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SHADING DEVICE DESIGN BASED ON SUN POSITION AND INDOOR LIGHTING REQUIREMENTS

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ABSTRACT

In certain decade, the shape of the building envelope looks similar to one another, in this case building with a glass veil in big cities for example those in Jakarta and in other tropical or four-season cities. Even though, a building was designed and built to accommodate human activities in that the space is comfortable to its maximum use. On the building orientation and protection against the sun, the following basic rules are applied: a. Open facade facing south or north to obviate direct sun radiation which will generate heat; b. In wet tropical climate protective for all building openings are required against direct and indirect sunlight, even the entire areas of the building. Besides that, it's necessary to use the study of sunlight angle by then the light protector and the building orientation can be correctly determined. To obtain an effective protective sunlight, every building facade should be separately reviewed. The same shape of sun-shade in all four building façade are irrational. The fall angle of sunlight can be determined by using graphics and the sun path diagrams (Lippsmeier).The architecture of the building must be empathetic, responsive, and resolvable. One of which is by integrating the energy efficient with that of environmentally friendly building. The use of natural lighting and ventilation in a residential building is one way of accommodating energy efficient, where the natural light is used as much as possible so as not to use artificial lighting during the day. This paper discusses building C, Campus A, Trisakti University as its focus of interest, with the purpose is planning the shade to protect the building from direct sunlight and heat radiation without obstructing the view. To protect openings from sunlight blocking so that it cannot directly get into the building, then the problem arises: what are the elements of the right sun-shades? Based on the research problem, descriptive method is used by tabulating data obtained from the plan, section, and detail measurement. Based on the data tabulation, the results then will be compared with the applicable standard value.

Keywords: shading device, sun position, indoor lighting requirements

ABSTRACT

Pada dekade tertentu bentuk selubung bangunan tampak sama satu dengan lainnya, misalnya bangunan dengan selubung kaca yang hadir dikota-kota besar baik di Jakarta maupun di kota-kota lain di negara tropis atau empat musim. Padahal suatu bangunan dirancang dan dibangun untuk menampung aktivitas manusia secara maksimal agar supaya ruang tersebut nyaman digunakan. Pada orientasi bangunan dan perlindungan terhadap cahaya matahari, berlaku aturan-aturan dasar yaitu: a. Fasade terbuka menghadap ke selatan atau utara, agar meniadakan radiasi langsung dari cahaya matahari yang akan menimbulkan panas; b. Pada daerah iklim tropic basah diperlukan pelindung untuk semua bukaan bangunan terhadap cahaya matahari langsung dan tidak langsung, bahkan untuk seluruh bidang bangunan. Disamping itu menggunakan studi sudut jatuhnya sinar matahari sangat diperlukan, karena dengan cara ini pelindung cahaya dan orientasi bangunan dapat ditentukan dengan benar. Untuk mendapatkan pelindung cahaya matahari yang efektif, setiap fasade bangunan harus ditinjau secara terpisah. Bentuk pelindung matahari yang sama pada keempat fasade bangunan tidak rasional. Sudut jatuhnya cahaya matahari dapat ditentukan dengan cara grafis dan menggunakan diagram matahari (Lippsmeier. Bentuk arsitektur gedung harus berempati, tanggap, dan memberikan solusi. Salah satunya adalah memadukan gedung yang hemat energi dan ramah lingkungan. Pemanfaatan pencahayaan dan pengudaraan alami dalam sebuah hunian merupakan salah satu cara efisiensi energi, dimana cahaya alami diusahakan masuk sebanyak mungkin agar tidak menggunakan pencahayaan buatan disiang hari. Pada kesempatan ini peneliti menggunakan gedung C dikampus A Universitas Trisakti sebagai studi kasus. Tujuan dari penulisan ini adalah merencanakan bentuk peneduh yang dapat melindungi bangunan dari cahaya matahari langsung dan panas radiasi matahari yang masuk ke dalam bangunan, serta memenuhi kebutuhan peneranagn di dalam ruang. Untuk mendapatkan pelindung bukaan yang dapat menghalangi cahaya matahari agar tidak dapat langsung masuk kedalam bangunan, maka permasalahannya adalah: Bagaimana bentuk elemen penghalang cahaya matahari yang tepat. Berdasarkan masalah penelitian, maka digunakan metode deskriptif, yaitu dengan cara membuat tabulasi data yang didapat dari mengukur pada denah, potongan dan detail. Kemudian hasil yang didapat dibandingkan dengan nilai standar yang berlaku.

Keywords: shading device, posisi cahaya matahari, pencahayaan

1. INTRODUCTION

A building designed and built to accommodate human to the maximize activity so that the space is comfortable to use and can answer environmental climate in which the building was constructed. On the orientation of buildings and protection against the sun, apply the basic rules are: a. façade is facing north, in order to nullify the direct radiation from the sun which will generate heat; b. In the area of wet tropical climate is necessary protection for all building openings against direct sunlight and indirect, even for the entire area of the building. Besides, the use of study angle of the fall of sunlight is necessary, because in this way the light protector and the orientation of the building can be correctly determined the fall of the sun angle can be determined by using graphics and the sun path diagrams (Lippsmeier).

Utilization of natural lighting in a building is one way of energy efficiency, where the natural light as much as possible so they must attempt to not use artificial lighting during the day. On this occasion the researchers used C building at Trisakti University campus A as a case study. The purpose of this paper is planning the shade to protect the building from direct sunlight and heat radiation of the sun into the building, as well as possible to use natural lighting

To gain a protective openings that can block sunlight so they can not immediately get into the building, then the problem is: What is the best type of shading devices. Based on the research problem, then used the descriptive method, that is by making tabulating data obtained from the measures in plan, section and detail. Then the results were compared with the value of the applicable standards.

2. METHODOLOGY

The method applied is qualitative method with descriptive analysis on a case study, by studying the literature relating to climate aspects of sunlight and position, as well as the layout of the building openings related to the position and angle of the sunlight potition. Then assess whether the shape of the facade of buildings already meet one of the requirements of building tropical. Determining the buildings are in the position and location with regard to sunlight, determine the angle and measure the angle of sunlight potition in graphically. It will get sun light protector is most appropriate.

The data collected will be analyzed refer to the literature related aspects studied. From the results of the depiction of sunlight angle potition will be obtained outline sunlight that enters the room. Then may recommend a protective form of sunlight to avoid the entry of direct sunlight and avoid glare

On this occasion the author takes the case of building C at campus A, Trisakti University in Grogol, West Jakarta. In the sunlight angle potition, measurements were taken only on the East side and the West, which is the area that are exposed to the morning sun until noon on the East side and during the day until the afternoon on the west side. The premiss for the East and West sides are due to the geographical location of Indonesia to orbit the sun. Likewise, the layout of the paths of the sun in the most critical is the North section on June 22, March 21 to September 23 at the top of the equator and 22 December in the southern part.

3. THEORETICAL REVIEW

Sun Potition

The sun position, which produces angle of sunlight influenced by the climate of a place, the position of the sun and the observations of the earth and depends on: the geographical latitude angle of observation; season; long daily irradiation. Indonesia is situated underlined the equator will get more sunlight than the countries that are located far from the equator. Sunlight needed by humans, while the light itself is avoided because it produces unwanted heat. So to counteract the sunlight is needed a shading device, either plant or construction elements.

To get the amount of sunlight coming into the room as we want, then we have to make a proper barrier. The barrier may be shading the sun roof and wall imagery that is both horizontal and vertical. Horizontal or vertical element may be as high / long or tall window openings and window located between the windows, while the width is adjusted to the desired amount of lighting room.

Some of the subject matter to consider is the orientation of the building and protection against sunlight, are: the facade facing towards the north and south should be open to avoid direct radiation from the sun low can cause heat gain. It takes protection to all holes / openings of buildings against direct and indirect light. To determine the angle of the sunlight potition knowable through direct observation, mathematical calculation and graphical representation. Graphic method using observations and calculations that can be applied through a solar diagram.

Sun Path Diagram

At Lippsmeier, the sun path diagram describes the position of azimuth, altitude, the date line, the clock line. Azimut is a declination of the sun from the north, is measured by the degree of north to the east, south, west and back to the north. It is stamped on the outermost circle diagram. High sun is the angle between the horizon and the sun is imprinted on a scale of 0^0-90^0 in a north (N) and south (S) on the diagram. The date line drawn in the direction of East - West depicting the path of the sun from sunrise to sunset, on the day in question of the position of the observer is always at the center of the circle, the sun appear to move away and come back once a year between the date line to 22.6 (22 June) and 22.12 (22 December). The clock line is a line that is vertical to the date line, respectively within one hour. Line which coincides with the North - South axis shows at the local noon.

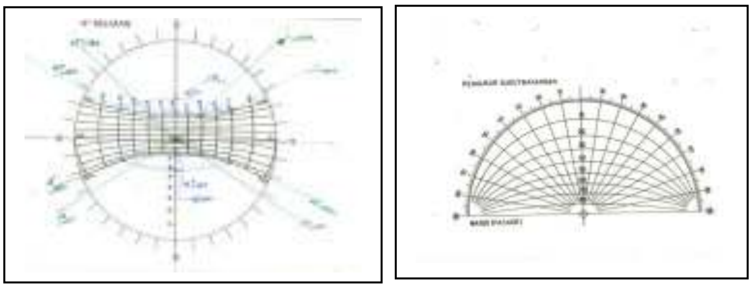

Figure 1: angle of the sun on the sun path diagram 6^0LS
Source: Tropical Architecture, Lippsmeier

Shading devise

At Lechner, the barrier of sunlight is an integral part of the architecture that contributes to express the aesthetics; where each orientation should have a different strategy sun barrier; if the transparent surface is minimized on the east and west it will be very difficult to have an effective barrier to sunlight; on the east and west facade, horizontal overhang is more frequently used than vertical fins, because the overhang is able to block out the sunlight and generate good daylight.

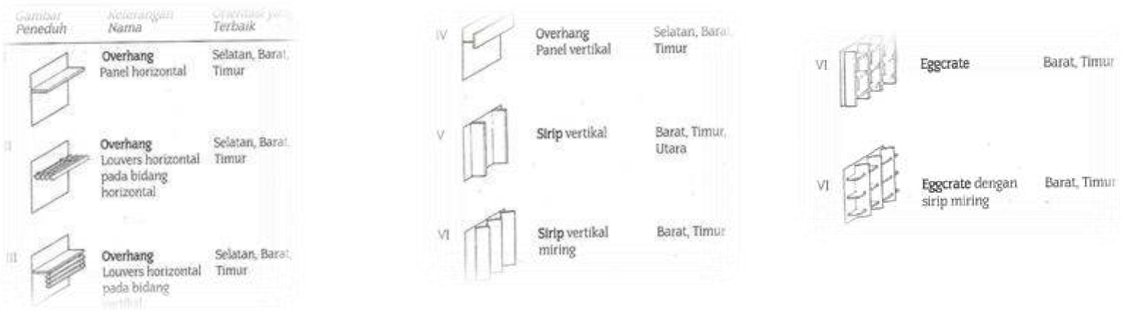

Figure 2: Various forms Shading device
Source: Heating, Cooling, Lighting, Lechner

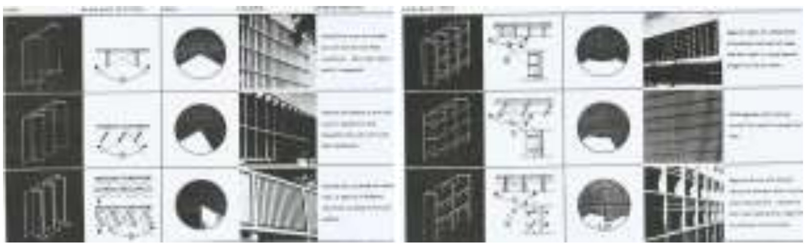

Figure 3: Various forms of vertical and eggcrate Shading device
Source: design with climate, Olgyay

Lighting Requirement

Light and bright is a prerequisite for human vision. Humans need light to move with healthy, convenient and fun. (Satwiko 1, p.78). How much of the light that humans need depends on what kind of activities in space. From Lechner, pp 413-416. Natural light coming through the windows could come from several sources: direct sun, clear skies, clouds or below the surface reflection and the surrounding buildings. While artificial light is more consistent in the amount needed. Meanwhile from Suptandar, et al., p.13: The benefits of sunlight into designs for lighting spaces where people can work, and comfort are very dependent on the lighting system and the local environmental conditions. Related aspects, namely: the dimensions (height and width) opening of doors, windows, walls, and the building layout of the position of the sun; rain clouds, long exposure, time and environmental conditions. Artificial lighting is necessary because we can not fully depend on the availability of natural lighting, for example at night or in a room that is not covered by natural light. Thus it should be mutually supportive of artificial lighting with natural lighting.

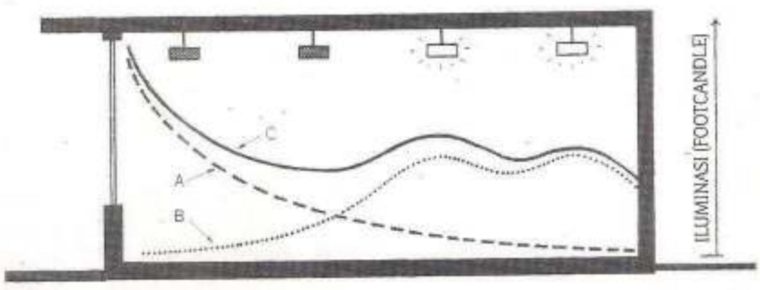

Figure 4.: Natural lighting (curve A) received additional sebag electric lighting (curve B) to produce a more even view of light (curve C)
Source: Heating, Cooling, Lighting, Lechner

Table 1.: Lighting Standards At Workspace

Fungsi ruangan	Tingkat pencahayaan (Lux)	Kelompok renderasi warna	Temperatur warna		
			Warm white <3300 K	*Cool white* 3300 K-5300K	*Daylight* >5300 K
Rumah tinggal :					
Teras	60	1 atau 2	•	•	
Ruang tamu	120 - 150	1 atau 2		•	
Ruang makan	120 - 250	1 atau 2	•		
Ruang kerja	120 - 250	1		•	•
Kamar tidur	120 - 250	1 atau 2	•	•	
Kamar mandi	250	1 atau 2		•	•
Dapur	250	1 atau 2	•	•	
Garasi	60	3 atau 4		•	•
Perkantoran :					
Ruang Direktur	350	1 atau 2		•	•
Ruang kerja	350	1 atau 2		•	•
Ruang komputer	350	1 atau 2		•	•
Ruang rapat	300	1	•	•	
Ruang gambar	750	1 atau 2		•	•
Gudang arsip	150	1 atau 2		•	•
Ruang arsip aktif	300	1 atau 2		•	•
Lembaga Pendidikan :					
Ruang kelas	250	1 atau 2		•	•
Perpustakaan	300	1 atau 2		•	•
Laboratorium	500	1		•	•
Ruang gambar	750	1		•	•
Kantin	200	1	•	•	
Hotel dan Restauran :					
Lobi, koridor	100	1	•	•	
Ruang serba guna	200	1	•	•	
Ruang makan	250	1	•	•	
Kafetaria	200	1	•	•	
Kamar tidur	150	1 atau 2	•		
Dapur	300	1	•	•	

Source: Energy Conservation Lighting Systems in Buildings, SNI 03-6197-2000

4. DISCUSSION

Building Complex at campus A, Trisakti University consists of buildings A, B, C, D, E, F, G, H, I, K, L, M, N, O, P and future support buildings consist of: mosque, cooperative student, post offices, monuments, and parking facilities, plazas, parks and outdoor activity space. C building is taken as a sample to represent the other building blocks. The rectangular building with a height of 10 floors and one basement, each floor is 4. 00 meters high, floor area are 35.00Mx36.00M. C building consists of a class room, laboratory, studio, administrative space, secretariat departments, lecturer office, office leaders, library, community student, along with complementary spaces. North-South orientation of the building, this building block position parallel to the North-South axis. Field of building openings located on all four sides, north, south, east and west, with completion (finishing) glass materials die and the glass windows that can be opened. In addition to the four sides of the openings to be composed with massive fields and structures are shown and serves as an aesthetic element. Aperture comes with eaves made of aluminum, the wide eaves ± 1.2 meters. This building use artificial air conditioning for the entire room.

Climate and Architecture in Indonesia, Amirudin, 1969 stated that the critical angle of the sun during the hours of 8.00 am – 16.00 pm. Because the C building in Jakarta which are in 6º 11 "LS, it can use solar diagram on 6 º LS.

Figure 5: The layout of Building C on the campus A, Univ. Trisakti
Source: authorities of Univ. Trisakti

Figure 6: plan ground floor, 1,2,3
Source: authorities o f Univ Trisakti

Figure 7.: plan. 4,5,6,7
Source: authorities o f Univ Trisakti

Figure 8.: plan 8,9
Source: authorities o f Univ Trisakti

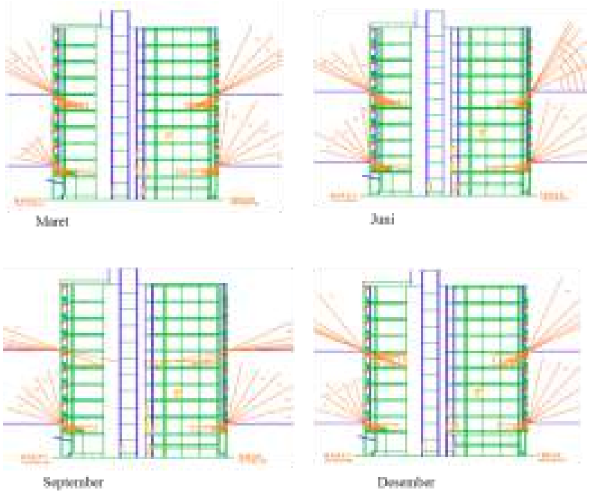

Figure 9.: North; South; East; West of C bld.
Source: authorities of Univ. Trisakti

Figure 10 .: The position of the shadow of the sun on a section of C bld.

Table 2.: The Results Of Measurements With The Sun Path Diagrams The Sun

an	Orientasi	Sudut jatuh bayangan (α^0)	Waktu pk./jarak thd dinding dalam										
			8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00
ıi	Utara	Horizontal	65	61	55	44	26	0	27	46	64	62	65
		Vertical	12	25	38	49	58	0	58	49	38	25	12
	Selatan	Horizontal	-	-	-	-	-	-	-	-	-	-	-
		Vertical	-	-	-	-	-	-	-	-	-	-	-
	Timur	Horizontal	25/7.16	28/3.15	34/1.87	45/1.27	64/0.99	90/-	-	-	-	-	-
		Vertical	12/10.65	28/2.89	42/1.27	60/0.21	76/*	0/-	-	-	-	-	-
	Barat	Horizontal	-	-	-	-	-	90	63/0.41	45/2.45	34/4.47	28/6.01	24/7.42
		Vertical	-	-	-	-	-	0	80/*	58/0.16	42/1.22	28/2.89	13/8.39
ret	Utara	Horizontal	88	86	84	80	65	0	70	80	84	86	88
		Vertical	80	81	82	84	85	0	85	84	82	81	80
	Selatan	Horizontal	68	67	65	58	38	0	38	61	67	68	69
		Vertical	38	58	65	72	75	90	85	72	68	58	40
	Timur	Horizontal	25/ 7.16	29/5.84	35 /3.38	47/ 2.46	64 /0.74	0 /-	-	-	-	-	-
		Vertical	12/9.03	28 /2.89	42 /1.22	60/0.52	82 /*	90 /-	-	-	-	-	-
	Barat	Horizontal	-	-	-	-	-	90/-	63 /0.70	45/2.6	35 /4.26	29 /5.72	25 /7.04
		Vertical	-	-	-	-	-	0	85/*	58 /0.16	42 /1.22	28 /2.89	13 /8.22
ptem	Utara	Horizontal	88	86	84	82	70	0	67	78	83	86	88
		Vertical	87	86	81	80	85						
	Selatan	Horizontal	-	-	-	-	-	-	-	-	-	-	-
		Vertical	-	-	-	-	-	-	-	-	-	-	-
	Timur	Horizontal	2/*	4/*	6 /*	11 /18.78	24 /7.55	90 /-	-	-	-	-	-
		Vertical	14/7.52	30 /2.56	44 /1.05	60 /0.56	77/*	0/-	-	-	-	-	-
	Barat	Horizontal	-	-	-	-	-	90/-	21 /*	11 /*	7 /*	4 /*	2 /*
		Vertical	-	-	-	-	-	0	75 /*	60 /0.56	43 /1.12	31/2.42	15 /6.92
sem	Utara	Horizontal	-	-	-	-	-	-	-	-	-	-	-
		Vertical	-	-	-	-	-	-	-	-	-	-	-
	Selatan	Horizontal	68	67	65	58	40	0	40	60	66	67	68
		Vertical	38	58	68	72	75	90	75	72	68	58	40
	Timur	Horizontal	25/7.2	29/5.66	35/4.38	45/2.73	65/0.66	90/-	-	-	-	-	-
		Vertical	16/6.4	33/2.2	47/0.83	62/*	77/*	0/-	-	-	-	-	-
	Barat	Horizontal	-	-	-	-	-	0/-	50/1.98	30/5.44	25/7.03	22/8.32	21/8.82
		Vertical	-	-	-	-	-	0/-	75/*	60/0.56	45/0.97	32/2.28	15/6.92

Table 3.: Light intensity on the West in March, June, September, December at C building

Titik pengukuran	Maret,sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam				Terang semua				Terang sebag.				Terang sebag.				
	waktu (pk.WIB)			Rata2				rata2	(a)			rata2	(b)			rata2	
	10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		
1	43	42	50	45	225	309	234	256	146	154	176	158.67	160	178	198	178.67	cerah
2	95	97	109	100.33	305	324	298	309	232	245	234	237	226	235	262	241	berawan
3	251	267	244	254	420	425	452	432.33	352	376	358	362	423	513	399	445	cerah
4	271	281	264	272	361	321	314	332	423	423	435	427	393	387	402	394	cerah
5	85	87	76	82.67	278	279	268	275	220	222	242	228	255	243	214	237.33	cerah
Rata2	149.00	154.80	148.60	150.80	317.80	331.60	313.20	320.87	274.60	284.00	289.00	282.53	291.40	311.20	295.00	299.20	

Titik pengukuran	Juni-sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam				Terang semua				Terang sebag.				Terang sebag.				
	Waktu (pk WIB)			Rata2				Rata2	(a)			Rata2	(b)			Rata2	
	11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		
1	2	3	1	2	182	177	182	180.33	182	138	178	166	13	4	12	9.67	cerah
2	6	4	5	5	176	183	175	178	176	148	183	169	20	11	19	16.67	berawan
3	49	17	47	37.67	203	208	201	204	203	273	201	225.67	42	33	42	39	
4	8	4	6	6	198	205	200	201	198	158	187	181	17	8	18	14.33	
5	22	5	21	16	242	283	245	256.67	242	195	231	222.67	30	15	32	25.67	
Rata2	17.40	6.60	16.00	13.33	200.20	211.20	200.60	204.00	200.20	182.40	196.00	192.87	24.40	14.20	24.60	21.07	

Titik pengukuran	September,sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam				Terang semua				Terang sebag.				Terang sebag.				
	waktu (pk.WIB)			Rata2				rata2	(a)			rata2	(b)			rata2	
	10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		
1	46	35	46	42.33	251	289	301	280.33	220	263	256	246.33	195	207	197	199.67	berawan
2	102	98	87	95.67	308	307	320	311.67	274	321	289	294.67	272	277	279	276	cerah
3	193	199	209	200.33	270	298	255	274.33	375	412	356	381	353	389	376	372.67	cerah
4	199	204	201	201.33	413	433	476	440.67	295	245	257	265.67	346	353	361	353.33	cerah
4	250	145	190	195	269	239	265	257.67	183	201	179	187.67	283	206	273	254	cerah
Rata2	158.00	136.20	146.60	146.93	302.20	313.20	323.40	312.93	269.40	288.40	267.40	275.07	289.80	286.40	297.20	291.13	

Titik pengukuran	Desember-sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam				Terang semua				Terang sebag.				Terang sebag.				
	Waktu (pk WIB)			Rata2				Rata2	(a)			Rata2	(b)			Rata2	
	11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		
6	83	41	81	68.33	290	225	287	267.33	290	234	281	268.33	92	45	90	75.67	
7	8	4	7	6.33	102	176	111	129.67	102	96	101	99.67	34	20	37	30.33	
8	20	13	17	16.67	182	245	177	201.33	182	165	171	172.67	40	35	43	39.33	
9	21	34	19	24.67	222	193	211	208.67	222	216	211	216.33	63	59	61	61	
10	6	6	5	5.67	123	134	131	129.33	35	34	33	34	99	95	98	97.33	
Rata2	27.60	19.60	25.80	24.33	183.80	194.60	183.40	187.27	166.20	149.00	159.40	158.20	65.60	50.80	65.80	60.73	

Table 4.: Light intensity on the East in March, June, September, December at C building

Titik pengukuran	Maret,sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam waktu (pk.WIB)			Rata2	Terang semua			rata2	Terang sebag. (a)			rata2	Terang sebag. (b)			rata2	
	10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		
1	43	42	50	45	225	309	234	256	146	154	176	158.67	160	178	198	178.67	cerah
2	95	97	109	100.33	305	324	298	309	232	245	234	237	226	235	262	241	berawan
3	251	267	244	254	420	425	452	432.33	352	376	358	362	423	513	399	445	cerah
4	271	281	264	272	361	321	314	332	423	423	435	427	393	387	402	394	cerah
5	85	87	76	82.67	278	279	268	275	220	222	242	228	255	243	214	237.33	cerah
Rata2	149.00	154.80	148.60	150.80	317.80	331.60	313.20	320.87	274.60	284.00	289.00	282.53	291.40	311.20	295.00	299.20	

Titik pengukuran	Juni-sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam Waktu (pk WIB)			Rata2	Terang semua			Rata2	Terang sebag. (a)			Rata2	Terang sebag. (b)			Rata2	
	11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		
1	2	3	1	2	182	177	182	180.33	182	138	178	166	13	4	12	9.67	cerah
2	6	4	5	5	176	183	175	178	176	148	183	169	20	11	19	16.67	berawan
3	49	17	47	37.67	203	208	201	204	203	273	201	225.67	42	33	42	39	
4	8	4	6	6	198	205	200	201	198	158	187	181	17	8	18	14.33	
5	22	5	21	16	242	283	245	256.67	242	195	231	222.67	30	15	32	25.67	
Rata2	17.40	6.60	16.00	13.33	200.20	211.20	200.60	204.00	200.20	182.40	196.00	192.87	24.40	14.20	24.60	21.07	

Titik pengukuran	September,sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam waktu (pk.WIB)			Rata2	Terang semua			rata2	Terang sebag. (a)			rata2	Terang sebag. (b)			rata2	
	10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		10:20	13:30	15:10		
1	46	35	46	42.33	251	289	301	280.33	220	263	256	246.33	195	207	197	199.67	berawan
2	102	98	87	95.67	308	307	320	311.67	274	321	289	294.67	272	277	279	276	cerah
3	193	199	209	200.33	270	298	255	274.33	375	412	356	381	353	389	376	372.67	cerah
4	199	204	201	201.33	413	433	476	440.67	295	245	257	265.67	346	353	361	353.33	cerah
4	250	145	190	195	269	239	265	257.67	183	201	179	187.67	283	206	273	254	cerah
Rata2	158.00	136.20	146.60	146.93	302.20	313.20	323.40	312.93	269.40	288.40	267.40	275.07	289.80	286.40	297.20	291.13	

Titik pengukuran	Desember-sisi TIMUR-Kuat penerangan (Lux)																Keadaan cuaca
	Cahaya alam Waktu (pk WIB)			Rata2	Terang semua			Rata2	Terang sebag. (a)			Rata2	Terang sebag. (b)			Rata2	
	11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		11:00	13:30	15:10		
6	83	41	81	68.33	290	225	287	267.33	290	234	281	268.33	92	45	90	75.67	
7	8	4	7	6.33	102	176	111	129.67	102	96	101	99.67	34	20	37	30.33	
8	20	13	17	16.67	182	245	177	201.33	182	165	171	172.67	40	35	43	39.33	
9	21	34	19	24.67	222	193	211	208.67	222	216	211	216.33	63	59	61	61	
10	6	6	5	5.67	123	134	131	129.33	35	34	33	34	99	95	98	97.33	
Rata2	27.60	19.60	25.80	24.33	183.80	194.60	183.40	187.27	166.20	149.00	159.40	158.20	65.60	50.80	65.80	60.73	

In analyzing the table and the image incoming light deep into the building, then obviously needed some shading devices. Where the vertical width of the device also plays a role as a barrier to direct sunlight to avoid glare and heat radiation brought by sunlight. The form used is matched to the needs of the building orientation to the sun positions circulation and form of the building itself. Building shaped almost like a cube (35 x36) M2, oriented West - East, on the North -south facade not much affected by the glare of sunlight, the opposite side of the East and the West is in need of protection against direct sunlight. The shape and type of shading devices can be reconsideration of the approach using figure.2 and 3. Which must to know previously that the layout of the building is on the latitude and longitude and the position of the sun's orbit.

In March, with observing the table 4. illuminance, table 2. angle of the shadow and building section (fig.10) that shows the incoming light into the building, then on the morning of 7:30 / 8:00 until noon 13:00 on the East side of the horizontal angle (concrete block) 25^0 made the shadow into the room as far as 7.16 M; altitut 29^0 as far as 5.84 M; 35^0 as far as 3.38 M; 47^0 as far as 2.46 M; 64^0 as far as 0,74M each measured from the outer boundary wall. As for the shadow caused by vertical shading device is 12^0 into the room as far as 9.03 M; 28^0 as far as 2.89 M; 42^0 as far as 1,22M; 60^0 as far as 0.52 M and the angle of 82^0 was falling outside the boundaries of the inner wall. After the midday sun is on the West side of the building.

On the west side of the building where the sun has been inclined to the west at about 14:00 where concrete block forming horizontal angle, where sunlight would angle of the shadow 63^0 into the room as far as 0.70 M; altitut 45^0 as far as 2.16 M; 35^0 as far as 4.26 M; 29^0 as far as 5.72; 25^0 as far as 7.04 M. Shadows caused by vertical shading device is at 85^0 shadow falls outside the walls; 58^0 as far as 0.16 M; 42^0 as far as 1.22 M; 28^0 as far as 2.89 M; 13^0 as far as 8.22 M. (table 2.)

The classrooms and workspaces are located on the East side by observing the table (tab 4.) then there are areas with strong illumination of less than 250 lux (146, 154 and 176 lux) is the space in which much of the window. There is also an area adjacent to the window but less than 250 lux (214-242 lux) as affected by the shadow of the furniture. While in the West, only a small area that is located away from the window is less than 250 lux (115-147 lux).

In June, with observing the table 4. illuminance, table 2. angle of the shadow and building section (fig.10) that shows the incoming light into the building, then on the morning of 7:30 - 8:00 until noon 13:00 on the East side of the horizontal angle (concrete block) 25^0 form the angle of the shadow into the room as far as 7.16 M; 28^0 as far as 3.15 M; 34^0 as far as 1.87 M; 45^0 as far as 1.27 M; 64^0 as far as 0.99 M each measured from the outer boundary wall. As for the shadow caused by vertical shading device is 12^0 into the room as far as 10.05 M; 28^0 as far as 2.89 M; 42^0 as far as 1,27M; 60^0 corner as far as 0.21 M and the angle of 78^0 was falling outside the boundaries of the inner wall. After the midday sun is the West side of the building.

On the west side of the building where the sun has been inclined to the west at about 14:00 where concrete block forming horizontal angle, where sunlight would angle of the shadow 63^0 into the room as far as 0.41 M; 45^0 as far as 2.45 M; 34^0 as far as 4.47 M; 28^0 as far as 6.01; 24^0 as far as 7.42 M. Shadows caused by vertical shading device is at 80^0 shadow falls outside the walls; 58^0 as far as 0.16 M; 42^0 as far as 1.22 M; 28^0 as far as 2.89 M; 13^0 as far as 8.37 M. (table 2.)

The classrooms and workspaces are located on the East side by observing the table4. then there are many areas with less than 250 lux illumination in the room in which much of the window as well as the area adjacent to the window. While in the West, there are some areas that are far from the windows of less than 250 lux. (table 3&4)

In September, with observing the table 4 illuminance, table 2. angle of the shadow and the building section (fig.10) that shows the incoming light into the building, then on the morning of 7:30-8:00 until noon 13:00 on the East side, the concrete block forming many horizontal shadow angle of 2^0; angle of 4^0; angle of 6^0 and the angle of 11^0 which each were outside wall as measured from the outer boundary wall. As for the shadow caused by vertical shading device is 14^0 into the room as far as 7.52 M; 30^0 as far as 2.56 M; 44^0 as far as 1.05 M; 60^0 as far as 0.56 M and the angle of 77^0 was falling outside the boundaries of the inner wall. After the midday sun is the West side of the building.

On the west side of the building where the sun has been inclined to the west at about 14:00 where the concrete block forming horizontal angle, where sunlight would angle of the shadow 21^0; angle of 11^0; angle 7^0; angle 4^0 and angle of 2^0 beyond the boundaries of space in the building. Shadow caused by vertical shading device is at 75^0 shadow falls outside the walls; 60^0 as far as 0.56 M; 43^0 as far as 1.12 M; 31^0 as far as 2.42 M; angle of 15^0 as far as 6.92 M.(table 2.)

The classrooms and workspaces are located on the East side by observing the table 4. there are few areas with illumination of less than 250 lux on the space in which far from the window as well as the area adjacent to the window caused furnishings shadowed. The same thing happened on the west side, there are only a few areas are located away from the window with illumination of less than 250 lux.(table 3 &4)

In December, with observing the table 4 illuminance, table 2. angle of the shadow and the building section (fig.10) that shows the incoming light into the building, then on the morning of 7:30 - 8:00 until noon 13:00 on the East side, the concrete block forming many horizontal angle 25^0 form the angle of the shadow into the room as far as 7.2 M; 29^0 as far as 5.66 M; 35^0 as far as 4.38 M; 45^0 as far as 2.73 M; 65^0 as far as 0.66 M each measured from the outer boundary wall. As for the shadow caused by vertical shading device is 16^0 transmitted into the room 6.4 M; 33^0 as far as 2.2 M; 47^0 as far as 0,83M; angle 77^0 and 62^0 was dropped outside from the boundaries of the inner wall. After the midday sun is the West side of building.

On the west side of the building where the sun has been declined to the west at about 14:00 where the concrete block forming horizontal angle, where sunlight would angle of the shadow 50^0 that chamber as far as 1.98 M; 30^0 as far as 5.44 M; 25^0 as far as 7.03 M; 22^0 as far as 8.32; 21^0 as far as 8.82 M. Shadows caused by vertical shading device is at 75^0 shadow falls outside the walls; 60^0 as far as 0.56 M; 45^0 as far as 0.97 M; 32^0 as far as 2.28 M; angle of 15^0 as far as 6.92 M.(table 2.)

The classrooms and workspaces are located on the East side by observing the table ... then there are many illuminance areas with less than 250 lux in the room in which far from the window as well as the area adjacent to the window. While in the West, there are some areas that are far from the window of less than 250 lux.(table 3&4)

By examining the position of sunlight into the building, then the shading device needs to be considered. Form of building C is relatively thick, resulting in natural light can not enter far into the room, and even if they entered the room, carrying heat radiation and glare. So to get the light evenly inside the building required to support the artificial light. Table 3 and 4.about illuminance, and from the description of the analysis, building C should always use the support of artificial light. And from the figure 4, table 3&4, then it needs to be organized artificial light settings, so that while one side of the room not / do not need artificial light, it does not need to be given artificial light on that area. From the observation and measurement data obtained from that part of space which is located adjacent to the window does not need artificial light, except when the weather is overcast (cloudy).

To have the shading device typical, then that should be considered is the orientation, shape and location of the building. Likewise, the activities that take place inside the building space. Considering the location of the building C is in Jakarta, in Indonesia, located on the equator, which must be considered is the direction of the rising and setting sun, namely the East and the West. So when trying to decide the use of shading device, then on the table ... It can be used several alternative to the position of the sun in the East-West. From the approach, the more precise is the use of shading devices vertical, vertical with horizontal grille and better shaped eggcrate. But we have to remember that there is activity in the room, because the tighter form of louvers will result in the room becomes darker, so it takes a lot more artificial lighting.

5. CONCLUSION AND RECOMMENDATION

To get the shading device typical, then that should be considered is the orientation, shape and location of the building. Likewise, the activities that take place inside the building space. Considering the location of the building C is in Jakarta, in Indonesia, located on the equator, which must be considered is the direction of the rising and setting sun, namely the East and the West. So when trying to decide the use of shading device, then on the table ... It can be used several alternative to the direction of the sun in the East-West. From the approach, the more precise is the use of shading devices vertical, vertical with horizontal grille and better shaped eggcrate. But we have to remember that there is activity in the room, because the tighter form of louvers will result in the room becomes darker, so it takes a lot more artificial lighting.

Of the arrangement and structuring desk lamp needs to be adapted to the needs of uneven illumination. If it is possible to apply a reading light on some of the desk that located far away from the light source. Whenever possible replacement should be considered a clear glass on all windows with alternative types of glass to reduce heat due to solar radiation. Thus in addition to the natural lighting needs are met, because the heat can be reduced, then the air conditioner can be minimized, thus saving energy, which means also save on electricity costs.

More research is needed to get the shading device typical is most appropriate to be able to protect the space from excessive sunlight. So people can comfortably work and or study with the support of natural or artificial lighting in accordance with the needs of its activities.

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