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# INTEGRATED LIGHT DESIGN FOR UNIVERSITY LIBRARIES IN NAIROBI

UNIVERSITY OF NAIROBI  
LIBRARY

University of Nairobi Library



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To my family, Pam and Speranza, my mum (Venansia) and dad (Mati), my brothers and sisters for always being there for me.

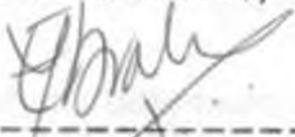
## DECLARATION

This thesis is my original work and has not been presented for award of degree in any other university or for any other award in any other institution to the best of my knowledge.

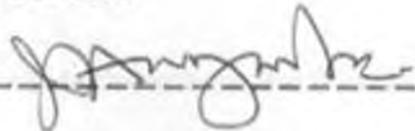
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To all the people that I have listed, and otherwise, I do express my gratitude.

## ABSTRACT

The study looked at light design in a library building in tropical upland climate, considering different ways used in lighting a library building, daylighting and artificial.

Case studies have been done, both local and international and the issue of lighting has been explored, with conclusion and recommendations made.

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## Chapter 1.0.

### 1.1. INTRODUCTION

Library is a repository for various forms of recorded information. Although the word library is derived from the Latin liber, meaning "book", the term now refers to collections of data in many other formats: microforms, magazines, phonorecordings, films, magnetic tapes, slides, videotapes, and electronic media.<sup>a</sup>

A library is more than just stacks of materials on shelves; it is also highly trained people that provide valuable services. These services include such things as organization and cataloguing, research, notification of new publications e.t.c. These high-valued services are one of the greatest assets of libraries. The World-Wide Web (WWW), while it probably contains more information than any single traditional library, is arguably not as useful as a traditional library because it lacks these services (particularly organization and sophisticated search support).<sup>b</sup>

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<sup>a</sup> Microsoft Encarta 2009 premium Encyclopedia

<sup>b</sup> <http://www.libriadesign.org>

Libraries, as repositories for written records, began where writing itself began—in the Middle East between 3000 and 2000 bc.

Library buildings have changed over the centuries in response to five major influences:

- The form in which information is recorded;
- The nature of the library's use and readership;
- Technological developments in both architecture and librarianship;
- Availability of funds;
- Recognition of traditional architecture as part of the cultural heritage.<sup>a</sup>

## 1.2. CONTEMPORARY LIBRARY DESIGN

Today, library buildings are constructed so that they can be easily expanded or modified to accommodate changes in collections, formats, and user needs, including those of users with disabilities. The rapid expansion of information technology since World War II has forced libraries to consider new methods of

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<sup>a</sup> Microsoft Encarta 2003 premium Encyclopedia.

storage such as compact movable shelving, the microfilming of bulky or deteriorating materials, and the relegation of less-used materials to storage.

The issue of lighting and acoustics has become a major design consideration factor in library design. The décor of modern libraries is determined largely by practical considerations. Lighting is bright, furnishings are sturdy, and structural elements are designed to conserve energy. In the future, libraries may see space once given over to bookshelves cleared to make way for extra computer terminals as Internet access supersedes access to books as the primary function of the institution.<sup>a</sup>

### 1.3. PROBLEM STATEMENT

City and county public libraries experience a growth of demand for more reader space with good lighting, noise control, shelving, technology infrastructure and staff areas. At the same time, buildings constructed for library services appropriate to a period twenty or more years ago become inadequate beyond just space or built-in infrastructure. There comes need for expansion where important design considerations such as lighting and acoustics are ignored.

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<sup>a</sup> Microsoft Encarta 2005 premium Encyclopedia.

The older buildings are typically less flexible for spatial change, have poor lighting for contemporary uses, consume too much energy, are not universally accessible, have relatively high maintenance costs and often have become physically degraded.

In learning institutions we have seen classrooms being converted to libraries and the two have different design criteria, one as teaching space and the other as reading space with different light requirements.

Public halls have also been converted to public libraries without any design considerations.

Inevitably, the idea arises of providing a modern facility by building a new library or renovating and expanding the existing library emphasizing on design for natural and artificial lighting within the active library space.

#### **1.4. AIMS AND OBJECTIVES**

This research aims to investigate ways of creating a comfortable visual internal space in library buildings within a tropical upland zone through proper lighting design.

This research will try to analyse the basic light design requirements for each functional space in a library to come up with a more user friendly spaces in both public and institutional libraries.

### 1.5. SCOPE AND LIMITATIONS

- Scope

This research will look at the salient design issues pertaining light to be taken into consideration when designing a new library for public or institutional use. Each functional space within a library building will be analysed and the standards established will be used to evaluate some existing library buildings.

The fundamental design issues to be looked at will be daylighting in libraries in tropical upland climate.

- limitations

Being a rather broad topic, lack of enough resources: literature, time and finance will limit the depth to which this study could have been carried out.

## 1.6. KEY TERMINOLOGIES

Lumen: Light energy is measured in lumens. One lumen is defined as the amount of light energy from a source of intensity one candlepower, incident on a unit area at a unit distance from the source.

Glare is the condition when the brightness ratios of surfaces exceed visual comfort conditions.

Daylight Aperture is a shaped opening in the exterior surface of a building that is designed to admit daylight.

Clerestory, Clerestory Window is a Glazing or window above the normal location of a window in an exterior wall.

Bi-Level Switching Light Controls is a type of electric light fixture control that switches lamps in the fixture separately to allow full "on" or partial "on".

Efficacy is ratio of the amount of light energy from a source to the heat content of that energy.

## 1.7. RESEARCH METHODOLOGY

- **Literature review**

published literature: books, journals, periodicals as well as unpublished works such as thesis and internet articles have been done to find out the basic variables in library design.

This approach has also tried to find out how library design variables such as lighting can be adopted in new buildings which were not formerly used as library buildings.

- **precedence studies**

These are studies which have been selected from internet and books .I conducted a study of a number of libraries, public and Institutional.

- **Field work (real life cases)**

This will aim at establishing the performance of various buildings adopted as library in terms of both natural and artificial lighting within the library building.

### 1.8. PROPOSITION

The author is of the opinion that most library buildings especially for institutions do not meet critical design parameters such as lighting for library buildings because these buildings were not initially built/ designed for this purpose.

## Chapter 2.0. LIGHTING FOR LIBRARIES

### 2.1. INTRODUCTION

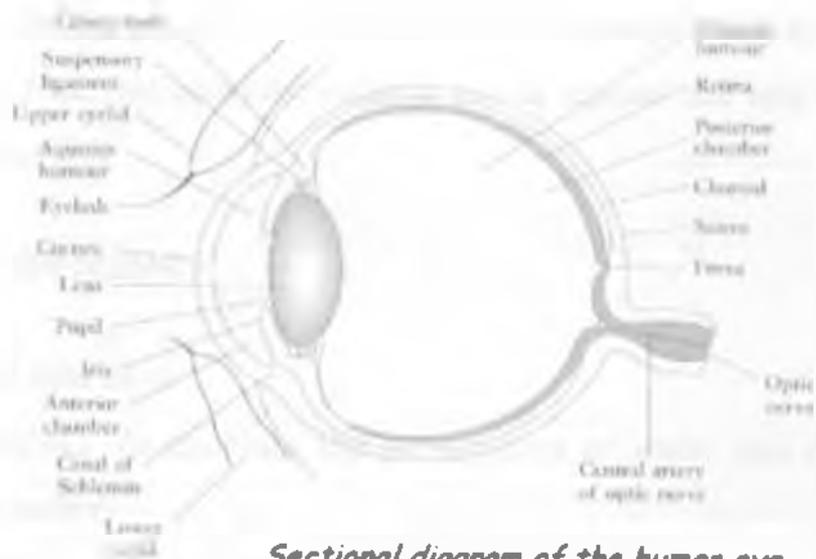
"Quality lighting is a powerful tool that can greatly impact and enhance an architectural and interior design project." - International Association of Lighting Designers (IALD).

Reading is the most important task in libraries. Proper lighting is crucial to the overall success of a library. Good lighting design in library buildings is the result of both technical skill and art on the part of the designer. This is particularly true in newer buildings where visual tasks are more diverse and technology poses new types of lighting requirements.

The use of natural light (*daylighting*) has traditionally been a desirable building feature and a hallmark of good design. When skillfully introduced, daylight creates an ambience of quiet contemplation and visual comfort, and 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.

Daylighting design has recently taken on a new importance, beyond these aesthetic and psychological aspects, with the advent of energy shortages and sustainability concerns. The alternative to daylighting, the use of electric power for library lighting, contributes to the strain on world's electric generation capacity as well as the inefficient use of non-renewable energy resources. Furthermore, the cost of lighting a library has become a major burden to communities and will continue to increase in the future. Daylight, which is free, provides the opportunity to greatly reduce these negative impacts created by the over-dependence on electric lighting sources. Effective use of daylight in library design is both an art (it creates emotional effects) and a science which every designer should be aware of when undertaking any design project.

My research will set specific criteria that, if met, will avoid major mistakes which keeps on occurring time and again in various library buildings we design. The most important communication channel of man with his environment is vision. Light is a prerequisite of seeing.



*Sectional diagram of the human eye*

Lighting criteria should be related to human activity and vision.

The human eye is capable of responding to a wide range of illumination extending over a million orders of magnitude from 0.1 lux (full moonlit night) to 100,00 lux (bright sunshine).<sup>4</sup>

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<sup>4</sup> *Manual of Tropical Housing and Building* by Koenigsberger, O.H. et al (1975) Longman, London



Localized lighting for visual task illumination is provided over the small area occupied by the task & immediate surrounding. There is less consumption of energy.



Visual performance curve, increasing the amount of light increases visual performance but after a certain level, performance becomes constant. Therefore there is need to provide just enough light for a specific task.

However, the eye cannot respond to the whole of this range at any one time and it is essential that this adaptation should not be abused and only utilized in emergency situations.

## 2.2. VISUAL EFFICIENCY

The purpose of light is to;

- a) **PRACTICAL:** To facilitate the performance of *visual task* and ensure *visual comfort*.
- b) **ARTISTIC:** To create emotional effects. This comes as a result of apparent colour of the light that the source emits or from the effect the light has on the colours of surfaces.

## 2.3. VISUAL PERFORMANCE

The speed and accuracy with which we can perceive details depends primarily on three things:

a) **Visual acuity/sharpness of vision:**

This is measured as the reciprocal of the visual angle  $\rho$  (expressed in minutes) subtended at the eye by the least perceptible detail - e.g. the critical detail might be the serif of a letter of the smallest type likely to be encountered.

b). **Contrast sensitivity:**

It's contrast with the background.

c). **Visual performance i.e. time required for seeing:**

Contrast and size of critical detail performance improves with illumination. Very high levels of illuminance are never justified except for some special tasks like work of a surgeon at the operating table which require very high levels of illuminance to give necessary accuracy of vision.

## 2.4. CRITERIA FOR SETTING LIGHT LEVELS AND LAWS FOR LIGHTING

The integrated building lighting system composed of both daylighting and electric sources must provide adequate levels of light that are distributed in a manner that is glare-free and comfortable.

Three main methods are used to set the correct light levels in buildings.

- ✓ The levels required to meet appropriate health and safety regulations.
- ✓ The levels required to produce a given standard of task performance.
- ✓ The levels required for the workers to be satisfied with the lighting.

The following laws apply in lighting:

### a) Inverse square law

In a Condition where illumination plane is perpendicular to the direction of light:

$$E = I / d^2$$

Where: E = Illumination, in lux or lm/m<sup>2</sup>

I = Luminous Intensity, in candela (cd),

d = Distance, in m.

## b) Cosine law

This law states that when the plane is tilted, the same illumination is distributed over a larger area.

$$E_{\beta} = E_n \times \cos\beta$$

Where:  $E_n$  = Illumination on a normal plane.

$E_{\beta}$  = Illumination on a plane tilted by  $\beta$  degrees.

$\beta$  = Angle of incidence.

## c) Additive illumination

Illumination of a surface from several sources will be the sum of the component illuminations:

$$E = E_1 + E_2 + E_3 + \dots$$

**d) Infinite length source**

Illumination reduces in direct proportion to the distance (and not the square of distance).

**e) Infinite large surface: e.g. the sky**

Illumination does not vary with the distance.

**f) High levels diminishing returns law**

Visual efficiency increases with the increase of illumination but the curve flattens out at higher levels.

Visual Task	Illumination: lux	Glare: index
Casual seeing	100	28
Rough task with large detail	200	25 - 28
Ordinary task, medium detail	400	25
Fairly severe task, small detail		
(eg Drawing office, sewing)	600	19 - 22

Recommended illumination levels

Source: Koenigsberger, O.H. et.al. (1973):

**g) Reciprocity law**

Stipulates that the rate at which a material is destroyed depends directly on the amount of light falling on it. Thus this rate can be controlled by the limiting the illumination level in relation to the material's sensitivity to light. This is important when designing special buildings as library and especially on issues of conservation.

Lighting is not just a matter of providing apertures on roof and walls neither is it a matter of fixing electric bulbs in a room. As a designer you should put into consideration the extent of the area you are going to light, kind of task which will take place in that space and type furniture and its arrangement.

Another thing to consider while designing for good lighting is the issue of noise because you may achieve good lighting but in terms of acoustics you fail because the apertures you provide for lighting will also be bringing in intrusive noise. Good lighting for libraries can only be achieved after taking into consideration the above laws for lighting.

## 2.5. QUALITY OF LIGHT

### 2.5.1. GLARE AND CONTROL DEVICES

#### THE VISUAL FIELD

With stationary head and eyes the visual field of an average person extends to 180° horizontally and 120° vertically.

Within this the central field is limited to  $2^\circ$  and the immediate background extends to about  $40^\circ$ . Visual comfort and efficiency can be ensured by the control of luminance distribution within the visual field.

The luminance ratios should be:

CENTRAL FIELD : BACKGROUND : ENVIRONMENT:

5 : 2 : 1

But: 10 : 3 : 1 should not be exceeded as this may cause glare.

Glare may also be caused when average luminance exceeds about 25 000 cd/m<sup>2</sup> (80 000 asb) even without any contrast.

### 2.5.2. QUALITY OF ILLUMINATION

It's determined by:

- a) Color of light.
- b) Color rendering. These two depend on the light source: subject to choice in electric lighting but given in daylighting.

c) **Light distribution.** Distribution in electric lighting depends on the fittings and their position.

In daylighting it depends on windows and reflective surfaces.

d) **Freedom from glare.**

e) **Luminance distribution**

### **2.5.3. GLARE INDEX**

It's the function of the following four factors:

a) **The luminance of the sky** which is seen from the window or roof light.

b) **The apparent size of the sky** that is visible.

c) **The position of this bright patch of sky** relative to the direction of view.

d) **The adaptation conditions in the room**, expressed in particular by the average luminance of the whole room and not including the visible sky.

### **2.6. MAINTENANCE, DISTRIBUTION AND CONTROL TECHNIQUES:**

Over a period of time, the light output of lamps falls, the lamps and luminaires gather dirt and deteriorate. The lamps may also fail.

The maintenance factor is intended to allow for these factors. By applying a maintenance factor the designer ensures that the initial average illuminance is significantly higher than the design value so that at the time when the maintenance procedures are carried out the installation will still just meet its illuminance specifications.

Maintenance factor is made up as follows:

$$MF = LLMF \times LMF \times RSMF \times LSF$$

Where LLMF is lamp lumen maintenance factor,

LMF is luminaire maintenance factor,

RSMF is room maintenance factor

LSF is lamp survival factor.

LMF, RSMF and LSF are provided by the lamp manufacturer, CIE<sup>a</sup> and CIBSE<sup>b</sup> data in its lighting code.

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<sup>a</sup> Illuminating Engineering Society

<sup>b</sup> Chartered Institution of Building Services Engineers

**Lamp lumen maintenance factor (LLMF) and lamp survival factor (LSF)**

Type of lamp	Time in operation (h)*			
	6000	8000	10 000	12 000
Fluorescent LLMF	0.87	0.86	0.85	0.84
Triphosphor LSF	0.99	0.95	0.85	0.75
Metal halide LLMF	0.77	0.69	0.66	0.63
LSF	0.91	0.87	0.83	0.77
HP sodium LLMF	0.91	0.89	0.88	0.87
LSF	0.96	0.94	0.92	0.89

\*Manufacturer's data preferred

**Luminaire maintenance factor**

Type of luminaire	Cleaning interval and situation								
	1 year			2 year			3 year		
	Clean	Normal	Dirty	Clean	Normal	Dirty	Clean	Normal	Dirty
Open top reflector	0.90	0.86	0.83	0.84	0.80	0.75	0.79	0.74	0.68
Enclosed luminaire IFIX	0.88	0.82	0.77	0.83	0.77	0.71	0.79	0.73	0.65
Uplighter	0.92	0.81	0.74	0.77	0.68	0.63	0.70	0.55	0.45

Recommended maximum cleaning interval for windows in non-industrial areas:

<u>Type of Building:</u>	<u>Side Window:</u>	<u>Roof Light:</u>
Offices:	3 Months	12 Months
Banks:	2 Months	3 Months
Shops: Outside:	1 Week	6 Months
Inside:	2 Weeks	
Shops (in main street):	Outside - daily	3 Months
	Inside - 1 Week	

<u>Type of Building:</u>	<u>Side window:</u>	<u>Roof Light:</u>
Hospitals:	3 Months	6 Months
Schools:	3 - 4 Months	12 Months
Hotels:	2 Weeks	3 Months
Factories (Light Industries):	1 Month	3 Months
Factories (Heavy Industries):	2 Months	6 Months
Domestic:	4 - 6 Weeks	

**Room surface maintenance factor**

Room type	Orientation	Maintenance factor								
		1 year			2 year			3 year		
		Clear	Maintained	Dirty	Clear	Maintained	Dirty	Clear	Maintained	Dirty
Small	Down	0.97	0.94	0.93	0.95	0.93	0.90	0.94	0.92	0.88
	Down/up	0.90	0.86	0.82	0.87	0.82	0.78	0.84	0.79	0.74
	Up	0.85	0.78	0.71	0.81	0.73	0.66	0.75	0.68	0.59
Medium to large R = 2.5	Down	0.98	0.94	0.95	0.96	0.93	0.94	0.96	0.95	0.94
	Down/up	0.92	0.88	0.85	0.89	0.85	0.81	0.84	0.82	0.78
	Up	0.90	0.82	0.77	0.84	0.77	0.70	0.78	0.72	0.64

Space	Recommended Illuminance (Foot-candle Level)	LUX
Active (occupied) Book Stacks	20 <sup>a</sup>	215
Inactive Book Stacks	3 <sup>b</sup>	33.8
Book Repair and Binding	50	522.8
Cataloging	50	522.8
Circulation Desk	50 <sup>c</sup>	522.8
Computer Areas	50	522.8
Audiovisual	50	522.8
Audio Listening	50	522.8
Reading (normal size and contrast newspaper, magazine, keyboard)	50	522.8
Knitting (very small size and low contrast fine detail items, small	50 <sup>d</sup>	534

IES Recommended Light Levels for Libraries

### Chapter 3.0. DAYLIGHTING DESIGN IN LIBRARIES

#### 3.1. GENERAL PRINCIPLES

The integrated building lighting system composed of both daylighting and electric sources must provide adequate levels of light that are distributed in a manner that is glare-free and comfortable.

#### 3.2. QUANTITY OF LIGHT

The Illuminating Engineering Society (IES) is an independent organization of professionals that sets light level guidelines which serve as the recognized standards for light in building spaces.

- <sup>a</sup>For book stacks, use vertical foot-candle levels
- <sup>b</sup>At 762mm above the finished floor level.
- <sup>c</sup>Although this is the IES standard, lighting designers typically prefer 430-538 lux at these desks.

\* This should not be used as an excuse to light the whole library to 538 lux, just because there are always some low contrast tasks interspersed throughout the library. The higher light level would apply only in specific areas, such as collections of phone books.

### Recommended illumination levels for schools

	<i>Standard maintained illuminance (lux)</i>	<i>Uniformity ratio</i>	<i>Limiting glare index</i>
1 General teaching spaces	300	0.8	19
2 Teaching spaces with close and detailed work, e.g. craft and art rooms	500	0.8	19
3 Circulation spaces - stairs and corridors lobbies, waiting areas and entrance halls	80-120 175-250		19 19

### **3.3. BOOK STACK ILLUMINATION**

Book stacks must be lit evenly across the stack face so that titles and call numbers can be easily found and read. The lighting level should be a minimum of 64.6 lux measured vertically on the face of the book spine at a height of 305 mm above the floor, and a maximum of 376.6 lux at any height, so that no more than a 6:1 ratio results across the entire vertical face of the book stack.



55 foot-candles  
(576.6 lux)

6 foot-candles  
(64.6 lux)

Ideal vertical foot-candle distribution at book stacks, source <http://www.libnadesign.org>

Daylight should be introduced above and behind the patron so that book titles are illuminated without glare.

### 3.4. LIGHT DISTRIBUTION

For good daylighting design, low glare lighting is a principal objective in libraries. Ideal ratios of brightness levels within the field of view are often described at 10:3:1, for brightness of visual task to brightness of the immediate surround to brightness of the general surround. A library space that largely achieves these ratios can be considered to have a good level of visual comfort and no glare conditions.

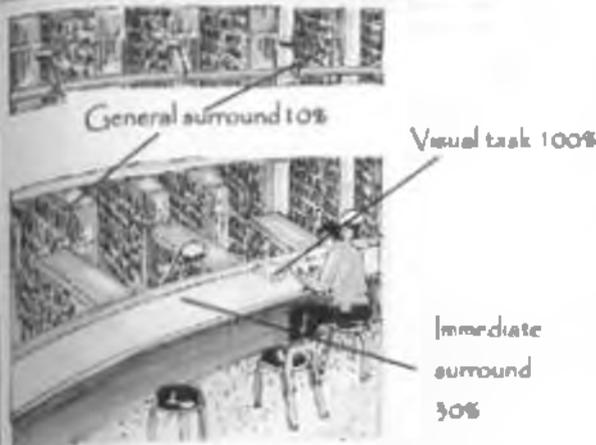
### 3.5. DESIGN FOR THE DAYLIGHT COMPONENT

There are four ways in which light can be received in a building:

- a. Diffused sky light which is either reflected by sky or clouds.
- b. Externally reflected light from neighbouring buildings and other objects.
- c. Reflected indoor component which is reflected by internal building surfaces and fixtures.
- d. Direct sunlight.



Daylighting in a building  
a - Diffused sky light  
b - Externally reflected light  
c - Internally reflected light



Recommended relative brightness of surfaces within the field of view for good visual comfort. Taking 100% as brightness for reading, immediate surrounding should be 30% while general surrounding should 10%  
source <http://www.libriadesign.org>



Cutaway view of skylight with an exterior sun control device to prevent direct sunlight from entering the library space below through a shallow aperture.  
source <http://www.libriadesign.org>

The efficacy and heat content of daylight require careful control of the daylight aperture size, wherever it is located.

The three fundamental design issues in daylight design are:

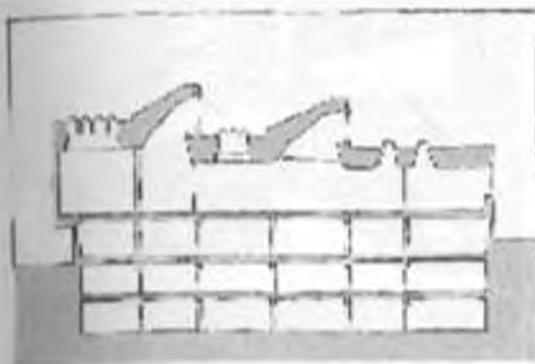
- Sun control, to mitigate any increase in the cooling load and to control direct glare.
- Glare control, to create and maintain comfortable brightness distribution, including no direct views of the bright sky in the normal direction of view.
- Variation control, to avoid any user perception of insufficient local light levels.

Daylight apertures in walls and roofs are essentially *in situ* light fixtures using renewable light energy from the sun.

The building design team must not only address the three principal issues above for a variable, heat-laden source, but must configure the daylight apertures to reflect and diffuse the light effectively to serve the lighting tasks appropriately.

Daylighting solutions that address the above issues are most successfully executed when focused on providing general background lighting as opposed to specific task lighting, and when augmented by electric lighting in an intelligently controlled and seamless manner.

When used as general lighting, the variability of daylight is more acceptable to users and easier to control. Smooth integration with electric lighting also helps mitigate the variability issue.



### 3.6. DAYLIGHT APERTURES IN LIBRARY BUILDINGS

#### a. Roof

Most libraries up to about 5 400m<sup>2</sup> are usually two stories in height with a fairly regular floor plan shape. Whereas designers can manipulate the building envelope configuration of office buildings, for example, to maximize access to daylight through windows for people sitting at desks all day, library space tends to be limited to more internal types of space, away from the 6m wide daylighting perimeter.

The design implication of these typical planning characteristics of libraries is to work with the roof component of the building envelope to provide the controlled

Section showing extensive use of various types of roof apertures, including different types of roof monitors and skylights

The upper level houses all primary library activities and the lower three levels are enclosed stack levels

source <http://www.libnsdesign.org>

use of the sun and daylight to offset much of the normally high internal lighting load.

Some of the methods used to introduce diffuse, low-glare daylight from the roof level, include skylights and roof monitors.

Roof monitors are popped-up extensions of the roof, with vertical glass areas. Large roof monitors often appear to be forms of vertical extensions of the ceiling, and can provide dramatic high internal spaces in special areas. One advantage of roof monitors compared to skylights is that there is less risk of water leakage than with conventional skylights. Furthermore, roof monitors avoid the strong solar impact of the overhead sun and can be designed with exterior sun control devices as necessary to diffuse direct sunlight.

Libraries are ideal building types for extensive use of roof monitors because of the typical one- or two-story configuration of the floor plan.

Roof monitors can also provide daylight to the lower floor level in a two-story facility by carefully locating openings on the second floor below the roof

aperture areas. Daylight easily penetrates the normal 7.5m - 9.0m from roof level to first floor level.

Skylights can be successful daylighting roof apertures provided that direct sun is prevented from coming within view by washing down walls or striking floor or table surfaces.

Skylights should be relatively small in area and should be accompanied by large adjacent diffusing surfaces to avoid accumulation of heat from direct sunlight.

A skylight with deep adjacent diffusing surfaces is a simple technique of protecting from direct sunlight while providing non-directional, comfortable light to the space below. A 2:1 ratio of depth to width normally provides enough diffusing reflections for glare-free light.

If deep apertures are not possible in a design, an alternative is to equip the skylight with some type of sun control device, such as exterior louvers or movable translucent shades. Normally, to be effective, the sun control device should be operable and should respond to the position of the sun to reflect all direct sunlight otherwise incident on the glass.



Architecturally interesting ceiling resulting from light fixtures hidden within skylight apertures, source: <http://www.ibnadesign.org>



Triangular skylights over the library's main reading room. source: <http://www.librisdesign.org>

Daylighting elements of the roof aperture can completely replace the normal appearance of a ceiling containing electric light fixtures.

The electric light fixtures, required for times of poor daylight availability, are visually hidden within the skylight apertures in both examples.

Deep cylindrical plaster tubes above the ceiling plane are integral with the skylights at roof level; they are painted matte white on the inside surface to maximize light diffusion for a soft uniform light.

The creative skills of architects and lighting designers can allow these basic criteria for good daylighting design to be the basis of exciting architectural space



Stylights and roof monitors combined, the size of the roof monitor creates interesting high space in the library. source <http://www.libriadeign.org>



Stylights and roof monitors combined over a central library space. The roof monitor slot outlines the shape of the lower floor area below. source <http://www.libriadeign.org>

### b. Wall

The perimeter spaces of the library can be effectively daylighted for approximately 6m from the exterior wall by using windows and clerestories (high windows). The taller or higher the window, the deeper will be the daylight penetration into the space.

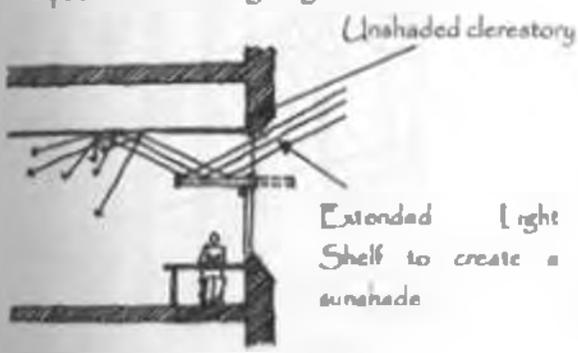
Clear glass is preferred for daylighting, but this in turn requires carefully designed exterior sun control devices to provide adequate shading. Although internally mounted shades and blinds reduce the high intensity and heat content of direct sunlight, the most effective sun control device is the exterior sunshade. An internal shade, even a light-colored fabric or blind, reduces solar heat gain by about one-third to one-half of the incident solar energy. An exterior shade will create a reduction of 80% of the incident solar energy.

The more open sunshade can still provide full shade at the window for the angles of incident light, while reflected daylight can pass through the openings to provide higher levels of light at the window face.

Simple fixed vertical elements are adequate to control direct glare.



Horizontal sunshade excludes all direct sunlight but is open to allow diffuse daylight to pass through source <http://www.libnadesign.org>

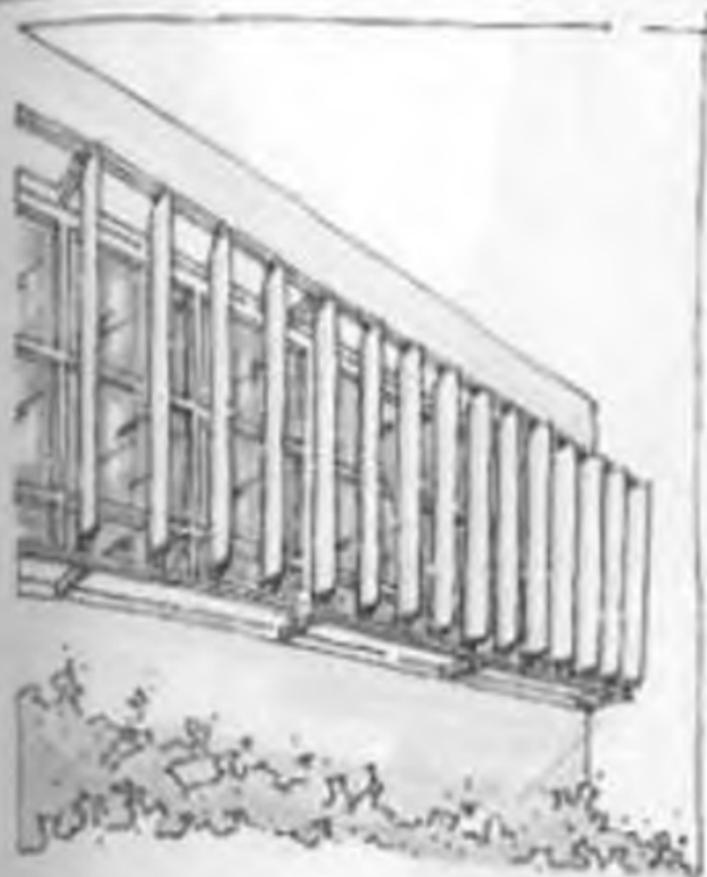


Sketch of a Light Shelf concept

East- and west-facing windows are more difficult to shade since the sun is low in the sky in the mornings and afternoons, and the angle of incident sunlight is almost perpendicular to the glass. For these windows, some kind of vertical device or operable shutter is generally needed.

Daylight through east or west windows is always best when the sun is on the opposite side of the building. When it is not, there will be no daylight at window level since the sunshade must be fully employed to screen the perpendicular low angle sunlight. This problem can be solved to some extent through the use of *clerestories* and shaping the ceiling as shown below or by adding a *light shelf*.

The light shelf is a device located at the bottom of a clerestory that captures direct sunlight by reflecting it off the top of a plane that extends into the space, either a mirrored or diffuse surface. If the plane of the light shelf screens the clerestory window from direct view, there will be no direct glare and the low angle sunlight will be reflected from light shelf and ceiling, and will reach the task level deep in the space as diffuse light. The light shelf can be used on the south-facing walls as well, and the light shelf can be extended to the exterior to form a horizontal sunshade for the lower window.



Vertical sunshade reduces glare from bright surroundings. The open design also allows view out and daylight penetration. This design should be augmented with internal shades for low perpendicular sun angles, source <http://www.libriadesign.org>

### 3.7. SUPPLEMENTARY LIGHTING

Rooms deeper than 6m can not depend on daylighting alone. Therefore a system has been developed, known as **PSALI (Permanent Supplementary Artificial Lighting of the Interiors)**. Meaning the interior parts of the room are lit permanently by electric lights, to provide the necessary illumination in such a way that the overall impression of day-lighting is maintained.

From this it was one step to the use of **PAL (Permanent Artificial Lighting)**, which ignores daylight altogether, possibly leading to windowless environments.

It has been claimed that, the window being the weakest point of the building envelope (in both thermal and noise insulation), great economic benefits would be obtained with a windowless building and the use of PAL.

The saving on heating or air conditioning would be greater than the cost of artificial lighting.

The counter-argument is that the purpose of windows is not only to provide daylighting, but to give a visual link with the outside world. With the use of



High clerestory windows in an exterior wall, with a back reflecting surface to provide light on the vertical surfaces of the stacks at the wall, source <http://www.librisdesign.org>

PSALI, this need would be satisfied with reduced sized windows, and the insufficient daylight would be supplemented by artificial means.

If the above is true in tropical climates, it must be even more so in hot climates. Particularly in hot-dry regions, where the windows would be small for thermal reasons and where some form of shading must be provided, the daylight reaching the interiors is likely to be insufficient.

As probably the thermal controls are of primary importance, there would be only two choices open: either to accept a below standard lighting or to use PSALI.

#### UNIVERSITY OF NAIROBI AND LIBRARY

### 3.8. HYBRID SCHEMES

Effective daylighting design requires the smooth integration of daylight design features with electric lighting in order to control the inherent variability of daylight, which can be undesirable in certain types of library spaces, and to provide sufficient light when adequate daylight is not available.

This integration is achieved by wiring the electric light fixtures separately near daylight apertures and using the light control system to reduce the use of

electric fixtures in these areas when they are not needed or only partially required.

The perpendicular and indirect schemes are sometimes combined, with rows of direct-indirect fixtures suspended perpendicular to the stacks. When the ceiling is higher than approximately 3m, this hybrid scheme can be a very successful solution that provides good lighting on stacks at moderate cost and with reasonable energy use.



Direct-indirect lighting running perpendicular to the stacks.

The lighting is very even across the entire stack face, source <http://www.librdesign.org>

Outward-facing periodical shelves are especially difficult to light because the clear plastic protective folders on the magazines reflect any overhead lighting, which obscures the covers. No scheme is perfect, so it may be best to simply use whichever lighting scheme is used for adjacent standard shelving and live with the compromise. Building lights into the bottoms of the shelves is very expensive and is usually ineffective.

Regardless of which scheme is selected, fixtures should not be located higher than approximately 4.5m above the floor, because this is the highest height that can safely be reached for re-lamping purposes from a 3.6m ladder that fits in the aisles. If it is necessary to hang lights higher than 4.5m, the

designers should work closely with the library maintenance staff to develop a feasible maintenance system.

### 3.9. LIGHTING IN GENERAL READING AND STAFF AREAS

#### Approaches

General lighting needs to suit a wide range of activities, and it must be flexible to suit present and future tasks. Glare reduction is a primary concern, especially where computers are prevalent. The basic issues are indirect versus direct lighting, and general versus task lighting.

#### a) Indirect Lighting

Indirect lighting uses fluorescent or metal halide lamps to up light a light color ceiling; the resulting reflected light is inherently very soft, shadow-free, and low-glare. Indirect lighting works well for both paper-based and computer tasks in rooms where the ceiling height is at least 2.85m and preferably more than 3.0m.



Indirect lighting softly illuminates the reading and staff areas. source <http://www.libriandesign.org>



Lights at service desks should be positioned so they do not reflect in computer monitors.  
source: author

### b) Direct Lighting

Direct lighting uses down lights to illuminate the reading tables. The down lights can be as small as 150mm diameter fixtures with compact fluorescent or metal halide lamps and parabolic cones, or they can be linear or rectangular fluorescent fixtures with parabolic louvers. The parabolic shape of the cones and louvers prevents seeing the lamps at shallow viewing angles and re-directs the light so it is less likely to be reflected in computer screens. The parabolic cones or louvers should be made of aluminium, not plastic, and they should have a "semi-specular" finish to reduce the visibility of dirt or fingerprints.

### 3.10. LIGHTING CONTROLS

Basic daylight controls are required near window areas. New buildings must use bi-level switching and separate control of light fixtures that are within 4.5m of exterior windows<sup>a</sup>. Separate control permits electric lighting to be reduced near the windows without affecting areas outside the daylighting zone. Electric light fixtures normally have more than one lamp, and bi-level switching allows

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<sup>a</sup> California Energy Standards of Title 24.

individual lamp control so that a portion of the lamps are turned on or off in response to the amount of daylight available.

Beyond code requirements, the most sophisticated daylight controls are the continuously dimming type. Both fluorescent lamps and some types of halogen lamps can be continuously dimmed in response to available daylight, avoiding the noticeable change in light level when entire arrays of lamps are turned on or off with a bi-level switch.

Continuous dimming is recommended for internal areas of daylighting, where roof monitors or skylights are located, since anything else would be particularly noticeable.

The bi-level switching can be done manually, where a staff person or a patron responds to available daylight by turning lamp arrays off or on at the switch. It would be more appropriate for libraries to use a photocell sensor, however, and continuous dimming, so that optimum savings are realized through automatic control and the highly responsive control is executed seamlessly in response to daylight availability.



Two-level manual switch for the Daylighting Zone

Switch for the Interior Zone

Bi-level Manual Switching control

Lighting circuits should be turned on and off by a control system that allows flexible timed programming for each circuit. A master control system should be set at the main circulation desk for manual override of groups of lights or to allow some lights to be turned off just before closing time as a signal for patrons to leave.

In small libraries, the lighting controls may consist of a row of switches at the main circulation desk.

Carrel lights, table lamps, and other task lights should be fed from circuits controlled by the lighting control system so they turn off after the library closes.

Lights near windows or skylights should be switched separately from other lights. Consider dimmable electronic fluorescent ballasts and photocells for areas that receive significant daylight. Some electronic ballasts can dim fluorescent lamps automatically in response to daylight sensors, producing corresponding energy savings. Fluorescent dimming should be evaluated based on a review of higher initial cost verses future estimated energy savings to see if it is cost-effective.



Automatic continuous dimming switch with photocell for the Daylighting Zone

Switch for the Interior Zone

Automatic Continuous Dimming with Photocell Switching control

### 3.11. CONCLUSION

Daylighting should be integrated with a dimmable or multi-level lighting control system so the lighting is automatically adjusted in response to available daylight, and electrical energy savings are possible as a result.

Effective use of daylighting can reduce energy consumption and make the library feel more human and less institutional. However, uncontrolled daylighting can be a source of glare and can damage sensitive materials.

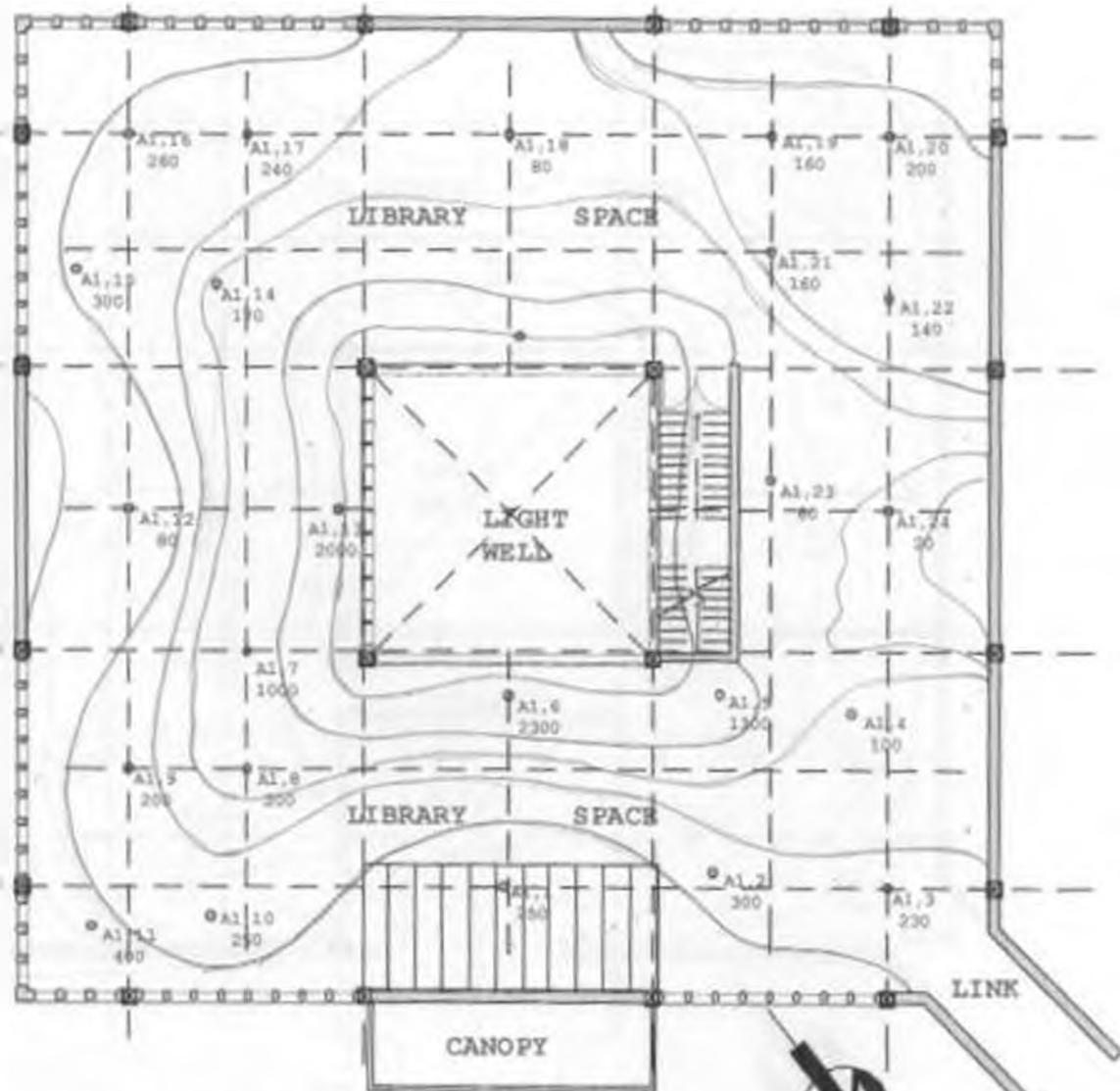
North-facing windows or clerestories admit daylight while excluding direct sunlight. South facing glazing with adequate overhangs can also be effective. Where direct sun is allowed to enter reading areas, adjustable window coverings should be provided.

## Chapter 4.0. CASE STUDIES

### 4.1. FIELD WORK (REAL LIFE CASES)

#### 4.1.1. CHIROMO LIBRARY, U.O.N



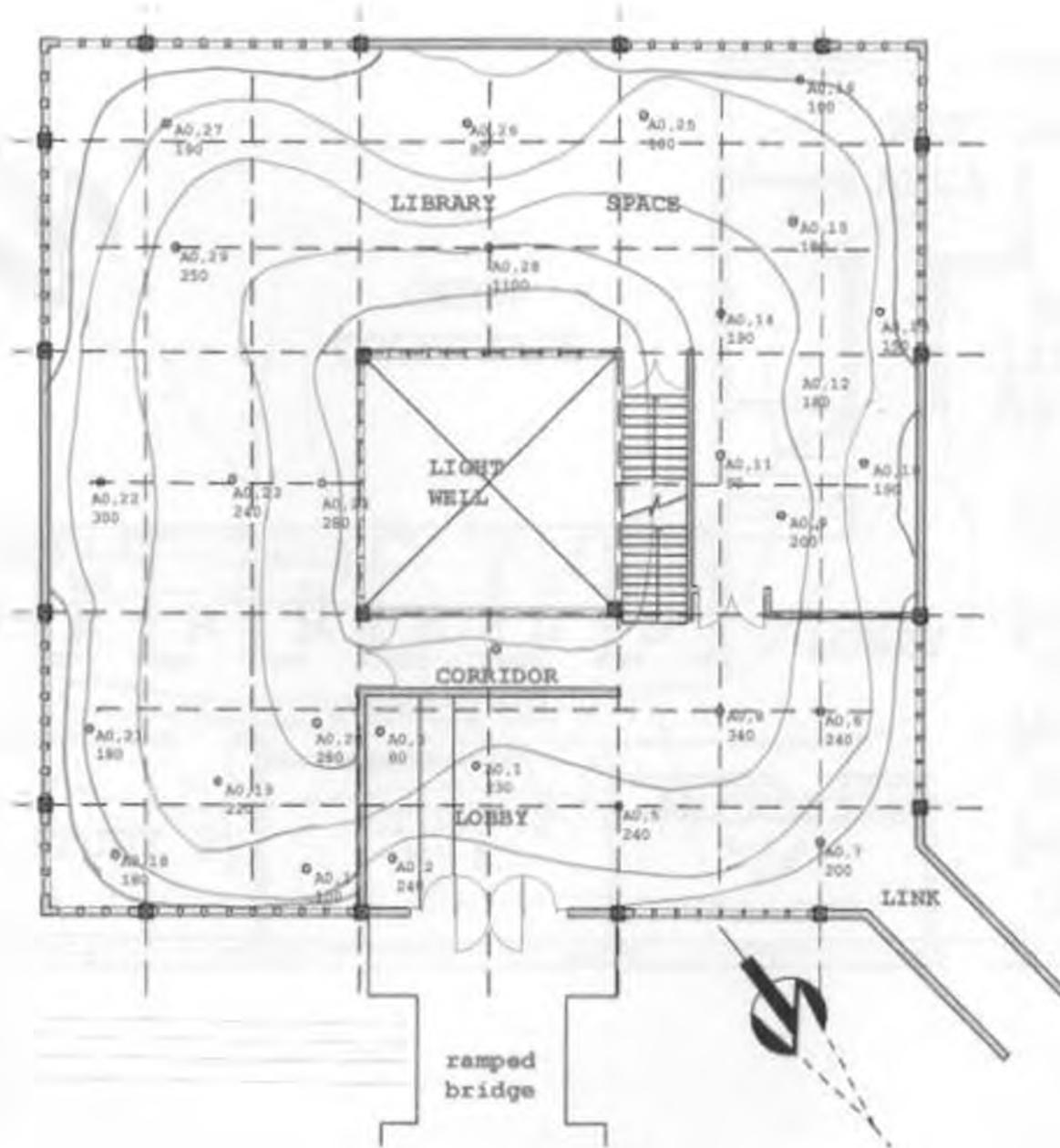


LEGEND  
 A1,9 → POINTS WHERE LIGHT LEVELS WERE TAKEN  
 200

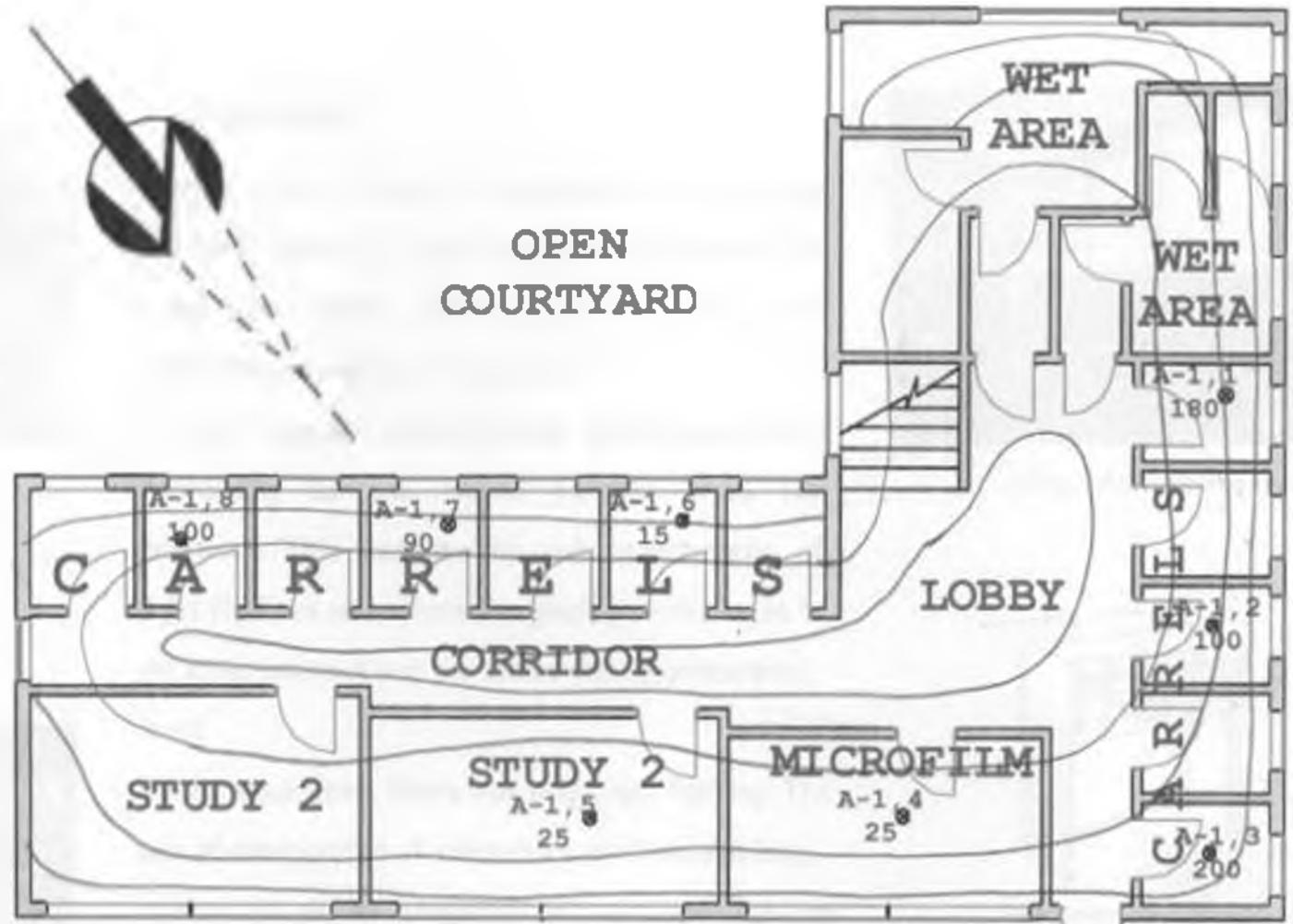
CHIROMO LIBRARY U.O.N  
FIRST FLOOR PLAN

NB: LIGHT LEVELS ARE IN LUX





CHIROMO LIBRARY, U.O.N  
UPPER GROUND FLOOR PLAN



CHIROMO LIBRARY, U.O.N  
LOWER GROUND FLOOR PLAN



Control Desk, Source; author.



Issue Desk, Source; ibid.

### Control desk

Control desk is well lit from both natural and artificial lighting. Light levels were within the acceptable limit. Turnstiles are used for controlling movements in and out.

In the luggage deposit area, light levels were decreasing as one moved further from the entrance. This was due to poor maintenance of light fixtures away from the glazing on the walls.

At some points it was far below the recommended level.

In the issue desk, there was sufficient lighting. The use of combination of clerestory windows and long narrow slot windows together with artificial lighting provides adequate lighting for use in this space.

The catalogue section is strategically placed along the wall to take advantage of natural lighting.



Catalogue Area, Source; ibid



Traditional card index



Direct sun falling on the Circulation Corridor next to Light Well, Source, author.



Reading Space next to Light Well abandoned due to direct sun falling on the reading desks, Source, ibid

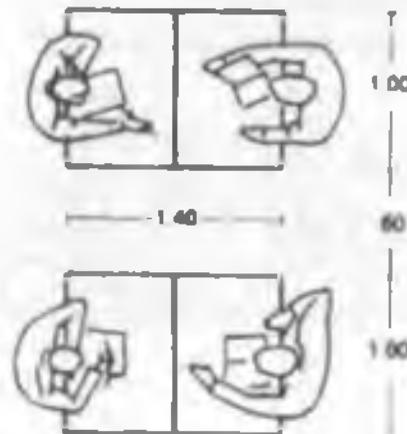
Large glass windows are used for lighting and views. Light levels are within the recommended range.

### The Light Well

Spaces around the light well have been utilized for circulation and reading.

These spaces receive adequate light but during sunny days the reading spaces are abandoned due to direct sun which is uncomfortable.

Light levels were highest in these spaces which were going up to 2300 lux.



Minimum distances between reading tables.



Staircase to First Floor is well lit from the light well. Glass glazing is used. Source, ibid



Reading Space next to Light Well. Source, ibid



Double sided Book stacks,  
Source; author,

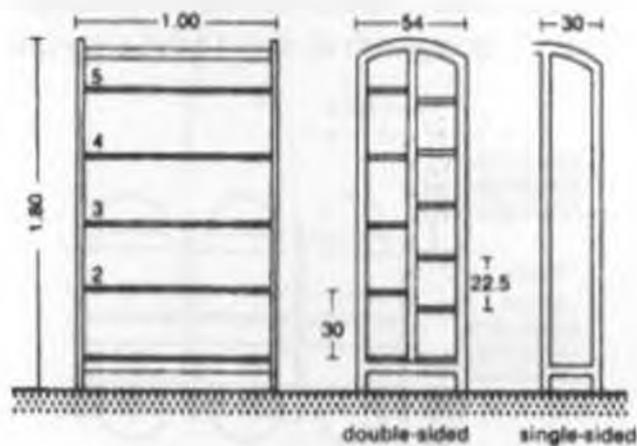


Reference Section, Source; ibid.

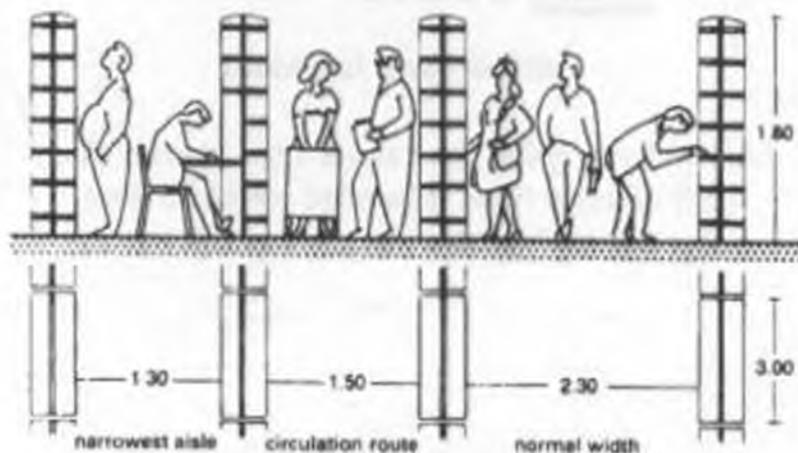
## Book Stack Area

Lighting is parallel to stacks.

Clerestory and long slot windows give sufficient light but where there is only use of clerestory and fluorescence tubes, light levels were falling below the recommended because most tubes were not working.



Shelf units for an institutional library



Double sided Book stacks,  
Source, *ibid.*



Reading Area, Source, *ibid.*

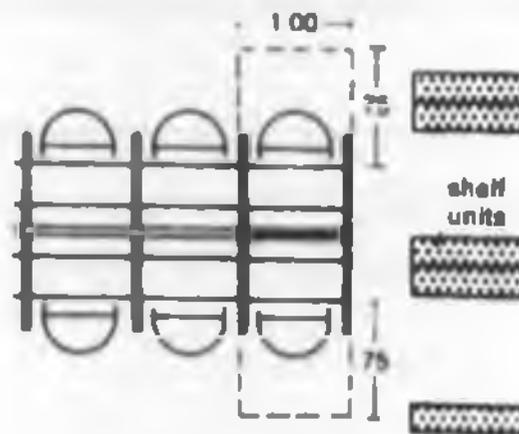


Reading in Reserve section, Source; author.

In reserve section, stacking is on sides and reading is placed at the centre. Light levels are falling below the recommended due to failure of electric fixtures and also use of only one side for natural lighting. Providing slot windows on the two sides and replacing blown fluorescent tubes could increase light levels in this space.



Stacking in reserve section, Source; ibid.



Individual study booth

In carrels, light levels were being very low and some could not be used at night because they were only depending on natural lighting.



Lighting in carrels, there is dim light due to ageing of the bulb, Source; ibid.



Lighting in carrels, the bulb is not working. The carrel can only be used during day time, Source; ibid.



Integration of sky lights and artificial  
light. Source, author



Classroom, windows and slot windows.  
Source, ibid

Lighting in the upper floor has integrated the use of skylights, windows and artificial.

Lighting in stalks is far below the recommended because of failure of most of artificial lighting fixtures and use of small clerestory windows.

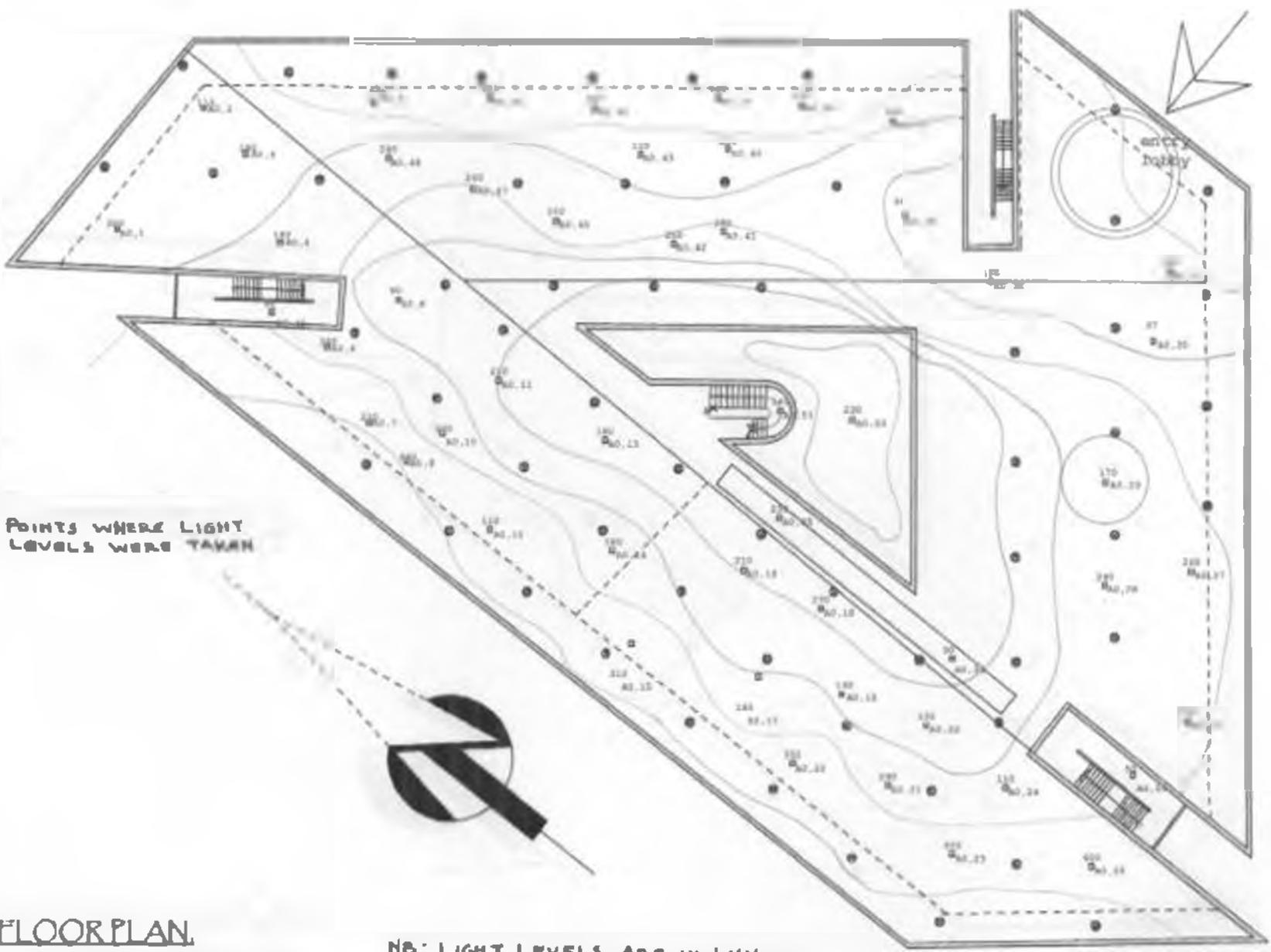
Deep slot windows and recessed clerestory windows have been used throughout the building to avoid direct sun in the library space.



A recessed light and a fluorescent tube for lighting. Source, *ibid.*

4.1.2. J.K.M.L, U.O.N

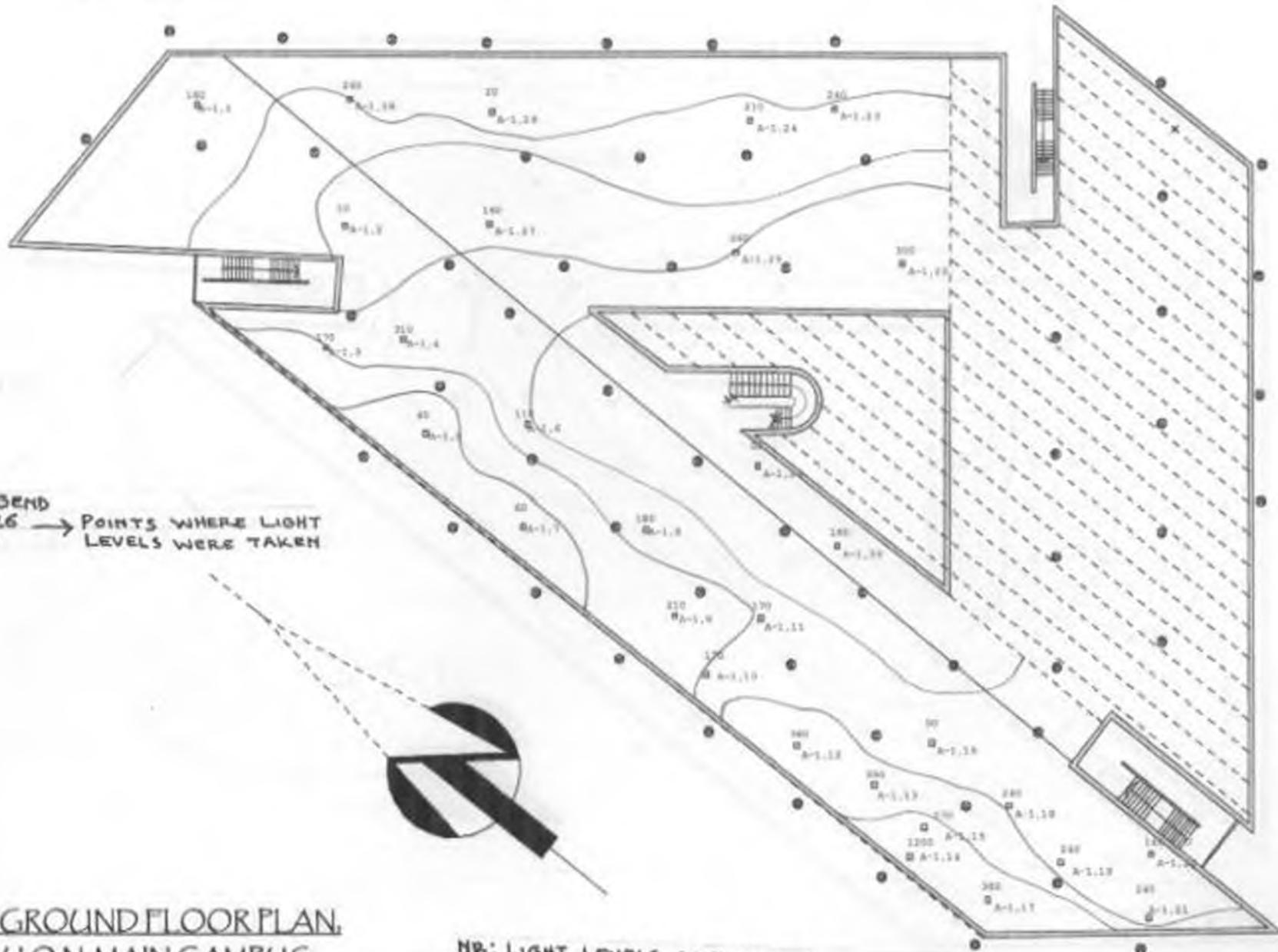




LEGEND  
 A0, A1 → POINTS WHERE LIGHT  
 200 LEVELS WERE TAKEN

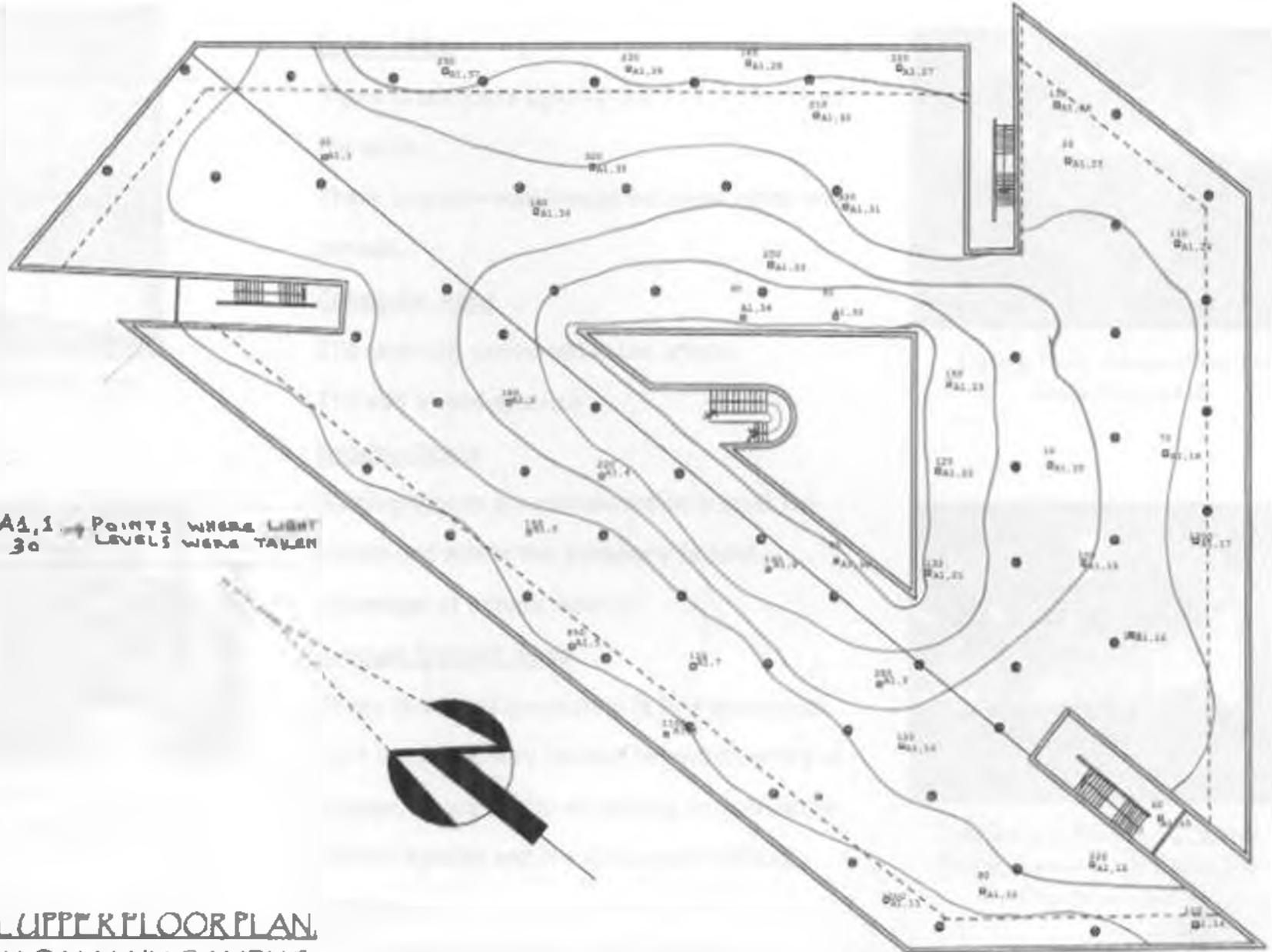
NB: LIGHT LEVELS ARE IN LUX

GROUND FLOOR PLAN  
 JK.M.L. - U.O.N. MAIN CAMPUS



LOWER GROUND FLOOR PLAN, JKML - U.O.N. MAIN CAMPUS

NB: LIGHT LEVELS ARE IN LUX



LEGEND  
 Levels A1,1 → Points where light levels were taken  
 30

NR: LIGHT LEVELS ARE IN LUX

TYPICAL UPPER FLOOR PLAN  
 J.K.M.L - U.O.N. MAIN CAMPUS



Full Glazing In The Entry Lobby.  
Source, author

### Entry lobby

There is adequate lighting due to full glazing of the walls.

There is good visual linkage between inside and outside.

### Catalogue Area

It's centrally positioned in the atrium.

It's well lit and spacious

### Reading Space

Reading spaces are concentration around the atrium and within the periphery to take advantage of natural lighting.

### Luggage Deposit Area

There is a lot of congestion in this space and light levels are very low due to overcrowding of luggage. There is also no opening to outside for natural lighting and the failure of artificial lighting.



Poor Lighting in the Luggage Deposit Area Source, ibid.



Lighting The Catalogues From The Atrium Source, ibid.



Full Glazing In The Reading Spaces Provide Adequate Light During The Day. Source: ibid



Lighting The Stacks,  
Source; author.



Parallel Lighting Along Circulation  
Path, Source; ibid

Stack Area

Fluorescent tubes are running perpendicular to the stacks. All the stacks are concentrated in the interior and depend mostly in artificial lighting.

Circulation Areas

Lighting in the main staircase is inadequate in the lower ground floor. Lighting depends on artificial lighting and their failure causes low light level in the circulation. In the library space, there is use of twin fluorescent tubes parallel to the circulation path.



Lighting The Staircase In The Lower  
Ground Floor, Source; ibid.



Lighting Of the Main Staircase in the  
Atrium, Source; ibid.



Poor Lighting In Such Areas Is Caused By Poor Maintenance Of Light Fixings In Such Areas. Light Levels Were Falling Far Below The Recommended 300 Lux. Source; author



Reading Area Along The Fully Glazed Windows Are Adequately Lit, Source; ibid.

Reading

Reading areas in the periphery is not uniform and where there is no full glazing, light levels are below the recommended.

In the upper floors, reading is concentrated around the atrium to utilize natural lighting which is coming from the roof monitors above.

In my observations, I noted that there was very little efforts in maintenance of light fixtures around the atrium making the spaces to have very little light levels at night when there is no natural lighting.



Reading Spaces Are Placed Around The Atrium Source; ibid.



Use of natural and artificial lighting in the reading space around the atrium. Source; ibid

J.O.N. b.arch thesis, July 1967



Lighting In The Newspaper Section  
Source, author



Combination of Roof Monitors and High-Intensity Discharge (HID) Lamps are Used to Light the Atrium, Source: ibid.

### Newspaper Section

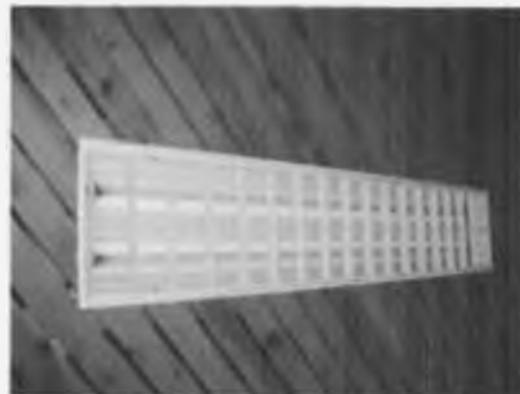
There is integration of natural and artificial lighting. Lighting is adequate.

### Atrium

It is used to light the central part of the library.

The main staircase is placed at the atrium for it to be lit adequately.

HID lamps are used to light the atrium at night.



Use of Two Fluorescent Tubes for Lighting Reading Areas Timber Ceiling Has Also Been Used Throughout The Library. Source, *ibid.*

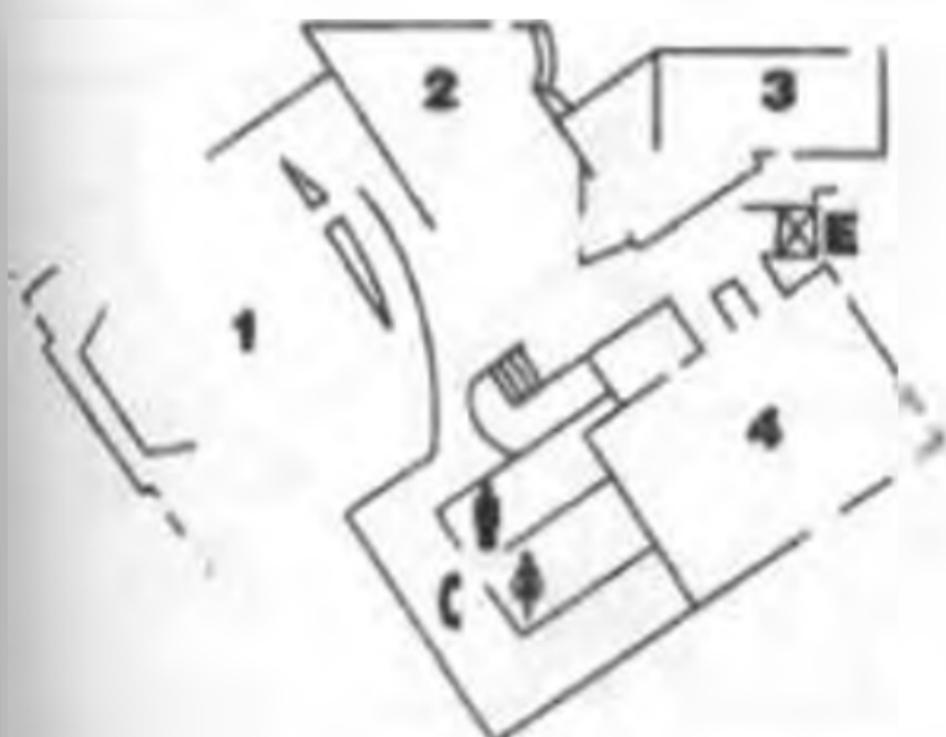


High-Intensity Discharge (HID) Lamps in the Atrium. Source, *ibid.*

## 4.2. PRECEDENT STUDIES

### 4.2.1. San Francisco Main Library





• To 1001



Police Street

## Site

2.65 acres, a full city block bordering the Civic Center and the downtown commercial district.

## Main library locations map

### **Lower Floor**

- 1** Koret Auditorium
- 2** Library Cafe
- 3** Jewett Gallery
- E** Elevator to Bridge
- 4** Latino/Hispanic  
Community Meeting  
Room

### **All Floors**

- C** Copier
- E** Elevator
- L** Listening/Viewing Rm
- M** Meeting Room
- P** Paging Desk
- R** Reference Desk
- S** Study Room
- ♿** Restrooms
- ☎** Telephones

### **First Floor**

- 1** Grove Street Entrance
- 2** Book Bay at the Main bookstore
- E1** Elevator to Bridge and Lower Level
- 3** Deaf Services Center
- 4** New Books, Videos, CDs, Audiobooks
- 5** Video/Audio Carrels
- 6** Check Out Materials
- 7** Library Cards, Registration, Book Return
- 8** Staircase to Children's Center

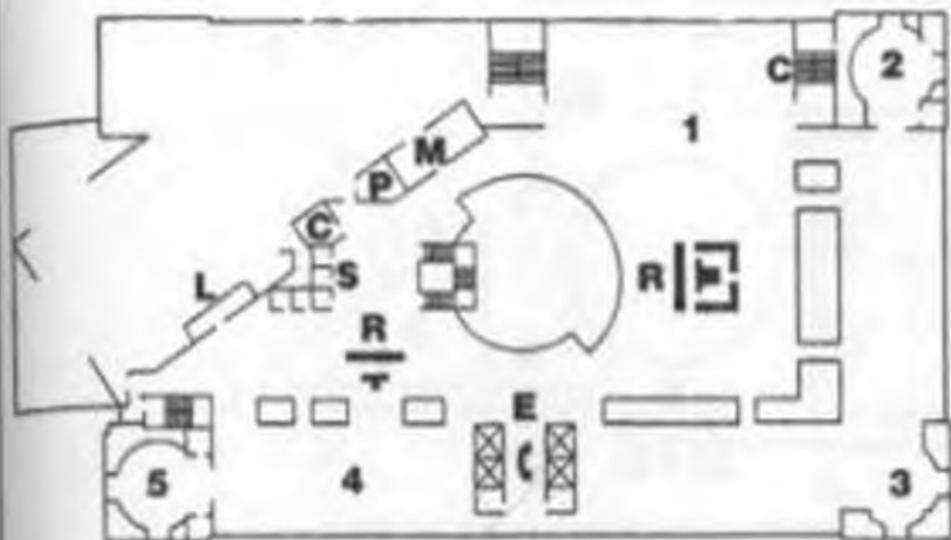


### **Second Floor and Bridge**

- 1** Fisher Children's Center (2nd floor)
- 1** Elevator to 1st Floor and Lower Level
- 2** Volunteer Services
- 3** Human Resources
- 4** Project Read Literacy Center (on bridge)
- 5** Stairs to Atrium Entrance
- 6** Larkin Street Entrance
- 7** Library for the Blind and Print Disabled (on bridge)
- 8** Fulton Street Entrance
- 9** Staircase to 3rd Floor

### **Third Floor**

- 1** Teen Center
- 2** Learning Differences Resource Collection
- 3** James C. Hormel Gay and Lesbian Center
- 4** General Collections and Humanities Center
- 5** African American Center
- 6** College Access Center/Educational Guidance Collection
- 7** Filipino American Center
- 8** International Center
- 9** Chinese Center
- 10** Internet Sign-up

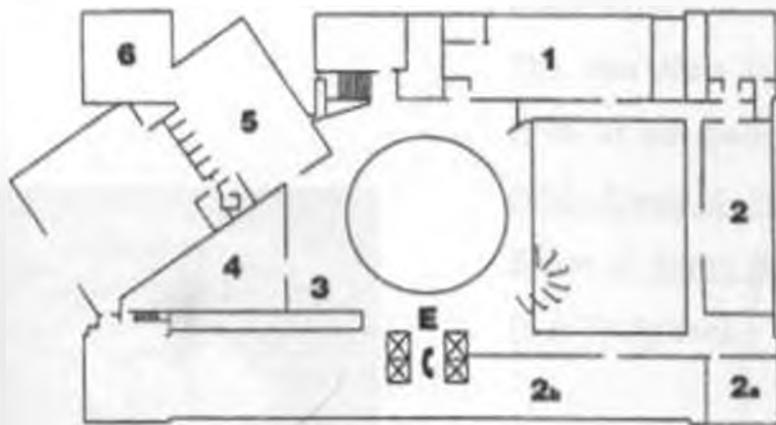


### **Fourth Floor**

- 1** Business, Science and Technology Center
- 2** Jobs and Careers Center
- 3** Small Business Collection
- 4** Osher Foundation Art, Music and Recreation Center
- 5** Steve Silver Beach Blanket Babylon Music Center

### **Fifth Floor**

- 1** Branch Libraries Administration
- 2a** Herb Caen Magazines and Newspapers Center
- 2b** Herb Caen Periodical Reading Room
- 3** Wallace Stegner Environmental Center
- 4** Government Information Center
- 5** Training Center
- 6** Brooks Walker Patent and Trademark Center



**Sixth Floor**

- 1 Friends & Foundation of the SFPL
- 2 Administration
- 2a City Librarian/Administration
- 2a Chief of Main/Public Affairs/Children & Youth Services/Administration
- 3 Skylight Gallery
- 4 Roof Terrace
- 5 Koshland San Francisco History Center
- 6 Stam Book Arts and Special Collections Center

**Floor Directory**

- |                                     |  |   |
|-------------------------------------|--|---|
| 6 Administration Offices            | 1 Deaf Services Center                                       | 4 Jobs and Careers Center                           |
| 3 African American Center           | 3 Educational Guidance Collection                            | LL Koret Auditorium                                 |
| 4 Art, Music and Recreation         | 5 Environmental Center                                       | LL Latino/Hispanic Community Meeting Room and Mural |
| 1 Audio/Video Carrels               | 3 Filipino American Center                                   | 5 Magazines and Newspapers                          |
| 2 Blind and Print Disabled Services | 6 Friends & Foundation                                       | 6 Main Library Administration                       |
| 6 Book Arts/Special Collections     | 3 Gay and Lesbian Center                                     | 4 Music Collection                                  |
| 1 Book Bay at the Main Bookstore    | 3 General Collections  | 5 Patent and Trademark Center                       |
| 5 Branch Libraries Administration   | 5 Government Information Center                              | 2 Project Read Literacy Center                      |
| 1 1Stop Browsing                    | 1 Grove Street Entrance                                      | 2 San Francisco History Center                      |
| 4 Business, Science and Technology  | 6 Human Resources  | 6 Skylight Gallery                                  |
| LL Cate                             | 1 Information Desk, Check Out & Return and Interlibrary Loan | 3 Teen Center                                       |
| 2 Children's Center                 | 3 International Center                                       | 5 Training Center                                   |
| 3 Chinese Center                    | LL Jewell Gallery  | LL-1-3 Restrooms                                    |
| 3 College Access Center             |  |   |

### Architecture of the Main Library

The new Main Library was opened on April 18, 1996. It was designed by James Ingo Freed of Pei Cobb Freed & Partners (New York) and Cathy Simon of Simon Martin-Vegas Winkelstein & Moris (San Francisco).



Skylight in the central atrium lighting the main staircase and the reading space around, source, <http://www.litwell.com/> (march 2007)

The Main Library represents the largest public-private partnership in the history of San Francisco.

Its Sierra White granite facade, obtained from the quarry that provided the stone for other Civic Center buildings, is compatible with their Beaux Arts style. The facade on Grove and Hyde Streets has a more contemporary feel, compatible with the commercial activity on Market Street.



A monumental open staircase beside a wall giving orientation in the building, source,

<http://www.litwell.com/>

(march 2007)

Inside, a dramatic skylight pours natural light into the building's five-story central atrium: bridges connect floors across light wells and a grand staircase rises four stories beside a wall lit with the names of more than a hundred authors, created by artist Nayland Blake.

Internal organization centers around a monumental open staircase and a five-story atrium, 18m in diameter, that provides a luminous hub of orientation. A glass-enclosed Periodicals Reading Room, suspended above, further helps to draw light into the core of the 90m x 200m building.

A unique configuration of open spaces and smaller intimate corner rooms are well lit with a combination of natural and artificial lights contributing to a sense of grandeur and welcome.

Among them are the African American, Chinese, and Gay and Lesbian Centers on the third floor;



Parallel scheme for lighting the aisle,  
source, <http://www.litwell.com/>  
(march 2007)

the Steve Silver Beach Blanket Babylon Music Center on the fourth floor; the Wallace E. Stegner Environmental Center on the fifth floor and the Book Arts and Special Collections Center on the sixth floor.

The interior design of each center includes inlaid hardwood floors, wool area rugs and upholstered chairs. Custom wall systems and cabinetry of sycamore, curly maple, lacewood, and cherry evoke the warm imagery of traditional library interiors, counterbalanced in each room by a stainless steel disc above, which integrates both lighting and air diffusion components.

The parallel scheme uses a single row of one-lamp linear fluorescent fixtures centered above each aisle. The fixtures can be recessed in the ceiling, suspended below the ceiling, or attached to the

stacks. Ceilings are often made of acoustic tiles that are installed on a 600mm module, but stacks are installed on various spacing from 1.5m to 1.8m on-center, so it is often difficult to center recessed lights over the aisles without modifying the ceiling grid.

The fixtures must distribute light evenly across the stacks, with adequate light reaching the bottom shelf and no dark areas at the top shelf. Attaching lights to the stacks may be the only solution in high-ceiling rooms where suspended fixtures would be visually obtrusive, but the mounting and wiring details for stack mounting can be expensive. Despite these cautions, the parallel scheme makes intuitive sense and has the potential to have the lowest energy use.



Adjustable downlights in San Francisco Library source, <http://www.litwell.com/> (march 2007)



Lighting in San Francisco Library Media Room

In the media room, the challenge was to create an attractive environment in single room in which one person could read while another person was watching a movie.

The solution was to install small adjustable downlights for art, reading light and ambient wall lighting. With the touch of a single button, a person can adjust all the lights for various activities and times of day via a pre-programmed lighting control system.



Sky light in boardroom Diffusing through cross-hatched slats source, Yuseuf Ibrahim.



Windows, Light and space in black wooden pillars, source

<http://www.fermentmagazine.org> (March 2007)

#### 4.2.2. GLASGOW SCHOOL OF ART LIBRARY, SCOTLAND. By Charles Rennie Mackintosh

The Glasgow School of Art assignment was the first and most important of Mackintosh's architectural commissions and was won through a competition. The building is based on an E shape with one side facing down a steep slope whilst the other fronts onto a major road.

The school is constructed from wrought iron and brickwork and Mackintosh paid particular attention to creating a lofty and light interior. This is clearly demonstrated by the north front which has huge studio windows, which are held in place with wrought iron brackets, to bathe the school in light.

The library is the most striking designed interior in the school. The 3 storey windows, built during



Skyscraper lampshades has been used throughout the library space.

Source

*Lighting Design for University Libraries*  
(march 2007)



Integration of natural and artificial lighting in library space, source, Yussuf Ebrahim.



Suspension lampshades in reading space. Source: <http://www.environmentalart.com> (March 2007)

the second phase, drawn the library in light and contrasts with the dark wood and the green, white and red interior. The library design combines traditional academic styling with modern, geometric patterns.

Art historians have described it as "the masterpiece within the masterpiece".

Whatever its aesthetic merits it is far and away the most extraordinary room in the entire building. Walls, furnishing and partitions are all painted a somber black. Powerful sunlight streams through high windows like those in the Board Room. Diffusing through cross-hatched slats, light and shadow fall onto the desks and chairs, making sinuous patterns which Mackintosh himself likened to the vines and foliage of a forest interlaced in multiple layers of braids and knots.



Large studio windows in north facade source, Yussuf Ebrahim.



Long windows admit natural lighting from north facade, source, Yuseuf Ebrahim,



Rendering of artificial lighting makes the spaces more interesting, source; ibid.

The natural element is also stressed in the very straight "trunks" of the black wooden pillars, which he called "trees". Decorations on and around the legs and backs of the chairs and tables are carved in flaming shapes. The Lampshades prepares one for the most amazing set of artifacts in this mysterious haven for the studios.

Artificial light fittings hang from the high ceiling on long black chains together with the long windows have been used to light the interior of the library. The light fittings are replicas in miniature of the skyscrapers that were being raised in New Macintosh's explanation of this metaphor was that the library ought to be dedicated to the fusion of Nature with Technology, the bounding themes of modern art.



Combination of natural and artificial lighting, source: *ibid*



Full grazing of walls creates a visual  
interacting space with outside Source.

<http://www.fermentmagazine.org>

(march 2007)

### Skyscraper lampshades

The Bridport Mackintosh Library pendant lamp, is an exact replica of the smaller model featured in the library. This replica has been made by careful measurement of the actual fittings which still illuminate the Library, but more importantly, by reference to the actual drawings prepared by Mackintosh, for these fittings.

Visitors fortunate enough to actually enter the Library at the Glasgow School of Art, will notice that the design for the pendant light fittings strongly reflect the fugue windows which rise uninterrupted through three floors. They have similarities to the western elevation entrance in Scott Street.

## Chapter 5.0. CONCLUSIONS AND RECOMMENDATIONS

To effectively light a library, hybrid scheme works well provided that the two systems are effectively combined.

Daylighting can be received in a library through skylights, roof monitor and openings in the wall. When using daylight, one should have a good design which avoid direct sunlight and glare in library space. This is achieved by use of both external and internal sun shaders.

In big libraries, an atrium should be used to light the interior part and also the main circulation which in most cases is centrally placed.

The use of a light well is a good idea in library design but consideration should be taken to avoid direct sun as experienced in Chiromo library which makes reading spaces around the light well unusable during some hours of the day..

Artificial lighting should be effectively used to supplement natural lighting at night and even during some hours of the day when light levels are low.

Maintenance of artificial light fixtures is fundamental and this is the most ignored factor in JKML and Chiromo libraries. This has made most of their

spaces have very low light levels making it impossible to use those spaces at night and causing strain during the day.

While designing for good interior library lighting to achieve comfortable visual spaces, the following design issues should not be ignored:

- Extensible, to allow new elements (collections, data types, services, etc.) to be easily added to a library building;
- Modular, in that new elements can be added or removed without effecting the operation of other elements;
- Scalable, to allow for the potential of millions of constituent elements;
- Affordable buildings with low running costs through appropriate light design;

### **B.1. FUTURE LIBRARY SCENARIOS**

In library design, very many parameters have to be put into consideration apart from lighting to come up with a good library design. Acoustics, Furniture and Shelving, Collection and Storage, Library Security among other factor has to be considered. In order to design libraries for the needs of future users, we need

to examine the varied elements involved in the complex range of libraries we have today.

We should stop seeing libraries as places of function - storing this, lending that, checking the other, and more as places of free and shared exploration and learning via all media, a democratic space wherein to free your mind.<sup>a</sup>

## 5.2. SOME KEY DESIGN ELEMENTS

The following are the design issues which will be paramount in these developments:

- **Establishing the appropriate ethos**

Each library design will need to reflect the priority services and ethos being offered in that library for its particular set of users.

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<sup>a</sup> John Dulan, Head of Birmingham Library Services

- **The library as a second home**

Libraries need to provide better signage, better displays and better presentation of stock. The institutional feel of the library needs to be removed.<sup>b</sup>

- **A window on the world**

Historically libraries have offered people a chance to escape, to explore other worlds through books, journals, and forms of self-education, and their design and architecture often reflected this. The design of libraries in future should also reflect this sense of uplift, of pleasure, and possibilities of life-enhancement.

- **Designing in (and out) technology**

All library facilities, of whatever size, will need to incorporate ICT and online services. All ICT equipment comes with specific design and construction requirements of its own: cabling, networking, lighting, heat-displacement, security, and so on.

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<sup>b</sup> Graham Fisher, Director, London Libraries Development Agency

### 5.3. SIGNIFICANT TRENDS IN LIBRARY DESIGN:

- In future, it is likely that more libraries will be developed in partnership with other organisations or services, whether commercial supermarkets or adult education providers .
- Greater adaptability may be required in areas such as internal design, circulation, access and hours of services in library buildings, even though the buildings themselves are only a part of wider library services delivered through many physical and electronic media.
- Libraries could become key communications centres for mobile populations, and their design will need to reflect different 'levels and layers of entry' or different temporal zones: hot-desking, browsing, long-term study.
- As the need for lifelong learning continues to increase, long stay use of libraries for study purposes will require more friendly and efficient support services - toilets, catering, recreational quiet zones - meaning that libraries are likely to become more like members' clubs.

- Electronic links between homes and libraries are likely to increase, so that the library service and the 'customer' are in constant contact with each other as and when required
- Children's services may grow in importance as the library becomes a secure, supervised, electronic safe haven in the city, and as government investment in early years provision continues to grow.
- Virtual library services could be provided 24 hours a day, while other services will be offered out of hours.

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