UCSI University

BACHELOR OF SCIENCE (HONS) IN ARCHITECTURE

AR453 BUILDING SCIENCE 02 (JAN 2021)

ASSIGNMENT 2

ARCHITECTURAL LIGHTING DESIGN

PREPARED BY : GROUP 5

PREPARED FOR: DR. TAKI EDDINE SEGHIER

GROUP MEMBERS

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PART 1

- INTRODUCTION
- CASE STUDY
- BUILDING BACKGROUND
- KEY PLAN
- LOCATION PLAN
- SITE PLAN

1 INTRODUCTION & SITE SIGNIFICANCE

INTRODUCTION

AIM AND OBJECTIVES

- To study the specific aspects of a building's space influenced by both the exterior and interior lighting factor.
- To introduced specific aspects of building performance with respect to lighting design and control in architecture.
- To create an awareness of indoor and outdoor lighting challenges in spaces and to refine student's knowledge to produce a responsive design.
- To understand the needs of comfortable lightings in building design, factors that affected them and criteria of the design that relates to the surrounding climate.

CASE STUDY

FUNCTION OF SPACE :
Residences

LOCATION :
210, Lorong Saujana Prima S2 Heights, Saujana Prima S2 Heights, 70300 Seremban.

INTRODUCTION :
The space that we choose for this assignment is Symphony S2 Heights. The unit that we have chosen is a double story semi-D unit. The reason that we choose this building as our case study is because the unit that we choose is facing north as well as the type of ventilation and shading devices that applied to the building makes it interesting case to study. Our group members would like to explore more in this building and obtain knowledge about the lighting factors within the interior spaces in this building.

SIZE OF SPACE :
2,470 sq. ft.

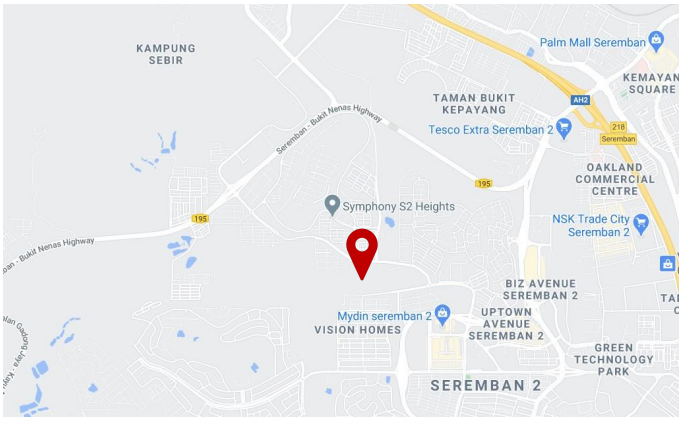
DEVELOPER :
IJM Land Bhd.

YEAR BUILT :
2011

1 INTRODUCTION & SITE SIGNIFICANCE

BUILDING BACKGROUND

S2 Heights is a low-density development that spans over 1,500 acres of prime freehold land. Sited on high grounds with an undulating terrain, S2 Heights offers homeowners a panoramic view of the surrounding breezy landscape below. It boasts a wide variety of modern and spacious homes designed to satisfy even the most discerning; from exclusive gated bungalows community to Semi detached homes and terrace houses. S2 Heights have few phases that developed in the past few years, the case study that we choose is in the Phase 2E1 which is Symphony 2, comprised of 89 units double-storey terraced house.



KEY PLAN

SCALE : NOT TO SCALE

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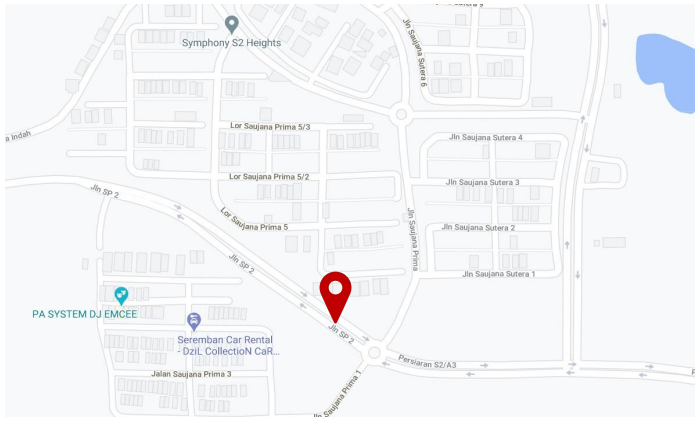

LOCATION PLAN

SCALE : NOT TO SCALE

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SITE PLAN

SCALE : 1:2000

N

PREPARED BY

SOH HOO ZE XIANG 1001849891

PART 2

- THEORETICAL PRINCIPLES IN LIGHTING STUDY
- TRANSMISSION OF LIGHT
- DAYLIGHT & SUNLIGHT
- ARTIFICIAL LIGHT

2 LITERATURE STUDY

WHAT IS LIGHT?
Light is defined as the portion of the **electromagnetic radiation spectrum**.

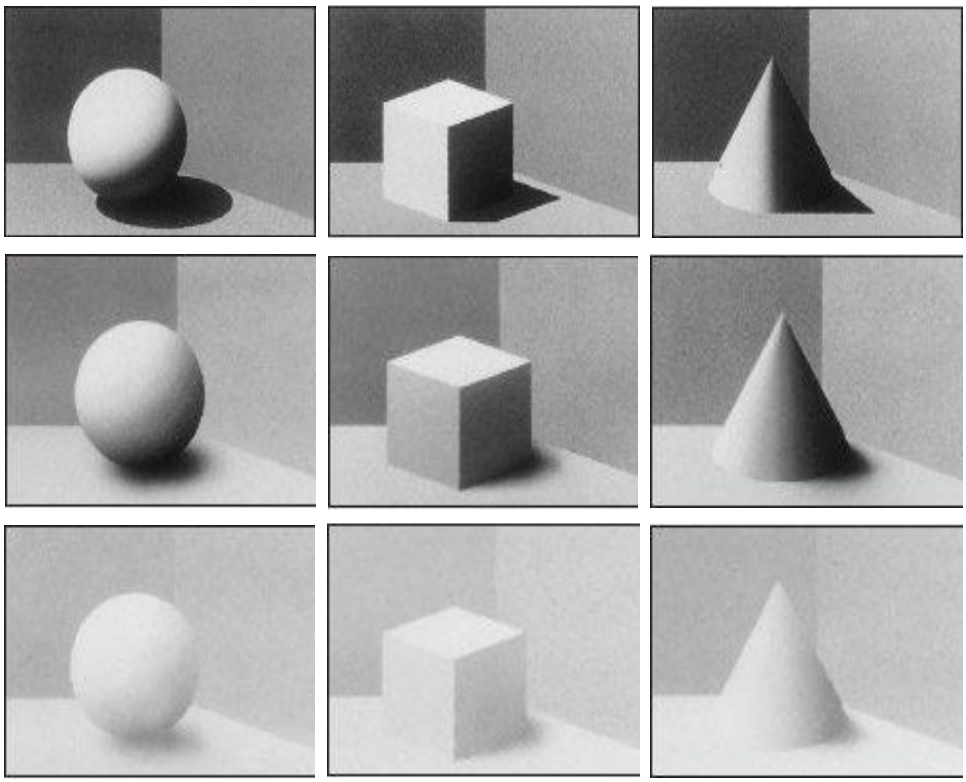
LIGHT SOURCE

Light source comes from two ways, natural lighting and artificial lighting. Architectural lighting design is a field of adapting the natural and artificial lighting to the building design as the aim is to give human a comfortable lighting environment in order to generate good human behaviour and efficient working quality.

- NATURAL LIGHTING
  - DAYLIGHT
  - MOONLIGHT
- ARTIFICIAL LIGHTING
  - FLUORESCENT LIGHT
  - INCANDESCENT LIGHT

LIGHT CONDITIONS

Perception of three-dimensional forms and surface structures under different lighting conditions.



Directed light produces pronounced shadows and strong shaping effects. While details can be concealed by the shadows.

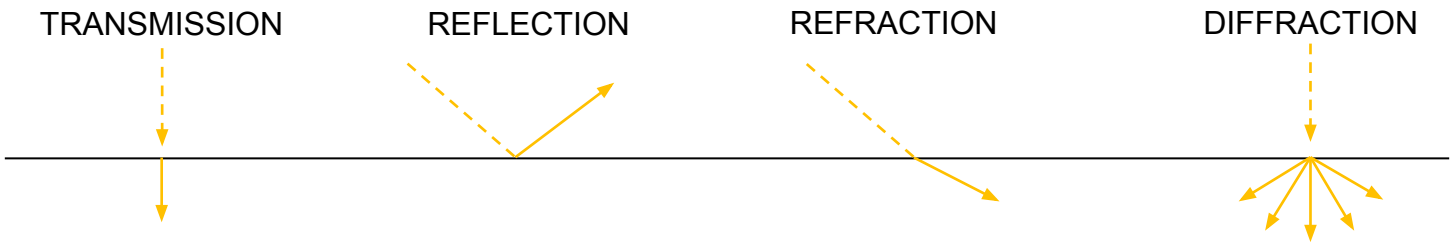
Combination produces soft shadows. Shape and structure effect clearly recognizable. There are no disturbing shadows.

Diffuse light produces negligible shadowing. Shapes and surface structures are poorly recognizable.

2 LITERATURE STUDY

TRANSMISSION OF LIGHT

Transmission of light is the moving of electromagnetic waves (whether visible light, radio waves, ultraviolet, etc.) through a material. This transmission can be reduced or stopped when light is reflected off the surface or absorbed by the molecules in the material.



Occurs when light passes through the object without interacting. Ex: light coming through from window.

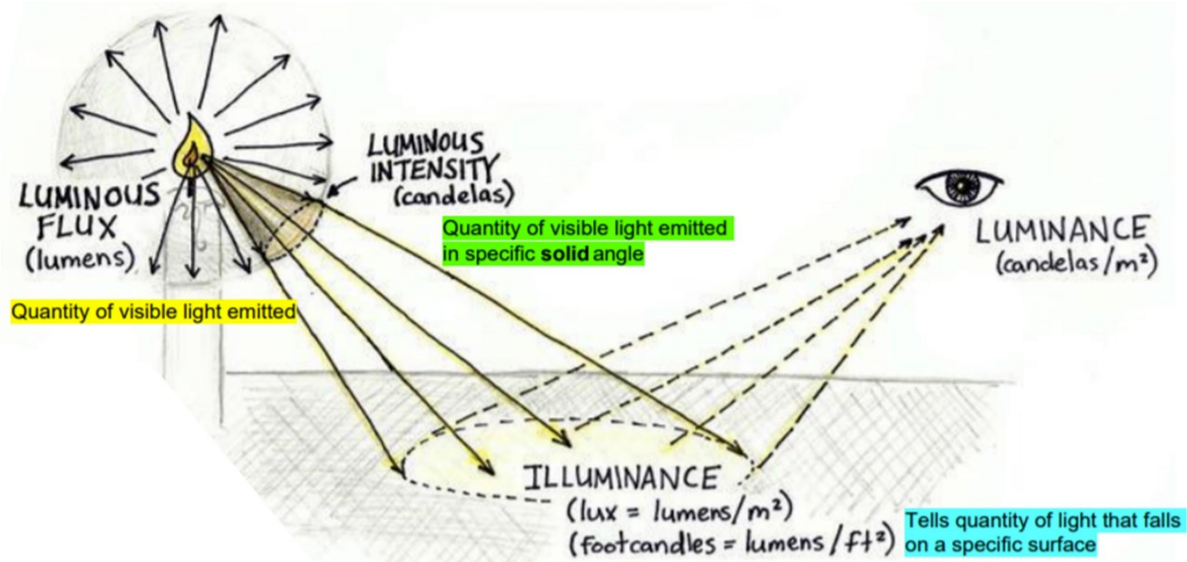
Occurs when the incoming light hits a very smooth surface like a mirror and bounces off. Ex: mirror.

Occurs when the incoming light travels through another medium, from air to glass. The light slows down and change direction. This change in direction is dependent on the light's wavelength so its spectrum of wavelengths are separated and spread out into a rainbow.

Occurs when the incoming light hits a very smooth surface like a mirror and bounces off. Ex: mirror.

PHOTOMETRY

Photometry is a science of measurement of light in terms of perceived brightness to the human eyes. Distinct from radiometry, which is the science of measurement of radiant energy (including light) in terms of absolute power.



2 LITERATURE STUDY

DAYLIGHT & SUNLIGHT

Day lighting is the practice of placing windows, skylights, other openings, and reflective surfaces so that sunlight (direct or indirect) can provide effective internal lighting. Particular attention is given to daylighting while designing a building when the aim is to maximize visual comfort or to reduce energy use. Energy savings can be achieved from the reduced use of artificial (electric) lighting or from passive solar heating.

PRINCIPLES

- DAYLIGHT COLOUR CHANGES (TIME)
  With time of the day, season & year
- LEVEL OF CLEANLINESS OF ATMOSPHERE (LOCATION)
  Setting in the city, suburban, highland & during haze
- INTERRELATION OF SURROUNDING OBJECT (CONTEXT)
  Trees & plants, buildings, walls, etc

DAYLIGHT FACTOR (DF)

Represent distribution of daylight inside a room to give an indication of where the illumination from outside falls and the effects of differing window shapes.

DAYLIGHT ILLUMINATION LEVEL RATIO
INSIDE : OUTSIDE

- To provide sufficient interior lighting while minimizing unwanted direct glaze and reflections
- Average <2% : gloomy interior
- 2% - 5% : daylit appearance
- Average >5% : strong daylit

FACTORS AFFECTING

AIM

Supply sufficient high-quality light while minimizing direct glare, veiling reflections + excessive brightness ratios.

ENVIRONMENTAL FACTORS

Building fabric and ambient environmental factors

OBSTRUCTION

Buildings opposite the window, trees, structure, etc. will decreases illuminance in room.

UNIFORMITY OF LIGHTING

Ratio of the minimum illuminance in the room to the average illuminance measured on a horizontal reference plane.

SHADOW INTENSITY

Working positions should be arranged so that hand and body shadows do not fall on the working surface.

2 LITERATURE STUDY

ARTIFICIAL LIGHT

Artificial light is a man-made lighting for human to function properly. It can be turned on and off with a switch

USAGES	• PROVIDE VISUAL CLARITY	- Establish general requirements for artificial lighting. (main visual task + activities to be carried out in a building)
	• ARCHITECTURE SURFACES the interior)	- Revealing the form of building.(lighting vertical surfaces assist to create the right character of
	• TYPE OF ILLUMINANCE	- Creating an ambiance to space.

TYPES OF ARTIFICIAL LIGHT

INCANDESCENT BULB

- The light produced by heating a highly resistant tungsten filament (a wire coil) with electric current until it glows.
- Its heat driven
- More energy used is radiated as heat rather than light.

FLUORESCENT BULB

- Available both in cool and warm colour spectrum.
- The central element in a fluorescent lamp is sealed glass tube.

HID BULB

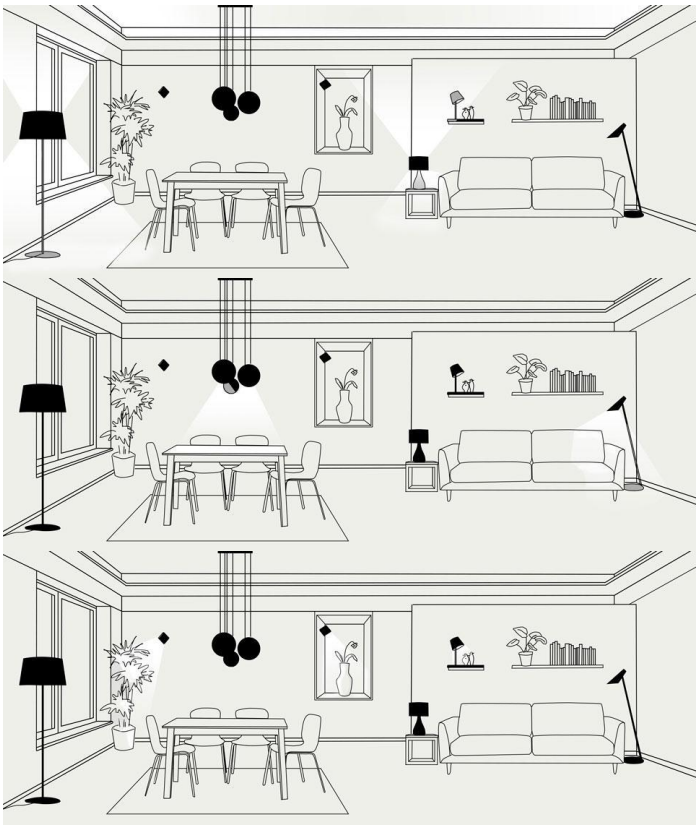
- Used for bright interior or exterior lighting: up light exterior of large building, interior of non-residential
- There are 2 types of discharge lamp depending on the pressure of the filler material : high and low-pressure discharge lamps

LED BULB

- The light produced when a light-emitting diode (LED) is forward-biased (switched on)
- Used as indicator lamps in many devices + are increasingly used for another lighting.

2 LITERATURE STUDY

TYPES OF ILLUMINATION



AMBIENT LIGHTING

Provides overall illumination and is meant to create a general and uniform lighting level. It's the first layer of lighting and sets the tone of a space.

TASK LIGHTING

This direct, intense illumination is ideal for detailed task work, such as reading and writing at a desk, grooming, and preparing food.

ACCENT LIGHTING

Intended to highlight a specific object or area, accent lights are typically three times as bright as ambient lights. Accent lighting draws attention to a feature, such as artwork, furnishings or architectural details, converting them into focal points.

LIGHTING REQUIREMENTS

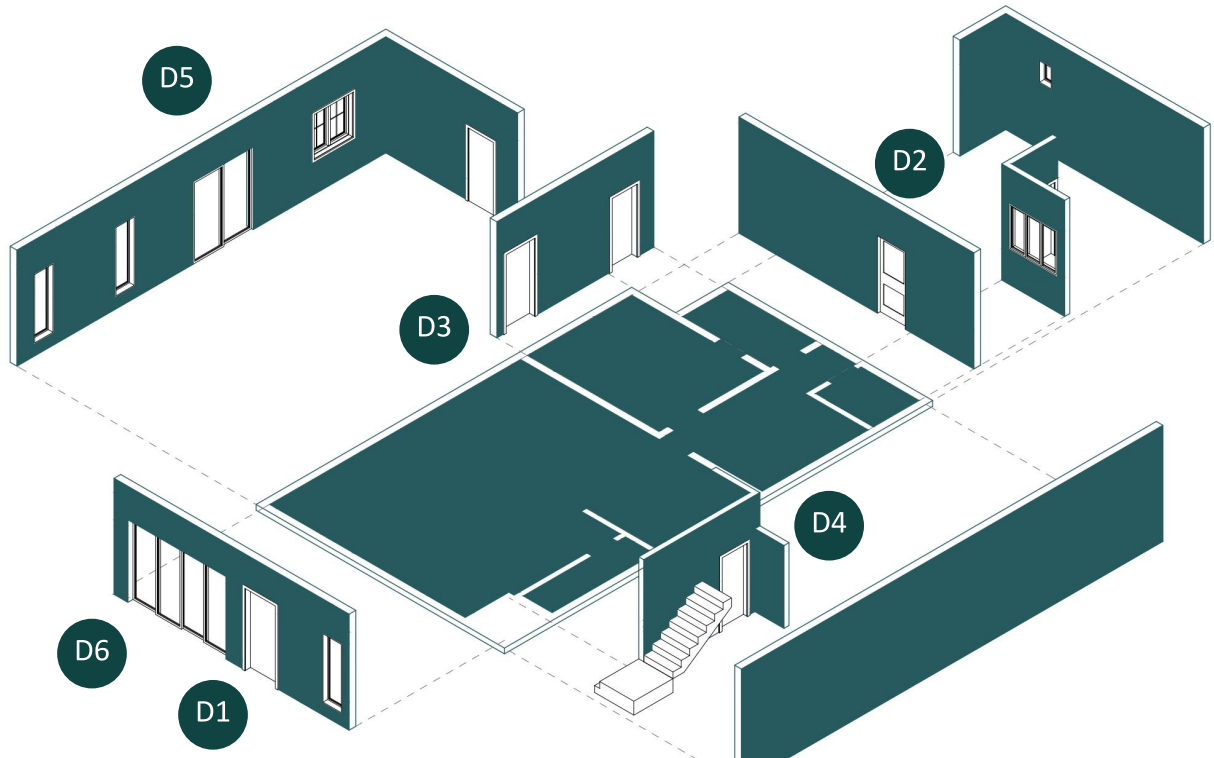
- Direction of Light : Downwards, Upwards or Multidirectional
- Distribution : Concentrated (≤30 degree) or Diffuse (>30 degree)
- Further enhanced or subdued by Surface Finishes and Reflectance
- Determine a degree of stimulation that will reinforce the activity
- Establish degree of brightness and contrast that will yield the necessary stimulation

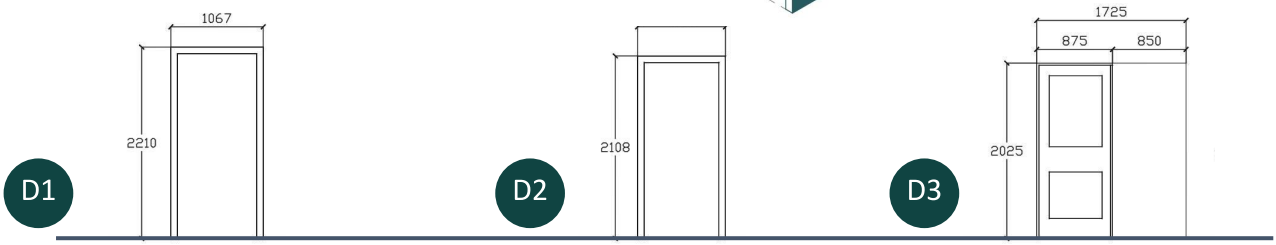
PART 3

- SITE OBSERVATION & SWOT ANALYSIS
- PROBLEM STATEMENT
- MEASURED DRAWING
- METHODOLOGY & ANALYSIS
- STIMULATE EI USING REVIT
- DATA TABULATION
- DAYLIGHT FACTOR CALCULATION
- LUMEN METHOD

3 SITE OBSERVATION

DOORS SCHEDULE

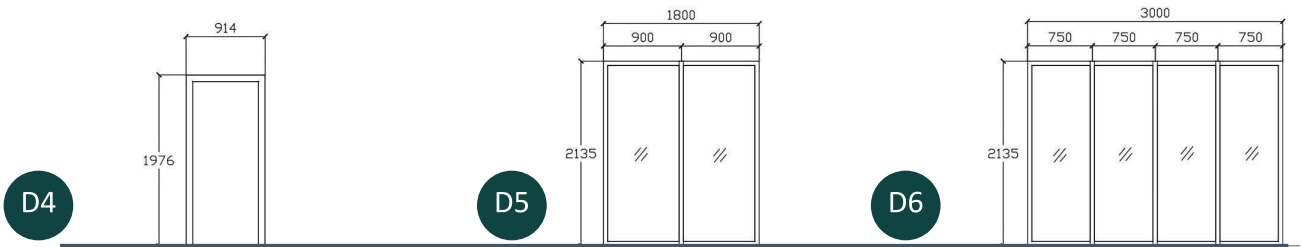




LOCATION: LIVING ROOM	QUANTITY: 2
DESCRIPTION: SINGLE FLUSH TIMBER DOOR 915 x 2134mm	

LOCATION: LIVING ROOM	QUANTITY: 2
DESCRIPTION: SINGLE FLUSH TIMBER DOOR 864 x 2032mm	

LOCATION: LIVING ROOM	QUANTITY: 2
DESCRIPTION: TIMBER INTERIOR DOOR WITH SINGLE POCKET WOOD PANEL 850 x 2000mm	



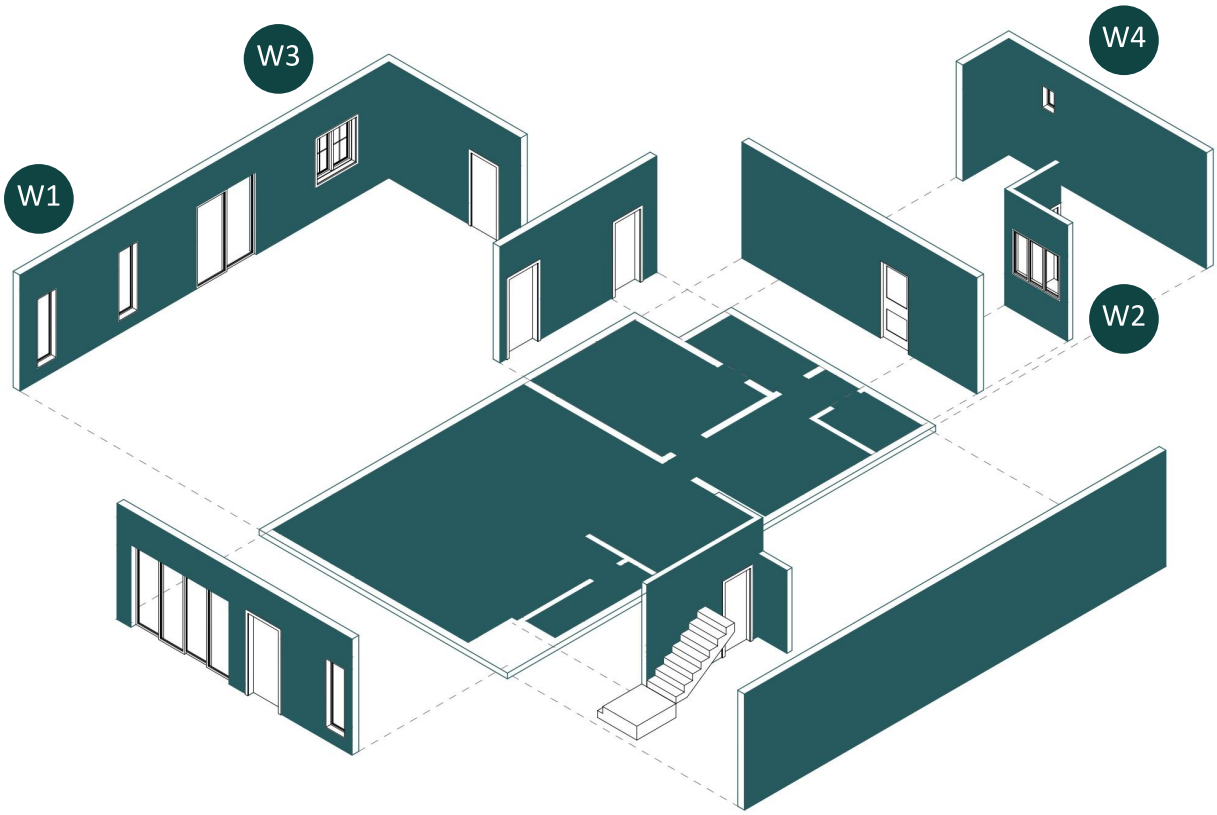
LOCATION: LIVING ROOM	QUANTITY: 2
DESCRIPTION: SINGLE FLUSH TIMBER DOOR 750 x 1800mm	

LOCATION: LIVING ROOM	QUANTITY: 2
DESCRIPTION: DOUBLE SLIDING DOOR 900 x 1025mm	

LOCATION: LIVING ROOM	QUANTITY: 2
DESCRIPTION: ALUMINIUM DOUBLE SLIDING DOOR 1800 x2050MM	

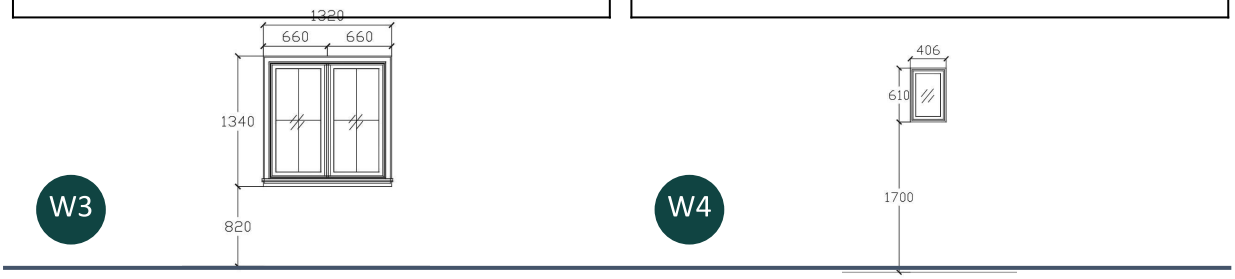
3 SITE OBSERVATION

WINDOWS SCHEDULE



LOCATION: LIVING ROOM	QUANTITY: 2
DESCRIPTION:IRON FIXED CLEAR GLASS CASEMENT WINDOW 610 x 1830 mm	

LOCATION: PIANO ROOM	QUANTITY: 1
DESCRIPTION:IRON WINDOW CASEMENT WITH TRIPLE MIDDLE TRANSOM 1550 x 1200mm	



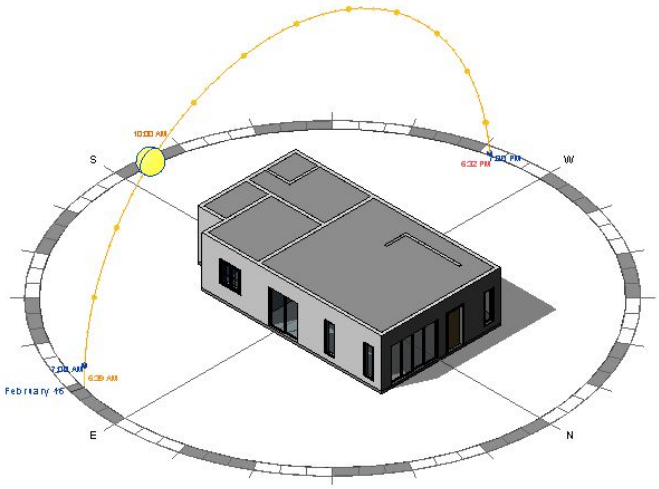
LOCATION: BEDROOM	QUANTITY: 1
DESCRIPTION: ALUMINIUM WINDOW CASEMENT DOUBLE 1200 x 1200mm	

LOCATION: TOILET	QUANTITY: 1
DESCRIPTION: ALUMINIUM FIXED WINDOW 610 X 1830mm	

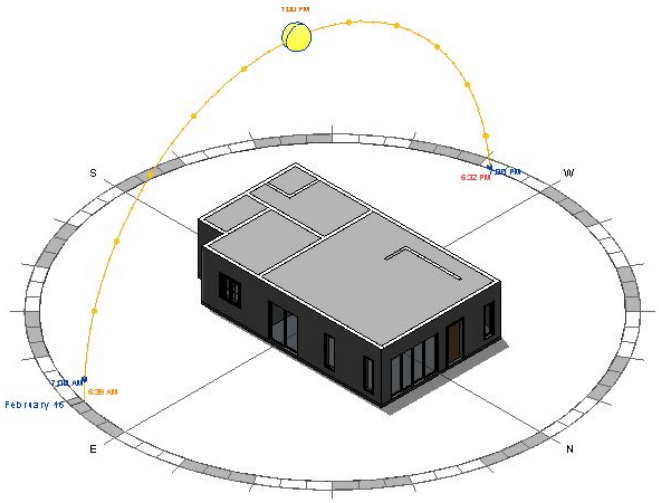
3 SITE OBSERVATION

SUNLIGHT PENETRATION

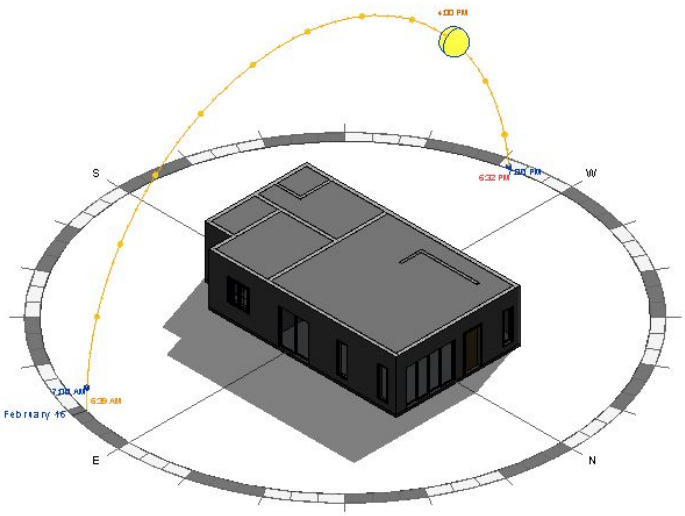
EQUINOX 16 FEB 2021
10.00 AM



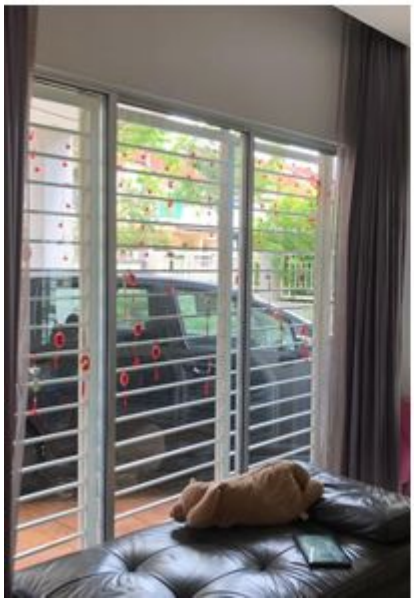
EQUINOX 16 FEB 2021
1.00 PM



EQUINOX 16 FEB 2021
4.00 PM



3 SWOT ANALYSIS



STRENGTH

•The house is a semi-D. The space chosen is able to receive large amount of natural light from different direction

•The house provided large opening toward the faced facing north. It provide large amount of natural light that can penetrated through the large opening and brighten up the entire house.

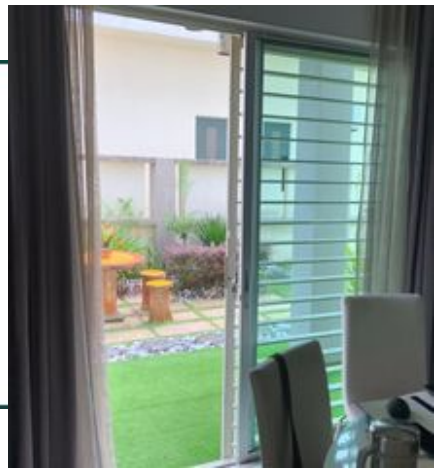
•The construction material and elements of the house will causing reflection of natural lighting and brighten the entire unit.

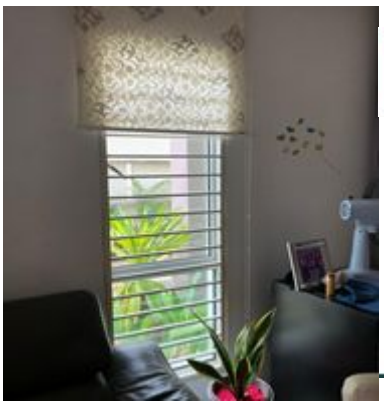
WEAKNESS

•Too much natural day lightning has cause the problem of perception of brightness

•The reflective light and excess amount of light enter caused glare

•The user may feel discomfort due to eye strain and headaches caused by glare





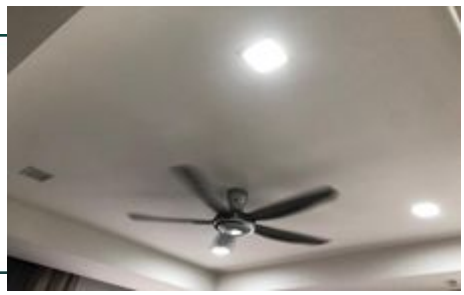
OPPURTUNITY

•The amount day light penetrate through opening is sufficient and no artificial light is needed

•The color and the material used for construction can are good reflectance and can save energy usage for the daytime

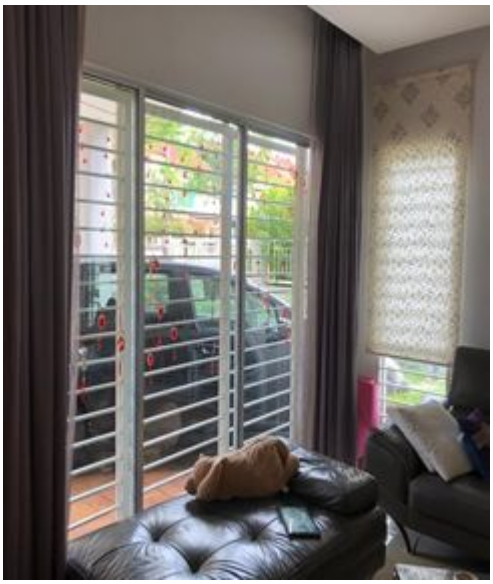
THREATS

•The insufficient artificial lightning in the living area could used up a lot of energy usage.



3 PROBLEM STATEMENT

LIVING ROOM



OPENING CONDITION

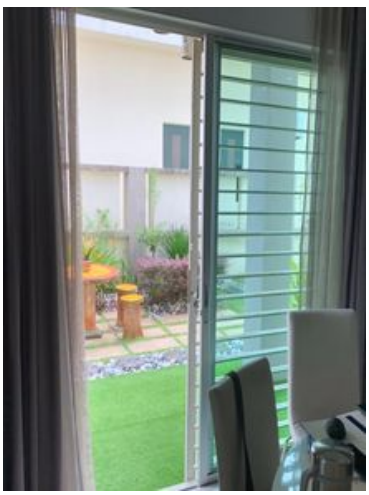
ORIENTATION OF TRIPLE FRENCH WINDOW

•The main natural light source of the house which facing to the north direction

CONDITION OF NATURAL LIGHT

•Direct natural light can be penetrate through the clear glass material of the sliding glass door and brighten up the entire living area during day time

SURFACE REFLECTANCE



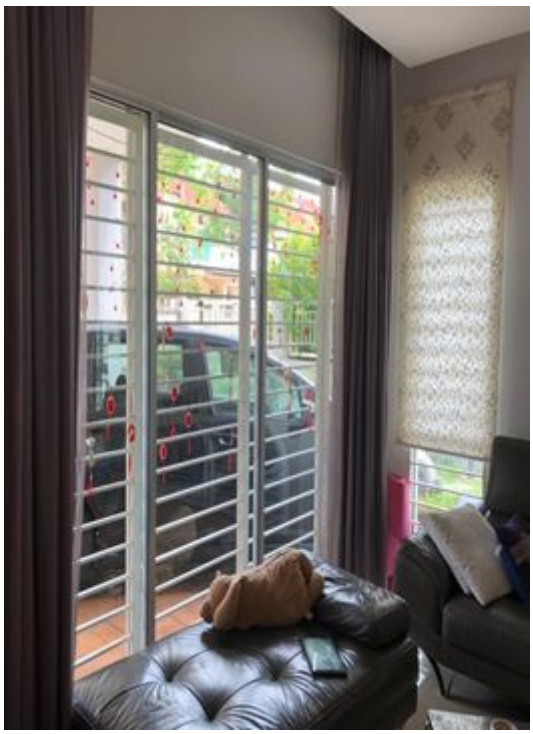
Elements	Type	Materials	Reflectance Value
Ceiling	Reinforced Concrete Slab	Plaster and Paint	Approx 80%
Wall	Precast Concrete Wall	Plaster and Paint	Approx 80%
Floor	Reinforced Concrete Wall	Ceramics tiles	Approx 90%

3 PROBLEM STATEMENT

ENVIRONMENT FACTOR

•Large amount of natural light allow to enter the interior space during daytime and provide brighter quality of light

•The living room facing north will tend to be warmer.



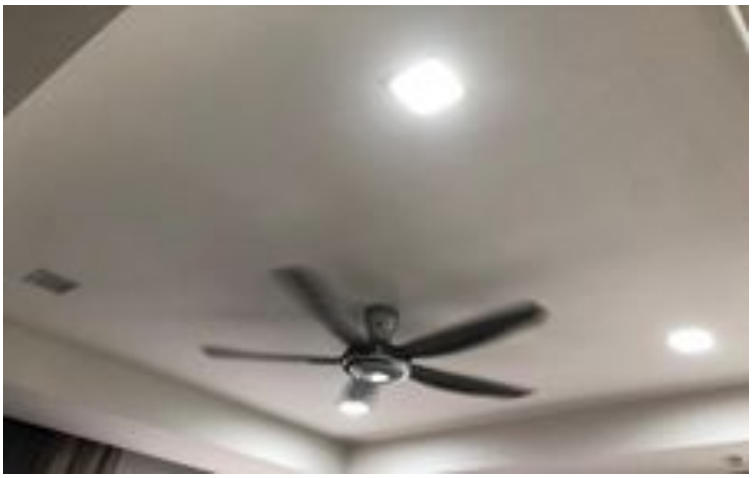
LIGHT UNIFORMITY

•Uniform lightning allow us to perceive the environment continuously and without sudden breaks caused by lightning level drops.

OBSTRUCTION FACTOR

•The house get obstructed partially by the neighboring building as it is a semi-D

•The opening facing north is sheltered by balcony roof so less natural light enter



NATURAL LIGHT SOURCE

•The amount of natural lightning are controlled when the sunlight reflected to man made source like walls and fabrics

ARTIFICIAL LIGHT SOURCE

•The artificially lights need to be switch on during night or cloudy day.

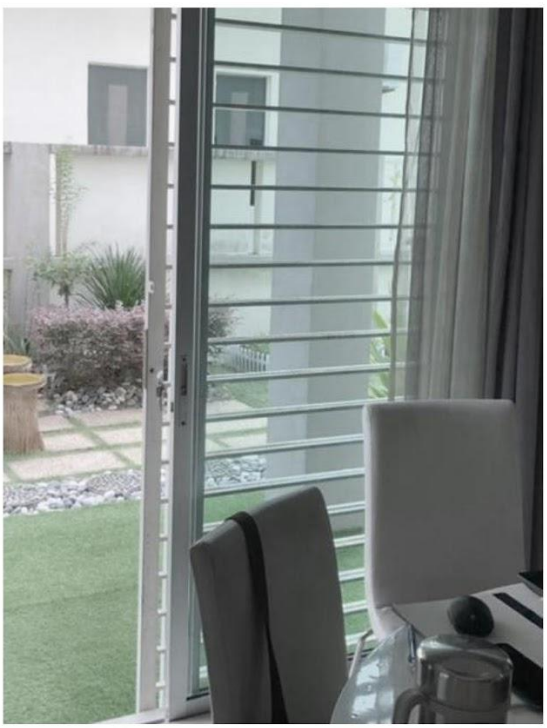
3 PROBLEM STATEMENT

DINING AREA

OPENING CONDITION

CAPABILITY OF DOUBLE SLIDING GLASS DOOR

- During the day, natural light can penetrate through the transparent glass material of the sliding door and illuminate the entire dining area during the day.



SURFACE REFLECTANCE

Elements	Type	Materials	Reflectance Value
Ceiling	Reinforced Concrete Slab	Plaster and Paint	Approx. 78%
Wall	Precast Concrete Wall	Plaster and Paint	Approx. 78%
Floor	Reinforced Concrete Wall	Ceramics tiles	Approx. 85%

Problem Statement

ENVIROEMNT FACTOR

- A large amount of natural light allows entering the dining area during warmer climate and provides a better light quality.
- The dining area with east lighting in the morning will tend to be warmer and brighter.

LIGHT UNIFORMITY

- Uniform lighting allows us to continuously perceive the environment without sudden interruption due to the drop of lighting.

OBSTRUCTION FACTOR

- The house is partially obscured by neighbor buildings.
- The east-facing opening allows more natural light to enter the space.

NATURAL LIGHT SOURCE

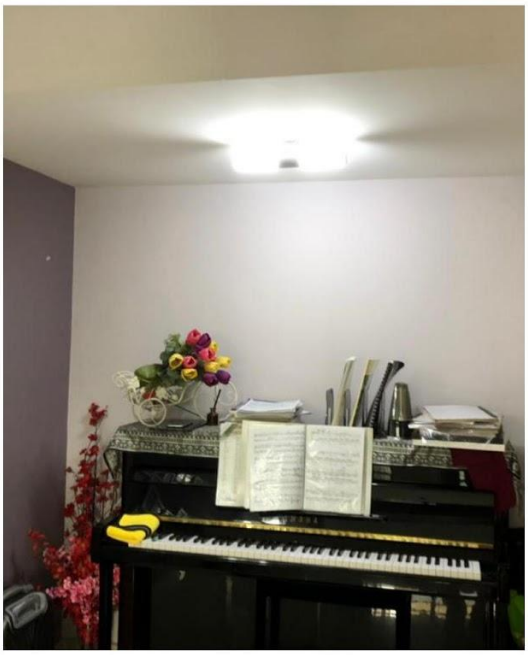
- When sunlight shined on manmade surface like walls and fabric, the amount of natural lighting entered can be controlled.

ARTIFICIAL LIGHT SOURCE

- Artificially lighting only to be used during windy day and at night.

3 PROBLEM STATEMENT

PIANO CORNER



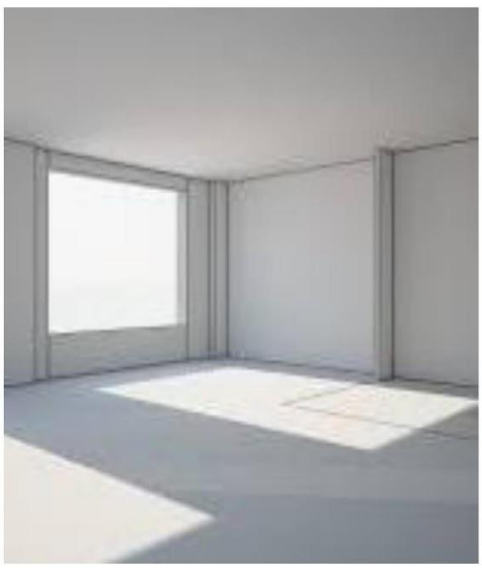
OPENING CONDITION

NO OPENING AROUND THIS AREA

- During the day, very least natural light reflected from dining area to the piano practice corner.
- There is no opening around this area, lighting condition are basically relying on the artificial light.

SURFACE REFLECTANCE

Elements	Type	Materials	Reflectance Value
Ceiling	Reinforced Concrete Slab	Plaster and Paint	Approx. 20%
Wall	Precast Concrete Wall	Plaster and Paint	Approx. 35%
Floor	Reinforced Concrete Wall	Ceramics tiles	Approx. 40%



Problem Statement

ENVIROEMNT FACTOR

- Only very least amount of natural light allows entering the piano corner during afternoon and provides a low light condition.
- The piano area is the most shaded area; therefore, it will be cooler in the afternoon.

LIGHT UNIFORMITY

- Uniform lighting allows us to continuously perceive the environment without sudden interruption due to the drop of lighting.

OBSTRUCTION FACTOR

- The area is partially obscured by three dead walls.
- Only least light source are reflected from dining area ceramic tiles floor.

NATURAL LIGHT SOURCE

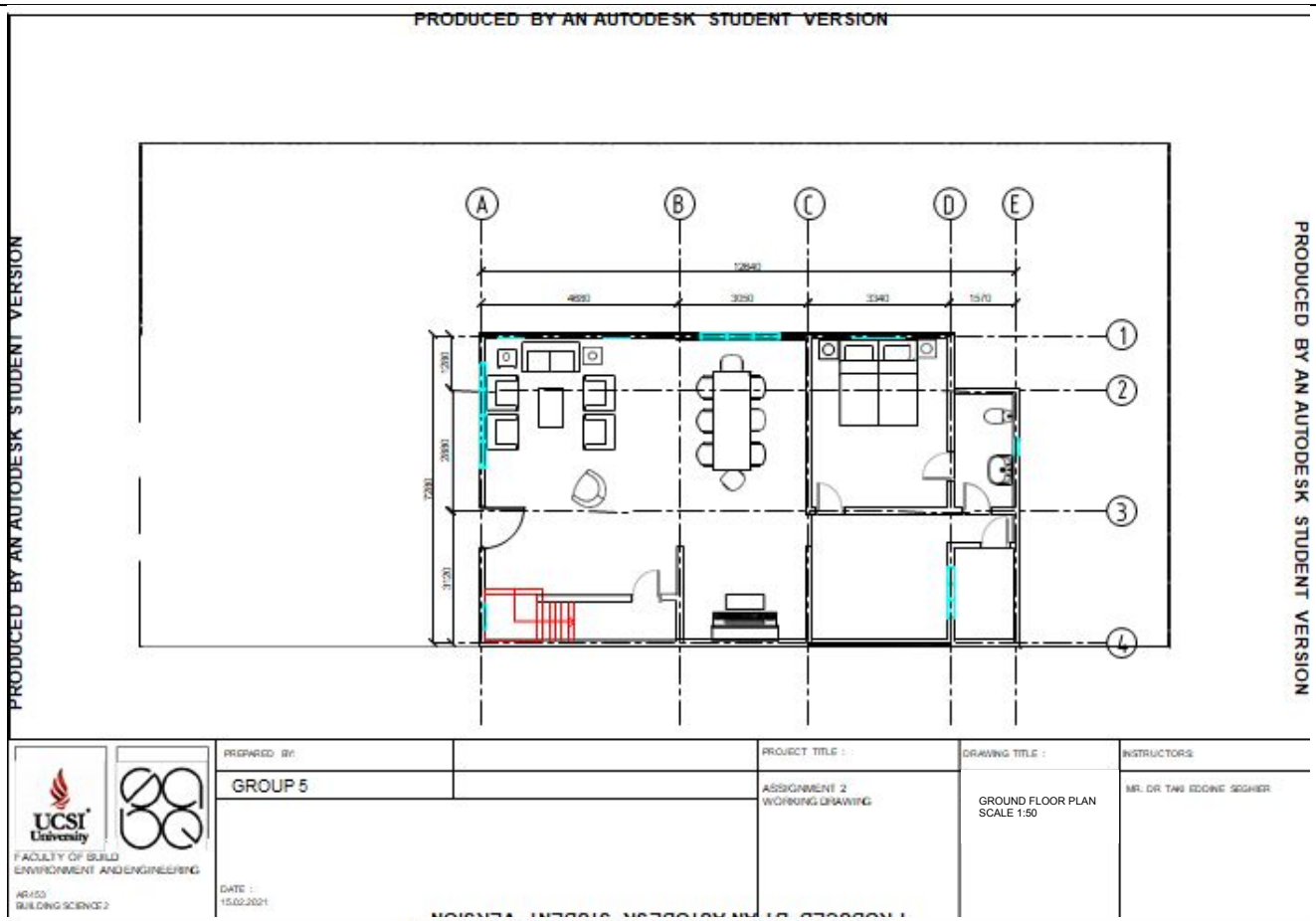
- There's no openings around the area; therefore, there are no natural light source.

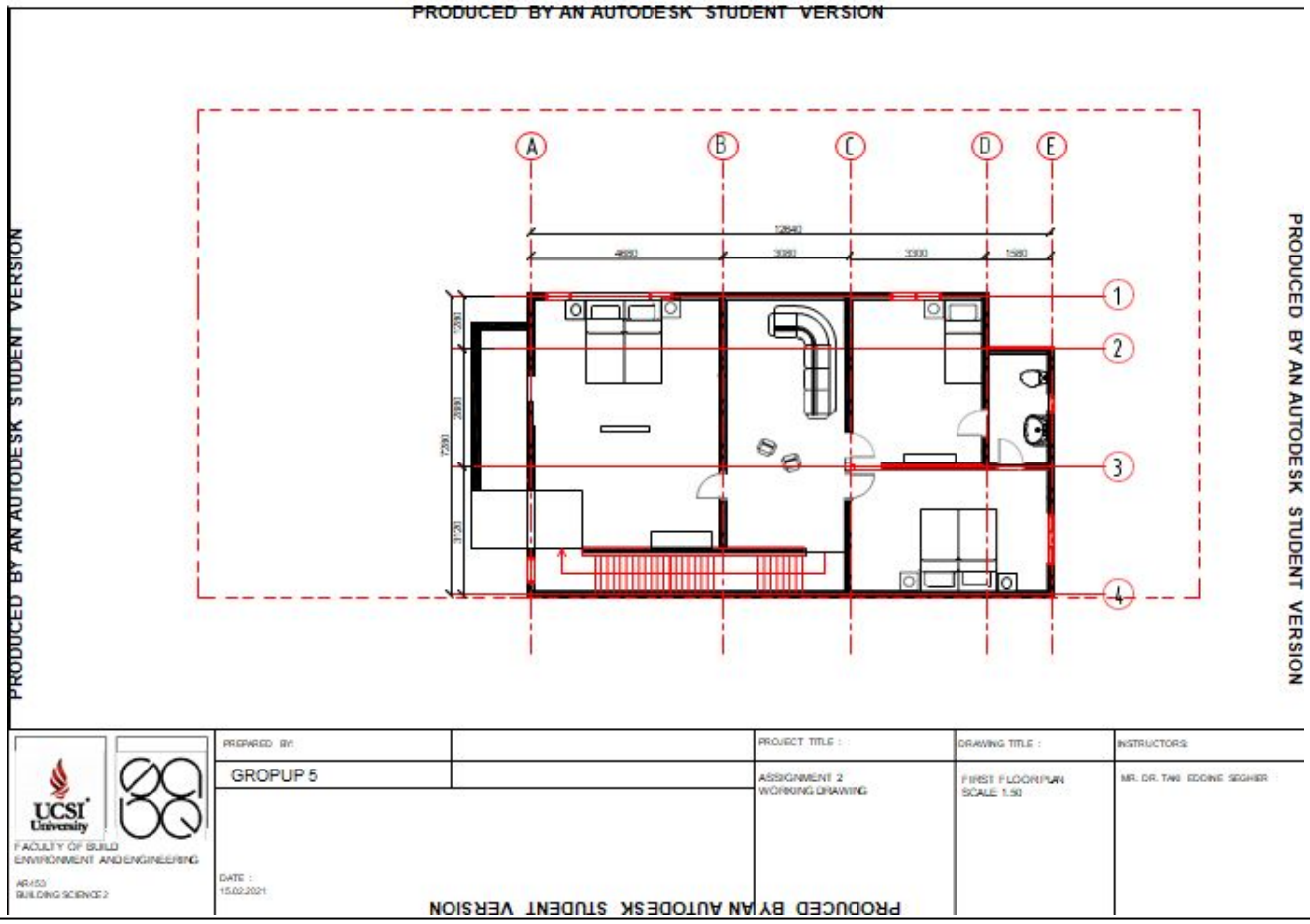
ARTIFICIAL LIGHT SOURCE

- Artificially lighting should be use when the area is active in use.

3 MEASURED DRAWING

GROUND FLOOR & FIRST FLOOR PLAN

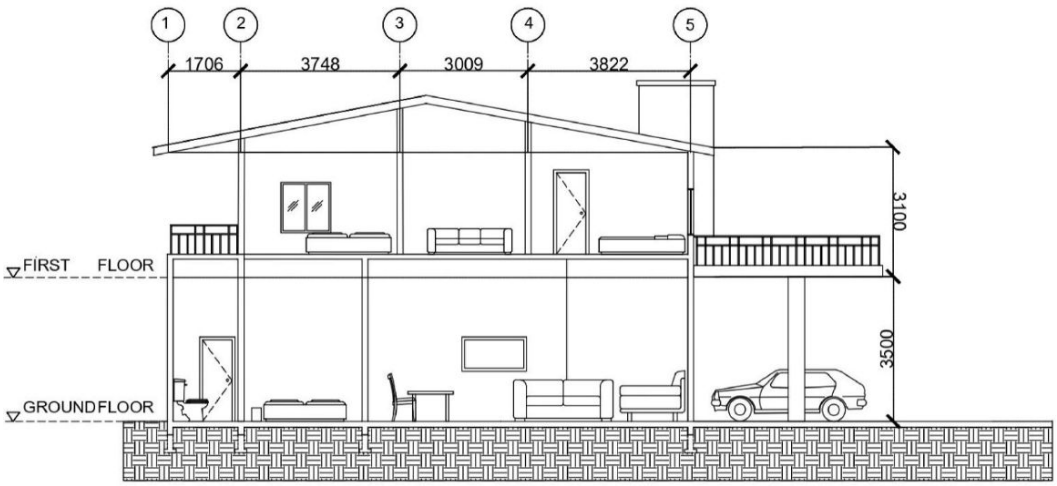




3 MEASURED DRAWING

ELEVATION & SECTION A-A

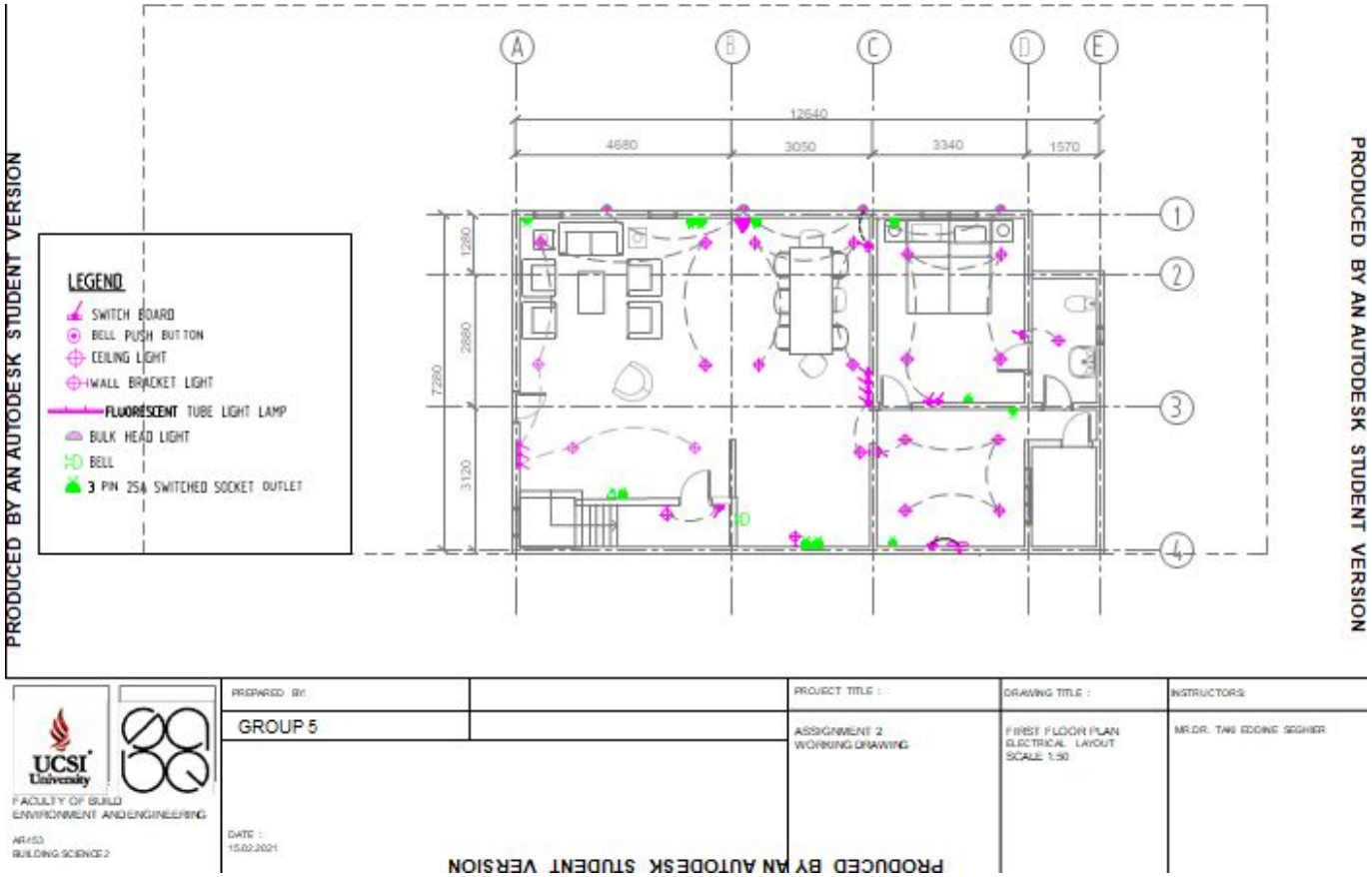
UCSI University FACULTY OF BUILD ENVIRONMENT AND ENGINEERING AR453 BUILDING SCIENCE 2	PREPARED BY: GROUP 5 DATE : 15.02.2021	PROJECT TITLE : ASSIGNMENT 2 WORKING DRAWING	DRAWING TITLE : ELEVATION SCALE 1:50	INSTRUCTORS: MR. DR. TAKI EDDINE SEGHIER

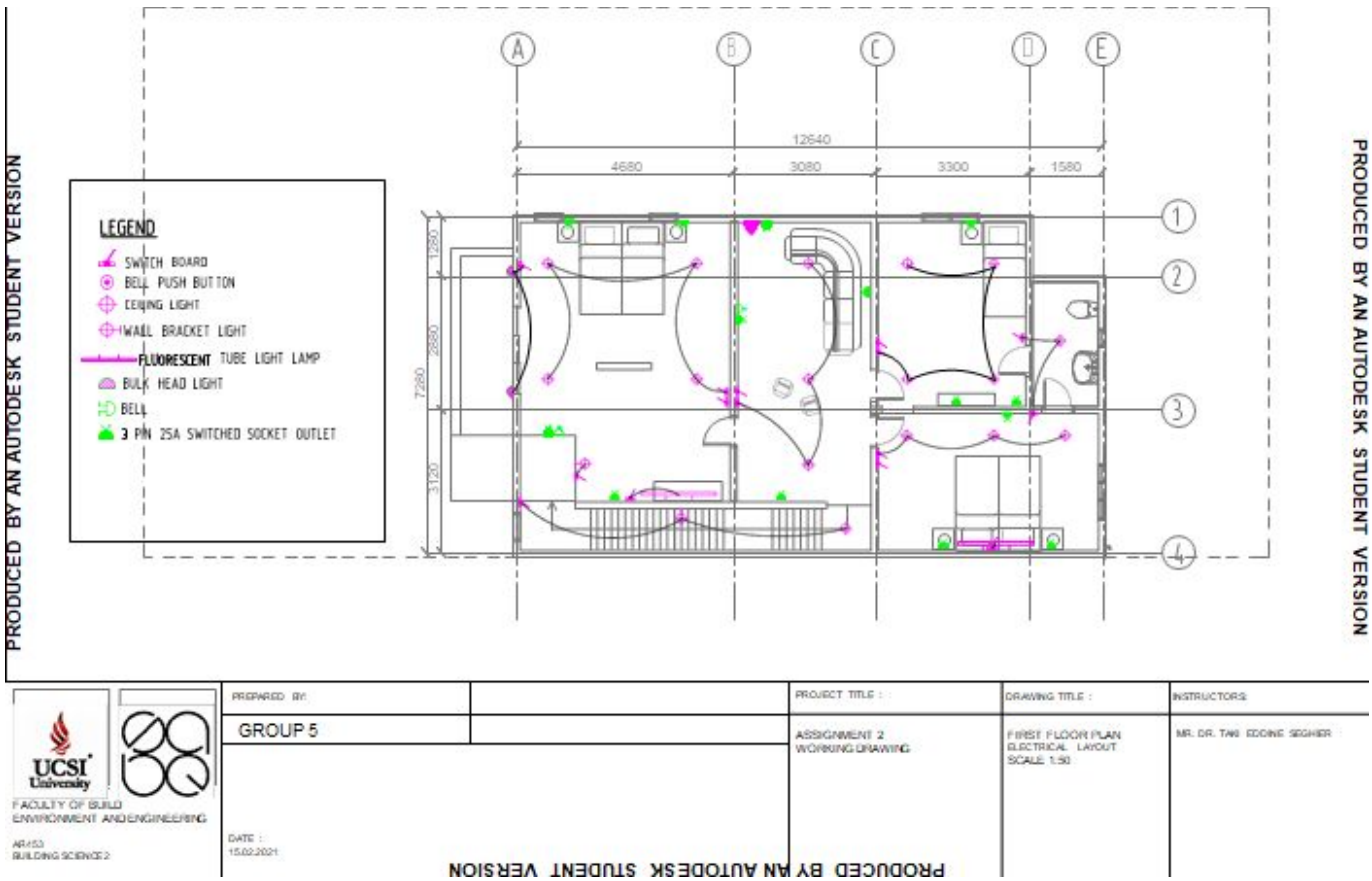


UCSI University UCSI UNIVERSITY FACULTY OF BUILD ENVIRONMENT AND ENGINEERING AR453 BUILDING SCIENCE 2	PREPARED BY: GROUP 5 DATE: 15.02.2021	PROJECT TITLE : ASSIGNMENT 2 WORKING DRAWING	DRAWING TITLE : SECTIONA-A SCALE 1:50	INSTRUCTORS: MR. DR. TAKI EDDINE SEGHIER

3 MEASURED DRAWING

ELECTRICAL PLAN





3 METHODOLOGY

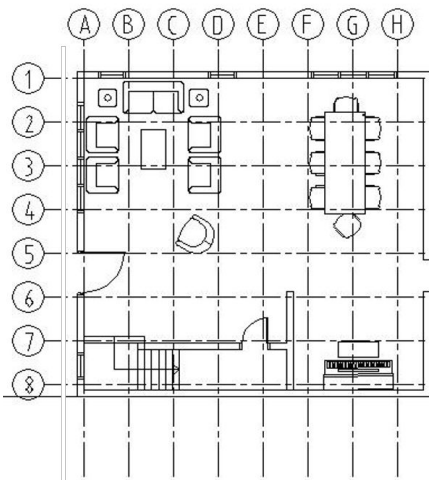
EQUIPMENTS

SMART LUX METER APP

SMART PHONE

MEASURING TAPE

STEP BY STEP PREPARATION



1 GRID LINES ARE DRAWN ONTO THE FLOOR PLAN, ILLUMINANCE READING CAN BE MEASURED ON EVERY COORDINATE OF GRID LINES. EACH GRID LINE IS 1 METER APART.

2 SMART LUX METER APP IS USED TO MEASURE LUX READING

3 METHODOLOGY

3

MEASURING TAPE IS USED TO MEASURE THE DIMENSIONS OF THE AREA (HEIGHT, WIDTH AND LENGTH OF THE AREA, FURNITURE, DOORS AND WINDOW.

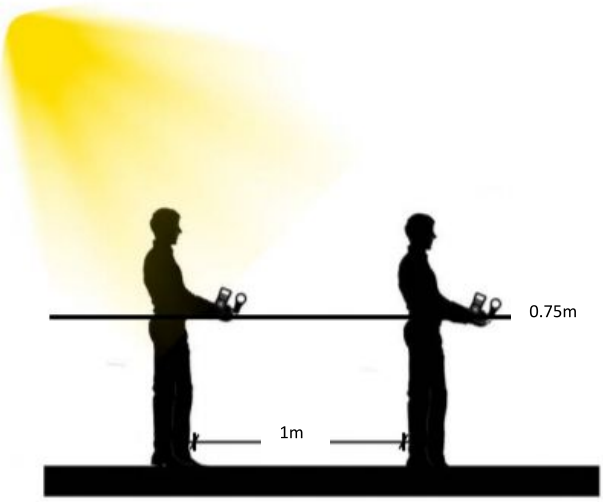
DATA COLLECTION

ONE OF OUR MEMBER MEASURED THE LUX READING WITH THE SMART LUX METER APP ON SMARTPHONE, IT IS SIMILAR WITH A LUX METER, IT USES THE PHONE'S SENSOR TO MEASURE THE NATURAL LIGHT INTENSITY OF THE ROOM.

I TO BEGIN, TURN OFF ANY LIGHTING IN THE ROOM WE ARE ABOUT TO MEASURE

II OPEN THE SMART LUX METER APP IN THE PHONE, MAKE SURE THAT THE SCREEN WITH THE SENSOR IS FACING THE AMBIENT LIGHT SOURCE.

III THE SMART PHONE SHOULD BE HANDLE AT 0.75 METRE ABOVE GROUND LEVEL. THIS IS TO MAKE SURE THE CONSISTENCY THROUGHOUT THE DATA COLLECTION

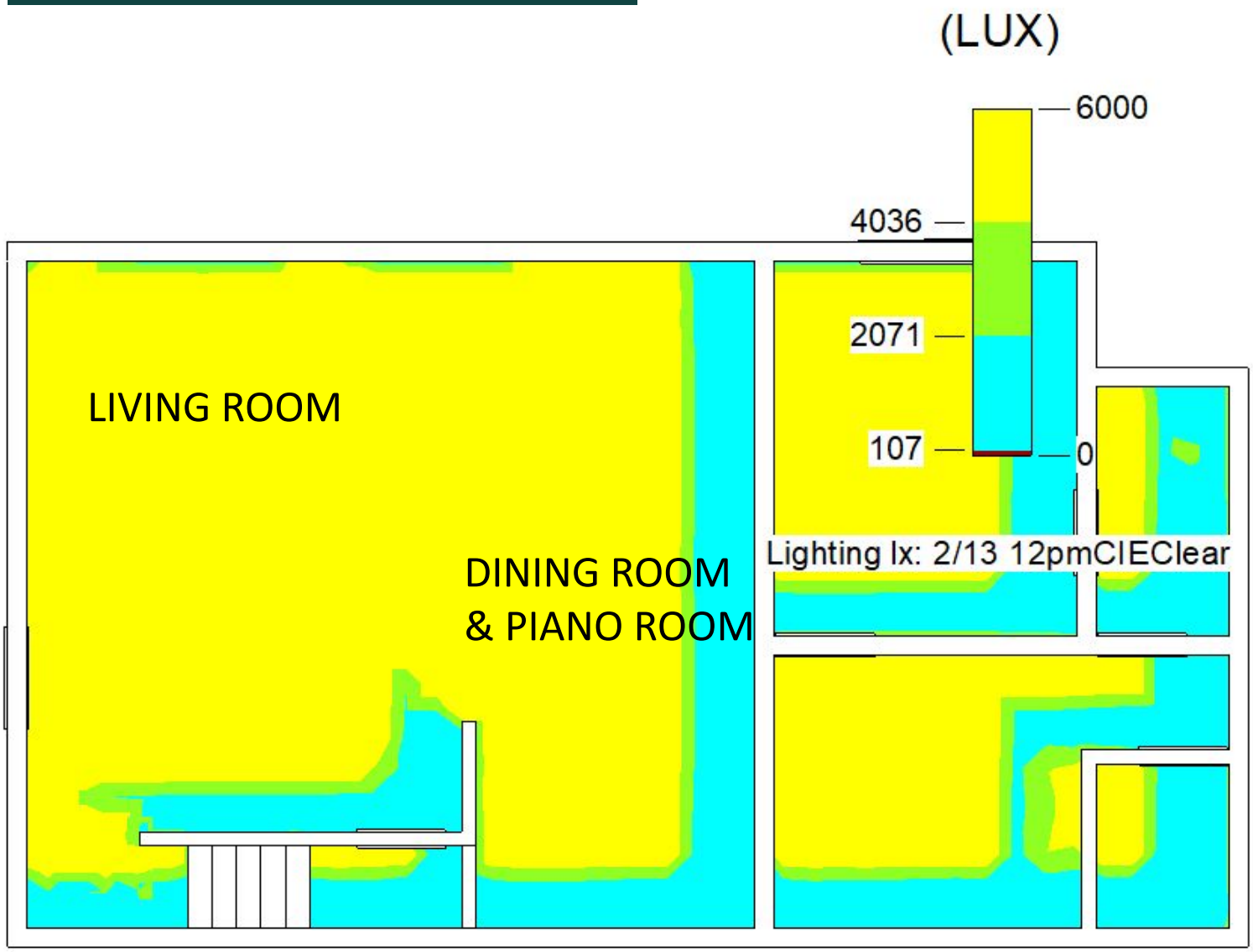


IV DATA IS COLLECTED IN EVERY COORDINATE, AND RECORDED DOWN IN A TABLE

V CALCULATION AND CONCLUSION IS MADE USING THE DATA COLLECTED

3 STIMULATE EI

STIMULATE EI USING REVIT



<_InsightLighting Floor Schedule>

Custom Analysis Whole Building Results: Kuala Lumpur, Malaysia

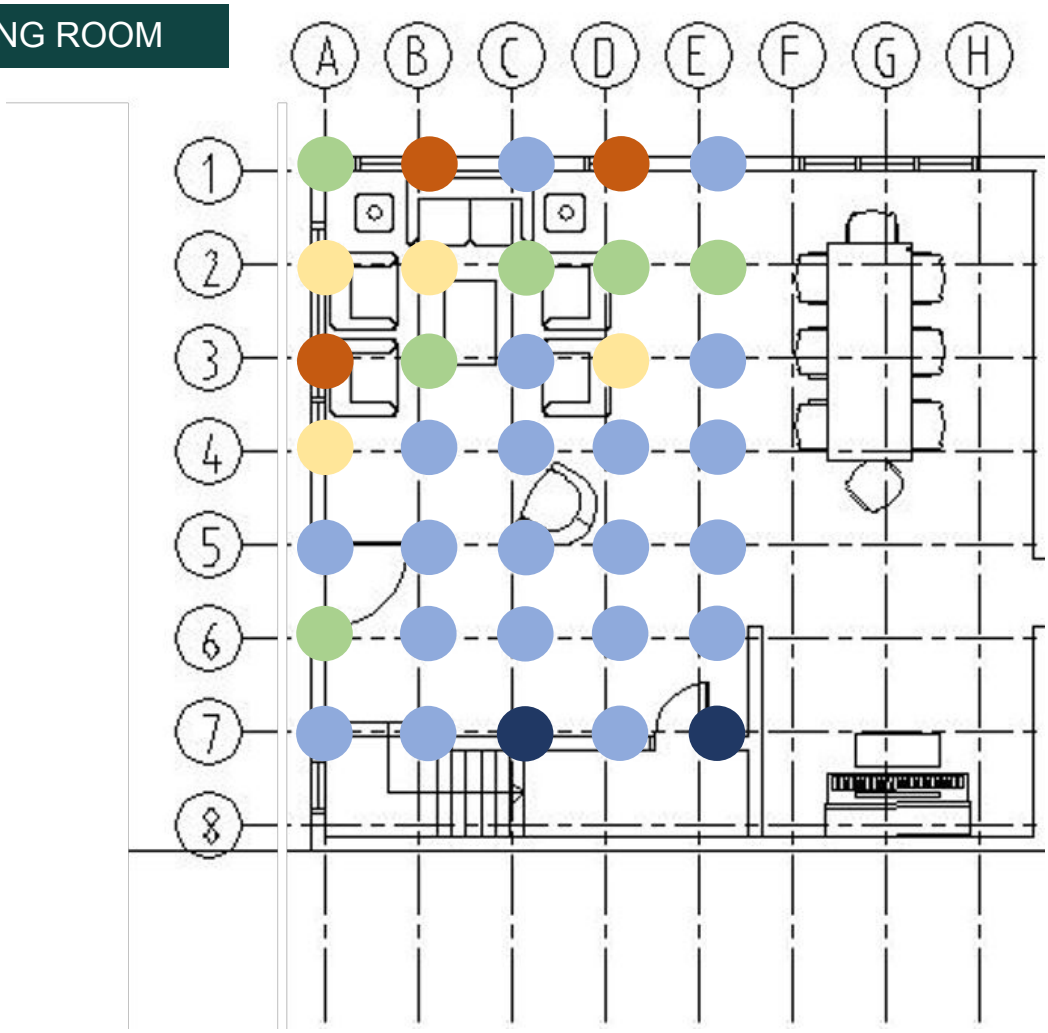
2/13 12pm: 7% & 2/13 3pm: 2% & both: 2% of points are between 300-3000 lux (28-279 fc)

Solar Values (W/m2): 2/13 12pm GHI: 169, DNI: 188, DHI: 24 & 2/13 3pm GHI: 13, DNI: 4, DHI: 9

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
			9am threshold results						3pm threshold results						Both time results	
	Floor Area Included in Daylighting		within threshold		above threshold		below threshold		within threshold		above threshold		below threshold		within threshold	
Name		Total Floor Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area
Level 1	96 m²	96 m²	7	7 m²	2	2 m²	88	85 m²	2	2 m²	0	0 m²	95	91 m²	2	2 m²
Level 2	93 m²	93 m²	0	0 m²	0	0 m²	0	0 m²	0	0 m²	0	0 m²	0	0 m²	0	0 m²

3 DATA TABULATION

LIVING ROOM



ABOVE 450
250-450
150-250
50-150
BELOW 50

1000MM BETWEEN EACH GRID LINES

LIVING ROOM DAYLIGHT, LUX (12PM)					
COORDINATE	A	B	C	D	E
1	152	1200	80	1500	110
2	421	363	104	432	148
3	507	209	95	123	129
4	257	110	100	115	117
5	52	100	110	110	93
6	189	93	94	95	60
7	65	60	49	77	34

3 DAYLIGHT FACTOR

LIVING ROOM

POINT OF DATA COLLECTED ON SITE (MEASUREMENT IN LUX)

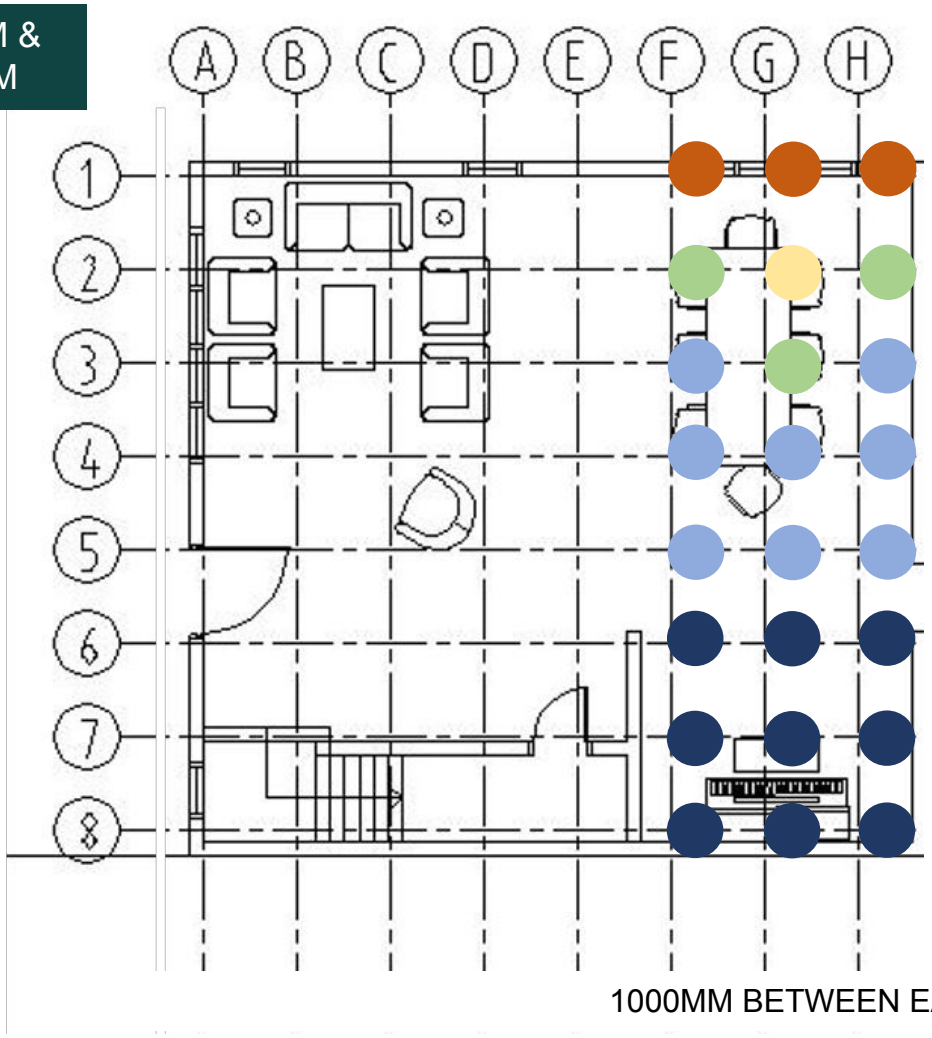
SUM OF ALL = 7553 / 35
MEAN AVERAGE = 215.8
CALCULATION OF DF (DAYLIGHT FACTOR)
EI = 215.8
EO = ?
DF = EI / EO X 100%
= 215.8 / EO X 100%
= ?

IF TAKEN AS EO = 6000LX
THEN
DF = EI / EO X 100%
= 215.8 / 6000 X 100%
= 3.6%

DUE TO DF IS BETWEEN 2% - 5%, PREDOMINANTLY DAYLIGHT APPEARANCE, IT IS GOOD BALANCE BETWEEN LIGHTING AND THERMAL ASPECTS

3 DATA TABULATION

DINING ROOM & PIANO ROOM



ABOVE 450
251-450
151-250
51-150
50 AND BELOW

1000MM BETWEEN EACH GRID LINES

LIVING ROOM DAYLIGHT, LUX (12PM)			
COORDINATE	A	B	C
1	1094	1420	1024
2	204	276	181
3	146	152	140
4	95	111	124
5	75	102	95
6	23	50	16
7	11	11	11
8	15	16	5

3 DAYLIGHT FACTOR

DINING ROOM & PIANO ROOM

POINT OF DATA COLLECTED ON SITE (MEASUREMENT IN LUX)

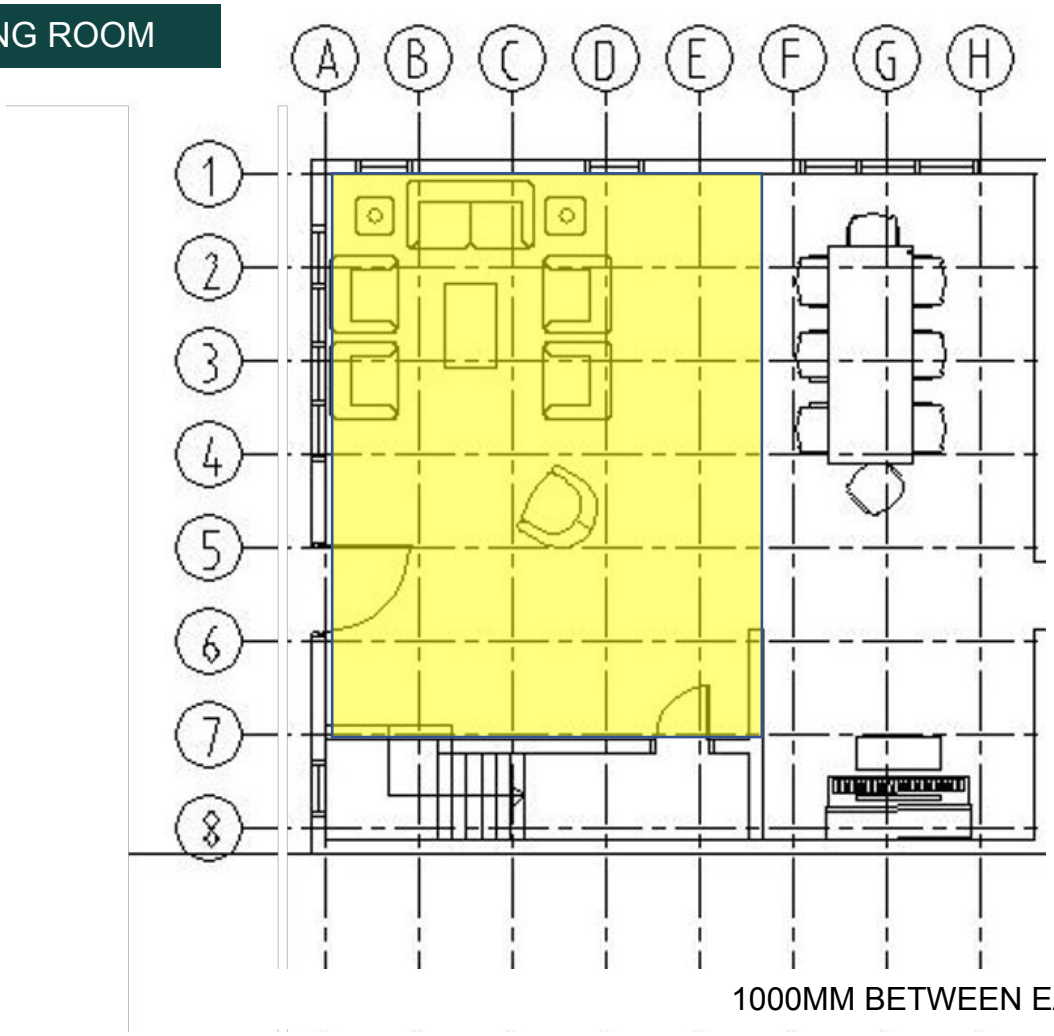
SUM OF ALL = 5397 / 24
MEAN AVERAGE = 224.9
CALCULATION OF DF (DAYLIGHT FACTOR)
EI = 224.9
EO = ?
DF = EI / EO X 100%
= 224.9 / EO X 100%
= ?

IF TAKEN AS EO = 6000LX
THEN
DF = EI / EO X 100%
= 224.9 / 6000 X 100%
= 3.7%

DUE TO DF IS BETWEEN 2% - 5%, PREDOMINANTLY DAYLIGHT APPEARANCE, IT IS GOOD BALANCE BETWEEN LIGHTING AND THERMAL ASPECTS

3 LUMEN METHOD

LIVING ROOM



1000MM BETWEEN EACH GRID LINES

1. PLAN AREA

WIDTH = 4650
LENGTH = 6000
HEIGHT = 3000
AREA = 27.9 M^2

2.AVERAGE HORIZONTAL ILLUMINATION, E

E = 300

3. ROOM INDEX, K

=[ROOM LENGTH(L) X ROOM WIDTH(W)] / HM (L+W)
= 4.65 x 6 / [2.6 (4.65 + 6)]
=27.9/ 27.69
=1

4. UTILISATION FACTOR (UF)

UF = 0.48

1 DOWNLIGHT = 800 LUMENS

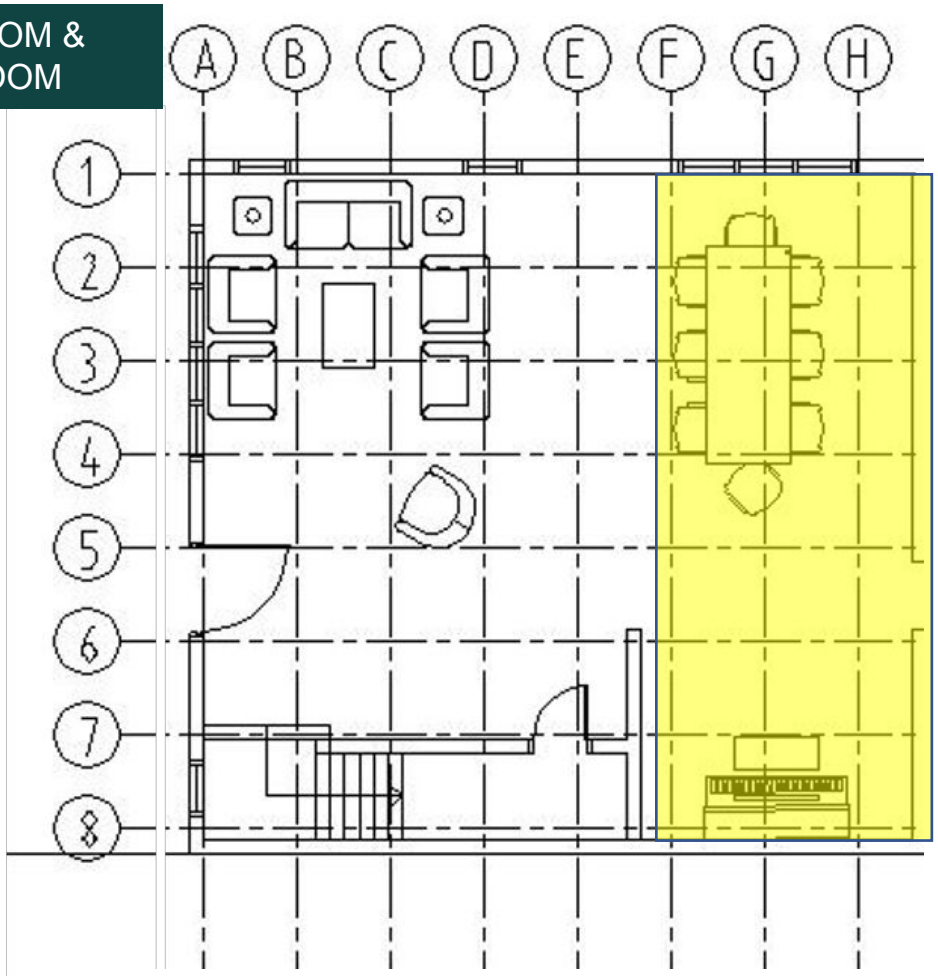
LLF = 0.8

5. LUMEN METHOD

E = (F X n X UF X LLF) / A
N = EA / (F X n X UF X LLF)
= (300 x 27.9) / 800 x 2 x 0.48 x 0.8
= 13.62
= 14 NOS

3 LUMEN METHOD

DINING ROOM & PIANO ROOM



1000MM BETWEEN EACH GRID LINES

1. PLAN AREA

WIDTH = 3m
LENGTH = 7.2m
HEIGHT = 3m
AREA = 21.6m^2

2. AVERAGE HORIZONTAL ILLUMINATION, E

E = 300 lux

3. ROOM INDEX, k

=[ROOM LENGTH(L) X ROOM WIDTH(W)] / HM (L+W)
= 3 x 7.2 / [2.2 (3 + 7.2)]
=21.6/ 22.44
=0.96

4. UTILISATION FACTOR (UF) & MAINTENANCE FACTOR(LLF)

UF = 0.48
LLF = 0.8

5. 1 FLUORESCENT TUBE IN EACH LUMINARES (HAVING AN OUTPUT OF 1600 lumens)

n = 1
F = 1600 lumens

6. LUMEN METHOD

E = (F X n X UF X LLF) / A
N = EA / (F X n X UF X LLF)
= (300 x 21.6) / 1600 x 1 x 0.48 x 0.8
= 10.55
= 11 nos

PART 4

INDIVIDUAL CRITICAL THINKING

METHOD TO IMPROVE THE PRESENT CONDITION

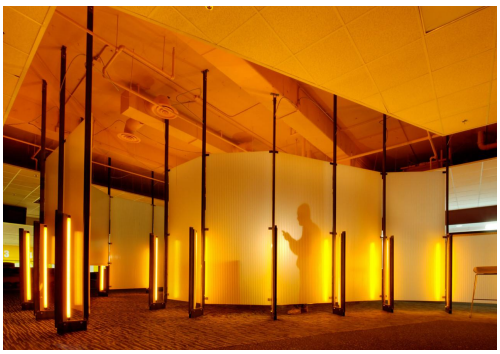
4 INDIVIDUAL REPORT
COLOURS

HOW COLOUR AFFECTS ARCHITECTURE?

COLOUR IN AN AREA CAN PROFOUNDLY INFLUENCE HOW THE USER FEEL WHEN THEY ARE IN THE ROOM. THE COLOUR OF PAINT, FURNITURE AND LIGHT AFFECTS HUMAN LIFE IN AN INEVITABLE WAY, ONE OF THE FACTORS CAUSING STRESS AND/OR RELAXATION IS COLOUR AND LIGHT. THUS, ONE SHALL PROVIDE HAPPY AND RELAXING ENVIRONMENT BY CORRECTING INTERIOR DESIGN AND USING LIGHTS AND COLOUR SERIOUSLY.

RED

PASSION, EXCITEMENT, OR WARMTH/ FEAR OR DANGER/HIGHLY EFFECTIVE METHOD OF DRAWING PEOPLE'S ATTENTION

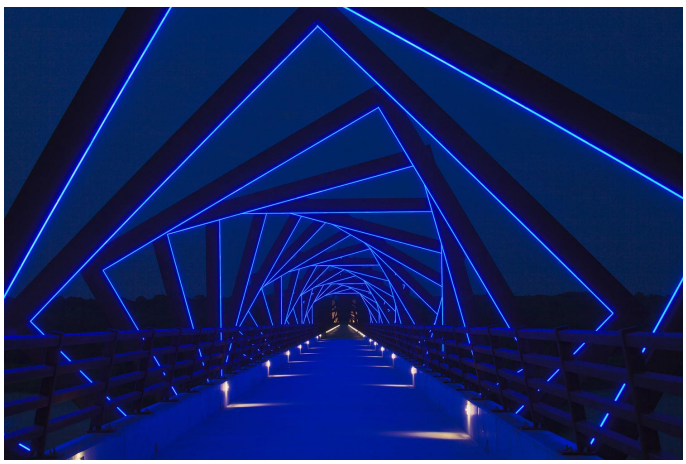


YELLOW

RADIANT AND CHEERFUL, COMMONLY IN CHILDREN SPACES

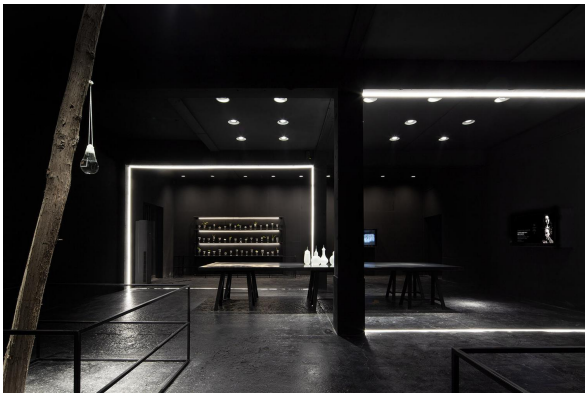
WHITE

PURITY & CLEANLINESS, PRODUCE DRAMATIC SHADOWS/ FEEL CALM BUT ALERT, BRIGHTER



BLUE

COOL, SOOTHING, DIGNIFIED AND SECURE, BLUE LIGHT INSTALLATIONS ARE MOST EFFECTIVE IN OUTDOOR SPACES



BLACK

COOL AND CONTEMPLATIVE/ RUSTIC AND INTROVERTED/ SLEEK AND MODERN

4 INDIVIDUAL REPORT
COLOURS

GREEN
SOOTHING & RELAXING, SUGGEST SUSTAINABILITY AND CONNOTE FRIENDLY WARMTH

PURPLE
GREATER EXTENT OF SOFT AND RELAXING/ FUN, BRIGHT AND EXCITING, UNIQUE

ORIGINAL LIVING ROOM

THE ORIGINAL COLOUR OF THE WALL IN THE LIVING ROOM IS **WHITE**, GIVING IT A CLEAN, BRIGHT AND SPACIOUS LOOK. **DARK COLOURED SOFA AND CURTAINS** IS PLACED IN THE LIVING ROOM. **WHITE LED LIGHTS** ARE USED. THE SPACE IS LOCATED BESIDE A LARGE WINDOW AND THE MAIN DOOR OF THE BUILDING, MAKING IT **EXTREMELY BRIGHT AND HOT DURING THE AFTERNOONS** IF CURTAINS ARE NOT PUTTED.

PROPOSED LIVING ROOM

WALL PAINT

THE LIVING ROOM CAN BE PAINTED **BLUE**, TO CREATE A **RELAXING**, **CALMING** AND **STABILIZING** EFFECT TO THE SPACE. THE MAIN PURPOSE OF THE LIVING ROOM IS TO **SERVE GUESTS** AND **FAMILY GATHERING**. BLUE WILL BE SUITABLE AS IT GIVES OFF A **CLEAN FEEL** TOO, WHEN USERS GATHER AT THE LIVING ROOM, THEY **WILL NOT FEEL TOO TENSE** OR **UNCOMFORTABLE** WITH THE ATMOSPHERE.

4 INDIVIDUAL REPORT
COLOURS

FURNITURE

A **DARK COLOURED (BROWN/BLACK) CARPET** CAN BE PLACED IN FRONT OF THE SOFA, WHEN USERS SIT DOWN ON THE SOFA, **MORE LIGHT WILL BE ABSORBED** BY THE CARPET AND **LESS LIGHT WILL BE REFLECTED** TO ONE'S EYES, MAKING IT MORE COMFORTABLE.

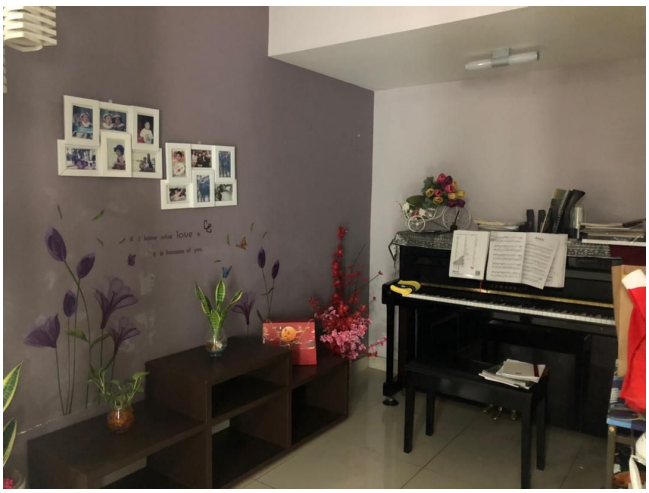
LIGHTS

WHITE COLOUR LED LIGHTS CAN BE **REMAINED** TO GIVE OFF A CLEAN AND SPACIOUS VIEW OF THE LIVING ROOM.

ORIGINAL DINING ROOM

WHITE COLOUR WALL PAINT IS USED, PLACED WITH **BLACK AND WHITE** DINING TABLE, **WHITE LED LIGHTS** ON TOP OF DINING TABLE.0

NO NEW PROPOSAL ARE MADE FOR THIS AREA, AS THE COLOURS ARE ALREADY SUITABLE FOR HAVING A MEAL, WHITE COLOUR GIVES OFF FEELING OF **CLEAN**, WHICH IS VERY IMPORTANT FOR A DINING PLACE. BLACK AND WHITE DINING TABLE GIVES OFF A **SLEEK** AND **MODERN** FEEL.



ORIGINAL PIANO ROOM

THE PIANO ROOM'S WALL IS PAINTED **PURPLE**, WITH **WHITE** AND **OAK** COLOUR CABINETS, AND A **BLACK** PIANO. **WHITE** LED LIGHTS ARE USED.

THE ORIGINAL COLOUR (**PURPLE**) GIVES OFF A **MYSTERIOUS** AND **MAGICAL** FEELING, **ELEGANT** IS SHOWED IN THE COLOUR PURPLE TOO.

4 INDIVIDUAL REPORT
COLOURS

PROPOSED PIANO ROOM

WALL PAINT

GREEN WILL BE A SUITABLE COLOUR TO PAINT THE PIANO ROOM. USERS WILL FEEL STRESSFUL WHEN THEY PRACTICE THEIR PIANO PIECES, GREEN SYMBOLISE NATURE AND IT CAN GIVE A COMFORTING AND HARMONY FEELING TO REDUCE STRESS OF THE USER.

FURNITURE

A **WHITE** PIANO WILL BE MORE SUITABLE, AS WHITE **REFLECTS MORE LIGHT**, AND MAKING THE AREA MORE **BRIGHT**, THE ORIGINAL SPACE FELT **GLOOMY** AND **SAD**, WHICH WILL AFFECT THE USER'S MOOD.

OAK BROWN CABINETS CAN BE USED, AS IT LOOKS MORE LIKE **NATURE**, AND WILL BE MORE **SOOTHING** AND **CALM** TO WORK WITH.

LIGHTS

YELLOW AND WHITE LIGHTS CAN BE USED TOGETHER, YELLOW LIGHTS GIVES OFF A MORE **ROMANTIC** AND **WARM** FEEL, WHICH LEADS THE USER TO THROW MORE **EMOTIONS** WHILE THEY ARE PLAYING PIANO.

CONCLUSION

COLOUR IS A IMPORTANT FACT TO CONSIDER WHEN DESIGNING A SPACE, THE VIBE AND FEELING IT GIVES STRONGLY AFFECTS THE USER'S ACTIVITY. EVERY COLOUR GIVES OUT DIFFERENT ATMOSPHERE, THE RIGHT COLOUR WILL ACHIEVE A HIGHER WORKING EFFICIENCY, AND ENABLE USERS TO REACH **COMFORT**.

4 INDIVIDUAL REPORT
TYPES OF OPENINGS

PROBLEMS

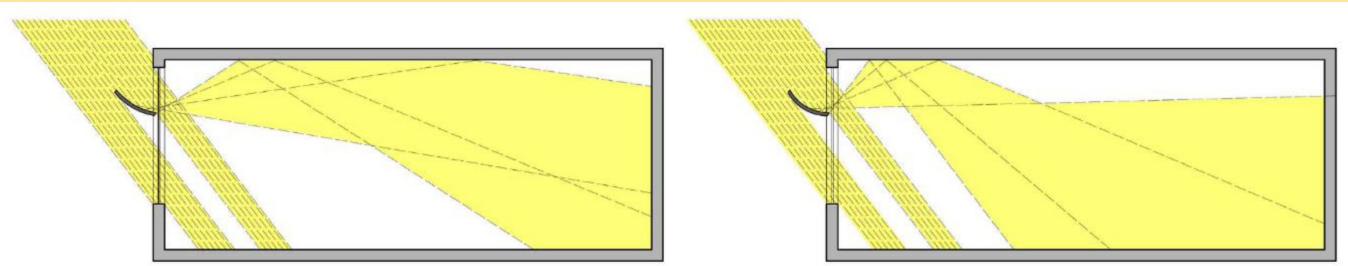
According to the case study, the window openings in the living room used is single panel vertical side-hung outward casement window while the dining area has a double-panel casement sliding door on the same wall, which is facing East. Useful daylight penetration is up to a depth equal to 2.5 times the height of the effective window head above the horizontal surface of interest. Thus, large different of illuminance level will be experienced between the corner closer to the wall and corner that is further to the wall and cause glare. This will cause discomfort and lower user's quality due to eye strain.

SOLUTIONS

Since the house is a Semi-detached house, light shelves or curtain wall can be used to allow sufficient sunlight penetration into the whole space. This is to balance the natural lighting in the interior and prevent high contrast level in the space, thus create a comfortable user's quality.

Light shelves

Light shelves is a window with a combination of double level of window panels. The height of the top panel will be lower than the main panel at the bottom. There will be a reflective device in between both panels to allow light path reflecting from the surface to the ceiling and increase the illuminance level of the whole space.



a) Curved light shelf with an arc angle of 20°

b) Curved light shelf with an arc angle of 40°

Advantages:

- Allow light penetration to the further area.
- Distribute wider and even amount of natural light to the space.
- Lower the shadow and contrast level to a few darker corners of the space.

Disadvantages:

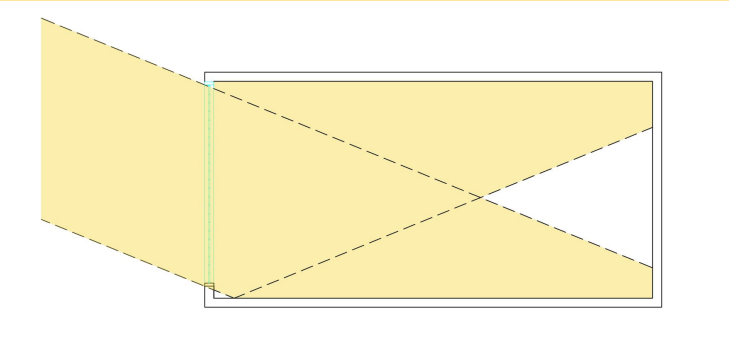
- Only effective during daytime due to the wall is facing East.
- Brightness level of the space will only be sufficient for a few spots.

4 INDIVIDUAL REPORT
TYPES OF OPENINGS

SOLUTIONS

Curtain wall

Curtain wall is a large window wall from ceiling to the floor, utilising large areas of glass to maximise sunlight in a room. This type of window allow larger amount of natural light to penetrate through.



Advantages:

- Allow light penetration to the further area.
- Provide larger amount of natural light to the space.
- Increase the interior brightness and improve the user's quality.
- Energy efficiency.

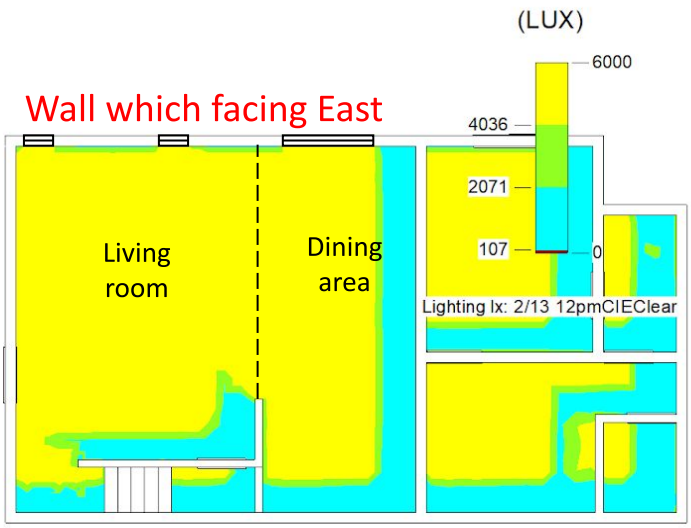
Disadvantages:

- Direct light penetration may make the user feel uncomfortable.
- May require shading device in the design.
- Higher cost to make due to larger glass panel required.

4 INDIVIDUAL REPORT
TYPES OF OPENINGS

COMPARISON

The area focused is the living room and dining room area which located on a same wall. The existing wall is facing East. The wall has 2 single panel side-hung outward casement window while along the wall at the dining area has a 2 panel sliding casement door.



Existing window openings

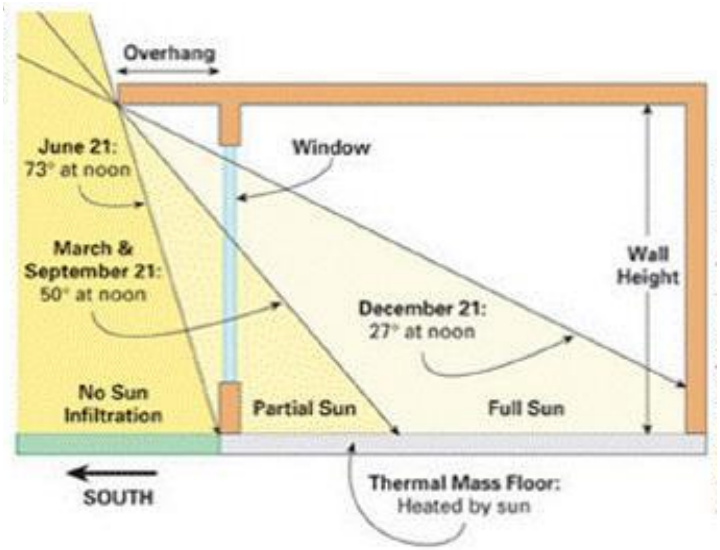
The existing windows show that the existing space which living room and dining area located has illuminance level which is not evenly distributed. This causes the a few further spots to experience high contrast, thus affect the user's quality.

Replace the wall to curtain wall

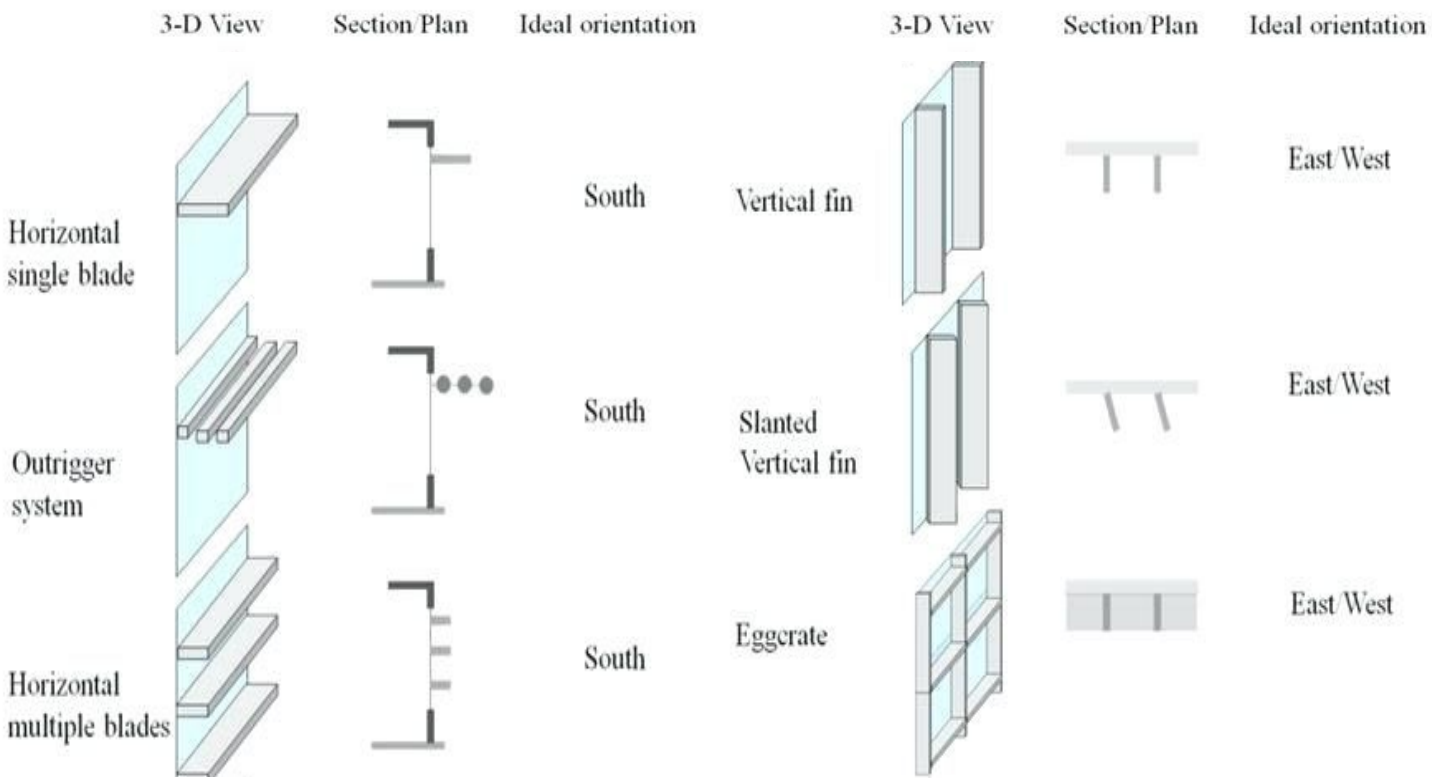
If replace the existing wall to a 7600mm (L) x 3600mm (H) curtain wall, useful light penetration becomes wider, the illuminance level cover larger area. It allows more light penetrates through and increases the brightness at the spots which are further from the wall.

4 INDIVIDUAL REPORT
SUN SHADING DEVICES

Well-designed sun control and shading devices can dramatically reduce building peak heat gain and cooling requirements and improve the natural lighting quality of building interiors. Depending on the amount and location of fenestration, reductions in annual cooling energy consumption of 5% to 15% have been reported. Sun control and shading devices can also improve user visual comfort by controlling glare and reducing contrast ratios. This often leads to increased satisfaction and productivity. Shading devices offer the opportunity of differentiating one building facade from another. This can provide interest and human scale to an otherwise undistinguished design.



TYPE OF SHADING DEVICES



EGG CRATE SHADING DEVICES

RESSON

- Egg Crate Sunshades have both vertical and horizontal orientation options
- Contemporary appeal, modern approach
- Attach to curtain wall or facade
- All outriggers, fasciae and infill can be customized to fulfill any design
- Egg Crate Sunshades integrate solar input during heating seasons and lower heat transfer during cooling seasons
- Wide variety of egg crate bar thickness, spacing, depth options
- Egg Crate Sunshades are strong, durable, functional
- These sunshades gain LEED credit for recycled content and energy savings
- PVDF (Kynar®) resin-based coatings for long term finish warranties
- Design options may include straight and tilted blades
- Custom fabrication available to match the contour of the building
- Custom design and engineering meet wind or load performance needs
- Re-direct and deflect sunlight from entering windows

EGG CRATE SHADING DEVICES

ADVANTAGES

- Allow ventilation because some of triangle design as blind
- No need too much lighting in daytime can save electricity cost
- Create as the outer form of building

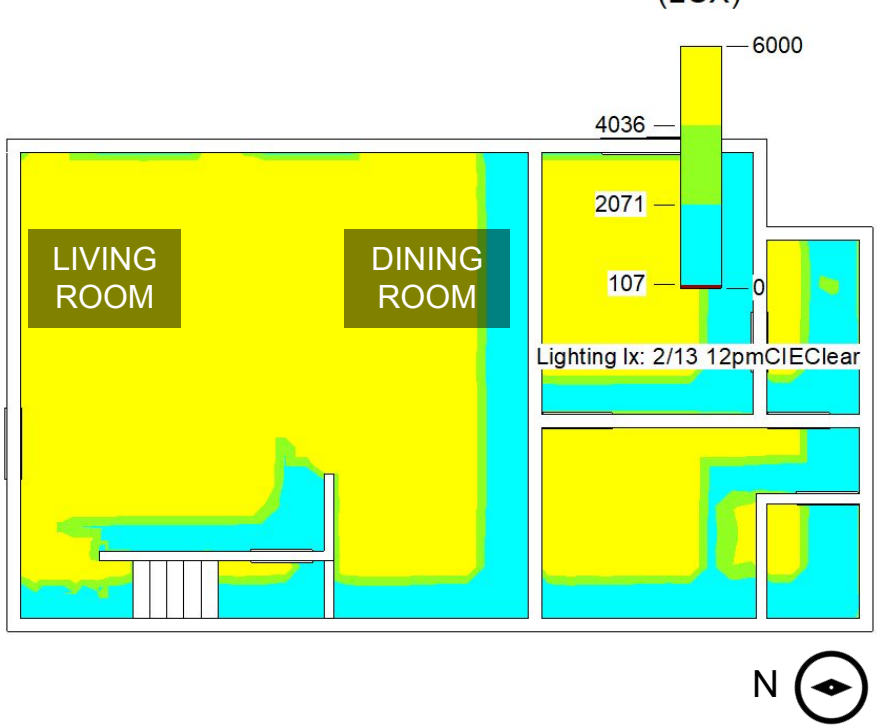
DISADVANTAGES

- Can not be adjust for the fixed shading device
- Direct sunlight into building especially in afternoon will increase indoor temperature because shading device on top of building only create some shading effect
- Low angle winter sunlight penetration can give rise to glare

4 INDIVIDUAL REPORT
SUN SHADING DEVICES

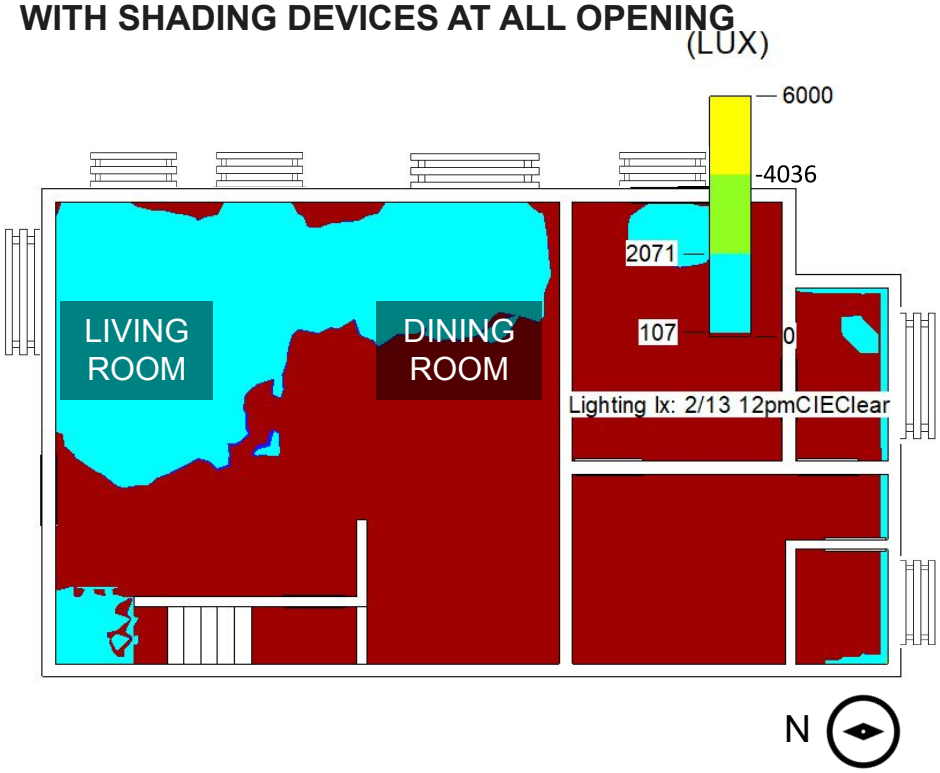
COMPARISON

WITHOUT SHADING DEVICES AT ALL OPENING



Based on the diagram at left side which is without shading devices at all opening, we can see that the indoor space are having high illuminance level. Hence , this causing the indoor temperature become higher and people living in the space become not comfortable.

WITH SHADING DEVICES AT ALL OPENING



Based on the diagram at left side which is with shading devices at all opening, we can see that the indoor space are having low illuminance level. Hence , this causing the indoor temperature become lower and people living in the space become comfortable.

4 INDIVIDUAL REPORT
PSALI

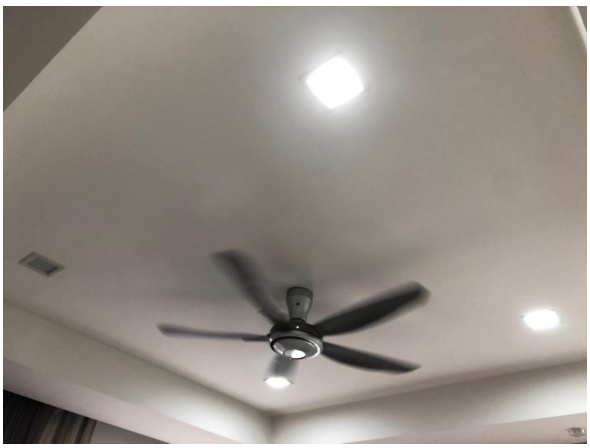
According to the simulation of Revit-insight shows that the natural lighting on 12pm in the dining room are dimmer compare to the living room is brighter than dining room even there's balcony outside and above the living room.

This causes the large usage of artificial lighting in the dining room which consume a lot of energy and electricity. The artificial lights that used in the living and dining rooms are light-emitting diode (LED) ceiling lights. LED lights will produce high ambient temperature that may results in overheating.

The depth of this space is approximately 7 meters deep, and it is difficult to provide the quality of daylighting factor after 3 times the window head height. To solve these issues, a system that is known as "permanent supplementary artificial lighting of the interiors" (PSALI) have created to work as a supplementary to the daylight in the spaces.

The principle of PSALI is to provide illumination that appears to be of good daylight character even though most of the working illumination may be from artificial light.

PSALI utilize the daylight as far as practicable. It provide low energy consumption which is ideal for the rooms.



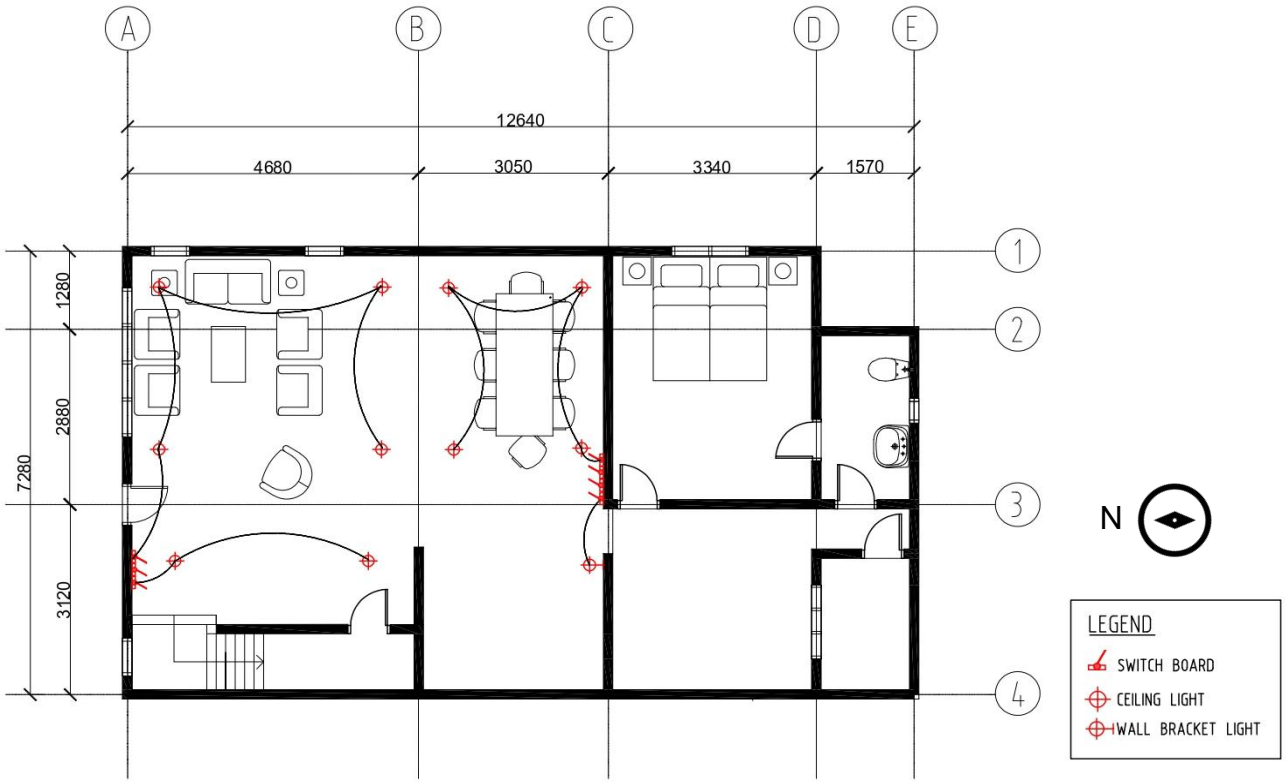
LIVING ROOM

DINING ROOM

4 INDIVIDUAL REPORT
PSALI

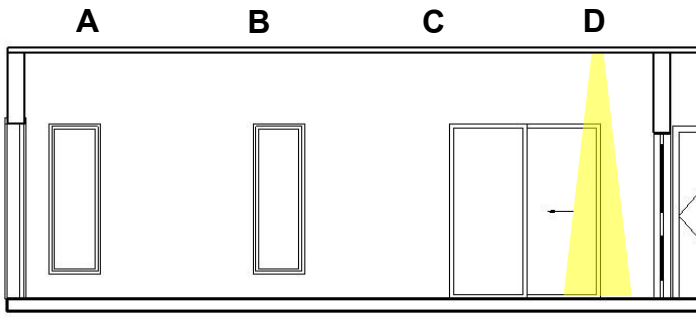
PSALI SCHEME

A total of 11 LED bulbs are required to light up the living and dining rooms. The bulbs are arranged in 4 rows and 1 luminaires and are controlled by 4 different switches.



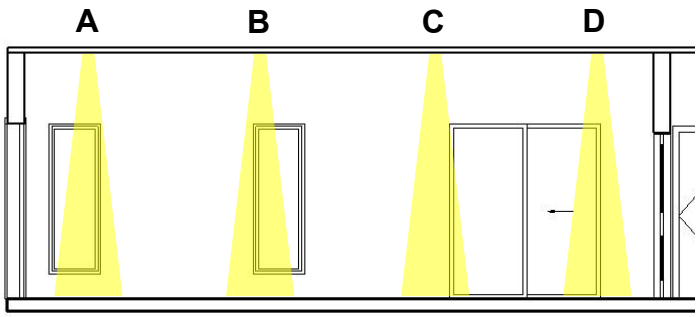
According to the illuminance simulation of purely natural daylight and natural artificial lighting, the wiring of the light fixture is determined.

DAY



During the brightest portion of the day which the daylight is sufficient (high DF), only row D light fixtures need to be turned on to ensure the combination of artificial and natural lighting is distributed evenly across the living and dining rooms.

NIGHT



Whereas light fixtures on every rows are to be turned on during night time or when natural lighting is insufficient to illuminate the area (low DF) closer to the windows to save energy consumption.

4 INDIVIDUAL REPORT
POSITION OF WINDOWS / OPENINGS

BACK THEN

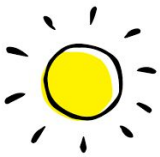
For centuries, daylight has been the only effective light source. Available light. Goals dominate the architecture. Span wide spaces and create large openings. Enough to distribute daylight to the interior of the building.

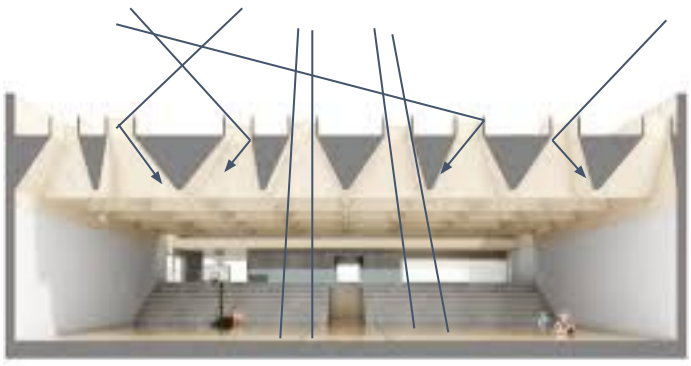
GOALS

Attention should be paid to creating lighting Conditions suitable for visual tasks Perform in a room and meet at the same time personal needs.

Our central vision should be taken seriously (The illumination of an objects) and our peripheral vision (The illumination of surroundings). Peripheral vision helps create an impression of the surrounding environment.

We find ourselves:
-Space size and shape, Environment, materials and light distribution. In the design phase, appropriate support
Place and resize windows to achieve
Smart balance between light intensity
Distribution and directionality.



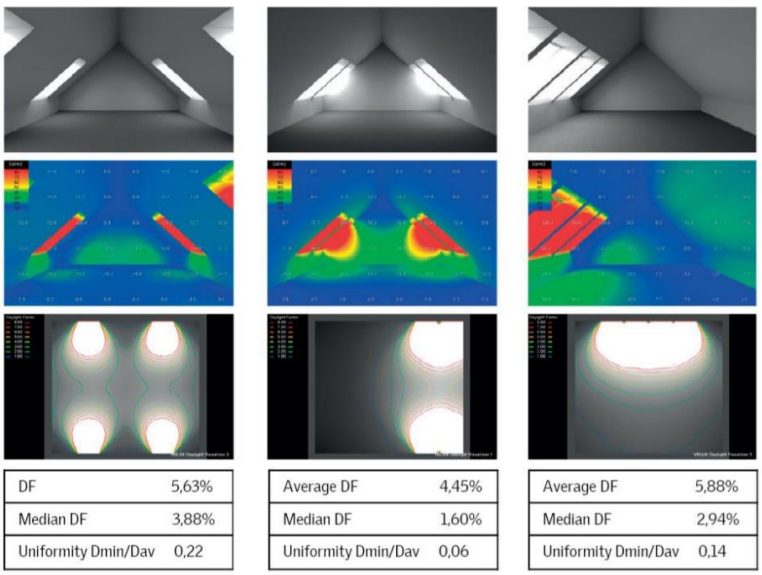


4 INDIVIDUAL REPORT
POSITION OF WINDOWS / OPENINGS

WINDOW ORIENTATION

In the northern hemisphere, the light from the north is Mainly composed of diffuse skylights and provide Functional and comfortable light inside Stable throughout the day. Light from In many cases, the south, east and west bits Provide direct sunlight and light indoors Great changes throughout the day. The quality and distribution of daylight in a room increase when it is delivered from multiple direction

OPENINGS POSITION



DF	5,63%
Median DF	3,88%
Uniformity Dmin/Dav	0,22

Average DF	4,45%
Median DF	1,60%
Uniformity Dmin/Dav	0,06

Average DF	5,88%
Median DF	2,94%
Uniformity Dmin/Dav	0,14

The position of the windows affects the distribution od under the sunlight in the room and determined the useful daylight. Good lighting design will provide larger glare-free light. However, poor lighting design will provide either inadequate amount of light. So that the artificial light will be used frequently.

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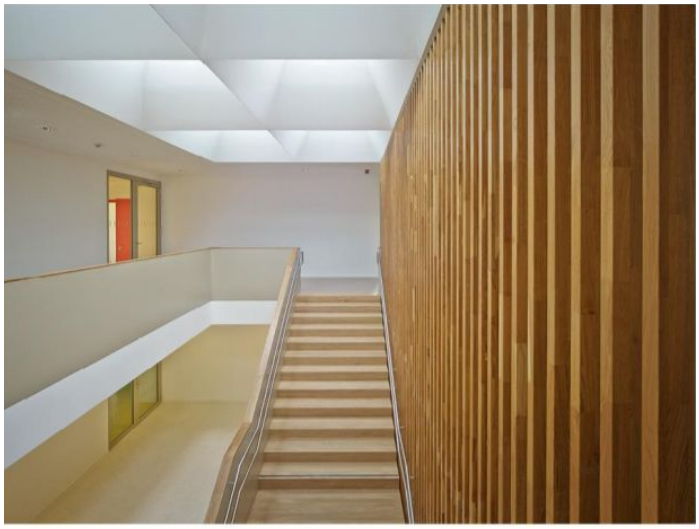
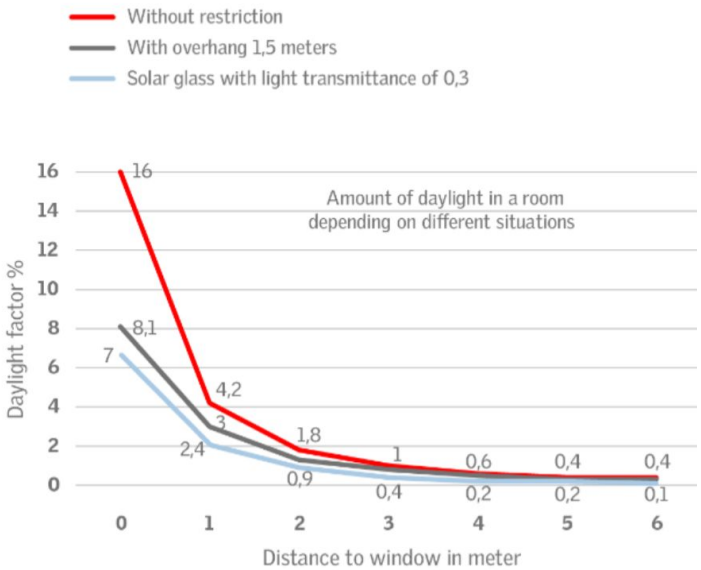
4 INDIVIDUAL REPORT
POSITION OF WINDOWS / OPENINGS

TOP LIGHTING

The sunlight from the top beings three times larger than the number of window from the facade. A combination of both will optimized on the one hand daylight conditions and additionally provides view to the outside.





DAYLIGHT PENETRATION

The amount of the daylight decrease with the distance to the window. Further reduction factors may be natural or man-made interference, such as:

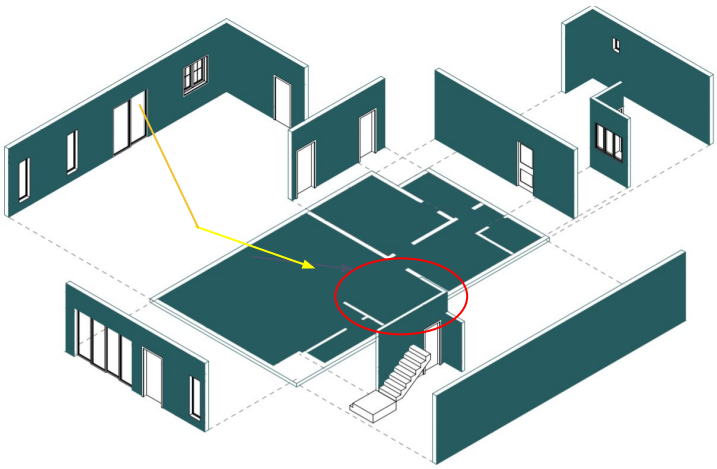
- Environmental (trees, neighbour buildings,...)
- Architectural (lintel, overhangs,....)
- Materials (sun protection glasses,...)

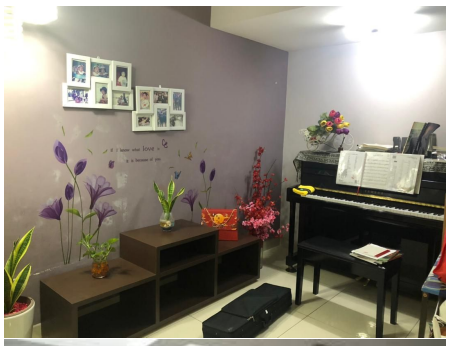

without restriction


with overhang 1,5 meters

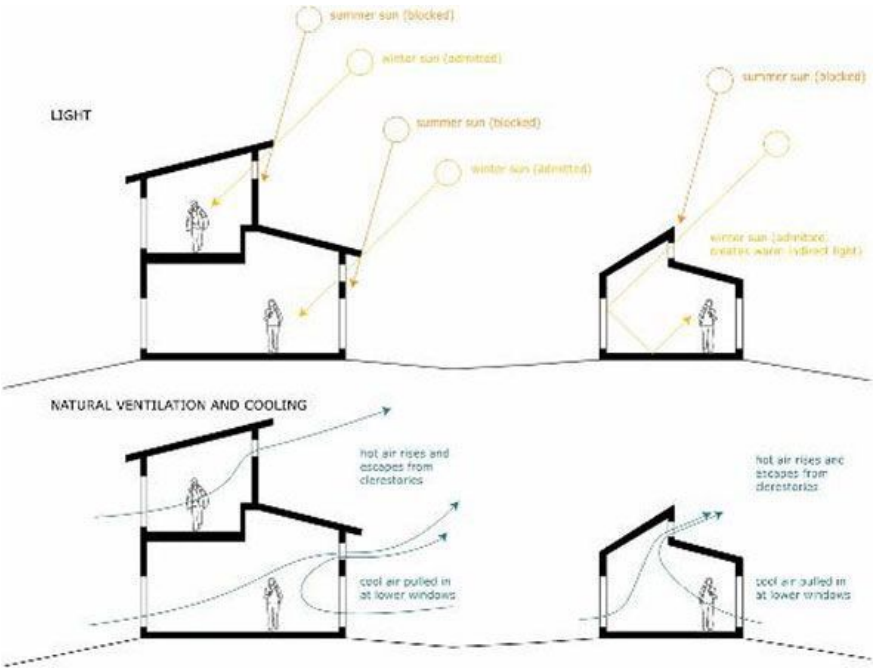

solar glass with light transmittance of 0,3

PROPOSE CLERESTORY OPENING



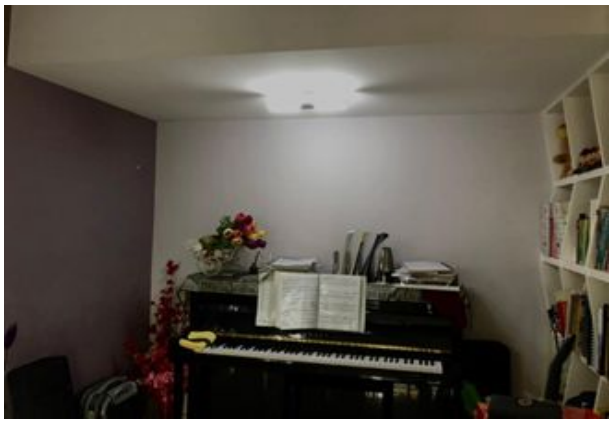


Clerestory, in architecture, any fenestrated wall of a room that is carried higher than the surrounding roofs to light the interior space. In a large building, where interior walls are far from the structure's exterior walls, this method of lighting otherwise enclosed, windowless spaces became a necessity.



Introduction

LIVING AREA



PIANO ROOM

DINING AREA

SELECTED AREA CONDITION

LIVING AREA

The living area is very contrast during the day due to the large opening where the sunlight can penetrate directly through the opening so it can become very contrast. However, during night the space will become dim since there is only 4 led downlight for the living area space of. The amount of artificial light is not enough to brighten up the entire living area

DINING AREA

4 LED downlight used that are same with the living room.

PIANO ROOM

The light used is ceiling light with 12w which can not provide sufficient light leading the user to have eye sore and discomfort after long time practicing.

DESIGN PROPOSAL 2

ARTIFICIAL LIGHT

Installing more artificial light is the design proposal that I proposed so that the lightning condition of the living area can be improved during the night and windy day. Moreover, installed more recessed downlight in the living area and installed pendant light at the dining area to separate the living and the dining area.

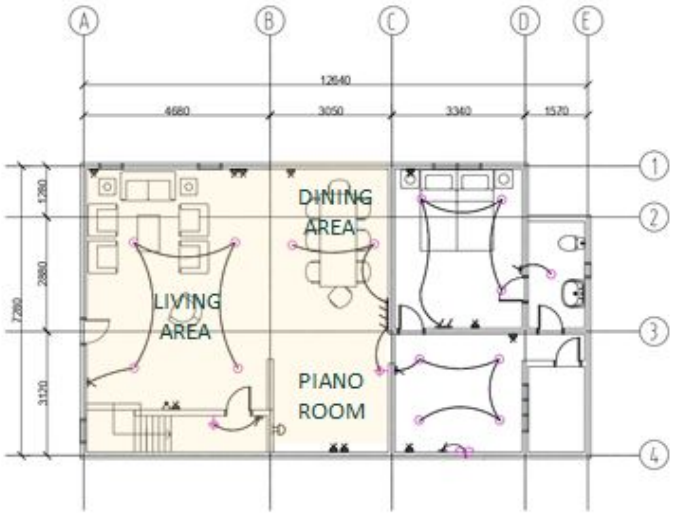
ADVANTAGE

- Brighten up the living area during the night or cloudy day
- Enhance the atmosphere for the dining area and provide comfort for the user
- Increase the productivity and enhance the visual profile of the house
- Artificial light is constantly available throughout the day and night

4 INDIVIDUAL REPORT
ARTIFICIAL LIGHT - DESIGN PROPOSAL

ARTIFICIAL LIGHT CURRENTLY USED

Based on the data collected, there are only 4 LED downlight each were installed in the living and dining area. Hence, during night or cloudy day, the artificial light currently installed are not enough to brighten up the whole area. Since the area of the living area is big, the led downlight will not be sufficient to brighten up every corner of the living area. The artificial light used for dining area is 4 LED downlight while the piano room is a LED ceiling light of 15w which has caused the area to be dimmer.

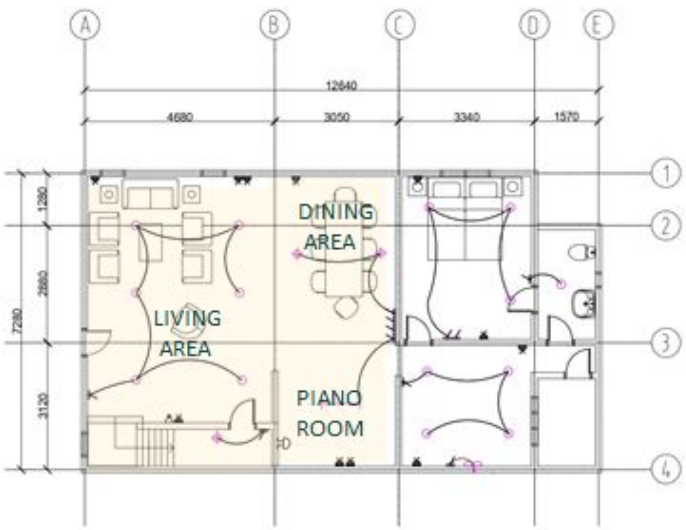


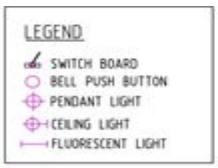
LED DOWNLIGHT

CEILING LIGHT

ARTIFICIAL LIGHT PROPOSED

For my opinion, I suggested to install more LED downlight to brighten up the living area. I have suggested to installed four LED downlight to further installed total 6 LED downlight in the living area. In this case, there will be sufficient light for every corner of the living area. Moreover, I proposed to change the led downlight to pendant light in the dining area not only to brighten up the place but to create a different atmosphere in the dining area. For the piano room, I proposed to installed a fluorescent light to brighten up the space.





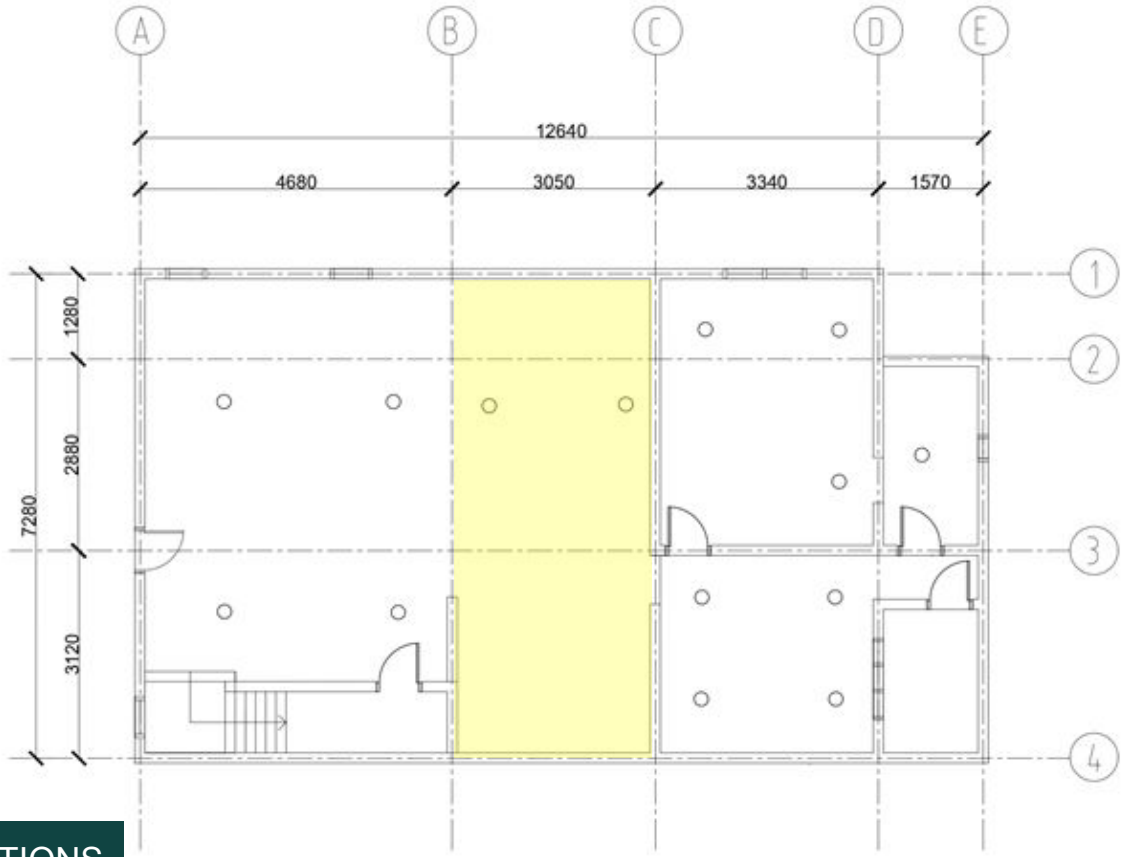
PENDANT LIGHT

LED DOWNLIGHT

FLUORESCENT LIGHT

4 INDIVIDUAL REPORT
LUMEN METHOD

DINING ROOM & PIANO ROOM



CALCULATIONS

1. PLAN AREA
WIDTH = 3m
LENGTH = 7.2m
HEIGHT = 3m
AREA = 21.6m^2

2. AVERAGE HORIZONTAL ILLUMINATION, E
E = 300 lux

3. ROOM INDEX, k
=[ROOM LENGTH(L) X ROOM WIDTH(W)] / HM (L+W)
= 3 x 7.2 / [2.2 (3 + 7.2)]
=21.6/ 22.44
=0.96

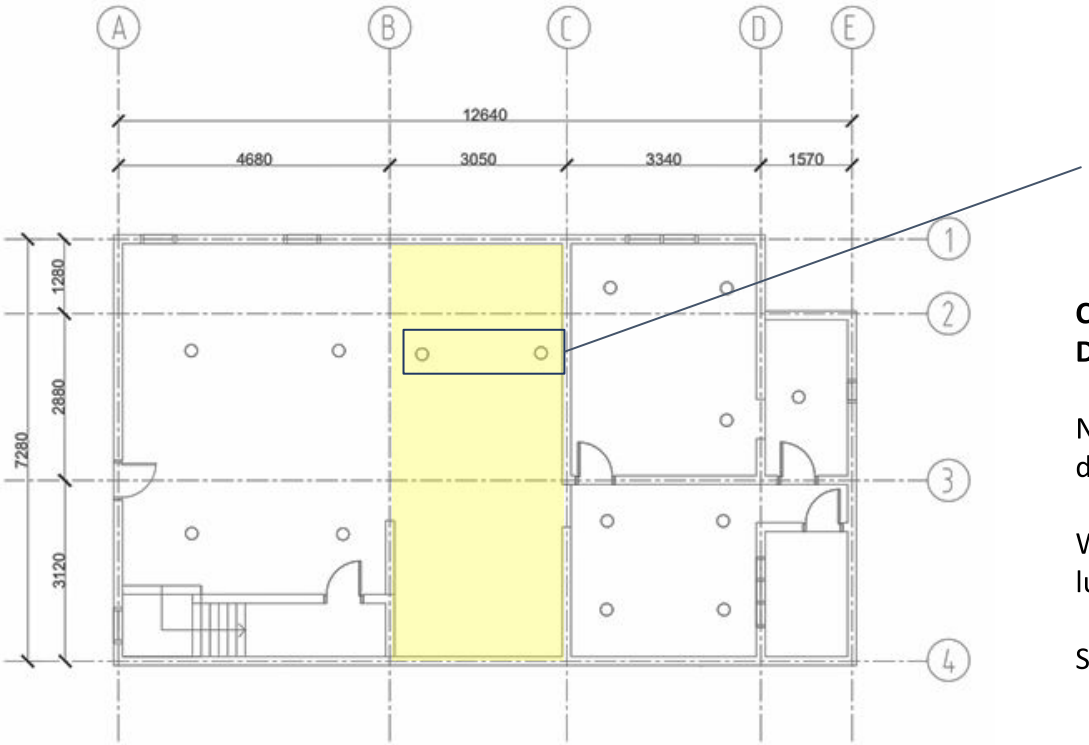
4. UTILISATION FACTOR (UF) & MAINTENANCE FACTOR(LLF)
UF = 0.48
LLF = 0.8

5. 1 LAMP IN EACH LUMINARES (HAVING AN OUTPUT OF 1600 lumens)
n = 1
F = 1600 lumens

6. LUMEN METHOD
E = (F X n X UF X LLF) / A
N = EA / (F X n X UF X LLF)
= (300 x 21.6) / 1600 x 1 x 0.48 x 0.8
= 10.55
= 11 nos

4 INDIVIDUAL REPORT
LUMEN METHOD

DINING ROOM & PIANO ROOM



COMPACT FLUORESCENT DOWNLIGHTS

Number of lamps in each downlights = 1

Watt = 60 W (produce 1600 lumens of light)

Size = 30cm (diameter)

ARTIFICIAL LIGHTING STRATEGIES

In terms of artificial light, dining room and piano room has 2 compact fluorescent downlights. However, less numbers of luminaires will cause insufficient supply of light to whole area during the night time. According to the calculation of lumen method, we can clearly know that artificial lighting strategies are required for dining room and piano room to provide good quality of space to the users.

REPOSITIONING ARTIFICIAL LIGHT

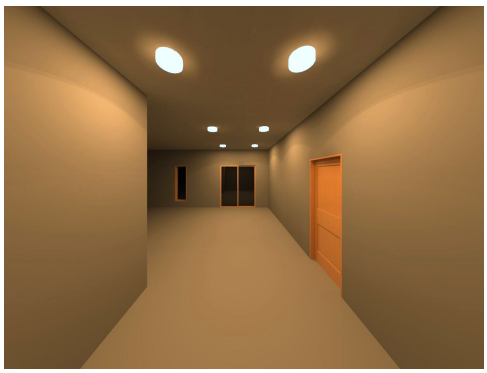
To allow artificial light to distribute the light ray evenly and decrease the contrast of the space.
In this scenario, the approach of repositioning and adding the quantity of luminaires is to achieve sufficient supply of light. When the number of luminaires increases, the area will be brighter and comfortable to stay in.

4 INDIVIDUAL REPORT
LUMEN METHOD

PROBLEMS

According to the lumen method, the final result of the number of luminaires required in dining room and piano room is 11nos. The result shows that this area should have 11 luminaires to have good users' quality but there are only 4 luminaries including 2 round downlights. This stated that the area is gloomy. Therefore, the existing 2 round downlight are not enough for the large area. Somehow, the area will be very dim during night time. The area becomes low spatial quality for the users.

SOLUTIONS



By adding the number of luminaires and the number of fluorescent tubes in each luminaires according to lumen method, the area will become brighter and comfortable to be stayed in. As in images, the area is brighter with fluorescent tubes in each luminares and luminares added.

CALCULATIONS

1. PLAN AREA

WIDTH = 3m
LENGTH = 7.2m
HEIGHT = 3m
AREA = 21.6m^2

2. AVERAGE HORIZONTAL ILLUMINATION, E

E = 300 lux

3. ROOM INDEX, k

=[ROOM LENGTH(L) X ROOM WIDTH(W)] / HM (L+W)
= 3 x 7.2 / [2.2 (3 + 7.2)]
=21.6/ 22.44
=0.96

4. UTILISATION FACTOR (UF) & MAINTENANCE FACTOR(LLF)

UF = 0.48
LLF = 0.8

5. 2 LAMPS IN EACH LUMINARES (HAVING AN OUTPUT OF 1600 lumens)

n = 2
F = 1600 lumens

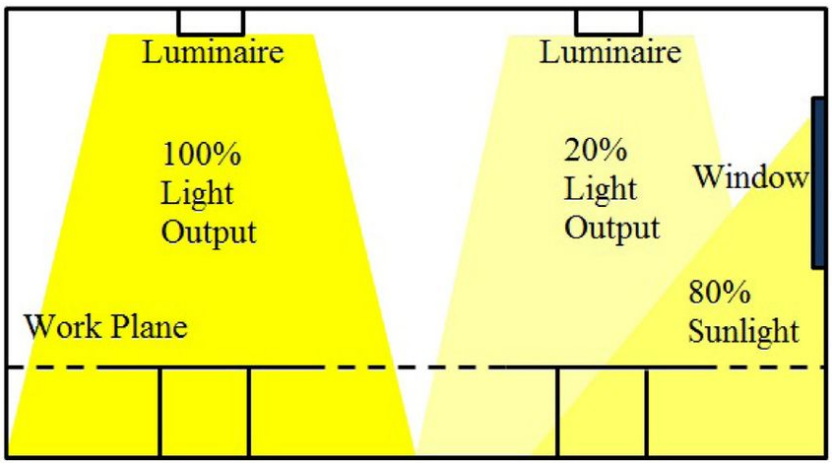
6. LUMEN METHOD

E = (F X n X UF X LLF) / A
N = EA / (F X n X UF X LLF)
= (300 x 21.6) / 1600 x 2 x 0.48 x 0.8
= 5.28
= 6 nos

ACTIVE TECHNIQUE PROPOSED

Daylight Harvesting Technique

Store solar energy used to power artificial lights used when natural light is not available. It use daylight to offset the amount of electric lighting needed to properly light a space, in order to reduce energy consumption. This is accomplished using lighting control systems that are able to dim or switch electric lighting in response to changing daylight availability.



Daylight-Responsive Electric Lighting Controls Photocells sense natural light illumination and reduce artificial light consumption accordingly by dimming electric lights and storing daylight.

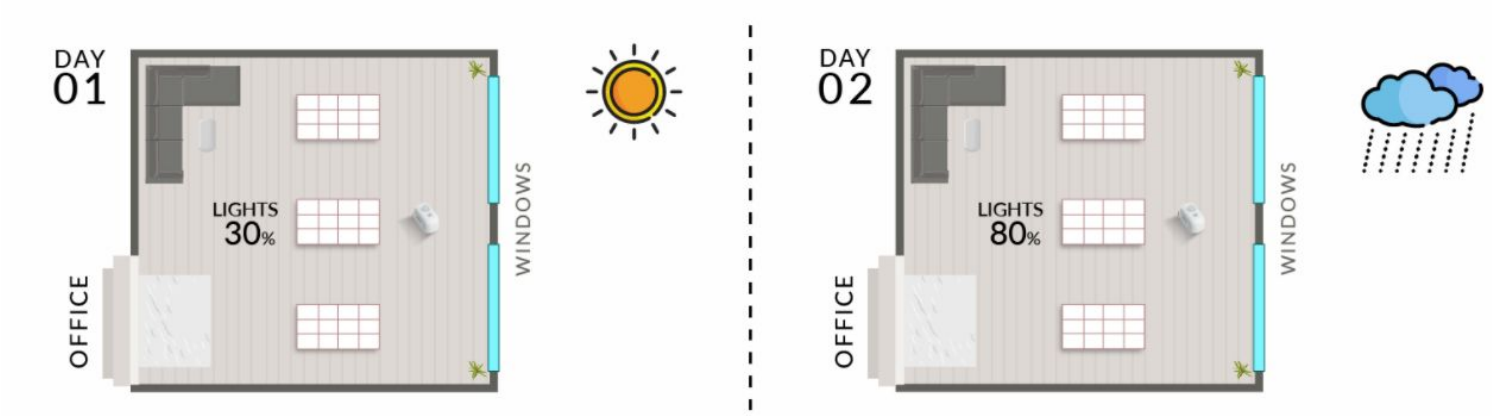
Photovoltaic Cells, Photocells, PV cells, PVs—store and distribute solar energy where it can be efficiently used

ADVANTAGE

- Reduce energy consumption
- Prevent glare and enhance user comfort
- Eco-friendly and save cost for electric use

4 INDIVIDUAL REPORT
ACTIVE TECHNIQUE

The daylight harvesting system employs light sensors, also known as photocell sensors, to detect the prevailing light level in the environment. It then sends the intensity of light received to a controller, which is connected to the lighting control system. The control system in turn adjusts the electric lights automatically according to the measured light level.



CLOSED- LOOP SYSTEM

There are two system which are open and closed loop system.

The system proposed in this study is a closed- loop system, the photo sensor detects the total amount of light intensity, from both natural and electric sources in the environment. And, based on the detected light intensity level, it adjusts the intensity level of the artificial light to maintain pre-set ambient light intensities.

Closed-loop sensors are typically installed indoors, facing away from the daylight source. Since the photo sensor measures the artificial lighting system's output, it provides feedback to controller and make further adjustments to maintain the pre-set value creating a closed loop.

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