

BAB V KESIMPULAN

5.1 PENDEKATAN EXCELLENCE IN DESIGN FOR GREATER EFFICIENCIES

Tabel 5.1 Energy Saving dari Kedalaman Bangunan

Floor Plan Depth = 14 m	Saving Energy	Saving Water	Saving Material
North	2,02%	1,10%	3.12%
Northeast	-0,35%	0,08%	2.35%
East	-1,78%	0,95%	3.12%
Southeast	-0,33%	-0,07%	2.35%
South	2,02%	1,10%	3.12%
Southwest	-0,35%	-0,08%	2.35%
West	-1,78%	0,95%	3.12%
Northwest	-0,33%	-0,07%	2.35%

Sumber: Data Pribadi.

Floor Plan Depth*** m
Main Orientation***

Gambar 5.1 Kedalaman Bangunan

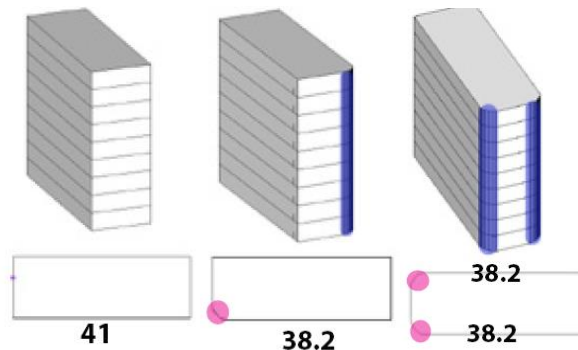
Sumber: Edge.

Dari tabel diatas menunjukkan jika orientasi tertinggi berada diarah utara dan selatan, sehingga mendapat gubahan memanjang dari timur ke barat, dan kedalaman bangunan semakin kecil semakin rendah energinya.

Tabel 5.2 Building Length

Building Length						
	Barat	Utara	Timur	Barat Laut	Selatan	Barat Daya
Lantai 1	7,6	38,2	14	3,3	38,2	3,3
Lantai 2	7,6	38,2	14	3,3	38,2	3,3
Lantai 3	7,6	38,2	14	3,3	38,2	3,3
Lantai 4	7,6	38,2	14	3,3	38,2	3,3
Lantai 5	7,6	38,2	14	3,3	38,2	3,3
Lantai 6	7,6	38,2	14	3,3	38,2	3,3
Lantai 7	7,6	38,2	14	3,3	38,2	3,3
Lantai 8	7,6	38,2	14	3,3	38,2	3,3
Total	60,8	305,6	112	26,4	305,6	26,4
Rata-Rata	7,6	38,2	14	3,3	38,2	3,3

Sumber: Data Pribadi.



Gambar 5.2 Gubahan

Sumber: Data Pribadi.

gubahan memanjang dari timur-selatan (desain pasif), gubahan dibentuk curved surfaces agar permukaan yang terkena matahari lebih sempit. Curved surface pada 2 sisi.

5.1.1 ENERGY SAVING

5.1.1.1 WINDOW TO WALL RATIO

Tabel 5.3 WWR

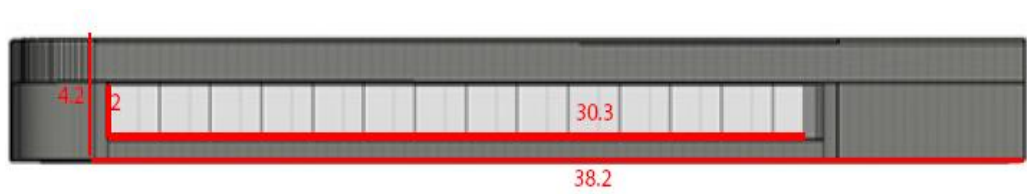
WWR						
	WINDOWS					
	Barat	Utara	Timur	Barat Laut	Selatan	Barat Daya
Lantai 1					51,73	
Lantai 2		60,6			60,6	
Lantai 3		60,6			60,6	
Lantai 4		60,6			60,6	
Lantai 5		60,6			60,6	
Lantai 6		60,6			60,6	
Lantai 7		60,6			60,6	
Lantai 8		60,6			60,6	
Lantai 9		60,6			60,6	
Total		484,8			536,53	

Sumber: Data Pribadi.

Tabel 5.4 Luas Dinding

	WALL					
	Barat	Utara	Timur	Barat Laut	Selatan	Barat Daya
Lantai 1					160,44	
Lantai 2		160,44			160,44	
Lantai 3		160,44			160,44	
Lantai 4		160,44			160,44	
Lantai 5		160,44			160,44	
Lantai 6		160,44			160,44	
Lantai 7		160,44			160,44	
Lantai 8		160,44			160,44	
Lantai 9		160,44			160,44	
Total		1283,52			1443,96	

Sumber: Data Pribadi.



Gambar 5.3 Wall dan WWR

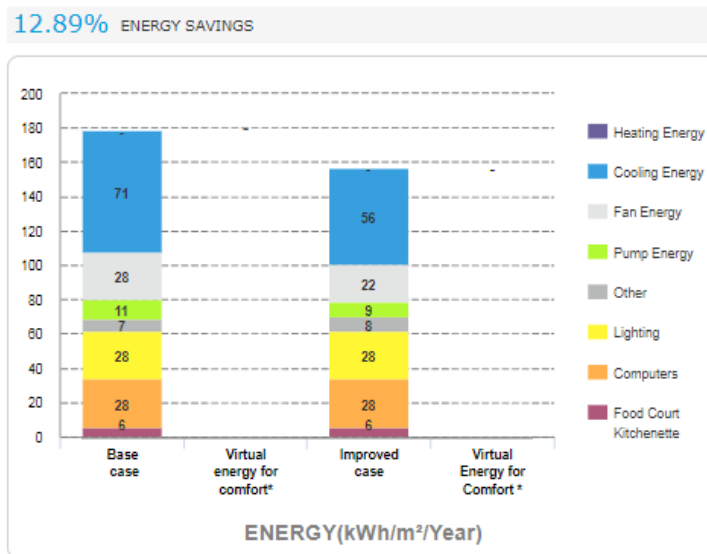
Sumber: Data Pribadi.

OFE01 - Reduced Window-to-Wall Ratio Calculator

Orientation	Wall Area (m ²) Example: 120	Glazing Area (m ²) Example: 60	Ratio in %
North	1443.96	536.53	37.16
South	1283.52	484.80	37.77
East			
West			
Northeast			
Northwest			
Southeast			
Southwest			
Total			
		2,727.48	1,021.33
			WWR
			37.45%
Insert calculated value on measure?			Insert
			Clear All

Gambar 5.4 Caculator WWR

Sumber: Edge.

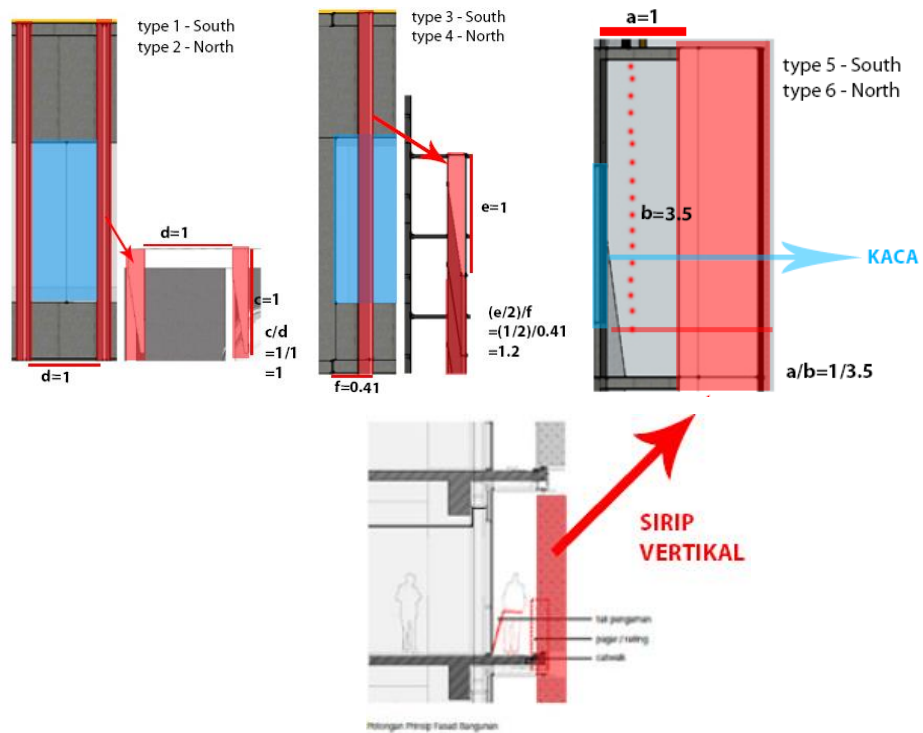


Gambar 5.5 Saving Energi

Sumber: Edge.

Luas dinding arah utara 1283.52 m² dan selatan 1443.96 m². Pada jendela dengan luas arah utara 484.8 m² dan selatan 536.53 m². Maka, energy saving yang di dapat pada WWR adalah 12.89%.

5.1.1.2 ANNUAL AVERAGE SHADING FACTOR



Gambar 5.6 Sirip Vertikal

Sumber: Data Pribadi.

Tabel 5.5 AASF

	AASF					
	utara			selatan		
	1	2	3	1	2	3
Lantai 1						
Lantai 2	1/3	1,219512	1	1/3	1,219512	1
Lantai 3	1/3	1,219512	1	1/3	1,219512	1
Lantai 4	1/3	1,219512	1	1/3	1,219512	1
Lantai 5	1/3	1,219512	1	1/3	1,219512	1
Lantai 6	1/3	1,219512	1	1/3	1,219512	1
Lantai 7	1/3	1,219512	1	1/3	1,219512	1
Lantai 8	1/3	1,219512	1	1/3	1,219512	1
Lantai 9	1/3	1,219512	1	1/3	1,219512	1

Sumber: Data Pribadi.

Window Type	Window Orientation	Window Area (m ²)	Overhang Type	Overhang Depth	AASF	Action
Type 1	South	58.8	Vertical Overhang	Du=WI (window overhang depth>window width)	0.23	
Type 2	North	58.8	Vertical Overhang	Du=WI (window overhang depth>window width)	0.23	
Type 3	South	58.8	Vertical Overhang	Du=WI (window overhang depth>window width)	0.23	
Type 4	North	58.8	Vertical Overhang	Du=WI (window overhang depth>window width)	0.23	
Type 5	South	58.8	Horizontal Overhang	Dh=H2 (window overhang depth=1/3 window height)	0.39	
Type 6	North	58.8	Horizontal Overhang	Dh=H2 (window overhang depth=1/3 window height)	0.39	

[Add Overhang Type](#)

Total Window Area 332.58 Overall AASF 0.28 [Insert](#)

Gambar 5.7 Calculator AASF

Sumber: Edge.

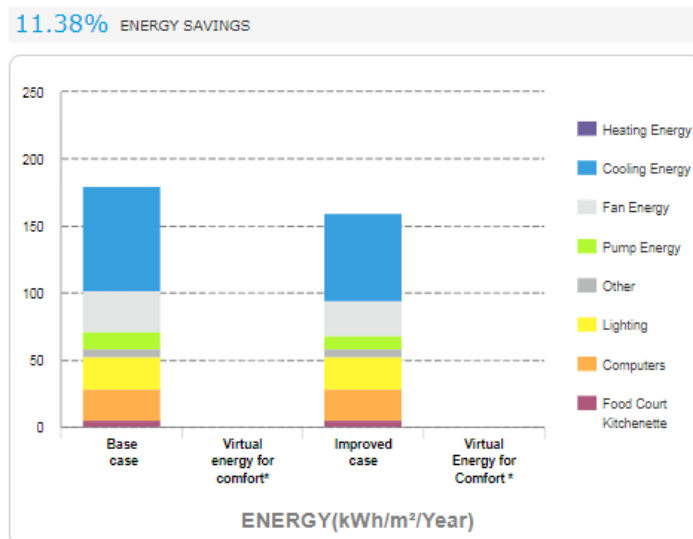
OFE04 External Shading Devices - Annual Average Shading Factor (AASF) of 0.28

AASF

[Upload Document\(s\)](#) | [Calculator](#)

Gambar 5.8 Checklist AASF

Sumber: Edge.



Gambar 5.9 Saving Energi

Sumber: Edge.

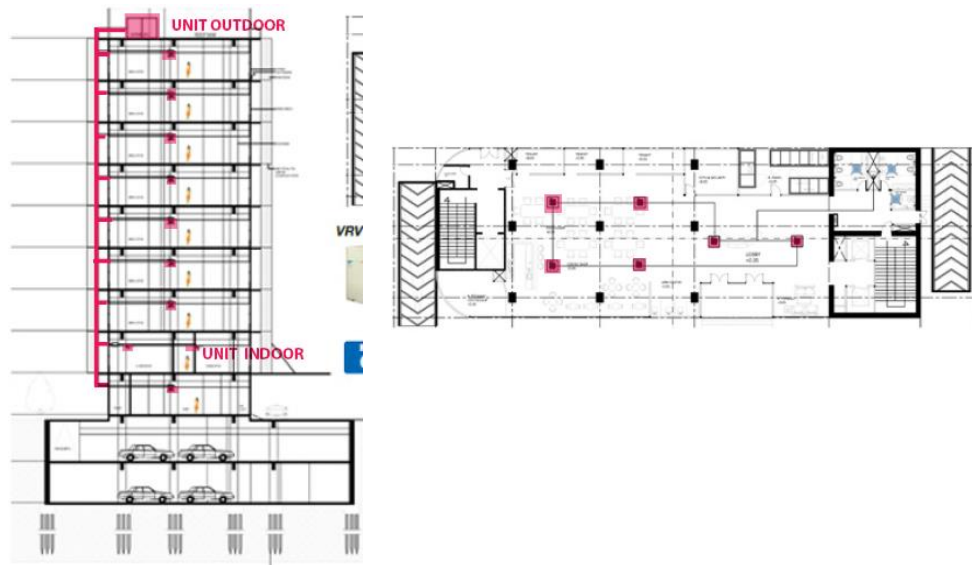
AASF yang didapat pada tipe 1 = 0.23, tipe 2 = 0.23, tipe 3 = 0.23, tipe 4 = 0.23, tipe 5 = 0.39 dan tipe 6 = 0.39. Maka, energi saving yang didapat pada AASF adalah 11.38%.

5.1.1.3 VARIABLE REFRIGERANT FLOW

Tabel 5.6 Perhitungan TR

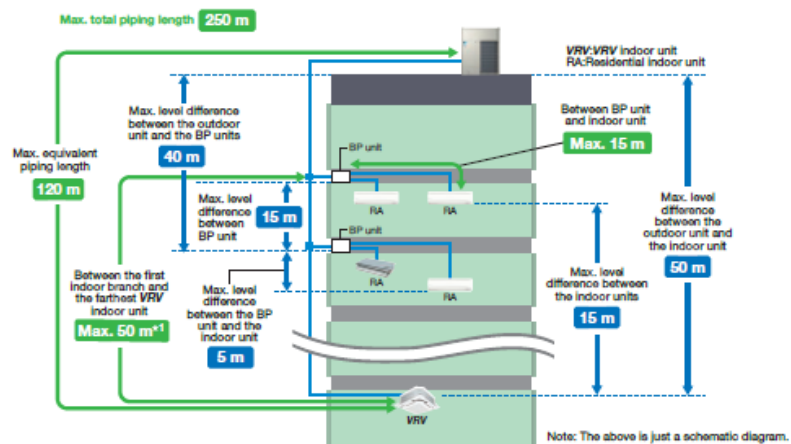
TR	61,9568	TR satu gd
	6,884088889	TR/It
	28	HP

Sumber: Data Pribadi.



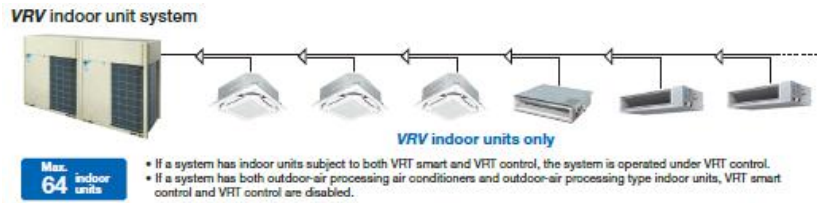
Gambar 5.10 Potongan dan Denah

Sumber: Data Pribadi.



Gambar 5.11 Skema VRF

Sumber: Brosur Daikin.



Gambar 5.12 VRF

Sumber: Brosur Daikin.

		HP	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	60		
VRF A SERIES	Single outdoor units		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	Double outdoor units																														
	Triple outdoor units																														

•Single Outdoor Units
6, 8, 10, 12 HP 14, 16, 18, 20 HP

•Double Outdoor Units
16, 20, 22, 24 HP 26, 28, 30 HP 32, 34, 36, 38, 40 HP

•Triple Outdoor Units
42, 44 HP

46, 48, 50, 52, 54, 56, 58, 60 HP

Gambar 5.13 VRF

Sumber: Brosur Daikin.

HP	kW	Capacity index	Model name	Combination	Outdoor unit multi connection piping kit ¹⁾	Total capacity index of connectable indoor units ²⁾	Maximum number of connectable indoor units ²⁾
6 HP	16.0	150	RXQ06A	RXQ06A	-	75 to 196 (300)	9 (15)
8 HP	22.4	200	RXQ08A	RXQ08A	-	100 to 260 (400)	13 (20)
10 HP	28.0	250	RXQ10A	RXQ10A	-	125 to 326 (600)	16 (26)
12 HP	33.6	300	RXQ12A	RXQ12A	-	150 to 390 (600)	19 (30)
14 HP	40.0	350	RXQ14A	RXQ14A	-	175 to 456 (700)	23 (36)
16 HP	48.0	400	RXQ16A	RXQ16A	-	200 to 520 (800)	26 (40)
18 HP	56.0	450	RXQ18A	RXQ18A	-	225 to 586 (900)	29 (46)
20 HP	65.0	500	RXQ20A	RXQ20A	-	250 to 650 (1,000)	32 (50)
18 HP	60.4	450	RXQ18AM	RXQ08A + RXQ10A	BHFP22P100	225 to 596 (720)	29 (36)
20 HP	66.9	500	RXQ20AM	RXQ08A + RXQ12A		250 to 650 (800)	32 (40)
22 HP	71.5	550	RXQ22AM	RXQ10A + RXQ12A		275 to 716 (800)	35 (44)
24 HP	77.0	600	RXQ24AM	RXQ12A x 2		300 to 780 (860)	39 (48)
26 HP	79.5	650	RXQ26AM	RXQ12A + RXQ14A		325 to 846 (1,040)	42 (52)
28 HP	78.5	700	RXQ28AM	RXQ12A + RXQ16A		350 to 910 (1,120)	45 (56)
30 HP	83.5	750	RXQ30AM	RXQ12A + RXQ18A		375 to 976 (1,200)	48 (60)
32 HP	90.0	800	RXQ32AM	RXQ14A + RXQ18A		400 to 1,040 (1,290)	52 (64)
34 HP	96.0	850	RXQ34AM	RXQ16A + RXQ18A		425 to 1,106 (1,380)	55 (64)
36 HP	100	900	RXQ36AM	RXQ18A x 2		450 to 1,170 (1,440)	58 (64)
38 HP	105	950	RXQ38AM	RXQ18A + RXQ20A	475 to 1,236 (1,520)	61 (64)	
40 HP	112	1,000	RXQ40AM	RXQ20A x 2	500 to 1,300 (1,600)	64 (64)	
42 HP	117	1,050	RXQ42AM	RXQ12A x 2 + RXQ18A	525 to 1,366 (1,366)		BHFP22P151
44 HP	123	1,100	RXQ44AM	RXQ12A x 2 + RXQ20A	550 to 1,430 (1,430)		
46 HP	130	1,150	RXQ46AM	RXQ14A x 2 + RXQ18A	575 to 1,496 (1,496)		
48 HP	133	1,200	RXQ48AM	RXQ14A + RXQ16A + RXQ18A	600 to 1,560 (1,560)		
50 HP	140	1,250	RXQ50AM	RXQ14A + RXQ18A x 2	625 to 1,626 (1,626)		
52 HP	145	1,300	RXQ52AM	RXQ16A + RXQ18A x 2	650 to 1,690 (1,690)		
54 HP	150	1,350	RXQ54AM	RXQ18A x 3	675 to 1,756 (1,756)		
56 HP	159	1,400	RXQ56AM	RXQ18A x 2 + RXQ20A	700 to 1,820 (1,820)		
58 HP	162	1,450	RXQ58AM	RXQ18A + RXQ20A x 2	725 to 1,886 (1,886)		
60 HP	168	1,500	RXQ60AM	RXQ20A x 3	750 to 1,950 (1,950)		

Note: ¹⁾ For multiple connection, the outdoor unit multi connection piping kit (separately sold) is required.
²⁾ Values inside brackets are based on connection of indoor units listed at maximum capacity, 200% for single outdoor units, 100% for double outdoor units, and 136% for triple outdoor units. Refer to page 35 for notes on connection capacity of indoor units.

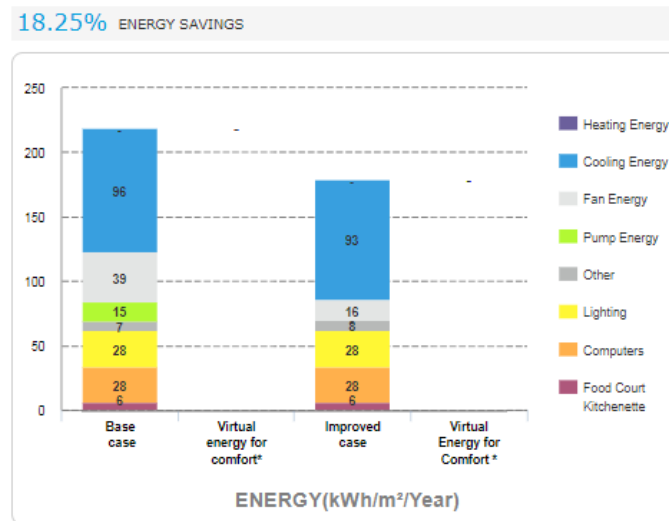
Gambar 5.14 Tipe VRF
 Sumber: Brosur Daikin.

OFE11* Variable Refrigerant Flow (VRF) System - COP of 4.41

COP

[Upload Document\(s\)](#) | [Calculator](#)

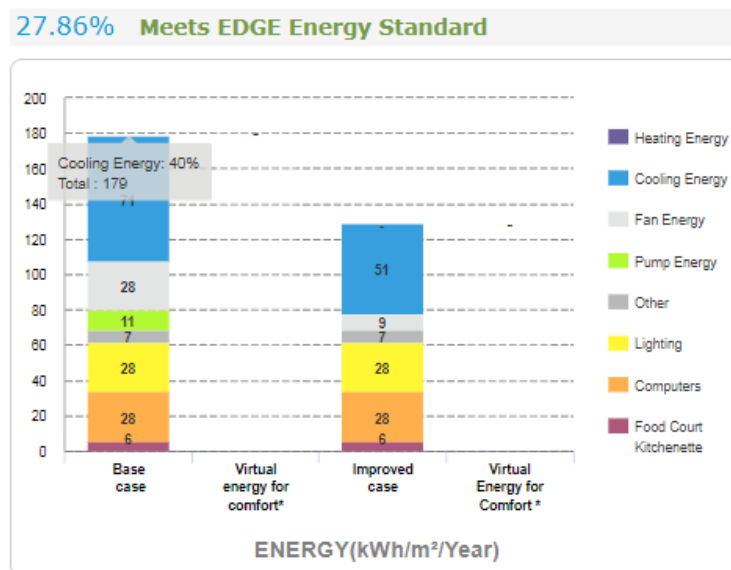
Gambar 5.15 Checklist VRF
 Sumber: Edge.



Gambar 5.16 Energi Saving
 Sumber: Edge.

Dari perhitungan satu TR gedung mendapat 28 HP/lantai, sehingga didapatkan tipe outdoor unit yaitu RXQ28AM (double unit). Pada lantai 1 terdapat ceiling mounted cassette 6 unit, lantai 2 terdapat ceiling mounted cassette 13 unit, dan lantai 3-9 terdapat ceiling mounted cassette 13 unit/lantai, dengan total 110 unit indoor, dan mendapat energi saving dari VRF adalah 18.25%

5.1.1.4 TOTAL ENERGY SAVING



Gambar 5.17 Total Energi Saving

Sumber: Edge.

Maka, total energi saving yang didapat dari WWR, AASF dan VRF adalah 27.86%.

5.1.2 WATER SAVING

Tabel 5.7 Perhitungan PDAM

Kebutuhan PDAM		
WC Flush Tank	1248,748	
Peturasan Flush Valve	861,6358	
Keran Tembok+Wastafel	1368,819	
Keran Wudhu	727,7083	
Total	4206,911	L/hari
	4,206911	m3
	4,2	m3

Sumber: Data Pribadi.

Tabel 5.8 Perhitungan RWH

Sumber Air daur Ulang (RWH)		
Rain Water Hartvesting	12.589	L/hari
	12,58869	m3
	12	m3

Sumber: Data Pribadi.

Sumber Air Daur Ulang (Grey Water)		
Keran Tembok + Wastafel	1368,819	
Keran Wudhu	727,7083	
Air Kondensasi	173	
Total	2.270	L/hari
	2,269899	m3
	2,3	m3

Sumber: Data Pribadi.

Tabel 5.9 Perhitungan GW+ RWH

Sumber Air Daur Ulang		
Grey Water	2,3	m3
RWH	12	m3
	14,3	

Sumber: Data Pribadi.

Tabel 5.10 Perhitungan BW

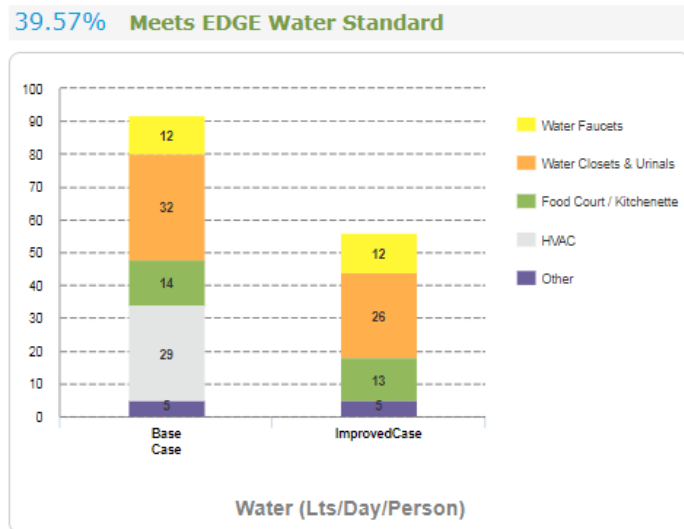
Black Water		
WC Flush Tank	1248,748	
Peturasan Flush Valve	861,6358	
	2110,383	L/hari
	2,110383	m3
	2,1	m3

Sumber: Data Pribadi.

- OFW06 Rainwater Harvesting System - 50% of Roof Area Used for Collection
 % of Roof Area Used
[Upload Document\(s\)](#)
- OFW07 Grey Water Treatment and Recycling System
[Upload Document\(s\)](#)

Gambar 5.18 Cheklist Water Saving

Sumber: Edge.



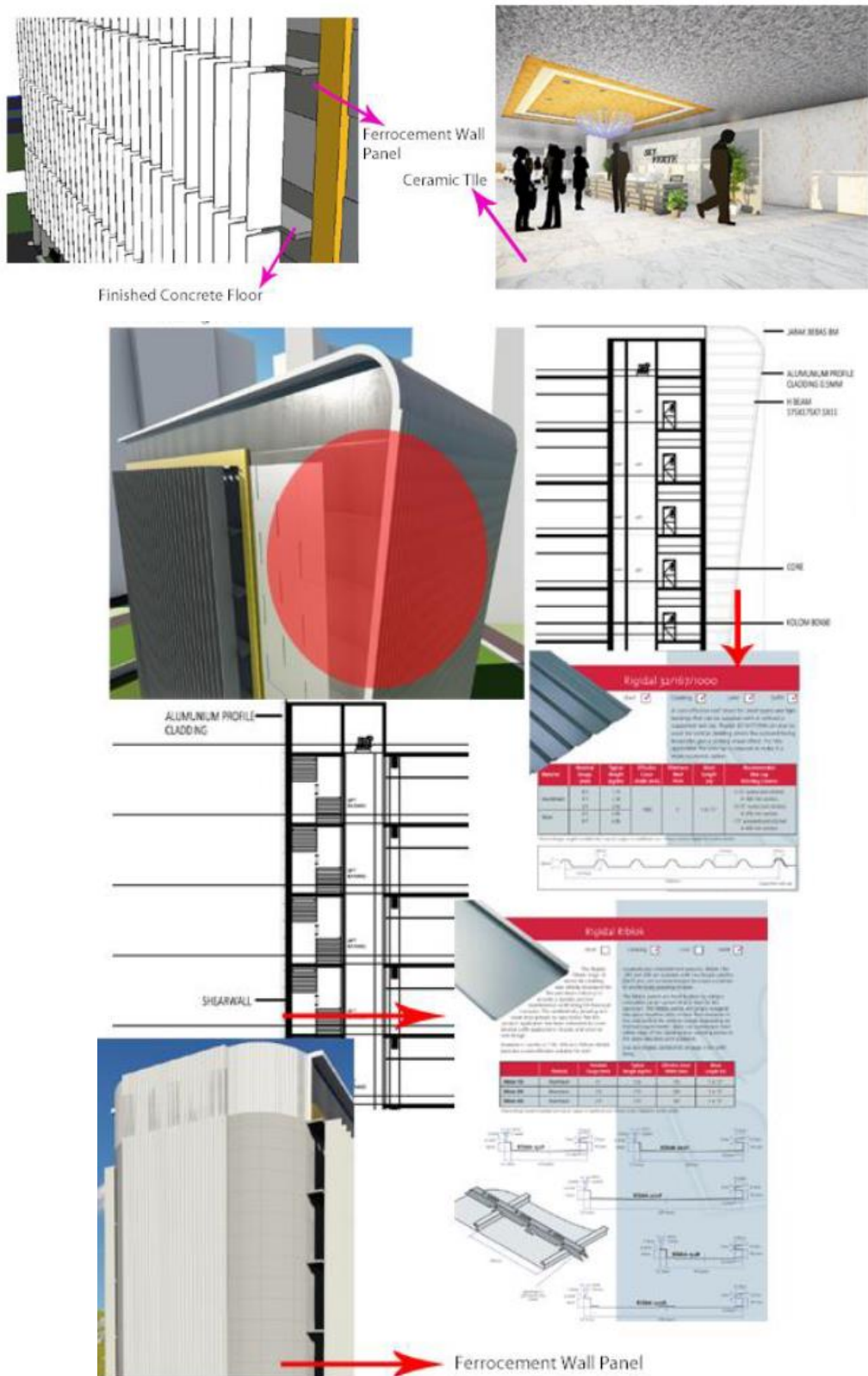
Gambar 5.19 Total Water Saving

Sumber: Edge.

Berdasarkan perhitungan, kebutuhan PDAM yaitu 4.2 m³/hari, RWH 12 m³/hari, GW 2.3 m³/hari, GW+RWH 14,3 m³/hari dan BW 2,1 m³/hari. Maka, total water saving 39.57%.

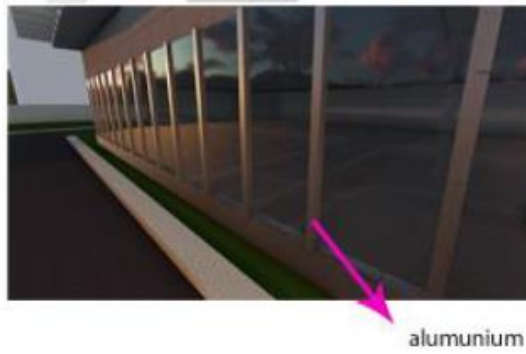
5.1.3 MATERIAL SAVING

Material yang digunakan untuk menutupi core yaitu aluminium profile cladding dengan pemasangan menggunakan H-Beam, berfungsi untuk mempertegas bangunan dari sekitar. Pada eksterior menggunakan dinding ferrocement wall panel, sedangkan interior dinding menggunakan ferrocement wall panel dan insitu reinforced wall. Pada lantai menggunakan ceramic tile dan finished concrete floor, floor slabs menggunakan hollow core precast slab, dan untuk window frames menggunakan aluminium.



Gambar 5.20 Keterangan

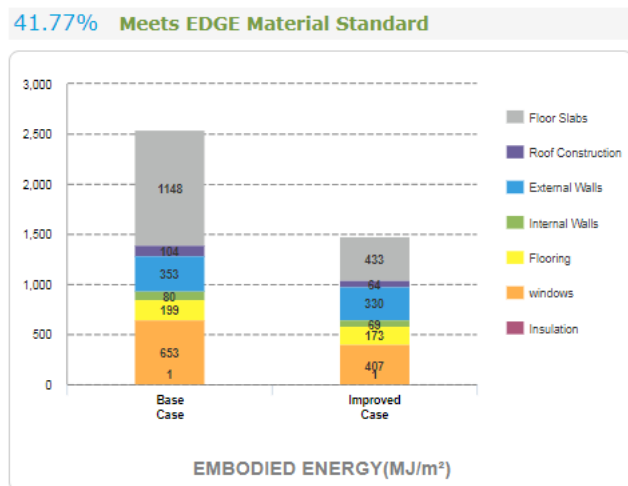
Sumber: Data Pribadi



Gambar 5.21 Keterangan
Sumber: Data Pribadi

Ref	Building Material	Improved Case Selection	Proportion %	Thickness	Steel Rebar
OFM01*	Floor Slabs Upload Document(s)	Hollow Core Precast Slab		120 mm	kg/m ²
OFM02*	Roof Construction Upload Document(s)	Type 1: In-Situ Reinforced Concrete Slab	100 %	120 mm	kg/m ²
OFM03*	External Walls Upload Document(s)	Type 1: Aluminium Profile Cladding	50 %		
		Type 2: Ferrocement Wall Panel	50 %	150 mm	
OFM04*	Internal Walls Upload Document(s)	Type 1: Ferrocement Wall Panel	40 %	150 mm	
		Type 2: In-Situ Reinforced Wall	60 %	200 mm	
OFM05*	Flooring Upload Document(s)	Type 1: Ceramic Tile	80 %		
		Type 2: Finished Concrete Floor	20 %		
OFM06*	Window Frames Upload Document(s)	Type 1: Aluminium	100 %		Single Glazing

Gambar 5.22 Cheklist Material Saving
Sumber: Edge.



Gambar 5.23 Total Material Saving
Sumber: Edge.

Maka, total material saving yang didapat adalah 41.77%.