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11800, USM Pulau Pinang
T : (6)04-653 3108/3178/3988/5019
F : (6)04-656 6466/8470
: (6)04-653 2350
L : www.research.usm.my

No. Fail : F0400
Tarikh : 2 Disember 2011

Prof. Madya Dr. Sharifah Fairuz Syed Fadzil
Pusat Pengajian Perumahan, Bangunan & Perancangan
Universiti Sains Malaysia

Puan,

LAPORAN AKHIR SKIM GERAN PENYELIDIKAN FUNDAMENTAL (FRGS)
Tajuk Projek : The Impact of Varied Design Modifications to the Environment at the Glass Showcase Building in the Malaysian Climate
No. Akaun : 203/PPBGN/671146

Dengan hormatnya perkara di atas dirujuk.

2. Terlebih dahulu saya ucapkan ribuan terima kasih di atas satu salinan laporan akhir untuk projek penyelidikan seperti tajuk di atas.

3. Adalah dimaklumkan walaupun projek ini telah selesai, kerjasama Jabatan Bendahari dipohon untuk menguruskan penutupan akaun projek pada selewat-lewatnya **31 Disember 2011**. Tempoh ini bertujuan untuk menyelesaikan semua urusan tuntutan dan bayaran yang telah dibelanjakan di dalam tempoh projek. Walau bagaimanapun, puan dinasihatkan supaya tidak mengeluarkan borang-borang pesanan baru di dalam tempoh ini.

4. Selanjutnya sila ambil perhatian terhadap perkara-perkara berikut sekiranya berkaitan:

(i) Semua penerbitan harus merakamkan penghargaan kepada **Skim Geran Penyelidikan Fundamental (FRGS)** dan puan dipohon mengemukakan satu salinan ke Pejabat ini.

(ii) Bahagian Penyelidikan & Inovasi boleh/akan mengagihkan semula peralatan yang telah dibeli menggunakan peruntukan geran ini seandainya terdapat penyelidik lain yang memerlukan peralatan tersebut.

5. Akhir sekali, tahniah di atas usaha dan kejayaan pihak puan dapat menyelesaikan projek ini dengan jayanya.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
'Memastikan Kelestarian Hari Esok'

Yang menjalankan tugas,

HBH, HAR, SM

(AMRA OTHMAN)
Penolong Pendaftar
Unit Pengurusan Geran & Kontrak

LAPORAN AKHIR SKIM GERAN PENYELIDIKAN FUNDAMENTAL (FRGS)
Tajuk Projek : The Impact of Varied Design Modifications to the Environment at the Glass Showcase Building in the Malaysian Climate
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s.k. Dekan Penyelidikan
Pelantar Sains Fundamental
Pejabat Pelantar Penyelidikan
Universiti Sains Malaysia

Dekan
Pusat Pengajian Perumahan, Bangunan & Perancangan
Universiti Sains Malaysia

Timbalan Dekan
(Pengajian Siswazah & Penyelidikan)
Pusat Pengajian Perumahan, Bangunan & Perancangan
Universiti Sains Malaysia

Ketua Pustakawan
Perpustakaan Hamzah Sendut
Universiti Sains Malaysia

} Disampaikan satu salinan laporan akhir projek untuk simpanan Perpustakaan

Penolong Bendahari Kanan
Unit Kumpulan Wang Penyelidikan
Jabatan Bendahari
Universiti Sains Malaysia

} Mohon kerjasama pihak puan untuk menguruskan penutupan akaun projek selewat-lewatnya pada **31 Disember 2011** dan mohon kemukakan satu salinan penyata kewangan terakhir ke Pejabat ini untuk tujuan rekod

Pegawai Sains
Pelantar Sains Fundamental
Pejabat Pelantar Penyelidikan
Universiti Sains Malaysia

F0400

BORANG FRGS – P3(R)

FINAL REPORT
FUNDAMENTAL RESEARCH GRANT SCHEME (FRGS)

Laporan Akhir Skim Geran Penyelidikan Asas (FRGS) IPT
Pindaan 1/2010

A

RESEARCH TITLE : **The impact of varied design modifications to the environmental performance of glazed buildings in the tropics**

PROJECT LEADER : **Assoc. Prof. Dr Sharifah Fairuz Syed Fadzil**
Ketua Projek

PROJECT MEMBERS (including GRA) :
1. **Dr Mohd. Rodzi Ismail**
2. **Pn. Wan Mariah Wan Harun**
Nedhal Ahmed Tamimi (GRA)
Adel Abdullah (GRA)

PROJECT ACHIEVEMENT (Pencapaian Projek)

B

ACHIEVEMENT PERCENTAGE			
Project progress according to milestones achieved up to this period	**0 - 50%**	**51 - 75%**	**76 - 100%**
Percentage			√

RESEARCH OUTPUT		
Number of articles/ manuscripts/ books *(Please attach the First Page of Publication)*	**Indexed Journal**	***Non-Indexed Journal***
	1(To be published in March 2011) 1 (under corrections stage)	1 (published)
Conference Proceeding *(Please attach the First Page of Publication)*	**International**	***National***
	7	Nil
Intellectual Property *(Please specify)*	Nil	

HUMAN CAPITAL DEVELOPMENT

Human Capital	Number				Others (please specify)
	On-going		Graduated		
Citizen	Malaysian	Non Malaysian	Malaysian	Non Malaysian	
PhD Student		2			
Master Student					
Undergraduate Student	1				
Total	3				

EXPENDITURE *(Perbelanjaan)*

C

Budget Approved *(Peruntukan diluluskan)*	:	**RM 60,000**
Amount Spent *(Jumlah Perbelanjaan)*	:	**RM 50,000**
Balance *(Baki)*	:	**RM 10,000**
Percentage of Amount Spent *(Peratusan Belanja)*	:	83 %

ADDITIONAL RESEARCH ACTIVITIES THAT CONTRIBUTE TOWARDS DEVELOPING SOFT AND HARD SKILLS
(Aktiviti Penyelidikan Sampingan yang menyumbang kepada pembangunan kemahiran insaniah)

D

International

Activity	Date (Month, Year)	Organizer
(e.g : Course/ Seminar/ Symposium/ Conference/ Workshop/ Site Visit)	10th International Conference for Enhanced Building Operations(2010) (Presented paper by GRA)	Kuwait (ICEBO)
	International Symposium on Construction in Developing Countries Oct 2009 (Presented 2 papers)	CIB Construction Industry Board
	International Conference IACSIT – SC 2009 Singapore Apr 2009	Singapore : International Assoc of Computer Science and Information Technology
	Internatonali International Conference on Built Environment in Developing Countries (ICBEDC 2009)(Presented 2 papers)	HBP, USM
	International conference on sustainable architecture and urban design (ICSAUD 2010) (Presented 1 paper)	HBP, USM

National

Activity	Date (Month, Year)	Organizer
(e.g : Course/ Seminar/ Symposium/ Conference/ Workshop/ Site Visit)	AutoCAD 3D modelling workshop 3 Days 18 – 20 Nov 2008	PSDC Penang Skilld Development Center Bayan Lepas
	Seminar : Green Malaysia 7 March 2009	Pertubuhan Akitek Malaysia (PAM) and Greenbuildingindex Sdn Bhd
	Workshop on the Part III Professional Architectural Examination 16 May 2009	Lembaga Arkitek Malaysia (LAM)
	Seminar : Green Sustainable Eco Architecture from theory to Practice 5 Sept 2009	Pertubuhan Akitek Malaysia (PAM) and Greenbuildingindex Sdn Bhd
	Green Building Index Facilitator Course	Pertubuhan Akitek Malaysia (PAM) and Greenbuildingindex Sdn Bhd

RESEARCH ABSTRACT – Not More Than 200 Words(*Abstrak Penyelidikan – Tidak Melebihi 200 patah perkataan*)

G

This research analyzes the effect of several design modifications to the environmental performance of glazed buildings in the tropics. The design variables studied include the effect of external shading, varied window to wall ratio (varying the glazed area), orientation and also natural ventilation. The environmental performances of selected buildings were monitored continuously using data loggers. Computerized environmental simulations using ECOTECT and IES were carried out to ensure compatibility with field data. Air temperatures, mean radiant temperature, air velocity and natural lighting data inside the building were measured to see the extent affected with the modifications. These were compared to external climatic data. Findings found that the performance of glazed buildings in the tropics can be significantly improved with selected modifications like adding external shading devices and insulation.

PROBLEMS / CONSTRAINTS IF ANY (*Masalah/kekangan sekiranya ada*)

E

Complicated procedures for permission to purchase of software for Environmental Modelling in Buildings for Academic stand alone licences

Reluctancy from owners of glazed buildings to participate in research

RECOMMENDATION (*Cadangan Penambahbaikan*)

F

Procedures of software purchasing be made easier and faster
Providing iIncentives for participation for private bodies

Date : Feb 14 2011
Tarikh

Project Leader's Signature:
Tandatangan Ketua Projek

PROF. DR. SHARIFAH FAIRUZ SYED FADZIL
B.Sc (Arch), M. Arch (Nebraska, USA) PhD (Wales, UK)
School of Housing, Building and Planning,
University Science Malaysia,
11800 Penang, Malaysia.

COMMENTS, IF ANY/ ENDORSEMENT BY RESEARCH MANAGEMENT CENTER (RMC)
(Komen, sekiranya ada/ Pengesahan oleh Pusat Pengurusan Penyelidikan)

H .....

.....

.....

Name:
Nama:

Signature:
Tandatangan:

Date:
Tarikh:

IACSIT (2009)

Improved illumination levels and energy savings by uplamping technology for office buildings

Nedhal Ahmed M. Ali*
School of Housing, Building and Planning, University Science Malaysia, Penang, Malaysia
nedhalali.rd08@student.usm.my

Sharifah Fairuz Syed Fadzil
School of Housing, Building and Planning, University Science Malaysia, Penang, Malaysia
sfsf@usm.my

B. L. Mallya
Lighting Regional Manager
Philips India Ltd
New Delhi, India.
b.l.mallya@philips.com

Abstract— This study introduces a simple solution for uplamping and its energy saving for office lighting in the buildings visited in Gurgaon, Manesar and Noida around the capital of India i.e. Delhi, by discussion with the technical and maintenance staff. Study was carried out to know what is the existing lighting system used, and suggestions of efficient lighting system with support of lighting energy simulation tool i.e. DIALux are given. The selected project as a case study is the Human Resources Developing Institute of Bharat Heavy Electricals Ltd BHEL (office building). The result of the efficient system in the building shows that, uplamping with fluorescent lamps and CFL has achieved in energy saving of 42% and 65% respectively, and increase in lux level by 30% for both.

Keywords- Uplamping; Energy saving; Office buildings; lighting technology; DIALux

I. INTRODUCTION

Energy consumption is an indicator of a country's industrial progress and the standard of living of its people. It plays a central role in the world development, it represents as well a major challenge for sustainable development [1].

According to U.S. Department of Energy figures, India currently ranks as the world's sixth greatest energy consumer, accounting for about 3.3% of the world's total annual energy consumption [2]. During the last decade, in the commercial sector, there has been a rapid increase in the consumption of electricity at a rate of about 13.2%. The electricity consumption in this sector is essentially in buildings and building establishments for various uses [3] the distribution is illustrated in the Fig. 1.

In India, lighting consumes around 18 % of the total power generated as compared to 11 % in the developed countries [4]. Thus, the energy consumed by lighting is considerable in India. This percentage of lighting consumption is increased for buildings without HVAC system, reaching 40-50% [5].

II. ENERGY EFFICIENT LIGHTING

The amount of energy used from lighting varies from industry to industry but, typically, lighting accounts for approximately 15% of the electrical load in industry. In offices, the lighting may account for 50% of the electrical load [6]. By having an understanding of the lamps, ballasts, luminaires and control options available today as well as the techniques used to develop efficient lighting, lighting can be produced so that it is energy efficient, cost effective and yields a better quality of light.

In recent years, there have been many new developments in the lighting industries, in both technological equipment and approaches to lighting design [7]. One objective of these technological developments in the lighting industry has been the improvement potential in lighting efficiency, thus a reduction in energy consumption and costs. These technologies are listed below:

- Developments in lamp technology have led to lamps yielding higher efficiency, improved colour rendering and longer lamp life.
- Developments in electronic ballasts have produced ballasts that provide discharge/ fluorescent lamps with flicker-free operation, longer life, faster run-up time and cooler operation.
- Developments in smooth and silent dimming.
- Developments in electronic controls for lighting, either integration linked with daylight or occupancy linked.

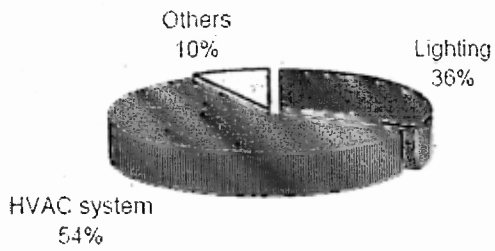

Figure 1. Electricity consumption in commercial and office buildings.

Experimental and Simulation Study for Thermal Performance Analysis in Residential Buildings in Hot-Humid Climate (Comparative Study)

Nedhal Ahmed M. Al-Tamimi[+], Sharifah Fairuz Syed Fadzilb[++]

Abstract

Glazed windows cause intensive overheating due to solar radiation for buildings in hot climates. These glazed windows, according to their apertures also provide for cross ventilation which is necessary for cooling and improving thermal comfort. Many computerized environmental simulation tools are available to help designers predict the environmental performance of their design at the early stage.

The thermal comfort study in this paper involved the use of field measurement and computer simulation tool i.e. Ecotect. Validation of Ecotect is carried out by comparing the computer simulation result with the field measurements of the east room at Fajar Harapan Hostel, USM which has a 50% glazed area to wall ratio. Output data from Ecotect has been compared to fieldwork data in terms of in/outdoor air temperatures and indoor air velocity. The impact of reducing the glazed area from WWR=50% in the base case to 25% and 00% has been investigated. Results show that field and simulated data compare well with a difference of less than 0.9oC between fieldwork and simulated indoor air temperatures. Results also show that rooms with a large glazed window area are relatively cool during night time only, and a smaller glazed window area performs well during daytime as well as nighttime.

Key Words: Thermal comfort, Glazed windows, Natural ventilation, Ecotect, Tropical region.

1. Introduction

Worldwide, the Worldwatch Institute estimated that buildings consume at least 40% of the world energy (D. M. Roodman et al, 1995). In Malaysia, there is a growing concern about energy consumption, and its climate does not offer sufficient climate conditions to ensure thermal comfort all year round. Commercial and residential buildings alone account for about 13% of total energy consumption of which 48% is from electricity (Lucas, Nigel, 2003). According to Abdul Malik and Rodzi, Malaysian buildings consume about 70% of energy just for cooling the indoor environment (Abdul Malik A. R., 2008). However, (Zain Ahmed, 2008) reported that, more than 40% of the energy consumed by Malaysian buildings can be reduced if energy efficiency is practiced and sustainable technologies are applied to the building envelope. Architects and designers should seriously consider their envelope design for energy efficiency from the first stage of the design process.

Ecotect is one of the most important building analysis tools, which can help in providing thermal and energy performances of buildings that users will eventually be working in. As Malaysia is located in the tropical region, the thermal performance of building envelopes is greatly affected by the amount of solar radiation that is introduced through the fenestration system.

[+] PhD candidate, School of Housing, Building & Planning, University Science Malaysia, 11800 Penang, Malaysia, nedhalali.rd08@student.usm.my.

[++] Associate Professor, School of Housing, Building & Planning, University Science Malaysia, 11800 Penang, Malaysia, sfsf@usm.my.

Kuwait Conf.

Evaluation on Cooling Energy Load with varied Envelope Design for High-Rise Residential Buildings in Malaysia

Nedhal Ahmed M. Al-Tamimi[1]
PhD candidate
nedhalanywhere@yahoo.com

Sharifah Fairuz Syed Fadzil[2]
Assoc. Prof. Dr.
sfsf@usm.my

[1, 2] School of Housing, Building and Planning, University Science Malaysia, Malaysia.

ABSTRACT
With the development of the economy in the recent years, Malaysia is maintaining a high economic growth and therefore, its energy consumption increases dramatically. Residential buildings are characterized by being envelope-load dominated buildings, hence are greatly influenced by the outside climatic conditions. Due to the hot humid climate of Malaysia, air conditioning system accounts for more than 45% of the total electricity used in the residential sector which is required to remove substantial amount of gained heat due to poor thermal envelope performance. This paper uses Ecotect software to analyze the impact of building envelope design on energy cooling load for residential building in Penang, Malaysia, which include area ratio of window to floor, exterior wall thermal insulation, and several kinds of shading system. This paper describes an integrated passive design approach to reduce the cooling requirement for high-rise apartments through an improved building envelope design. Comparing with the other passive strategies investigated in this paper, the results indicated that exterior wall thermal insulation is the best strategy to decrease both annual cooling energy load and peak cooling load which achieved a reduction of 10.2% and 26.3% respectively. However, the other passive strategies applied also have some marginal effect on decreasing the cooling load.

Keywords: *Energy efficiency; envelope Design; Residential building; Malaysia; Ecotect*

INTRODUCTION

Buildings, energy and the environment are key issues facing the building fraternity worldwide. With the increasing population and living standards, energy issue is becoming more and more important today because of a possible energy shortage in the future (Yilmaz 2007). In Malaysia, there is a growing concern about energy consumption, and its climate doesn't offer sufficient climate conditions to ensure thermal comfort all the year. However, electricity generation in 2006 was 96,000 GWh, which represents an increase of 328% from 22,400 GWh in 1990 (EIA 2009) This means Malaysia has a strong need and great potential to apply energy efficient strategies in lowering energy consumption in buildings.

Worldwide, the Worldwatch Institute estimated that buildings consume at least 40% of the world energy and 16% of the water used annually (Roodman and Lenssen 2005). Hence, energy growth in developing countries has been realized recently due to major developments in several sectors such as residential, commercial, and industrial and transportation. Commercial and residential buildings alone account for about 13.6% of total energy consumption and 48% of electricity consumption (Al-Mofleh, Taib et al. 2009). According to the Ninth Malaysia Plan, energy conservation culture must be inculcated. Buildings should be designed to optimise energy usage. Such resources need to be prudently and carefully utilised. The Malaysian government is adopting measures to reduce wastage by enhancing energy efficient buildings and increasing energy sufficiency (9th-Malaysia-Plan 2006). On this guideline, the government launched the National Green Technology Policy in August 2009. The objective of the policy is to provide direction towards management of sustainable environment. Moreover the 2010 budget earmarks 1.5 billion Malaysian Ringgit to promote green technology. Therefore, reducing energy use for space cooling in buildings is a key measure to energy conservation and environmental protection in Malaysia. It has also been reported that more than 40% of the energy consumed by Malaysian buildings can be reduced if energy efficiency is practiced and sustainable technologies are applied to building envelope (Azni Zain 2008). On other hand, the MS 1525 (MS_1525 2007) which is the Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-residential Buildings was developed as a guide for energy efficient measures in Malaysian buildings. The Malaysian standard also emphasized that passive method should be utilized before going to active method.

This paper describes an investigation of the effect of three passive design strategies, namely, window size, thermal insulation, and external

THE EFFECT OF GLAZED FENESTRATION AREA AND NATURAL VENTILATION ON THERMAL PERFORMANCE IN RESIDENTIAL BUILDINGS IN TROPICAL REGION

Nedhal Ahmed M. Al-Tamimi
School of Housing, Building and Planning,
Universit Sains Malaysia, Malaysia
E-mail: nedhalali.rd08@student.usm.my

Sharifah Fairuz Syed Fadzil
School of Housing, Building and Planning,
Universit Sains Malaysia, Malaysia
E-mail: sfsf@usm.my

ABSTRACT

Building orientation is a significant design consideration, mainly with regard to solar radiation and wind. In predominantly hot humid regions like Malaysia which receives sunlight all year around, buildings should be oriented to minimize solar gain and maximize natural ventilation (NV). This paper describes an investigation into the effect of building orientation in view of solar radiation absorptance of exterior wall, varied area ratio of glazed window to wall and the effect of natural ventilation on the thermal performance for residential building in tropical region. The FAJAR BAKTI building (postgraduate student residential building) which is oriented in the east west directions, and a located in USM Campus, Penang. The selected case study are two rooms, the first one is facing east direction while the other faced west. The differences in in/out door air temperature and air velocity of both rooms have been measured from the field directly using the comprehensive datalogger BABUC/M, this data have been analyzed and investigated. The results shows that east windows have more obvious effect on increasing indoor air temperature than west windows, that is applicable for ventilated or unventilated rooms.

Keywords: Fenestration; Natural ventilation; Thermal performance; Orientation; Tropical region

1.0 INTRODUCTION

Architecturally, the hot and humid region is one of the hardest climates to ameliorate through design. This is due to the high humidity and daytime temperatures that result in high indoor temperatures exceeding the ASHRAE summertime comfort upper limit of 26°C for most of the year *(Sabarinah Sh. Ahmed, 2008)*. Glazed building's facade imposes itself as an icon for the developing cities. This large area of glazing in each facade needs protection against overheating and sun glare in tropical region, especially when it faces east or west direction.

In Malaysia for example, east and west façade expostulate to direct sun radiation every morning and evening, while north façade faces sun radiation during May, Jun Jul and Aug, and south façade faces it during Nov, Dec, Jan and Feb. Therefore building orientation, particularly in tropical region should be seriously considered according to its interaction with solar radiation as well as wind direction. *(Givoni, 1994)* has reported that, in hot humid regions the provision of effective cross ventilation under the local wind direction is the major factor that may affect the building's orientation. Air movements inside a building depend not only on external wind velocity, but also largely on the architectural parameters. Architectural means for achieving this aim include

THE IMPACT OF VARIED ORIENTATION AND WALL WINDOW RATIO (WWR) TO DAYLIGHT DISTRIBUTION IN RESIDENTAL ROOMS

Sharifah Fairuz Syed Fadzil
School of Housing Building and Planning
Universiti Sains Malaysia, Penang, Malaysia
E-mail: sfsf@usm.my

Adel Abdullah
School of Housing Building and Planning
Universiti Sains Malaysia, Penang, Malaysia
E-mail: aao.rd08@student.usm.my

Wan Mariah Wan Harun
School of Housing Building and Planning
Universiti Sains Malaysia, Penang, Malaysia
E-mail: mariah@usm.my

ABSTRACT

Natural lighting requirements for rooms in Malaysia are according to the Uniform Building by Laws (UBBL). This research analyzes the sufficiency of this by law on the requirement of natural lighting for rooms and suggests ways how they can be improved. Two rooms of the Fajar Building at the University Science Malaysia campus were used as case studies and the effect of varied orientation and window to wall ratio WWR along with the percentage of window to floor area were studied. The daylight factors were calculated and illumination levels were assessed comparing the different orientation and the modified window area. Study concluded that wall window ratio WWR of 50% and 25% and the corresponding window to floor area of 35% and 17% for rooms in the Malaysian context have daylight levels exceeding the suggested standards. The by law that requires openings for daylight be 'not less' may now be adjusted to 'not more' than 10% of total floor area because of the nature of the bright Malaysian skies. This is to prevent the implications of glare and over lit rooms.

Keywords: (Daylight factor, UBBL Uniform Building By Law, illumination level, WWR Wall Window Ratio)

1.0 INTRODUCTION

In buildings, windows are designed primarily for these functions of admitting daylight, enjoying the views and allowing for cross ventilation. In the tropics, glazed windows should be designed with care because glazing also allows heat admittance very easily through the processes of radiation, conduction and convection. Glare is another problem which occurs if the glazing is unprotected by any shading devices.

The three requirements for quality in day lighting design are satisfactory balance of brightness throughout the room, the right proportions of direct and indirect light, and absence of glare from sky and sun. The aim for good lighting in any design is to help the users see well, clearly and comfortably in any of the many varied tasks they may undertake.

Standards are set for recommending these lighting levels that are appropriate and that are usually being considered for efficient lighting practice. Table 1 below lists the suitable lighting for the performance of a range of tasks taken from the Malaysian Standards MS 1525 2001. There are

DAYLIGHT ILLUMINATION LEVELS IN VARIED ROOM CONFIGURATIONS AT THE VIEW CONDOMINIUM, PENANG, MALAYSIA

Adel Abdullah[1], Sharifah Fairuz Syed Fadzil[2] and Nedhal Ahmed M. Al-Tamimi[3]

[1, 2,3] School of Housing, Building and Planning, University Science Malaysia, Malaysia
aao.rd08@student.usm.my; sfsf@usm.my and nedhalali.rd08@student.usm.my

ABSTRACT Daylight illumination levels in a room depend on the room design and configurations especially in its glazed area and location in the wall surfaces that allows light to penetrate in. The design of the room varies according to the architect and this allow for many shapes and configurations not limited to the simple rectangle only. Daylight entry in these varied rooms can be developed according to the architects intuition and intention. In this paper, daylight illumination levels were measured in three varied room configurations at The View condominiums in Penang, Malaysia. The percentage daylight factors were calculated and analysis of the sky component exposure was carried out for each room. Recommendations were given for day lighting design for rooms in the tropical climate.

Key words: *Daylight factor, illumination, WFR window to floor ration, sky component*

1. INTRODUCTION

Daylighting is the illumination of building interiors with sunlight or sky light and is known to affect visual performance, lighting quality, health, human performance, and energy efficiency. Daylighting the interior space of buildings is an important consideration for architectural design. Studies have shown that increased daylighting improves worker productivity, provides for faster patient recovery, and improves students' grades. Additional benefits of daylighting include keeping our biological clocks in order and relieving stress. These benefits have long been recognized in Europe, where minimum amounts of daylighting and an opportunity to enjoy an exterior view are regulated (ASHRAE, 2001). Successful daylighting schemes enhance architectural design, provide health benefits to occupants, and reduce energy consumption for electric lighting.

THE EFFECT OF ORIENTATION AND GLAZED AREA TO THE INDOOR AIR TEMPERATURE IN UNVENTILATED BUILDINGS IN HOT-HUMID CLIMATE

Nedhal Ahmed M. Al-Tamimi[1*], Sharifah Fairuz Syed Fadzil[2] and Adel Abdullah[3]

[1, 2,3] School of Housing, Building and Planning, University Science Malaysia, Malaysia

nedhalali.rd08@student.usm.my; sfsf@usm.my and aao.rd08@student.usm.my

ABSTRACT: Glazed building envelope is becoming an important component of contemporary architecture. Glass allows natural light, offer a visual communication with outdoors, reduce structural load and enhance aesthetic appearance of buildings. With many benefits that the gazing offers the occupants and the designers, it is not free of problems if it is not properly selected. Building envelope and its glazed fenestration represent a major source of unwanted heat, solar gain and thermal discomfort. Moreover glazed curtain walls cause glare problems and increased energy consumption required for cooling systems due to the high internal air temperature. This has resulted in a complete reliance on the mechanical means to manipulate the indoor temperature and finally to achieve the thermal comfort at high energy consumption. Thus, this paper investigates the relationship between glazed window area in effecting the increase in indoor temperature. The effect of the orientation of the glazing is also investigated. The result shows that, it is possible to minimize the undesirable effect of glazed windows in a given orientation and to secure their beneficial effect by selecting appropriate size and position of the windows according to the local climate condition.

Keywords: Window wall Ratio (WWR); Window Floor Ratio (WFR); Building orientation; Hot-Humid climate; Glazed building.

1. INTRODUCTION

Glazed building's facade imposes itself as an icon for the developing cities. This large area of glazing in each facade needs protection against overheating and sun glare in tropical region, especially when it faces east or west direction (Al-Tamimi & Syed Fadzil 2009).

The frequently use of glass, especially in hot humid climate, has resulted in more usage of air conditioners for creating thermal comfort. In any domestic, commercial or industry, the biggest portion of electricity bill goes to paying for the energy consumed by air conditioning. consequently the electricity consumption in Malaysia has rapidly been increased, and half of this energy is consumed by just commercial and residential building, many of these buildings have not been design and operated efficiently, resulting in buildings contributing more to the total energy consumption.

Unfortunately, in Malaysia, new building envelope designs are developed to meet the client's requirements without much concern to the local climate and

(ICSAUD 2010)

WALL WINDOW RATIO (WWR) AND ITS INFLUENCE ON INTERNAL AIR TEMPERATURES AND NATURAL LIGHT LEVEL IN GLAZED ROOM IN THE TROPICS

Sharifah Fairuz Syed Fadzil[1], Nedhal A. Al-Tamimi[2], Adel Abdullah[3] and Wan Mariah Wan Harun[4]
[1, 2, 3 & 4] Architecture: School of Housing, Building and Planning, University Science Malaysia
sfsf@usm.my; nedhalali.rd08@student.usm.my; aao.rd08@student.usm.my & mariah@usm.my

ABSTRACT

In the tropics, there are no set standards as to the optimum wall window ratio (WWR) for rooms especially in the residential buildings. The compromise needed for the desired views, for the appropriate natural light admittance, for minimizing heat gains inside, is not easily achievable more so when the thermal performance of glass in the building envelope differ significantly in the extreme daytime compared to the cooler night time. Study found that glazing in the daytime is undesirable because the more the glazing area and the higher the WWR the higher the internal air temperatures will be and the higher the difference between To and Ti. Study also found that WWR of 60% to 40% to 20% come with an average percentage daylight factor (%DF) 3.7, 2.5 and 1.7 respectively. The WWR 20% is found to be more than adequate for natural lighting requirements for residential and it could be decreased even more to WWR 15 – 10% due to the abundance of natural daylight. In the night time however, heat build up is found to easily escape to the cooler outdoors with the most glazing i.e. WWR 60% compared with WWR 40% and 20%.

Keywords: *WWR Wall window ratio, glazing, daylight factor (%DF), radiation*

INTRODUCTION

Glazed buildings in the tropics are usually not considered as energy efficient (Zain, Z., et al. 2007). As glass, being thin and transparent lets in heat easily through the process of radiation. As light is energy, allowing in light lets in heat energy as well. The hypothesis and logical reasoning is that the more the light is allowed in, the higher the internal air temperatures will be. In the tropics this is true only in the daytime duration, when the outdoor is characterized by high temperatures and solar radiation especially at midday. However, the thermal performance of glazed building will change during the night time when outdoor air temperatures are lower and a lot cooler, and solar radiation is nil.

Natural lighting level will depend on the amount of transparent area which light can travel and penetrate. However, admission of daylight into a room often causes glare and discomfort due to the high radiation level in Malaysia. Lighting standards (MS 1525) guide designers so as not to over lit the spaces they design, what more if the consequences of heat accumulation is already on the high scale. Thus, good daylighting requires that the illumination level in spaces be within the acceptable range that doesn't negatively affect occupant's health and contribute positively to their productivity.

Wall window ratio (WWR) (ASHRAE, 2004) is a ratio often used to indicate the amount of glazing in a building. A high WWR indicate a high area of glazing

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NATURAL VENTILATION EFFECTS IN MALAYSIAN HOUSES

Nedhal Ahmed M. Al-Tamimi[1*], Sharifah Fairuz Syed Fadzil[2] and Wan Mariah Wan Harun[3]

[1, 2,3] School of Housing, Building and Planning, University Science Malaysia, Malaysia
nedhalanywhere@yahoo.com; sfsf@usm.my and mariah@usm.my

ABSTRACT: Hot and humid region is one of the hardest climates to ameliorate through design. This is due to the high humidity and daytime temperatures that result in high indoor air temperatures exceeding the upper limit of thermal comfort zone. This problem is more noticeable in glazed residential buildings in the Malaysian climate. As a result of an overall poor thermal performance, these glazed buildings have become more dependent on artificial and active means to provide comfortable thermal environment at high energy consumption. An alternative method to overcome this problem is by providing natural ventilation which is an efficient passive method for cooling and is energy efficient. This study aims to overcome the overheating problem in high-rise glazed residential buildings in Malaysia. The main objective of this study is to investigate the improvement in the indoor thermal condition by passive cooling approaches without auxiliary cooling from air conditioning equipments. A field study is carried out in "The View" apartments, Penang, Malaysia, in order to ascertain the environmental performance of these glazed residential buildings. The impact of day-time and night-time natural ventilation as a passive cooling strategy has been investigated, and this is compared with unventilated situations. The results showed significant improvements in indoor environmental performance can reach 80% and 50% in day-time and night-time respectively in cases where natural ventilation have been applied and considered in the building.

Keywords: Natural Ventilation, Thermal Performance; Sustainable Building, Residential Building

1. INTRODUCTION

With the threat of "Global Warming" and increasing energy cost, keeping residential buildings cool will become increasingly important in the future. In Hong Kong, Air-conditioning accounted for about 40% to 50% of the total residential sector electricity consumption (Lam, Tsang et al. 2005) (Yu, Yang et al. 2008). Therefore, a study of Household Energy use by CETDEM – Center for Enviroment, Technology & Development, Malaysia as shown in fig. 1. found that, air conditioning takes up nearly 45% of the average household electricity consumption and air conditioning is the largest consumer of electricity in the home (CETDAM 2006). And the number of air conditioners has been increased from 57,340 unit in 1980 to 860,462 in 2008

Indoor thermal environment is one of the main important characteristics of buildings. A comfortable thermal environment is a prerequisite for a human to perform his day to day activities. In traditional buildings, a comfortable environment is solely achieved by utilizing a proper combination of building

(under corrections stage)

EXPERIMENTAL AND SIMULATION STUDY FOR THERMAL PERFORMANCE OPTIMIZATION IN RESIDENTIAL BUILDINGS IN HOT-HUMID CLIMATE

Nedhal Ahmed M. Al-Tamimi [a,*]
nedhalali.rd08@student.usm.my
PhD candidate

Sharifah Fairuz Syed Fadzil [b]
sfsf@usm.my
Associate Professor

[a,b] School of Housing, Building & Planning, University Science Malaysia, 11800 Penang, Malaysia.

ABSTRACT

Glazed windows cause intensive overheating due to solar radiation for buildings in hot climates. These glazed windows, according to their apertures also provide for cross ventilation which is necessary for cooling and improving thermal comfort. Many computerized environmental simulation tools are available to help designers predict the environmental performance of their design at the early stage.

The thermal comfort study in this paper involved the use of field measurement and computer simulation tool i.e. Ecotect. Validation of Ecotect is carried out by comparing the computer simulation result with the field measurements of the east room at Fajar Harapan Hostel, USM which has a 50% glazed area to wall ratio. Output data from Ecotect has been compared to fieldwork data in terms of in/outdoor air temperatures and indoor air velocity. The impact of reducing the glazed area from WWR=50% in the base case to 25% and 00% has been investigated. Results show that field and simulated data compare well with a difference of less than 0.9°C between fieldwork and simulated indoor air temperatures. Results also show that rooms with a large glazed window area are relatively cool during night time only, and a smaller glazed window area performs well during daytime as well as nighttime.

Key Words: *Thermal comfort; Glazed windows; Natural ventilation; Ecotect; Tropical region*

1. INTRODUCTION

Worldwide, the Worldwatch Institute estimated that buildings consume at least 40% of the world energy (D. M. Roodman et al, 1995). In Malaysia, there is a growing concern about energy consumption, and its climate does not offer sufficient climate conditions to ensure thermal comfort all year round. Commercial and residential buildings alone account for about 13% of total energy consumption of which 48% is from electricity (Lucas, Nigel, 2003). According to Abdul Malik and Rodzi, Malaysian buildings consume about 70% of energy just for cooling the indoor environment (Abdul Malik A. R., 2008). However, (Zain Ahmed, 2008) reported that, more than 40% of the energy consumed by Malaysian buildings can be reduced if energy efficiency is practiced and sustainable technologies are applied to the building envelope. Architects and designers should seriously consider their envelope design for energy efficiency from the first stage of the design process.

Ecotect is one of the most important building analysis tools, which can help in providing thermal and energy performances of buildings that users will eventually be working in. As Malaysia is located in the tropical region, the thermal performance of building envelopes is greatly affected by the amount of solar radiation that is introduced through the fenestration system. The generated heat within the indoor environment especially in a glazed building increases with the admitted solar radiation. The percentage of glazing area in the exterior building envelope or its window wall ratio (WWR) will impact its thermal performance.