SUBMISSION FORM

ASEAN Energy Efficiency and Conservation (EE&C)
Best Practice Competition in Buildings
ASEAN Energy Awards - 2014

Pluit Residential House

CATEGORY: GREEN BUILDING

Sub Category Small and Medium

At
Laos Plaza Hotel, Vientiane, Lao PDR, 26-30 May 2014

CERTIFICATION AND COVERING NOTE FROM CONSULTANT

The Pluit Residensial House occupies a site area of about 250 square meters and was completed in March 2013. The building has 3 storeys and 1 flat roof for Solar cell, 1 cold Water Tank, 1 hot water tank, 1 VRF Air Conditioning unit with hot water generation, 3 parabolas, 1 Pyramid meditation,, 2 out lets voids, 1 sky lighting, Green roof and 1 Gazebo for leisure area. A total gross floor area of 781 square meters.

The details of client and project consultants are:

Client : Pluit Residential House
Architect : Aria Architect
M&E Engineers : John Budi H Listijono

ITEM	DATA	COMPLIANCE (PUT CHECK)
Submission Requirement		
- Certification and covering note from consultants	1 page	V
- Cover of Report	1 page	V
- Energy Efficiency (active and passive designs)	Max 4 pages	V
- Renewable Energy	Max 2 pages	V
- Water efficiency	1 page	V
- Environmental Sustainability (Materials, Greenery, Sustainable Site, etc)	Max 2 pages	V
- Indoor Environmental Quality	Max 3 pages	V
- Operation and maintenance & Other Green features, and Innovation	Max 3 pages	V
- Building Information	Max 4 pages	V
- Drawings (in A4 / A3 size): Typical floor plan, site layout, roof plan and vertical cross section, etc	Max 4 pages	V
Pre-Qualification		
- Energy Efficiency Index of Occupied Air-conditioned Area: Office: 160 kWh/m^2/yr; Library: 160 kWh/ m^2/yr; Retail/Shopping Malls: 192 kWh/ m^2/yr; Hotels: 216 kWh/ m^2/yr; Hospital: 288 kWh/m^2/yr	18.4 kWh/m^2/yr (2000 hours)	V
- Temperature and Other Settings: Not less than 21ºC but not more than 26ºC; RH: max 70% (applies to air-conditioning. Not pre-requisite - Higher score for having RH control system (below 65%).	25 ºC 60% RH	V
- Lighting Load: Office - Max 12 watts/m^2; Others - Max 20 watts/m^2	3.4 watts/m^2	V
- Operating hours/yr: 2,000 hours/year	8760 hours/year	V
- At least 1 full-year of operation prior to nomination in national competition	1.3 years	V

The Pluit Residential House hereby agreed to allow the ACE Board of Judges and the Japanese experts to visit the building and verify the authenticity of the data. However, two weeks advance notice is required to allow for necessary arrangements.

The undersigned certified that the information given is true and accurate and prepared with the consent of the party/ies involved.

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Over All Design

Pluit Residential House

This Pluit Residential House is a house designed using Green building and high performance sustainable low energy building concept to create a harmonized relationships among the human, environment and bio-climatic, is located in the northern part of the heart of Metropolitan City of Jakarta which has 250 sq meter of land, 3 stories buildings and 1 flat roof with the total gross floor areas of 781 sq meter, and facing southern part.

1). Using bio-climatic of Jakarta, Sky lighting concept to create natural ventilation with air speed of **> 0.5m/s** and day lighting on none air conditioned area and **air conditioned area during the day time** to save both the electric energy for AC, fan and lighting.

2). Using modified VRF air conditioning unit to produce free hot water (up to **50 ºC**) from hot refrigerant gas.

3). Using new concept of 2 tanks (an insulated hot tank and cold water tank with equalized pipe) to distribute with equal gravitation pressure of water system in the house without using a pump.

4). Installed 48 solar Panels @ 50W output to generate 2400W electricity during the day time, average daily electricity produced by these Solar PV is **12 kWH** and total **4380 kWH** of electricity per annum or $**526**.-

5). The average electricity from the grid is **17065** kWH/year (8760 hours) or **3896** kWH/year (2000 hours) or Energy Efficiency Index based on air conditioned area (212 sq meter) is **18.4** kWH/sq meter year (2000 hours). EEI based on gross area (781 sq m) will be **5** kWH/sqm yr.

6). **98%** of the lighting systems in this house are using LED light with the average **3.4** w/sq meter in common area and **2** w/sq meter for gross area.

7). Use Rainwater gardening on the ground yard to preserve the water for running to the drainage.

8). Use green roof and solar panels on the flat roof to reduce RTTV to the lower floors.

9). Have a Gymnasium, Smart TVs at each rooms,3 parabolas, 4G internet connection, a library with more than 2000 books, a reading/study room, a music room, a pyramid meditation, 12 pcs of CCTV etc. Since Human consists of: Body, Mind, and Spirit then in this house, we have to full fill these needs. Body → Shelter, Food, Gymnasium etc.; Mind → Music, Reading room, Library, TV, Internet. etc.: Spirit → Pyramid Meditation etc.

Figure 2. Typical buildings in metropolitan Jakarta.

Since most buildings in big cities such as Jakarta are in close proximity, effectively resulting in minimal side-space, the remaining relevant communication between a building and the environment is essentially its road-facing aspect. Therefore we don't need to worry too much about the building envelope design (OTTV) only RTTV. See Figure 2.

ENERGY EFFICIENCY - ACTIVE & PASSIVE DESIGN

As it is shown in figure 2, Most of the buildings in Metropolitan Jakarta are in close proximity, therefore most of these buildings are using either air conditioning units or mechanical ventilation system to achieve the thermal comfort, these methods will consume a lot of electrical energy both for AC, ventilation and lighting, it is hardly possible to use natural ventilation in this close proximity unless otherwise are designed and prepared using bio-climatic architecture from the early stage such as applied in Pluit Resident house.

1.0 Passive Design Concepts

Pluit Resident house is also close proximity to the adjoining buildings, the OTTV of this building is almost Zero. RTTV is also very small due to green roof, PV panels, 2 water tanks, 3 parabolas, 2 outlets of voids and 1 sky lighting are all located in this flat roof.

This building is facing southern part (the road) where all the doors and windows are located as the openings of natural ventilation and designed from the early stage of using sky lighting to create natural ventilation to induce air speed of **>0.5m/s** in each floor system and day lighting system for non- air conditioned areas and **air conditioned area during daytime:**

- The first/ground floor area consists of: 1st bed room, guest room, car park, kitchen, living room and dining room. (see drawing Information)
  Louver Car Door (3mx3m), Front door (2mx2.8m), windows (6 sq meter) are facing south (the street) as the opening for natural ventilation.
  The total air conditioned areas in this first floor are 1st bed room (3m x 5m x3.2m (height)) = 15 sq meter and the living and dining room (3m x 10m x3.2m) = 30 sq meter, total area is **45** sq meter or **21%** from the total first floor area (210 sq meter).
- The second floor area consists of: 2nd bed room, 3rd bed room and master bed room, and 3 voids for stack effect and sky lighting chimneys (see drawing information).
  The door (1.2m x2.8m), windows (7 sq meter) are also facing south as openings.
  The total air conditioned areas in this 2nd floor are 2nd bed room (3m x 5m x 3.2m) = 15 sq meter, 3rd bed room (3m x 6m x 3.2m) = 18 sq meter, master bed room (10m x 4.5m x 3.2m) = **45** sq meter and total area are **78** sq meter or **42%** of the 2nd floor area (184 sq meter).
- The third floor area consists of: Library, reading/study room, gymnasium, music or karaoke room. (see drawing information).
  Door (1.2m x2.8m), windows (7 sq meter) are also facing south as opening.
  The total air conditioned areas in this 3rd floor are Library (4m x 7m x 3.2m) = 28 sq meter, reading/study room (3m x 6m x 3.2m) = 18 sq meter, gymnasium (4m x 7m x 3.2m) = 28 sq meter, music or karaoke room (3m x 5m x 3.2m) = 15 sq meter, the total areas are **89** sq meter or **48%** of the 3rd floor area (187 sq meter).
- The flat roof /fourth floor is non air conditioned area with the total area of 200 sq meter. There are 2 outlets of voids and 1 sky lighting, 1 Gazebo for leisure, Pyramid meditation, solar PV panel (2.5m x 9m) to generate 2400 w of electricity, under this PV panel there is also leisure area and green roof. (see building information).

1.1 **Climate in Jakarta area**.

Figure 3, 4, and 5 show the Dry Bulb Temperature, Relative Humidity (RH) and Wet Bulb temperature of Jakarta area for 1 year period respectively.

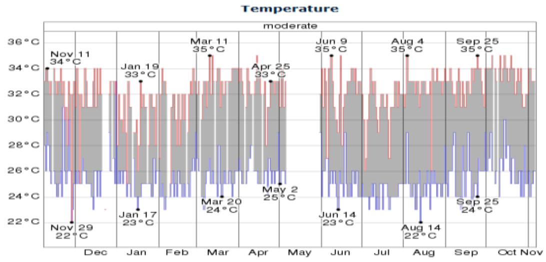
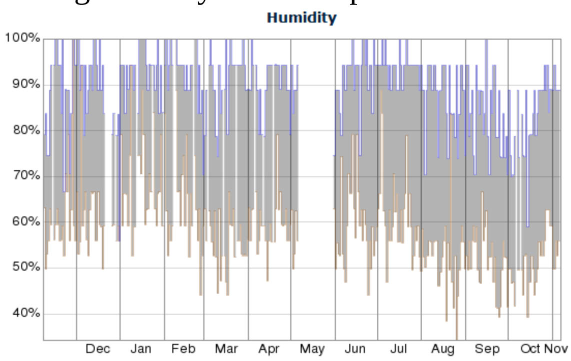


Figure 3 Dry Bulb Temperature of Jakarta

The Dry Bulb Temperature of Jakarta area is ranging from 24 ºC up to 34 ºC



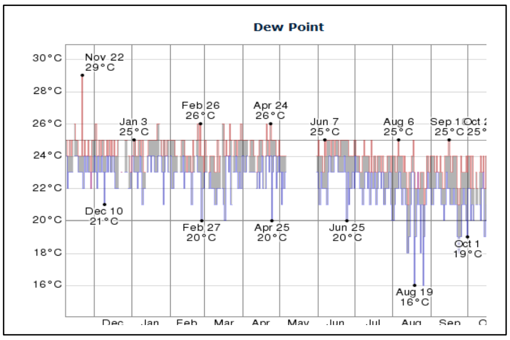


Figure 4 The RH of Jakarta 55% -95%

Figure 5 Dew point of Jakarta 22 ºC- 25 ºC

Based on ASHRAE research, figure 6 shows us the area in Psychometric chart for natural ventilation (red circle) the temperature is ranging from 24 ºC-32.2 ºC and Relative Humidity is ranging from 30% - 95%, therefore it is possible to use natural ventilation in Jakarta climate condition to maintain the thermal comfort condition provided that the air speed is maintained at **0.4- 1.0m/s** see figure 7.

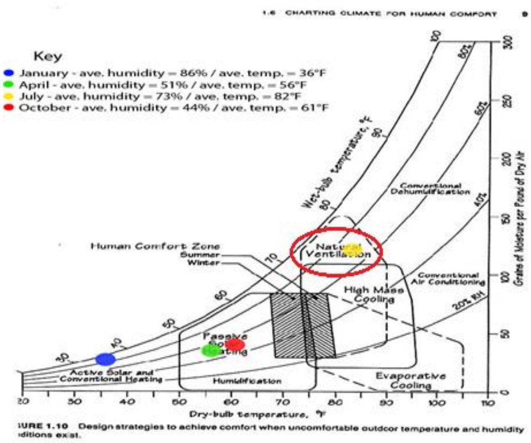


Figure 6 Natural Ventilation

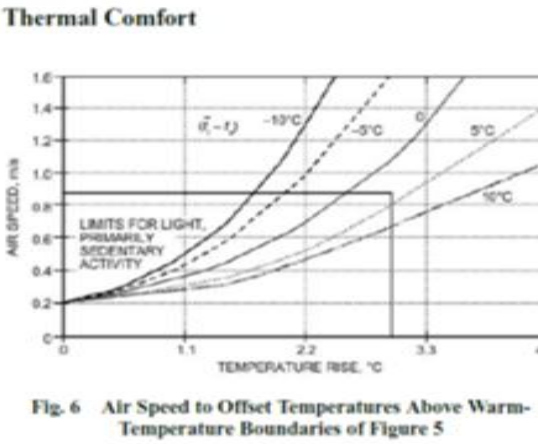


Figure 7 Increasing air speed to offset temperature

1.2 Natural Ventilation

By using bio-climatic of Jakarta, figure 3, 4 and 5. It is possible to create natural ventilation. The natural ventilation of this building is created by 2 voids and 1 sky lighting void as stacks effect (figure 8) and all the floor to ceiling height is **3.2m** i/o 2.7m as usual. However sky lighting void (figure 9) is mainly designed as stack effect plus temperature difference to create natural ventilation and day lighting during the day. By using sky lighting, the air at the 3rd floor (figure 10) will be heated by the solar radiation which heat the top stairs first, therefore the temperature of the air will rise **5 ºC -10 ºC** comparing with the lower floor temperature, this will create the buoyancy force to push the hot air out to the ambient air from the louvers of sky lighting and will induce a negative pressure below, this negative pressure will create a natural ventilation with air velocity > **0.5 m/s** in each floor which will maintain the thermal comfort as recommended by ASHRAE in non-air conditioned area **as well as air conditioned areas** (bed rooms, living room, dining room, library, reading room, gymnasium) during day time . See figure 11,12,13

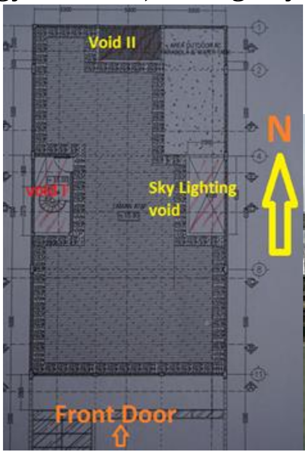


Figure 8: 3 Voids

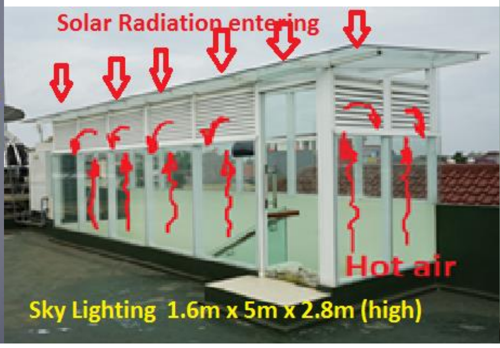


Figure 9 Sky lighting with clean glass And louvers (0.6m x 8m)

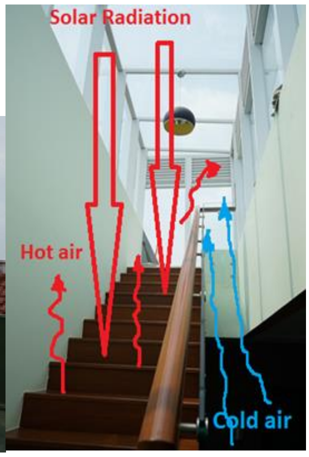


figure 10 room below Sky lighting

Figure 11 Natural Ventilation in 1st floor

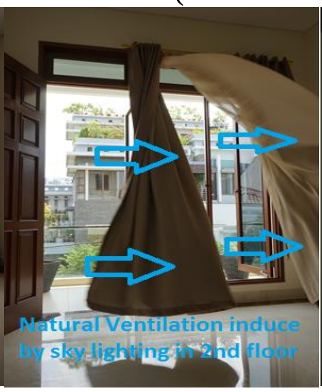


Figure 12 Natural ventilation in 2nd floor

Figure 13 Natural Ventilation in 3rd floor

It is clearly seen in figure 11, 12, 13 that the air speed induced by this natural ventilation of sky lighting is very powerful that the curtains were blown with air speed of more than **1.0m/s** even if the doors are fully opened.

This sky lighting will also produce day lighting in none air conditioned area, see figure 14, 15 and 16 for 1st, 2nd and 3th floor respectively. And also suck the hot air up to the sky lighting. The 1st floor void area is 4m x 5m, and the 2nd floor void area is also 4m x 5m, however the 3th floor void area is 1.5m x 5m. This smaller area is to prevent the solar radiation from sky lighting entering to the lower floor to reduce solar heat gain to the lower floor but still big enough to pass the cold air up and create natural ventilation and diffuse radiation to the lower floor.

Figure 14 day Lighting 1st fl

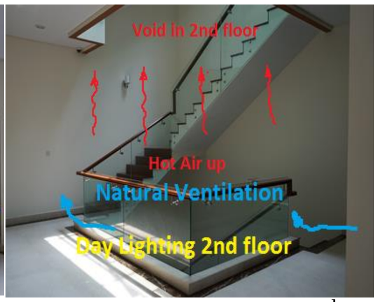


Figure 15 day Lighting 2nd fl

Figure 16 day lighting 3rd fl

2.0 Active Design Concepts

2.1 Air-conditioning system in this Pluit residential house is used 10hp VRF air conditioning unit with some modification to installed Brazed Plate Heat Exchanger (PHE) to generate free hot water (up to **50 °C) from the hot refrigerant gas discharge from the compressor** see figure 17.

Summary table:

VRF AC 10 hp (8 Ton)	Efficiency (kW/ton)
Total VRF (A)	1.3 kW/Ton
Hot water pump (B)	0.015 kW/Ton
Condenser water pump (C)	0
Cooling tower (D)	0
System efficiency (A + B + C + D)	**1.315 kW/Ton**

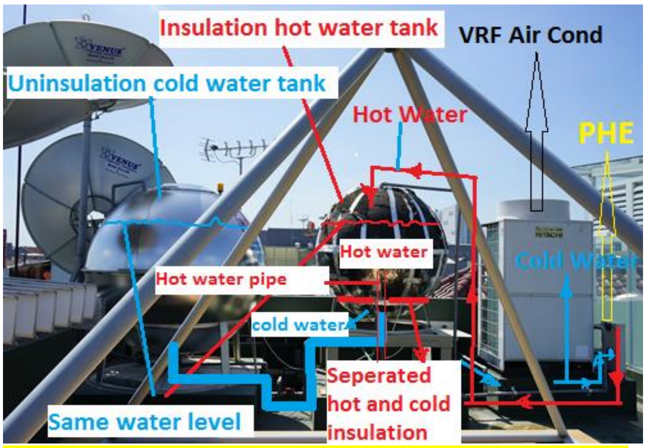


Figure 17 VRF AC with insulated hot water tank

Figure 17 shows us the modified VRF air conditioning system with insulated hot water tank and un-insulated cold water tank. When the VRF unit is running, a hot water pump will be activated to circulate cold water from the bottom of insulated hot water tank to Plate Heat Exchanger (PHE) to generate hot water from the discharge refrigerant gas from the compressor. This hot water will fill the top part of the hot water tank.

Inside hot water tank, we installed hollow insulation to separate the hot water at the top of the tank with cold water at the bottom of the tank, this cold water part is connected to the cold water tank to maintain the same water level between cold water tank and hot water tank. Therefore the pressure of the cold water and hot water will be the same and no need to use water pump to distribute the cold water and hot water to the building just use gravitation force to distribute it (the height of water level to the flat roof is 2.8m).

Almost all the lights **(98%)** in this Pluit Resident House used **LED light**, and we hardly turn on the light during the day time because of day lighting generated from the sky lighting, and two others void in this building. The light load in this building is only **3.4** W/sq meter.

The Air conditioning load is **130** w/sq meter and the ventilation rate is calculated using ASHRAE 62.1 standard or **10** CFM/person in the bed room, however we hardly use air conditioning even at the bed room during the day time because of the natural ventilation generate from the sky lighting when we open the window (since each bed room have windows and cross open door for natural ventilation).

There are 12 CCTV cameras installed in this building for monitoring and security purpose, 7 units are in ground floor,(2 units are monitoring the gate, 1 unit is installed at the car part, 1 unit is at the kitchen, 1 unit is at the living/dining room and 1 unit is at the 1st bed room). 1 unit is at the second floor to monitor the people up and down the stair, 2 units are at the third floor (1 is at the gymnasium room, 1 unit is monitoring the people up and down the stair), and

2 units are at the flat roof to monitor the people up to this floor and monitoring of the equipments.

RENEWABLE ENERGY

We installed on grid 48 solar PV panels @ 50W output with the total installed capacity of 2400 W at the flat roof, and divided into 3 groups and using 3 units of solar inverter @ 1500 W output to connect on 3 phase grid 16 kW capacity. The total area occupied by these solar panels is 2.5m x 9m. See picture 18.
The average electric energy generated with these PV is **12 kWH/day** and total energy generated is **4380 kWH/year** with the equivalent in **USD 526/annum.** This energy will replace **25.7%** of the total building energy consumption from the grid (**17065 kWH/year**).

The total investment of this 48 solar PV panels with 3 on grid solar inverters is Rp. 80,000,000.- or USD 6,667.-, since we can save USD 526/annum, then the pay-back period is USD 6,667.- : USD 526.- = **12.7 years.**

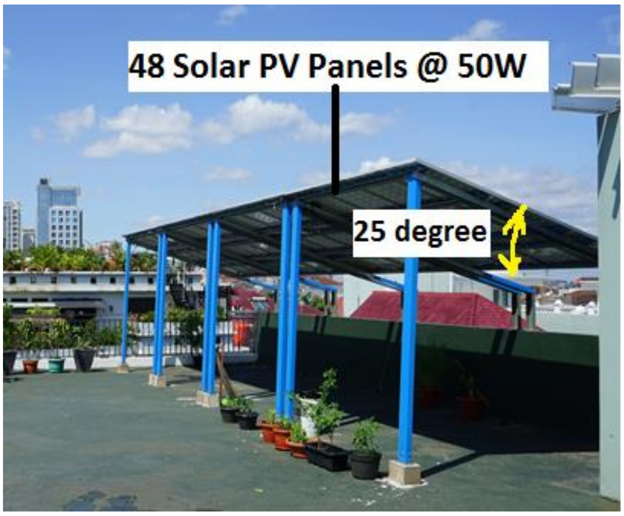


Figure 18: 48 pcs Solar PV Panel @ 50W

Figure 18 shows the solar PV panels installed at the flat roof tilting facing west with 25 degree to optimize the solar energy and to have self-cleaning purpose.
Figure 19 is the on grid solar inverter @1500 W output x 3 units.
Figure 20 is the display of this on grid solar inverter showing the total electricity generated per day, MPPV voltage of the solar panel, the grid voltage etc.

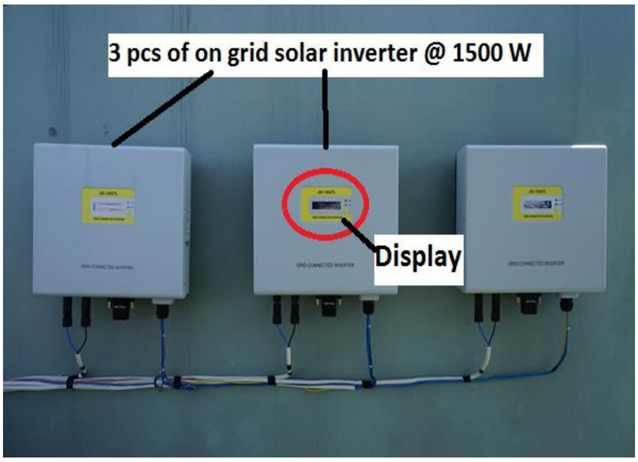


Figure 19: 3 pcs on grid solar inverter @1500W

Figure 20: Display of on grid solar inverter

WATER EFFICIENCY

As it is explained in section 2.0 and figure 17, that the water distribution of this Pluit residential house is using gravitation force to distribute the whole cold as well as hot water system, therefore the water pressure to each floors is ranging from 0.5 kg/sq cm at the 3^{rd} floor to 1.2 kg/sq cm at the ground floor, this low water pressure will not create any problem to the fittings and water flow rate, in addition to that, it will save a lot electric energy since no water pump is used.

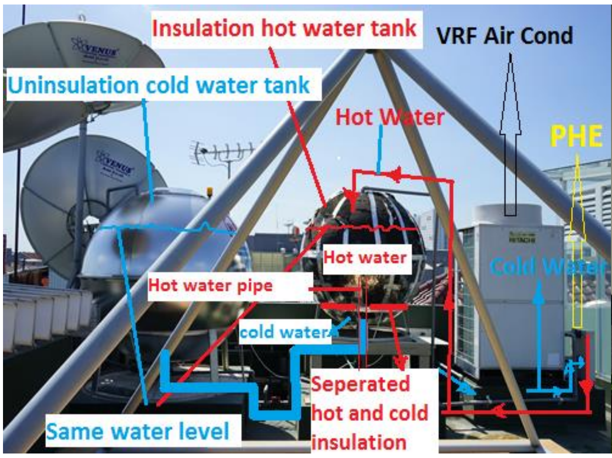


Figure 17 Cold water tank and hot water tank with Equalized pipe to maintain the same water level.

Figure 21 Rainwater harvesting garden

In order to conserve the rain water, we develop rainwater harvesting garden at ground floor (4m x 6m) to prevent rainwater pass through to the water drainage directly. See figure 21, this will preserve fresh water in the ground.

In addition to that we also collect rain water from the solar panels (2.5m x 9m) for watering green roof.

Therefore during the raining season, we hardly used any tap water for gardening.

ENVIRONMENTAL SUSTAINABILITY

Most of the building materials used in this building such as, marble, door wood, window wood, stairs, furniture, glass, tables, chairs are locally made and environmentally friendly products with green label.

There are 4 greenery areas in this building: see figure 21, 29, 30 and 31

Rainwater harvesting garden at the ground (4m x 6m) see picture 21.

Figure 21 Rainwater harvesting garden

We hardly believe that in the metropolitan city like Jakarta, this rainwater garden will still attract so many biodiversity: such as birds (figure 27), butterfly, dragon -fly (figure 24, 25), frogs, bees, insects, bats etc.
In the morning and evening, Birds (figure 27) will come to pick up some red fruit in this tree. (see figure 23). In the morning some bees, butterfly and insects are picking up pollen from the flowers (figure 28).

Figure 23 Red fruit

Figure 24 Dragon fly

Figure 25 Dragon Fly

Figure 26 Insect

Figure 27 Bird

Figure 28 Flower

Figure 29 Greenery Under 2nd Void

Figure 30 Greenery at Mezzanine at 2nd floor

Figure 31 Greenery at green roof

The Building environment not only should be sustainable to the surrounding but also should be harmonized with the people living in that building.

As explained in the first paragraph, that this building is designed for the harmonized relationship among Human, Environment and the Bio-climatic, therefore:
The environment of this building should fulfill the requirement of Human needs: **Physical Body, Mind and Spirit**. As Maslow's (1943, 1954) hierarchy needs figure 27. Pluit Residential house provide all those needs including Gymnasium, Music, Library with more than 2000 books, Reading/study room, 4G internet connections for digital library to supply the up to date information and International journal. Not only our body need exercise, but our mind and spiritual also need exercise by using Pyramid meditation for self- actualization.

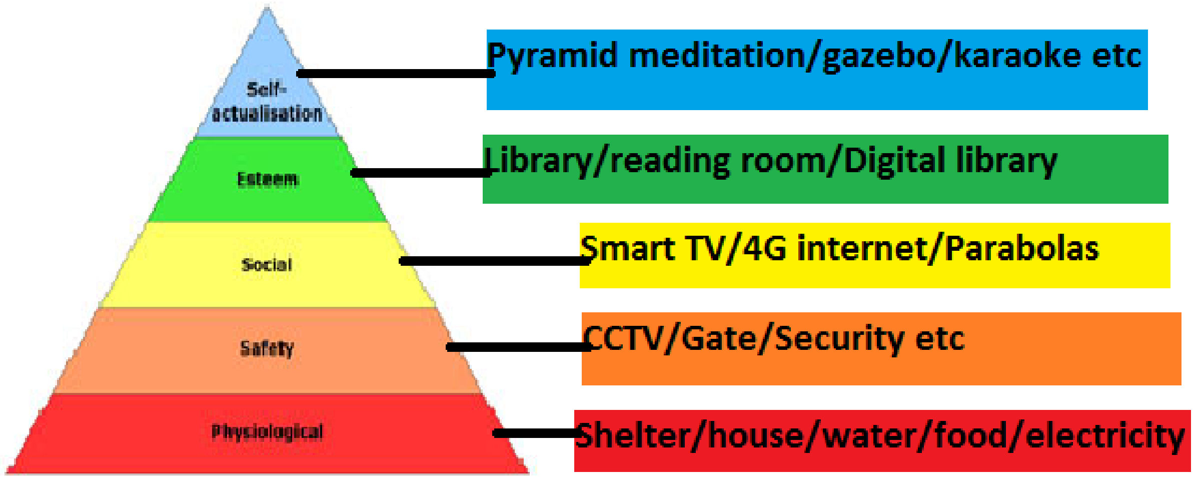


Figure 27 Maslow's hierarchy needs

INDOOR ENVIRONMENTAL QUALITY

Indoor environmental quality is inarguably one of the most important characteristic of green buildings intended for human occupancy. The benefits of improving the learning, living, work-place and resting environment (all aspects of indoor environmental quality) and feeling of well-being can yield big gains in human productivity, living quality and improving the standard of living.
The four major aspects of indoor environmental quality are **indoor air quality**, **thermal condition, illumination and acoustics.**

1. **Indoor air quality (IAQ)**
   Good IAQ is defined by the absence of harmful or unpleasant constituents such as pollutants, metabolic products (CO_2, smell) and Volatile organic compound from building material. The major means for achieving good IAQ are eliminating or reducing the sources of those pollutants in the building such as use non VOC paint or no smoking areas as it is applied in this Pluit residential house, or using good ventilation to eliminate unavoidable pollutants such as CO_2 or smell from metabolic products (use natural ventilation by sky lighting for non- Air Conditioned area and use ASHRAE Standard 62.1 for Air Conditioned area).
   - We divided into 2 areas of ventilation rate: none air conditioned area and air conditioned area.
     a. Non- air conditioned area

Since we use natural ventilation system induced by sky lighting and 2 voids stack effects we don't need to worry too much about IAQ for this area since the number of ventilation air is more than 3 x Air Change per hours (3 x ACH) this high ventilation rate will dilute most of the pollutants, therefore good IAQ is automatically achieved see figure 28.

Figure 28 Shows the number of CO_2 concentration measured in non- air conditioned area is less than 440 ppm, which is far below standard CO_2 should be < 1000 ppm, even if the temperature is 30.4 ºC, and the RH is 69.2% since the air speed in this non air conditioned area is > 0.5m/s, we still fill comfortable.

Figure 28: CO2, Temperature and RH in non- air conditioned area

b. Air conditioned area

We implied the ASHRAE standard 62.1-2010 to calculate the rate of breathing ventilation rate see table 3:

Table 3 Total Ventilation Air Requirements

Area Based	Occupancy Based
0.15 L/s per square metre of floor space	3.5 L/s per person, based on normal occupancy

For the bed room with the room area of 15 sqm with 2 persons, the request ventilation rate is: 0.15 L/s x 15sqm + 2 persons x 3.5 L/s per person = 2.25 L/s + 7 L/s = 9.25 L/s → 19.59 CFM/2 persons or ~ 10 CFM/person as stated in section 1.

Figure 29 and 30 shows the CO_2 concentration, temperature and RH in air conditioned area for one person and two persons attend respectively. Both show almost no difference in temperature and RH, however the CO_2 concentration is quite difference, for two persons attend, the CO_2 concentration increases by 70 ppm but both are still < 1000 ppm. (The Maximum allowable CO_2 concentration).

Figure 29: one person attends
In air conditioned area

Figure 30: two persons attend in air-conditioned area

In addition to this we also use recommended pre filter MERV 6 or 7 (G4 European standard) to filter the particles with the size of PM 2.5 (2.5 micron) up to PM 10 (10 micron) as it is requested by ASHRAE standard 52.2

2. Thermal Comfort

The primary reference standard for designing a thermally comfortable space is ANSI/ASHRAE standard 55-2010, *Thermal Environmental conditions for Human Occupancy.* See figure 31.

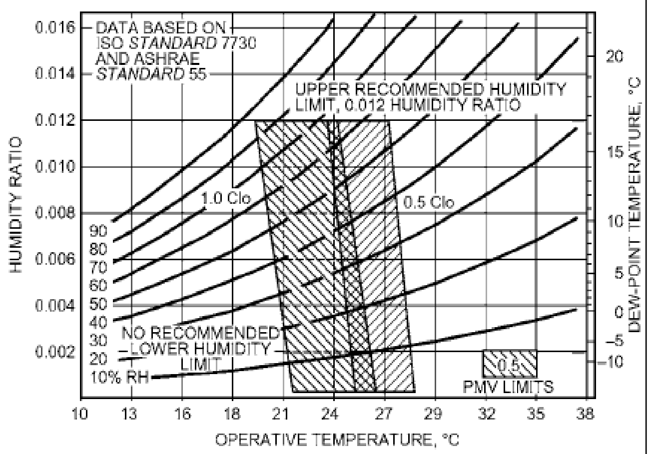


Figure 31 ANSI/ASHRAE standard 55-2010

Figure 31 shows the psychometric chart applied for Air Conditioned area where the air speed is designed < 0.2m/s.
For Natural ventilation case where we can increase the air speed to compensate/offset the warm air temperature see figure 32 (figure 7). This figure shows us, even though the warm air temperature is 30 ºC (as for Jakarta case), provided the air speed is 1 m/s, we will still feel thermally comfortable since the operative air temperature will become 27 ºC (30 ºC-3 ºC see figure 32).

Thermal Comfort

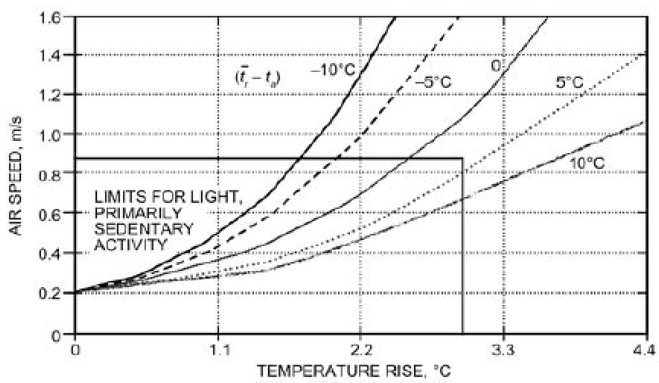


Fig. 6 Air Speed to Offset Temperatures Above Warm-Temperature Boundaries of Figure 5

Figure 32/figure 7 Air speed to offset above warm Temperature in figure 31

For non- air conditioned area, we utilize figure 32 by using sky lighting and 2 voids system to obtain the thermally comfort zone since the air speed generated by natural ventilation can produce up to 1 m/s air speed. see figure 11, 12 and 13.
For air conditioning area, we design the room temperature is 25 ºC+/- 1 ºC and RH 55% +/-5% as it is recommended by ASHRAE standard 55-2010 (figure 31). Whereas for non-air conditioned area is depended on the ambient air of Jakarta see figure 3, 4 and 5 with the offset warm temperature from figure 32/figure 7.

3. Illumination

Maintaining and designing proper light levels is crucial for virtually all human occupancy. Insufficient or impropriate illumination can result in other health and safety hazards as well as poor performance on tanks requiring good illuminations. However energy efficiency in illumination is also very important part of energy efficiency of the building.

In order to save the lighting energy, **98%** of the lighting in Pluit residential house is used LED lights with the lighting energy of 3.4 w/sqm or 2 w/sqm (gross area), each room/zone will be controlled using at least 2 light switch controllers to reduce or to increase the intensity of the room/zone, and each room is designed by using 300 lux lighting intensity (maximum) including the bed room. During the day time almost none of the light is on due to the day lighting generated by sky lighting see figure 34, 35. Figure 33 shows the lighting intensity at night when one, two and three light switch controllers is on respectively.

Figure 33 one light on 177 lux two light on 226 lux three light on 302 lux

Figure 34 shows the lighting intensity due to day lighting at non-air conditioned area at 9.05 AM, the intensity is 309 lux and air conditioned area (bed room) is 756 lux. Figure 36 is the 12W LED light used in Pluit residential house.

Figure 34: Non-Air conditioned Illumination 309 lux

Figure 35: air condi tioned illumination 756 lux

Figure 36: 12W LED light

4. **Acoustic**

Many sources of acoustic dissatisfaction are related to the design of the building, especially if those building used day-lighting and natural ventilation system. Since day-lighting and natural ventilation systems usually use larger amounts of glass and bigger openings located at the perimeter of the building which will lead to more sound transmission into and between spaces.

Pluit residential house, however design using different approach instead of using larger amounts of glass and bigger openings at the perimeters, used sky lighting located at the flat roof in the right center of the building to generate the day-lighting for the lower floors. Natural ventilation will also be introduced by the stack effect and big temperature difference due to the solar radiation at the room below the sky lighting as explained in section 1.0. The common areas such as living room, dining room, and master bed room are located at the back of the building which is far from the openings at the front doors/road. Therefore the noise/acoustic in this building is reasonable quite.

OPERATION AND MAINTENANCE & OTHER GREEN FEATURES, AND INNOVATION

The best designed, constructed, and commissioned building will, over time, degrade in performance if it is not properly operated and maintained.

In order to maintain high performance building and sustainable environment building, a preparing plan of monitoring operation of equipment should be well document as building standard of operation procedures (SOP).

1. Air Conditioning system:
   Since air conditioning system contribute so much on indoor air quality and thermal comfort condition in the building as well as consume the most electrical energy of the whole building for the air conditioned areas, therefore monitoring the operation of air conditioning unit is the most priority in operation and maintenance.
   The standard of operation procedure of air conditioning unit is as follow:
   Weekly and monthly monitor: We use IAQ50 (figure 29, 30) to monitor and measure the C02 concentration, Humidity and temperature of the rooms and check the filter light indicator, if this filter light indicator in on, it means we have to clean the filter as well as clean the indoor unit. For outdoor unit we usually clean the outdoor unit coil monthly, and check the suction pressure, discharge pressure and the current and voltage of the outdoor fan and compressor.
2. Non-air conditioning area:
   Weekly: Since the most part of the natural ventilation is sky lighting, therefore we clean the glass of sky lighting and its louvers weekly to make sure the solar radiation is big enough to enter to the lower room and let the hot air escape from these louvers.
3. Solar PV Panels:

   Daily and weekly: As explained in Renewable energy section that the solar PV panels contribute 25.7% of the total electric energy from the grid, therefore it is very important to monitor and maintain the performance of this solar PV Panel. We use WIFI Plug installed in those 3 solar inverters, therefore we can monitor and record the total electricity generated in these solar PV and make a graph to see the down turn of these solar PV, if the average electric energy generated less than 8 kWH/day (the average is 12 kWH/day) then we need to clean the solar PV using water.

Green Building and innovation features in this building:

- Implemented the bio-climatic architecture concept using sky lighting system to create natural ventilation and day lighting system in a proximity building in metropolitan city which will save a lot of electric energy of air conditioning, mechanical ventilation, and lighting system and still maintain the indoor environment quality of the building.
- Using modified VRF air conditioning system to generate a free hot water up to 50 degree C.

- Using 2 water tanks, one with insulated tank for hot water and the other un-insulated tank for cold water and connected with equalizing pipe to maintain equal pressure both for cold and hot water and distributed that cold and hot water in the whole building without using a water pump. And save a lot of electricity for the distribution pump.
- Use renewable energy of solar PV panels which generated electricity energy average of 12 kWH/day or 25.7% of the total energy from the Grid.
- Use rainwater garden at the ground floor to preserve the rain water of running to the drainage. And to attract bio-diversity in big city like Jakarta.
- Use 4 greenery gardens to create a micro-climate surrounding the building.
- Use 4 G internet connection to monitor the CCTV, to watch smart TV's, to collect the up to date information and latest journals from digital library.
- Use Gymnasium facility for physical exercises.
- Use Pyramid meditation for mind and spiritual exercises.
- Use 3 parabolas to watch world news.

BUILDING INFORMATION

A. General Information

1. Name of the building : Pluit Residential House
2. Name of owner : John Budi Harjanto Listijono
3. Address : Jl. Pluit Selatan VIII/22, Jakarta - Indonesia
4. Tel. No ./E-mail address : +62 21 6690321/ jbudi@indosat.net.id

B. Building Physical Information

5. Physical building background
   - Brief history : Totally dismantle in Jan 2012, completed March 2013
   - Single function usage or mix function usage (specify): Residential House.
6. Age of building : 1.3 year
7. Any retrofit done? When? What?: none
8. Total number of storeys : 3 storeys and 1 flat roof.
9. Total number of basement floor: none
10. Number of car park storeys : 2 car park.
11. Total gross floor area: 781 sq meter
12. Surface area of the envelope including the roof to gross floor area ratio: 320 sq meter or 41% of gross floor area.
13. Car park area: 40 sq meter.
14. Gross lettable area: none
15. Air-conditioned area: 212 sq meter
16. Non-air conditioned area : 569 sq meter
17. Plot ratio (total GFA / ground area) : 3.124

C. Building Design and Practice Information

18. Plants and landscape design/ wind and natural ventilation/ water features/ daylighting/ etc. Use 2 voids and 1 sky lighting to crease natural ventilation and daylighting.

Rainwater ground garden to preserve fresh water of running to the drainage and green roof.

19. Facade and shading design: close proximity with adjoin buiding (OTTV ~ 0)
    - Type of façade : use ray bent glass for windows:
    - Color of façade: 60% dark.
    - Use of shading devices: none
20. Location of service core : 1st void on the left center side of the building.
21. Shape of building: Rectangular.
22. Overall heat transfer through building envelope:
    Wall ~ 0W/m^2; Roof < 20 W/m^2
23. Lighting fixtures
24. *Lighting load 2 W/m^2 (gross floor area) in common area 3.4 w/m^2
25. Building air-conditioner system and equipment
    - Fresh air exchange rate: 18 m^3/hour/person
      2.4 m^3/hour/m^2
      0.75 m^3/hour
    - Energy efficiency of air condition VRF: 1.3 kW/ton
26. Cooling Load 130 W/m2 (air-conditioned area)

D. Operation Information

27. Occupancy rate (year 2001): Minimum 80 % of total area
28. Total number of occupants: 5 persons
29. Ownership of building (occupied by owner(s), renter(s), etc.)
30. Building operating schedule
    - weekdays from ________________ to ________________
    - Saturday from ________________ to ________________
    - Sunday from ________________ to ________________
    - Operating hours/ yr 8760 hours: 8760 hours/year.
31. Building indoor environment: Indoor air quality setting:temperature 25 ºC+/- 1 ºC and the relative humidity is set at 55%+/-5%.

E. Energy Consumption Information: 1. Grid → 17065 kWH/year (8760 hours).
   2. Solar PV Panel → 4380 kWH/year (8760 hours)
   Base on 2000 hours: Net Energy Consumption: 3896.11 kWH/year or EEI 18.4 kWH/sqm.year based on Air Conditioned area.

32. Peak demand (monthly) 1553 kWH/month in October (24 hours/day).
33. Energy used (monthly) 1422 kWH/month (24 hours/day).
34. Typical Load curve (weekdays, weekends)
35. * Energy efficiency index: air-conditioned area 18.4 kWh/m^2/year
    (based on 2,000 operational hours/year), based on gross area will be 5 kWH/ m2/year
36. Energy consumption: Electricity _3896.11 kWh/m^2/year
    (based on 2,000 operational hours/yr)
    - Fuel 0 Liters/year (not for electricity generation)

F. Energy Management Information

37. Building energy management system Connected physical points ________ (no)
38. Energy saving: Schedule programme ______ kWh/yr
    Duty cycle programme ______ kWh/yr
    Optimum start / stop programme ______ kWh/yr
    Power demand programme ______ kW (mean)

G. Maintenance Information

39. Maintenance programme
    - Manpower: 20 man-hr/yr
    - Maintenance contractor : none
    - Availability of energy management engineer : none
    - Training of maintenance workers: none cumulative hours/yr.

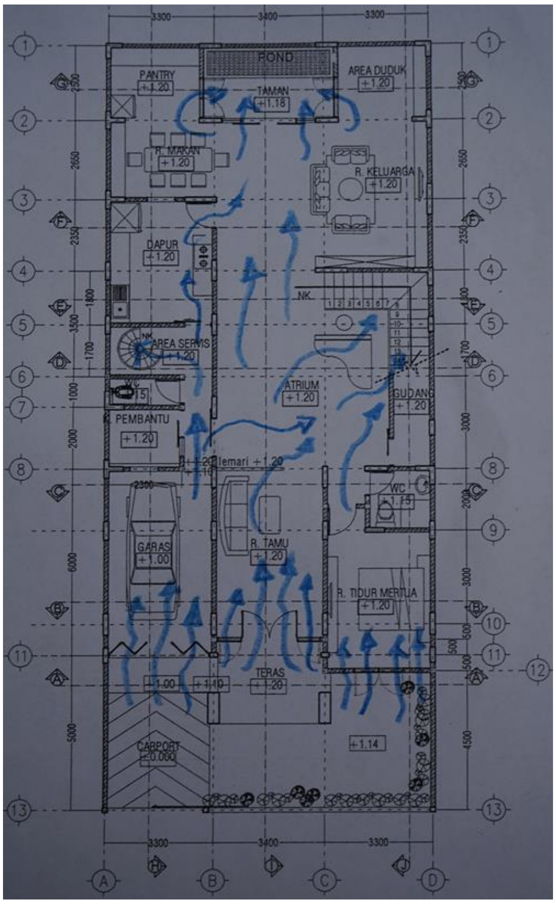
H. Environmental Impacts

40. Impacts of waste: none
41. Impacts of pollution (air, noise, visual, exhaust, etc.) very environment friendly

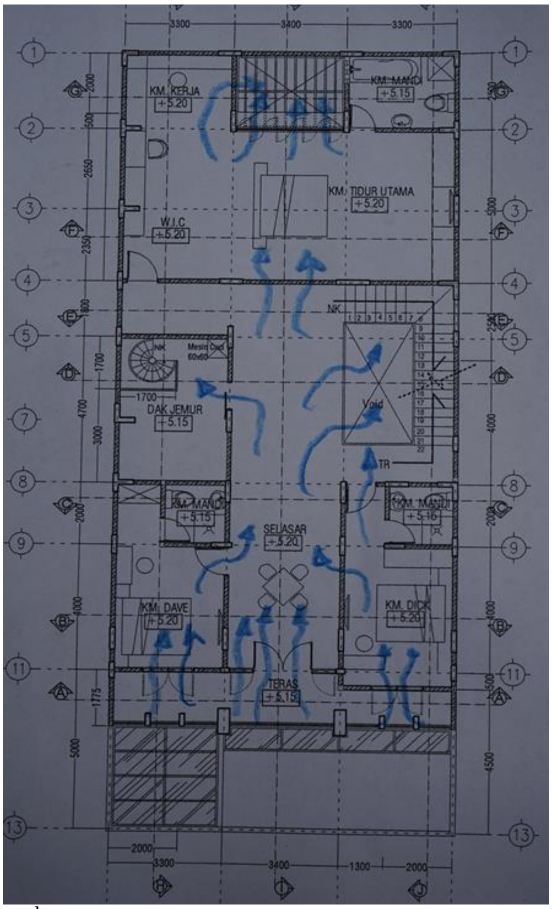
H. Additional Information for Retrofitted Buildings

42. *Energy savings in air-conditioned area none kWh/m^2/yr (based on 2,000 operational hours/year
43. *Energy savings in lighting systems none kWh/m^2/yr (based on 2,000 operational hours/year)
44. *Retrofitted area: none % of total area

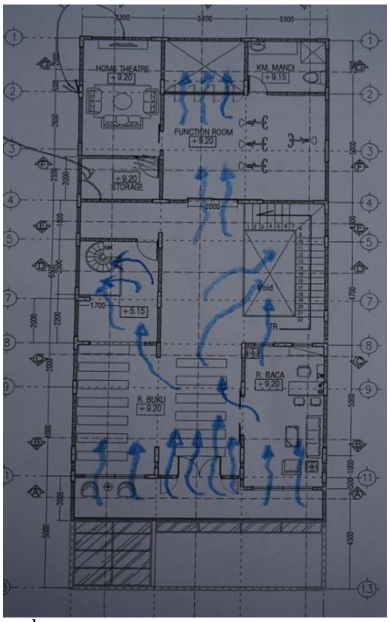
BUILDING INFORMATION



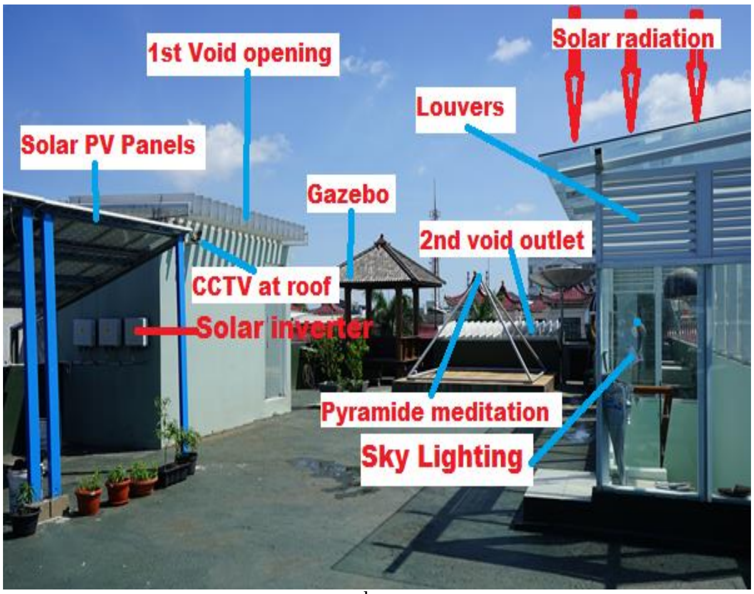
1st floor lay out with natural ventilation



2nd floor lay out with natural ventilation



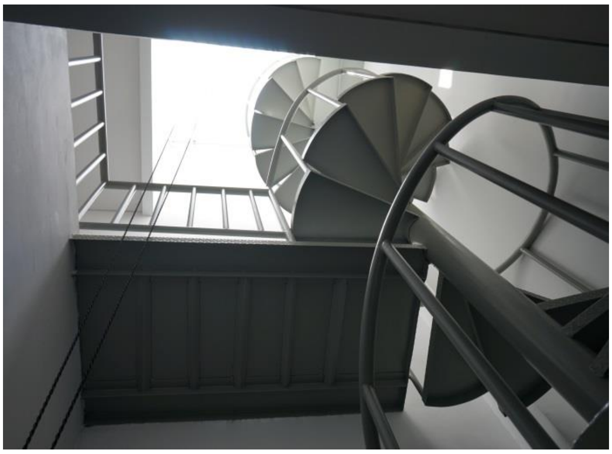
3rd floor lay out with natural ventilation



Flat roof/4th floor lay out

FRONT DOOR AND WINDOWS

1ST BED ROOM WINDOWS

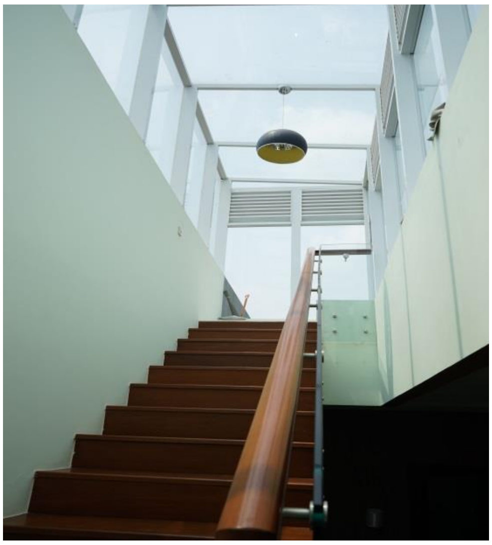


1ST VOID ON THE LEFT MIDDLE BUILDING

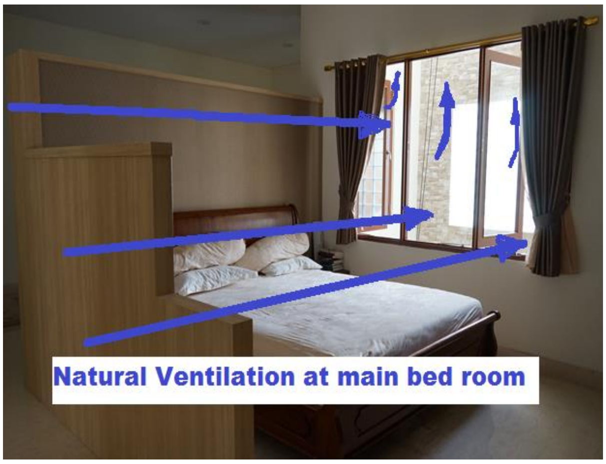
2ND VOID AT THE BACK OF THE BUILDING

1ST VOID AT 2ND FLOOR

1ST VOID AT 3RD FLOOR



SKY LIGHTING VOID AT 3RD FLOOR

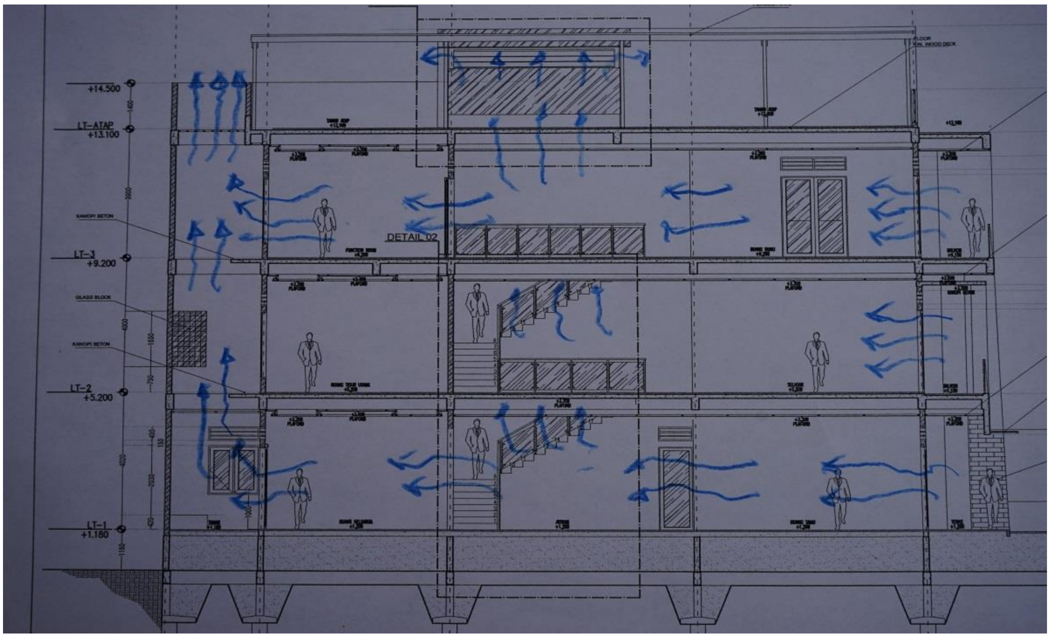


NATURAL VENTILATION AT MAIN BEDROOM

GYMNASIUM AT 3RD FLOOR

Natural ventilation at gymnasium at 3rd floor

Natural ventilation at library at 3rd floor



Cross section of the building shows natural ventilation flow to the voids

CCTV and Day Lighting at 1st floor

Flat roof at 4th floor

Flower at Rainwater harvesting garden

Insect at Rainwater harvesting garden

Soursop fruit at Rainwater harvesting garden

Car door Louvers at front door as openings