel (2005) examined that the perceived privacy and task complexity on the perception and performance of employees working in open plan offices, finding that satisfaction and performance of the employees reduced with poor stimulus screening, low perceived privacy or complex tasks (Yıldırım et al., 2007). As cited in Yıldırım, Akalın and Çelebi (2007), it is possible that partitions in an open-plan environment may reduce distractions and increase some of the required privacy for working. In general, privacy, communication, and satisfaction seem to increase as workspace enclosure height increases (Yıldırım et al., 2007).

The idea that removing physical barriers between office workers makes for greater communication is not always true. Open offices allowed for easiest communication but only when each person had their own enclosure. Ease of communication affects both environmental and job satisfication. Speech privacy, while contributing to ease of communication, only affected environmental satisfaction, not job satisfaction or performance. However, noise affected job satisfaction rather than performance (Yıldırım et al., 2007).

In the late 1970's, the Buffalo Organization for Social and Technological Innovation (BOSTI) carried out a study of environmental effects of work spaces. According to this study, if the loss of privacy and the loss of noise control can not be solved, the continuing pressure and possible dissatisfaction might very well contribute to exhaustion for the library users (Isacco, 1985). Today, teamwork and communication has become more important to organizational performance. Unfortunately, in the typical open plan, finding a workspace that provides adequate levels of privacy can be a real challenge. One reason is because many working spaces are not always designed to support the various types of privacy (Hamp, 2008).

The relationship between daylight and privacy can be explained by the study of Stone and Irvine (2001). They compared windowed and windowless rooms to investigate their effects on job performance, mood, and satisfaction. Confidence and control were rated higher in the windowless room. Windowless rooms provided more privacy and the absence of a window meant that all stimulation and distractions from the outside environment had been eliminated, allowing the students to focus on the task (Stone and Irvine, 2001). On the other hand, Kaplan (1993) worked on privacy

issues with the relation to the height of partitions and walls. Students in seats further away from a window with a low partition height would complain about planning and privacy requirements, but would be happy to have the daylight and view from outside provided by the lower partition height (Yıldırım et al., 2007).

In addition, Wotton and Barkow (1983) found that employees highly value any size of window that they can have access to and value it more than privacy in their office. Also, they found that 74% of the employees preferred to have a window close to their workspace. When offered a window, 57% of employees stated that they would like the window to be beside their workspace rather than in front or behind their workspace (Edwards and Torcellini, 2002).

2.4.2. Personal Space and Daylight

Robert Sommer mentioned that "personal space refers to an area with invisible boundaries surrounding a person’s body into which intruders may not come" (Gifford, 2007). It is a subjective experience. It does not exist without interaction and it is essentially a portable, flexible territory relative to other people and things. There are four basic interpersonal distance zones: "Intimate zone" (0-45 cm.) for close friends, lovers and family members, "personal zone" (45 cm.-120 cm.) for members of clubs and organizations, "social zone" (120 cm.-365 cm.) for friends of friends and "public zone" (365 cm.-762 cm.) for two people waiting for a bus on the same platform (Kopec, 2006).

A number of researchers have specifically examined the role of personal space in the built environment. Most of these studies have concentrated on personal space as reflected in seating arrangements in such public spaces as libraries, airports and schools. Most researches have centered on the effect of furniture arrangements on social interaction (Gifford, 2007).

Researchers began one study by observing how the managers of a university library reading rooms used the space. The researchers recorded which seats were taken, in what order, for how long and what sort of users. It was found that there was a strong tendency for users to select unoccupied tables if they were available. Individuals avoided choosing side by side arrangements, but when they sit side by side, conversation always ensued. If a table was occupied, the next most desirable seat was the one furthest from the other person. Seats that allowed a back to back arrangement were preferred over side by side arrangements (Gifford, 2007). These were not only studies about the effects of seating layout on personal space but also studies which discussed the effects of daylight on personal space.

The connection between daylight and personal space can be explained by the study of Oldham and Rotchford (1983). They proposed that more interpersonal contact was in dark places than in light places, because people experience these places as small and hence would feel physically closer to other people (Oldham and Rotchford, 1983). Furthermore, people are less tolerant of closer distances in dimmer lighting, seem to need more space in corners as compared with the centers of rooms and tend to prefer more personal space when they are indoors than they do when they are outside (Kopec, 2006).

2.4.3. Territoriality and Daylight

Territoriality is based on feelings of ownership. It involves the defense of physical space, as well as the exclusiveness of use, personalization and identity of that space by the occupant or user. When people are in their own space, they feel more secure and expect to be able to control distractions (Kopec, 2006).

> "Territoriality is a pattern of behavior and attitudes held by an individual or group, based on perceived, attempted, or actual ownership or control of a definable physical space, object or idea that may involve habitual occupation, defense, personalization and marking on it" (Gifford, 2007:166).

Territories can be explained with four notions: "Primary, secondary, public and interactional territories". "Primary territories" are spaces that are generally owned by individuals. "Secondary territories" are usually not owned by the occupants and are likely to change, rotate or be shared with others. "Public territories" are open to anyone and occupants can not expect to have much control. "Interactional territories" are temporarily controlled by a group of interacting individuals. For example, groups of students often use library conference rooms in order to discuss group projects; although no one student or group owns the room, no other student or group enter while the others occupy it (Kopec, 2006).

As cited in Clemons et al. (2005), "functional factors" of a quality interior space, such as daylighting, can improve feelings of relaxation and enhance creativity, use of daylighting, privacy and physical comfort. Moreover, "aesthetic factors" include those that relate to perceived beauty and personal well-being, and "personalization

factors" include establishment of status, depiction of family in the space, identity and a home-like environment.

As cited in Dinç (2007), in the study of Vischer (1996), air quality, thermal comfort, spatial comfort, privacy, office noise control and lighting comfort are considered as the integral parts of an overall approach. Besides these, also emotional attachment was introduced by Vischer (1996). Emotional attachment covers the following issues according to Vischer (1996):

> "Territoriality: Closure, personalization and labeling behaviours". "Home away from home: Decorating the office in a homely manner". "Conflict: Define and defense behaviour via shaping boundaries". "Size and status of office: Furniture and layout preference". It is obvious that if people do not feel attached to their workplaces, they do not feel high satisfaction from their workplaces (Vischer, 1996:1).

In the Dinç study (2007), findings showed that participants' attachment to their offices is highly related with the satisfaction of their emotional status at the time of studying. The more academicians feel positive during their concentrated work, the more they feel attached to their offices. Thus, the more offices can give users support for their privacy. Emotional attachment is a concept which is closely related with how the spaces are perceived, how they are decorated thus defined with their aesthetic content. The last significant one was the functional properties of space. Accordingly, sizes, adequacies, utility and facilities that take place in the rooms had effect on the emotional attachment that people feel for their workplaces.

As mentioned in section 2.4.2, the relationship between daylight and territoriality can be explained that more interpersonal contact was in dark places than in light places,

because people experience these places as small and hence would feel physically closer to other people (Oldham and Rotchford, 1983). According to this study, it can be said that if the place is dark, people create their territories closer to others in order to feel more secure.

2.4.4. Crowding and Daylight

Crowding refers to people feeling physically constrained and others interfere with them. This happens to people when there are too many people, too little space or both. Crowding is psychological, it is individualistic, and subjective. Feelings of crowdedness are directly proportional to the level of stress a person feels, increased crowding equals increased stress. For example, we expect libraries to be empty at certain times and when they are not we tend to feel more crowded (Kopec, 2006).

Finnegan and Solomon (1981) studied the relationship between the physical environment of the occupant and job satisfaction. Surveys of the occupants of windowless offices have shown that when the space is small and the occupant has little opportunity to leave the space, the occupants are less satisfied with their jobs and with the physical environment. In addition, the lack of windows is disliked, however, in larger spaces, the lack of windows has a much more variable impact. This may be because in a large space, there are many other activities going on and there is a lot of interaction between people. In a small office, it may be that the view out of the window is the only source of environmental stimulation (Boyce et al., 2003).

However, studies have also shown that high density (a high rate of environmental stimulation) is associated with low job satisfaction (Oldham and Rotchford, 1983). As cited in Oldham (1991), Block and Stokes (1989) found that individuals performing a simple task performed best when working in a room with four people, whereas individuals performing a more complex task performed best when working alone in a room (Oldham, 1991). Research has also shown that employees experience an increase in physiological and psychological stress after moving from conventional offices to open offices (Yıldırım et al., 2007).

Another study examined the impact of density changes resulting from moving to a new building. Results showed that professional employees who experienced an increase in density reported significantly more friendship opportunities and greater work satisfaction than before the move; employees who experienced a decrease in density reported a decrease in friendship opportunities and less work satisfaction (Oldham and Rotchford, 1983). Crowding might produce discomfort and decrease job performance. Sundstrom also found negative relationships between perceived crowding and people's job and workspace satisfaction. The study also showed positive relationships between experienced privacy and the measures of satisfaction (Sundstrom, 1980).

Regarding the effects of daylight on crowding, it has been stated in Kopec (2006) that, brightness leads to less perceived crowding and sunnier places are perceived to be less crowded than darker places. Also, less crowding is elicited by rectangular rooms than square ones and especially by rooms with windows.

In the next chapter, the design layout of the libraries according to daylight, location of windows, diffusion of daylight within the library space, and the effects of daylight on library users will be analysed.

CHAPTER 3

DAYLIGHT DESIGN IN LIBRARIES

This chapter focuses on how daylight can be used efficiently in libraries, mostly university libraries. However, it is not easy to separate the social role of the libraries in the community from the daylighting concepts. This is due to the concept of library as a place that brings the community together to partake knowledge. Therefore, when explaining the daylight usage in a library space, the reflection of the libraries on the city structure will be also mentioned in this chapter.

Since the beginning of the built history, architects have thought about daylight as one of the most important elements of design (Baker and Steemers, 2002). Daylight is not only an element of design but also there are psychological needs for daylight and views as a means for connecting to the outdoors and our internal clock that relies on cues from the environment. These relationships had not been investigated thoroughly until the research of Roger Ulrich and have gained significance especially with health and productivity (Sands, 2004). In the development of the overall building form, it is not always possible for the architect to see daylighting design as a primary consideration. However, with increasing realisation of benefits of daylight both from the psychological and physical environment points of view, new technologies in glazing and window construction, especially in terms of, daylight harvesting control systems for a more sustainable use of energy, the daylight criterion is moving up on

the list of priorities (Baker and Steemers, 2002; DiLouie, 2008).

The interior layout and circulation of a building affect the built form. The relationship between planning and form is to a certain extent determined by the quantitative daylighting needs of each space and by qualitative intentions of the design team. These two aspects of lighting criteria can be strongly related, particularly in terms of dealing with the transition between spaces and the setting up of a luminous hierarchy between the exterior and the interior. For example, the workplace environment, this issue of relationship between spaces and the lighting criteria have strong implications for internal planning and room layout. In such cases, the relationship between such uses need particular attention. The library is an example for buildings that need particular attention in terms of layout and daylighting (Baker and Steemers, 2002), and how spaces are perceived, used, judged, and evaluated by their users is very important for satisfaction of library users (Fisher, 2006).

Libraries are where books and people unite. It is not only a place where the things are kept but also a place where ideas are kept and utilised (Dickinson, 1946). Today, libraries are no longer viewed as spaces that stack books. With the accelerated development in information and communication technology, libraries have become more focused on people and learning processes than on just books, because libraries are fundamentally about people, how they learn, how they use the information and how they interact in a learning community. When redefining the role of the library as a center for learning requires, the integration of flexibility can be one key concept of a design. Allocation of internal spaces, movable partitions, modular interiors and

appropriate cable installations in floors and ceilings to allow for the integration of new technology to the space can be thought for designing a flexible satisfying environment (Wastawy, 2006). Therefore, the environment where the library users work becomes a basic concern.

Library buildings not only correspond to the information requirements of the users but also to the psychological requirements of the users by creating a cultural and social environment with their activities (Küçükcan, 2007). Libraries can be designed as inviting, attractive, comfortable and flexible connections of learning and social spaces and integrated technology, where the full range of their users with different study needs should be happy to remain for as long as they have a need.

> "It is important to recognise that not all people study in the same way. The new library model provided for a variety of study styles, with the character of the study spaces such as group study, individual study rooms, comfortable reading areas, study with coffee and with music, study spaces for people with disabilities and electronic study" (Bundy, 2004:6).

3.1. Selected Libraries According to Their Use of Daylight

This part focuses on the libraries according to their daylight use and these examples of libraries are classified into three: The first part discusses the examples of libraries from pre-20th century such as Jesus College Library (16th century), Trinity College Library (17th century), and Bibliotheque Nationale (19th century). The second part includes examples of 20th century such as Stockholm City Library (1928), University of Michigan Law Library (1933), Seinojoki Library (1965), Roveniemi Library (1968), Mount Angel Abbey Library (1970), Gentofte Public Library (1980), Darwin

College Library (1993), Phoenix Central Library (1995), and Harmony Library (1998). The last part looks at the examples of the libraries from post-20th century such as Minneapolis Central Library (2002), Seattle Public Library (2004), Free University's Faculty of Philology Library (Berlin Brain) (2004), and Santa Monica Public Library (2006).

3.1.1. Pre-20th Century Libraries

> "The survival of the library as a space is not dependent on smart architecture – it is dependent on the ability of the library to meet the needs of people and convicingly and value to their lives". (Thorhauge, 2004:20).

Many things have changed as libraries have developed over the years. The atmosphere, ability to find information, safety and organization of collections has change for creating a productive and satisfying user experience (See Figure 1) (Andrzejewski, 2008).

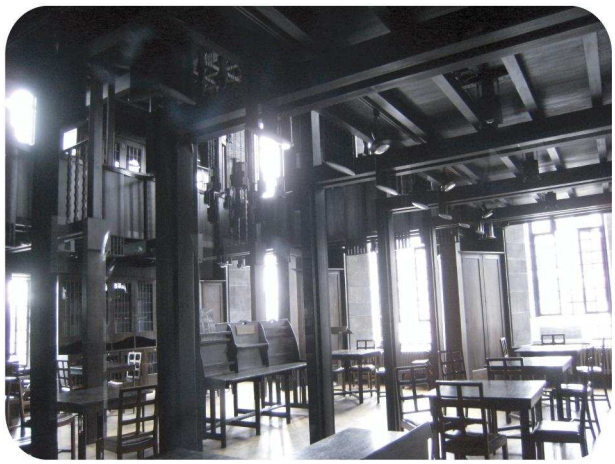


Figure 1: Glasgow School of Art Reading Room
(Photographed by author, 2008)

Jesus College Library (16th century), Trinity College Library (17th century) and Bibliotheque Nationale (19th century) are the most well-known libraries planned according to daylight use, and these libraries have also incorporated the typical features of libraries during that period.

3.1.1.1. Jesus College Library (16th century)

Generally, a medieval college library was a long narrow room lit by aligned windows on either side and by a window at one end. The windows and ceiling heights were much lower than that seen in later libraries and the windows in themselves were narrower and close together and there were a short distance from the floor (See Figure 2) (Datta, 2005).

Daylighting was very significant in medieval libraries because there were no means of artificial lighting and the users were dependent on daylight for reading. Jesus College Library in Cambridge has been chosen as an example here, because it incorporated the typical features of libraries during that period. Jesus College Library has a low ceiling height (2,8 m.) and is 14,6 m. long and 6,6 m. wide and has seven bays with narrow windows facing East and West (Datta, 2005).

It is seen that after 16th century, the considerations for personal comfort began to be generally accepted and the major glazing areas of the libraries changed from East-West to North-South (Datta, 2005). North light is the best for daylighting because it is indirect. South light is easy to control because the sun is high. Toward East and West the sun is low and horizontal so it is hard to control (Bently, 2004).

There are advantages for the main facades of a building to face North-South, rather than East-West. This is because the sun is low in the sky in the East-West, even in the summer, which makes shading difficult and impossible if a view is to be maintained. On the other hand, North-facing windows receive direct sunlight only in high summer, early in the morning and in the evening, while South-facing facades can be easily shaded by small overhangs, due to the high angle of the sun when it is in the Southern sky (Baker and Steemers, 2002).

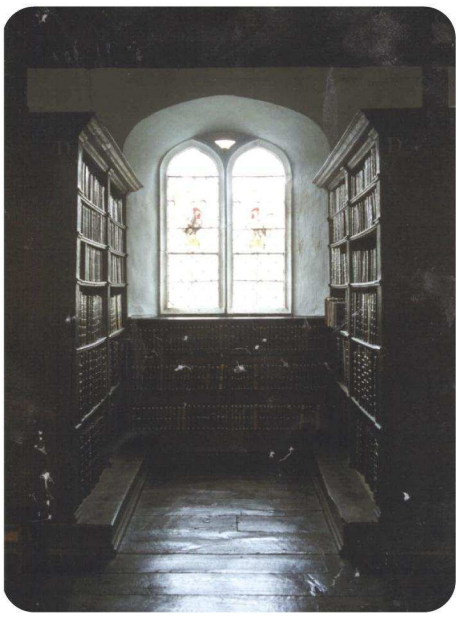


Figure 2: Jesus College Library
(http://www.maxfordham.com/projects-item**,** 2008)

3.1.1.2. Trinity College Library (17th century)

Trinity College Library was designed by Sir Christopher Wren has been studied as a prototype of this period since it initiated a rethinking in library daylighting and later buildings used the same techniques as applied by him.

Daylighting design of the library of Trinity College is very innovative for a 17th century construction. It aims for the reading activity to be efficiently lit without significant glare (Datta, 2005).

This library consists of one large space with a long corridor in the center. The lower edges of the windows are located 0.6 m. above the bookcases. Cornices prevent light from falling directly onto the shelves and tables below. Raising the windows above the bookshelves allows light to enter both from above and the side. It results in a homogeneous luminous environment suitable for reading and consulting documents (See Figure 3) (Fontoynont, 1999).

Figure 3: Trinity College Library
(http://www.cambridgelibrarytrainees.co.uk/ CATALOG/, 2008)

The arches on the ground floor were filled in till to gain extra height in the library above. By doing this, windows in the library rose high and gave place to the bookshelves. This method of rasing cill level of the windows as well as the ceiling height achieved more uniform and increased daylighting that could light up the book spines as well as give an amount of light on the workplane (Datta, 2005). The design layout of Trinity College Library is very similar to Jesus College Library.

3.1.1.3. Bibliotheque Nationale (19th century)

The Bibliotheque Nationale is important because of using daylight with an early application of iron in a monumental public building. The slender iron columns and arches are revealed by daylight. Daylight enters through oculi in the domed ceilings and through high North-facing windows. The rooflights provide daylight across the plan, but more importantly they light the structure with the help of the tent-like ceiling. The tent-like ceiling and iron structure are revealed in daylight by the circular rooflights in the domes and creates a poetic light inside the building (See Figure 4) (Baker and Steemers, 2002).

Figure 4: Bibliotheque Nationale seating layout (http://www.britannica.com/EBchecked/topic-art/, 2008)

3.1.2. Libraries of 20th Century

The main feature of 20th century libraries is the distinction between the places where books are stored and the places where they are read. The store rooms that are often placed in the lower floors are darker areas where lighting levels are low. On the other hand, the reading areas are generally daylit (Datta, 2005). Libraries have a variety of

lighting needs, such as reading areas, circulation and exhibition areas and computer work area. Two areas are specific to libraries which require special attention are the study carrels and bookshelf (Egan and Olgyay, 2002). In addition to this, another property of this century library is the user satisfaction and rendering high quality service to the users (Ucak, 2000).

In this century, library spatial atmosphere becomes important for satisfying users and with the spatial atmosphere it can encourage the users to work in the libraries. The formats of the knowledge and information begin to change in this period, so the value of the physical presence of university library space is the first place for the duration of the library users.

3.1.2.1. Stockholm City Library (1928)

> "Stockholm City Library which was built by Gunnar Asplund is another good example of how effective daylight is used in the library space. The substitution of a tall cylinder imparted monumental stature to the room and to the exterior of this moderately sized building, at the same time making it possible for light to be admitted through clear-glass windows in the outer walls instead of through the opaque glazing of the roof-lights" (Caldenby and Hultin, 1986: 92).

Visual and physical relations from one floor to the other are defined by light circular stair wells, which guide the users to the entire library. Their glazed walls display as a cabinet or bookshelf and as a strong light source caused by their translucency. The proposal interrelates the zones rather than forming a hierarchical circulation pattern. The idea behind is to create a flexible usage of each space and at the same time to form a strong identity within the space by the glazed round partitions and walls,

which reflect a soft light towards the study carrels and bookshelves (See Figure 5) (Hanada, 2007).

Figure 5: Stockholm City Library
(http://blog.buildllc.com/2008/08/the-modern-list-stockholm/, 2008)

3.1.2.2. The University of Michigan Law Library (1933)

The University of Michigan Law Library has received architectural awards with its new underground addition and creative use of it which was constructed by Gunnar Birkets & Associates (1924-1933). This underground addition shows the innovative glass trench that brightens the addition. A triangular opening in the foreground is another light source for the addition.

Light streams into this underground addition through V-shaped glass that reflects the original building and gives users a view of the Gothic tower from 56 m. below ground level (See Figure 6) (American Libraries, 1985).

Due to the underground placement of the building's structure, the skylighting provides the only connection to the outdoors. This addition contains bookstacks,

study areas, a lounge and space for future expansion. The library staff think that the open, airy quality, the views of sky and daylight quality, trees and satisfaction of the library makes it a successful design (American Libraries, 1985).

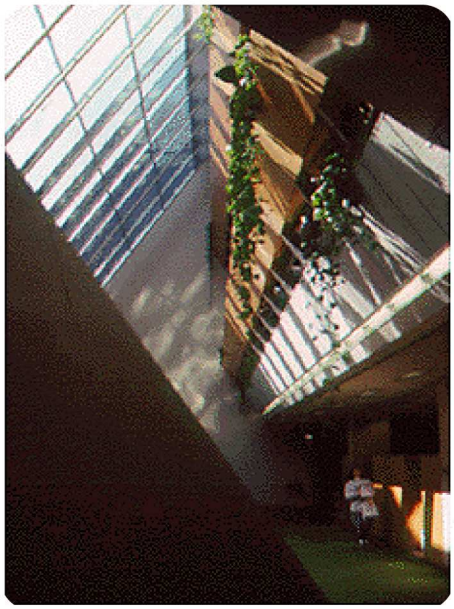


Figure 6: The University of Michigan Law Library (http://arch.ced.berkeley.edu/vitalsigns/workup/rpi/watson_michigan.html, 2007)

3.1.2.3. Seinojoki Library (1965)

Alvar Aalto is probably the most famous architect in this period who works with daylight in libraries, with the route, with massing and modeling of the building form He used daylighting as a primary design consideration for most of his buildings (Baker and Steemers, 2002) and he shows how to use architectural design features to create impressive spaces with daylight (SHCP, 1999).

In the Seinajoki Library (1963-65), Alvar Aalto worked with daylight again and split a double-loaded corridor block about a third of the way along to provide the focus of the library, the entrance and control desk. The roof identifies and contains the

functional separation of elements of the library, rising over the main stacks to allow light to enter and bounce around in the space (See Figure 7) (Dunster, 1984).

Roveniemi Library and Mount Angel Library are two examples of Alvar Aalto libraries and the common point of these libraries is the daylight is the primary design consideration.

Figure 7: Seinojoki Library seating layout (http://pro.corbis.com/search/Enlargement.aspx, 2008)

3.1.2.4. Roveniemi Library (1968)

Roveniemi Library has one of Aalto's most successful late interiors with several changes of level and with lighting designed to exploit the low Northern sun and in addition, it includes an exhibition room and small auditorium and in the basement, a music library and museum (Richards, 1978). Recurring features are the lightscoops and conical rooflights found for example in Rovaniemi Library (1965-68) (See Figure 8).

Figure 8: Roveniemi Library bookshelves
(http://pro.corbis.com/search/Enlargement.aspx?, 2008)

The conical rooflights provide focal points and illuminate the horizontal planes. Daylight can not directly enter the conical rooflights because their depth is sufficient to diffuse the low sun angles of Finland (Baker and Steemers, 2002).

3.1.2.5. Mount Angel Library (1970)

> "Mount Angel Abbey Library is another masterpiece of Alvar Aalto and it is known for its careful use of daylight, balanced with integrated electric light (Egan and Olgyay, 2002). The central space is ringed by skylights and the back part of the shape has large clerestory windows. These windows let in a pleasing light which permeates the library. Openings are framed views of the valley and mountains". (Aalto, 1970).

The center is the brightest space and has the greatest spatial complexity. Most of the light is indirect, although small slivers of direct sunlight enter the reference area. The Northern perimeter clerestory brings light against a ceiling, effectively toplighting the adjacent study carrels. Needs related to luminosity are supported by the layout of this building. For example, the most demanding needs are located where light is sufficient, carrels by the perimeter windows and reference reading by the central

clerestory. The book shelves are arranged perpendicular to the perimeter windows and central clerestory, so they do not block the light. The perimeter study carrels which are enclosed are glazed with clear and translucent panels, so the adjacent areas still benefit from the borrowed light (See Figure 9) (Egan and Olgyay, 2002).

The features for this library are most known with its daylighting. Aalto made best use of the available light to this Northern site- utilizing the North light to its full advantage (Sands, 2004). It has only 20% exterior glass and still manages to give daylight an important presence in the building. The critical thing here is not how much exterior glass there is within the building, but where and how it is used (Bentley, 2004). The curves of the monitors in the ceiling assist in the reduction of glare from the light and broadcast the light throughout the interior space. The skylights in this library make maximum use of already diffuse Northern light by using a curved reflective surface. Daylight is also provided to the stacks away from the atrium with solar tubes (Sands, 2004).

Figure 9: Mount Angle Library
(http://brettholverstott.blogspot.com/2008/06/, 2008)

3.1.2.6. Gentofte Public Library (1980)

This building was constructed in Copenhagen, Denmark. The success of this project has resulted in an increasing for support from other institutions in the municipality. The design for the library describes a two storey building with a central area that extends over both levels. The juxtaposition of the inward oriented library and the extensive park area around, creates one of the interesting dynamics of the design (See Figure 10).

Figure 10: Gentofte Public Library
(http://www.iea-shc.org/task21/, 2008)

The daylighting strategy of this library is skylights. To emphasize the central plaza, nine circular overhead skylights provide a considerable amount of distributed daylight. Continuous light clefs along the perimeter of this space highlight the galleries. These light clefs have vertical glazing in order to transmit changes of the luminance distribution of the sky vault more directly than the circular skylights do (SHCP, 1999).

3.1.2.7. Darwin College Library (1993)

New information and retrieval systems introduce new lighting criteria as can be seen in the Darwin College Library in Cambridge (See Figure 11).

Figure 11: Darwin College Library
(http://www.earchitect.co.uk/cambridge/, 2008)

In Darwin College Library, the corridor on the North side contains most of the books which receive light from the South. The main reading desks are located on the South side with large areas of glazing. Daylight levels are high and the glazing offers views across the river to a green space. The unshaded South leads to glare problems here when direct daylight falls on the reading area. However, in user surveys, it seems that this is tolerated due to the enjoyment of the outside view (Baker and Steemers, 2002).

It is not a conventional library in the sense that it combines both books and computers, as well as a seminar room, and a residential apartment. The study center of this library gives an immediate impression of light and space (Fontoynont, 1999).

3.1.2.8. Phoenix Central Library (1995)

Phoenix Library is located in Phoenix, Arizona and it is constructed of concrete walls to the East and West and glass curtain walls to the North and South. The interior is effectively daylit with skylights designed to deflect any direct sunlight penetration that may harm the books. The sun at sunrise and sunset during summer in Phoenix is just North of East-West. These sunshades on the North face of the Phoenix Library protect the body agains direct sunlight and the interior from the solar heat gain (See Figure 12) (Sands, 2004).

Figure 12: Phoenix Central Library
(http://flickr.com/photos/danielgreene/751694790/, 2008)

This building was chosen because of its reputation for energy efficiency. It was sculpted as "a box in the desert" and had a very complex solar control system with its light shelves and skylights (Burrelsman et. al, 1996).

The building is composed of two main parts, a central reading room which contains the library's public space and the saddlebags which contains the meeting rooms, service zones and rest rooms (See Figure 13). The reading room has glazed facades

to the North and South. With these glazed facades daylighting has been used for dramatic effect (Burrelsman et. al, 1996).

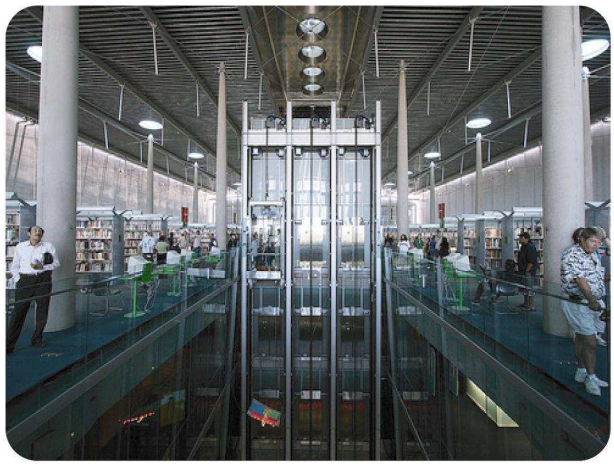


Figure 13: Two main parts of Phoenix Central Library (http://flickr.com/photos/danielgreene/751694790/, 2008)

3.1.2.9. Harmony Library (1998)

In 1998, Harmony Library was opened to the citizens of Fort Collins, Colorado and to the students of Fort Range Community College. Fort Collins is a city with a high level of awareness about energy efficiency and daylighting (Lighting Research Center, 2004).

This example was chosen because the daylighting design was part of an integrated, whole building approach intended to provide a high quality library environment. It also shows how thoughtful integration of architectural elements and electric lighting can result in good daylighting design (See Figure 14) (Lighting Research Center, 2004).

Figure 14: Harmony Library
(http://www.pubyac.org/gallery/harmonylibrary.html, 2008)

The design strategy of this library focuses on the main public areas that use daylighting, including the main bookshelves, public study areas and children's bookshelves. Like previous 20th century library examples, most windows face North and South, and this facilitates shading of direct sun and daylight penetrates deep into the central part of the bookshelves from upper clerestory windows. Bookshelves are oriented perpendicular to the windows, so both sides are free from shadows. In this library space, daylight is uniform, pleasant and free from glare (Lighting Research Center, 2004).

3.1.3. Post-20th Century Libraries

Daylight links the modern library user psychologically with the pre-technological past. Memorable library spaces for centuries have been characterized by volumes and surfaces illuminated with natural light, providing glare-free light in reading spaces (Dean, 2005).

Unlike other environmental services, the elements of daylighting are the most visual and expressive. The particular challenge of the modern library design is to manipulate daylight for reading and book storage. It is still a field not fully explored and it remains to be seen how daylighting design can successfuly meet all the needs of a modern library (Datta, 2007).

Minneapolis Central Library, Seattle Public Library, Free University's Faculty of Philology Library and Santa Monica Library are the examples of successful daylighting design in 21th century.

3.1.3.1. Minneopolis Central Library (2002)

Minneapolis Central Library was constructed by Cesar Pelli in Minneapolis in 2006. This example was chosen because it has an ideal daylighting scheme which supports human comfort. This library is famous for with its atrium (See Figure 15). This atrium links the building's North and South wings and it is flooded with daylight during the day. As in the atrium, the lighting throughout the building is developed to meet the needs of a modern library, including the technological advances of the information age. On the South side of the building –where the direct sunlight is the strongest– approximately 70% of the window wall is opaque glass, insulated panels that protects books and other materials from the sun's direct light. On the North side, a higher ratio of clear glass can be used to maximize daylighting and minimize the use of artificial light when the sun is out (Nayar, 2007).

> "Libraries are different than they were in the past", says the manager Butler. He adds, "on the one hand, a library is a grand civic building that embodies the cultural values of a community, they are much more social than they were before and serve as centers for community gathering with spaces for book clubs and lecturers". He also adds "each reinforced what the other needed all along and the building got stronger and stronger. Usually lighting is driven more by utility than by celebratory reasoning, because different aspects of this building were accentuated with light, in ways that make each one unique, the entire building feels more glorious" (Nayar, 2007).

It shows that the significance of physical environment and spatial atmosphere of library space for the satisfaction and perception of the users. The architect provided with the architecture, a symbolic relationship between the structure of knowledge and the articulation of space. The roof of the structure (planetarium dome) let the users know that this is more than just another library building (See 3.2.3. for social considerations) (Construction Bulletin, 2002).

Figure 15: Atrium of Minneapolis Central Library (http://www.metrocouncil.org/Directions/planning/, 2008)

3.1.3.2. Seattle Central Library (2004)

Seattle Central Library was constructed by Rem Koolhaas in Seattle, USA. It was chosen as an example of good daylight use into space. It connects people to the outdoors with daylight and views of the water, mountains, and the surrounding city. The building's glass exterior lets in daylight which decreases the need for artificial light (See Figure 16) (Ramus, 2003).

In the reading room on level 10, a North facing skylights brings in daylight. Even level 2, where books are stored, has daylight. This feature has not been included in most library processing areas (See 3.2.4. for social considerations) (Ramus, 2003).

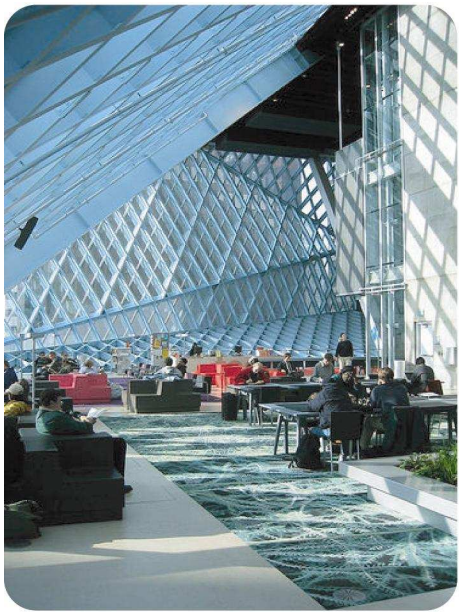


Figure 16: Seattle Central Library (http://www.flickr.com/photos/kellan/2008)

3.1.3.3. Free University's Faculty of Philology Library ("Berlin Brain") (2004)

Foster and Partners designed a campus library of Free University in Berlin. Its nickname is "Berlin Brain". The building is organised on a radial geometry and the white translucent panels of the dome diffused daylight throughout the space (See Figure 17). An inner fabric membrane of glass fibre filters the daylight and creates an atmosphere of concentration while transparent openings allow momentary views of sky. The bookshelves are located at the center of each floor with reading desks arranged around the perimeter (Foster and Partners, 2005).

Foster and Partners mentioned that this library has been designed to enable generations of students to study in an building that is filled with daylight and air (Foster and Partners, 2005). The building combines a concrete structural mass with a curved translucent skin that diffuses daylight and naturally ventilates the space.

Figure 17: The inside view of Berlin Brain

(http://1.bp.blogspot.com/_4b8inIdgm8M/ RmLT8c0zSFI/ free3.jpg, 2008)

3.1.3.3. Santa Monica Public Library (2006)

Santa Monica Public Library was opened in 2006. Daylight harvesting is the primary design goal of this library. The aim was to highlight local natural resources while protecting the environment and well-being (See Figure 18). Daylight penetrates the entire building, decreasing reliance upon artificial lighting (Lighting Control and Design, 2008).

The geometry of the building is like a rectangular donut which allows daylight exposure from two directions in the public reading areas. All windows have sunshades in the public area and these provide maximum comfort and reducing glare. The Santa Monica Public Library required a system with advanced programming capabilities to incorporate daylight harvesting principles to reduce electric light when daylight was sufficient (Lighting Control and Design, 2008).

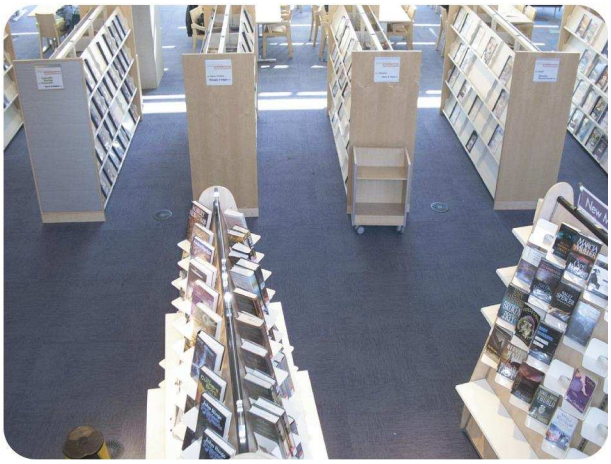


Figure 18: Santa Monica Public Library
(http://flickr.com/photos/21889415@N00/2617705288/, 2008)

3.2. Social Functions of Libraries

A library should be an environment where people feel comfortable and varied activities can take place. People expect a place where they can study individually or in a group. In the means of providing an environment for the different working and communication types of zones based on the different levels of noise can be created (Lines, 2004).

The digital revolution has changed the appearance of today's libraries. In the past, books made up library, but today information is available in a variety of forms. This makes using a library more complicated for the user and requires both the latest information technology and guidance. The library provides not only an environment for working and learning, but also place for people to meet and communicate (Hohmann, 2006).

Libraries serve as a symbols of knowledge, places for private study, gathering places for conversation, resources of information and a civic monuments representing that the community can be. The library has reflected these serious roles in a design that welcomes, protects and supports the user with the increasing of the importance of social factor of the libraries after the 20^{th} century. The design of a library can evoke its vision to be a welcoming place for the knowledge (Erickson, 2000).

New planning principles are required to meet the changing needs of the users of the library of the future. The majority of today's information resources are a non-physical nature and accessing information is more varied (Hohmann, 2006). The

recently completed examples of Lanchester Library, Minneapolis Central Library, The University of Nevada Lied Library, Peckham Library, Seattle Public Library, Santa Monia College Library, in addition, METU and Bilkent University Library and the Turkish National Library from Turkey are all highly popular, frequented and show current trends in library design.

3.2.1. Lanchester Library (2000)

The Lanchester Library at Coventry University opened in 2000. The design idea of this library is to make the power, network infrastucture and the configuration of library space as flexible as possible. An integrated learning resource center that brought books, journals together, the architects also wanted to include in the facility provision for other student facing services so that it was created a new focal point for student activity around the building was created. This included a cafe, a bookshop, and a copy center.

> "The vision of this library is to provide an exciting and highly effective center for information access study and learning, which will affirm the university's commitment to the students learning experience and to develop an exciting focal point for students which will attract and delight users and in which staff and students will find it a pleasure to work. In other words, we wanted a building that turned on its head the conventional view of the library by creating a building where students chose to go because they liked it" (Noon, 2008:131).

3.2.2. The University of Nevada Lied Library (UNLV) (2002)

Lied Library in Nevada University is another example of corresponding the requirements of the users in the high-level. This library is the resource center of the

university in which university students, university staff and people from community can meet (See Figure 19).

Figure 19: Outside view of the University of Nevada Lied Library (http://library.nevada.edu/oral_histories/index.html, 2008)

As mentioned by the architect of Lied Library, this library is alive in the late hours of Friday and Saturday night as well. It has become the heart and soul of the campus, a central gathering spot and an important campus resource for the students and the community. This library includes a dynamic, five-storey North-lit atrium, 100 seats, a 24 hour open coffee shop, automated storage and retrieval systems, collaborative study booths and small and large classrooms.

3.2.3. Minneapolis Central Library (2002)

The architect of Minneapolis Central Library, Cesar Pelli mentioned that this library embodies a sense of joy, excitement, imagination and discovery in it. It is a landmark library and cultural center library for Minneapolis (See Figure 20).

Figure 20: Minneapolis Central Library
(http://www.metrocouncil.org/Directions/planning/, 2008)

The design layout of the library provides a unique and recognazible structure as the city's living room (Post et. al, 2006). It includes a children's library for learning, imagination and discovery, teenage center, computer work area and community spaces such as galleries, exhibition areas, public common area and also cafe (Construction Bulletin, 2002).

The library's North section is for public use, the South section is not open to the public. The two sections are linked by pedestrian bridges. It creates a flexible environment. The library is in harmony with the urban geometry (See 3.1.3.1. for daylight use considerations) (Post, et. al, 2006).

3.2.4. Seattle Public Library (2004)

It is a good example of how a library can be redefined according to changing media and needs of the users. It offers much more spaces for social interaction including reading room, children's center and living room. Flexibility in the Seattle Public

Library is the creation of floors on which any activity can happen. Rooms or individual spaces do not have unique characters (See Figure 21) (Ramus, 2003).

The Seattle Public Library introduces a network of community centers for life-long-learning, cultural, and educational events. The interior design layout offers an attractive and comfortable environment both users and staff (See 3.1.3.2. for daylight use considerations) (Lines, 2004).

Figure 4: Seattle Public Library
(http://www.capndesign.com/photo/, 2008)

This means that bookshelves define generous reading areas an opening day. In this form of flexibility, the architects carefully designed these spaces for public gathering for many years to come. The primary consideration of Seattle Public Library is to redefine the library concept as an institution no longer dedicated to the book (Ramus, 2003). In other words, this library provides not only an environment for working and learning, but also a place for people to meet and communicate.

3.2.5. Peckham Library (2006)

Peckham Library is a reinvention of what is expected of a library building. According to the clients, the underlying philosophy is creating a dynamic building whose services people wanted to use, it is attractive to all age groups and to make a major contribution to the regeneration of Peckham. It gains an identity with its literature center, meeting space, conference hall, exhibition platforms, and cafe in the city. It means that the library becomes a busy urban center rather than just another building on a street (See Figure 22) (Cabe, 2007).

Figure 22: South facade of Peckham Library
(http://architectook.net/peckham-library/, 2008)

The North-facing side is covered with multi-coloured glass panels (See Figure 30). This design benefits the reading hall for excellent daylight penetration and spectacular views across London (Architectook, 2007). All these features make Peckham Library a cultural and social center of community. The primary aim of designing Peckham Library is to change the structure of the community and create a new opportunity for the people to spend their time in a cultural and educational center.

3.2.6. Santa Monica College Library (Renewed in 2007)

Santa Monica College Library won 2007 AIA/ALA Library Building Awards. The jury members thought: "The architects have transformed an out-dated library into a modern community landmark on a college campus". In this library, the goal was to modernize and enlarge the existing structure (See Figure 23).

Figure 23: Santa Monica College Library
(http://www.architectureweek.com/, 2008)

A new porch was designed for the library. It creates meeing spaces for the users and unifies the existing building with the new addition. This new porch has become the campus heart, a place to meet, come together and to learn (Architectureweek, 2007).

3.2.7. The New Library of Alexandria (19th century – renewed in 21th century)

The mission of the New Library of Alexandria is to be a center of excellence in the production and dissemination of knowledge and to be a place of dialogue, learning and understanding between cultures and people (See Figure 24). With this role, the

new complex is much more than a library. Apart from its function as a library that can hold millions of books, the complex has a center for the internet, and six specialized libraries for audio-visual materials (Wastawy, 2006).

Figure 54: Outside view of the New Library of Alexandria (http://www.wayfaring.info/index.php?s=Helsinki, 2008)

In addition, there are three museums, an exhibition hall for children, as well as the two permanent exhibition, six art galleries for temporary exhibitons, a conference center and eight research institutes has managed to become an embodiment of a true learning space. With all these functions in it, this library encourages the community to take an active role in the learning process and the library invites the public to become an active participants in a learning community. By making all its resources available to the public, bringing all forms of knowledge closer to the people, the new Library of Alexandria is a living example of learning space (Wastawy, 2006). The design idea is to design a library where the books are secondary in the act of gathering knowledge (Erickson, 2000).

3.2.8. The METU Library and Bilkent University Library

The METU Library and Bilkent University Library can be stated to be examples for the best university libraries in Turkey because (as mentioned in the Introduction Chapter) these two libraries have changed the concept of library viewpoint with their exhibition platforms, conference halls, multimedia and projection zones, and gathering places.

The METU Library (12058 m²) is an independent library building with the conference hall and exhibition space. It is not only the resource center of the university but also the gathering space for university students with the activities in them such as exhibition platforms, conference halls and group work areas. It also has individual study carrels in order to study without others crowding the users. For all these reasons, it is the most used university library according to seating layout (Karasözen, 2007).

Bilkent University Library (13165 m²) has two separate buildings with the conference hall and exhibition space (YÖK, 2008). There are also 17 individual carrels in which users can listen to music. Working tables, carrels and bookshelves were located according to daylight entrance to the space (Arkiv, 2008). The number of use of the libraries can be increased by providing adequate physical conditions, designing space for individual work and team work, exhibition platforms and conference hall (İzmir University of Economics Strategical Report, 2007).

3.9. The Turkish National Library (Ankara) (1983)

National libraries are in charge of collecting all scientific and cultural documents and transferring them from generates to generates (The Turkish National Library, 2008). The Turkish National Library is one of the youngest national library in the world. It was opened to users in 1946, but this building did not meet the future needs of the users, the new building was completed in 1983. The library is built on a space of 39.000 m² and is large enough to enable the addition of new modules. It is consisting of three modular blocking and has reading rooms, group study areas and study rooms for five arts. There are also exhibition halls and multi functional concert halls (Journal of Ottoman Calligraphy, 2006).

The function of this library is to follow the developments in the field of library and information science and get to know the library systems abroad through effective coordination with libraries and information centers abroad. The users of the Turkish National Library come from different parts of the community, including students, academics staff and researchers and has the collection of more than 1.200.000 books (The Turkish National Library, 2008).

3.3. Illumination Levels in Libraries

The examples of reinvention of library building viewpoint bring the importance of satisfaction of users when spending time in the libraries. With this viewpoint, the physical conditions of library space affect the length of stay of the users in it. For instance, the light level of reading area affects the duration of library users. If the

space is not well-lit, they can spend less time because of visual discomfort (Küçükcan, 2007). The number of users of a library illustrates the efficiency of using library building. The satisfaction of library users increase the efficiency of using the building, satisfied indoor environment affects the efficiency of users in it. It may be stated that, in the future, an adequate amount of daylight at the workplaces will be a deciding mark of quality, not only for the building itself, but also for gaining highly-motivated users.

The luminous program needs for soft glare-free light to read, to circulate in and to find stored books, must be combined with a quiet atmosphere which supports concentration and contemplation (Egan and Olgyay, 2002). Visual perception has 95% importance in the relation between environment and users. For visual perception, light is a key element. To know how much light is necessary for the specific function and volume is the important part of application (Küçükcan, 2007). It is concerned with the distribution of the brightness of surfaces, not just the task or object of interest, but also the surrounding surfaces, the views of which contribute to a person's overall perception of the space and satisfaction with it (Baker and Steemers, 2002). Visual functions parameters are used to determine whether a given lighting condition permits sight or visibility and are directly related to the physiology of the eye (IES). Good visibility is defined by an adequate quantity of light for the expected visual task and the absence of glare (SHCP, 1999). Following is the information about recommended light levels for libraries according to IES Lighting Handbook (1987) (See Table 1) (Küçükcan, 2007). The table gives general information on lux levels. For each individual library effectors such as, climate,

daylight, orientation of building, window size and shape, artificial light, design layout and contrast between the spaces should be considered.

Table 1: Recommended light levels for libraries

Function	**Lux Needs**
Auditorium	100-150-200 lux
Entrance	50 lux
Conference hall	200-300-500 lux
Exhibition hall	1500-3000-5000 lux
Book shelves	200-300-500 lux
Individual carrels	200-300-500 lux
Computer desks	500-750-1000 lux
Desks for handwriting	500-750-1000 lux
Circulation desks	200-300-500 lux
Permanent publications area	200-300-500 lux
Relaxation areas	100-150-200 lux
Circulation path (corridor, stairs, hall)	50-75-100 lux

In libraries, artificial light must be supported by daylight. Every space of the library building needs daylight for visual comfort, social relationship with others and a sense of well-being. The research on this subject has shown that the information which is learnt in daylit environment is not forgotten easily (Dean, 2005).

For good daylighting design, low glare lighting is a principal objective in libraries. Discomfort glare is a sensation of annoyance caused by high or non-uniform distributions of brightness in the field of view (SHCP, 1999). Ideal ratios of

brightness levels within the field of view are described at 10:3:1, for brightness of visual task to brightness of the immediate surround to brightness of the general surrounding. A library space that largely achieves these ratios can be considered to have a good level of visual comfort and no glare conditions (Dean, 2005).

The effect of lighting on vision is the most obvious impact of light on humans. Physically or physiologically, daylight is just one more light source. How daylight influences visual performance depends on how it is delivered. Either good task performance or poor task performance can be expected depending on the amount of daylight delivered and whether glare, shadows or reflections are produced. Poorly designed daylighting will deliver either inadequate amounts of light, so that electric lighting has to be used (Boyce et al., 2003).

There can be no guarantee that daylight will always be successful in maximizing visual performance. Daylight can cause visual discomfort through glare and distraction and it can dimnish the stimuli the task presents to the visual system by producing reflections or by shadows. The satisfaction of daylight for visual performance will depend on how it is delivered (Boyce et al., 2003).

The first requirement for library lighting is to provide enough light to accomplish a visual task such as reading. The second requirement is that the contrast brightness of other objects within the field of view must not be excessive, such that the library user can view the task comfortably and not become visually fatigued over time (Dean, 2005).

Daylighting design is part of the overall lighting design of a library (Baker and Steemers, 2002). One of the characteristics of daylight is its variability. The amount of daylight and its direction at the window or roof of a building varies during a typical day as the sun moves and seasonally as the sun's position in the sky changes. Daylight direction on cloudy days is still variable, though the light is more diffuse than on a clear day. It is important in libraries to maintain a relatively constant light level for visual tasks so that short term variability does not become distracting or inadequate (Dean, 2005).

Consequently, daylighting plays an important role in the libraries. The quality of light is more significant than its quantity (Evans, 1981). There is a clear need to study the effect of the visual environment on people's behaviour. As it is mentioned, visual comfort is generally affected positively in daylight compared to artificial light (Yıldırım et al., 2007). In addition, as Vischer (1996) mentions, better comfort ratings are generally received from people with access to windows than from those seated away from windows in all types of space. Boubekri, Hulliv and Boyer (1991) analysed that the impact of daylight on job satisfaction. It is well documented with the penetration of sunlight into the workplace assessed in terms of both its duration and the size of the sun patches. The researchers studied comfort ratings in relation to access to a window and daylight and the positive effects of it to the occupants' satisfaction.

In this study, the relationship between satisfaction of users and daylight will be investigated. The benefits of daylighting in libraries is not governed by energy conservation, but by the increase of users' satisfaction and performance. The benefits

of daylighting in library buildings have been mentioned by many researchers, but there is no work attempting to show relationships between satisfaction, preference of users and daylight comparatively in terms of university libraries that this study analyses. The university libraries are chosen, because universities are now more concentrated on student-centred and problem resource-based learning and information literacy development. Thus, with this point of view, university libraries are the significant position in the education role of the university students.

CHAPTER 4

THE CASE STUDY

This chapter describes the methodology that was used in the study to provide an understanding how the research was conducted. It documents of the steps while conducting the research that explains the interpretation of the research analysis results. Thus, this chapter is intended to provide this full documentation of the research process.

The chapter begins by discussing the pilot studies in the library of İzmir University of Economics and in the library of Duncan of Jordanstone College of Art and Design. Pilot studies are the part of the methodology which experience the instruments for the case study. The case study of the Main Library of Dundee University is described in the last section of this chapter. In the case study, the results of the questionnaire are discussed and certain scenarios for future studies are given according to the users' answers and comments.

4.1. Methodology

The data collection process mainly makes use of 2 different instruments: observation and questionnaire. The physical model, the heliodon and artificial sky were added after the pilot studies were completed. After the participants were randomly assigned

according to the users of the library at the chosen time (See Section 4.1.1. for further information), pilot studies were carried out in the library of İzmir University of Economics (İUE) and library of Duncan of Jordanstone College of Art and Design (DoJ). After the pilot studies, the case study was carried out in the Main Library of Dundee University. The data was collected on site by the researcher in the pilot study of DoJ Library and in the case of the Main Library of Dundee University, and by 3rd year İUE, Interior Architecture and Environmental Design students in the pilot study of İUE Library. According to observation and questionnaire with the library users and library staff, the statistical values were calculated and recommended potential future activities and design suggestions for designing the university libraries.

4.1.1. Participants

The participants of the study were randomly assigned according to the users of the library at the chosen time during the day of the application. Thus, the users of the pilot study libraries (İUE and DoJ) in addition to the case study (The Main Library of Dundee University) were the participants. In the pilot study of library of İzmir University of Economics, there were 77 participants of whom 35 (44%) were male and 42 (56%) were female. The majority of the participants (64%) were between 18 to 22. The remaining (36%) were between 22 to 30. In this library, participants were all from different fields such as design, human relations and economics (See Table 2).

Table 2: Weather condition and time information during the questionnaire application

Participants	Weather Conditions	Participants	Time
20%	sunny	13%	9.00-11.00 a.m.
26%	overcast	46%	11.00-13.00 p.m.
54%	rainy	28%	13.00-16.00 p.m.
		13%	16.00-18.00 p.m.

The second pilot study in the library of Duncan of Jordanstone College of Art and Design, there were 33 participants of whom 15 were the staff of the library. There were 18 university library users who completed the questionnaire of whom 27% were male and 73% were female. The majority of the participants (55%) were between 22 to 30, 28% of them were between 18 to 22 and the rest (17%) were between 30 to 40. All participants completed the questionnaire in the sunny weather mostly in the middle of the day. Half of the participants completed the questionnaire between 11.00-13.00 p.m., 33% completed between 16.00-18.00 p.m. and the rest completed between 13.00-16.00 p.m. The library of Duncan of Jordanstone College of Art and Design located in the design building. Therefore, all participants were from design students or from design background.

In the case of the Main Library of Dundee University, there were 81 participants of whom 20 were the staff of the library. 41% of the participants were male and 59% of the participants were female. The age range was between 22 to 30. Half were between 22-30, 43% were between 18 to 22, and the rest was between 30 to 40. The Main Library of Dundee University could be used by all faculty members and students. Therefore, there were both students between 18 to 22 and faculty members

between 30 to 40. Half of the participants completed the questionnaire in the sunny weather, 27% of the participants in overcast sky, the rest in the rainy weather condition. 70% of the participants finished the questionnaire in the middle of the day between 13.00-16.00 p.m. 30% finished between 11.00-13.00 p.m.

Participants for the pilot studies and the case study were all chosen from the library users who use the library for studying, reading and doing research at the choosen time in the library.

4.1.2. Observation

This part discusses the process and results of the observation which were done in the pilot studies of İUE Library and DoJ Library and in the case of the Main Library of Dundee University during the chosen observation day.

4.1.2.1. The İUE Library

In the first pilot study of the İUE Library, 3rd year IAED students were responsible of conducting observations and questionnaire with the library users. They began the observation at 09.00 a.m. and ended at 17.00 p.m. during the chosen observation day. In addition, the observations were continued in different weather conditions by the students. They marked the seat preference of the users to the library users' observation sheet at specific time of the day and tried to figure out that how often the users use the library for studying, reading and doing research and where the users prefer to sit in the chosen observation time (See Appendix A.3.).

According to the observations, the library users prefer to study in the ground floor because of more privacy and concentration. In the ground floor, there were large tables for studying as a group and individual carrels for studying alone. This area could get daylight efficiently between 09.00 a.m. and 13.00 p.m.. Therefore, users mostly preferred to study in the ground floor. The first floor did not provide a space for individual work and group work and they suggested more groupwork areas in the library. During the midterm and final periods, the library place was very crowded, so the users mentioned a need for more flexible and multifunctional furniture in the library.

In addition, the users stated that they needed more comfortable places to read magazines, news and books. The library organization was not comfortable for the users. The spaces between desks and bookshelves were not enough for studying in concentration and the carrels in the middle of the library were not preferred by the users because of the privacy problem. It also affects the amount of time spent in the library. They suggested locating the bookshelves in the middle of the library to get daylight easily to the workspace and to have a more comfortable library organization.

According to observations, daylight affects the users' seat preference and the amount of time spent in the library. Users preferred window seats between 09.00-13.00 and to sit at a central location because of the glare in the afternoon. In addition to these, they suggested a social area for drinking or eating in the library. Users thought that the library should be changed into a meeting point for the students instead of just a research center.

4.1.2.2. DoJ Library

The second pilot study was made in the DoJ Library in Dundee, Scotland. These two libraries (DoJ Library and İUE Library) have been similarly using their spaces for electronic, group work, and individual study areas. The observation was made on the chosen days by the researcher in the early morning at 9.00, in the afternoon at 13.00 and at 17.00 towards the closing time of the library. The researcher marked each user's seat preference on the observation sheet at the specific time of the day (See Appendix B.2.).

It was found that the users generally preferred to study between 09.00 a.m. to 15.00 p.m. because of the amount of daylight in the space and chose to study in the individual study carrels near the window where they could also access the outside view. The groupwork area could not be used efficiently because of the design layout. The orientation of the bookstacks did not allow to study as a group. If the users wanted to study as a group, they had to use the area for the journals. However, mostly this library was used by design students who wanted to make research and study by themselves.

4.1.2.3. The Main Library of Dundee University

The main library of Dundee University, Scotland was chosen as a case study. In this study, the observation was also made by the researcher. The observation method was not changed after the pilot study of DoJ Library. The observation was made on the chosen days at 09.00 a.m. in the morning, at 13.00 p.m. in the afternoon and at 17.00

p.m. The researcher marked each user's seat preference to the observation sheet at the chosen time of the day. The observations gave the idea about how daylight and the outside view affects the users' seat preference and in which time of the day users prefer to use the library more. The amount of daylight in the space was changing throughout the day. It was seen after the observations that, the users preferred to use the library for different purposes mostly in the middle of the day and they usually preferred a seat near the window and where they could be alone.

Mostly, the users did not want others crowding them and therefore preferred a carrel with visual partitions. In this library layout, all individual study carrels were located near the window and the partitions allow the taking of daylight to the desk work area and access to the outside view. The design layout of the library allowed opportunity to study alone and to take enough daylight into the study area due to the low partitions. It also allowed to study as a group without disturbing the individual study carrels and study in the computer part. According to this observation, it can be said that the main library of Dundee University is used after it gets dark because of the good organization of the specific work areas. Questionnaires were self-administered by each user in each pilot study and the case study and observations were made to double-check the findings.

4.1.3. Questionnaire

The questionnaires were done with the library users who used the library for studying, reading, and doing research at the chosen time in the library. It is a part of a research project to determine users' satisfaction with daylight in the library space

considering the 4 environmental pyschology issues; namely privacy, personal space, territoriality, and crowding.

The study was conducted using a questionnaire consisting of 5 parts. All parts of the questionnaire made use of a 5 item-scale. The respondents had to evaluate the importance of each question on a 1 to 5 differential scale where "1" meant "strongly disagree" and "5" meant "strongly agree". Initially, some general information was collected from the user such as age, gender, weather condition and the time of the day (See Appendix A.4., B.3., C.2.).

The first part of the questionnaire included some questions about "privacy" preference of the users. The second part of the questionnaire also consisted of a 5 point numerical scale which measured "personal space" regulations of the users. The third part measured "territoriality" preference and the fourth part included some questions about "crowding". The last part was about the daylighting preference of the users in the library place such as where they prefer to sit in the specific time of the day.

After the first pilot study which was carried out in the library of İzmir University of Economics, some questions were altered for clarification purposes. In addition to this, it was realised that there were not enough questions assessing "Visual Comfort". Therefore, a "Visual Comfort" part was added to the questionnaire before the second pilot study which was done in the library of Duncan of Jordanstone College of Art and Design. In the second version of the questionnaire, there were 35 questions

covering the plan of the library place for showing their seat preference at the specific time of the day.

After these two pilot studies at İUE and DoJ, the main library of Dundee University was chosen as a case study. In this case study, the questions were arranged one more time for clarification. In addition, the cover page was added for explaining the aim of the study to the users. In the final version of the questionnaire, there were 35 questions covering the 4 processes of environmental psychology, daylighting preference part and "Visual Comfort" part. In total, it consisted of 6 parts with the plan of the library place for showing their seat preference at the specific time of the day.

4.1.4. Pilot Studies: İzmir University of Economics Library and DoJ Library

Two different university libraries were considered as pilot studies in this research. One of them is the library of İzmir University of Economics located in the university building and the other pilot study is the library of Duncan of Jordanstone College of Art and Design which is also within the university building. Each library faced the North-West direction and they have been similarly using their spaces for computer work, group work, and individual work. In addition, each library had direct visual access to the building’s windows and therefore had a chance to view the natural landscape and make use of the daylight in the work area.

The first pilot study was done in the library of İUE (See Figures 25 and 26).

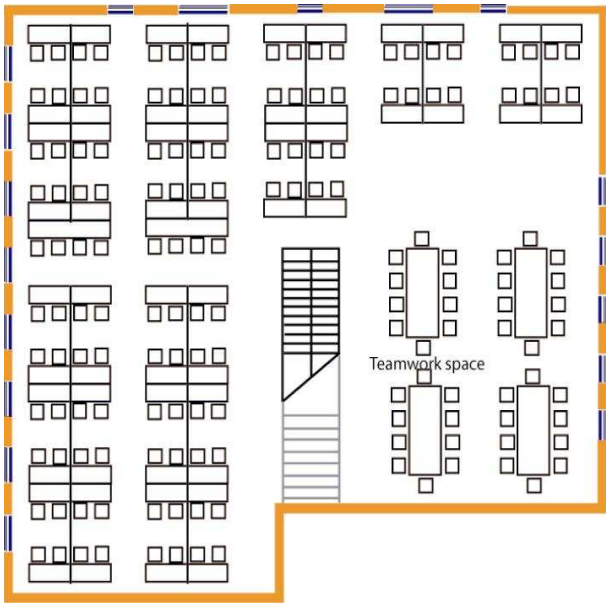


Figure 25: Ground floor plan of İUE Library
(Drawn by author, 2008)

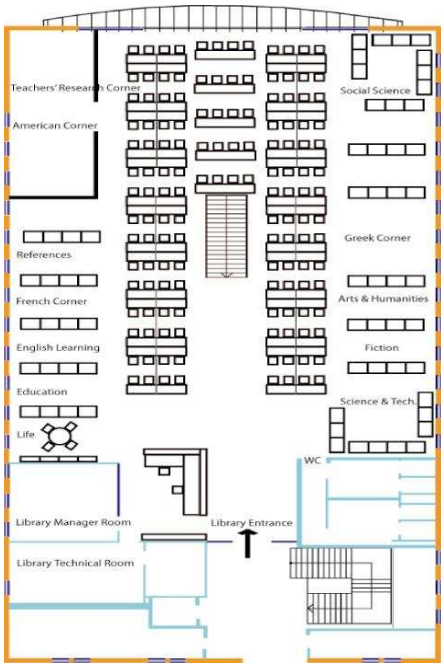


Figure 26: First floor plan of İUE Library
(Drawn by author, 2008)

According to the interview based on the questionnaire with library architect Mehmet Hamuroğlu, the conference hall of İzmir University of Economics was initially thought to be used as a library. However when the library needed to enlarge, he designed the present space as a library. He designed the library on two levels, but the lower level was not put to use until 2006. In the first plan of the upper floor, there were sitting units between the book shelves, but the seating and circulation orientation were changed because of the addition of British Council library collection. Initially, he had suggested modules that were 2×3 m. for the lower floor and gathering places in the center of these modules, but according to rector, the lower floor must be total space which the students can study and discuss as a group without modules, hence he had to redesign lower floor plan. He designed the North facade as a source of daylight. This library had allocated spaces for study as an

individual, journals, group work and computers. On the other hand, as the library architect explained that there was not enough space to work without others crowding the users and concentrate on their work because of the number of bookstacks in the library (See Figures 27 and 28).

Figure 27: The view from ground floor plan of İUE Library

(Photographed by author, 2008)

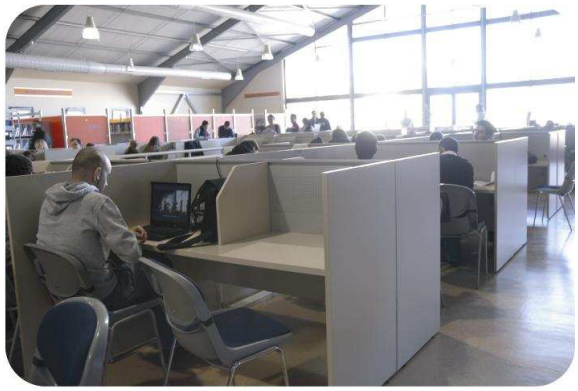


Figure 28: The view from first floor plan of İUE Library

(Photographed by author, 2008)

4.1.4.1. Results and Discussion of İUE Library

Observations and questionnaires were the instruments used in this pilot study. The questionnaire results were analysed by SPSS 13.0 using Chi-square test. Chi-square demonstrates a statistically significant relationship between two chosen variables or if they will show that the two variables are statistically elaborate (Einspruch, 1998). The results and discussions of the questionnaires are explained below:

- **Finding 1:** There was a significant relationship between weather the users preferred their seats according to daylight and whether the users have places where they can be alone if they want to (X^2=39.54, df=25, $p<0.05$). The users prefer to study near a window which also provides privacy space for study. Privacy is also as important as daylight for the users for study. The individual

study carrels near the window provide a space for the users where they can be alone if they want to.

- **Finding 2:** There was a significant relationship between the seating preference according to daylight and if the users believed that they had sufficient space allocated for study (X^2=19.18, df=10, $p<0.05$) and it is related to the perceived comfort of library organization (X^2=98.33, df=25, $p<0.01$) and how pleasant the user found the library place (X^2=102.97, df=25, $p<0.01$). In this pilot study, it is shown that most users prefer window seats and these window seats provide sufficient space for studying. This means that in this library, there are enough individual carrels near a window for study. Users think that if they choose a window seat and it is sufficient for study, they perceive the library place comfortable and pleasant place for studying.

- **Finding 3:** There was a significant relationship between the amount of time the user spent in the library based on daylight and the perceived comfort of library organization (X^2=101.28, df=25, $p<0.01$) and how pleasant the user found the library place (X^2=93.63, df=25, $p<0.01$). The amount of time spent affects the users' perceived comfort. If the users spend much time in the library because of efficient daylight in the work area, they perceive the library organization comfortable and they think that library is a pleasant place for study.

- **Finding 4:** A significant relationship was found between if the users thought that the seating layout was designed by daylight and if they believed that they had sufficient space allocated for groupwork (X^2=29.44, df=10, p<0.001) and it is related to the perceived comfort of library organization (X^2=98.69, df=25, p<0.01) and how pleasant the users found the library place (X^2=97.19, df=15, p<0.01). In the library, each function has different lux needs. If the seating layout was designed according to daylight, it provided sufficient space sufficient space for groupwork. When the users were given the opportunity to study as a group in the library, the users thought that the library had a comfortable library organization and a pleasant space for the users.

- **Finding 5:** There was a significant relationship between if the users thought the circulation areas were designed by daylight and the perceived comfort of library organization (X^2=68.10, df=25**,** p<0.01) and how pleasant the users found the library place (X^2=71.11, df=25, p<0.01). In addition, there was a significant relationship between if the users thought the arrangement of bookshelf were designed by daylight and the perceived comfort of library organization (X^2=100.09, df=25, p<0.01) and how pleasant the users found the library place (X^2=100.97, df=25, p<0.01). If the circulation areas and the bookshelf schemes are designed according to daylight, it creates a comfortable library organization and a pleasant place for the users for study. The perpendicular organization of bookshelves to the narrow windows in the East-West orientation creates perpendicular circulation paths to the study carrels in the middle part of the library. This design layout helps to take

controlled daylight in the work area from East and West. The controlled daylight creates a pleasant library space for the users.

- **Finding 6:** There was a significant relationship between a preference for enough space to work without others crowding the users and if the users thought the seating area belongs to them (X^2=109.22, df=25, p<0.001). In addition, there was a significant relationship between if the users felt that they could change the arrangement of furniture and equipment, and if the users thought the seating area belonged to them (X^2=107.27, df=25, p<0.001). This is related to the perceived comfort of library organization (X^2=54.20, df=25, p<0.001). Users feel that they have enough space to work without others crowding them and they do not have to change their seat during their work time. Thus, they feel that the seating area belongs to them during the work time. If the users spend much time in the library in one place because of good concentration, they can change the arrangement of furniture and equipment in the work area. It also creates the feeling of belonging for the users. The feeling of freedom creates comfortable library organization for the users.

- **Finding 7:** There was a significant relationship between enough space for the users to be able to concentrate on what they are doing and the amount of time spent in the library in one place (X^2=31.71, df=20, p<0.05). When the users find enough space to be able to concentrate on what they are doing, it affects the amount of time spent by them in the library in one place. The amount of time spent in one place generally shows the satisfaction of the users in any work space.

- **Finding 8:** There was a significant relationship between a preference for partitions for visual privacy and if the users believed that they had sufficient space allocated for PC's (X^2=17.55, df=8, p<0.05). However, there was not a significant relationship between a preference for partitions for visual privacy and if the users believed that they had sufficient space allocated for study (X^2=4.96, df=8, p>0.761), journal (X^2=6.95, df=8, p>0.541) and group work (X^2=5.95, df=8, p>0.653). The study shows that there are sufficient space allocated for PC's and this spaces have partitions for visual privacy, but there are no partitions for visual privacy in study work area, journal area and group work area. Thus, the users prefer to study in PC's work area. Partitions are generally thought in connection to PC's and their screens. Thus, they are neglected from other library areas in design. However, these results show that there is a need for visual privacy and controlled daylight.

- **Finding 9:** There was a significant relationship between enough space to work without others crowding the user and the perceived comfort of library place (X^2=43.65, df=25, p<0.05). The study shows that if the users can find enough space to work others crowding them, they perceive the library place comfortable. Finding sufficient space they can spend much more time in the library and they can concentrate on what they are doing. It affects their perception to the library place and the satisfaction of the users.

Depending on the users' comments in the pilot study which was carried out in the İUE Library, the observers made certain design suggestions. The following are suggestions for seating units.

One of the observer suggested an insulated glass cube which includes seating units and plants in it. They can be placed in specific areas in the library for the users who want to study alone without others crowding them. These glass cubes provide a private space where the users can be alone if they want to. The observer suggested the glass tube because of the privacy needs of the library users. He/she thought that this design unit can be useful for the crowded days of the library (See Figure 29).

Figure 29: Glass tube suggestion for İUE Library
(drawn by İUE student)

Another observer suggested a seating unit for the center part of the library. This chair gives inspiration and is suitable for an interactive space in which relaxing, study, talking or eating, and drinking can be take place. This structure includes a bookshelf at the back part and seating area in the reversed angle. In addition, the observer thought that all students could be able to get the same amount of daylight when they are studying in this structure (See Figure 30).

Figure 30: Seating unit suggestion for İUE Library (drawn by İUE student)

This seating unit provides an alternative solution to the seat preference according to concentration need of the users. The observer suggested this seating unit in the middle part of the library, because he/she thought that university library could be a meeting point for the student for relaxing and spending time. The circular shape of the design unit allows the reception of the same amount of daylight to the seating area and created a social platform in the library place.

The second pilot study was done in the library of DoJ in Dundee, Scotland (See Figure 31). This library has been similarly using its spaces as the library of İUE. There were different work areas for different purposes such as computer, journal, and study. However, there were no specific spaces for group work study. Users used the journals area for the group work study. There were not enough spaces for bookstacks. Therefore, the spaces between bookstacks and desks were not comfortable for the users and for the work environment.

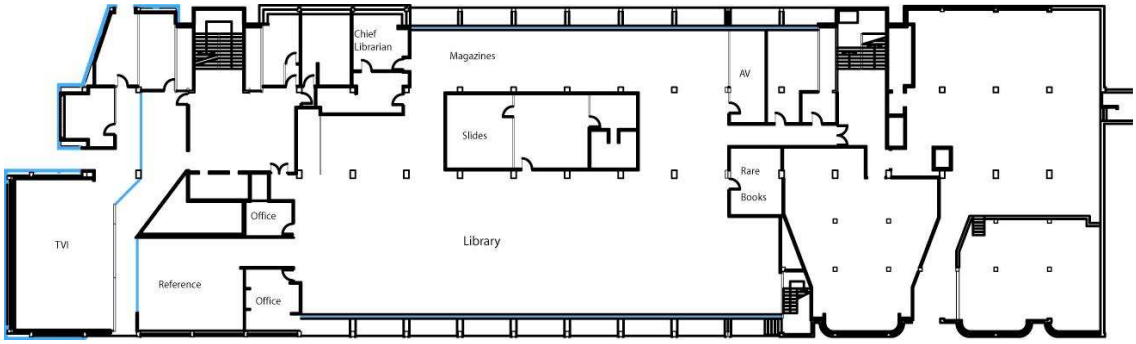


Figure 31: The plan of DoJ Library
(Drawn by author, 2008)

An additional instrument added during the pilot study of DoJ was the lightmeter that measured the daylight in the library space when applying the questionnaires to the users at the same time (See Figure 32). The lightmeter is best used to measure illuminance and is suitable for measuring both under indoor and outdoor lighting conditions (Egan and Olgyay, 2002). The lightmeter is held parallel to the plane interest, usually the work surface (See Figure 33).

Figure 32: The instruments of the pilot study of DoJ Library
(Photographed by author, 2008)

Figure 33: The lightmeter
(Photographed by author, 2008)

It is important that, there are no shadows on the meter and then the amount of illuminance in the work surface can be seen on the digital indicator. The lightmeter was used when making observations and applying the questionnaires. The amount of illuminance which was calculated by the lightmeter at the specific time of the day

showed that the amount of illuminance affected the users' seat preference and the length of time spent in the library.

4.1.4.2. Results and Discussion of DoJ Library

The questionnaires were analysed by SPSS 13.0 using Chi-square test. The results and discussions of the questionnaires are explained in the following section.

- **Finding 1:** There was a significant relationship between the seating preference according to daylight and if the users thought the library place was comfortable (X^2=18.45, df=9, $p<0.05$). This finding is also related to if the users had a place in the library where they could keep their belongings (X^2=23.43, df=9, $p<0.01$). Mostly the users chose window seats in the library and they prefer a place in a window seat where they can keep their belongings. If the individual study carrels near a window are designed with a place to keep the users belongings, it affects the perceived comfort of library place. Therefore, it affects the satisfaction of the users.

- **Finding 2:** There was a significant relationship between the amount of time the user spent in the library according to daylight and the amount of time in the library in one place (X^2=28.82, df=12, $p<0.01$). It is also related to the perceived comfort of library organization (X^2=24.80, df=12, $p<0.05$). If the user prefers to sit near a window, it affects the amount of time the user spent in the library and the satisfaction of the users. Thus, they do not want to change their seat and spend much more time in one place in the library. It

also affects the users' perception of the library organization. They begin to think that the library has comfortable design layout for the study for a long time.

- **Finding 3:** There was a significant relationship between if the users thought that the seating layout was designed by daylight and if they believed that they had sufficient space allocated for study (X^2=9.75, df=4, $p<0.05$) and for group work (X^2=30.68, df=12, $p<0.01$). This finding is related to the perceived comfort of library organization (X^2=13.33, df=6, $p<0.05$). The study shows that the seating layout was designed by daylight provides sufficient space allocated for study and group work. It also creates a comfortable library organization for the users for individual study and study as a group.

- **Finding 4:** There was a significant relationship between places where the users can be alone if they want to and if the users thought that they can sit wherever they want in the library (X^2=23.76, df=6, $p<0.001$). This is also related to if the users thought the seating area belongs to them (X^2=17.23, df=9, $p<0.05$). There is enough space in the library where the users can be alone and they can sit wherever they want in the library. The important thing is especially the privacy issue. If the users choose a place where they can be alone, it affects the amount of time spent in the library and they feel that the seating area belongs to them Thus, the feeling of belongingness is an important indicator of privacy.

- **Finding 5:** There was a significant relationship between a preference for partitions for visual privacy and if the users thought the seating area belonged to them (X^2=21.35, df=12, p<0.05). The feeling of privacy gives the feeling of belonging to the users. If they can concentrate on their work with the help of partitions for visual privacy, it affects the feeling of belonging of the users.

- **Finding 6:** There was a significant relationship between enough space without others crowding the users and if the users thought that they can sit wherever they want in the library (X^2=10.66, df=2, p<0.01) and it is related to perceived comfort of the library (X^2=7.87, df=3, p<0.05). In this space, there seems to be enough space to study without others crowding the users. It is not much crowded in the library. Thus, the users can sit wherever they want in the library and concentrate on what they are doing. These investigations show that if the users have enough space without others crowding them and they can sit wherever they want, they think that the library is comfortable place for the study.

- **Finding 7:** There was a significant relationship between if the users believed they had places where the users could be alone if they wanted to and if they believed that they had sufficient space allocated for study (X^2=13.08, df=6, p<0.05). However, this was not found relation to sufficient space allocated for PC's (X^2=22.17, df=15, p>0.05), journals (X^2=11.25, df=6, p>0.05) and group work (X^2=13.06, df=12, p>0.05). In addition, there was a significant relationship between enough space for the user to be able to concentrate on what they are doing and sufficient space allocated for study (X^2=6.18, df=2,

$p<0.05$) and for journals ($X^2=6.86$, df=2, $p<0.05$). The library place provides sufficient space allocated for study and the users can be alone if they want to in this study work area. However, the library does not provide a space for the users for study alone in the PC's, journals and group work area. On the other hand, the study shows that the library provides a space for the users for concentrate on their work in the individual study area and journals area.

- **Finding 8:** There was a significant relationship between if the users thought that they could change the furniture layout in the library and the perceived comfort of library place ($X^2=19.30$, df=6, $p<0.01$). This was also related to the comfortable spaces between the desks and bookshelves ($X^2=15.95$, df=6, $p<0.01$). If the users can change the places of the furniture, they perceive the library as a comfortable place. If there are comfortable spaces between desks and bookshelves, they can change the arrangement of the furniture layout easily. This library provides enough space for changing the layout of the furnitures. Flexibility gives the feeling of freedom to the library users and it affects the satisfaction of the users.

- **Finding 9:** There was a significant relationship between the seating preference according to daylight and the amount of light in the space ($X^2=25.60$, df=9, $p<0.01$), the brightness of the desk work area in relation to the rest of the room ($X^2=12.51$, df=6, $p<0.05$) and it is also related to the amount of glare from windows ($X^2=23.55$, df=9, $p<0.01$). The amount of light in the space and the brightness of the desk work area in relation to the rest of the room affects the seating preference of the users. The users also

choose their seat according to the amount of glare from windows. The desk work area needs 500-750 lux for study. If the amount of daylight is more than need, it creates a glare for the users for study. Therefore, it does not mean that the more daylight is the better daylight.

- **Finding 10:** There was a significant relationship between if the users thought that the seating layout was designed by daylight and if they thought adequate daylight in the computer work area (X^2=26.33, df=15, $p<0.05$) and there was a significant relationship between if the users thought that the arrangement of bookshelves scheme was designed according to daylight and adequate daylight in the computer work area (X^2=27.72, df=15, $p<0.05$). The study shows that if the users believed daylight was taken into consideration in the seating layout and the bookshelf arrangement, this meant that there was adequate daylight in the parts of the library where daylight is of prime importance. It provided adequate daylight in the computer work area. The users preferred to study in the computer work area because of the adequate daylight in the work space and it affects the satisfaction of the users.

- **Finding 11:** A significant relationship was found between the amount of lux in the library place and if the users thought that the library was comfortable place (X^2=23.76, df=12, $p<0.05$). As lux increased, the users found the library more comfortable. The amount of lux in the library place affects the users' seating preference and the amount of time spent in the library. The users who think that the library is a comfortable place for study are more likely to spend more time in the library because they are satisfied.

- **Finding 12:** There was a significant relationship between the amount of lux in the library place and the amount of glare from windows (X^2=22.28, df=12, $p<0.05$). The amount of lux in the library affects the amount of glare from windows. Every task has its own lux needs. If there is an uncontrolled amount of lux in the study area, it creates glare in the space. If there is much glare in the work space, the users can not spend much time in the library. It affects the satisfaction of the users in a bad way.

- **Finding 13:** There was a significant relationship between places where the users can be alone if they want to and the amount of view through the window (X^2=20.56, df=9, $p<0.05$) and the quality of the view through the window (X^2=20.58, df=9, $p<0.05$). The library provides places where the users can be alone if they want to and also these places provide a pleasant outside view through the window. It affects the amount of time spent of the users and also their satisfaction.

- **Finding 14:** There was a significant relationship between a preference for partitions for visual privacy and the brightness of computer work area in relation to the rest of the room (X^2=24.75, df=12, $p<0.01$). The partitions provide visual privacy for the users in the computer work area and these low partitions take controlled daylight to the work space when they provide a privacy for the users.

- **Finding 15:** There was a significant relationship between the brightness of the desk work area in relation to the rest of the room and the amount of time spent in the library in one place and (X^2=24.75, df=9, p<0.01). The brightness of the desk work area in relation to the rest of the room affects the amount of time spent in the library in one place. If the brightness of the desk work area increases, the users can not study in the same place for a long time. If there is no glare and there is adequate brightness in the desk work area, the users can study much more time in the same place. Thus, the amount of time spent in the library in one place affects the satisfaction of the users.

- **Finding 16:** There was a significant relationship between if the users believed that they had sufficient space allocated for PC's and the amount of light in the work space (X^2=34.13, df=15, p<0.01). In the library, each function has different lux needs. The computer work area need the amount of lux between 500-1000 lux. This means that the library provides sufficient space allocated for PC's and this space has enough amount of daylight for study and adequate brightness in relation to the rest of the room

4.2. The Case of Main Library of Dundee University

The main library of Dundee University in Scotland was chosen as a case study (See Figures 34 and 35). The main library is not only a library or a resource center, but also a gathering place of the university students with its groupwork areas. The design layout of the library space differs from the two pilot study spaces as the library users can work. There are many options for every type of study such as groupwork or

individual, on the floor or big comfortable sofa, separated computer areas and wireless access area.

Figure 34: Seating layout in the Main Library of Dundee University

(Photographed by author, 2008)

Figure 35: Window seats in the Main Library of Dundee University

(Photographed by author, 2008)

The design layout was developed according to the idea of receiving the already limited daylight of Dundee effectively into space. That is why, all individual carrels are located near windows and bookshelves are located in the middle of the space for protection from daylight. An atrium divides individual and groupwork zones from computer areas with daylight.

In Northern climates, where the brightest part of the overcast sky is immediately overhead, horizontal roof apertures are found more frequently. In climates where the clear, sunny sky is most typical, the design of openings become complex. The reason is that the clear sky is much more changeable and dynamic with the time of the day and year (Baker and Steemers, 2002).

The Main Library of Dundee University oriented with the long axis running East-West for getting Southern sunlight. In the winter in the Northern hemisphere, the South elevation receives the greatest amount of solar radiation. In addition, North

and South facades are the easiest to shade by a horizontal device. The effects of orientation are the greatest at the Northern latitudes where the sun angles are lower (Egan and Olgyay, 2002).

As the design layout of Main Library of Dundee University is based on daylight, it was chosen as an appropriate space for testing the influences of daylight on users' satisfaction in university libraries. The study is conducted making observations and using questionnaires with the library users who use the library for studying, reading, and research during the day time. Measuring illuminance with a lightmeter, applying questionnaires to the users at the same time, making physical model of the main library of Dundee University, and using a heliodon and artificial sky with the help of the physical model for showing the amount of daylight into space, shadow of the building and taking photos of them, are the development tools of pilot studies in the case study. A physical model was built because viewing the inside of the model shows how the building form affects light under various conditions. The model was built from translucent plastic materials and white foam board (See Figure 36).

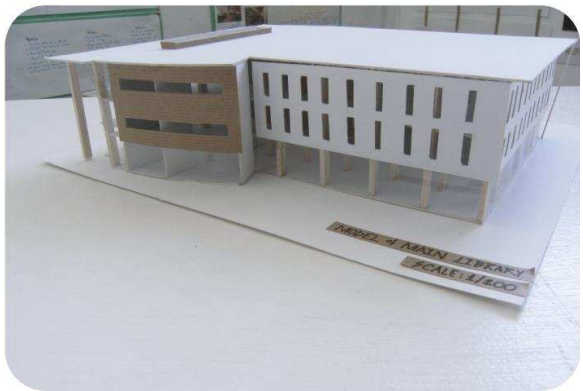


Figure 36: The pyhsical model of the Main Library of Dundee University (Made by author, 2008)

Physical models are used to study daylight in buildings. Despite advances in computer modeling, physical modeling is the most effective method to predict the qualitative and quantitative effects of daylight (Egan and Olgyay, 2002). To allow light sensors to fit into the model, its scale was 1/100. This physical model was made for using heliodon and artificial sky in Dundee University's Lighting Laboratory.

Models can be tested under artificial sky and heliodon. The heliodon is made up of a beam light source and an adjustable table (See Figure 37).

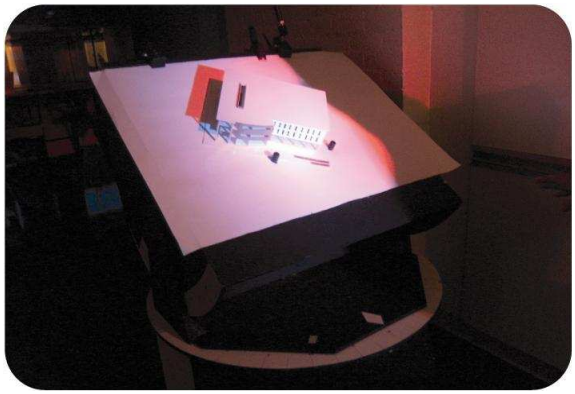


Figure 37: The heliodon
(Photographed by author, 2008)

Two basic techniques are stationary earth and movable sun and movable earth and stationary sun (Egan and Olgyay, 2002). The model was put onto the heliodon in the North-East orientation and the light conditions were set for the proper time. The sundial was mounted on the same plane as the model. The latitude of Dundee (56° angle) was set in the heliodon. With the help of the heliodon, the amount of daylight could be seen in different month of the year and different time of the day. The study was made in every month for 09.00 a.m. in the morning, 12.00 p.m. in the afternoon and 15.00 p.m. in the middle afternoon.

Also the outside shadows of the library building in different month of the year and different time of the day could be calculated. Artificial skies were used also for studying daylight under constant sky conditions to be conducted on scale models (Egan and Olgyay, 2002). The cells were put into the physical model and calculated the amount of daylight in the main library of Dundee University was calculated (See Figure 38).

Figure 38: The artificial sky equipments
(Photographed by author, 2008)

The distribution of light in the model was the qualitative test of the amount of light and the quantitative test was done by the help of the cells in the model (See Figure 39).

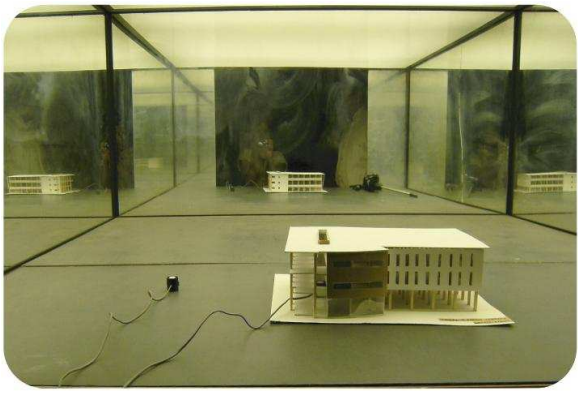


Figure 39: The artificial sky
(Photographed by author, 2008)

The design sky for Dundee was 5000 lux. The cells calculated the amount of light in the model under this sky. The cells calculated 1100 lux for the reading room of the Main Library of Dundee University. It means that the daylight factor for the place was 1100/5000=0.22.

According to the observations and questionnaires with the library users, the statistical values were calculated, suggestions were analysed, and further implications were discussed. Questionnaires were analysed by SPSS 13.0 using Chi-square test, one-way and two-way ANOVA. ANOVA is used to test for significant differences between groups (Einspruch, 1998). The following are the results and discussions of the questionnaires completed by the users.

4.3. Results and Discussions

The following are the results and discussions of hypothesis 1 and hypothesis 2. The first hypothesis is that, 'Daylight strongly influences the satisfaction and dissatisfaction of the users depending on the 4 processes of environmental psychology; privacy, personal space, territoriality, and crowding'. There are findings regarding to satisfaction and 4 processes of environmental psychology in the first part. The second hypothesis is that, 'Daylight strongly influences the seat preference of the users'. The second part discusses the findings regarding seat preference.

4.3.1. Findings Regarding to Satisfaction and the 4 processes of environmental psychology

In order to find out the difference between weather conditions and 4 processes of environmental psychology in general, one way ANOVA was carried out. Comparisons which were done by one way ANOVA indicated that there was not significant difference between weather conditions (sunny, overcast, rainy) and 4 processes of environmental psychology namely privacy, personal space, territoriality, and crowding ($F(2,58) = 0.062$, $p>0.05$). Weather conditions are related to the amount of lux (daylight and artificial light) in the space. This means that there was not a significant difference in the amount of daylight between 4 processes of environmental psychology ($F(2,58)=1.401$, $p>0.05$). On the other hand, daylighting was significantly different from privacy ($F(3,57) = 4.074$, $p<0.01$) and personal space ($F(2,58) = 3.268$, $p<0.05$). The amount of daylight and the quality of outside view increases, the users need more privacy. The absence of a daylight and outside view mean that all stimulation and distractions from the outside environment can be eliminated, allowing the users focus on the task.

Chi-square was used to find out detailed relationships as below.

- **Finding 1:** It was found that there was a significant relationship between the seating preference according to daylight and a preference for partitions for visual privacy ($X^2=36.54$, $df=20$, $p<0.05$). In this study, it is shown that most users choose window seats first, but also they prefer the partitions of the carrels for visual privacy. Users would be happy to have controlled daylight

and view from outside with the help of the low partitions in the window seat and also prefer to work without others crowding them. From the participants who have commented (71%) to the questionnaire, more than half (56%) preferred to study near a window in an individual study carrels. It is also related to the privacy preference of the users, as study carrels have partitions for visual privacy. For the users, privacy was found to be as important as daylight for study in the library. In addition, in the pilot studies, it was also found that there was a significant relationship between the seating preference according to daylight and whether the users have places where they can be alone if they want to (X^2=39.54, df=25, $p<0.05$). The individual study carrels near a window provide a space for the users where they can be alone if they want to with the partitions for visual privacy .

- **Finding 2:** It was found that there was a significant relationship between if the users thought the seating layout was designed by daylight and partitions preference for visual privacy (X^2=47.8, df=25, $p<0.01$) and furniture arrangements for private conversations (X^2=34.38, df=20, $p<0.05$). In addition to these findings, there was a significant relationship between if the users thought the seating layout was designed by daylight and if they thought they had enough space to concentrate on what they are doing (X^2=43.60, df=20, $p<0.01$) and space to work without others crowding them (X^2=37.38, df=20, $p<0.05$). These findings show that when designing the seating layout according to daylight, partitions for the visual privacy and concentration and furniture arrangements for private conversations are also designed with the

carrels. For example, low partitions allow to take controlled daylight to the desk work area and also provide privacy and concentration for the users.

- **Finding 3:** It was found that there was a significant relationship between the seating preference according to daylight and whether the users have a place where they can keep their belongings or not (X^2=35.64, df=20, $p<0.05$). This is related to perceived comfort of library place (X^2=26.44, df=12, $p<0.01$) and the amount of time spent according to daylight (X^2=40.95, df=20, $p<0.01$). When users think that they have a choice to select a window seat, if the library place is more comfortable. User seat preference according to daylight is also related to whether the users have a place where they can keep their belongings or not. In the pilot study which was carried out in DoJ Library, it was also found that there was a significant relationship between the seating preference according to daylight and if the users had a place of their own in the library where they could keep their belongings (X^2=23.43, df=9, $p<0.01$) and if the users thought the library place was comfortable (X^2=18.45, df=9, $p<0.05$). They want to feel that the seating area belongs to them It is about the feeling of belonging. Seat preference according to daylight and whether the users have a place where they can keep their belongings or not affects the the amount of time spent in the library and the satisfaction of the users.

- **Finding 4:** It was found that there was a significant relationship between if the users thought that the seating layout was designed by daylight and the amount of time spent in the library in one place (X^2=41.24, df=20, $p<0.01$). Also it is related to the users thought the library was a comfortable place

(X^2=34.83, df=15, p<0.01). If the seating layout is designed according to daylight use in the library, it increases the time spent of the users in the library. When the users spend much more time in the library, they think that the library place is comfortable for studying. In the pilot study which was carried out in the library of İUE, it was also found that there was a significant relationship between the amount of the time spent in the library according to daylight and the perceived comfort of library organization (X^2=101.28, df=25, p<0.01) and how pleasant the user found the library place (X^2=93.63, df=25, p<0.01). According to these studies, it can be said that the amount of time spent affects the users' satisfaction.

- **Finding 5:** It was found that there was a significant relationship between if the users thought that the seating layout was designed by daylight and if they believed they had sufficient place allocated for the study area (X^2=68.70, df=20, p<0.001), for PC's (X^2=46.23, df=20, p<0.001), for journals (X^2=78.13, df=25, p<0.001), and for the group work (X^2=43.99, df=25, p<0.01). In addition, there was a significant relationship between if the users thought the seating layout was designed by daylight and perceived comfort of the library organization have significant relationship (X^2=49.63, df=25, p<0.01). It is also related to how pleasant the user found the library place (X^2=36.88, df=20, p=0.01). The case study which was carried out in the Main Library of Dundee University shows that the seating layout, circulation areas and the bookshelf scheme was designed by daylight provides sufficient place allocated for study area, PC's, journals and group work. It also creates a comfortable library organization and a pleasant space for studying for the

users. In the pilot studies, it was also found that there was a significant relationship between if the users thought that the seating layout was designed by daylight and if they believed that they had sufficient space allocated for study (X^2=9.75, df=4, p<0.05) and groupwork (X^2=29.44, df=10, p<0.001) and it is related to the perceived comfort of library organization (X^2=98.69, df=25, p<0.01) and how pleasant the users found the library place (X^2=97.19, df=15, p<0.01). In the case study, seating layout, circulation area and bookshelf scheme which can be called the total design layout of the library were also compared one by one with the same questions and the results are the same. Each one of the design layout issues provides sufficient place allocated by study area, PC's, journals, and group work. Also, the users thought it created comfortable library organization.

- **Finding 6:** It was found that there was a significant relationship between the place where the user can be alone if they wanted to and if they thought that the library was a comfortable place (X^2=18.72, df=12, p<0.05). Also they thought furniture arrangements which allow for private conversation made the library place comfortable (X^2=22.13, df=12, p<0.05). If the user can find a place where they can be alone, it provides a comfortable library place for the users. It is important especially for privacy and crowding issue. It was also found in the pilot study which was carried out in the library of İUE, there was a significant relationship between enough space to work without others crowding the user and the perceived comfort of library place (X^2=43.65, df=25, p<0.05). If the users can spend much more time in the library and concentrate on what they are doing, it affects the satisfaction of the users.

- **Finding 7:** It was found that partitions for visual privacy affect the amount of time spent in the library in one place (X^2=31.92, df=20, p<0.05)**.** Also, the users thought that the library was a comfortable place because of the partitions which provides visual privacy (X^2=38.11, df=15, p<0.001). This study shows that users can spend their time in the library in one place if the place has a partition for visual privacy. In other words, they prefer to sit in a place with the partitions. Partitions for visual privacy affect the time spent in the library in one place and it affects the satisfaction of the user. It was also found in the pilot study which was carried out in the library of İUE, there was a significant relationship between enough space for the users to be able to concentrate on what they are doing and the amount of time spent in the library in one place (X^2=31.71, df=20, p<0.05). When the space satisfies the users in terms of privacy, the amount of time spent increases. When they spend much time in the library in one place, the user thinks that the library is a comfortable place for studying.

- **Finding 8:** It was found that there was a significant relationship between a preference for enough space to work without others crowding the user and a place where the user can sit wherever they want (X^2=21.49, df=12, p<0.05). If there was enough space to work without others crowding the user, they thought the library was a comfortable place (X^2=33.14, df=12, p<0.001). In addition, there was significant relationship between enough space for the user to be able to concentrate on what they are doing and a place where the user can sit wherever they want (X^2=31.25, df=12, p<0.05) and if there was

enough space for the user to be able to concentrate on what they are doing, they thought the library was a comfortable place (X^2=61.09, df=12, p<0.001). Users can choose a place wherever they want in the library. It means that the library has enough space to work without others crowding them and to concentrate on what they are doing. The feeling of freedom within the library space makes it comfortable for the user. The feeling of freedom affects the satisfaction of the users and the satisfaction of the users affect the amount of time spent in the library.

- **Finding 9:** It was found that there was a significant relationship between places where the user can be alone if they want to and sufficient space allocated for the study (X^2=34.40, df=16, p<0.01), for PC's (X^2=35.02, df=16, p<0.01), for journals (X^2=48.92, df=20, p<0.001) and for the group work areas (X^2=40.90, df=20, p<0.01). In addition, if there are places where the user can be alone if they want to, the users think that the library place has comfortable library organization (X^2=74.40, df=20, p<0.001) and also they find the library place pleasant (X^2=30.45, df=16, p<0.01). These findings show that the library organization is available for studying on desk, PC, journals and as a group. Therefore, users can be alone if they want to in the library. It makes the design layout of the library comfortable for the users and provides a pleasant space for studying. From the participants who have commented (71%) on the questionnaire, some of the users (37%) prefer to study in the computer work area because of the less crowding in the early morning at 9.00-11.00. After 15.00 p.m. some of the users prefer to study in the group work area because of the comfortable furniture. However, in the

pilot study which was carried out in the library of İUE, it was found that there was a significant relationship between a preference for partitions for visual privacy and if the users believed that they had sufficient space allocated for PC's (X^2=17.55, df=8, p<0.05). There was not a significant relationship between partitions for visual privacy and if the users believed that they had sufficient space allocated for study (X^2=4.96, df=8, p>0.761), journal (X^2=6.95, df=8, p>0.541) and group work (X^2=5.95, df=8, p>0.653).

- **Finding 10:** It was found that there was a significant relationship between furniture arrangements for private conversations and sufficient place allocated for the study (X^2=30.28, df=16, p<0.05), for PC's (X^2=27.02, df=16, p<0.05) and for journals (X^2=32.70, df=20, p<0.05). In addition, they thought that if there were furniture arrangements for private conversations, it was perceived that the library place had a comfortable layout (X^2=59.67, df=20, p<0.001) and also they found the library place pleasant (X^2=48.76, df=16, p<0.001). Furniture arrangements which allow for private conversations provide sufficient space allocated for study, PC and journals but not for group work. The users thought they do not need furniture arrangements for private conversations in the group work area. It makes the design layout of the library comfortable for the users and a pleasant space for studying.

- **Finding 11:** It was found that there was a significant relationship between a preference for partitions for visual privacy and sufficient space allocated for the study (X^2=45.08, df=20, p<0.001), for journals (X^2=55.85, df=25,

$p<0.001$) and for the group work ($X^2=41.10$, df=25, $p<0.05$). The users also thought that partitions for visual privacy provided a pleasant library place for the users ($X^2=39.29$, df=20, $p<0.01$). Partitions for visual privacy provides sufficient space allocated for the study, journals, and group work. However, the users thought there was no need of partitions for visual privacy for the PC area. This library has partitions for visual privacy in the study area, journal area and group work area. It creates a pleasant library space for studying as an individual, journals and studying as a group.

- **Finding 12:** It was found that there was significant relationship between the space to work without others crowding the users and if the users thought there was sufficient space allocated for the study ($X^2=54.02$, df=16, $p<0.001$) and for journals ($X^2=53.96$, df=20, $p<0.001$). If there is enough space to work without others crowding them, the users think that perceived library organization is comfortable ($X^2=43.59$, df=16, $p<0.01$) and it is a pleasant place for studying ($X^2=32.88$, df=16, $p<0.01$). In addition, there was significant relationship between the space for the user to be able to concentrate on what they are doing and if the users thought there was sufficient space allocated for study ($X^2=31.66$, df=16, $p<0.01$) and for journals ($X^2=35.23$, df=20, $p<0.05$). If there is a space for the user to be able to concentrate on what they are doing, the users think that the library organization is comfortable ($X^2=39.92$, df=20, $p<0.01$) and that it is a pleasant place for studying ($X^2=42.99$, df=16, $p<0.01$). The library provides enough space to work without others crowding them and also to concentrate on their work. These spaces are sufficient space allocated for the study and

journals, but not for the PC's or group work. Users may not choose these areas because of crowding or they may not able to concentrate on their work. If the users could choose a place for studying without others crowding them, they would perceive the design layout of this library as a comfortable and a pleasant place for studying or meeting.

- **Finding 13:** It was found that there was a significant relationship between if the users thought they had a place where they can sit wherever they want and if they thought there was sufficient space allocated for the study area (X^2=27.69, df=12, p<0.01), for PC's (X^2=26.78, df=12, p<0.01), or for journals (X^2=31.39, df=15, p<0.01). If the library is a place where the user can sit wherever they want, the users perceived library organization as comfortable (X^2=35.81, df=15, p<0.01) and it was a pleasant place for studying (X^2=32.04, df=12, p<0.001). The feeling that the users can choose a place for study, PC and journals, there is enough space for these functions and the user can sit wherever they want makes the library organization comfortable and pleasant place for studying. If the users feel free, it affects the perception of space, in that they feel they have more space in the library. According to the users' comments, the library has sufficient spaces allocated for study, PC's, journals and group work study. The users can study wherever they want. The users also commented that the library was too crowded during the exam period. The furniture and study carrels were not enough for all the users to study without others crowding them or to study alone. The library is used until night during these periods. On the other hand, during summer holidays and term time, the users can sit wherever they want in the library.

- **Finding 14:** It was found that there was a significant relationship between if the users thought the library was a comfortable place and if the users thought there was sufficient space allocated for study (X^2=28.51, df=12, p<0.01), for PC's (X^2=22.04, df=12, p<0.05), for journals (X^2=36.30, df=15, p<0.01) and for the group work (X^2=33.61, df=15, p<0.01). If the users thought that the library was a comfortable place, the perceived library organization was found to be comfortable for the users (X^2=68.09, df=15 p<0.001) and was related how pleasant the user found the library place (X^2=76.38, df=12, p<0.001). The places for study, PC's, journals and group work provide a comfortable library environment for the users. The differentiation of the functions helps the users feel that the space is pleasant and to think that the library organization is comfortable. Therefore, the amount of time spent can change positively with the organization of the library with a focus on sufficient space and privacy.

- **Finding 15:** It was found that there was significant relationship between perceived comfort of the library organization and the amount of circulation space between the desks and bookshelves (X^2=34.66, df=20, p<0.05). The library organization includes seating layout, circulation and bookshelves scheme. This study shows that if there was enough space between the desks and bookshelves for movement and circulation for users and adequate circulation space for library book casts, the library organization would be comfortable for the users in the library.

4.3.2. Findings Regarding Seat Preference

- **Finding 1:** It was found that there was a significant relationship between daylight induced seating preference and perceived comfort of the library organization (X^2=44.05, df=20, p<0.001). Also, if the users thought that it provided a pleasant library place (X^2=27.56, df=16, p<0.05). The study shows that daylight is a prime effector of a comfortable library organization. This is made possible by designing the seating layout, circulation and bookshelves scheme according to daylight. The comfortable library organization affects the user seating preference and users think that the library place is a pleasant place for studying and meeting.

- **Finding 2:** It was found that there was a significant relationship between the arrangement of bookshelves which were designed by considering daylight and brightness contrast between the room and what the user see through the window (X^2=30.23, df=15, p<0.01) and the amount of view through the window (X^2=33.50, df=15, p<0.01). The perpendicular organization of the bookshelves to the windows help to take controlled daylight (also increase the amount of view through window) inside and direct it to the seating area. In the pilot study which was carried out in the library of İUE, it was found that there was a significant relationship between if the users thought the circulation areas were designed by daylight and the perceived comfort of library organization (X^2=68.10, df=25, p<0.01) and how pleasant the users found the library place (X^2=71.11, df=25, p<0.01). In addition, there was a significant relationship between if the users thought the arrangement of the

bookshelves were designed by daylight and the perceived comfort of library organization (X^2=100.09, df=25**,** p<0.01) and how pleasant the users found the library place (X^2=100.97, df=25, p<0.01). The pilot study and the case study showed that the design layout of the library (seating layout, circulation and bookshelves scheme) provided adequate brightness for the each space.

- **Finding 3:** It was found that there was a significant relationship between if the users thought that the seating layout was designed according to daylight and the amount of lux in space (X^2=76.95, df=25, p<0.001). In addition, there was a significant relationship between if the users thought that the arrangement of bookshelves were designed according to daylight and the amount of lux in space (X^2=26.43, df=15, p<0.05). The design of seating layout in the library affects the amount of lux in the space. Each function in the library such as desk work, computer work or group work has different lux needs. Therefore, the seating layout of the library, circulation areas and bookshelves scheme are designed according to the lux needs of each function. In the pilot study which was carried out in the library of DoJ, it was found that there was a significant relationship between the amount of lux in the library place and the amount of glare from windows (X^2=22.28, df=12, p<0.05).The amount of lux is also related to the amount of glare in the work area.

- **Finding 4:** It was found that there was a significant relationship between the amount of lux in space and sufficient place allocated for study area (X^2=81.08, df=20, p<0.001), for PC's (X^2=46.74, df=20, p<0.001) and for

journals (X^2=75.10, df=25, p<0.001). It is also related to whether the users thought the library organization was comfortable for them (X^2=42.18, df=25**,** p<0.05). As mentioned above, study area, PC's, journal area and group work area has different lux needs. When designing the layout of the library, these spaces should be located taking into consideration how much lux there is inside the various parts of the library. If each space gets enough lux for its purpose, it provides comfortable library organization for the users. From the participants who have commented (71%) in the questionnaire, some of them (37%) prefer to sit in the study area until 15.00 p.m. They thought that it is related to the amount of daylight in the space. The building can get much amount of daylight to the study area from 9.00 a.m. to 15.00 p.m. There is not much amount of daylight in the space after 15.00 p.m. In the late afternoon, they prefer to study in the group work area or computer work area.

- **Finding 5:** It was found that there was a significant relationship between the amount of daylight in the space and the amount of time spent in the library in one place (X^2=35.81, df=16, p<0.01). If the user does not change his/her place for a long time and can work comfortable in this place, it was found to be related to the adequate daylight in this place. The amount of time spent shows the satisfaction of users to the work environment. In the pilot study which was carried out in the library of DoJ, there was a significant relationship between the seating preference according to daylight and the amount of light into space (X^2=25.60, df=9, p<0.01). It was also found related to the amount of glare from windows (X^2=23.55, df=9, p<0.01).

- **Finding 6:** It was found that there was a significant relationship between adequate daylight for desk work and the amount of time spent in the library in one place (X^2=26.99, df=16, $p<0.05$) and for computer work (X^2=42.63, df=20, $p<0.01$). In addition, the amount of time spent in the library in one place is also related to the brightness of work area in relation to the rest of the room (X^2=34.25, df=16, $p<0.01$). The amount of time spent in one place in the library is strongly related to the adequate daylight for deskwork and computer work. It affects the satisfaction of the user and the time spent in the same place. It is also related to the brightness of the space during the work. In the pilot study which was carried out in the library of DoJ, there was a significant relationship between the amount of time spent in the library in one place and the brightness of the desk work area in relation to the rest of the room (X^2=24.75, df=9, $p<0.01$). In other words, the amount of daylight and the brightness of the work environment affect the satisfaction of the user and the amount of time spent in the library.

- **Finding 7:** It was found that there was a significant relationship between the brightness contrast between the room and in front of the window and if the user thought the library was a comfortable place (X^2=18.66, df=20, $p<0.05$). The brightness level of the work environment is very important for the satisfaction of the user. If there is adequate brightness in the work environment, the user thinks that the library is comfortable place for studying. In the pilot study which was carried out in the library of DoJ, there was a significant relationship between the amount of lux in the library place and if

the users thought that the library was comfortable place (X^2=23.76, df=12, $p<0.05$).

- **Finding 8:** It was found that there was a significant relationship between the absence of glare and if the users thought there was sufficient space allocated for PC's (X^2=31.58, df=20, $p<0.05$). Glare is very important for the PC's work environment. If there is glare in this space, the user does not spend much time in the same space as it affects his/her satisfaction. However in this study, comfortable view in terms of glare provides sufficient space for PC's. A further investigation was done by two way ANOVA and it was found that there were no significant differences in the amount of glare from windows between weather conditions and 4 processes of environmental psychology. In other words, there were not significant differences between weather conditions and 4 processes of environmental psychology namely privacy, personal space, territoriality, and crowding depending on the amount of glare from windows (F (8,60)=1.423, $p>0.05$). In sunny and overcast weather conditions there was strong glare in the space which affected the 4 processes of environmental psychology. However, in rainy weather conditions, there was no strong glare from windows and this affected the satisfaction of the library users in a positive way.

- **Finding 9:** It was found that there was a significant relationship between the perception of sufficient space allocated for journals and the brightness of the desk work area in relation to the rest of the room (X^2=38.00, df=25, $p<0.05$). The brightness of the journal area is very important for the user's satisfaction

because it affects the the amount of time spent in the library. This study shows that there is sufficient space allocated for the journal and that the brightness of this space is adequate. According to comparisons which were done by two way ANOVA, there were not significant differences in adequate daylight measured by the lightmeter in the “desk work area” and “computer work area” under different weather conditions and the 4 processes of environmental psychology according to the questionnaire answers ($F(8,60)=1.621$, $p>0.05$), ($F(8,60)=0.695$, $p>0.05$, respectively).

- **Finding 10:** It was found that there was a significant relationship between the amount of view through window and the perception of sufficient space allocated for the group ($X^2=40.79$, $df=25$, $p<0.05$). The users thought that this provides the comfortable views in terms of glare ($X^2=45.08$, $df=25$, $p<0.01$). The amount of view and comfortable view in terms of glare is very important for the user satisfaction. In this study, in the group work area, there is good quality of view and adequate glare, so the users feel satisfied. This affects the amount of time spent in one place for the users.

- **Finding 11:** It was found that there was a significant relationship between the quality of view through window and how pleasant the user found the library place ($X^2=40.68$, $df=20$, $p<0.01$) and there is a significant relationship between how pleasant the user found the library place and comfortable view in terms of glare ($X^2=31.52$, $df=20$, $p<0.05$). The pleasant quality of view through window and comfortable view in terms of glare provides pleasant library space for studying for the users.

During the research, the question of whether gender has different effects on the 4 processes of environmental psychology was also investigated. It was found that, gender was effective on the 4 processes of environmental psychology ($F(2,58)=4.202$, $p<0.05$). Gender was especially significantly different from the “privacy” issue ($F(3,57)=4.074$, $p<0.01$). According to the observations, it can be said that, female and male university library users have different privacy needs. Females are less tolerant than males about privacy issues and need more space for studying alone.

4.3.3. Overview of All Findings

According to the case study results, the discussion can be concluded as follows:

From the participants who have commented (71%) to the questionnaire, more than half of them (56%) preferred to study near a window and did not want to change their seats during the work time. One of the comments was very specific regarding his needs:
"Daylight often a factor in my seat choice, but I do not prefer direct sunlight from a window".

Computer work area was preferred by 37% of the users in the early morning. The rest of the users (7%) preferred to study as a group because of mostly the comfortable furnitures of group work area. From the participants who have commented on the questionnaire, 49% of them commented in the sunny weather

condition, 28% of them commented in the overcast sky, and the rest (23%) commented in the rainy weather.

4.3.3.1. Design Layout According to Daylight, Satisfaction of Library Users, 4 Processes of Environmental Psychology

It was found that in the Main Library of Dundee University, daylight and outside view are important factors for the satisfaction of the users in the library. Therefore, the seating layout, the circulation areas and the arrangement of bookshelf was designed according to daylight. The seating area which was designed according to daylight, partitions for visual privacy and furniture arrangements for private conversations were also designed with the individual study carrels located near a window. Low partitions allowed taking controlled daylight and view from outside to the work area. As cited also in Yıldırım, et al. (2007), it is believed that access to a window, with enough daylight, and an outside view is beneficial to users and it affects their satisfaction with their workspace.

In addition, the users preferred to study under controlled daylight with the help of low partitions. They also preferred to study without others crowding them, concentrate on what they are doing and wanted to feel the sense of belonging. It means that privacy and crowding issues are as important as daylight for the users while they are studying. Sense of place is a theory that searches the feeling of belonging to an environment and security within it. Steele (1981) described a sense of place as a theory of experience of a person in a particular place or how he or she feels about the place in the section 2.3. The relationship between a sense of

attachment and the satisfaction of the users was also described in the Dinç study (2007) in the section 2.4.3.

Another finding is if the users thought that they had a place to study alone when they want to, sit wherever they want and concentrate on what they are doing, it affects the amount of time spent of the users in one place in the library. When they spend much more time in the library in one place, it affects the perceived comfort of the library organization for the users for the study and the satisfaction of the library users as well as, borrowing more books and using the library space more effictively. As Wilson (2002) mentioned that the organisation of the space is an important factor, including desk orientation and circulation orientation. In addition, Baker and Steemers (2002) mentioned the relationship between spaces and the daylighting criteria for internal planning and room layout in Chapter 3.

4.3.3.2. Design Layout According to Daylight - Satisfaction of Library Users - The Amount of Lux

If the arrangement of bookshelf and circulation areas had been designed according to daylight, it would have provided a sufficient space for the seating area according to daylight. Individual study carrels, PC's, journals and group work area are all in the seating area and each function has different lux needs. The information about recommended light levels for libraries according to IES Lighting Handbook (1987) is in the section 3.3.

The arrangement of the bookshelves which was designed according to daylight can take controlled daylight and outside view to the seating area and create adequate brightness for the study area, PC's, journals and group work area. If the bookshelves are oriented perpendicular to the windows, they do not block the daylight as mentioned in the examples of libraries in Chapter 3.

The partitions for visual privacy in the study carrels and the arrangement of the bookshelves according to daylight provide the amount of lux and the amount of outside view which is needed for different functions in the library and the bookshelves prevents the space from the strong glare from the outside. The participants of this study believed that the outside view affected their judgment about the amount of glare in the space. In addition, it affects the amount of time spent of the users in the library and the perceived comfort of the library organization and satisfaction of the library users. As was also mentioned in Chapter 2, Hopkinson (1970) described that when a pleasant view is seen from the window, the tolerance for higher glare levels increases (Veitch and Galasiu, 2006). The following chapter discusses the conclusion part of the thesis.

CHAPTER 5

CONCLUSION

This chapter comprises the conclusion part of the thesis. It also discusses the future research recommendations for the researchers and gives a set of design guidlines for the university libraries for the designers and the limitations that could not be controlled during the data collection.

In keeping with the changing nature of resources and their use, university libraries should be seen as a cultural center rather than merely resource centers. In today's libraries, gathering places are designed for the users so that they can spend much more time in the library. If the users spend much more time in the library, it creates a feeling of belonging and increases the satisfaction of the users. The space can be designed as inviting, attractive, comfortable and flexible connections of learning and social spaces where the users are satisfied to remain for as long as they have a need. The university library is more user-centered and the satisfaction of the users is the most important thing for these spaces. Therefore, the relationship between daylight and the 4 processes of environmental psychology should be considered when designing the university libraries to achieve quality spaces that encourage students to make use of libraries to their full extent. It is believed that, this has the potential to support university education.

Interpretation of the results of this study may have been affected by a number of factors that could not be controlled in the design of the study and during the data collection. Therefore, they should be considered before replicating the study or taking it to a future direction. First, the number of participants in the research was limited to the 81 library users in the case study. With a larger group, or with the same group followed over time, results might have been different, as in all studies. Another limitation of this study is timing and schedule of the research. The study was conducted in the exam period in the month of May and it is not known that how the results of the study would be change in the term periods and also in the winter. This may be one of many directions this study may be furthered.

Based on the research process and an understanding of the limitations of the study, the following recommendations are listed for the future research directions. First, the research can be conducted on a larger sample group including different user groups such as library staff, researchers and educators. This would provide a large data set and the researcher can get more varied results according to participants' gender and age differences may be obtained. Characteristics such as gender and age could be further dwelled on in detail. These criteria were not the focus of this study.

The sample group can be controlled by a camera for a long time and the changes of users' seat and privacy preferences according to time of the day can be examined. The results can be compared and results may be reached that will cast light on these issues.

The research can be conducted for a longer time frame to include winter and summer time. The sample group preferences can be examined according to changes of the seasons. The research can be also conducted in exam periods and term periods and how the users' perception and preferences can change according to crowding can be examined.

This was a study that analysed users' preferences and satisfaction in the existing library space. A further step may be to analyse different combinations of the design layout. The number of the study carrels can be reduced or some partitions can be added and the changes of the users' preferences according to design layout changes can be examined.

Two different countries can be chosen from South-hemisphere and North-hemisphere or two different cities which are well-known with their university libraries can be chosen and comparisons can be done between these two libraries. Needless to say, comparison studies involve several other criteria regarding cultural and geographical differences that have to be considered.

Moreover, environmental issues that influence the perception of daylight, such as, color, material, surface treatment, texture (which may be dependent on one another), may be considered as a focus of a further elaboration of this study.

From this study, certain "design guidelines" can be derived. They are as follows: Library furniture and equipment can be designed to receive controlled daylight in the space and study alone without one user crowding the other. This will be important

especially for crowded days such as exam periods. Seating units can have a compact design which answers users' needs. The design can have movable partitions for visual privacy so that users can concentrate on their work and be more satisfied. In addition, it can have a place in which the users can keep their belongings. This would give the feeling of freedom and belonging to the users. Therefore, it would affect the satisfaction of the users. It can be a modular design which allows fixing to another module to create a larger study area for more than two people or more. These modularity design criteria can create functional spaces for individual study or PC's in one seating unit. This modular unit can be carried from one space to another according to the amount of daylight needs of the users and the design can give the chance to change the direction of the study area for the users' daylighting preference. The design unit can be flexible and the shape of the seating area can be changed the shape of the seating area according to the comfort preference of the users. In addition, it can be used during crowded days such as exam periods and it can provide sufficient space according to daylight, the feel of belonging and concentration for study for the users. When the library is empty after exam periods, these modular design units can be fixed to each other for creating other functions in the library.

According to this study, it was found that daylight and outside view have significant role on users' satisfaction. The design layout of the university library (seating layout, circulation areas and the bookshelf arrangement) according to daylight can be one of the priorities of the library place. The design layout can be more user-centered and create sufficient spaces for individual study, PC work and group work area, because each function needs different amount of daylight. The bookshelves can be oriented perpendicular to the windows in order to take controlled daylight to the working

area. With the perpendicular arrangement of bookshelves, the daylight can not be blocked and used efficiently in the space.

This study is thought to be beneficial to building users who wish to work in and enjoy being in a university library space receiving a full capacity of daylight. It is relevant to researchers who wish to study the environmental psychology issues and daylighting strategies in the library buildings in different countries and cultures. This study can be beneficial to lighting designers who design lighting systems for library buildings. They can apply the systems considering daylighting effects and the human-space relationships. Interior architects and architects designing libraries can use this study before designing a library place. Designers should begin to design considering environmental inputs such as daylight, views from windows, wind, and the like.

The information about human-space relationships which are often overlooked during the design process can be found in this study. Understanding the importance of daylight quality is one thing, but knowing its influences on users' satisfaction and achieving daylight quality in the workspace is something else. In order to get there, one needs to understand what it means to have quality daylighting and how to plan for it taking into consideration the complicated relationships between daylight and the 4 processes of environmental psychology when designing the university libraries.

REFERENCES

Aalto, A. 1970. *Mount Angel Abbey Library*. [Internet], Available from: <http://www.galinsky.com/buildings/mountangel/index.htm> [Accessed 10 December 2008].

Akbayrak, H. 2007. *METU Library Conference Proceedings.* [Internet], Available from:<http://www.iatul.org/doclibrary/public/Conf_Proceedings/2002/Akbayrak.pdf > [Accessed 7 November 2008].

Altman, I. 1975. *The Environmental and Social Behavior*. Monterey, CA: Brooks/Cole.

American Libraries. 1985. *Five Libraries Capture Architectural Awards.*

Ander, G. D. 1995. *Daylighting: Performance and Design.* New York: Van Nostrand Reinhold Company.

Andrzejewski, G. 2008. *General Considerations for Library Layout*. [Internet], Available from: <http://librarylayout6010.wordpress.com/tag/library-design> [Accessed 3 January 2009].

Architectureweek. 2007. *Libraries of Excellence.* [Internet], Available from: <http://www.architectureweek.com/2007/0516/images > [Accessed 2 March 2009].

Arkiv. 2008. *Bilkent Kütüphanesi Ek Binası.* [Internet], Available from: <http://arkiv.arkitera.com/p2570-bilkent-kutuphanesi-ek-binasi.html> [Accessed 7 November 2008].

Baker, N. and Steemers, K. 2002. *Daylight Design of Buildings.* London: James & James Ltd.

Bell, J., Burt, W. 1995. Designing Buildings For Daylight. Construction Research.

Block, L. and Stokes, G. 1989. *Performance and satisfaction in private versus nonprivate work settings*. Environment and Behavior, 21, 277.

Boyce, P., Hunter, C. and Howlett, O. 2003. *The Benefits of Daylight Through Windows.* New York: U.S. Department of Energy.

Boubekri, M, Hulliv, R. and Boyer, L. 1991. *Impact of window size and sunlight penetration on office workers' mood and satisfaction, a novel way of assessing sunlight.* Environment and Behavior, 23, 474–493.

Bundy, A. 2004. *Places of Connection: New Public and Academic Library Buildings In Australia and New Zealand.* UK: The Library Buildings Conference, 6.

Burrelsman, T., Villiers, B. and Lewis, F. 1996. *The Phoenix Central Library.* [Internet], Available from:<http://arch.ced.berkeley.edu/vitalsigns/bld/Casestudies/Abstracts/UArz_phoenlib_ab.html> [Accessed 11 November 2008].

Butler, D. L. and Biner, P. M (1989). *Effects of setting on window preferences and factors associated with those preferences.* Environment and Behavior, 21, 17–31.

Caldenby, C. and Hultin, O. 1986. *Asplund*. New York: Rizzal International Publications, 92.

Celal, M. 2008. *Türkiye Kitap Okuyor mu?*. Cumhuriyet Kitap Sayı: 956.

Charles, K. E. and Veitch, J. A. 2002. *Environmental satisfaction in openplan environments.* Canada: Institute for Research in Construction (IRC).

Cheung, H.D., Chung, T. M. 2007. *A Study On Subjective Preference to Daylit Residential Indoor Environment Using Conjoint Analysis*. Hong Kong: The Hong Kong Polytechnic University, 9.

Christoffersen, J., Johnsen, K., Peterson, E., Valbjorn, O., Hygge, S. 2000. *Windows and Daylight.* Proceedings of the CIBSE/ILE Joint Conference.

Clements, D. and Croome, D. 2006. *Creating the Productive Workplace*. NewYork: Taylor&Francis.

Clemons, S. A., Banning, J. H., McKelfresh, D. A. 2005. *The Importane of Sense of Place and Sense of Self in Residence Hall Room Design.* [Internet], Available from:<http://www.sahe.colostate.edu/Journal_articles/Journal2003_2004vol 3/Sense_of_Place.pdf> [Accessed 11 November 2008].

Collins, B. L. 1975. *Windows and people: A literature survey. Psychological reaction to environments with and without windows*.Washington, DC: Natural Bureau of Standards.

Construction Bulletin. 2002. *Minneapolis Central Library.* [Internet], Available from: <http://www.highbeam.com/doc/1G1-124004573.html> [Accessed 17 December 2008].

Cuttle, C. 1983. *People and Windows in Workplaces.* New Zealand: Proceedings of the People and Physical Environment Research Conference. Danish Building Research Institute. *Gentofte Public Library.* [Internet], Available from:<http://www.iea- shc.org/task21/publications/A_survey _architectural_solutions /Public-Library.pdf> [Accessed 3 January 2009].

Datta, A. 2005. *Daylighting In Cambridge Libraries: Shifting Focus Over Time.* College of Architecture and Environmental Design. Arizona: Arizona State University.

Dean, E. 2005. *Daylighting Design in Libraries.* [Internet], Available from: <http://www.librisdesign.org/> [Accessed 11 December 2007].

Debatty, R. 2007. *The Lungs of the Library.* [Internet], Available from: <http://www.bfi.org/our_programs/bfi_community/norman_foster> [Accessed 19 December 2008].

Dickinson, S. G. 1946. *The Living Library.* Michigan: National Association Schools of Music.

Dijkstra, K., Pieterse, M and Pruyn, A. 2006. *Physical environmental stimuli that turn healthcare facilities into healing environments through psychologically mediated effects.* The Netherlands: University of Twente.

DiLouie, C. 2008. *Sustainable Technology : Daylighting*. ARCHI-TECH, Advancing Technology in Commercial Buildings. [Internet], Available from: <http://www.architechweb.com/ArticleDetails/tabid/254/ArticleID/5600/> [Accessed 29 March 2009].

Dinç, P. 2007. *Spatial and Behavioral Variables That Affect 'Emotional Attachment' of Users.* Ankara: Gazi University.

Dubois, M C. 2003. *Shading Devices and Daylight Quality: An Evaluation Based on Simple Performance Indicators*. Lighting Research and Technology.

Dunster, D. 1984. *Architectural Monographs 4:* Alvar Aalto. New York: St. Martin's Pres.

Edwards, L. and Torcellini, P. 2002. *A Literature Review of the Effects of Natural Light on Building Occupants.* Colorado: National Renewable Energy Laboratory.

Egan, D. M and Olgyay V. 2002. *Architectural Lighting*. New York: McGraw-Hill Company.

Einspruch E. L. 1998. *An Introductory Guide to SPSS for Windows.* England: Sage Publications.

Erickson, S. J. 2000. *Library Design Issues in the Writings of Architects and Librarians.* A Master's paper for the MS. in L.S. degree.

Escuyer, S. and Fontoynont, M. 2001. *Lighting Controls: A Field Study of Office Workers' Reactions.* Lighting Research and Technology.

Evans, B. H. 1981. *Daylight In Architecture*. New York: McGraw-Hill Book Company.

Fontoynant, M 1999. *Daylight Performance of Buildings.* France: Earthscan Publications.

Foster and Partners. (2005). *Free University Opens Foster and Partners Berlin Brain.* [Internet], Available from: <http://www. fosterandpartners. com/ News/200/Default.aspx> [Accessed 17 December 2008].

Frampton, S. and Gilpin, L. (2004). *Healing Spaces: Elements of Environmental Design that Make an Impact on Health.* The Journal of Alternative and Complementary Medicine.

Galasiu, A. D. and Veitch, J. A. 2006. *Occupant Preferences and Satisfaction with the Luminous Environment and Control Systems in Daylit Offices.* Canada: National Research Council.

Gifford, R. 2002. *Environmental Psychology: Principles and practice.* Colville: W.A. Optimal Books.

Glossary of Lighting Terms. 2008. [Internet], Available from: <http://www.thornlighting.com>[Accessed 29 March 2009].

Gretchen, A. 2006. *Foster's Green Berlin Library.* [Internet], Available from: <http://www.inhabitat.com/2006/02/27/ >[Accessed 17 December 2008].

Hanada, H. 2007. *The New Stockholm City Library*. [Internet], Available from: < http://www.archiweb.cz/buildings.php?type=9&action=show&id=1664 [Accessed 17 November 2008].

Heerwagen, J. H. and Heerwagen, D. R. 1986. *Lighting and Psychological Comfort.* Lighting Design and Application.

Heschong, L. D., Mahone, K., Kuttaiah, N. and Baker, N. 1999. *Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance.* CA: The Heschong Mahone Group.

Heschong, L. 1999. *An Investigation into the Relationship Between Daylighting and Human Performance*. California Board for Energy Efficiency Third Party Program.

Howitt, D. and Cramer D. 1999. *A Guide to Computing Statistics with SPSS for Windows.* England: Pearson Education Limited.

Hürriyet. 2007. *Türkiye'nin En İyi 10 Kütüphanesi.* [Internet], Available from: <http://www.modifiyemcom/forum/f285/turkiye-nin-en-iyi-10-kutuphanesi-50184/> [Accessed 7 November 2008].

Isacco, J. M. 1985. *Work Spaces, Satisfaction and Productivity in Libraries.* Library Journal.

Journal of Ottoman Calligraphy. 2006. [Internet], Available from: <http://calligrapher.blogsome.com/2006/04/20/the-turkish-national-library-ankara/> [Accessed 5 March 2009].

Lam, W. 1986. *Sunlighting as Formgiver for Architecture*. New York: Van Nostrand Reinhold Company.

Laurentin, C., Berrutto, M. and Fontoynont, P. 1998. *Manual Control Artificial Lighting in a Daylit Space.* France: 3rd International Conference on Indoor Air Quality, Ventilation and Energy Conversation in Buildings.

Lechner, N. 2001. *Heating, Cooling, Lighting: Design Methods for Architects.* New York: Wiley.

Leslie, R. P. 2003. *Capturing the Daylight Dividend in Buildings: Why and How?* Building and Environment.

Lighting Control and Design. 2008. *Santa Monica Public Library.* Los Angeles: Frank Tobin Publicity. [Internet], Available from: <http://www. lightingcontrols.com/PressDocuments/Santa_Monica_Public_Library_LEED _Press_Release.pdf > [Accessed 19 December 2008].

Lines, A. 2004. *The Changing Roles of Today's Libraries.* Berkshire: National Foundation for Educational Research.

Kaplan, R. 1993. *The role of nature in the context of the workplace.* Landscape and Urban Planning, 26, 193–201.

Kaplan, S. and Kaplan, R. 2003. *Health, Supportive Environments and the Reasonable Person Model.* American Journal of Public Health.

Karasözen, B. 2007. *50. Yılında ODTÜ Kütüphanesi.* [Internet], Available from: <http://eprints.rclis.org/archive/00010084/01/odtu-bult.pdf> [Accessed 7 November 2008].

Kopec, D. 2006. *Environmental Psychology for Design*. China: Fairchild Publications.

Köster, H. 2004. *Dynamic Daylighting Architecture: Basics, systems, projects.* Switzerland: Birkhauser.

Küçükcan, B. 2007. *Üniversitelerde Kütüphane Binaları Kullanım Verimliliğinin Yapı Biyolojisi Açısından İncelenmesi*. İstanbul: Mart Matbaacılık Sanatları.

Kwok, A. and Grondzik W. 2006. *Environmental Strategies for Schematic Design.* Oxford: Elsevier Inc.

Maher, A.and Von Hippel, C. 2005. *Individual differences in employee reactions to open plan offices.* Journal of Environmental Psychology, 25, 219–229.

McNicholl, A. and Lewis, J. O. 1994. *Daylighting in Buildings.* Dublin: Energy Research Group, School of Architecture, University College of Dublin.

Middle East Technical University. 2008. [Internet], Available from: <http://ww2.lib.metu.edu.tr/tr/yan.php?id=1> [Accessed 7 November 2008].

Moore, F. 1991. *Concepts and Practice of Architectural Daylighting.* New York: Van Nostrand Reinhold Co.

Nasar, L. J. 1992. *Environmental Aesthetics*. Cambridge: University of Cambridge.

National Libraries: Collections, registered users, works loaned out, employees. 2007. [Internet], Available from: <http://stats.uis.unesco.org/unesco/Table Viewer/tableView.aspx?ReportId=206> [Accessed 9 November 2007].

Ne'eman, E., Hopkinson, R.G. 1970. *Critical Minimum Acceptable Window Size*. Lighting Research and Technology.

Noon, P. 2008. *The Lanchester Library.* Utrecht Publishing and Archieving Services, Volume 18-131.

Peckham Library. 2007. [Internet], Available from: <http://www.cabe.org.uk/ default.aspx?contentitemid=231> [Accessed 10 November 2008].

Pedersen, D. M. 1996. *A Factorial Comprasion of Privacy Questionnaires*. Social Behaviour and Personality.

Oldham, G. R. and Rotchford, N. L. 1983. *Relationships between office characteristics and employee reactions.* A study of the physical environment. Administrative Science Quarterly, 28, 542–556.

Oldham, G. R. 1991. *Physical environments and employee reactions.* Academy of Management Journal, 34, 929-938.

Post, C., Torres, H. and Henning, K. 2006. *Landmark Library.* New York: Civil Engineering

Richards, J. M. 1978. *800 Years of Finnish Architecture.* Vancouver: David and Charles

Robbins, C. L. 1983. *Daylighting: Design and Analysis.* New York: Van Nostrand Reinhold Co.

Sands, J. 2004. *Sustainable Library Design.* [Internet], Available from: < http://librisdesign.org/> [Accessed 3 January 2009].

Solar Heating and Cooling Programme (SHCP). 1999. *Daylighting in Buildings: Design Tools and Performance Analysis.* [Internet], Available from: <http://www.ieo-shc.org/task 21/publications/> [Accessed 5 March 2009].

Solomon, F. Z. and Finnegan, M C. 1981. *Work attitudes in windowed vs. windowless environments.* Journal of Social Psychology, 115, 291-292.

Stewart, A. 2007. *Individual Psychology and Environmental Psychology.* Journal of Individual Psychology.

Stone, N. J. 2001. *Designing effective study environments.* Journal of Environmental Psychology, 21, 179–190.

Stone, N. J. and Irvine, J. M. 2001. *Performance, mood, satisfaction and task type in various work environments.* Journal of General Psychology, 120, 489-497.

Strategical Report of İzmir University of Economics Library. 2007.

Sundstrom E., Burt, E. R. and Kamp, D. 1980. *Privacy at Work: Architectural Correlates of Job Satisfaction and Job Performance.* Academy of Management Journal, 23, 101-117.

Thorhauge, J. 2004. *Building Design for the Digital Age Danish Library.* Ireland: Watmand Authority, 20.

The Turkish National Library. 2008. [Internet], Available from: <http://www.kutuphaneci.org.tr/web/node.php?action=6&type=6&target=contentShw&id=978&node_id=128> [Accessed 5 March 2009].

Ucak, N. 2000. *The Importance of User-centered University Library Design.* [Internet], Available from: <yordammanas.kg/ ekitap/pdf/ Manasdergi/ sbd/sbd8/sbd-8-14.pdf > [Accessed 3 January 2007].

Ulrich, R. S. 1984. *View through a window may influence recovery from surgery.* Science, 224, 420–421.

Ulrich, R. S. 2006. *Evidence-based Healthcare Architecture.* Medicine and Creativity, 368, 38-39.

Ulrich, R. S. and Gilpin, L. 2003. *Healing arts and nutrition for soul.* San Francisco: Jossey Bass.

Unesco Institute for Statistics. 2007. [Internet], Available from: <http://stats.uis.unescoorg/unesco/tableviewer/document.aspx?ReportId=14> [Accessed 9 November 2007].

Vischer, J. C. 1996. *Workspace Strategies: Environment as a tool for work.* New York: Chapman & Hall.

Veitch, J. A.and Gifford R. 1993. *End Users' Knowledge, Beliefs and Preferences for Lighting.* Journal of Interior Design.

Wells, B.W. 1965. *Subjective Responses to theLightingınstallations in a Modern Office Building and Their Design Implications.* Building and Environment.

Yıldırım, K., Akalın, A. and Çelebi, M. 2007. *The effects of window proximity, partition height, and gender on perceptions of open-plan offices*. Journal of Environmental Psychology, 27, 154-165.

YÖK. 2008. *Statistics.* [Internet], Available from: <http://www.yok.gov.tr/Istatistikler/istatistikler.htm> [Accessed 9 November 2007].

Wastway, S. F. (2006). *Libraries: The Learning Space Within.* Egypt: Library of Alexandria.

Wilson, M (2002). *Visual Comfort and Energy Saving.* [Internet], Available from: <http://www.learn.londonmet.ac.uk/student/resources/doc/vis_comf_energy_save> [Accessed 21 December 2007].

APPENDIX A

PILOT STUDY OF İUE LIBRARY

A.1. İUE Library Images

First Floor of İUE Library






Ground Floor of İUE Library



A.2. İUE Library Staff Questionnaire

The Library Staff's Questionnaire

Date:

Legend Please put a cross as an example is shown

☒ ☐ ☐ ☐ ☐
1 2 3 4 5

1: strongly disagree 2: disagree 3: neither agree nor disagree 4: agree 5: strongly agree

GENERAL

1. There is difference between the library usage proportion of men and the library usage proportion of women.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

PRIVACY

2. The library provides enough private study places at exam time.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

3. The library have furniture arrangements for conversational privacy.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

4. The library have partitions (transparent or opaque partitions) for visual privacy.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

5. The users have enough space to work without others crowding them.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

6. The library space provide space for users to be able to concentrate on what they are doing.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

PERSONAL SPACE

7. The users can sit wherever they want in the library.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

8. The users feel like the seating place belongs to them.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

9. The users spend their time in the library in one place.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

10 The library is a comfortable place for the users.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

TERRITORIALITY

11 The users can change the furniture layout in the library.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

12 The users can alter the arrangement of furniture of equipment.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

CROWDING AND DENSITY

13 Which time of the day is the library more crowded?

☐ ☐ ☐ ☐ ☐
09.00 11.00 | 11.00 13.00 | 13.00 16.00 | 16.00 18.00 | 18.00 20.00

14 Which time of the day is the library less crowded?

☐ ☐ ☐ ☐ ☐
09.00 11.00 | 11.00 13.00 | 13.00 16.00 | 16.00 18.00 | 18.00 20.00

15 There is sufficient space allocated for each area of the library.

Study

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

PCs

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

Journals

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

Groupwork

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

16. The library organization (seating place, circulation areas, book shelves) is comfortable for the students.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

17. The library is a pleasant place for the students.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

DAYLIGHTING

18. Daylighting affects user's seating preference.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

19. Daylighting affects the amount of time users spend.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

20. The design of the seating layout optimizes daylight.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

21. The design of the spaces to move around the library optimizes daylight.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

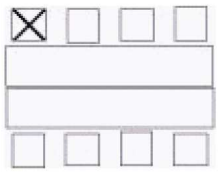
A.3. İUE Library Users' Qbservation

The Library Users' Observation

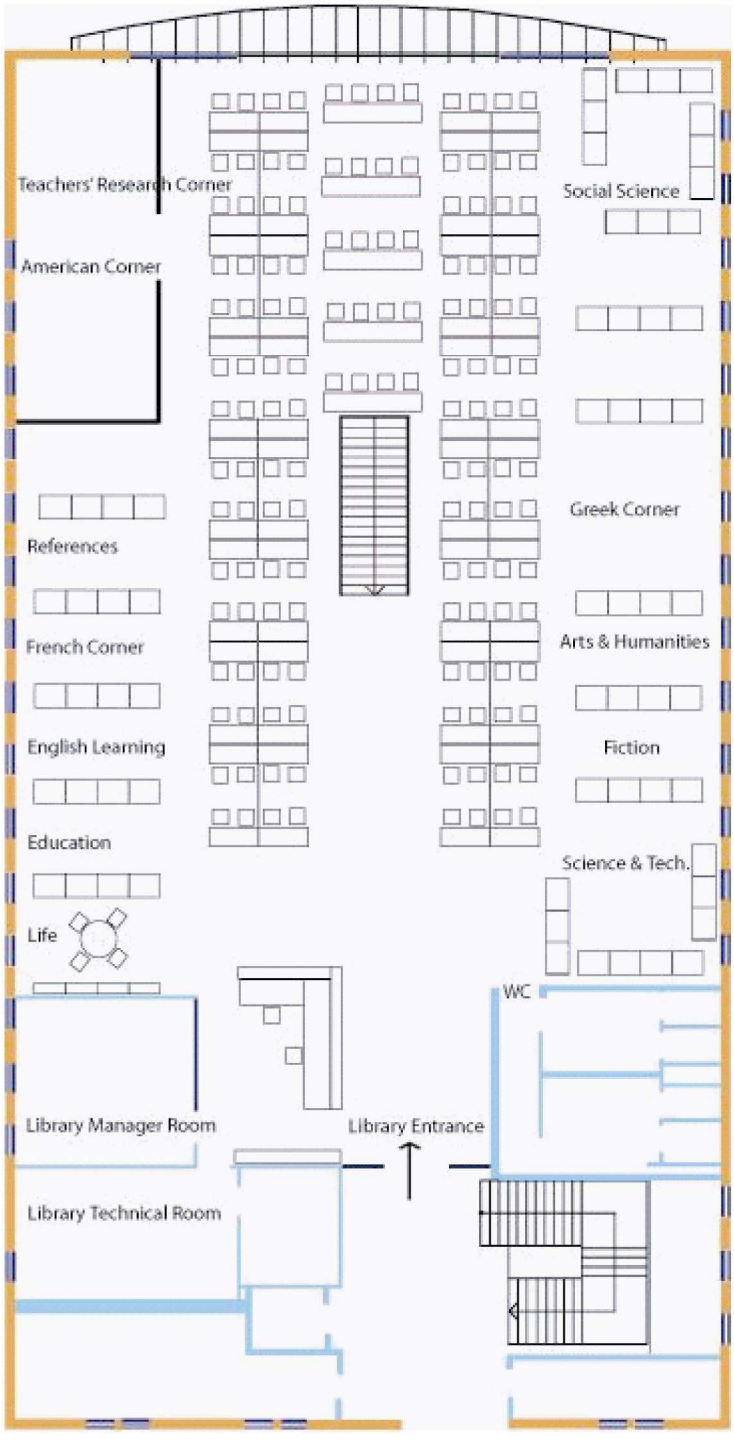
Ideally, the observation should be done for each weather condition and time period.

Please circle the appropriate conditions for the day of the observation.

Gender:	Age:	Date:	Weather	Time:
F M	18-22		Conditions:	09.00-11.00
	22-30		Rainy	11.00-13.00
	30-40		Overcast	13.00-16.00
			Sunny	16.00-18.00



Please mark with an **X** where the user prefers sitting in the given time above



SECOND FLOOR PLAN

A.4. İUE Library Users' Questionnaire

IUE Library User Preference Scale

Please circle the appropriate conditions for the day of the observation.

Gender:	Age:	Date:	Weather	Time:
F M	18-22		**Conditions:**	09.00-11.00
	22-30		Rainy	11.00-13.00
	30-40		Overcast	13.00-16.00
			Sunny	16.00-18.00

Legend Please put a cross as an example is shown

☒ ☐ ☐ ☐ ☐
1 2 3 4 5

1: strongly disagree 2: disagree 3: neither agree nor disagree 4: agree 5: strongly agree

PRIVACY

1. Does the library have places where you can be alone if you want to?

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

2. Does the library have furniture arrangements for conversational privacy?

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

3. Does the library have partitions (transparent, translucent or opaque partitions) for visual privacy?

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

4. Do you have enough space to work without others crowding you?

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

5. Does the library space provide space for you to be able to concentrate on what you are doing?

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

PERSONAL SPACE

6. Can you sit wherever you want in the library?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

7. Do you feel like the seating place belongs to you?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

8. Do you usually spend your time in the library in one place?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

9. Do you think that the library is a comfortable place for you?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

10 Do you have a place of your own in the library where you can keep your belongings?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 please describe:

TERRITORIALITY

11 Can you change the furniture layout in the library?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

12 Can you alter the arrangement of furniture and equipment?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

CROWDING AND DENSITY

13. Is there sufficient space allocated for each area of the library? Please put a cross

	yes	no	not sure
Study			
Internet			
Journal			
Group			

14. Is the library organization (seating places, circulation areas, book shelves) comfortable for you?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

15. Do you think the library is a pleasant place for you?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

DAYLIGHTING

16. Do you think daylighting affects your seating preference?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

17. Do you think daylighting affects the amount of the time users spend?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

18. Do you think that the design of the seating layout optimizes daylight?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

19. Do you think that the design of circulation scheme optimizes daylight?

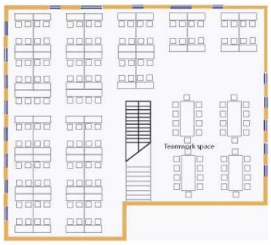
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

20. Do you think that the design of book shelves scheme optimizes daylight?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

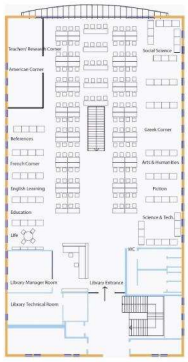
21. Where do you prefer sitting between the daytime hours 09.00 – 11.00?

Ground Floor Plan

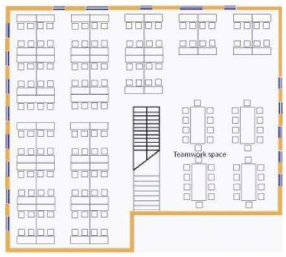


-1 Floor Plan

22 Where do you prefer sitting between the daytime hours 11.00 – 13.00?

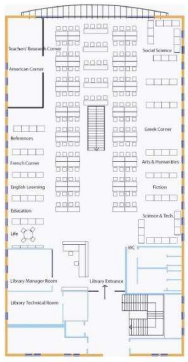


Ground Floor Plan

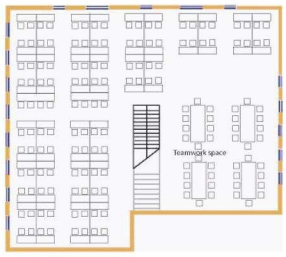


-1 Floor Plan

23 Where do you prefer sitting between the daytime hours 13.00 – 16.00?

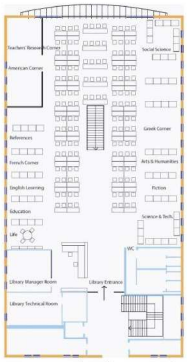


Ground Floor Plan

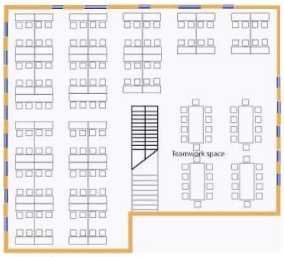


-1 Floor Plan

24 Where do you prefer sitting between the daytime hours 16.00 - 18.00?



Ground Floor Plan



-1 Floor Plan

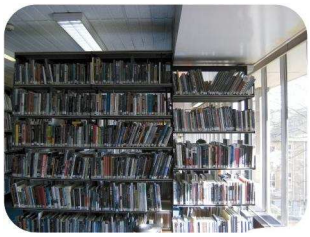
APPENDIX B

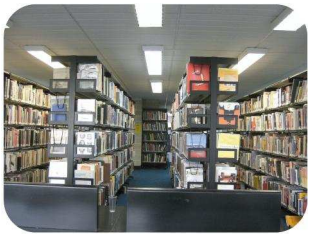
PILOT STUDY OF DoJ LIBRARY

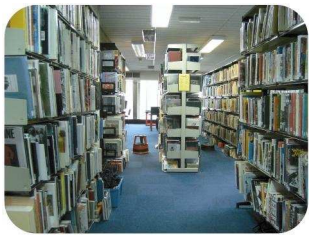
B.1. DoJ Library Images











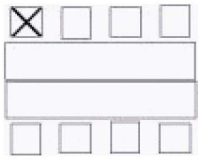
B.2. DoJ Library Users' Observation

The Library Users' Observation

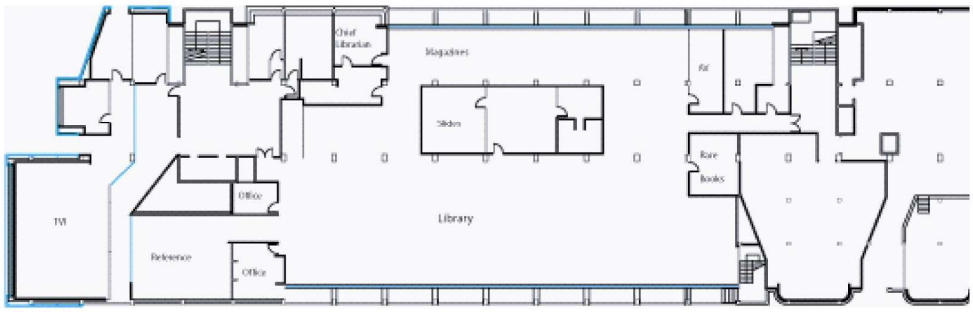
Ideally, the observation should be done for each weather condition and time period.

Please circle the appropriate conditions for the day of the observation.

Gender:	Age:	Date:	Weather	Time:
F M	18-22		**Conditions:**	09.00-11.00
	22-30		Rainy	11.00-13.00
	30-40		Overcast	13.00-16.00
			Sunny	16.00-18.00
				18.00-22.00



Please mark with an **X** where the user prefers sitting in the given time above



B.3. DoJ Library Users' Questionnaire

DoJ Library User Preference Scale

Please circle the appropriate conditions for the day of the observation.

Gender:	Age:	Date:	Weather	Time:
F M	18-22		**Conditions:**	09.00-11.00
	22-30		Rainy	11.00-13.00
	30-40		Overcast	13.00-16.00
	40-50		Sunny	16.00-18.00
				18.00-22.00

Legend Please put a cross as an example is shown

☒ ☐ ☐ ☐ ☐
1 2 3 4 5

1: strongly disagree 2: disagree 3: neither agree nor disagree 4: agree 5: strongly agree

PRIVACY

1. The library has places where you can be alone if you want to.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

2. The library has furniture arrangements which allow for private conversations.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

3. The library has partitions (transparent, translucent or opaque partitions) for visual privacy.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

4. You have enough space to work without others crowding you.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

5. The library provides enough space for you to be able to concentrate on what you are doing.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

PERSONAL SPACE

6. You can sit wherever you want in the library.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

7. You feel like the seating area belongs to you.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

8. You usually spend your time in the library in one place.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

9. You think that the library is a comfortable place for you.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

10 You have a place of your own in the library where you can keep your belongings.

☐ ☐ ☐ ☐ ☐ please describe:
1 2 3 4 5

TERRITORY

11 You can change the furniture layout in the library.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

12 You can alter the arrangement of furniture and equipment.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

CROWDING AND DENSITY

13 There is sufficient space allocated for each area of the library.

Study

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

PCs

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

Journals

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

Groupwork

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

14 The library organization (seating places, circulation areas, book shelves) is comfortable for you.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

15 The library is a pleasant place for you.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

DAYLIGHTING

16 Daylight affects your seating preference.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

17 Daylight affects the amount of the time you spend in the library.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

18 The design of the seating layout optimizes daylight.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

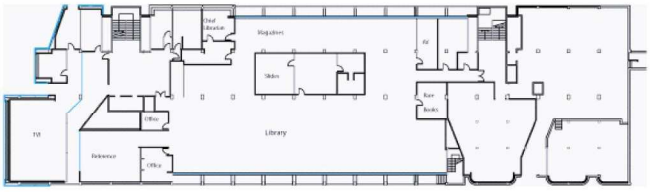
19 The design of the spaces to move around the library optimizes daylight.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

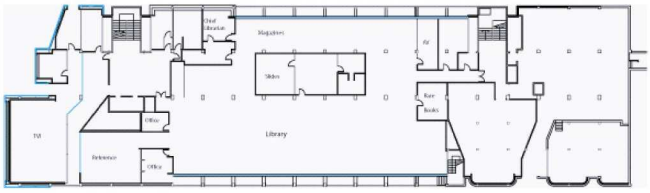
20 The arrangement of book shelves scheme optimizes daylight.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

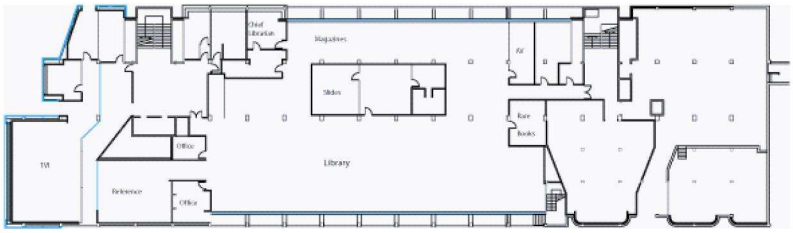
21 Where do you prefer sitting between the daytime hours 09.00 – 11.00?



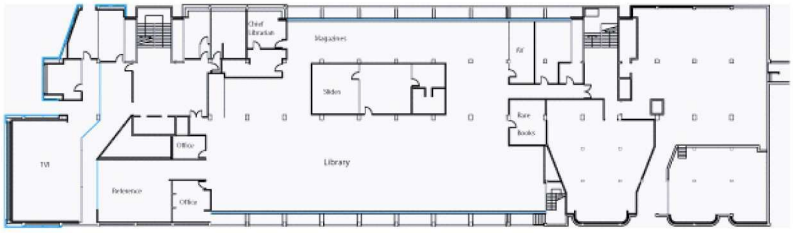
22. Where do you prefer sitting between the daytime hours 11.00 – 13.00?



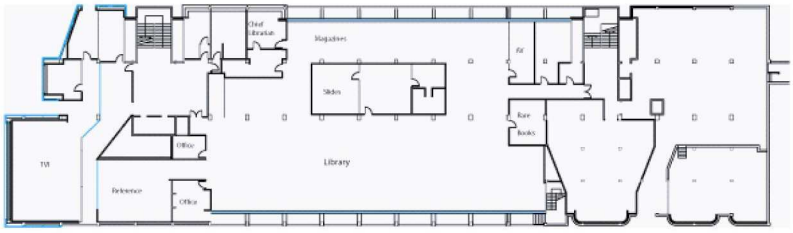
23 Where do you prefer sitting between the daytime hours 13.00 – 16.00?



24 Where do you prefer sitting between the daytime hours 16.00 - 18.00?



25 Where do you prefer sitting between the daytime hours 18.00 - 22.00?



VISUAL COMFORT

26. Your impressions of the space at this time

very unpleasant	1	2	3	4	5	very pleasant
not enough light	1	2	3	4	5	too much light

27. Deskwork – writing, reading pages and paperwork at main area

A- Is daylight adequate?

totally inadequate	1	2	3	4	5	completely adequate

B- The brightness of this work area in relation to the rest of the room

too bright	1	2	3	4	5	too dark

28. Computer work– data entry and looking at the compter screen

A- Is daylight adequate?

totally inadequate 1 2 3 4 5 completely adequate

B- The brightness of this work area in relation to the rest of the room

too bright 1 2 3 4 5 too dark

29. There is glare from windows

too strong glare 1 2 3 4 5 no glare

30. Thereis a brightness contrast between the room and what you see through the window

great contrast 1 2 3 4 5 no contrast

31. The amount of viewthrough the window is

inadequate 1 2 3 4 5 adequate

32. The quality of the view through the window

unpleasant 1 2 3 4 5 pleasant

33. Facing the direction where you would normally sit to meet with someone,the view is comfortable in terms of glare

uncomfortable 1 2 3 4 5 comfortable

APPENDIX C

THE CASE STUDY OF MAIN LIBRARY OF DUNDEE UNIVERSITY

C.1. The Main Library of Dundee University Images












C.2. The Main Library of Dundee University Users' Questionnaire

The Main Library of Dundee University User Preference Scale

Questionnaire for Daylight in Library Spaces

I am master of design programme student in Duncan of Jordanstone College of Art and Design, University of Dundee. My study is about *'Daylight Concepts in University Libraries and Their Influences on Users' Satisfaction'* .

The following questions ask you to provide me with an understanding of your privacy preference, comfort preference, crowding preference, seating preference and **daylighting** preference for a variety of everyday tasks you carry out in the library such as desk work, computer work and group studying.

The information you will give will help me to establishing criteria to improve the design of university spaces in the future.

Thanks for your help

Didem Kan
Duncan of Jordanstone College of Art and Design, University of Dundee
Master of Design Programme

The Main Library of Dundee University User Preference Scale

Please circle the appropriate conditions for the day of the observation.

Gender:	Age:	Date:	Weather	Time:
F M	18-22		**Conditions:**	09.00-11.00
	22-30		Rainy	11.00-13.00
	30-40		Overcast	13.00-16.00
			Sunny	16.00-18.00
				18.00-22.00

Legend Please put a cross as an example is shown

☒ ☐ ☐ ☐ ☐
1 2 3 4 5

1: strongly disagree 2: disagree 3: neither agree nor disagree 4: agree 5: strongly agree

PRIVACY

1. The library has places where you can be alone if you want to.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

2. The library has furniture arrangements which allow for private conversations.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

3. The library has partitions (transparent, translucent or opaque partitions) for visual privacy.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

4. You have enough space to work without others crowding you.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

5. The library provides enough space for you to be able to concentrate on what you are doing.

☐ ☐ ☐ ☐ ☐ notes:
1 2 3 4 5

PERSONAL SPACE

6. You can sit wherever you want in the library.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

7. You feel like the seating area belongs to you.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

8. You usually spend your time in the library in one place.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

9. You think that the library is a comfortable place for you.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

10 You have a place of your own in the library where you can keep your belongings.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 please describe:

TERRITORY

11 You can change the furniture layout in the library.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

12 You can alter the arrangement of furniture and equipment.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

CROWDING AND DENSITY

13 There is sufficient space allocated for each area of the library.

Study

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

PCs

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

Journals

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

Groupwork

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

14 The library organization (seating places, circulation areas, book shelves) is comfortable for you.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

15 The library is a pleasant place for you.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

DAYLIGHTING

16 Daylight affects your seating preference.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

17 Daylight affects the amount of the time you spend in the library.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

18 The design of the seating layout optimizes daylight.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

19 The design of the spaces to move around the library optimizes daylight.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

20 The arrangement of book shelves scheme optimizes daylight.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 notes:

21 Where do you prefer sitting between the daytime hours 09.00 – 11.00?

22. Where do you prefer sitting between the daytime hours 11.00 – 13.00?

23 Where do you prefer sitting between the daytime hours 13.00 – 16.00?

24 Where do you prefer sitting between the daytime hours 16.00 - 18.00?

25. Where do you prefer sitting between the daytime hours 18.00 - 22.00?

VISUAL COMFORT

26Your impressions of the space at this time

very unpleasant 1 2 3 4 5 very pleasant

not enough light 1 2 3 4 5 too much light

27. Desk work– writing, reading pages and paperwork at main area

A- Is daylight adequate?

totally inadequate 1 2 3 4 5 completely adequate

B- The brightness of this work area in relation to the rest of the room

too bright 1 2 3 4 5 too dark

28. Computer work– data entry and looking at the compter screen

A- Is daylight adequate?

totally inadequate 1 2 3 4 5 completely adequate

B- The brightness of this work area in relation to the rest of the room

too bright 1 2 3 4 5 too dark

29. There is glare from windows

too strong glare 1 2 3 4 5 no glare

30. Thereis a brightness contrast between the room and what you see through the window

great contrast 1 2 3 4 5 no contrast

31. The amount of viewthrough the window is

inadequate 1 2 3 4 5 adequate

32. The quality of the view through the window

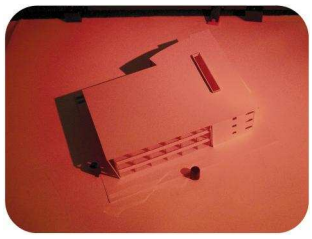
unpleasant 1 2 3 4 5 pleasant

33. Facing the direction where you would normally sit to meet with someone,the view is comfortable in terms of glare

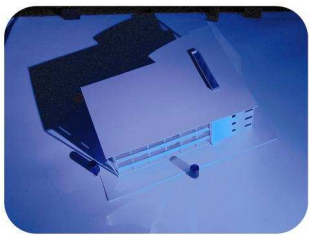
uncomfortable 1 2 3 4 5 comfortable

C.3. The Instrument of Case Study: Heliodon

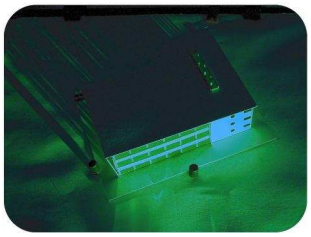
June 21st– 09.00



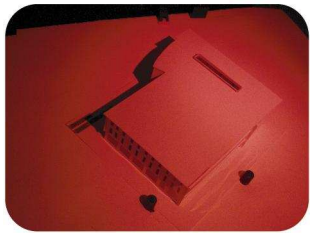
June 21st – 12.00



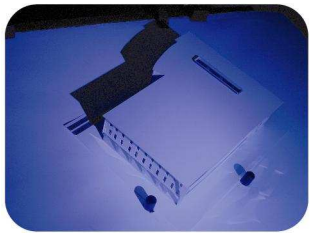
June 21st – 15.00



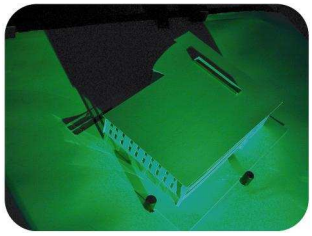
March 21st – 09.00
September 21st – 09.00



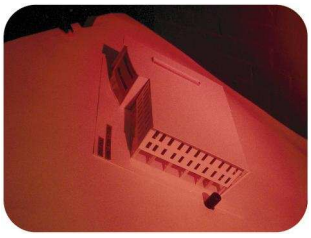
March 21st – 12.00
September 21st – 12.00



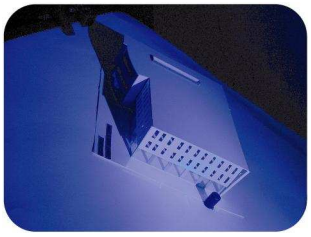
March 21st – 15.00
September 21st – 15.00



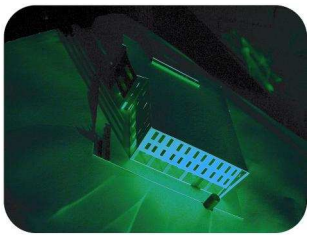
December 21st – 09.00



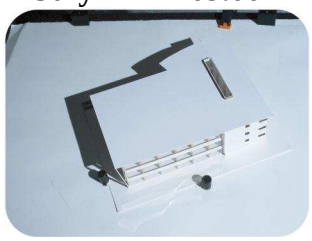
December 21st – 12.00



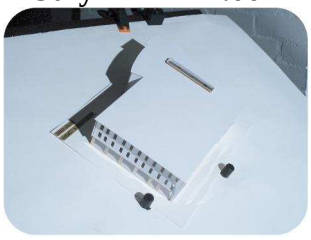
December 21st – 15.00



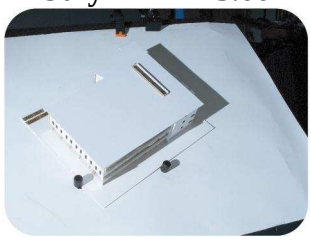
May 21st – 09.00
July 21st – 09.00



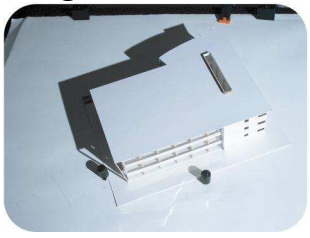
May 21st – 12.00
July 21st – 12.00



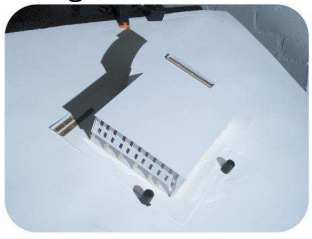
May 21st – 15.00
July 21st – 15.00



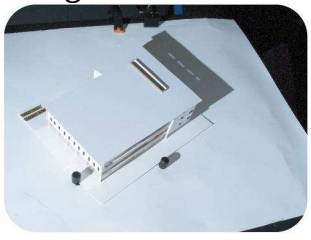
April 21st – 09.00
August 21st – 09.00



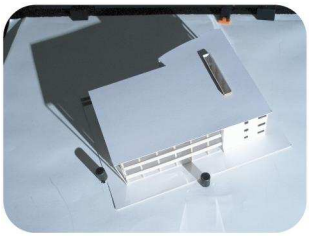
April 21st – 12.00
August 21st – 12.00



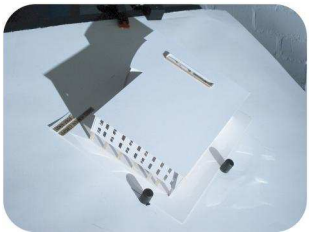
April 21st – 15.00
August 21st – 15.00



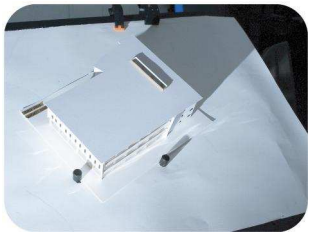
February 21st – 09.00
October 21st – 09.00



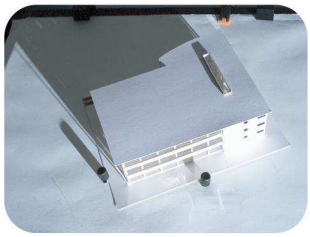
February 21st – 12.00
October 21st – 12.00



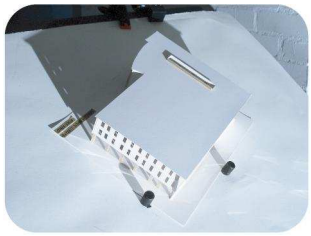
February 21st – 15.00
October 21st – 15.00



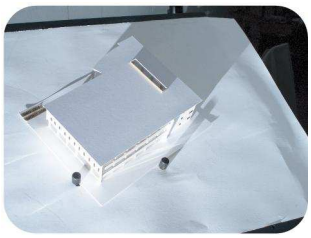
January 21st – 09.00
November 21st – 09.00



January 21st – 12.00
November 21st – 12.00



January 21st – 15.00
November 21st – 15.00



The Interior Photos of Physical Model