



UNIVERSITI PUTRA MALAYSIA

**SIDE-LIT WINDOW DESIGN FOR OPTIMUM DAYLIGHTING IN
LIBRARY READING AREAS**

NUR DALILAH DAHLAN.

FRSB 2005 5



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READING AREAS**

By

NUR DALILAH DAHLAN

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of Requirements for the Degree of Master Science**

December 2005



DEDICATION

This thesis is dedicated to:
my beloved parents, Dahlan Ismail and Hamidah Bidin.

Thank you very much for
all your love, patience and sacrifice...



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment
of the requirement for the degree of Master Science

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Chairman: Ar. Professor Dato' Elias bin Salleh, PhD

Faculty: Design and Architecture

Conventional tropical building designs are experiencing new paradigm in its environmental response to improve lighting ambiance and users' comfort by exploiting daylighting. This research focused on accessing existing daylight factors, illuminance levels, users' preference and their perception towards daylit library reading areas. The performance of daylighting applied in library design in tropical country like Malaysia is evaluated based on their Side-Lit Window Design (SLWD). Daylighting evaluation is done through three methodologies, namely, via Field Measurement; Computer Simulation and User Survey. Reading areas in three libraries have been identified as case studies. The libraries selected are Perpustakaan Sultan Abdul Samad (L.1), Universiti Putra Malaysia (UPM), Perpustakaan Tun Abdul Razak 1 (L.2), Universiti Teknologi MARA (UiTM) and the Main Library of International Islamic University of Malaysia (L.3). By applying the Window to Wall Ratio (WWR) and Window to Floor Ratio (WFR), each window design from the case study is classified into three Typical Daylighted Bays (TDB), which are; low WFR (0.2) with moderate headroom height (3m high); high WFR (0.4) with moderate headroom height and high WFR with high headroom height (4 m).



Illumination level readings are collected at three separate periods of a day, namely, in the morning, afternoon and evening. Measurements are indicated using portable Konica-Minolta Illuminance Meter T10 at 7 'P' test points 1m apart from each other starting from the windows of each TDB. Parametric analyses using RadianceIES predicted potential window and interior criteria applicable in designing of future daylighting designs in large public indoor areas. The simulations are generated under '10K CIE Overcast Sky' file to predict daylighting performance during worst case scenario affects in a tropical country. Furthermore, the survey carried out measured users' comfort and awareness according to impacts shown in relation to three different SLWD. The responses are recorded via questionnaires issued to them at each of the selected TDB. The surveys are performed during diurnal operation hours of the particular libraries.

Findings revealed that window design at the reading area in L.3 with WWR of 0.76, WFR of 0.43 and headroom height of 4m allowed sufficient daylight transmittance. However, users at this particular TDB complaint of too much daylighting within 7m distance from the windows. Further parametric analyses revealed that at WWR of 0.5 achieved a close approximate of DF with WWR of 0.76. Therefore SLWD with WWR of 0.5 can promote effective daylighting up to 3% of DF within 4m distance from the windows in deep interior building such as libraries.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**REKABENTUK TINGKAP PENCAHAYAAN SISI BAGI OPTIMUM
PENCAHAYAAN SIANG DI RUANG BACAAN PERPUSTAKAAN**

Oleh

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Rekabentuk bangunan-bangunan sedia ada di negara-negara beriklim tropikal kini mengalami anjakan paradigma melalui respon persekitarannya bagi memperbaiki persekitaran pencahayaan dan keselesaan para pengguna. Penyelidikan ini memberi tumpuan kepada penilaian Faktor Cahaya Siang (FCS), tahap penerangan, keutamaan dan persepsi pengguna terhadap ruang bacaan di perpustakaan yang diterangi cahaya siang. Aplikasi penggunaan pencahayaan siang di dalam rekabentuk perpustakaan di negara beriklim tropikal seperti Malaysia dinilai berpandukan Rekabentuk Tingkat melalui Pencahayaan Sisi (RTPS). Penilaian terhadap pencahayaan siang telah dilaksanakan melalui tiga kaedah iaitu melalui Pengukuran Lapangan; Simulasi Komputer dan Survey terhadap penggunaan sesuatu ruang. Ruang pembacaan dalam tiga perpustakaan telah dikenalpasti sebagai kajian kes. Perpustakaan yang telah dipilih adalah Perpustakaan Sultan Abdul Samad (L.1), Universiti Putra Malaysia (UPM), Perpustakaan Tun Abdul Razak 1 (L.2), Universiti Teknologi MARA (UiTM) dan Perpustakaan Utama di Universiti Islam Antarabangsa Malaysia (L.3). Dengan menggunakan Nisbah Tingkat kepada Dinding (NTD) dan Nisbah Tingkat kepada Lantai (NTL) setiap rekabentuk tingkat



yang dipilih dari kajian kes telah diklasifikasikan mengikut tiga Ruang Lazim yang Dichayai (RLC) iaitu; NTL yang rendah (0.2) dengan ketinggian ruang yang sederhana (3m); NTL yang tinggi (0.4) dengan ketinggian ruang yang sederhana dan NTL yang tinggi dengan ketinggian ruang yang tinggi (4m).

Tahap pencahayaan di ruang pembacaan telah dikumpul pada tiga masa yang berbeza iaitu pada waktu pagi, tengah hari dan petang. Pengukuran ditentukan dengan menggunakan *Konica-Minolta Illuminance Meter T10* yang mudah alih di tujuh titik ujian berjarak 1m dari satu sama lain dan bacaan diambil bermula dari tingkap di setiap RLC. Analisa parametrik dengan menggunakan '*RadianceIES*' meramalkan potensi sesuatu tingkap dan ciri-ciri dalaman sesuai dalam menyediakan rekabentuk pencahayaan terkini bagi ruang-ruang dalaman yang besar. Simulasi telah dijalankan berpandukan fail '*10K CIE Overcast Sky*' bagi meramalkan penggunaan pencahayaan siang semasa '*worst case scenario*' yang memberi kesan kepada negara beriklim tropikal. Di samping itu, kaedah mengukur keselesaan pengguna dan kesedaran mereka terhadap impak yang dihasilkan mengikut RTPS yang berbeza. Respon pengguna telah direkodkan dengan menggunakan borang soal selidik yang diberikan di setiap RLC terlibat. Pengukuran dilaksanakan pada waktu siang di setiap perpustakaan tersebut.

Dapatan yang ditemui menyatakan bahawa rekabentuk tingkap di ruang pembacaan di L.3 dengan NTD sebanyak 0.76, NTL sebanyak 0.43 dan ketinggian ruang sebanyak 4m membenarkan pencahayaan yang cukup. Walau bagaimanapun, pengguna di RLC tersebut mengadu bahawa keadaan pencahayaan yang terdapat dalam lingkungan 7m dari tingkap sangat terang. Analisis parametrik lanjutan

menjelaskan bahwa NTD sebanyak 0.5 mendapat bacaan FCS yang hampir sama dengan FCS dengan NTD sebanyak 0.76. Oleh yang demikian, RTPS dengan menggunakan NTD sebanyak 0.5 mempunyai potensi untuk menggalakkan pencahayaan secara efektif iaitu sebanyak 3% (FCS) dari 4m jarak dari tingkap dalam bangunan-bangunan besar seperti perpustakaan.

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I certify that an Examination Committee met on 23rd December 2005 to conduct the final examination of Nur Dalilah Dahlan on her Master of Science thesis entitled "Slide-lit Window Design for Optimum Daylighting in Library Reading Areas" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

N. Dalilah Dahlan

NUR DALILAH DAHLAN

Date: 30 Dec 2005

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