STRATEGI PERANCANGAN

GREEN BUILDING

Baju Arie Wibawa, S.T, M.T

GREEN BUILDING

	2010	2012	2014	2015	2016	2017 - Next
Institutional	GBCI	Jakarta Provincial Govt.	GBCI	Ministry of Housing & Public Works	Bandung City Administration.	**Next Cities ???** **-Makassar (South Sulawesi)** **-Surabaya (East Java)** **- Medan (North Sumatera)** **- Semarang ?** **- Jogjakarta ?** **- Others ?**
Regulation	Greenship Rating Tool v.1	Jakarta's Green Building Regulation	Greenship Rating Tool v.1.2	National Green Building	Bandung's Green Building Regulation	
OTTV Req	≤ 45 w/m2	≤ 45 w/m2	≤ 35 w/m2	Gradually to ≤ 35 w/m2	≤ 45 w/m2	
Enforcement	Voluntary	JKT Mandatory in April'12	Voluntary	Target : National Mandatory by 2018	BDG Mandatory in Jan'17	
Incentive	Rating Certification	Building Construction Permit	Rating Certification	Based on City/Province's policy	≤ 45 w/m2 Building Construction Permit ≤ 35 – 30 w/m2 -Increase Building storeys allowance - Building & Land Tax Reduction	
Applied To	Building (New & Existing)	New Building ≥10 KSqm ≥50 KSqm	Building (New & Existing)	Building classification based on City/Province	New and Renovated Building (≥ 5 KSqm)	

AGC Group

GREEN BUILDING

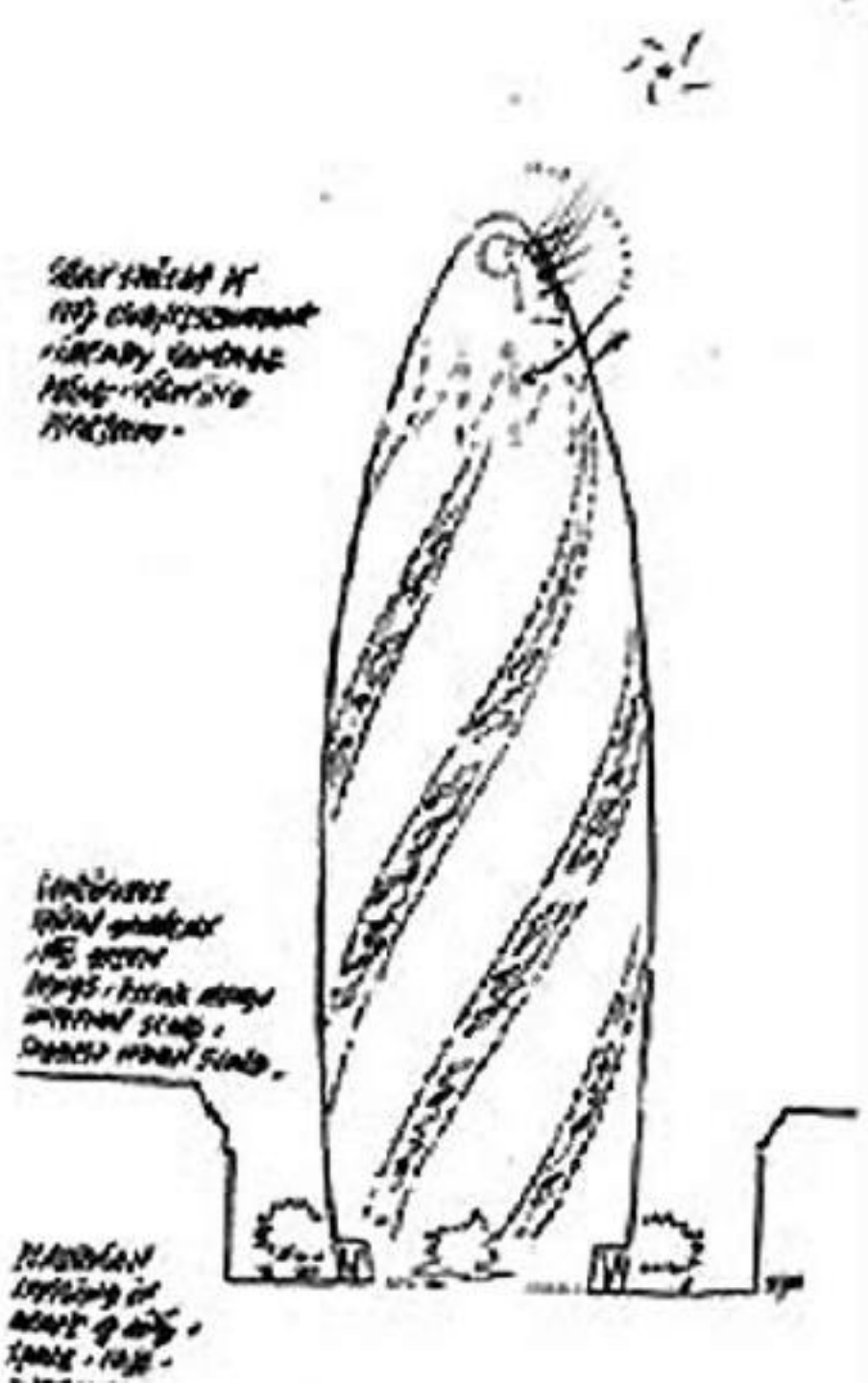
DKI Jakarta Government Regulation No. 38/2012

- **OTTV ≤ 45 W/m² (Mandatory for New Building)**
- **Implementation in DKI Jakarta ~Apr 23,2013**

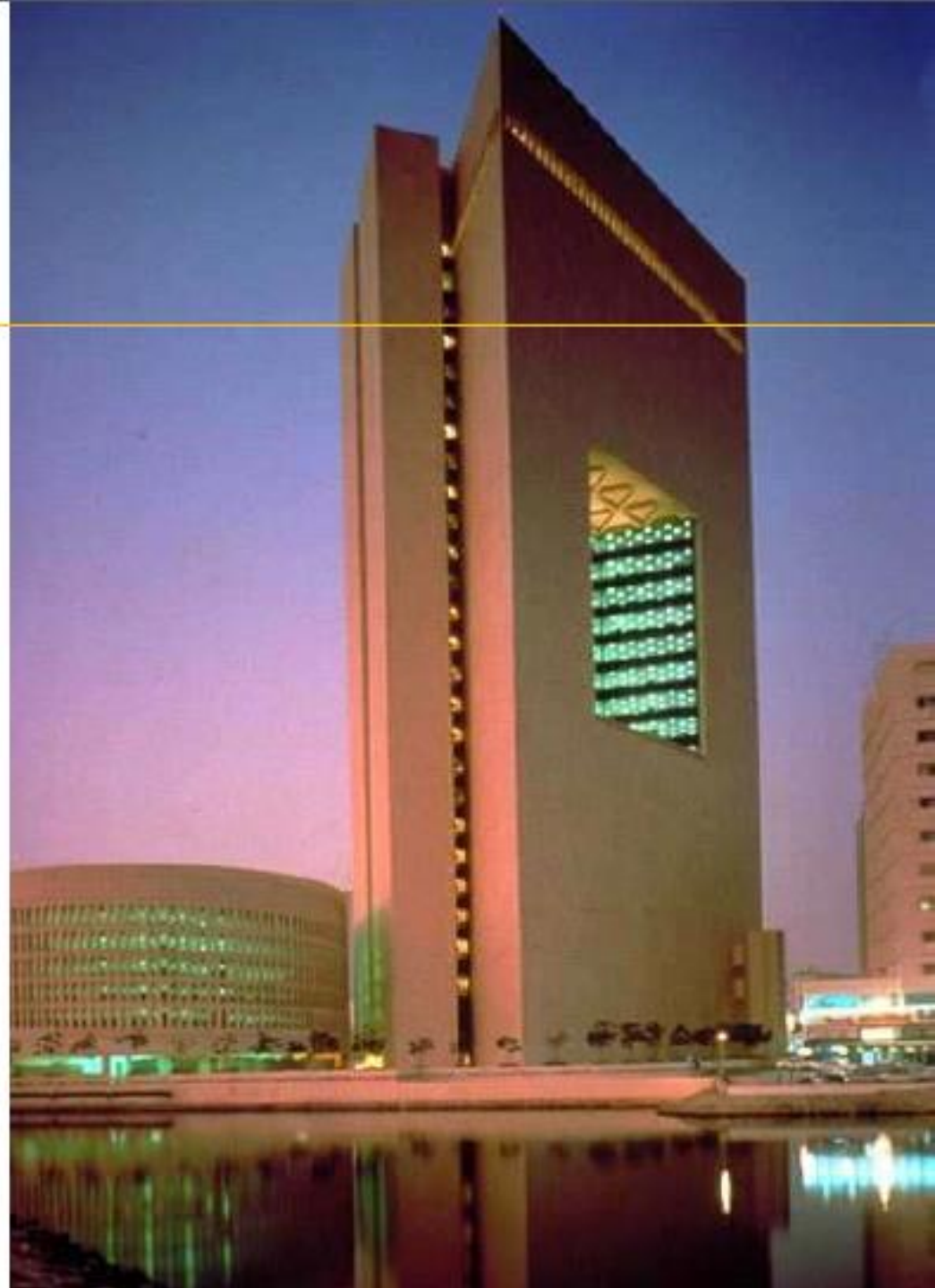
Bandung Government Regulation No. 1023/2016

- **OTTV ≤ 45 W/m² (Mandatory for New Building)**
- **OTTV ≤ 35 W/m² (Voluntary with incentive)**
- **Implementation in Bandung ~Jan 1,2017**

Norman Foster



SOM



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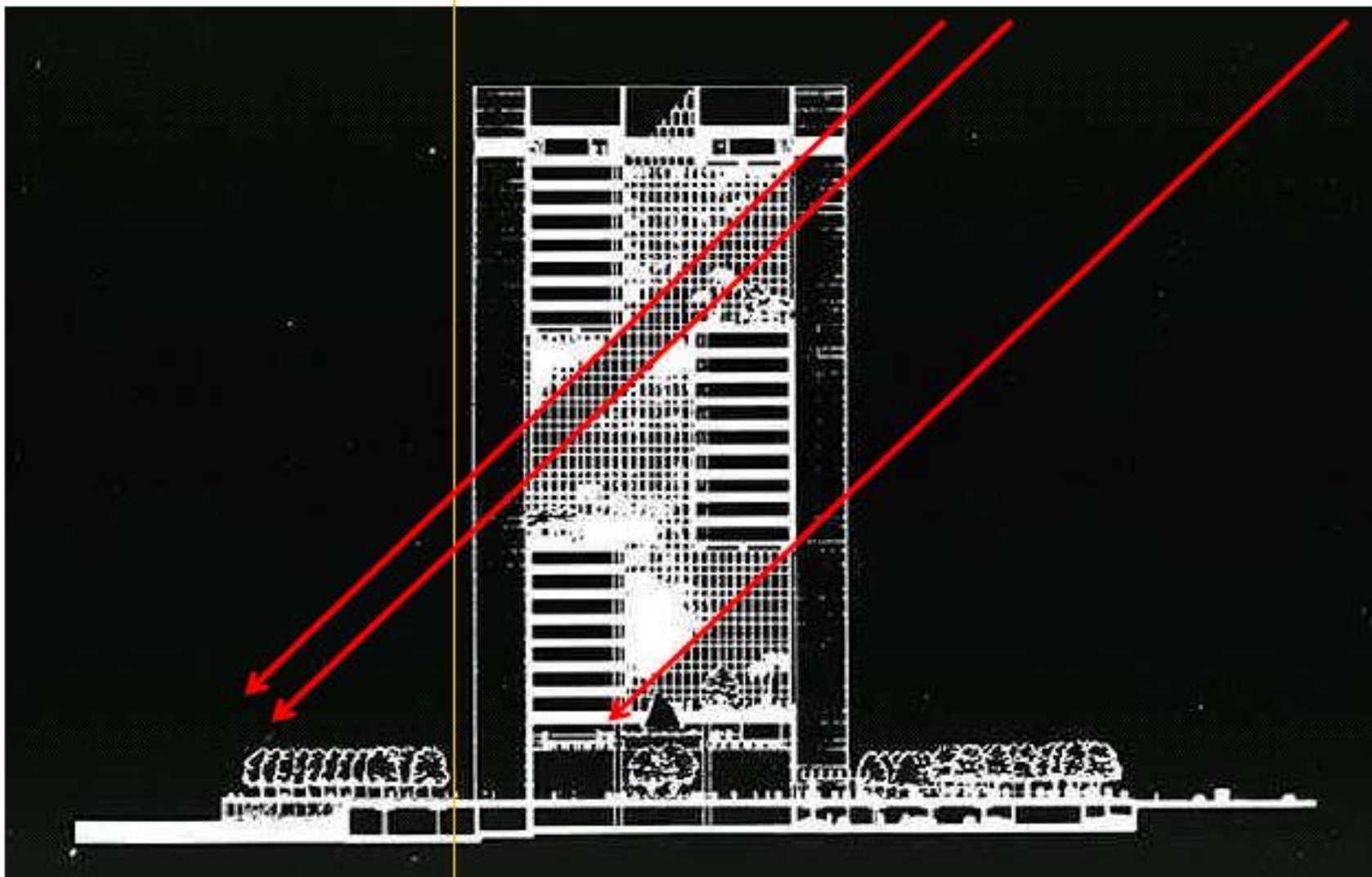
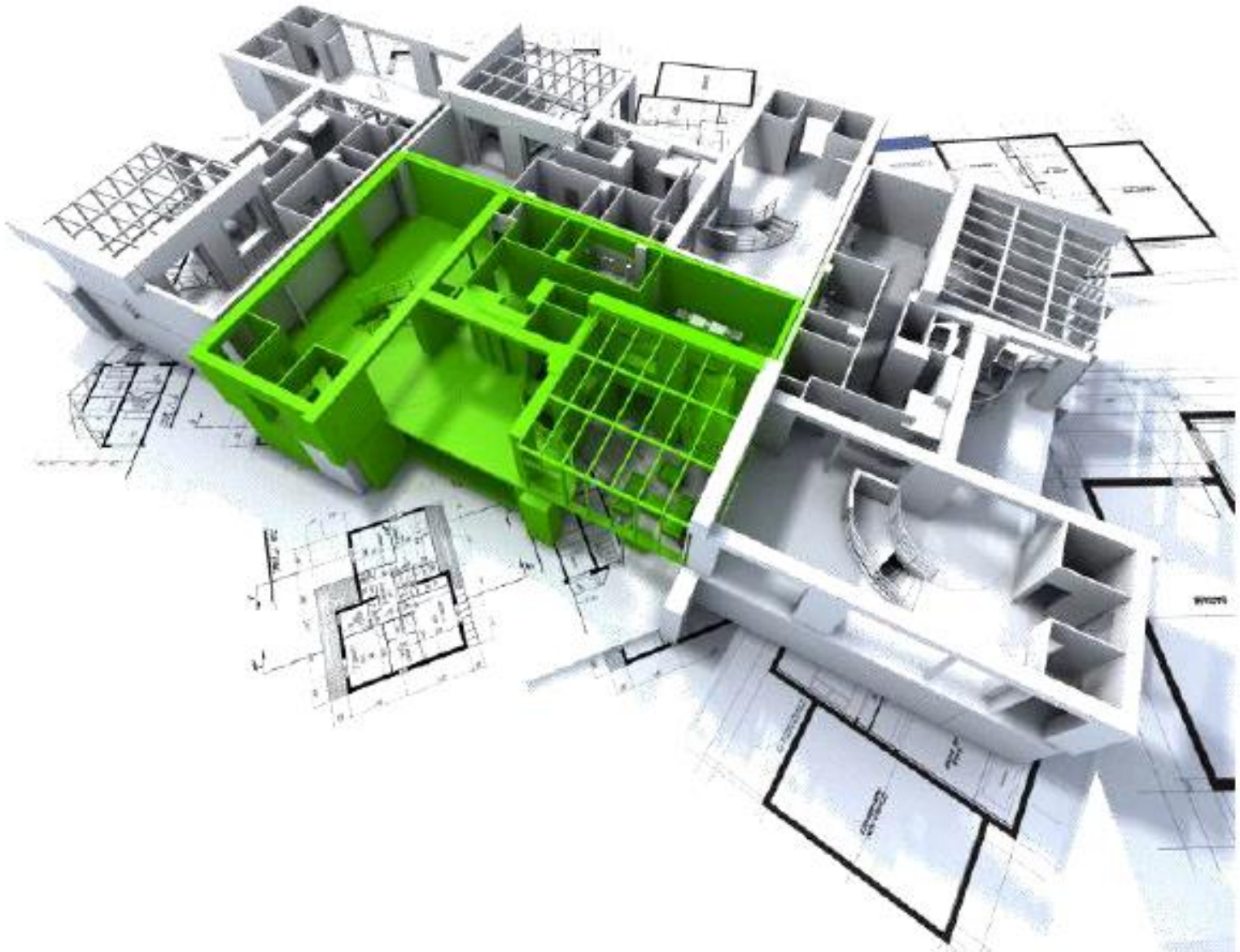


SOM

Green design / passive design / bioclimatic design



Is not a style ….

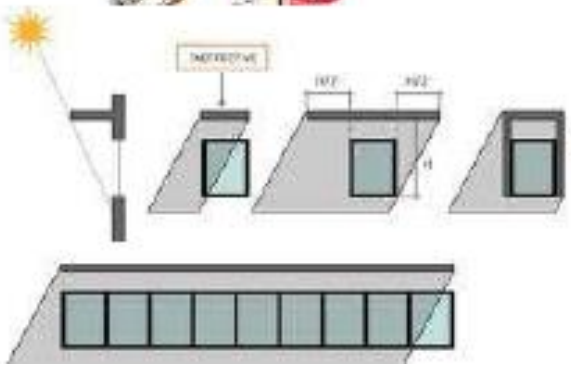
It is a design principles

PASSIVE DESIGN STRATEGIES:

Building orientation

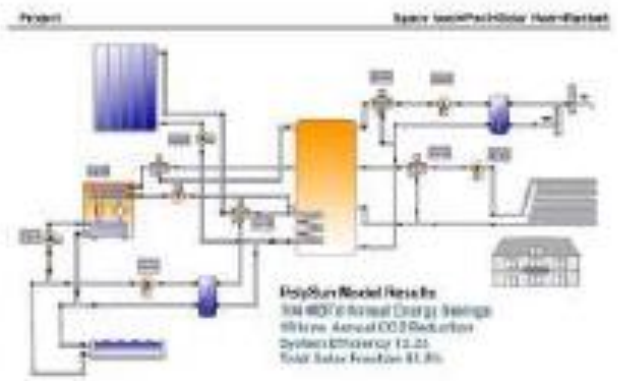
Window to wall ratio

Glazing Performance (Solar Heat Gain Coefficient)

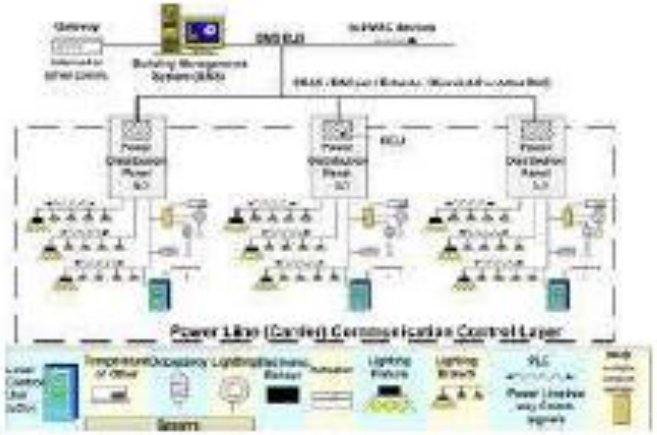


Shading devices & double facades system

ACTIVE DESIGN STRATEGIES:



Highly efficient AC System
Right & not oversized AC system
Heat Recovery/Heat exchanger



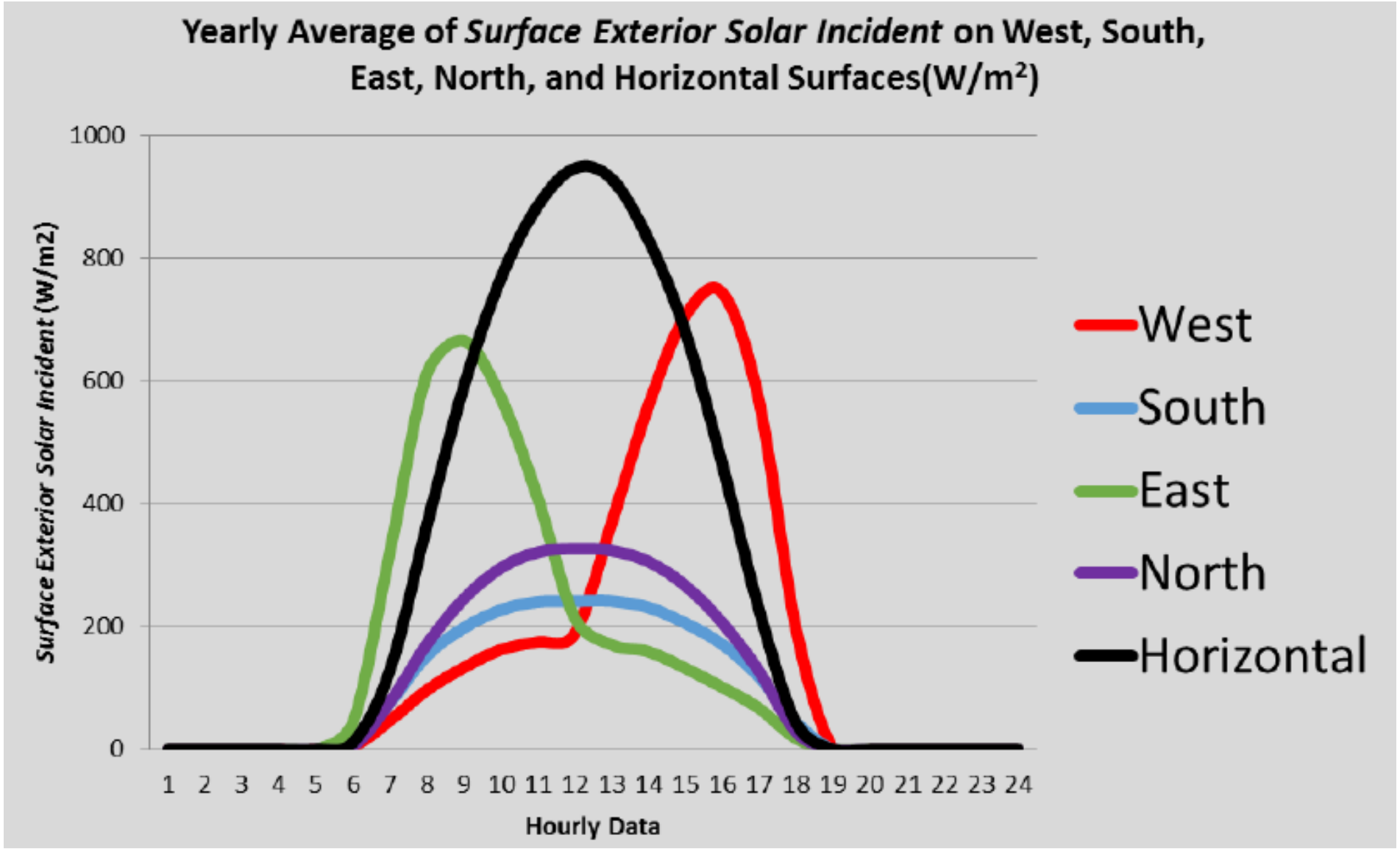
Automatic Control via BAS/BMS

High Performance lighting system & design

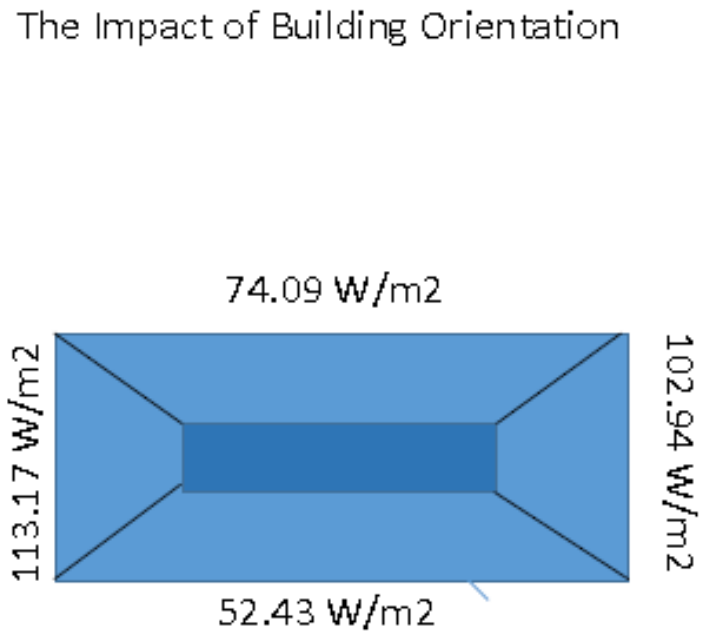
1

BUILDING ORIENTATION

Impact Building Orientation



Impact Building Orientation



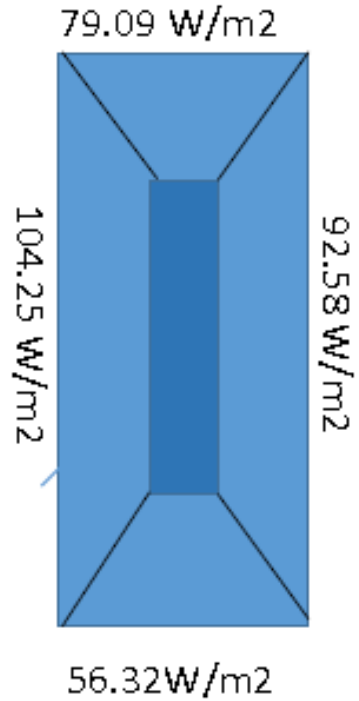
WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 74.47 W/m2

IKE = 171.99 kWh/m2/year



WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 98.82 W/m2

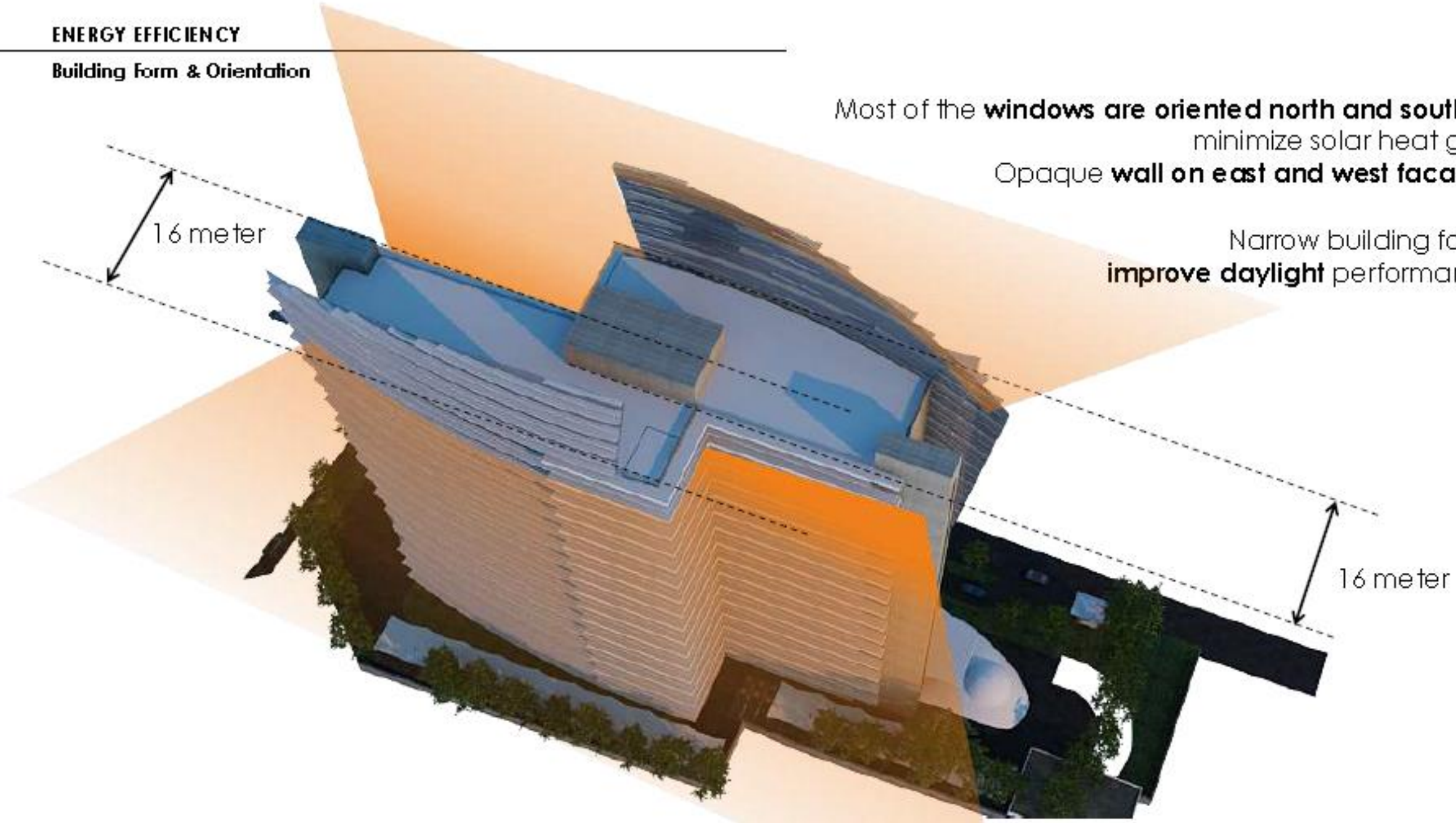
IKE =201.40 kWh/m2/year

ENERGY EFFICIENCY

Building Form & Orientation

Most of the **windows are oriented north and south** to minimize solar heat gain
Opaque **wall on east and west facades**

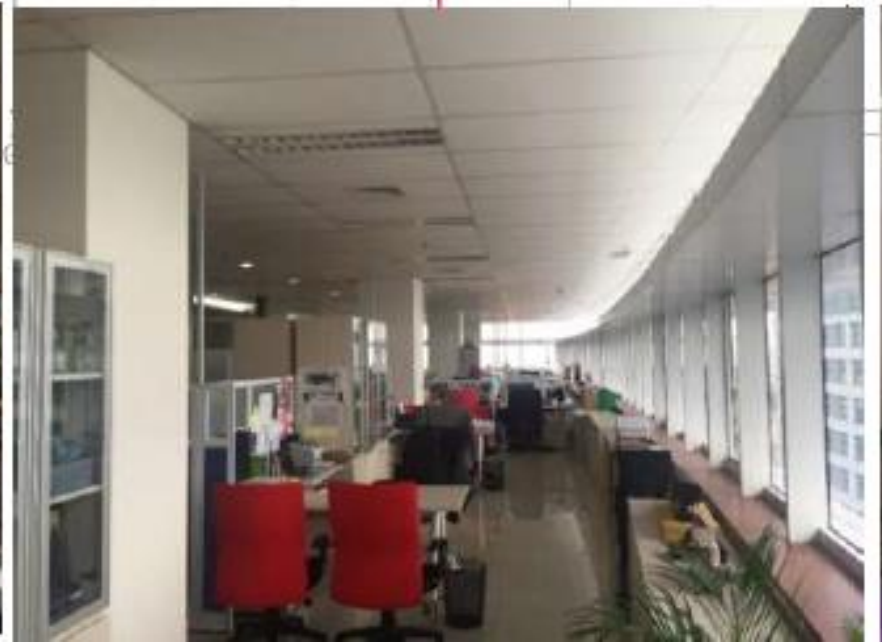
Narrow building form, **improve daylight** performance



ENERGY EFFICIENCY

Daylighting

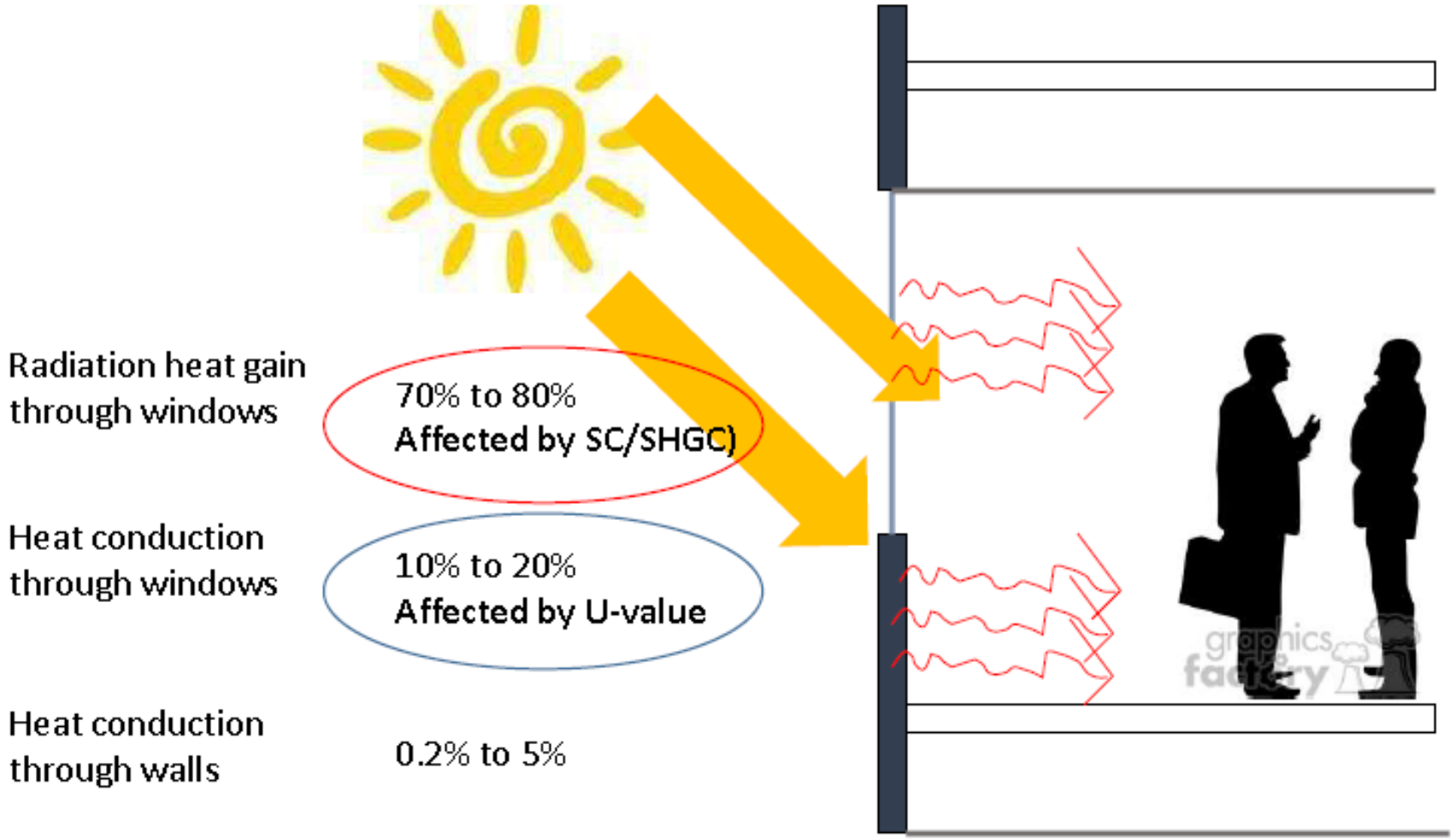
Standar illum. : 300 lux
Area daylight : 33.00%



2 WALL WINDOW RATIO

Heat Transfer

External heat gain / Overall Thermal Transfer Value
(Externally Dominated Load Buildings)



Radiation heat gain through windows — 70% to 80% Affected by SC/SHGC)

Heat conduction through windows — 10% to 20% Affected by U-value

Heat conduction through walls — 0.2% to 5%

$$OTTV = \alpha((1-WWR)*Uw)*TDeq) + (WWR*Uf*\Delta T) + (WWR*SC*SF)$$

Wall Windows Ratio

WWR: Window to Wall Ratio (%), yaitu persentase luasan jendela kaca terhadap dinding masif.

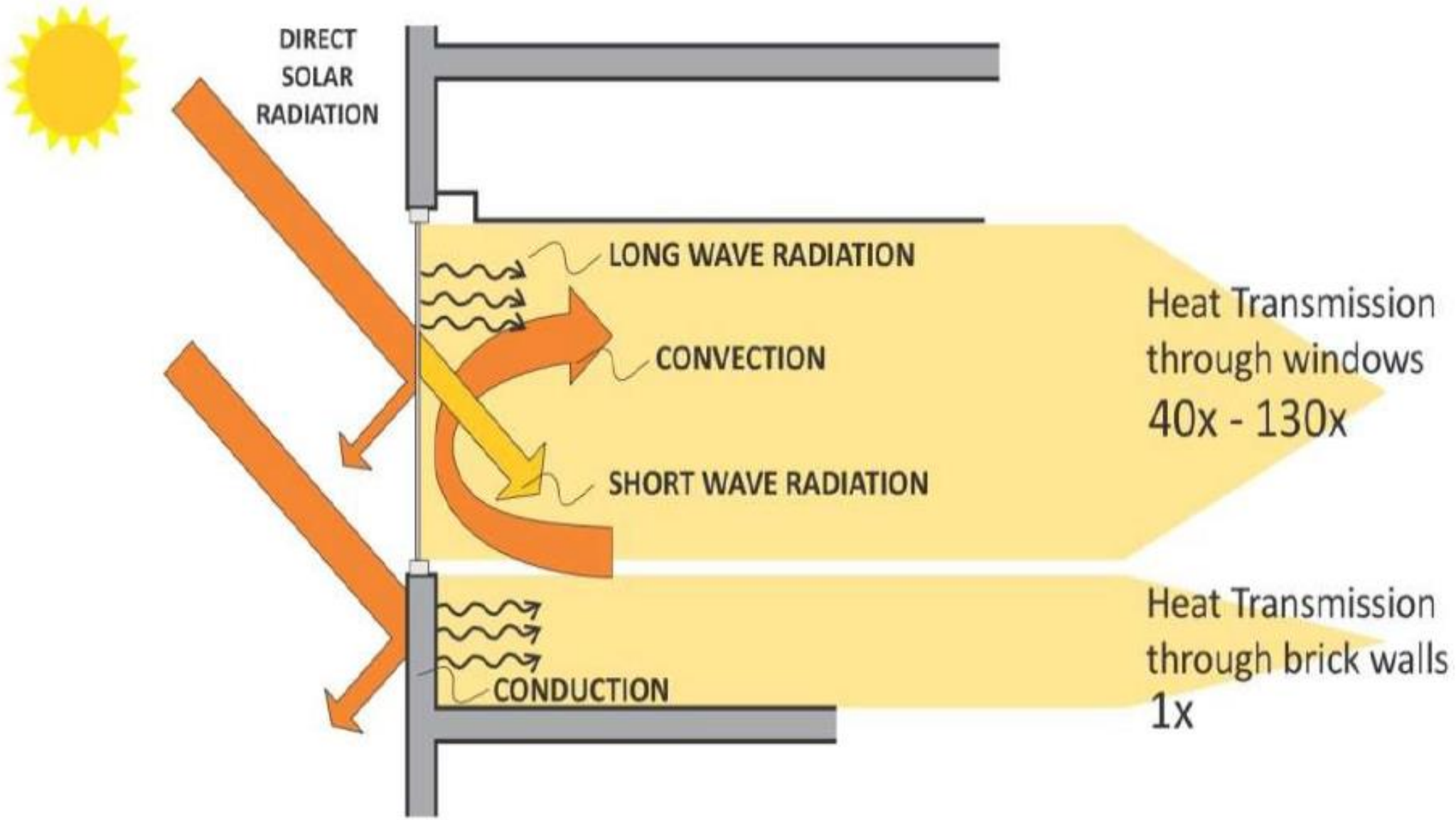
Semakin besar luasan jendela, semakin banyak beban panas untuk AC dan semakin tinggi konsumsi energy.

WWR 20%

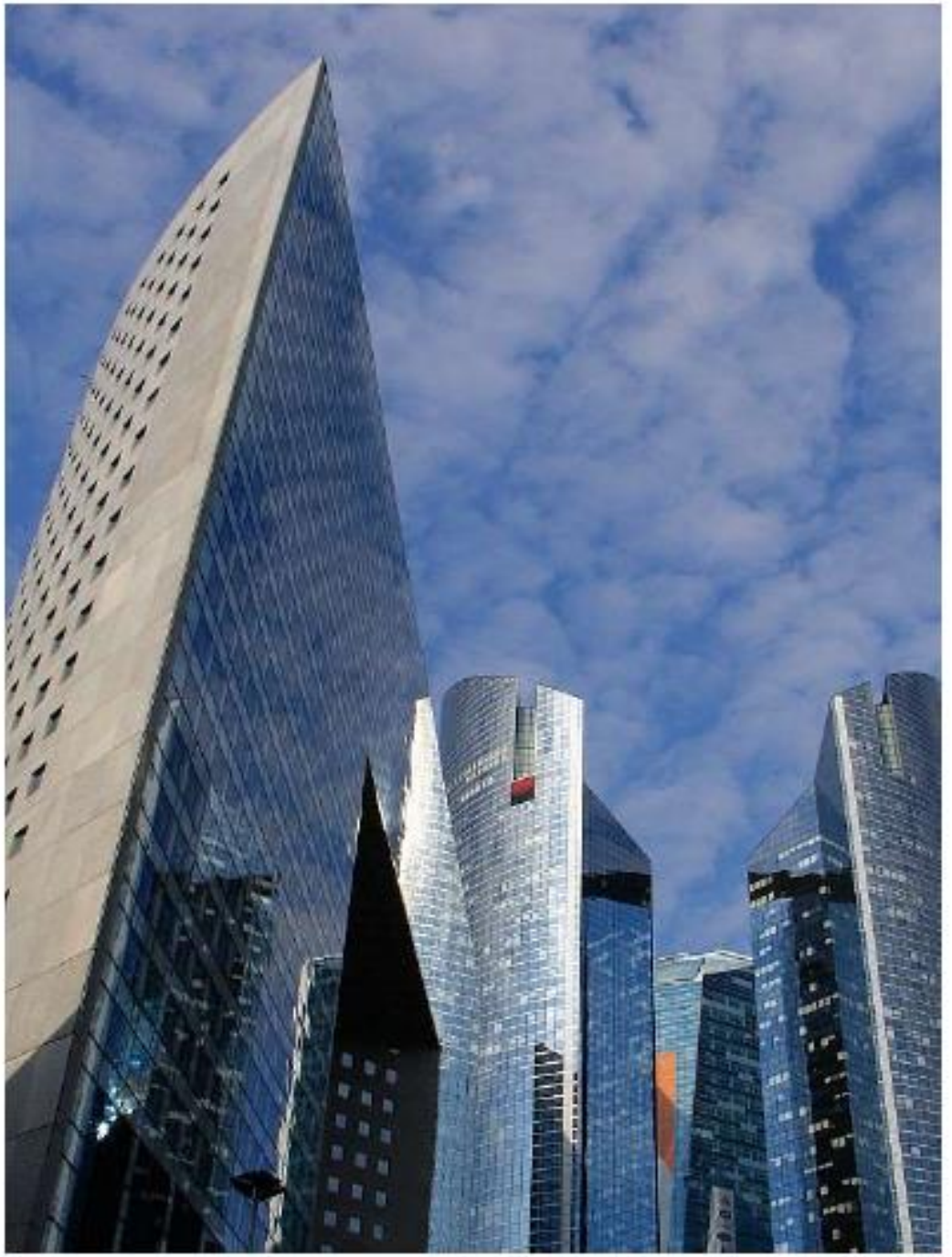
WWR 33% - 50%

WWR 70 %

Window vs Brick

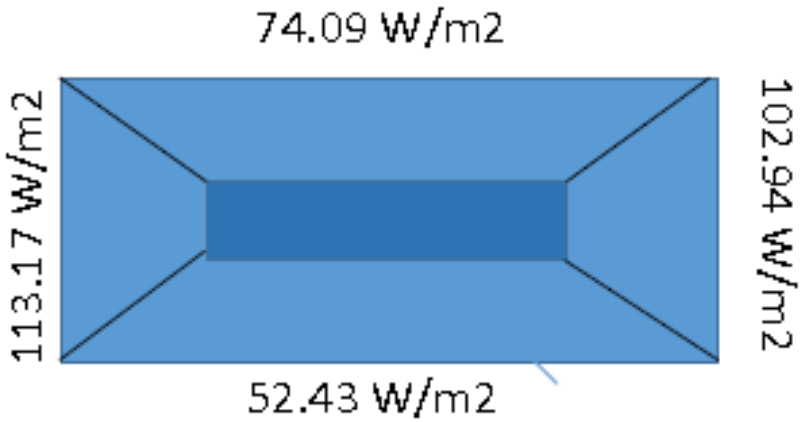


Window vs



3 GLAZING PERFORMANCE

The Impact of WWR 70% → 30%



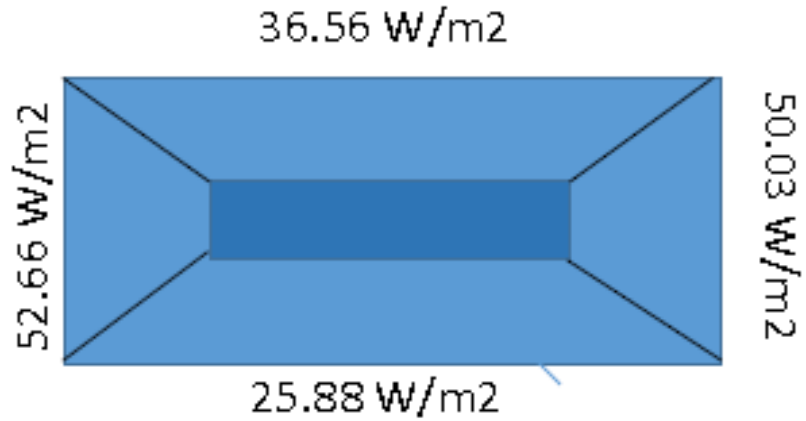
WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 74.47 W/m2

IKE = 171.99 kWh/m2/year



WWR = 30%

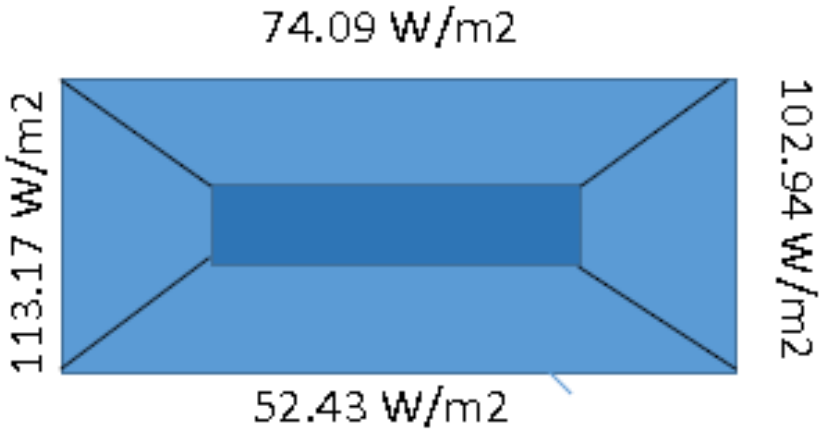
SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 36.26 W/m2

IKE = 143.36 kWh/m2/year

The Impact of SHGC 0.6 → 0.4 (stopsol)



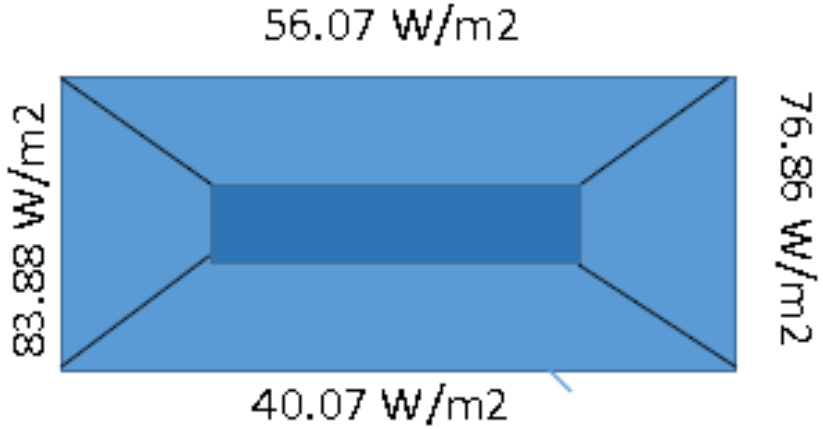
WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 74.47 W/m2

IKE = 171.99 kWh/m2/year



WWR = 70%

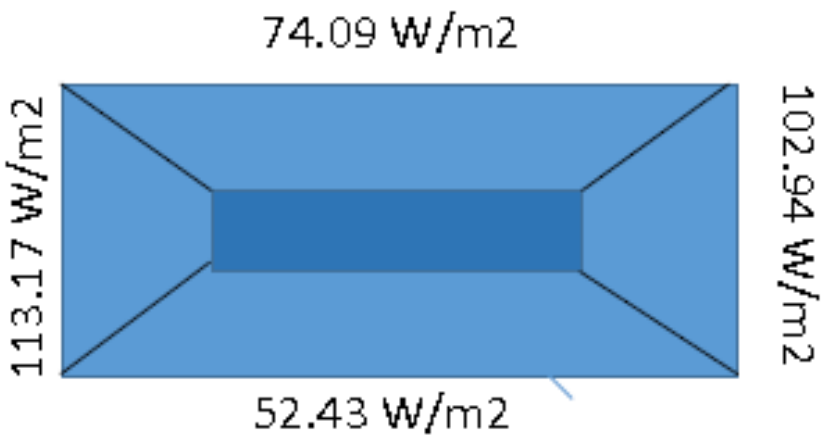
SHGC = 0.4 (stopsol)

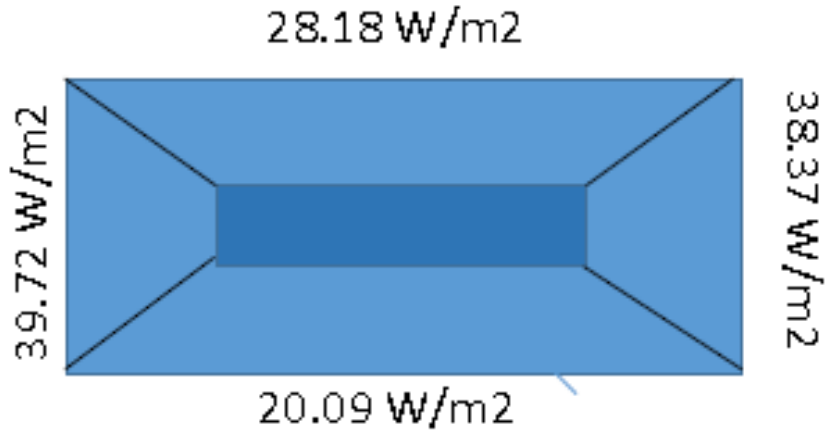
HVAC COP = 3 (package system, VRF/VRV)

OTTV = 56.14 W/m2

IKE = 154.02 kWh/m2/year

Best Practices → passive & active





WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3

OTTV = 74.47 W/m2

IKE = 171.99 kWh/m2/year

WWR = 30%

SHGC = 0.4 (stopsol)

HVAC COP = 3

OTTV = 27.86 W/m2

IKE = 151.10 kWh/m2/year

HVAC COP = 5.8

IKE = 129.33 kWh/m2/year

Model Pemasangan Kaca

The Impact of Building Double Glazing

- Does not improve SHGC/SC (with second layer of clear glass)
- Improve U-value from around 5.2 W/m^{o}K to around 2.5 W/m^{o}K
- Reduce sound transmission by 5 dB (about one third)

Single Pane

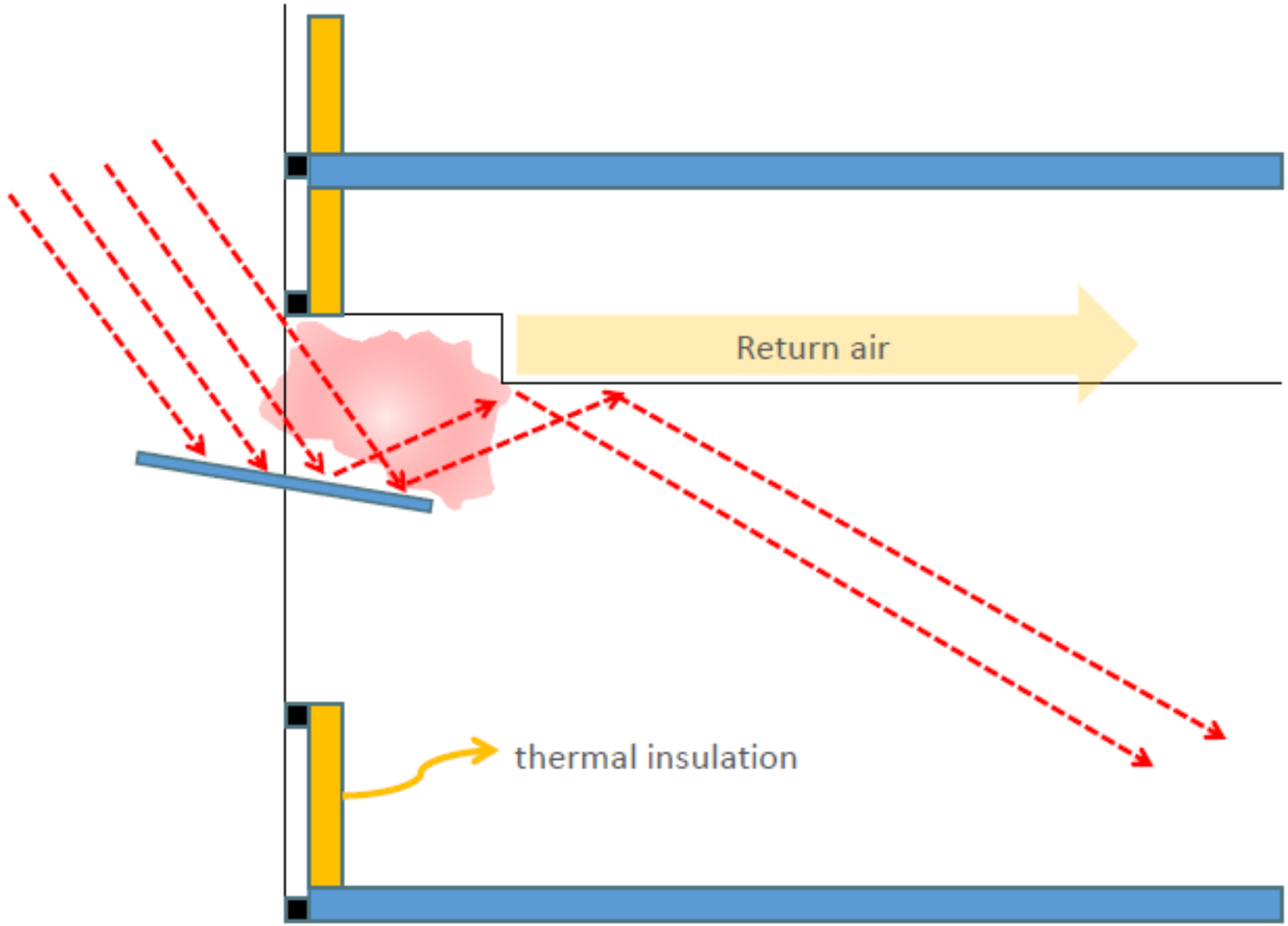
Double Pane

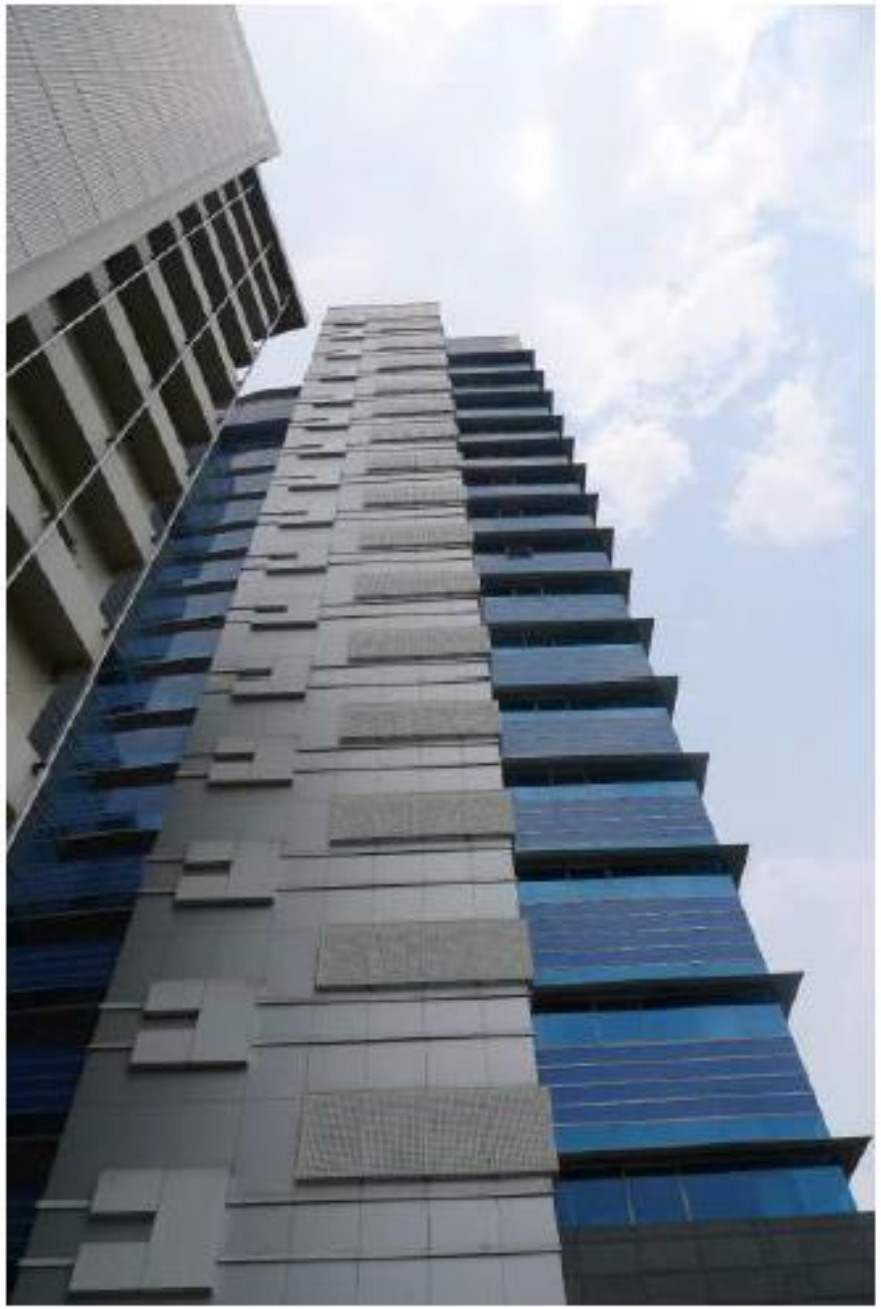
Triple Pane

4

SHADING DEVICE

Daylighting → light shelves for better daylight distribution



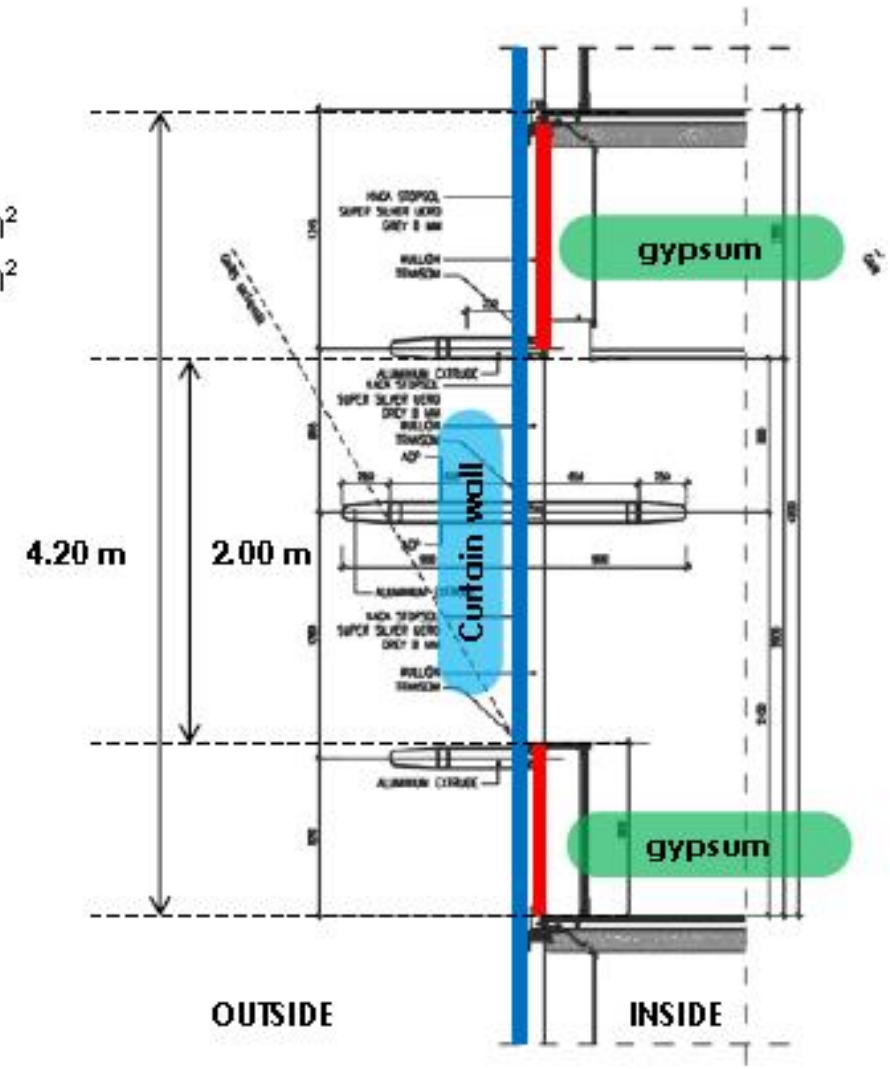


Windows with perforated metal shading on west side

ENERGY EFFICIENCY

Shading & Building Skin

Glass Material	: Asahimas 8mm Stopsol Supersilver Grey
SHGC	: 0.423
U-value	: 5.731
Visible Trans.	: 0.226
WWR	: 45.20%
OTTV manual	: 44.25 w/m²
OTTV simulasi	: 37.62 w/m²
Outside view	: 94.00%

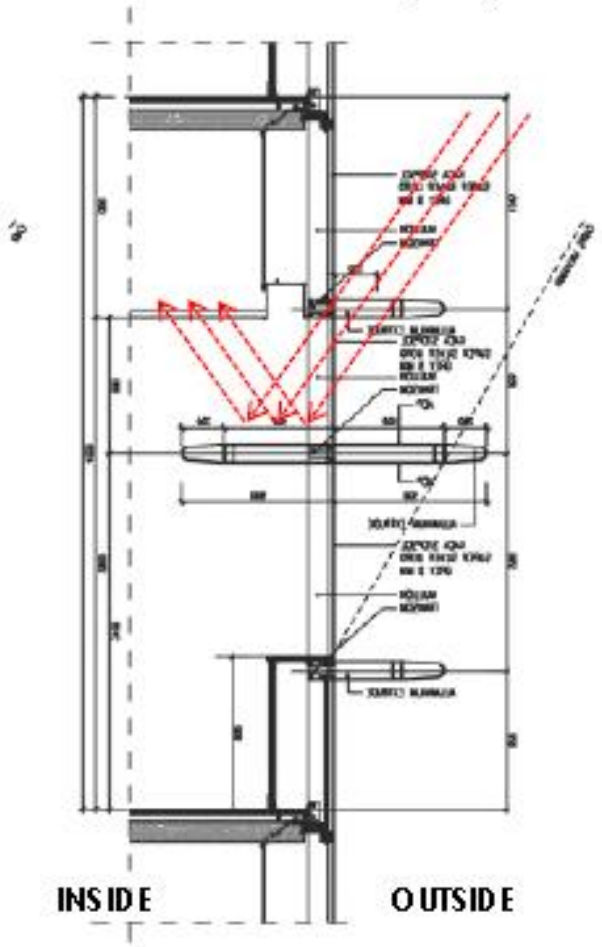


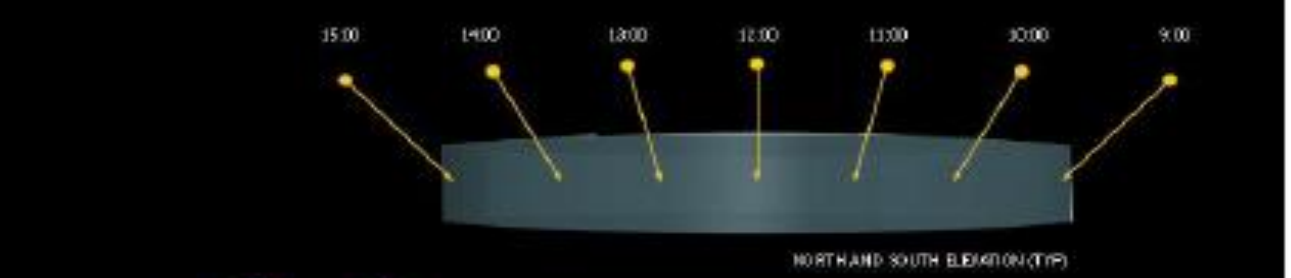
Daylighting

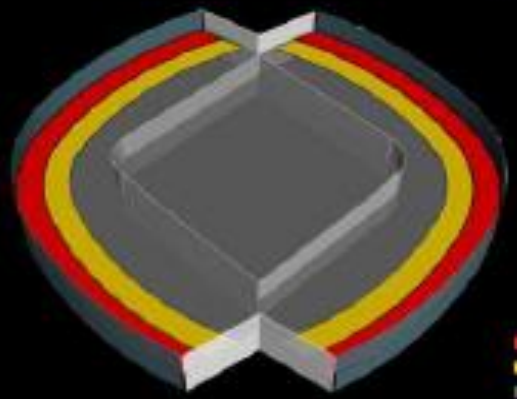
Light shelves

Reduce heat gain

Better daylight distribution
(more uniform and deeper penetration)



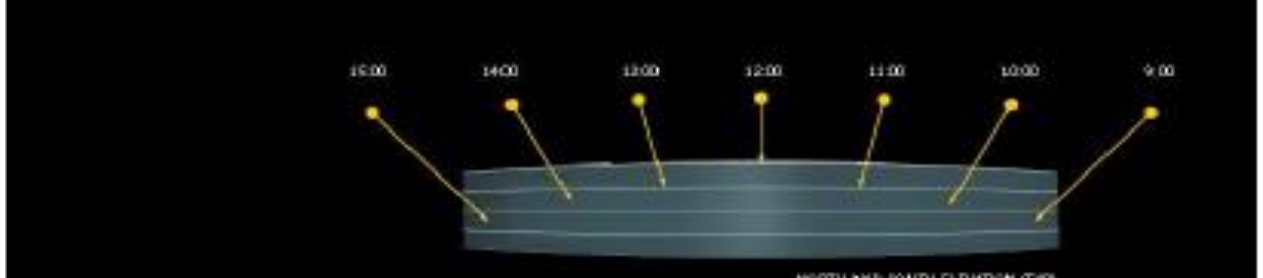


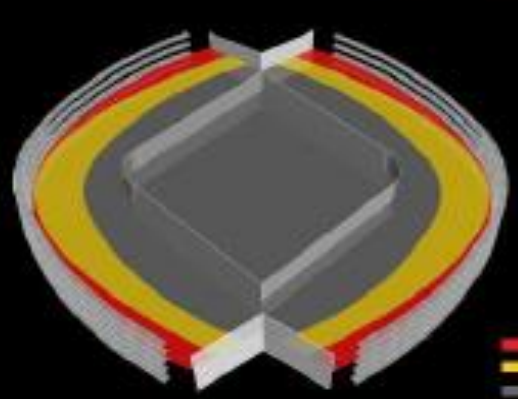


NO SHADING

Floor areas within 3.5 meters of the glazing plane receive uncomfortably high levels of sunlight resulting in visual and thermal discomfort.

- Visual and thermal discomfort
- Desirable condition - useful daylight
- Not enough useful daylight

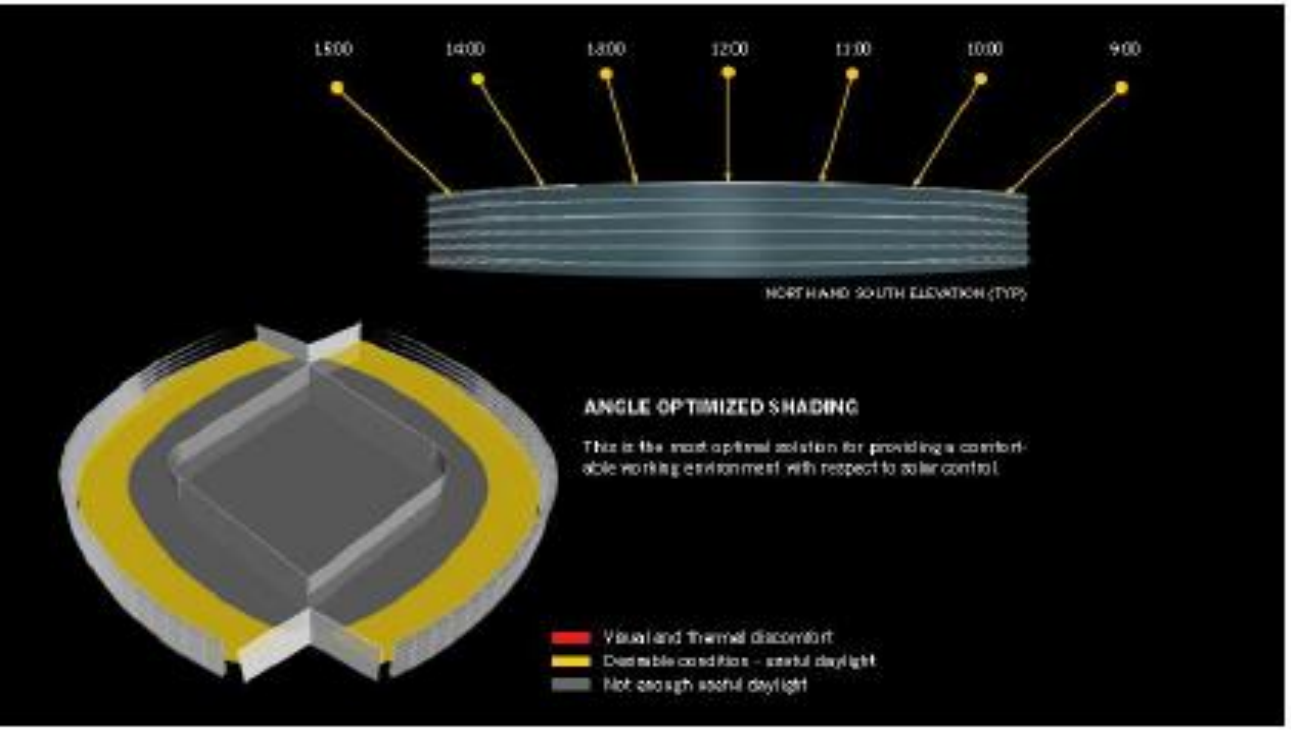




HORIZONTAL SHADING

This alternate provides adequate shading in the center of the floor plate at the north and south elevations, but is unable to adequately protect east and west floor areas.

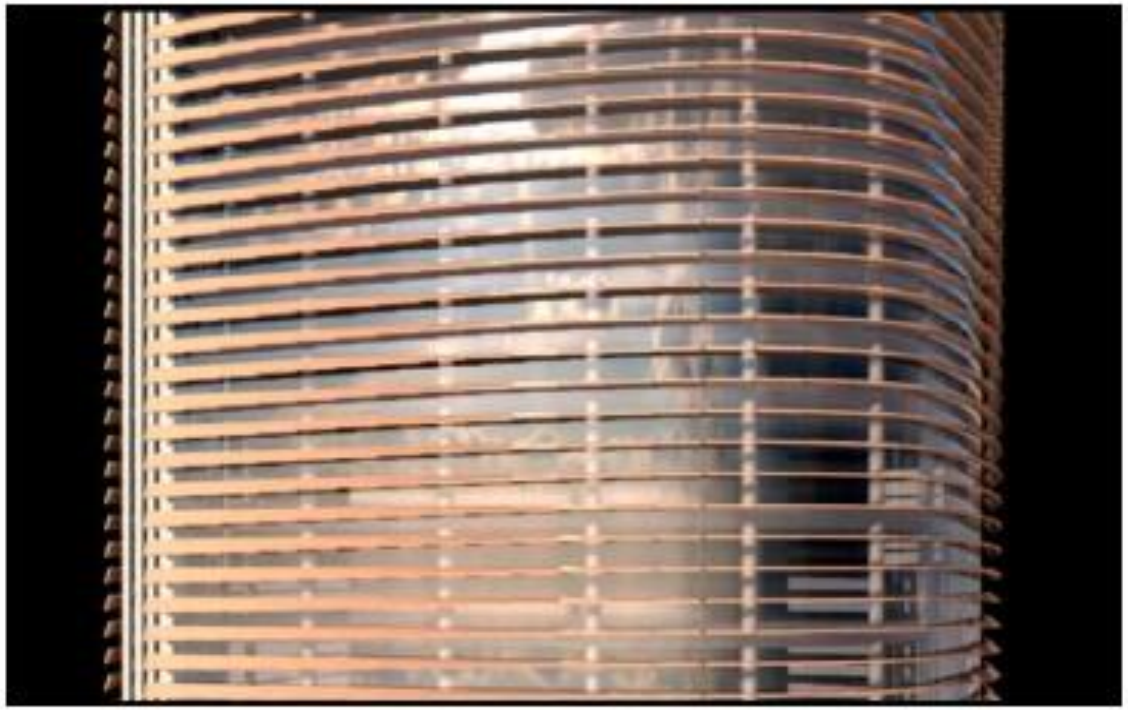
- Visual and thermal discomfort
- Desirable condition - useful daylight
- Not enough useful daylight



ANGLE OPTIMIZED SHADING

This is the most optimal solution for providing a comfortable working environment with respect to solar control.

- Visual and thermal discomfort
- Desirable condition - useful daylight
- Not enough useful daylight



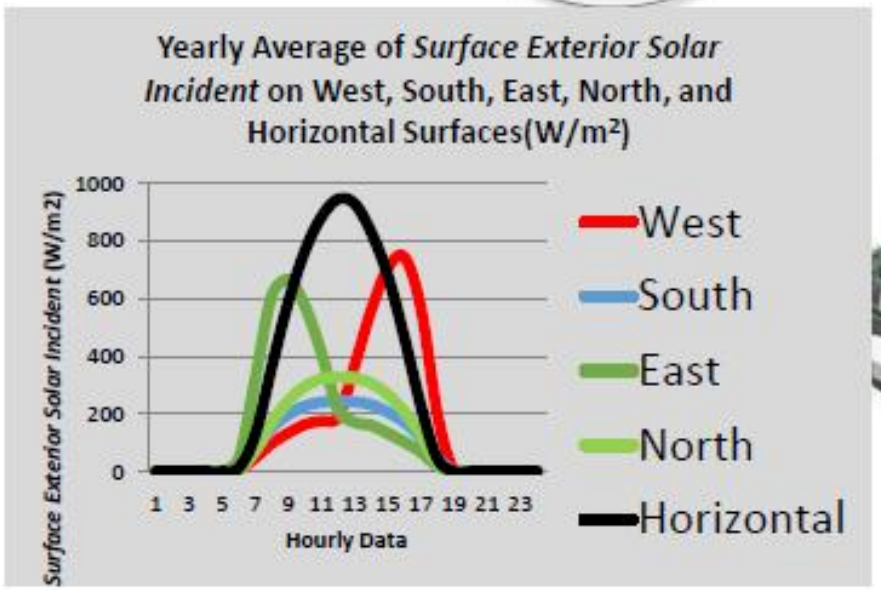
5

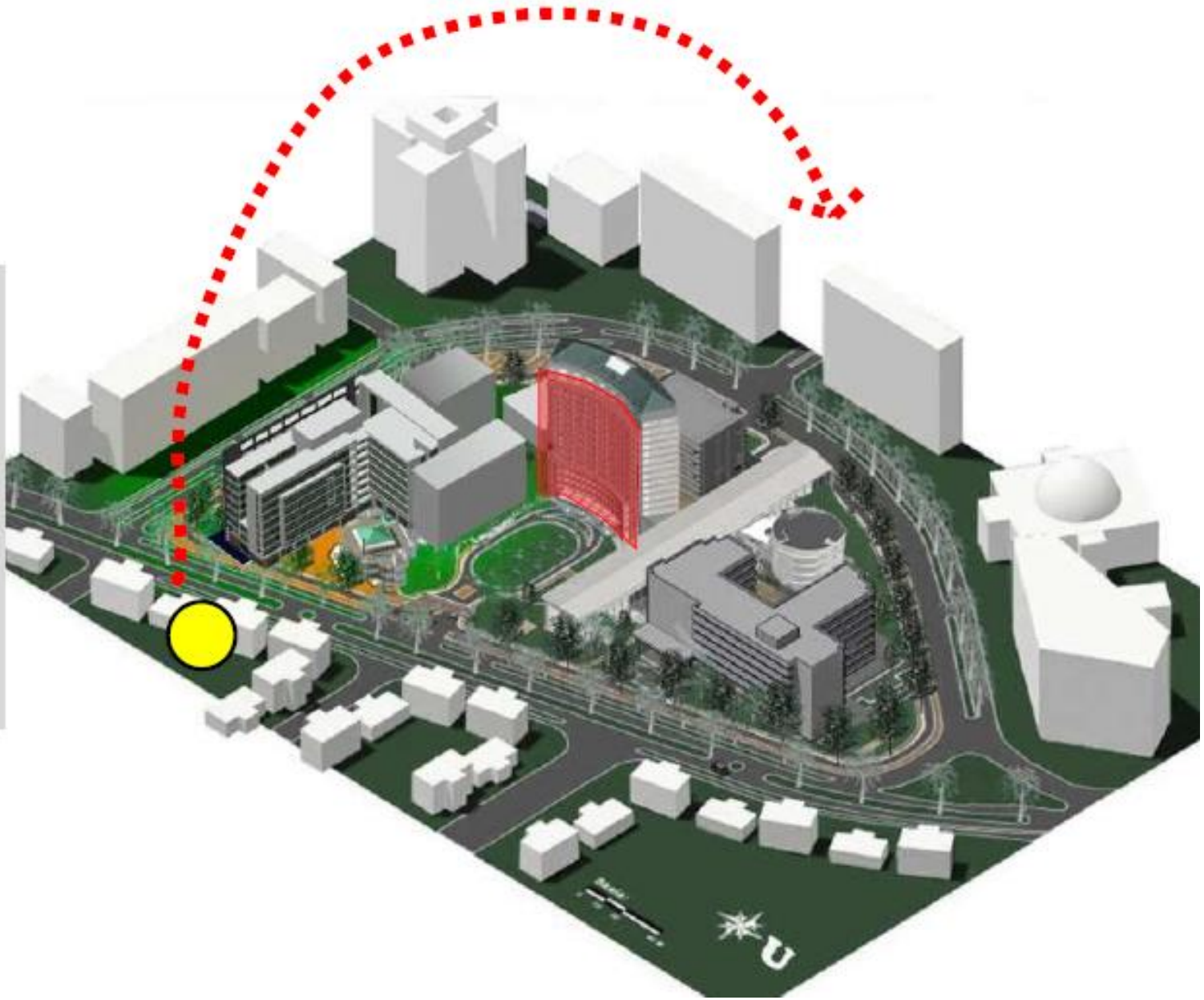
BEST PRACTICE
GEDUNG KEMENTERIAN PU

GREEN BUILDING

Gedung Utama Kementerian PU

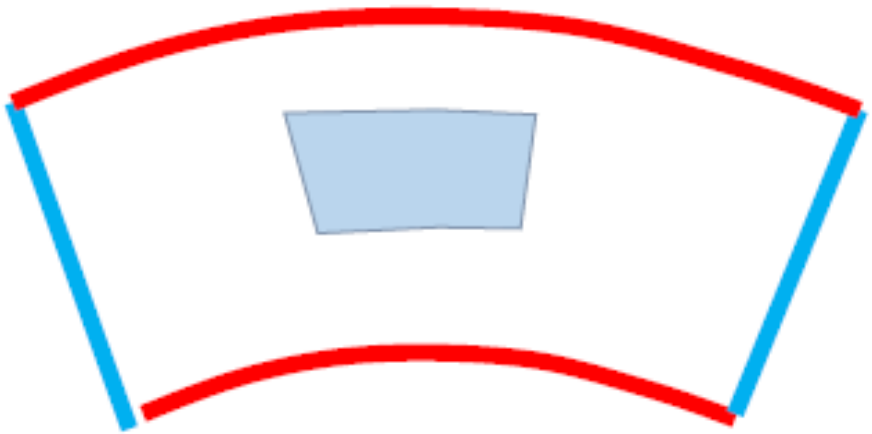
Building form & orientation



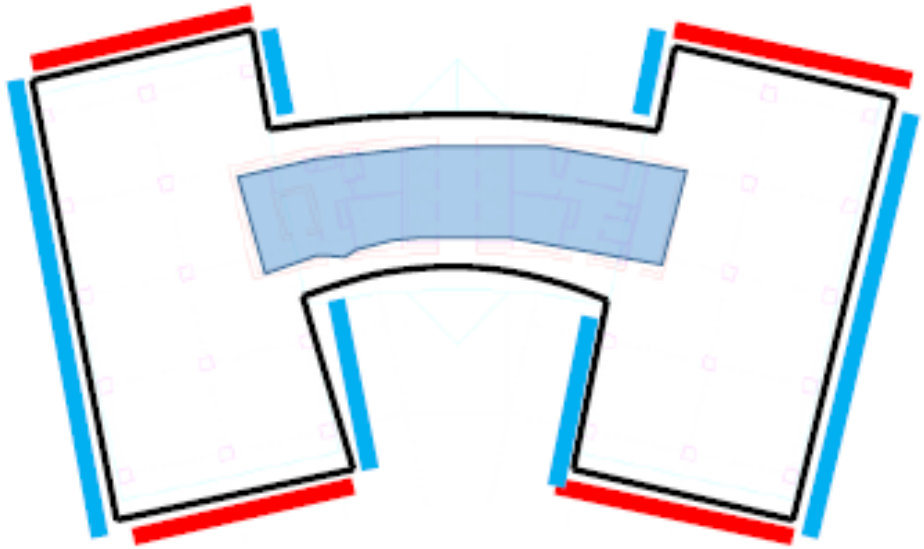


Original block plan:
Larger area of the building is oriented to east and west

Building form & orientation → minimize exposure to east and west solar radiation



Original building form

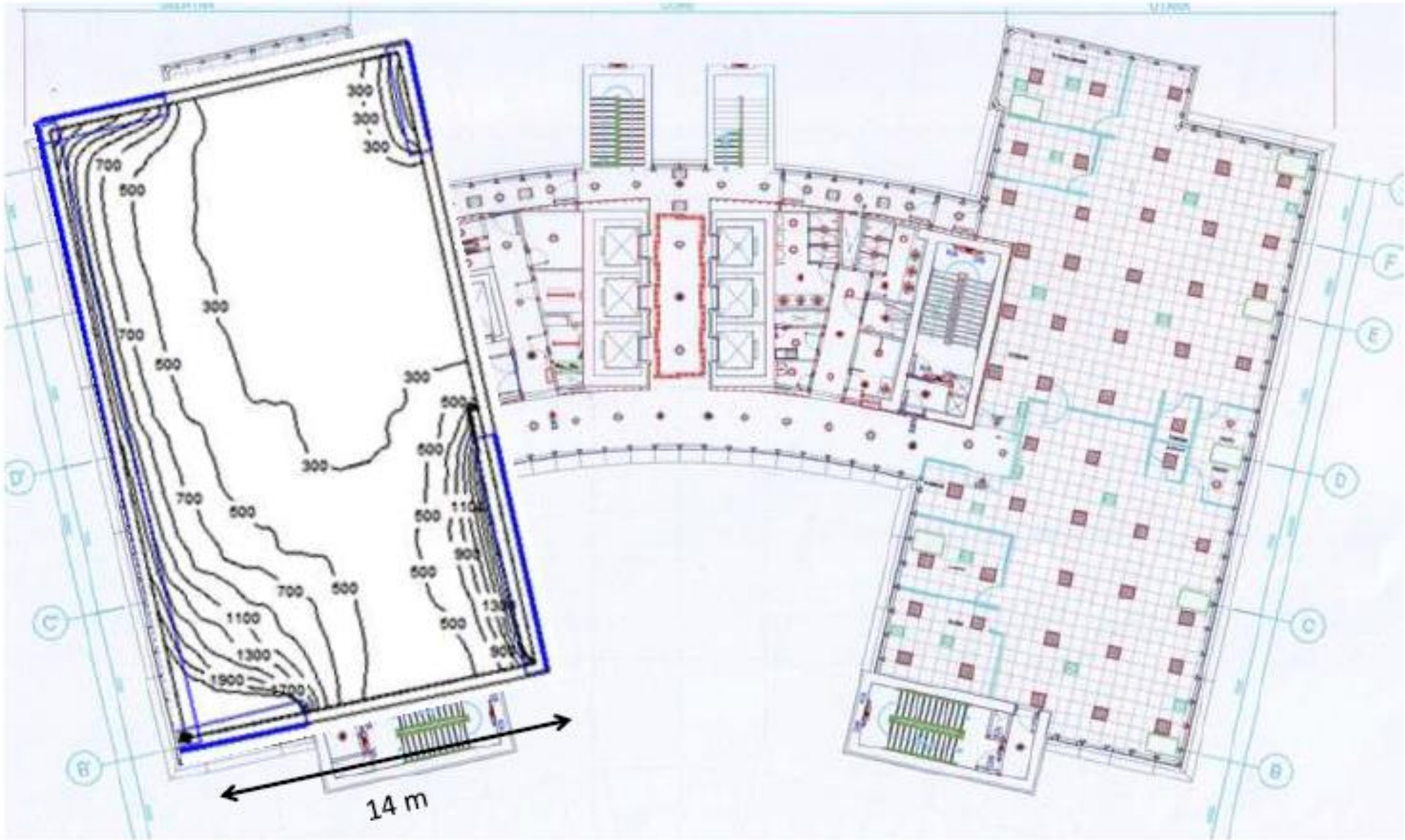


Modified building form

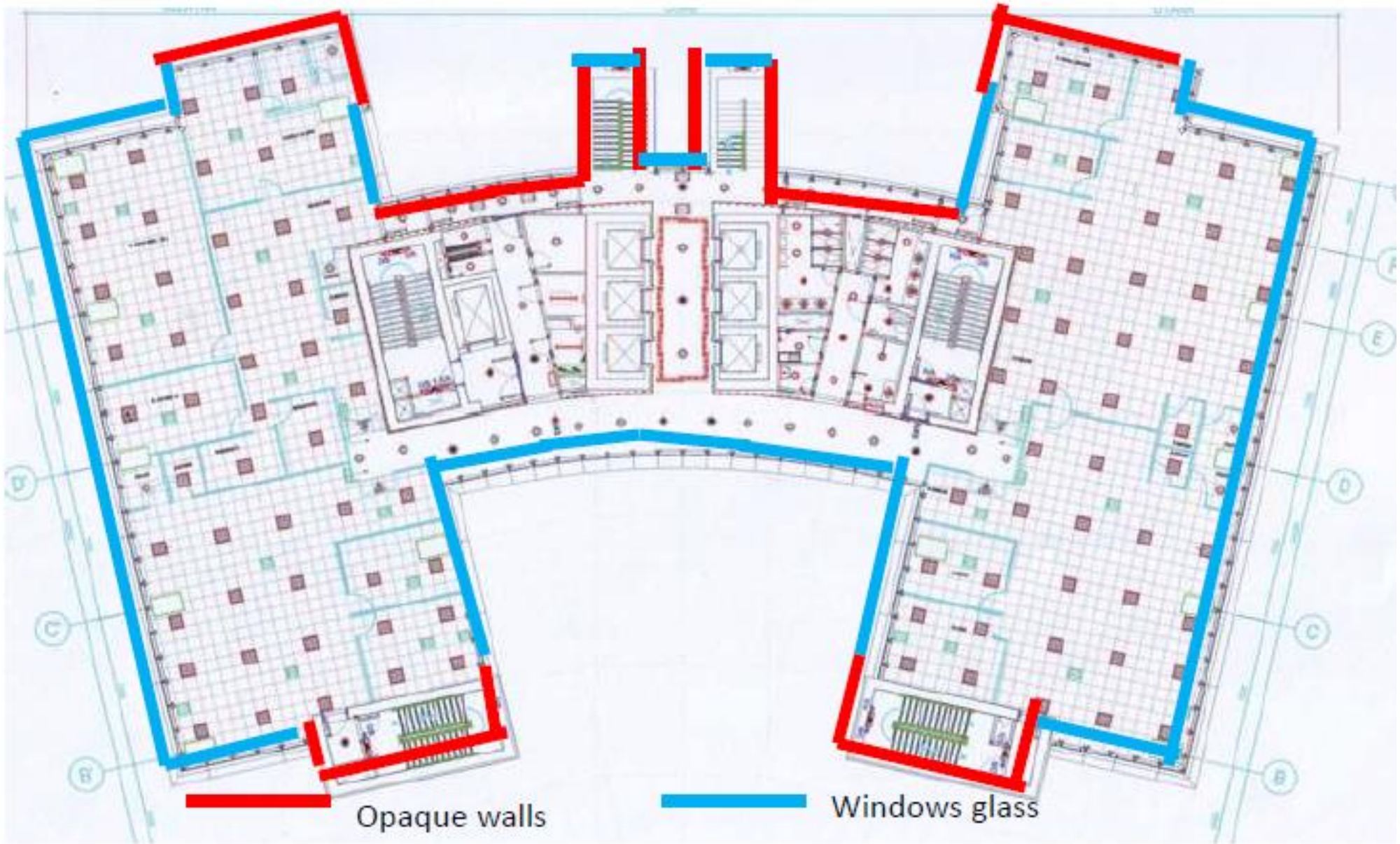
Modified Building form:

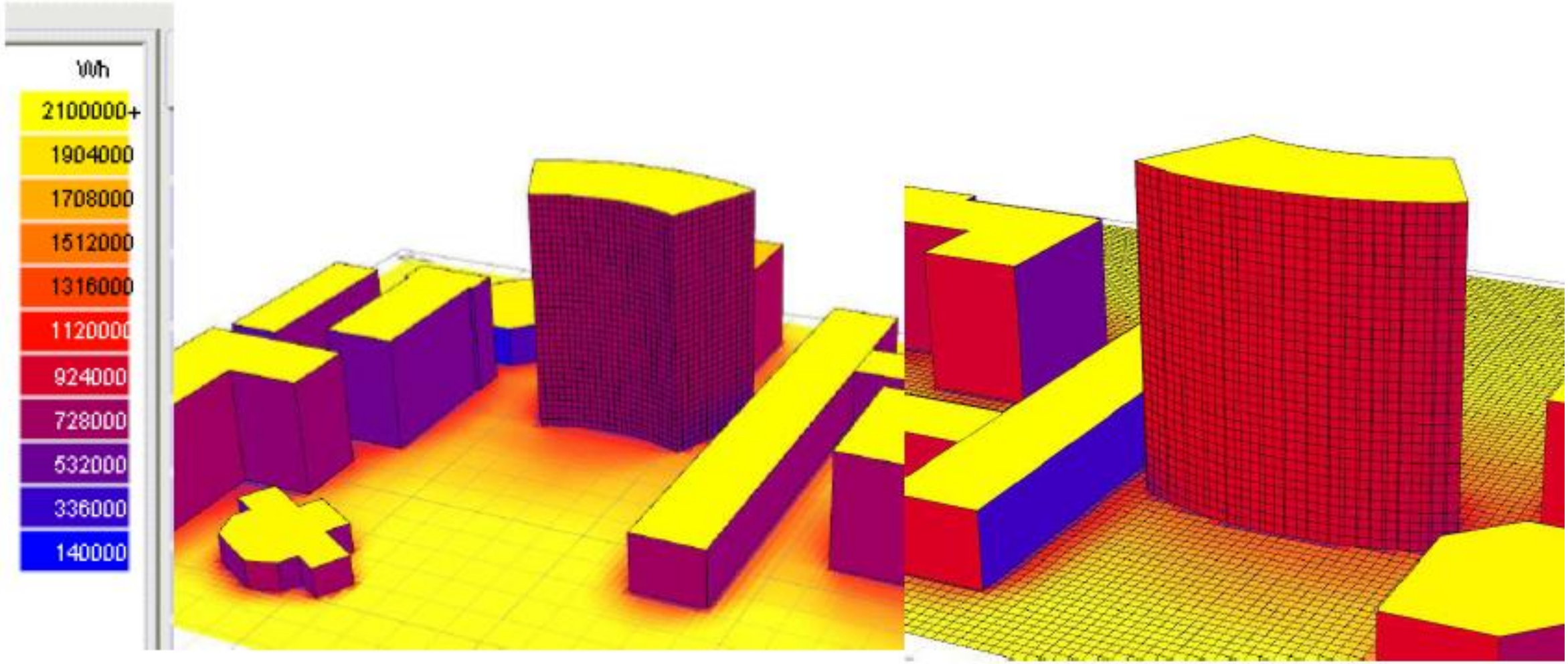
1. Reduced surface exposure of the working spaces to east and west sun
2. Narrow building form → improve daylight performance

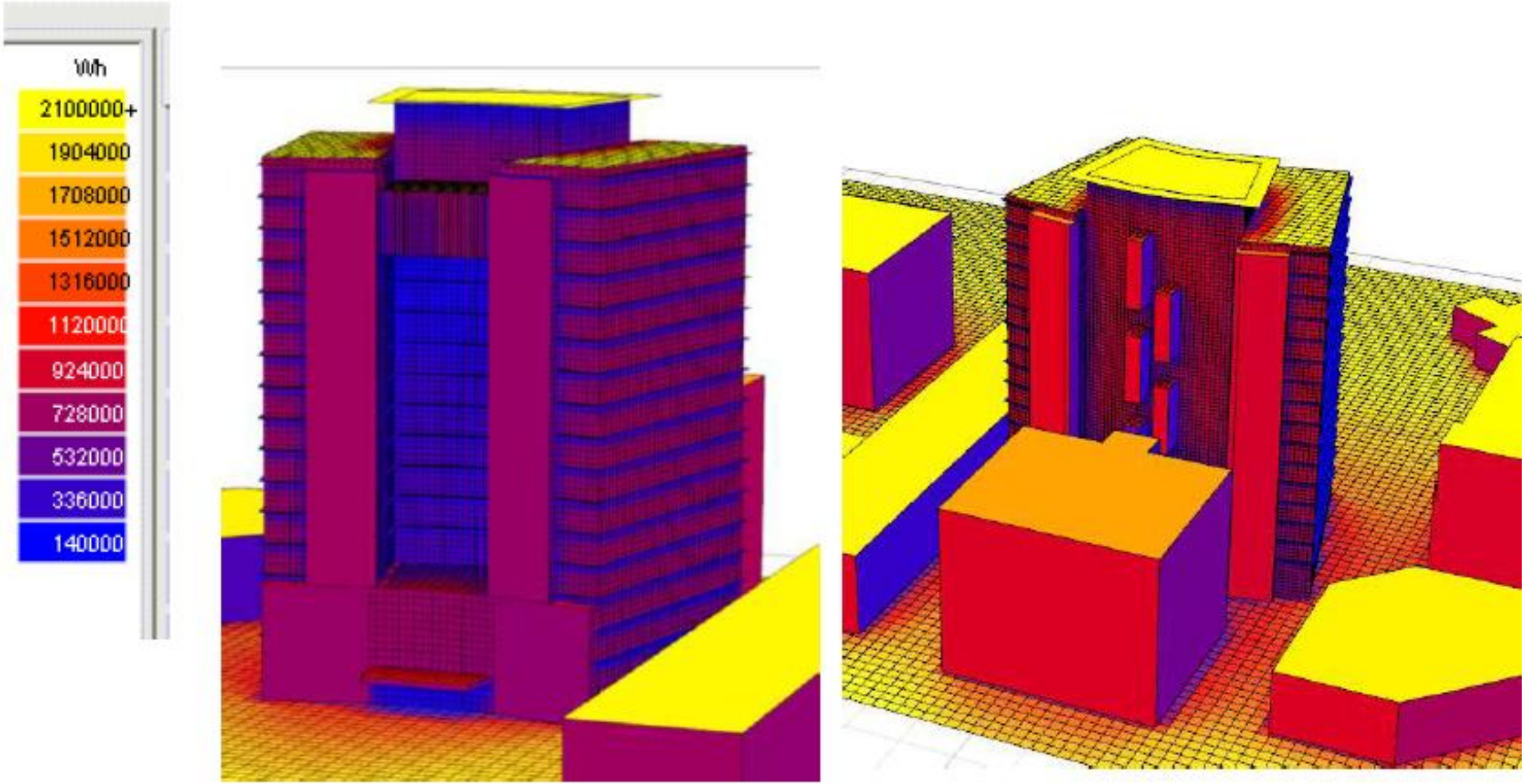
Daylight Performance → narrow building span & light shelves



Building form & orientation → orienting windows to north and south




Wh
2100000+
1904000
1708000
1512000
1316000
1120000
924000
728000
532000
336000
140000


Wh
2100000+
1904000
1708000
1512000
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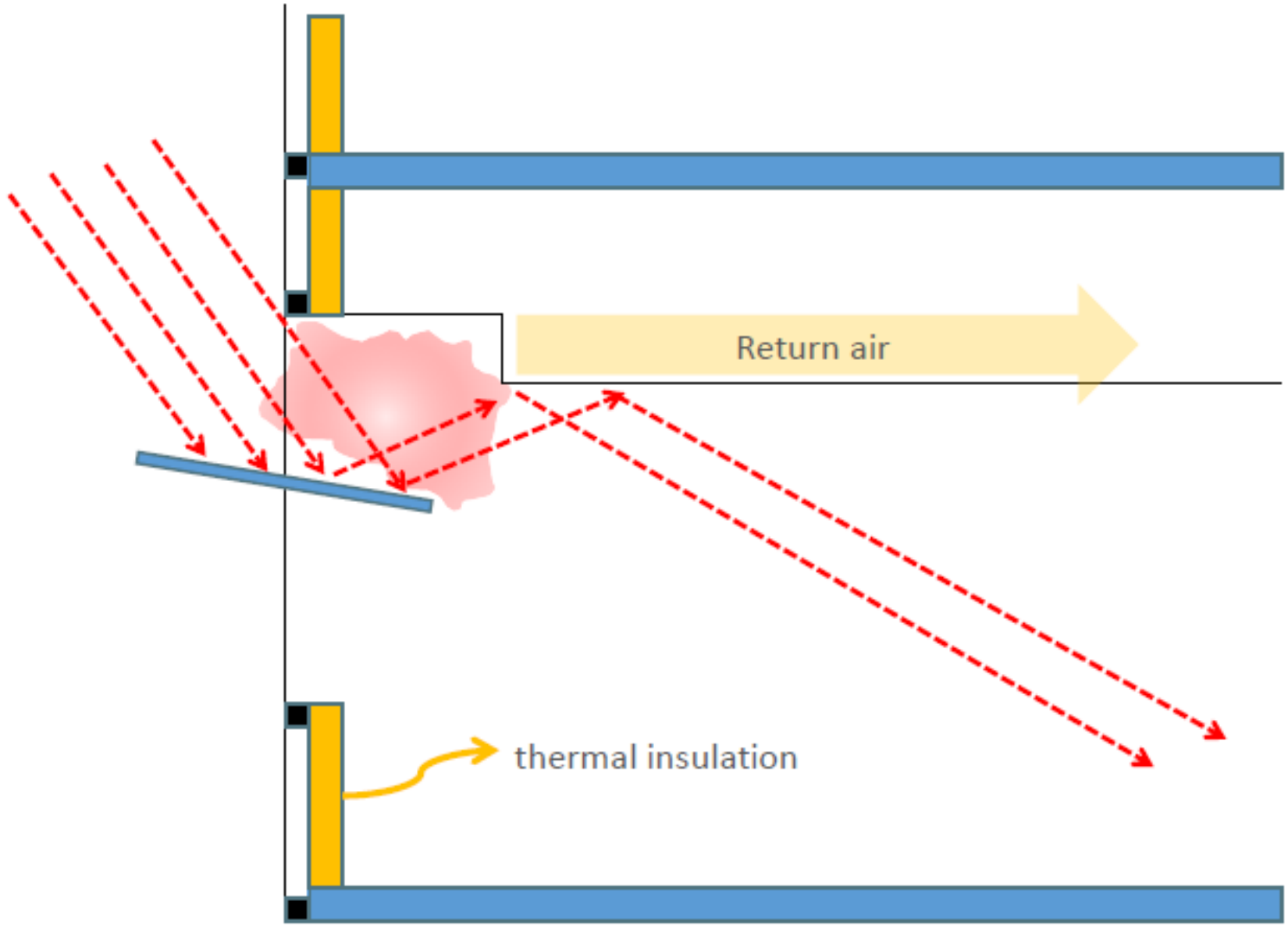
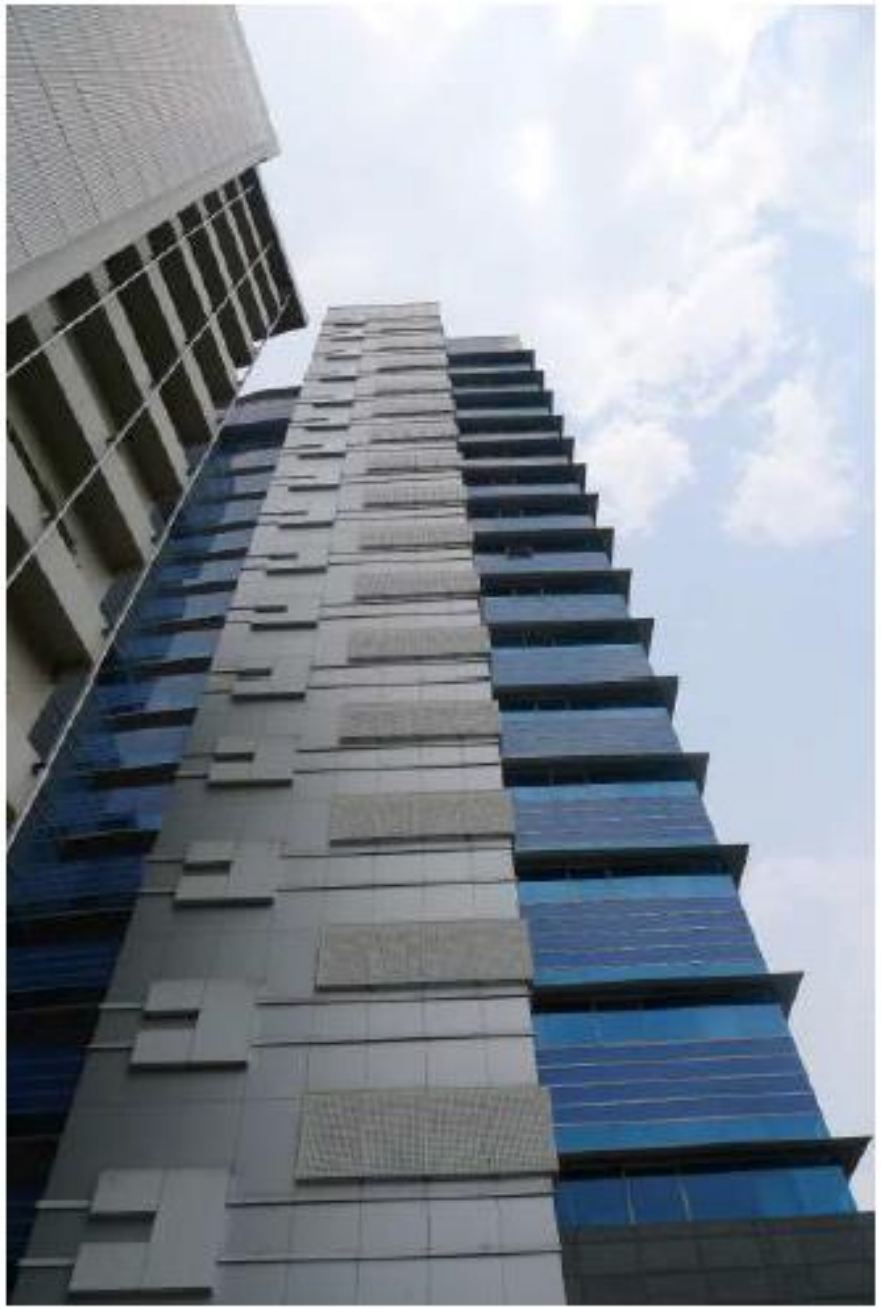
1120000
924000
728000
532000
336000
140000

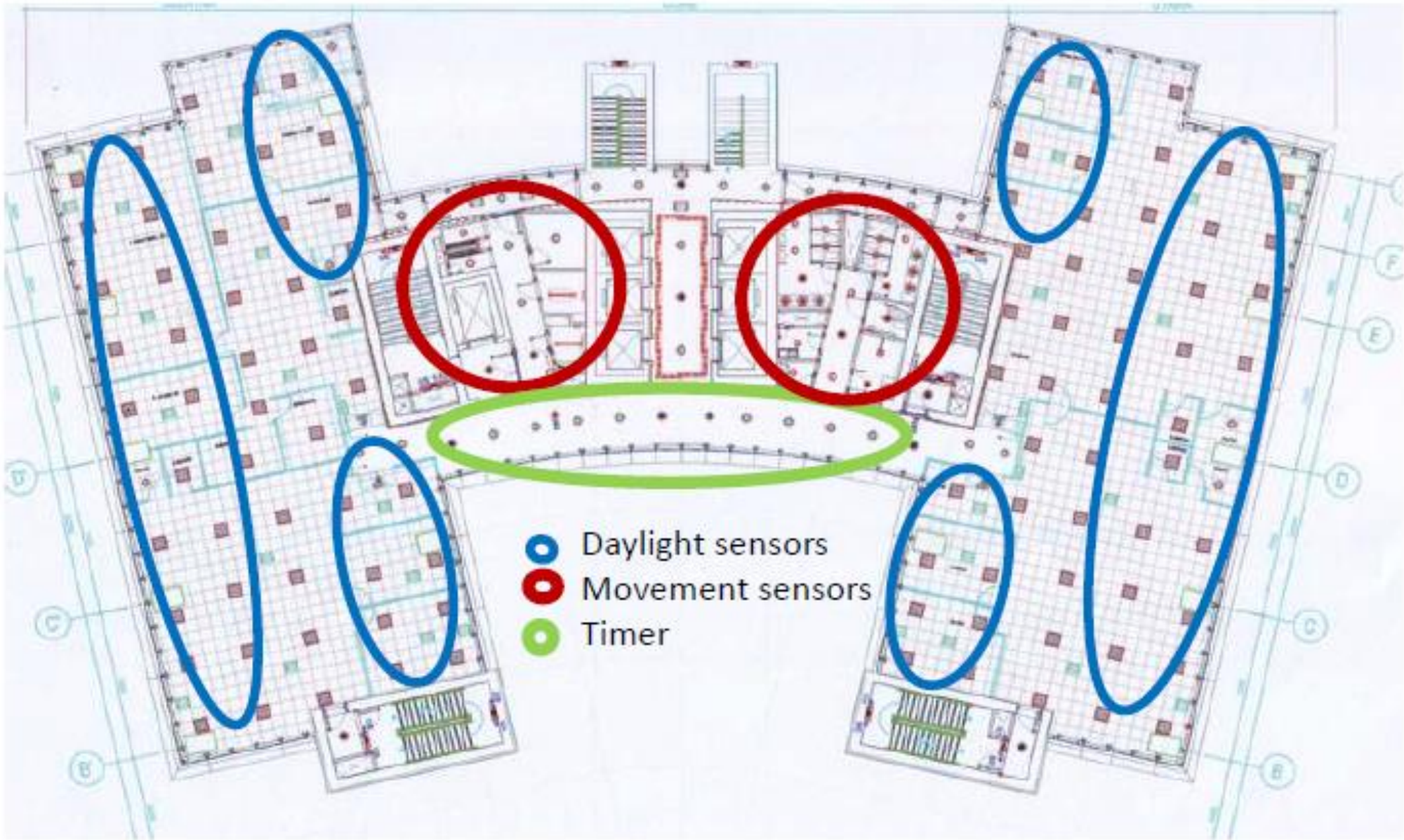
Daylighting → light shelves for better daylight distribution





Windows with perforated metal shading on west side

Automatic Lighting Control Zone → saving electric lighting energy consumption > 30%



Energy cost Savings
+ IDR 230 mil/mo

Platinum certification by GBCI

Winner 2014 ASEAN Energy Awards for new Building

Winner 2016 ASEAN Energy Awards for Green Building

5

BEST PRACTICE
GEDUNG KEMENTERIAN KELAUTAN DAN PERIKANAN

Kementerian Kelautan dan Perikanan

OTTV 35 W/m2
IKE **165.28 kWh/m2/yr**

KAPAL PINISI

GMB IV KKP

Design Strategies to reduce building energy consumption

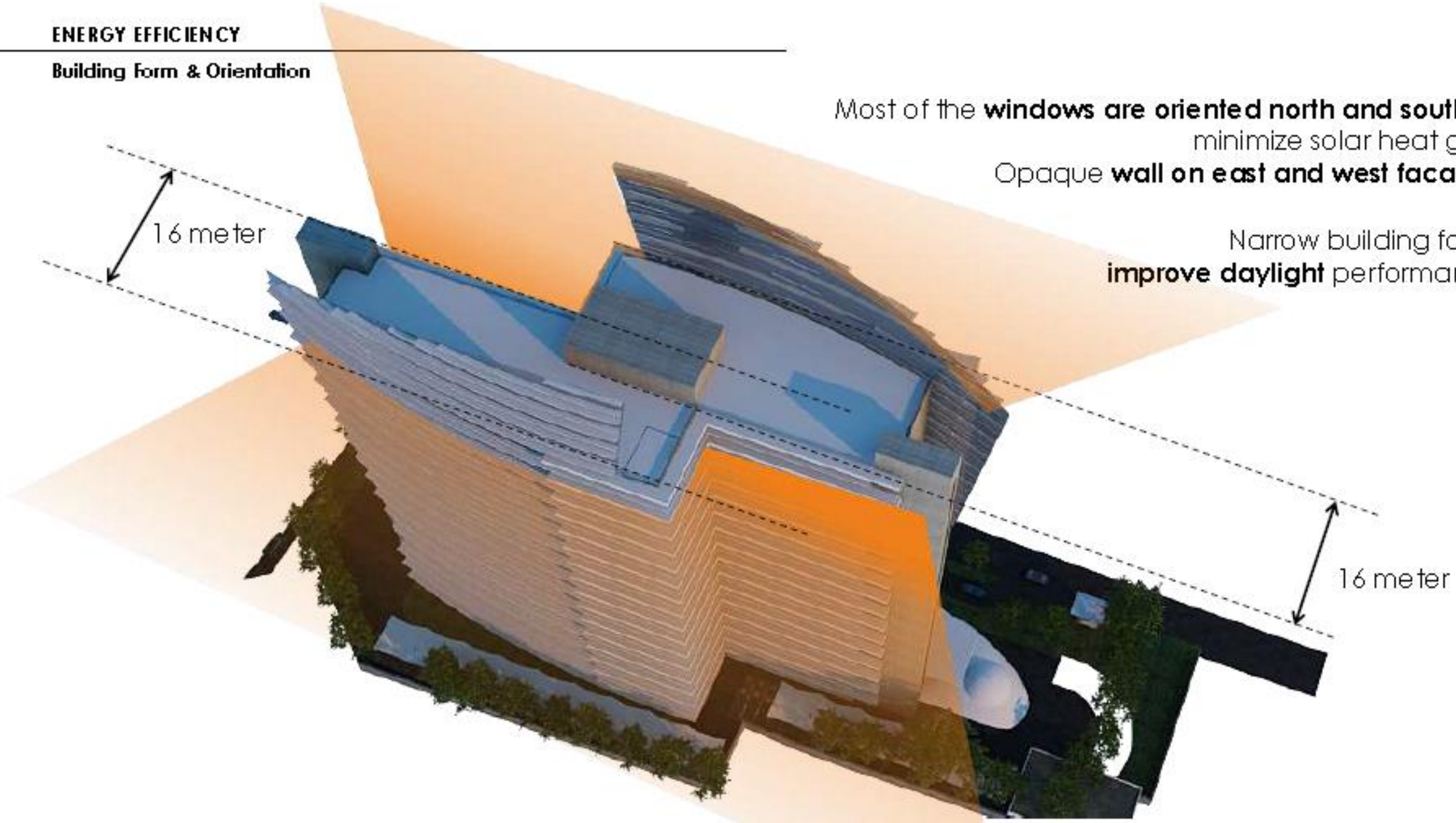
- **Building Form and Orientation**
- **Shading & Building Skin**
- **Day Lighting**
- **Highly Energy Efficient Lighting System**
- **Highly Energy Efficient HVAC System**

ENERGY EFFICIENCY

Building Form & Orientation

Most of the **windows are oriented north and south** to minimize solar heat gain
Opaque **wall on east and west facades**

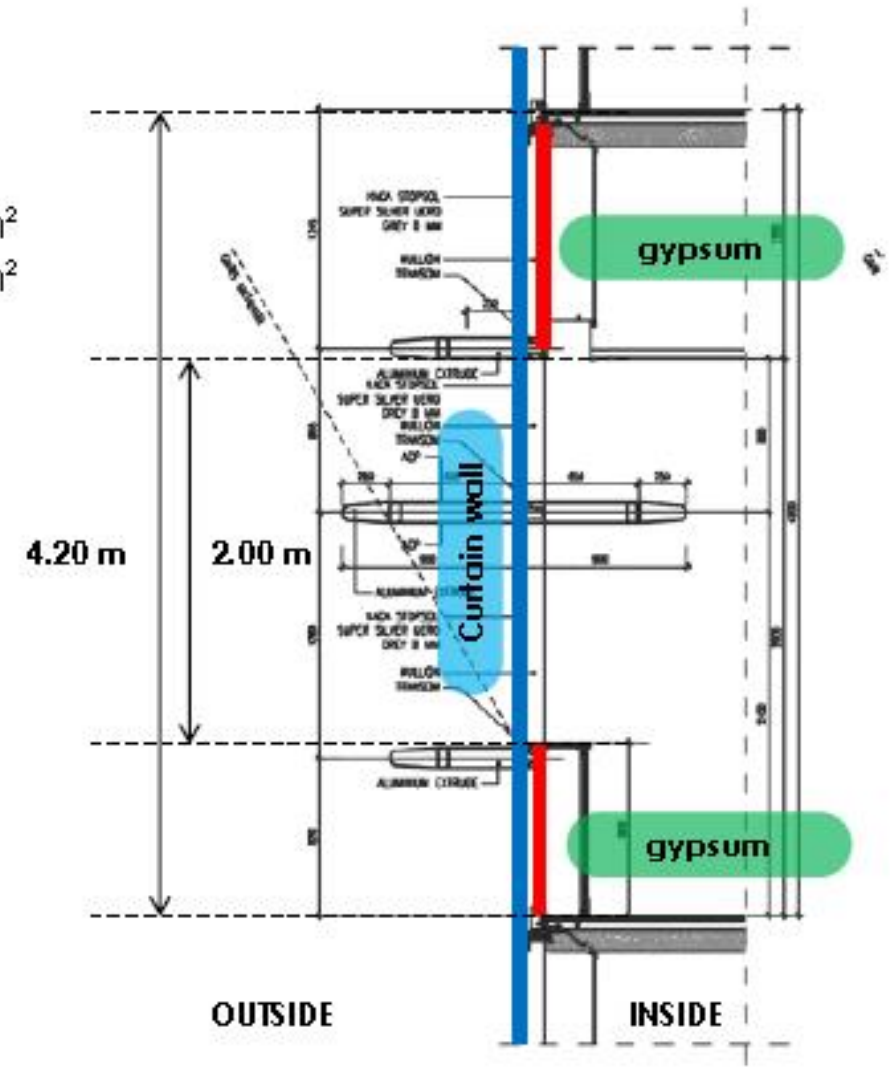
Narrow building form, **improve daylight** performance



ENERGY EFFICIENCY

Shading & Building Skin

Glass Material	: Asahimas 8mm Stopsol Supersilver Grey
SHGC	: 0.423
U-value	: 5.731
Visible Trans.	: 0.226
WWR	: 45.20%
OTTV manual	: 44.25 w/m²
OTTV simulasi	: 37.62 w/m²
Outside view	: 94.00%

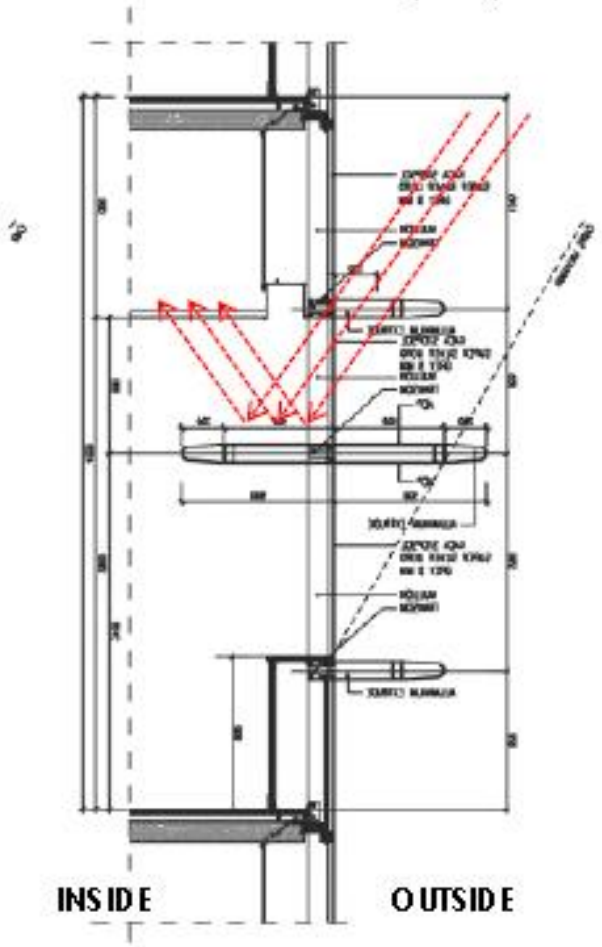


Daylighting

Light shelves

Reduce heat gain

Better daylight distribution
(more uniform and deeper penetration)



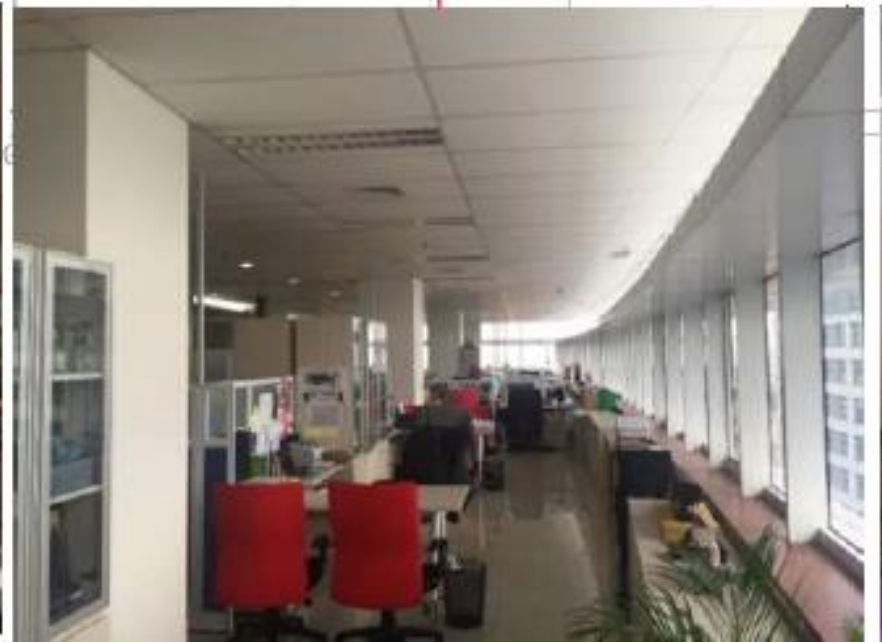
ENERGY EFFICIENCY

Shading & Building Skin

ENERGY EFFICIENCY

Daylighting

Standar illum. : 300 lux
Area daylight : 33.00%



ENERGY EFFICIENCY

Cooling — kWh/m²/year

47.60 | 83.50 | 43%

Lighting — kWh/m²/year

24.76 | 81.15 | 69%

Equipment — kWh/m²/year

40.22

Others — kWh/m²/year

66.47 | 71.37 | 7%

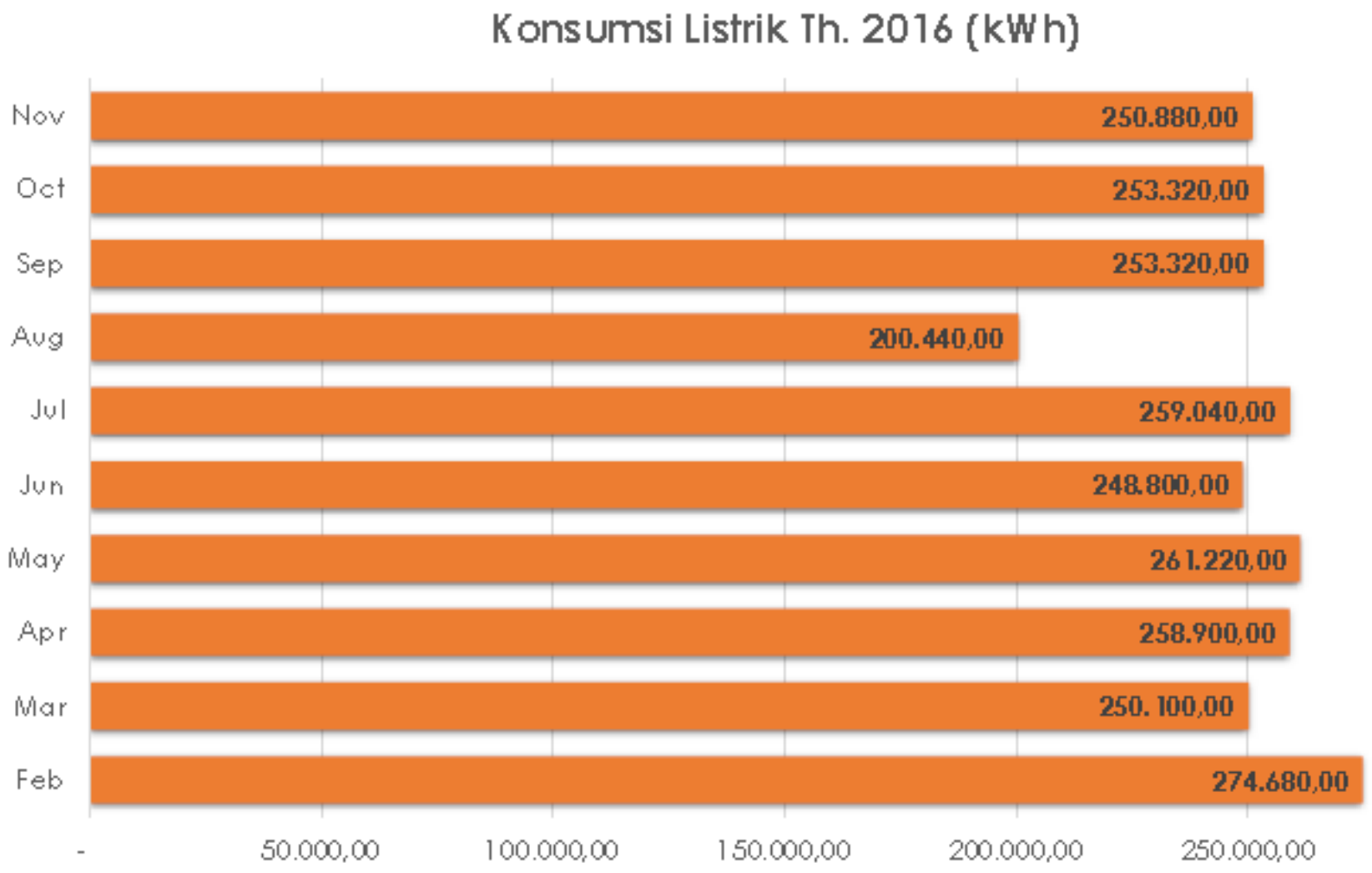
Energy Performance Index — kWh/m²/year

179.04 | 276.23 | 35%

Emisi CO2 — ton/year

1,681

ENERGY EFFICIENCY



Conditioned Area
18,695.35 m²
Energy performance Index
155.13 kWh/m²/year
or
124.93 kWh/m2/th (w/o servers & basements

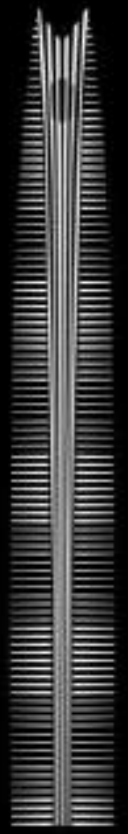
Conditioned Area
18,695.35 m^3
Energy performance Index
134.30 kWh/m^2/year
or 124.93 kWh/m2/th (w/o servers & basements

Greenship Gold Certified
No additional Cost

Penghematan:
Listrik:
(225 – 124) x 1450 x 18695 =
Rp. 2.737.882.750,-
Air:
(50 – 22,69) x 1.408 x (12,500 – 5000) =
Rp 269,167,360 (PAM)
(50 – 22,69) x 1.408 x (23,333 – 5000) =
Rp. 704,949,315 (Deep well).

6

BEST PRACTICE
GEDUNG PERTAMINA TOWER



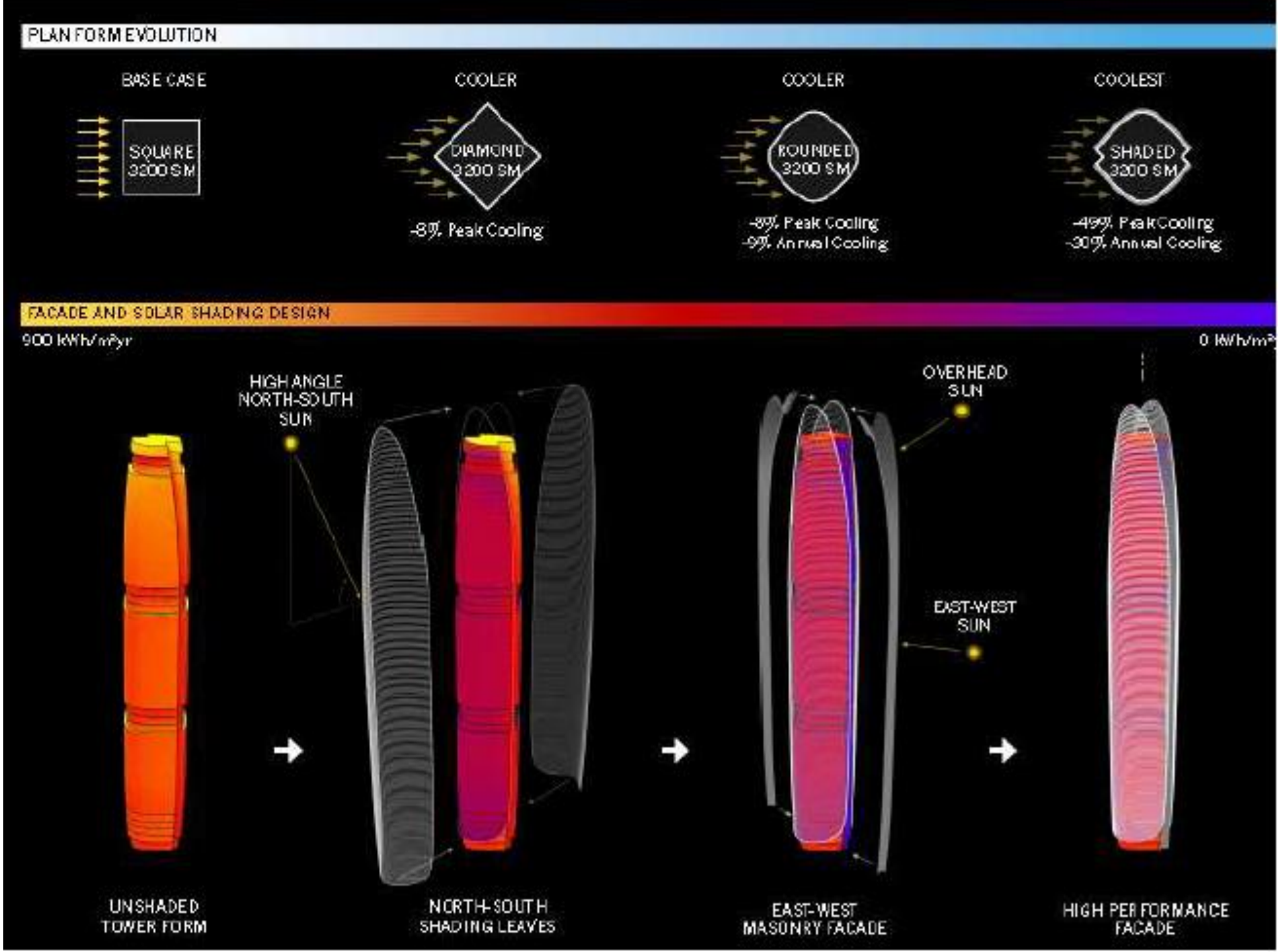
Pertamina Energy Tower

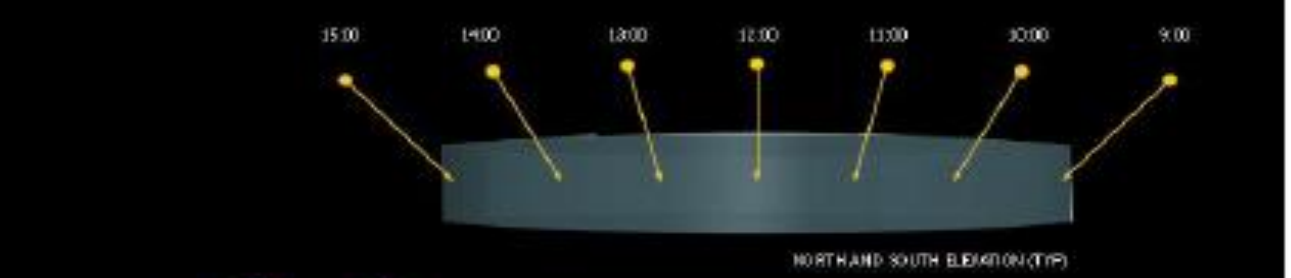
INTERIM SCHEMATIC DESIGN PRESENTATION

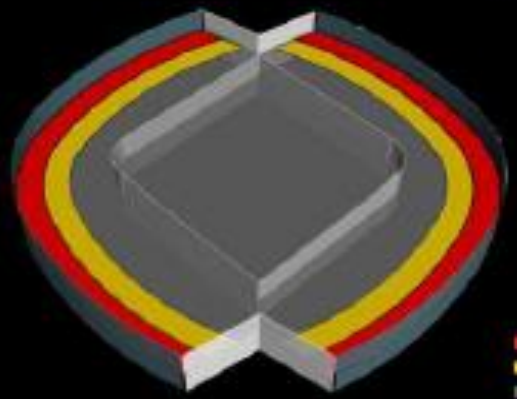
NOVEMBER 12, 2013

PERTAMINA SOM


555 M (TOWER HEIGHT)
569 M (ELEVATION)


PLAN FORM EVOLUTION
BASE CASE
SQUARE
3200 SM
COOLER
DIAMOND
3200 SM
-8% Peak Cooling
COOLER
ROUNDED
3200 SM
-8% Peak Cooling
-9% Annual Cooling
COOLEST
SHADED
3200 SM
-49% Peak Cooling
-30% Annual Cooling
FACADE AND SOLAR SHADING DESIGN
900 kWh/m²yr
0 kWh/m²
HIGH ANGLE
NORTH-SOUTH
SUN
OVERHEAD
SUN
EAST-WEST
SUN
UNSHADED
TOWER FORM
NORTH-SOUTH
SHADING LEAVES
EAST-WEST
MASONRY FACADE
HIGH PERFORMANCE
FACADE

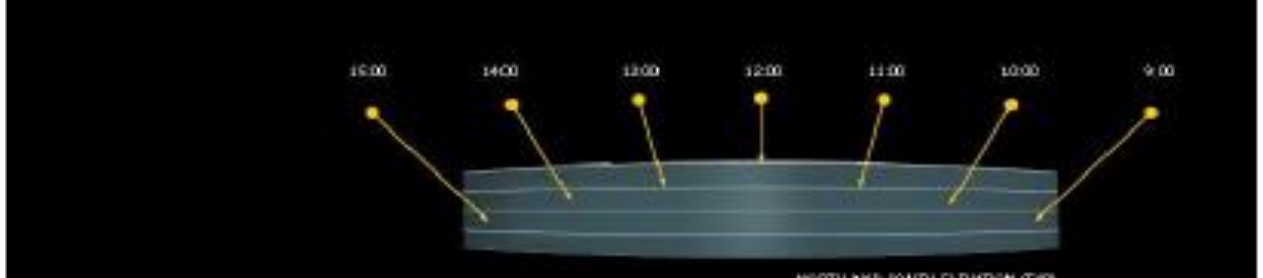


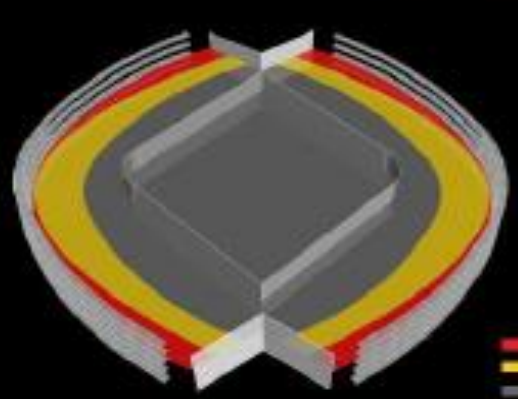


NO SHADING

Floor areas within 3.5 meters of the glazing plane receive uncomfortably high levels of sunlight resulting in visual and thermal discomfort.

- Visual and thermal discomfort
- Desirable condition - useful daylight
- Not enough useful daylight

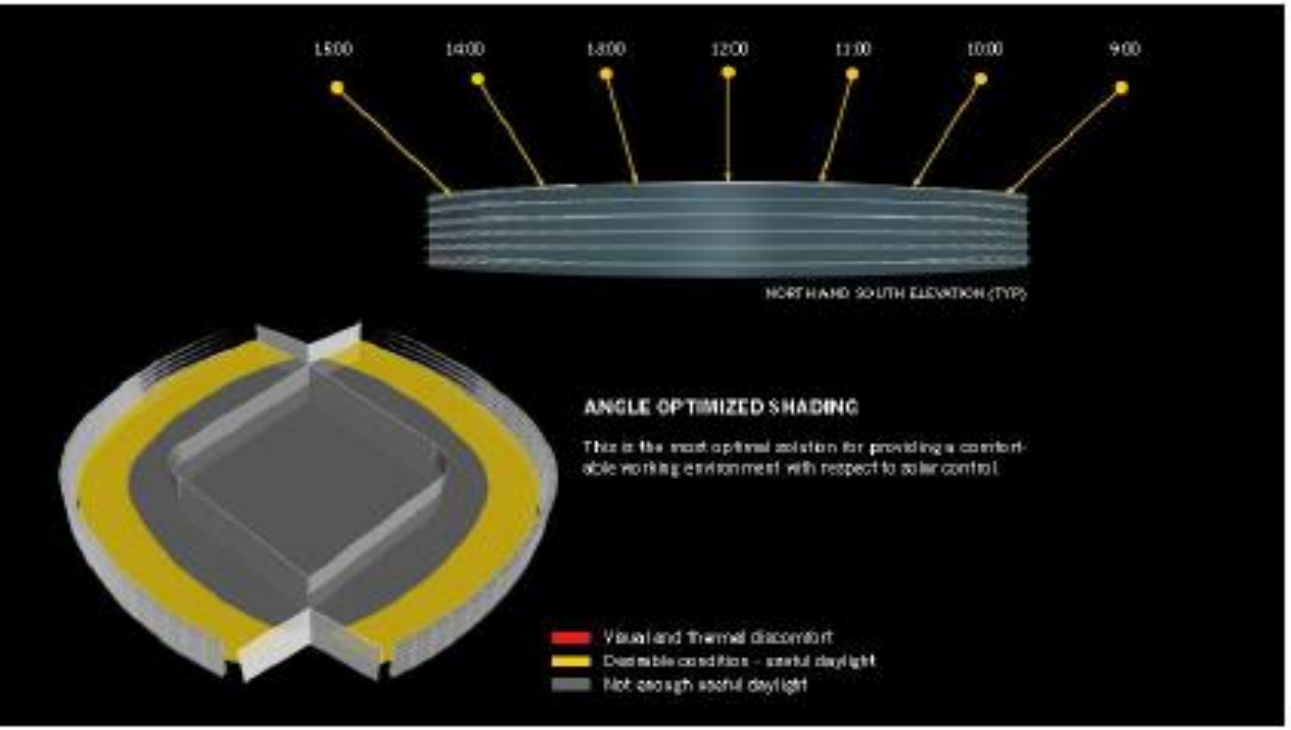




HORIZONTAL SHADING

This alternate provides adequate shading in the center of the floor plate at the north and south elevations, but is unable to adequately protect east and west floor areas.

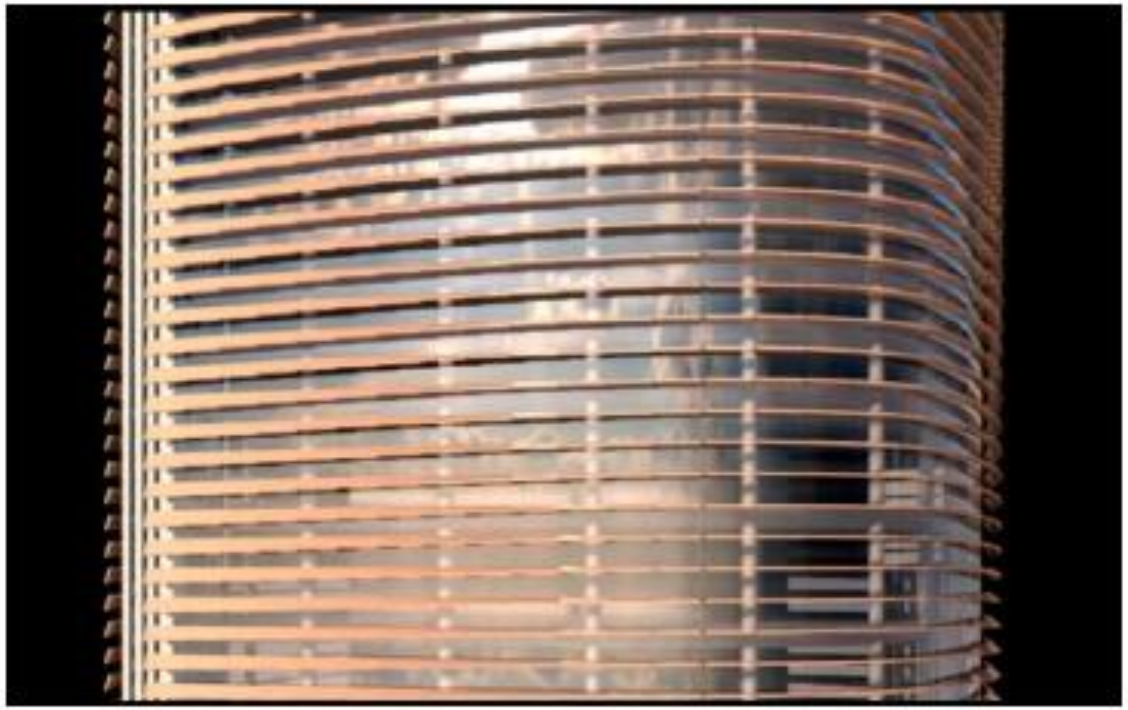
- Visual and thermal discomfort
- Desirable condition - useful daylight
- Not enough useful daylight



ANGLE OPTIMIZED SHADING

This is the most optimal solution for providing a comfortable working environment with respect to solar control.

- Visual and thermal discomfort
- Desirable condition - useful daylight
- Not enough useful daylight



6 ENERGY CONSERVATION

TERIMA KASIH

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