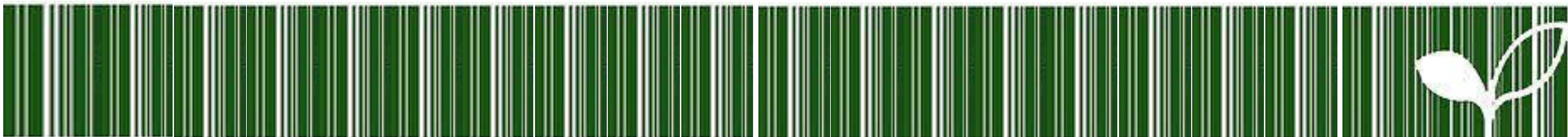


The **Art** of Designing **Green Building Envelop**

Michael Ching

29 June 24



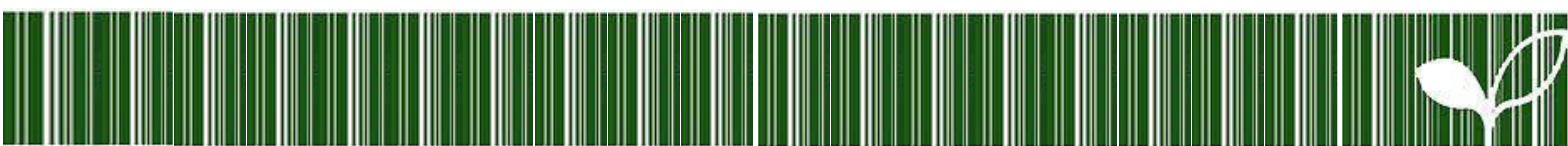
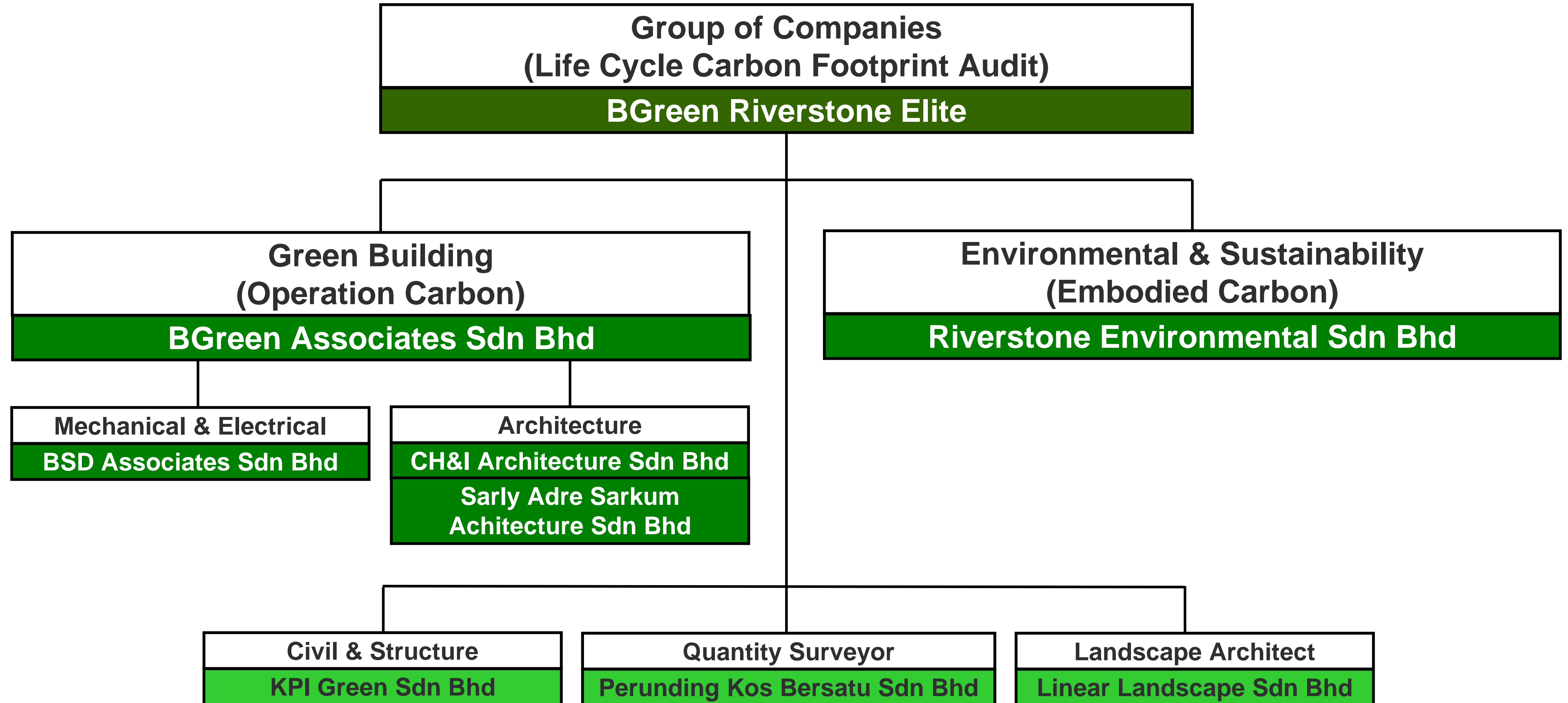
BGREEN
RIVERSTONE
ELITE

Content

1. Introduction
2. Green Building – GBI vs GreenRE
3. Green Building – Malaysian Expectation
4. Green Façade – The Art of Designing
5. Green Roof – Types & Suitability
6. Energy Efficiency and Conservation Act (EECA)
7. MPPP – GBI Silver/Gold, 50% RE

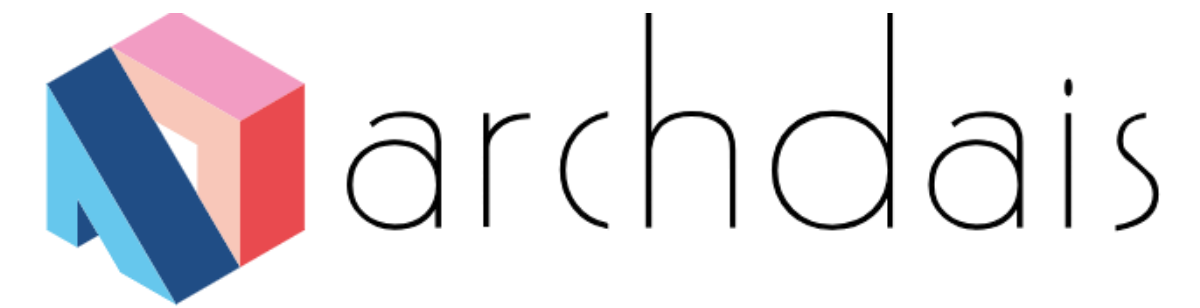


Introduction





BGREEN
RIVERSTONE
ELITE



malaysiaGBC



2022 Awards



Malaysia Green Building Council
Leadership in Sustainability Award 2022
Best New Green Institutional Building – Winner
Best Sustainability Leadership for Consultant – Honorary Mention



Malaysia Ministry of Energy and Natural Resources
National Energy Awards 2022
Energy Efficient Green Building (Large) – Winner
Energy Efficient Green Building (Large) – Runner Up



ASEAN Centre for Energy
ASEAN Energy Efficiency and Conservation Best Practices Awards 2022
Green Building (Large) – Winner
Green Building (Large) – 2nd Runner Up

2023 Awards



Malaysia Ministry of Energy and Natural Resources
National Energy Awards 2023
Green Building (Large) – Winner
Green Building (Large) – Merit
Energy Efficient Green Building (Large) – Runner Up (2nos)



ASEAN Centre for Energy
ASEAN Energy Efficiency and Conservation Best Practices Awards 2023
Green Building (Large) – Winner

2024 Awards



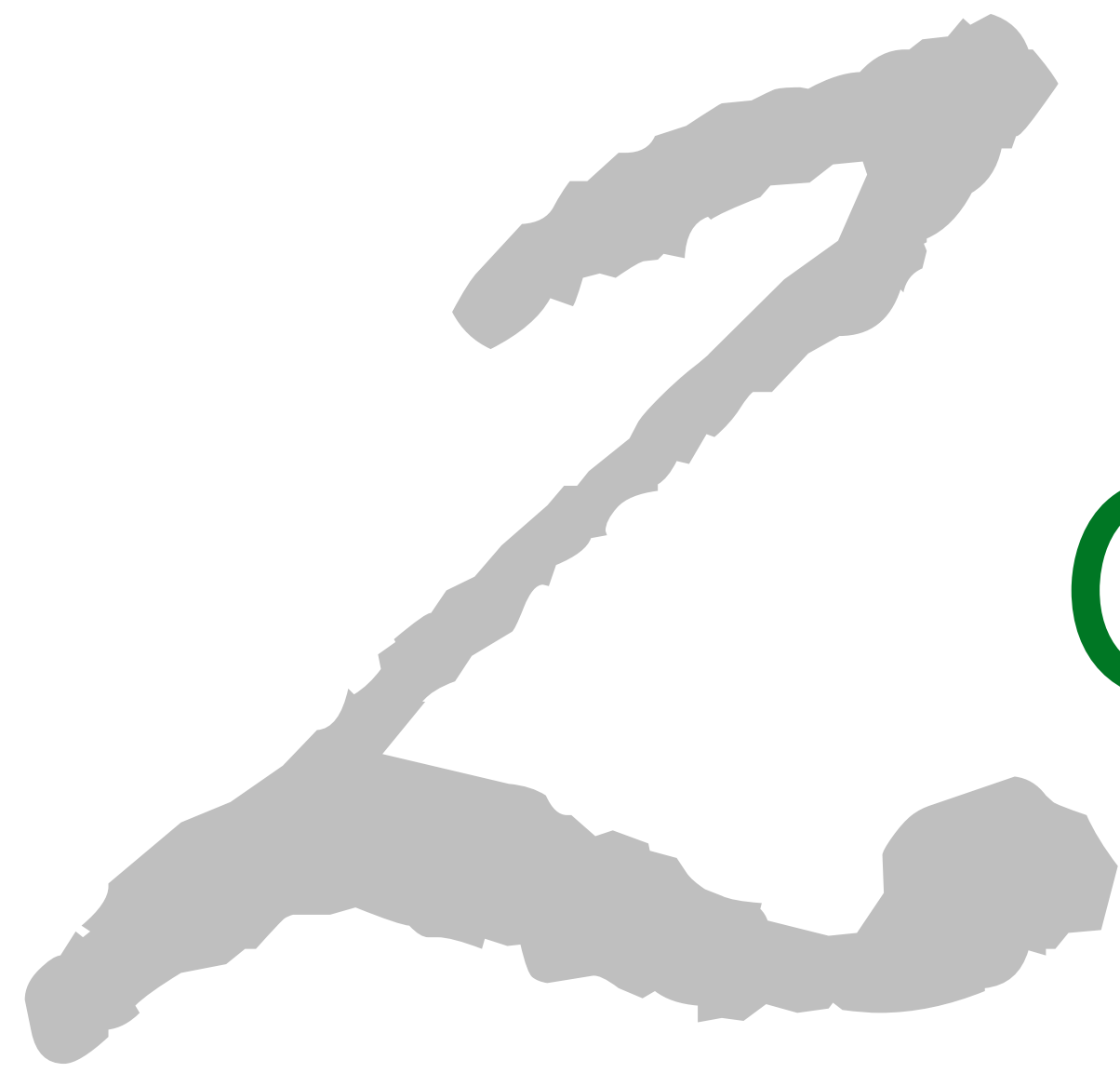
**Malaysia Green Building Council
Leadership in Sustainability Award 2024**
Best New Green Commercial Building
Best New Green Residential Building (2nos)
Best New Green Institutional Building
**Pending result*



**Malaysia Ministry of Energy and Natural Resources
National Energy Awards 2024**
Energy Efficient Green Building (Large)(2nos)
Green Resident
**Pending result. Represent Malaysia for ASEAN Energy Awards*



**ASEAN Centre for Energy
ASEAN Energy Efficiency and Conservation Best Practices
Awards 2024**
Green Building (Large)(2nos)
Green Resident
**Pending result*



Green Building

GBI vs GreenRE



vs



	GBI	GreenRE
a. Ownership	PAM + ACEM	REDHA
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark
c. Administered	WorldGBC MalaysiaGBC	Advisory Panel
d. Registration Fee (Except Mega Project)	RM 5,000 – 45,000	RM 5,000 – 45,000 20% Discount for REDHA Members
e. Minimum Certification Score/Credit	RNC – 50% NRNC – 50%	RES (HR & Landed) – 43.48% (50/115 points) cap NRB (AC & non AC) – 41.67% (50/120 points) cap
f. Score/Credit from Passive Design (Arch)		

	GBI	GreenRE
a. Ownership	PAM + ACEM	REDHA



PAM

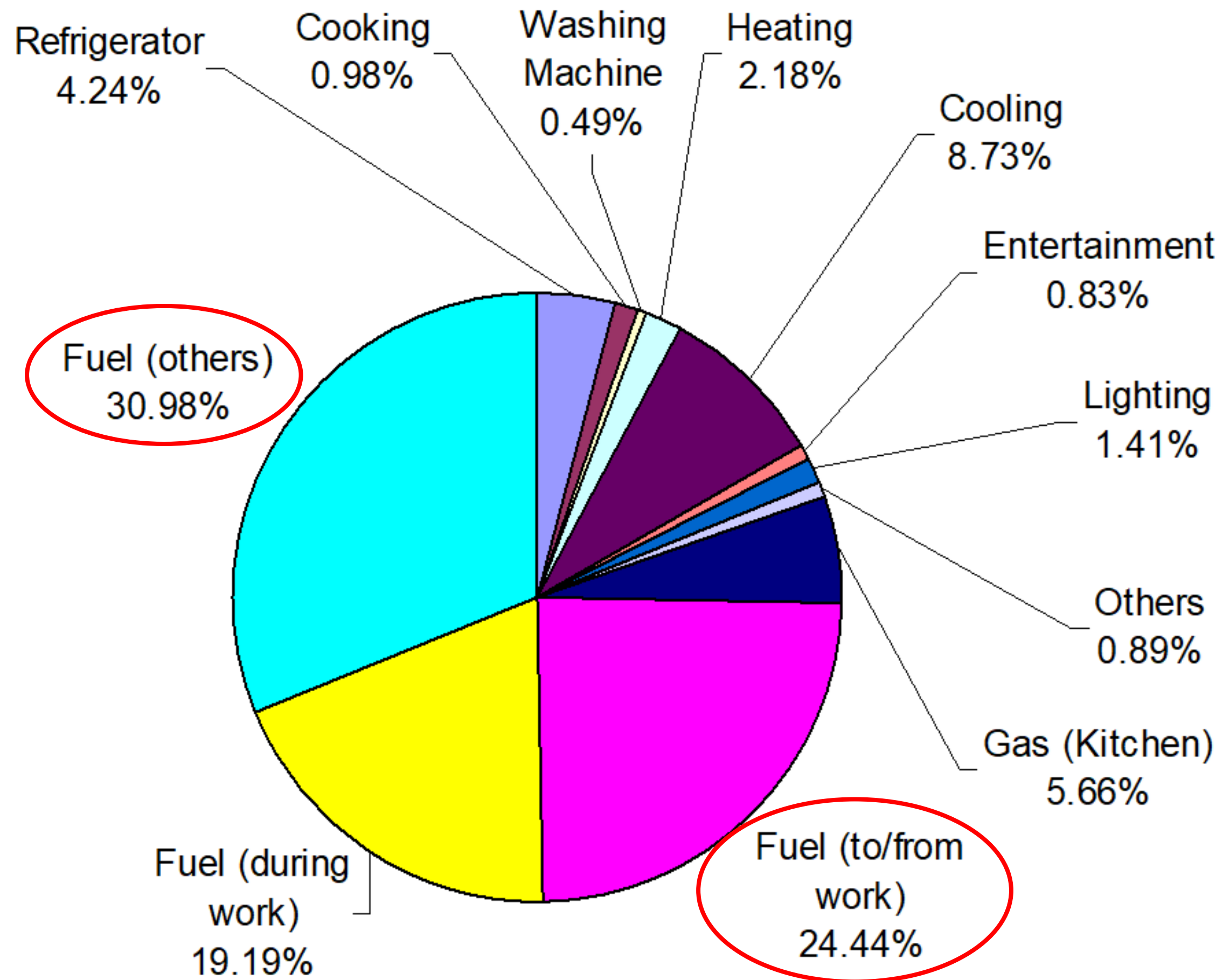


ASSOCIATION OF CONSULTING ENGINEERS MALAYSIA



REDHA

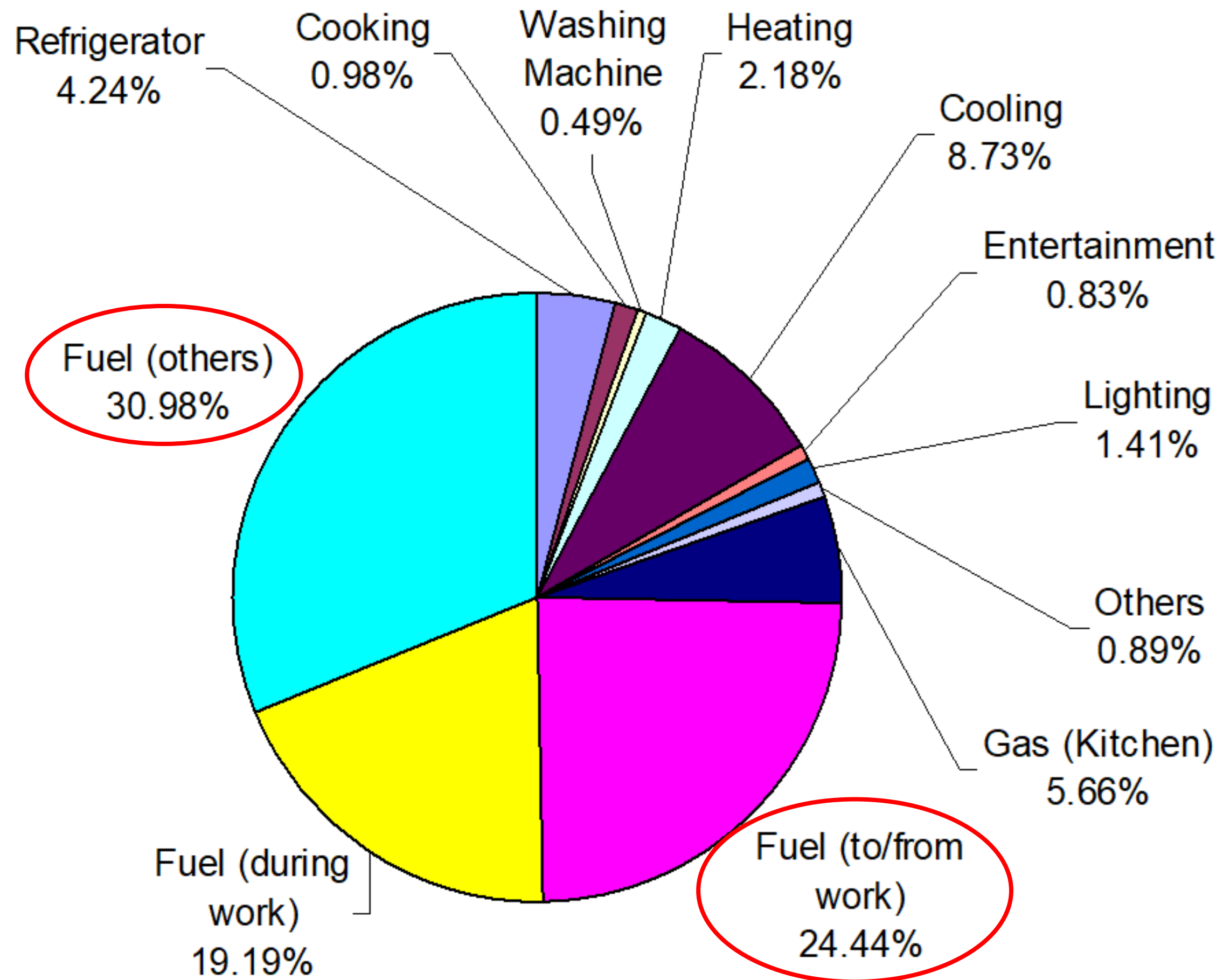
	GBI	GreenRE
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark



GBI ASSESSMENT CRITERIA FOR RESIDENTIAL NEW CONSTRUCTION (RNC)

PART	ITEM	MAXIMUM POINTS	SCORE
1	Energy Efficiency (EE)	23	
2	Indoor Environmental Quality (EQ)	12	
3	Sustainable Site Planning & Management (SM)	33	
4	Material & Resources (MR)	12	
5	Water Efficiency (WE)	12	
6	Innovation (IN)	8	
TOTAL SCORE		100	

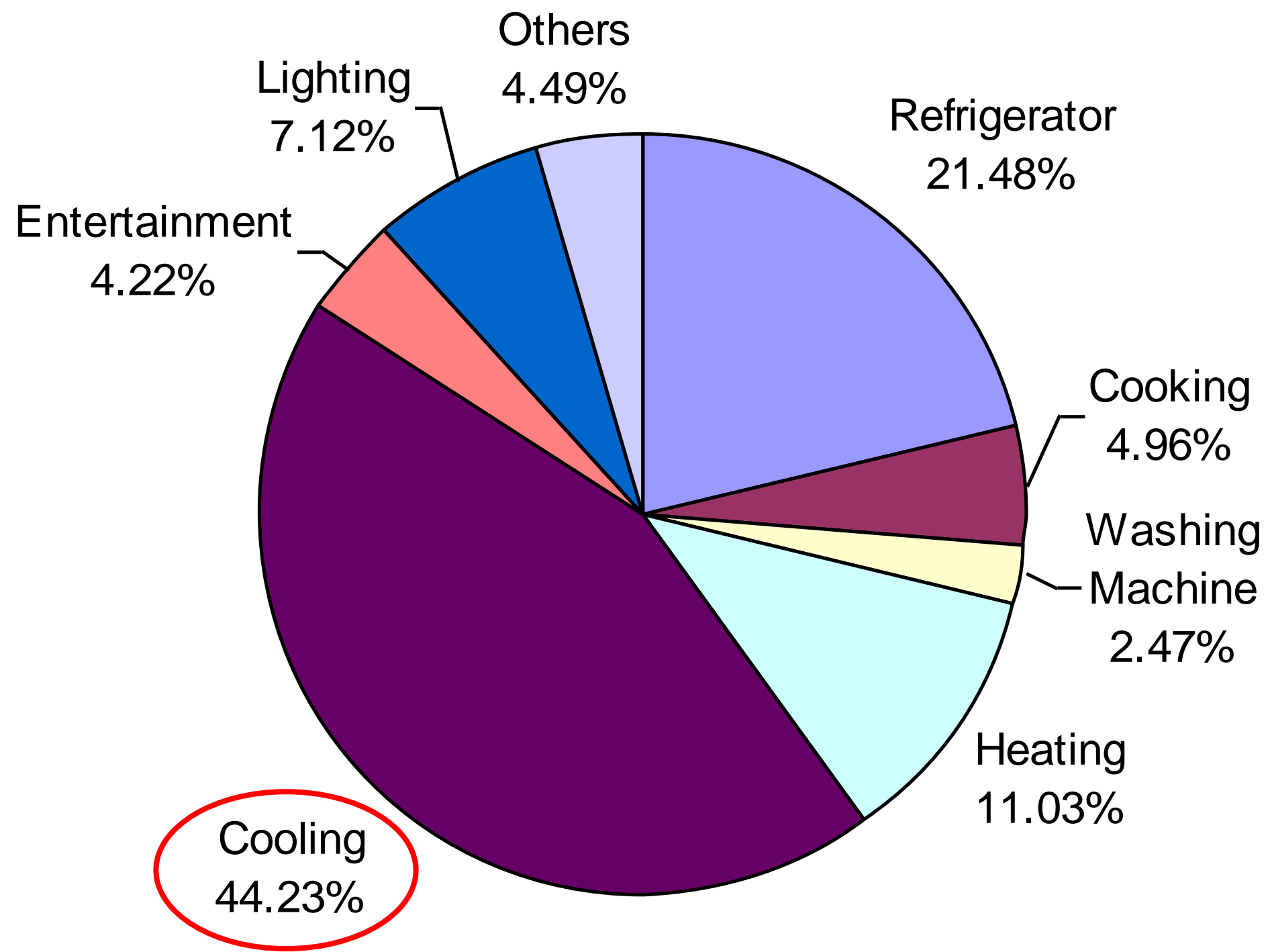
	GBI	GreenRE
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark



GBI ASSESSMENT CRITERIA FOR RESIDENTIAL NEW CONSTRUCTION (RNC)

SM	SUSTAINABLE SITE PLANNING & MANAGEMENT		33
	Site Planning		
SM1	Site Selection & Planning	1	
SM2	Re-habilitation of Brownfield Sites OR Re-development of Existing Buildings	1	
SM3	Community Connectivity	4	
Construction Management			
SM4	Earthworks – Construction Activity Pollution Control	1	
SM5	QLASSIC – Quality Assessment System For Building Construction Work	1	
SM6	Workers’ Site Amenities	1	
SM7	IBS – Industrialised Building System	2	
Transportation			
SM8	Public Transportation Access	8	
SM9	Dedicated Cycling Network	2	
Design			
SM10	Stormwater Design – Quantity and Quality Control	3	
SM11	Heat Island Effect – Greenscape and Water Bodies	5	
SM12	Heat Island Effect – Hardscape	2	
SM13	Heat Island Effect – Roof	1	
SM14	Composting	1	

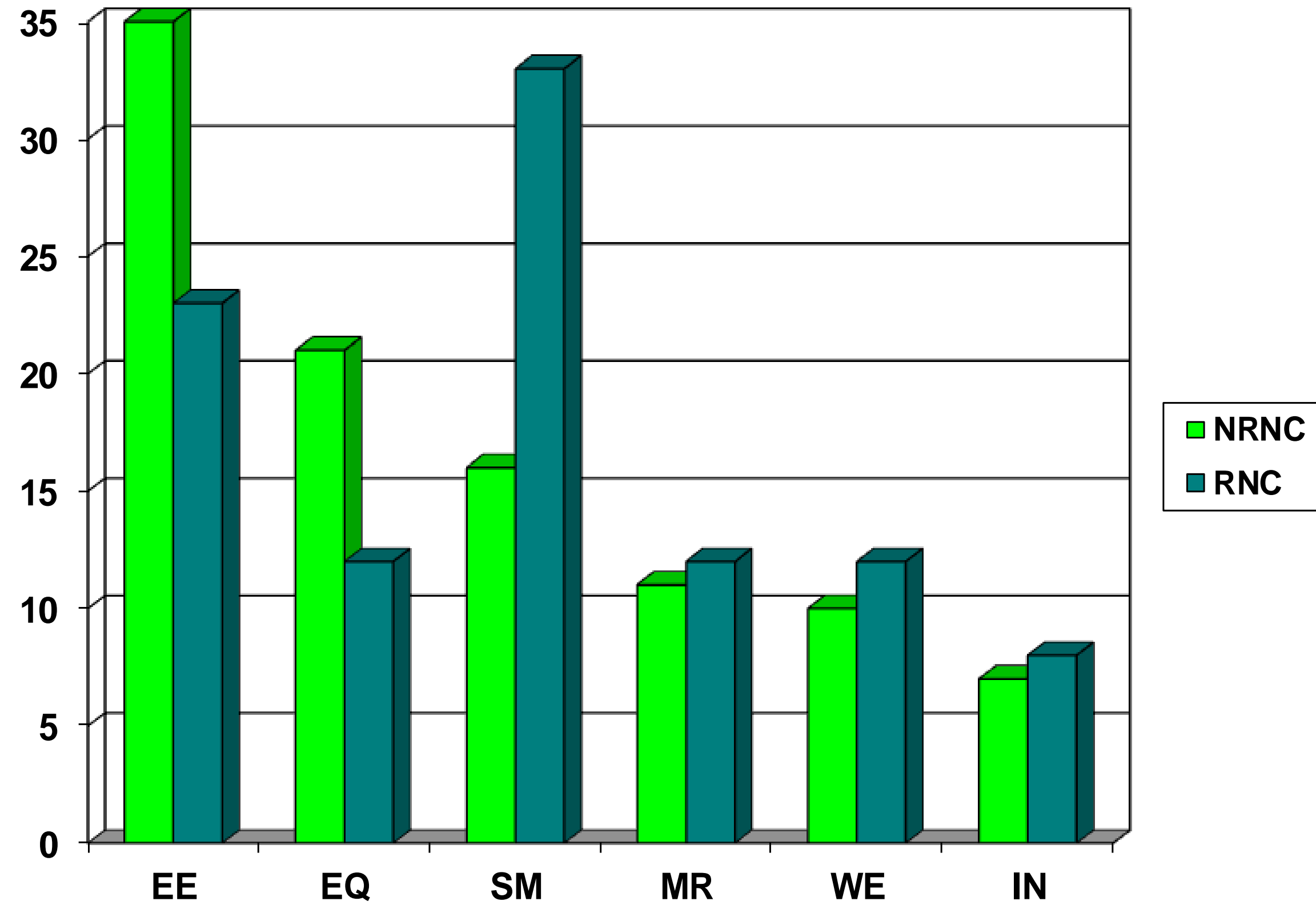
	GBI	GreenRE
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark



GBI ASSESSMENT CRITERIA FOR RESIDENTIAL NEW CONSTRUCTION (RNC)

PART	CRITERIA	ASSESSMENT CRITERIA	POINTS	TOTAL
1	EE	ENERGY EFFICIENCY		23
	Design			
	EE1	Minimum EE Performance (Mandatory Compliance)	1	
	EE2	Advanced EE Performance	12	
	EE3	Renewable Energy	5	
	Energy Efficiency			
	EE4	External Lighting and Control	2	
	EE5	Internet Connectivity	1	
	Maintenance			
	EE6	Sustainable Maintenance and Building User Manual (BUM)	2	

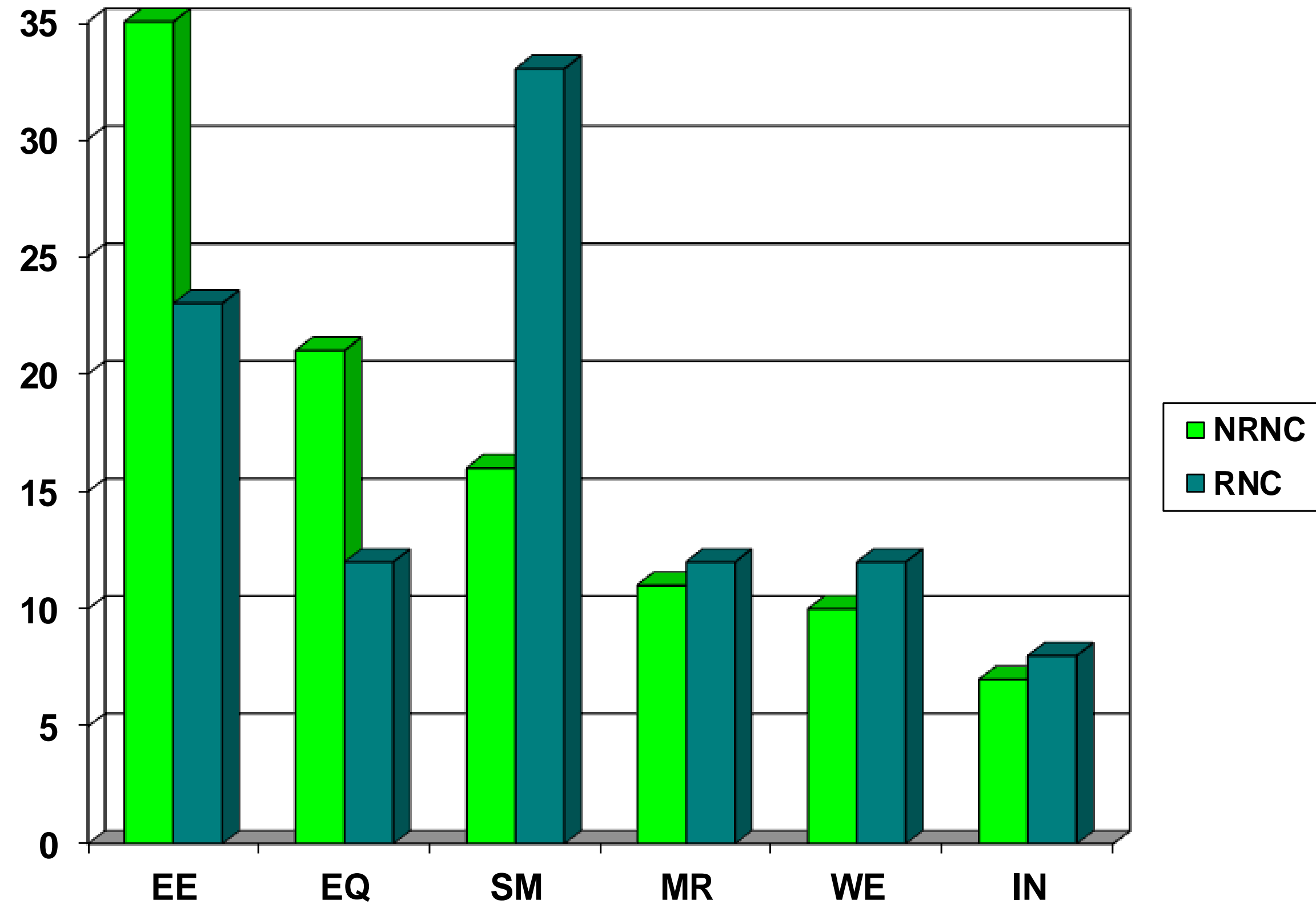
	GBI	GreenRE
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark



GBI ASSESSMENT CRITERIA FOR NON-RESIDENTIAL NEW CONSTRUCTION (NRNC)

PART	ITEM	MAXIMUM POINTS	SCORE
1	Energy Efficiency	35	
2	Indoor Environmental Quality	21	
3	Sustainable Site Planning & Management	16	
4	Material & Resources	11	
5	Water Efficiency	10	
6	Innovation	7	
TOTAL SCORE		100	

	GBI	GreenRE
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark



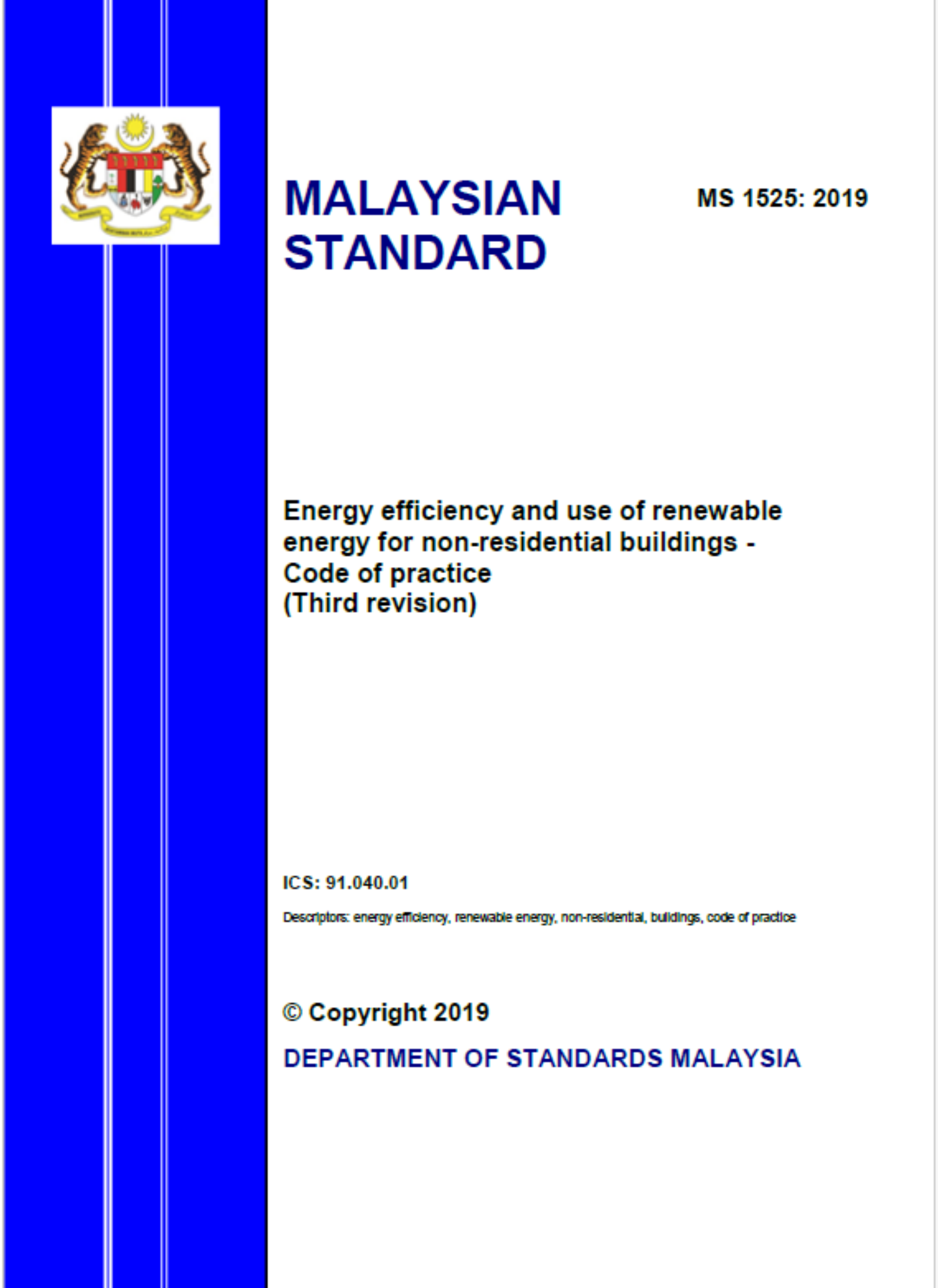
GBI ASSESSMENT CRITERIA FOR NON-RESIDENTIAL NEW CONSTRUCTION (NRNC)

PART	CRITERIA	ITEM	POINTS	TOTAL	
1	EE	ENERGY EFFICIENCY		35	
	Design				
	EE1	Minimum EE Performance	1		
	EE2	Lighting Zoning	3		
	EE3	Electrical Sub-metering	1		
	EE4	Renewable Energy	5		
	EE5	Advanced EE Performance - BEI	15		
	Commissioning				
	EE6	Enhanced Commissioning	3		
	EE7	Post Occupancy Commissioning	2		
	Verification & Maintenance				
	EE8	EE Verification	2		
EE9	Sustainable Maintenance	3			

	GBI	GreenRE
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark

Malaysia's own Building By-Laws, Building Standards & Guidelines and Codes of Practices into the tools:

- **Uniform Building By-Laws(UBBL), including By-Law 38A**
- **RE Act**
- **Malaysian Standards such as MS1525 OTTV, BEI, Lighting, etc**
- **Local Authorities' Structure/Local Plans**
- **Local Authorities' Planning, Building Plan, Engineering (ESCP), RWHS requirement**
- **CIDB's QLASSIC and IBS**
- **DoE Act**
- **MSMA**



The image shows the cover of the Malaysian Standard MS 1525: 2019. The cover features a blue vertical band on the left with the Malaysian coat of arms. The title 'MALAYSIAN STANDARD' is prominently displayed in blue. The specific title of the standard is 'Energy efficiency and use of renewable energy for non-residential buildings - Code of practice (Third revision)'. The cover also includes the ICS number 91.040.01, a list of descriptors, the copyright year 2019, and the publisher 'DEPARTMENT OF STANDARDS MALAYSIA'.

MALAYSIAN STANDARD MS 1525: 2019

Energy efficiency and use of renewable energy for non-residential buildings - Code of practice (Third revision)

ICS: 91.040.01
 Descriptors: energy efficiency, renewable energy, non-residential, buildings, code of practice

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 DEPARTMENT OF STANDARDS MALAYSIA

	GBI	GreenRE
c. Administered	WorldGBC MalaysiaGBC	Advisory Panel



**WORLD
GREEN
BUILDING
COUNCIL**

List of sustainable building certifications

Below is a list of building certifications (in alphabetical order) that are administered by our Green Building Councils. This is not a comprehensive list, as there are a number of certifications that exist but are not administered by a Green Building Council.

[Green Building Index](#)

[Find out more](#)

	GBI	GreenRE
c. Administered	WorldGBC MalaysiaGBC	Advisory Panel

-  Natural Resources and Environmental Sustainability (NRES)
-  Ministry of Energy Transition and Public Utilities (METPU)
-  Minister of Local Government Development (KPKT)
-  Ministry of Science, Technology & Innovation (MOSTI)
-  Ministry of Transport Malaysia (MOT)
-  Suruhanjaya Perkhidmatan Air Negara (SPAN)
-  Department of Environment (DOE)
-  Federal Department of Town and Country Planning
-  Energy Commission (ST)
-  Sustainable Energy Development Authority (SEDA)
-  Malaysia Investment Development Authority (MIDA)
-  Jabatan Kerja Raya

-  Institute Sultan Iskandar, Universiti Teknologi Malaysia
-  Universiti Tunku Abdul Rahman
-  National University Singapore
-  Malaysia University of Science and Technology (MUST)
-  Jeff Sachs Centre of Sustainable Development
-  Universiti Malaya (UM)

-  Royal Institute of Surveyors Malaysia (RISM)
-  Construction Industry Development Board (CIDB)
-  Standard and Industrial Research Institute of Malaysia (SIRIM)
-  Malaysia Institute of Planners (MIP)
-  The Institution of Engineers Malaysia (IEM)
-  Malaysian Association of Facility Management (MAFM)
-  Persatuan Pengurusan Kompleks Malaysia (PPKM)
-  Tenaga Nasional Berhad (TNB)
-  Malaysia Green Technology Corporation (MGTC)
-  Master Builders Association Malaysia (MBAM)
-  Institute of Landscape Architects Malaysia (ILAM)
-  Association of Consulting Architects Malaysia (ACAM)
-  International Green Training Centre Sdn Bhd (IGTC)
-  Malaysian Photovoltaic Industry Association (MPIA)
-  International Green Training Centre Sdn Bhd (IGTC)

	GBI	GreenRE
d. Registration Fee (Except Mega Project)	RM 5,000 – 45,000	RM 5,000 – 45,000 20% Discount for REHDA Members

MALAYSIAN PROJECT FEE SCALE

Size of Development	Total Gross Floor Area TGFA (m2)	Assessment Fee (RM)	
		New Buildings	Existing Building
Single Residence	Below 2,000	5,000	3,000
Small	Up to 4,000	8,000	6,000
Intermediate	4,001 - 10,000	10,000	9,000
Medium	10,001 - 30,000	20,000	12,000
Large	30,001 - 50,000	32,000	14,000
Extra Large	50,001 - 100,000	45,000	19,000
Mega Project	>100,001	Assessment fee will be determined on a project-by-project basis.*	

REHDA Members are eligible to 20% discount on assessment fees (excluding SST/GST).

	GBI	GreenRE
e. Minimum Certification Score/Credit	RNC – 50% NRNC – 50%	RES (HR & Landed) – 43.48% (50/115 points) cap NRB (AC & non AC) – 41.67% (50/120 points) cap

Categories of GBI Rating

POINTS	GBI RATING
86 to 100 points	Platinum
76 to 85 points	Gold
66 to 75 points	Silver
50 to 65 points	Certified

GreenRE Building Rating System Scoring

Score	Rating	RES	NRB
91 and above	GreenRE Platinum	79.13%	75.83%
86 to ≤ 90	GreenRE Gold	74.78%	71.67%
76 to ≤ 85	GreenRE Silver	66.09%	63.33%
50 to ≤ 75	GreenRE Bronze	43.48%	41.67%

	GBI	GreenRE
e. Minimum Certification Score/Credit	RNC – 50% NRNC – 50%	RES (HR & Landed) – 43.48% (50/115 points) cap NRB (AC & non AC) – 41.67% (50/120 points) cap

GBI Mandatory Requirement

EE1 : Minimum EE Performance

- a. OTTV
- b. Roof U-Value / RTTV
- c. EMS (AC Space \geq 4000m²)

GreenRE Pre-Requisite & Mandatory

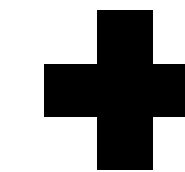
Prerequisite & Mandatory Requirements
All relevant prerequisite and mandatory requirements for the specific GreenRE Rating are to be complied with

Multi-Storey Residential -
Energy Related Requirements
Minimum 30 credits

Landed Homes - Energy
Related Requirements
Minimum 22 credits

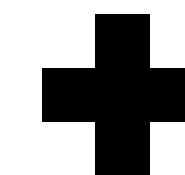
Energy Related Requirements
Minimum 30 credits
Shop Lot / Office Minimum 22 credits

RES



Other Green Requirements
Minimum 20 credits

NRB



Other Green Requirements
Minimum 20 credits

	GBI	GreenRE
e. Minimum Certification Score/Credit	RNC – 50% NRNC – 50%	RES (HR & Landed) – 43.48% (50/115 points) cap NRB (AC & non AC) – 41.67% (50/120 points) cap

GBI Mandatory Requirement

EE1 : Minimum EE Performance

- a. OTTV
- b. Roof U-Value / RTTV
- c. EMS (AC Space \geq 4000m²)

GreenRE Pre-Requisite & Mandatory (Bronze)

RES (Pre-Requisite)

- 1. 100% AC and/or Ceiling Fan (Dwelling & Common) >ST 3-Stars
- 4. Building User Guide & Sustainable O&M Guidelines
- 5. Calculation of EUI for Highrise Common Area and G&G Landed
- 6. Calculation of Operational and Embodied Carbon
- 7. Roof U-Value

	GBI	GreenRE
e. Minimum Certification Score/Credit	RNC – 50% NRNC – 50%	RES (HR & Landed) – 43.48% (50/115 points) cap NRB (AC & non AC) – 41.67% (50/120 points) cap

GBI Mandatory Requirement

EE1 : Minimum EE Performance

- a. OTTV
- b. Roof U-Value / RTTV
- c. EMS (AC Space \geq 4000m²)

GreenRE Pre-Requisite & Mandatory (Bronze)

NRB (Pre-Requisite)

- 1a. >6% Energy Saving
- 1b. Calculation of BEI
- 1c. >10% Potable Water Usage Reduction through Water Efficient Fitting
- 1d. Green Plot Ratio, including Site Inventory Analysis & Carbon Sequestration Calculation
- 1e. Environmental Management Plan (EMP) during Construction
- 1f. Provision of Recycling Bins & Waste Management Route
- 1g. Building User Guide & Sustainable O&M Guidelines
- 1h. ASHRAS 62.1 Ventilation for Acceptable Indoor Air Quality
- 1i. Calculation of Operational and Embodied Carbon
- 2a. Minimum Design System Efficiency(DSE) / Operating System Efficiency (OSE)
- 2b. Measurement and Verification (M&V) Instrumentation (for Centralised AC system)

NRB (Mandatory)

1. OTTV
2. Roof U-Value / RTTV
3. EMS (AC Space \geq 4000m²)
4. Provision of Differently-Able Amenities (UBBL, MS1183 Part-8, MS1184, MS 1331, etc)

	GBI	GreenRE
f. Score/Credit from Passive Design (Arch)	RNC – 37% NRNC – 19%	RES (HR) – 37.10% (59/159 points) RES (Landed) – 39.24% (62/158 points) NRB (AC) – 31.94% (46/144 points) NRB (non AC) – 48.64% (71/146 points)



37%



19%



High-Rise
37%

Landed
39%



AC
32%

Non AC
49%



GBI ASSESSMENT CRITERIA
FOR
RESIDENTIAL NEW CONSTRUCTION (RNC)

VERSION 3.0 | JULY 2013

37%

PART	CRITERIA	ASSESSMENT CRITERIA	POINTS	TOTAL
1	EE	ENERGY EFFICIENCY		23
	Design			
	EE1	Minimum EE Performance (Mandatory Compliance)	1	
	EE2	Advanced EE Performance	12	
	EE3	Renewable Energy	5	
	Energy Efficiency			
	EE4	External Lighting and Control	2	
	EE5	Internet Connectivity	1	
	Maintenance			
EE6	Sustainable Maintenance and Building User Manual (BUM)	2		
2	EQ	INDOOR ENVIRONMENTAL QUALITY		12
	Air Quality			
	EQ1	Minimum Indoor Air Quality Performance	3	
	EQ2	Volatile Organic Compounds Minimisation	2	
	EQ3	Formaldehyde Minimisation	1	
	Lighting, Visual and Acoustic Comfort			
	EQ4	Daylighting	3	
	EQ5	External Views	1	
	EQ6	Sound Insulation	1	
Evaluation				
EQ7	Post Occupancy Evaluation	1		
3	SM	SUSTAINABLE SITE PLANNING & MANAGEMENT		33
	Site Planning			
	SM1	Site Selection & Planning	1	
	SM2	Re-habilitation of Brownfield Sites OR Re-development of Existing Buildings	1	
	SM3	Community Connectivity	4	
	Construction Management			
	SM4	Earthworks – Construction Activity Pollution Control	1	
	SM5	QLASSIC – Quality Assessment System For Building Construction Work	1	
	SM6	Workers’ Site Amenities	1	
	SM7	IBS – Industrialised Building System	2	
	Transportation			
	SM8	Public Transportation Access	8	
	SM9	Dedicated Cycling Network	2	
	Design			
	SM10	Stormwater Design – Quantity and Quality Control	3	
SM11	Heat Island Effect – Greenscape and Water Bodies	5		
SM12	Heat Island Effect – Hardscape	2		
SM13	Heat Island Effect – Roof	1		
SM14	Composting	1		

PART	CRITERIA	ASSESSMENT CRITERIA	POINTS	TOTAL
4	MR	MATERIALS & RESOURCES		12
	Reused & Recycled Materials			
	MR1	Materials Reuse And Selection	2	
	MR2	Recycled Content Materials	2	
	Sustainable Resources			
	MR3	Regional Materials	2	
	MR4	Sustainable Timber	2	
	Waste Management			
	MR5	Storage and Collection of Recyclables	2	
MR6	Construction Waste Management	2		
5	WE	WATER EFFICIENCY		12
	Water Harvesting & Recycling			
	WE1	Rainwater Harvesting	4	
	WE2	Waste Water Recycling	2	
	Increased Efficiency			
	WE3	Water Efficient Irrigation and Landscaping	2	
WE4	Water Efficient Fittings	4		
6	IN	INNOVATION		8
	IN1	Innovation in Design and Environmental Design Initiatives	7	
	IN2	Green Building Index Facilitator (GIBF)	1	
			TOTAL POINTS	100

1 Point only



GBI ASSESSMENT CRITERIA
FOR
NON-RESIDENTIAL NEW CONSTRUCTION (NRNC)

FIRST EDITION | APRIL 2009 | VERSION 1.0

19%

PART	CRITERIA	ITEM	POINTS	TOTAL			
1	EE	ENERGY EFFICIENCY			35		
	Design						
	EE1	Minimum EE Performance	1				
	EE2	Lighting Zoning	3				
	EE3	Electrical Sub-metering	1				
	EE4	Renewable Energy	5				
	EE5	Advanced EE Performance - BEI	15				
	Commissioning						
	EE6	Enhanced Commissioning	3				
	EE7	Post Occupancy Commissioning	2				
	Verification & Maintenance						
	EE8	EE Verification	2				
	EE9	Sustainable Maintenance	3				
	2	EQ	INDOOR ENVIRONMENTAL QUALITY			21	
		Air Quality					
EQ1		Minimum IAQ Performance	1				
EQ2		Environmental Tobacco Smoke (ETS) Control	1				
EQ3		Carbon Dioxide Monitoring and Control	1				
EQ4		Indoor Air Pollutants	2				
EQ5		Mould Prevention	1				
Thermal Comfort							
EQ6		Thermal Comfort: Design & Controllability of Systems	2				
EQ7		Air Change Effectiveness	1				
Lighting, Visual & Acoustic Comfort							
EQ8		Daylighting	2				
EQ9		Daylight Glare Control	1				
EQ10		Electric Lighting Levels	1				
EQ11		High Frequency Ballasts	1				
EQ12	External Views	2					
EQ13	Internal Noise Levels	1					
Verification							
EQ14	IAQ Before & During Occupancy	2					
EQ15	Post Occupancy Comfort Survey: Verification	2					

PART	CRITERIA	ITEM	POINTS	TOTAL	
3	SM	SUSTAINABLE SITE PLANNING & MANAGEMENT			16
	Site Planning				
	SM1	Site Selection	1		
	SM2	Brownfield Redevelopment	1		
	SM3	Development Density & Community Connectivity	2		
	SM4	Environment Management	2		
	Construction Management				
	SM5	Earthworks - Construction Activity Pollution Control	1		
	SM6	QLASSIC	1		
	SM7	Workers' Site Amenities	1		
	Transportation				
	SM8	Public Transportation Access	1		
	SM9	Green Vehicle Priority	1		
SM10	Parking Capacity	1			
Design					
SM11	Stormwater Design - Quantity & Quality Control	1			
SM12	Greenery & Roof	2			
SM13	Building User Manual	1			
4	MR	MATERIALS & RESOURCES			11
	Reused & Recycled Materials				
	MR1	Materials reuse and selection	2		
	MR2	Recycled content materials	2		
	Sustainable Resources				
	MR3	Regional Materials	1		
	MR4	Sustainable Timber	1		
	Waste Management				
	MR5	Storage & Collection of recyclables	1		
	MR6	Construction waste management	2		
Green Products					
MR7	Refrigerants & Clean Agents	2			
5	WE	WATER EFFICIENCY			10
	Water Harvesting & Recycling				
	WE1	Rainwater Harvesting	2		
	WE2	Water Recycling	2		
	Increased Efficiency				
	WE3	Water Efficient - Irrigation/Landscaping	2		
WE4	Water Efficient Fittings	2			
WE5	Metering & Leak Detection System	2			
6	IN	INNOVATION			7
	IN1	Innovation in Design & Environmental Design Initiatives	6		
	IN2	Green Building Index Accredited Facilitator	1		
TOTAL POINTS				100	



Residential Building & Landed Home

Version 3.3

January 2024

High-Rise

37%

Landed

39%

Category		Credits Allocations		
		High- Rise	Landed	
(I) Energy Related Requirements				
Minimum 30 credits	Part 1: Energy Efficiency			
	RES 1-1 Thermal Performance of Building Envelope -RETV	15	22	
	RES 1-2 Naturally Ventilated Design and Energy Efficient Cooling	22	22	
	RES 1-3 Daylighting	6	6	
	RES 1-4 Artificial Lighting	8	4	
	RES 1-5 Ventilation in Carparks	6	2	
	RES 1-6 Domestic Hot Water System	3	3	
	RES 1-7 Lifts	1	1	
	RES 1-8 Cool Hardscaped Areas	2	2	
	RES 1-9 Energy Efficient Features	7	7	
	RES 1-10 Renewable Energy	15	15	
Category Score for Part 1 – Energy Efficiency		85 (Max)	84 (Max)	
(II) Other Green Requirements				
Minimum 20 credits	Part 2: Water Efficiency			
	RES 2-1 Water Efficient Fittings	8	8	
	RES 2-2 Water Usage Monitoring	1	1	
	RES 2-3 Irrigation System and Landscaping	3	3	
	Category Score for Part 2 – Water Efficiency		12	12
	Part 3: Environmental Protection			
	RES 3-1 Sustainable Construction	10	10	
	RES 3-2 Sustainable Products	8	8	
	RES 3-3 Greenery Provision	8	8	
	RES 3-4 Environmental Management Practice	10	10	
	RES 3-5 Green Transport	5	5	
	RES 3-6 Stormwater Management	3	3	
	RES 3-7 Internet Connectivity	1	1	
	RES 3-8 Community Connectivity	1	1	
	Category Score for Part 3 – Environmental Protection		46	46
	Part 4: Indoor Environmental Quality			
	RES 4-1 Noise Level	1	1	
	RES 4-2 Indoor Air Pollutants	2	2	
	RES 4-3 Waste Disposal	1	1	
	RES 4-4 Indoor Air Quality in Wet Areas	2	2	
Category Score for Part 4 – Environmental Quality		6	6	
Part 5: Other Green Features				
RES 5-1 Green Features & Innovations	7	7		
Category Score for Part 5 – Other Green Features		7	7	
Part 6: Carbon Emission of Development				
RES 6-1 Carbon Emission of Development	3	3		
Category Score for Part 6 – Carbon Emission of Development		3	3	
GreenRE Score:		159 (Max)	158 (Max)	

Ventilation Design – 12 Credits

Omit Composting – 7 Credits only

The maximum GreenRE score achievable for a project is capped at 100 credits and this does not include 15 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources. The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e from GreenRE Bronze or Silver to Gold or Platinum)



Non-Residential Building

Version 4.0
June 2023

AC

32%

Non AC

49%

Category		Credits Allocation	
(I) Energy Related Requirements			
Minimum 30 credits	Part 1: Energy Efficiency		
	NRB 1-1 Thermal Performance of Building Envelope – OTTV	Section (A) Applicable to air-cond. areas	15
	NRB 1-2 Air – Conditioning System		33
	Sub -Total (A) – NRB 1-1 to 1-2		48
	NRB 1-3 Building Envelope – Design/ Thermal Parameters	Section (B) Applicable to non air- cond. areas	30
	NRB 1-4 Natural Ventilation/Mechanical Ventilation		20
	Sub – Total (B) – NRB 1-3 to 1-4		50
	NRB 1-5 Daylighting	Section(C)	6
	NRB 1-6 Artificial Lighting	Applicable to all areas	12
	NRB 1-7 Ventilation in Carparks		4
	NRB 1-8 Ventilation in Common Areas		5
	NRB 1-9 Lifts and Escalators		2
	NRB 1-10 Energy Efficient Practices & Features		12
NRB 1-11 Renewable Energy		20	
Sub – Total (C) – NRB 1-5 to 1-11		61	
Category Score for Part 1 – Energy Efficiency [Prorate Subtotal (A) + Prorate Subtotal (B)] + Subtotal (C)		111 (MAX)	
(II) Other Green Requirements			
Minimum 20 credits	Part 2: Water Efficiency		
	NRB 2-1 Water Efficient Fittings		8
	NRB 2-2 Water Usage and Leak Detection		2
	NRB 2-3 Irrigation System and Landscaping		3
	NRB 2-4 Water Consumption of Cooling Tower		2
	Category Score for Part 2 – Water Efficiency		15
	Part 3: Environmental Protection		
	NRB 3-1 Sustainable Construction		10
	NRB 3-2 Sustainable Products		10
	NRB 3-3 Greenery Provision		8
	NRB 3-4 Environmental Management Practice		10
	NRB 3-5 Green Transport		6
	NRB 3-6 Stormwater Management		3
	NRB 3-7 Refrigerants		2
	Category Score for Part 3 – Environmental Protection		49
	Part 4: Indoor Environmental Quality		
	NRB 4-1 Thermal Comfort		2
	NRB 4-2 Noise Level		1
	NRB 4-3 Indoor Air pollutants		2
NRB 4-4 Indoor Air Quality (IAQ) Management		2	
NRB 4-5 High Frequency Ballasts		1	
NRB 4-6 Access to view from Work Area		1	
Category Score for Part 4: Indoor Environmental Quality		9	
Part 5: Other Green Features			
NRB 5-1 Green Features & Innovations		7	
Category Score for Part 5: Other Green Features		7	
Part 6: Carbon Emission of Development			
NRB 6-1 Carbon Emission of Development		3	
Category Score for Part 6: Carbon Emission of Development		3	
Category Score for Part 2 to Part 6 – Other Green Requirements		83	
GreenRE Non-Residential Building Score:		194 (MAX)	

Ventilation Design – 10 Credits

Omit Composting – 7 Credits only

The maximum GreenRE score achievable for a project is capped at 100 credits and this does not include 20 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources. The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e from GreenRE Bronze or Silver to Gold or Platinum)

	GBI	GreenRE
g. Score/Credit from Passive Design (Arch) & Connectivity	RNC – 49% NRNC – 19%	RES (HR) – 38.99% (62/159 points) RES (Landed) – 41.14% (65/158 points) NRB (AC) – 31.94% (46/144 points) NRB (non AC) – 48.64% (71/146 points)



49%



19%



High-Rise
39%

Landed
41%



AC
32%

Non AC
49%



GBI ASSESSMENT CRITERIA
FOR
RESIDENTIAL NEW CONSTRUCTION (RNC)

VERSION 3.0 | JULY 2013

49%

PART	CRITERIA	ASSESSMENT CRITERIA	POINTS	TOTAL
1	EE	ENERGY EFFICIENCY		
	Design			23
	EE1	Minimum EE Performance (Mandatory Compliance)	1	
	EE2	Advanced EE Performance	12	
	EE3	Renewable Energy	5	
	Energy Efficiency			
	EE4	External Lighting and Control	2	
	EE5	Internet Connectivity	1	
	Maintenance			
EE6	Sustainable Maintenance and Building User Manual (BUM)	2		
2	EQ	INDOOR ENVIRONMENTAL QUALITY		
	Air Quality			12
	EQ1	Minimum Indoor Air Quality Performance	3	
	EQ2	Volatile Organic Compounds Minimisation	2	
	EQ3	Formaldehyde Minimisation	1	
	Lighting, Visual and Acoustic Comfort			
	EQ4	Daylighting	3	
	EQ5	External Views	1	
	EQ6	Sound Insulation	1	
Evaluation				
EQ7	Post Occupancy Evaluation	1		
3	SM	SUSTAINABLE SITE PLANNING & MANAGEMENT		
	Site Planning			33
	SM1	Site Selection & Planning	1	
	SM2	Re-habilitation of Brownfield Sites OR Re-development of Existing Buildings	1	
	SM3	Community Connectivity	4	
	Construction Management			
	SM4	Earthworks – Construction Activity Pollution Control	1	
	SM5	QLASSIC – Quality Assessment System For Building Construction Work	1	
	SM6	Workers’ Site Amenities	1	
	SM7	IBS – Industrialised Building System	2	
	Transportation			
	SM8	Public Transportation Access	8	
	SM9	Dedicated Cycling Network	2	
	Design			
	SM10	Stormwater Design – Quantity and Quality Control	3	
SM11	Heat Island Effect – Greenscape and Water Bodies	5		
SM12	Heat Island Effect – Hardscape	2		
SM13	Heat Island Effect – Roof	1		
SM14	Composting	1		

PART	CRITERIA	ASSESSMENT CRITERIA	POINTS	TOTAL
4	MR	MATERIALS & RESOURCES		
	Reused & Recycled Materials			12
	MR1	Materials Reuse And Selection	2	
	MR2	Recycled Content Materials	2	
	Sustainable Resources			
	MR3	Regional Materials	2	
	MR4	Sustainable Timber	2	
	Waste Management			
	MR5	Storage and Collection of Recyclables	2	
MR6	Construction Waste Management	2		
5	WE	WATER EFFICIENCY		
	Water Harvesting & Recycling			12
	WE1	Rainwater Harvesting	4	
	WE2	Waste Water Recycling	2	
	Increased Efficiency			
	WE3	Water Efficient Irrigation and Landscaping	2	
WE4	Water Efficient Fittings	4		
6	IN	INNOVATION		
	IN1	Innovation in Design and Environmental Design Initiatives	7	8
	IN2	Green Building Index Facilitator (GIBF)	1	
TOTAL POINTS			100	

1 Point only



Residential Building & Landed Home

Version 3.3

January 2024

High-Rise

39%

Landed

41%

Category		Credits Allocations		
(I) Energy Related Requirements		High- Rise	Landed	
Minimum 30 credits	Part 1: Energy Efficiency			
	RES 1-1 Thermal Performance of Building Envelope -RETV	15	22	
	RES 1-2 Naturally Ventilated Design and Energy Efficient Cooling	22	22	
	RES 1-3 Daylighting	6	6	
	RES 1-4 Artificial Lighting	8	4	
	RES 1-5 Ventilation in Carparks	6	2	
	RES 1-6 Domestic Hot Water System	3	3	
	RES 1-7 Lifts	1	1	
	RES 1-8 Cool Hardscaped Areas	2	2	
	RES 1-9 Energy Efficient Features	7	7	
	RES 1-10 Renewable Energy	15	15	
Category Score for Part 1 – Energy Efficiency		85 (Max)	84 (Max)	
(II) Other Green Requirements				
Minimum 20 credits	Part 2: Water Efficiency			
	RES 2-1 Water Efficient Fittings	8	8	
	RES 2-2 Water Usage Monitoring	1	1	
	RES 2-3 Irrigation System and Landscaping	3	3	
	Category Score for Part 2 – Water Efficiency		12	12
	Part 3: Environmental Protection			
	RES 3-1 Sustainable Construction	10	10	
	RES 3-2 Sustainable Products	8	8	
	RES 3-3 Greenery Provision	8	8	
	RES 3-4 Environmental Management Practice	10	10	
	RES 3-5 Green Transport	5	5	
	RES 3-6 Stormwater Management	3	3	
	RES 3-7 Internet Connectivity	1	1	
	RES 3-8 Community Connectivity	1	1	
	Category Score for Part 3 – Environmental Protection		46	46
	Part 4: Indoor Environmental Quality			
	RES 4-1 Noise Level	1	1	
	RES 4-2 Indoor Air Pollutants	2	2	
	RES 4-3 Waste Disposal	1	1	
	RES 4-4 Indoor Air Quality in Wet Areas	2	2	
Category Score for Part 4 – Environmental Quality		6	6	
Part 5: Other Green Features				
RES 5-1 Green Features & Innovations	7	7		
Category Score for Part 5 – Other Green Features		7	7	
Part 6: Carbon Emission of Development				
RES 6-1 Carbon Emission of Development	3	3		
Category Score for Part 6 – Carbon Emission of Development		3	3	
GreenRE Score:		159 (Max)	158 (Max)	

Ventilation Design – 12 Credits

Omit Composting – 7 Credits only

Public Transport Network & Covered Walkway – 2 Credits only

The maximum GreenRE score achievable for a project is capped at 100 credits and this does not include 15 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources. The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e from GreenRE Bronze or Silver to Gold or Platinum)

	GBI	GreenRE
a. Ownership	PAM + ACEM	REDHA
b. Development	Localised based on Climate, Resources and Priority	Partially localised based on the derivation from Green Mark
c. Administered	WorldGBC MalaysiaGBC	Advisory Panel
d. Registration Fee (Except Mega Project)	RM 5,000 – 45,000	RM 5,000 – 45,000 20% Discount for REHDA Members
e. Minimum Certification Score/Credit	RNC – 50% NRNC – 50%	RES (HR & Landed) – 43.48% (50/115 points) cap NRB (AC & non AC) – 41.67% (50/120 points) cap
f. Score/Credit from Passive Design (Arch)	RNC – 37% NRNC – 19%	RES (HR) – 37.10% (59/159 points) RES (Landed) – 39.24% (62/158 points) NRB (AC) – 31.94% (46/144 points) NRB (non AC) – 48.64% (71/146 points)
g. Score/Credit from Passive Design (Arch) & Connectivity	RNC – 49% NRNC – 19%	RES (HR) – 38.99% (62/159 points) RES (Landed) – 41.14% (65/158 points) NRB (AC) – 31.94% (46/144 points) NRB (non AC) – 48.64% (71/146 points)



Green Building

Malaysian Expectation

Greenery



Greenery

Daylight



Greenery

Daylight

Solar PV



Greenery

Daylight

Solar PV

Rainwater Harvesting



Greenery

Daylight

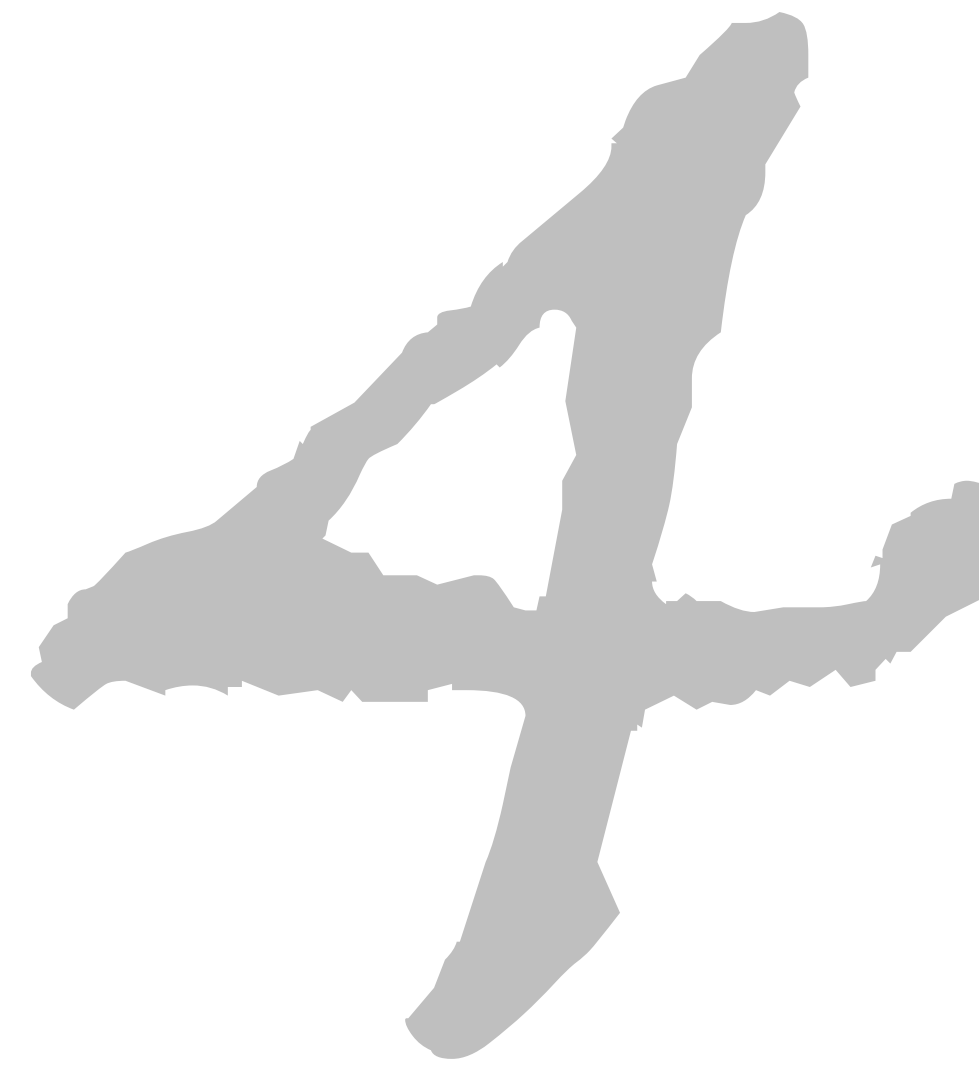
Solar PV

Rainwater Harvesting

Recycle Bin







Green Facade

The Art of Designing

	GBI	GreenRE
Score/Credit from Façade & Roof Design	RNC – 13% NRNC – 1%	RES (HR) – 9.43% (15/159 points) RES (Landed) – 13.92% (22/158 points) NRB (AC) – 10.42% (15/144 points) NRB (non AC) – 20.55% (30/146 points)



13%



1%



High-Rise

9%

Landed

14%



AC

10%

Non AC

21%



GBI ASSESSMENT CRITERIA
FOR
RESIDENTIAL NEW CONSTRUCTION (RNC)

VERSION 3.0 | JULY 2013

13%

PART	CRITERIA	ASSESSMENT CRITERIA	POINTS	TOTAL
1	EE	ENERGY EFFICIENCY		
	Design			23
	EE1	Minimum EE Performance (Mandatory Compliance)	1	
	EE2	Advanced EE Performance	12	
	EE3	Renewable Energy	5	
	Energy Efficiency			
	EE4	External Lighting and Control	2	
	EE5	Internet Connectivity	1	
	Maintenance			
EE6	Sustainable Maintenance and Building User Manual (BUM)	2		
2	EQ	INDOOR ENVIRONMENTAL QUALITY		
	Air Quality			12
	EQ1	Minimum Indoor Air Quality Performance	3	
	EQ2	Volatile Organic Compounds Minimisation	2	
	EQ3	Formaldehyde Minimisation	1	
	Lighting, Visual and Acoustic Comfort			
	EQ4	Daylighting	3	
	EQ5	External Views	1	
	EQ6	Sound Insulation	1	
Evaluation				
EQ7	Post Occupancy Evaluation	1		
3	SM	SUSTAINABLE SITE PLANNING & MANAGEMENT		
	Site Planning			33
	SM1	Site Selection & Planning	1	
	SM2	Re-habilitation of Brownfield Sites OR Re-development of Existing Buildings	1	
	SM3	Community Connectivity	4	
	Construction Management			
	SM4	Earthworks – Construction Activity Pollution Control	1	
	SM5	QLASSIC – Quality Assessment System For Building Construction Work	1	
	SM6	Workers’ Site Amenities	1	
	SM7	IBS – Industrialised Building System	2	
	Transportation			
	SM8	Public Transportation Access	8	
	SM9	Dedicated Cycling Network	2	
	Design			
	SM10	Stormwater Design – Quantity and Quality Control	3	
SM11	Heat Island Effect – Greenscape and Water Bodies	5		
SM12	Heat Island Effect – Hardscape	2		
SM13	Heat Island Effect – Roof	1		
SM14	Composting	1		

PART	CRITERIA	ASSESSMENT CRITERIA	POINTS	TOTAL
4	MR	MATERIALS & RESOURCES		
	Reused & Recycled Materials			12
	MR1	Materials Reuse And Selection	2	
	MR2	Recycled Content Materials	2	
	Sustainable Resources			
	MR3	Regional Materials	2	
	MR4	Sustainable Timber	2	
	Waste Management			
	MR5	Storage and Collection of Recyclables	2	
MR6	Construction Waste Management	2		
5	WE	WATER EFFICIENCY		
	Water Harvesting & Recycling			12
	WE1	Rainwater Harvesting	4	
	WE2	Waste Water Recycling	2	
	Increased Efficiency			
	WE3	Water Efficient Irrigation and Landscaping	2	
WE4	Water Efficient Fittings	4		
6	IN	INNOVATION		
	IN1	Innovation in Design and Environmental Design Initiatives	7	8
	IN2	Green Building Index Facilitator (GIBF)	1	
TOTAL POINTS			100	



GBI ASSESSMENT CRITERIA
FOR
NON-RESIDENTIAL NEW CONSTRUCTION (NRNC)

FIRST EDITION | APRIL 2009 | VERSION 1.0

1%

PART	CRITERIA	ITEM	POINTS	TOTAL			
1	EE	ENERGY EFFICIENCY			35		
	Design						
	EE1	Minimum EE Performance	1				
	EE2	Lighting Zoning	3				
	EE3	Electrical Sub-metering	1				
	EE4	Renewable Energy	5				
	EE5	Advanced EE Performance - BEI	15				
	Commissioning						
	EE6	Enhanced Commissioning	3				
	EE7	Post Occupancy Commissioning	2				
	Verification & Maintenance						
	EE8	EE Verification	2				
	EE9	Sustainable Maintenance	3				
	2	EQ	INDOOR ENVIRONMENTAL QUALITY			21	
		Air Quality					
EQ1		Minimum IAQ Performance	1				
EQ2		Environmental Tobacco Smoke (ETS) Control	1				
EQ3		Carbon Dioxide Monitoring and Control	1				
EQ4		Indoor Air Pollutants	2				
EQ5		Mould Prevention	1				
Thermal Comfort							
EQ6		Thermal Comfort: Design & Controllability of Systems	2				
EQ7		Air Change Effectiveness	1				
Lighting, Visual & Acoustic Comfort							
EQ8		Daylighting	2				
EQ9		Daylight Glare Control	1				
EQ10		Electric Lighting Levels	1				
EQ11		High Frequency Ballasts	1				
EQ12	External Views	2					
EQ13	Internal Noise Levels	1					
Verification							
EQ14	IAQ Before & During Occupancy	2					
EQ15	Post Occupancy Comfort Survey: Verification	2					

PART	CRITERIA	ITEM	POINTS	TOTAL	
3	SM	SUSTAINABLE SITE PLANNING & MANAGEMENT			16
	Site Planning				
	SM1	Site Selection	1		
	SM2	Brownfield Redevelopment	1		
	SM3	Development Density & Community Connectivity	2		
	SM4	Environment Management	2		
	Construction Management				
	SM5	Earthworks - Construction Activity Pollution Control	1		
	SM6	QLASSIC	1		
	SM7	Workers' Site Amenities	1		
	Transportation				
	SM8	Public Transportation Access	1		
	SM9	Green Vehicle Priority	1		
SM10	Parking Capacity	1			
Design					
SM11	Stormwater Design - Quantity & Quality Control	1			
SM12	Greenery & Roof	2			
SM13	Building User Manual	1			
4	MR	MATERIALS & RESOURCES			11
	Reused & Recycled Materials				
	MR1	Materials reuse and selection	2		
	MR2	Recycled content materials	2		
	Sustainable Resources				
	MR3	Regional Materials	1		
	MR4	Sustainable Timber	1		
	Waste Management				
	MR5	Storage & Collection of recyclables	1		
	MR6	Construction waste management	2		
Green Products					
MR7	Refrigerants & Clean Agents	2			
5	WE	WATER EFFICIENCY			10
	Water Harvesting & Recycling				
	WE1	Rainwater Harvesting	2		
	WE2	Water Recycling	2		
	Increased Efficiency				
	WE3	Water Efficient - Irrigation/Landscaping	2		
WE4	Water Efficient Fittings	2			
WE5	Metering & Leak Detection System	2			
6	IN	INNOVATION			7
	IN1	Innovation in Design & Environmental Design Initiatives	6		
	IN2	Green Building Index Accredited Facilitator	1		
TOTAL POINTS				100	



Residential Building & Landed Home

Version 3.3

January 2024

High-Rise

9%

Landed

14%

Category		Credits Allocations		
		High- Rise	Landed	
(I) Energy Related Requirements				
Minimum 30 credits	Part 1: Energy Efficiency			
	RES 1-1 Thermal Performance of Building Envelope -RETV	15	22	
	RES 1-2 Naturally Ventilated Design and Energy Efficient Cooling	22	22	
	RES 1-3 Daylighting	6	6	
	RES 1-4 Artificial Lighting	8	4	
	RES 1-5 Ventilation in Carparks	6	2	
	RES 1-6 Domestic Hot Water System	3	3	
	RES 1-7 Lifts	1	1	
	RES 1-8 Cool Hardscaped Areas	2	2	
	RES 1-9 Energy Efficient Features	7	7	
	RES 1-10 Renewable Energy	15	15	
Category Score for Part 1 – Energy Efficiency		85 (Max)	84 (Max)	
(II) Other Green Requirements				
Minimum 20 credits	Part 2: Water Efficiency			
	RES 2-1 Water Efficient Fittings	8	8	
	RES 2-2 Water Usage Monitoring	1	1	
	RES 2-3 Irrigation System and Landscaping	3	3	
	Category Score for Part 2 – Water Efficiency		12	12
	Part 3: Environmental Protection			
	RES 3-1 Sustainable Construction	10	10	
	RES 3-2 Sustainable Products	8	8	
	RES 3-3 Greenery Provision	8	8	
	RES 3-4 Environmental Management Practice	10	10	
	RES 3-5 Green Transport	5	5	
	RES 3-6 Stormwater Management	3	3	
	RES 3-7 Internet Connectivity	1	1	
	RES 3-8 Community Connectivity	1	1	
	Category Score for Part 3 – Environmental Protection		46	46
	Part 4: Indoor Environmental Quality			
	RES 4-1 Noise Level	1	1	
	RES 4-2 Indoor Air Pollutants	2	2	
	RES 4-3 Waste Disposal	1	1	
	RES 4-4 Indoor Air Quality in Wet Areas	2	2	
Category Score for Part 4 – Environmental Quality		6	6	
Part 5: Other Green Features				
RES 5-1 Green Features & Innovations	7	7		
Category Score for Part 5 – Other Green Features		7	7	
Part 6: Carbon Emission of Development				
RES 6-1 Carbon Emission of Development	3	3		
Category Score for Part 6 – Carbon Emission of Development		3	3	
GreenRE Score:		159 (Max)	158 (Max)	

The maximum GreenRE score achievable for a project is capped at 100 credits and this does not include 15 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources. The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e from GreenRE Bronze or Silver to Gold or Platinum)



Non-Residential Building

Version 4.0

June 2023

AC

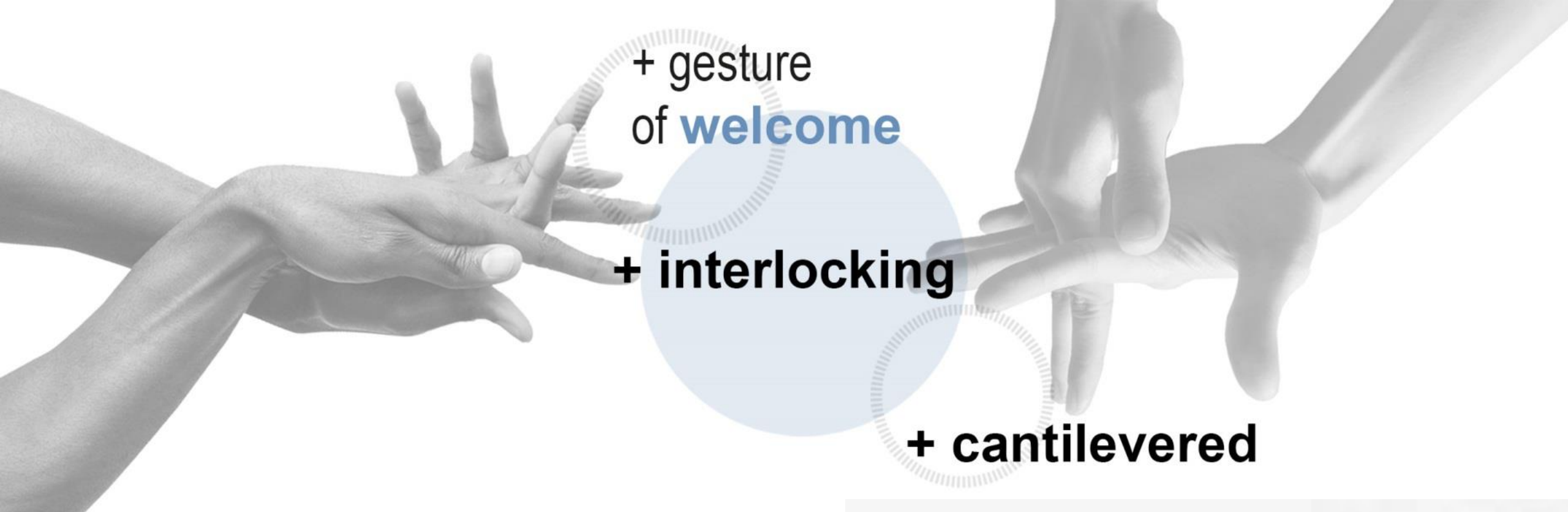
10%

Non AC

21%

Category		Credits Allocation	
(I) Energy Related Requirements			
Minimum 30 credits	Part 1: Energy Efficiency		
	NRB 1-1 Thermal Performance of Building Envelope – OTTV	Section (A) Applicable to air-cond. areas	15
	NRB 1-2 Air – Conditioning System		33
	Sub -Total (A) – NRB 1-1 to 1-2		48
	NRB 1-3 Building Envelope – Design/ Thermal Parameters	Section (B)	30
	NRB 1-4 Natural Ventilation/Mechanical Ventilation	Applicable to non air- cond. areas	20
	Sub – Total (B) – NRB 1-3 to 1-4		50
	NRB 1-5 Daylighting	Section(C)	6
	NRB 1-6 Artificial Lighting	Applicable to all areas	12
	NRB 1-7 Ventilation in Carparks		4
	NRB 1-8 Ventilation in Common Areas		5
	NRB 1-9 Lifts and Escalators		2
NRB 1-10 Energy Efficient Practices & Features		12	
NRB 1-11 Renewable Energy		20	
Sub – Total (C) – NRB 1-5 to 1-11		61	
Category Score for Part 1 – Energy Efficiency [Prorate Subtotal (A) + Prorate Subtotal (B)] + Subtotal (C)		111 (MAX)	
(II) Other Green Requirements			
Minimum 20 credits	Part 2: Water Efficiency		
	NRB 2-1 Water Efficient Fittings		8
	NRB 2-2 Water Usage and Leak Detection		2
	NRB 2-3 Irrigation System and Landscaping		3
	NRB 2-4 Water Consumption of Cooling Tower		2
	Category Score for Part 2 – Water Efficiency		15
	Part 3: Environmental Protection		
	NRB 3-1 Sustainable Construction		10
	NRB 3-2 Sustainable Products		10
	NRB 3-3 Greenery Provision		8
	NRB 3-4 Environmental Management Practice		10
	NRB 3-5 Green Transport		6
	NRB 3-6 Stormwater Management		3
	NRB 3-7 Refrigerants		2
	Category Score for Part 3 – Environmental Protection		49
	Part 4: Indoor Environmental Quality		
	NRB 4-1 Thermal Comfort		2
NRB 4-2 Noise Level		1	
NRB 4-3 Indoor Air pollutants		2	
NRB 4-4 Indoor Air Quality (IAQ) Management		2	
NRB 4-5 High Frequency Ballasts		1	
NRB 4-6 Access to view from Work Area		1	
Category Score for Part 4: Indoor Environmental Quality		9	
Part 5: Other Green Features			
NRB 5-1 Green Features & Innovations		7	
Category Score for Part 5: Other Green Features		7	
Part 6: Carbon Emission of Development			
NRB 6-1 Carbon Emission of Development		3	
Category Score for Part 6: Carbon Emission of Development		3	
Category Score for Part 2 to Part 6 – Other Green Requirements		83	
GreenRE Non-Residential Building Score:		194 (MAX)	

The maximum GreenRE score achievable for a project is capped at 100 credits and this does not include 20 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources. The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e from GreenRE Bronze or Silver to Gold or Platinum)



+ gesture of **welcome**

+ interlocking

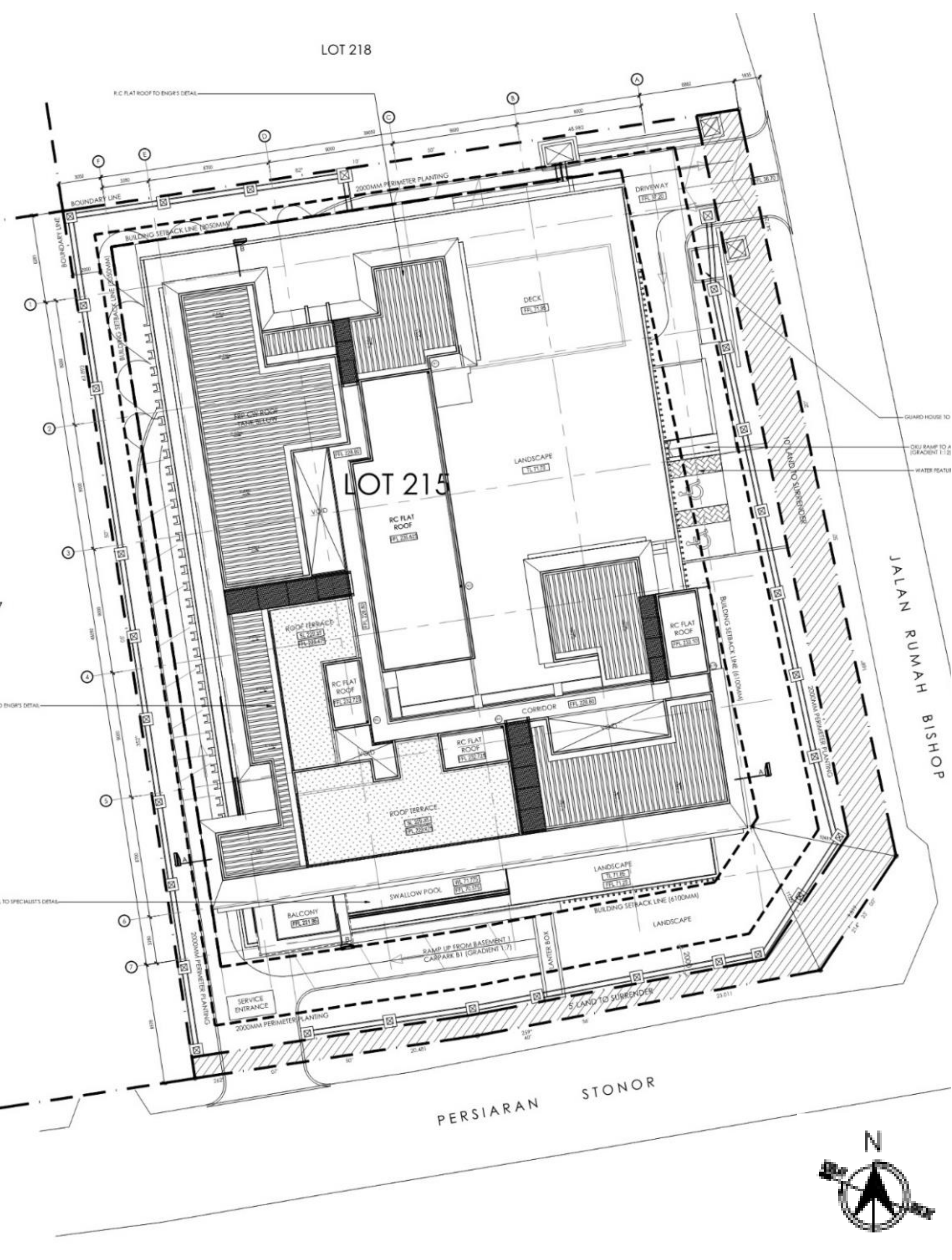
+ cantilevered

Case Study



OTTV

44.65 w/m2K





OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

Heat
Conduction
through
Walls

+

Heat
Conduction
through
Windows

+

Solar Heat
Gain
through
Windows

The lower the OTTV, the better.

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

6. Solar Absorptivity
of Wall (Color)

5. U-value of Wall

4. U-value of Fenestration (Glass)

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

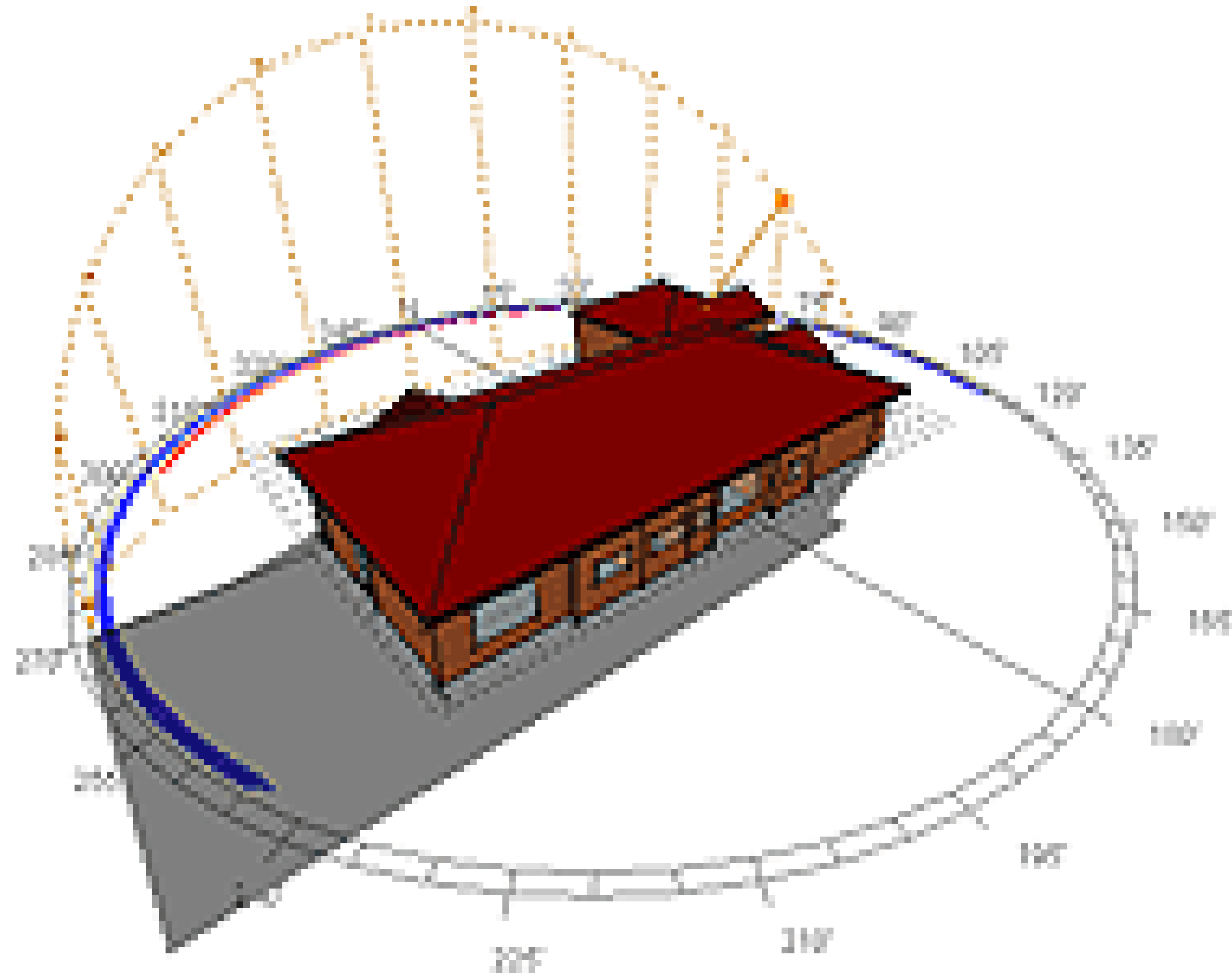
OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

1. Orientation Factor



1. Orientation



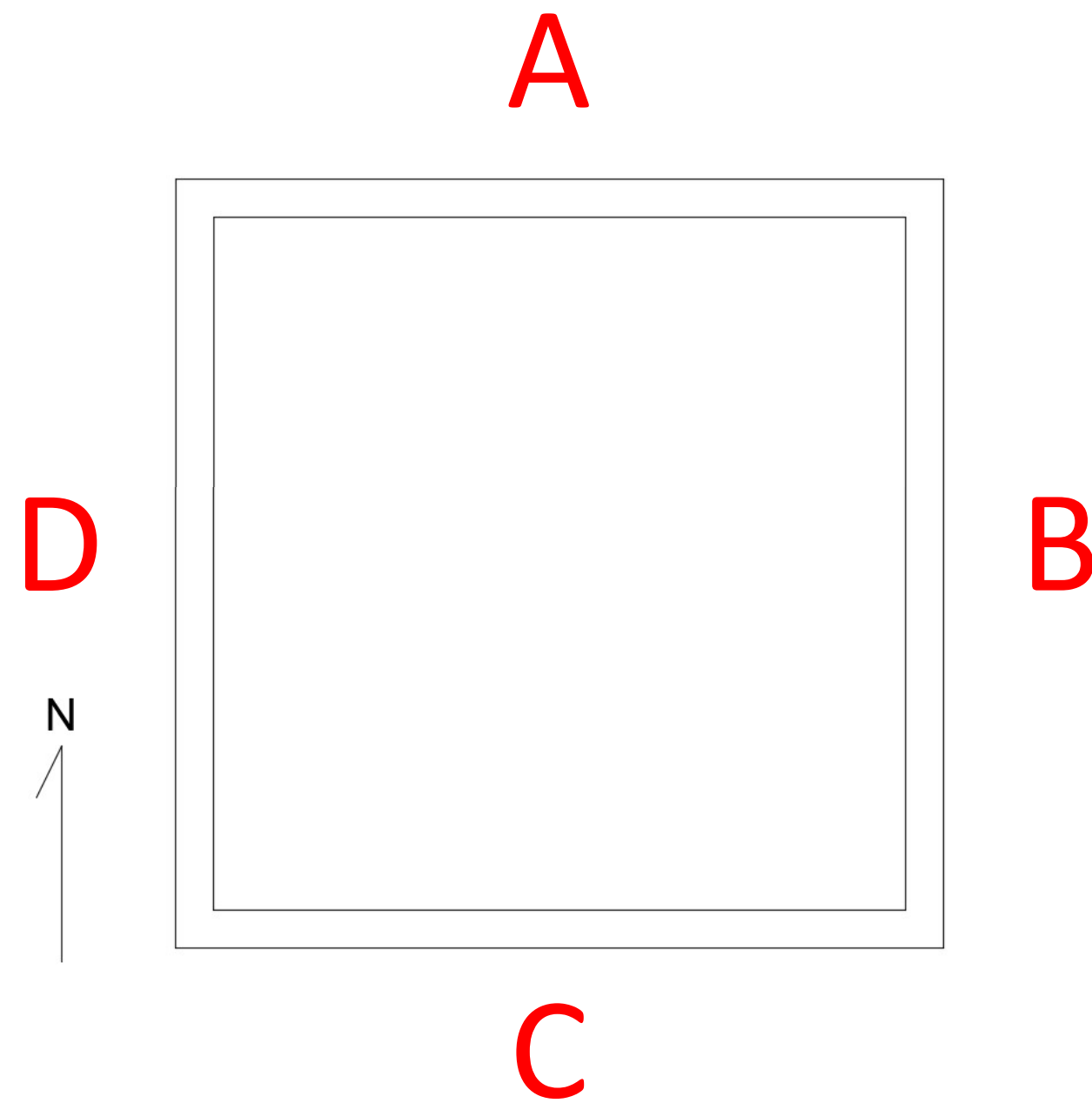
1. Orientation

Orientation	<i>OF</i>
North	0.90
Northeast	1.09
East	1.23
Southeast	1.13
South	0.92
Southwest	0.90
West	0.94
Northwest	0.90

NOTES:

1. Table 5 specifies *OF* for the various orientation of the fenestration. For the calculation of *OF*, it is recommended that the nearest predominant orientation be selected.
2. A fenestration system may consist of a glazing material such as glass, a shading device and a combination of both.

1. Orientation

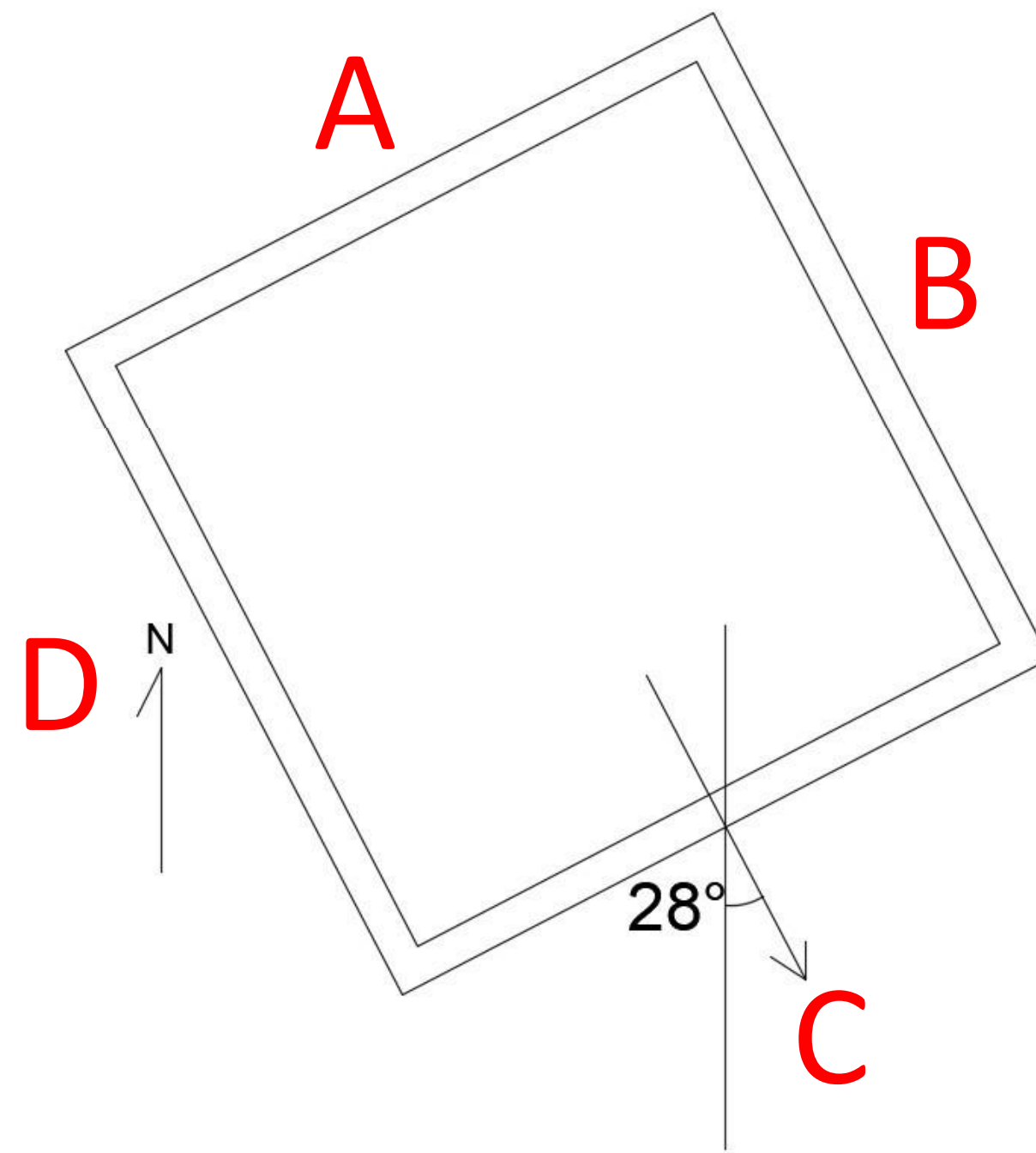


Orientation	<i>OF</i>	
North	0.90	A
Northeast	1.09	
East	1.23	B
Southeast	1.13	
South	0.92	C
Southwest	0.90	
West	0.94	D
Northwest	0.90	

NOTES:

1. Table 5 specifies *OF* for the various orientation of the fenestration. For the calculation of *OF*, it is recommended that the nearest predominant orientation be selected.
2. A fenestration system may consist of a glazing material such as glass, a shading device and a combination of both.

1. Orientation



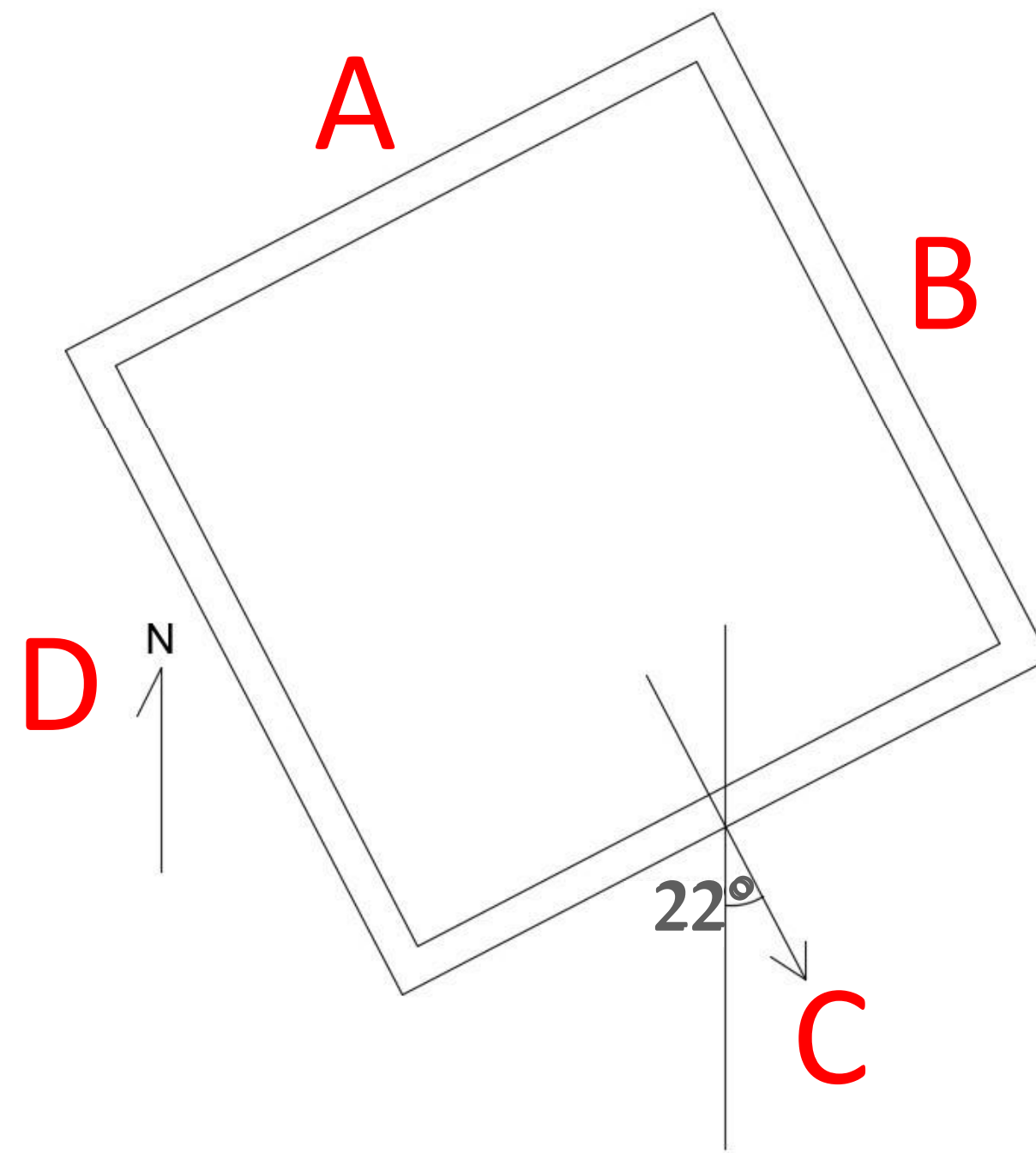
Orientation	<i>OF</i>
North	0.90
Northeast	1.09
East	1.23
Southeast	1.13
South	0.92
Southwest	0.90
West	0.94
Northwest	0.90

C (>22.5 deg)

NOTES:

1. Table 5 specifies *OF* for the various orientation of the fenestration. For the calculation of *OF*, it is recommended that the nearest predominant orientation be selected.
2. A fenestration system may consist of a glazing material such as glass, a shading device and a combination of both.

1. Orientation

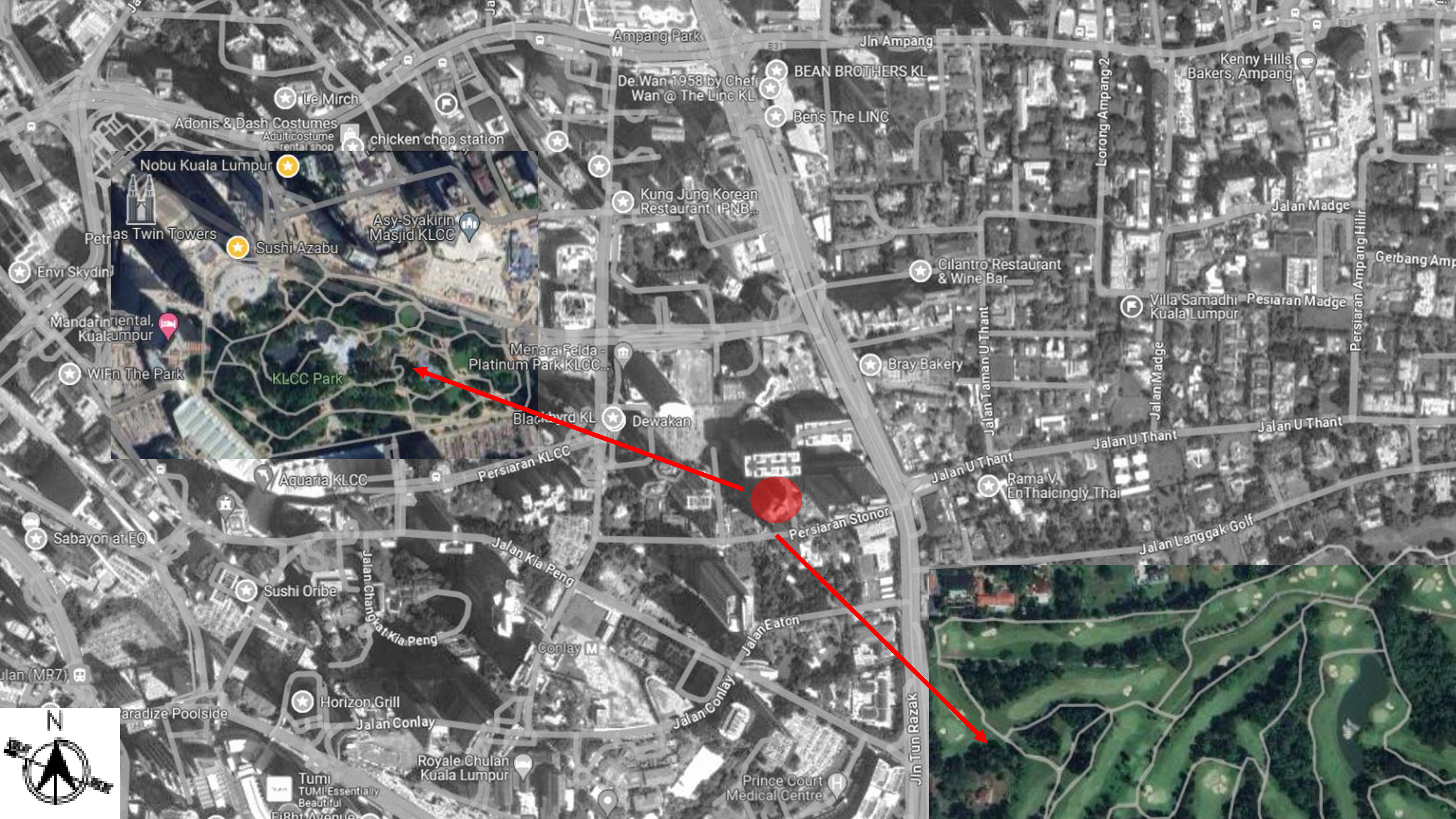


Orientation	<i>OF</i>
North	0.90
Northeast	1.09
East	1.23
Southeast	1.13
South	0.92
Southwest	0.90
West	0.94
Northwest	0.90

C (<22.5 deg)

NOTES:

1. Table 5 specifies *OF* for the various orientation of the fenestration. For the calculation of *OF*, it is recommended that the nearest predominant orientation be selected.
2. A fenestration system may consist of a glazing material such as glass, a shading device and a combination of both.



Ampang Park

Jln Ampang

Kenny Hills Bakers, Ampang

Le Mirch

De Wan 1958 by Chef Wan @ The Linc KL

BEAN BROTHERS KL

Adonis & Dash Costumes Adult costume rental shop

chicken chop station

Ben's The LINC

Nobu Kuala Lumpur

Kung Jung Korean Restaurant (PNB...)

Jalan Madge

Petras Twin Towers

Asy-Syakirin Masjid KLCC

Sushi Azabu

Cilantro Restaurant & Wine Bar

Pesiaran Madge

Envi Skydin

Mandarin Oriental, Kuala Lumpur

Menara Felda - Platinum Park KLCC...

Bray Bakery

Villa Samadhi Kuala Lumpur

WIFn The Park

KLCC Park

Blackbyrd KL

Dewakan

Rama V, EnThaicingly Thai

Aquaria KLCC

Persiaran KLCC

Persiaran Stonor

Jalan U Thant

Jalan U Thant

Jalan U Thant

Jalan Langgak Golf

Sabayon at EQ

Sushi Oribe

Jalan Kia Peng

Jalan Eaton

Jalan (MR7)

Conlay M

Jalan Conlay

Jln Tun Razak

Paradize Poolside

Horizon Grill

Jalan Conlay

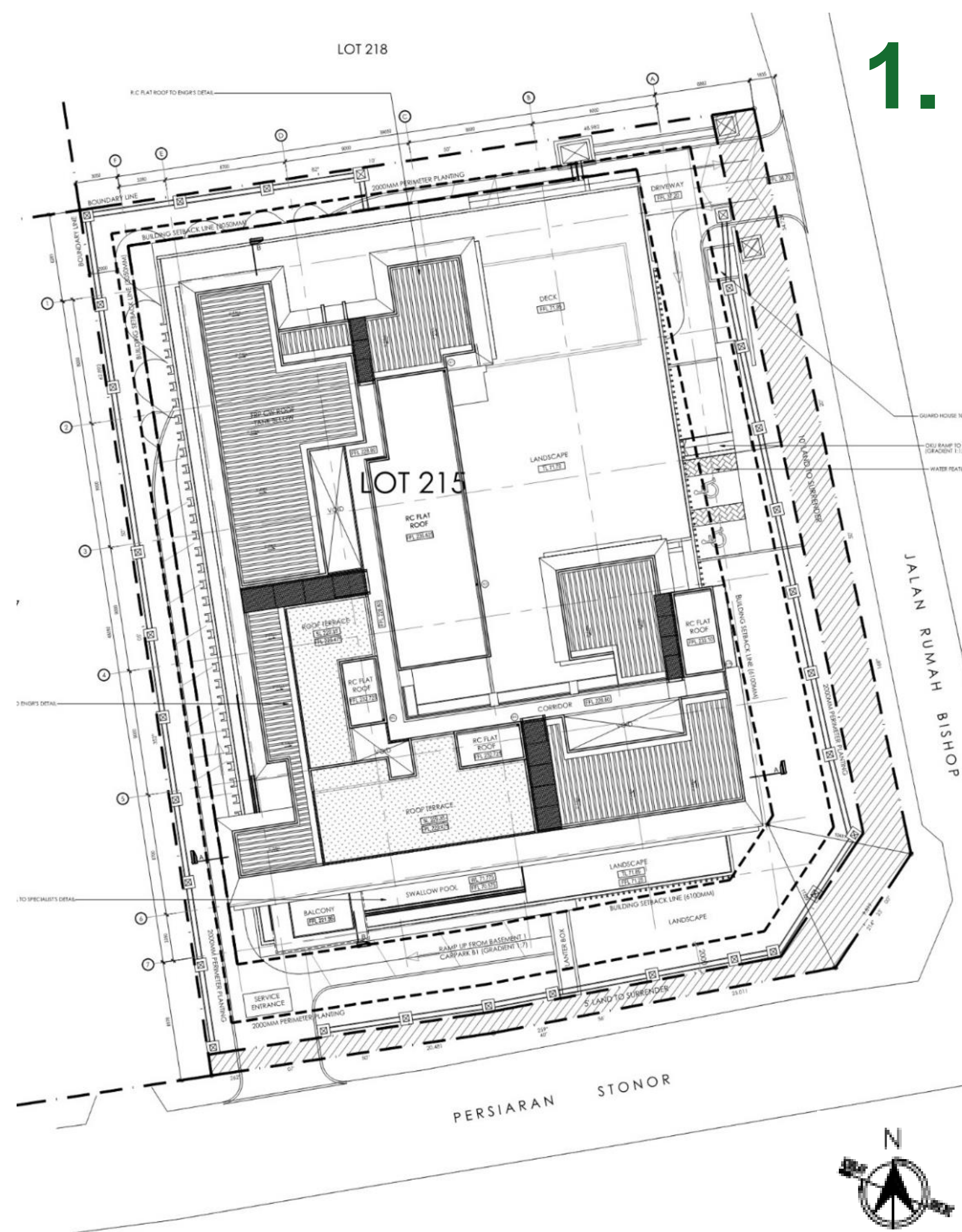
Royale Chulan Kuala Lumpur

Prince Court Medical Centre

Tumi TUMI Essentially Beautiful

Eight Avenue





1. Orientation

1. Orientation

Orientation	<i>OF</i>
North	0.90
Northeast	1.09
East	1.23
Southeast	1.13
South	0.92
Southwest	0.90
West	0.94
Northwest	0.90

NOTES:

1. Table 5 specifies *OF* for the various orientation of the fenestration. For the calculation of *OF*, it is recommended that the nearest predominant orientation be selected.
2. A fenestration system may consist of a glazing material such as glass, a shading device and a combination of both.

1. Orientation

OTTV = 44.65 W/m² (CVA)

10 Stonor

OTTV 44.65 w/m²K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION _STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	3.76	194.00	0.92	0.41	1.00	1.00	0.41	80.10	4657.80
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	3.76	194.00	0.92	0.41	0.78	1.00	0.32	66.14	2371.46
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	3.85	194.00	0.92	0.41	1.00	1.00	0.41	56.30	2537.06
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	3.76	194.00	0.92	0.41	1.00	1.00	0.41	73.60	9524.75
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	3.76	194.00	0.92	0.41	0.79	1.00	0.33	61.84	4934.05

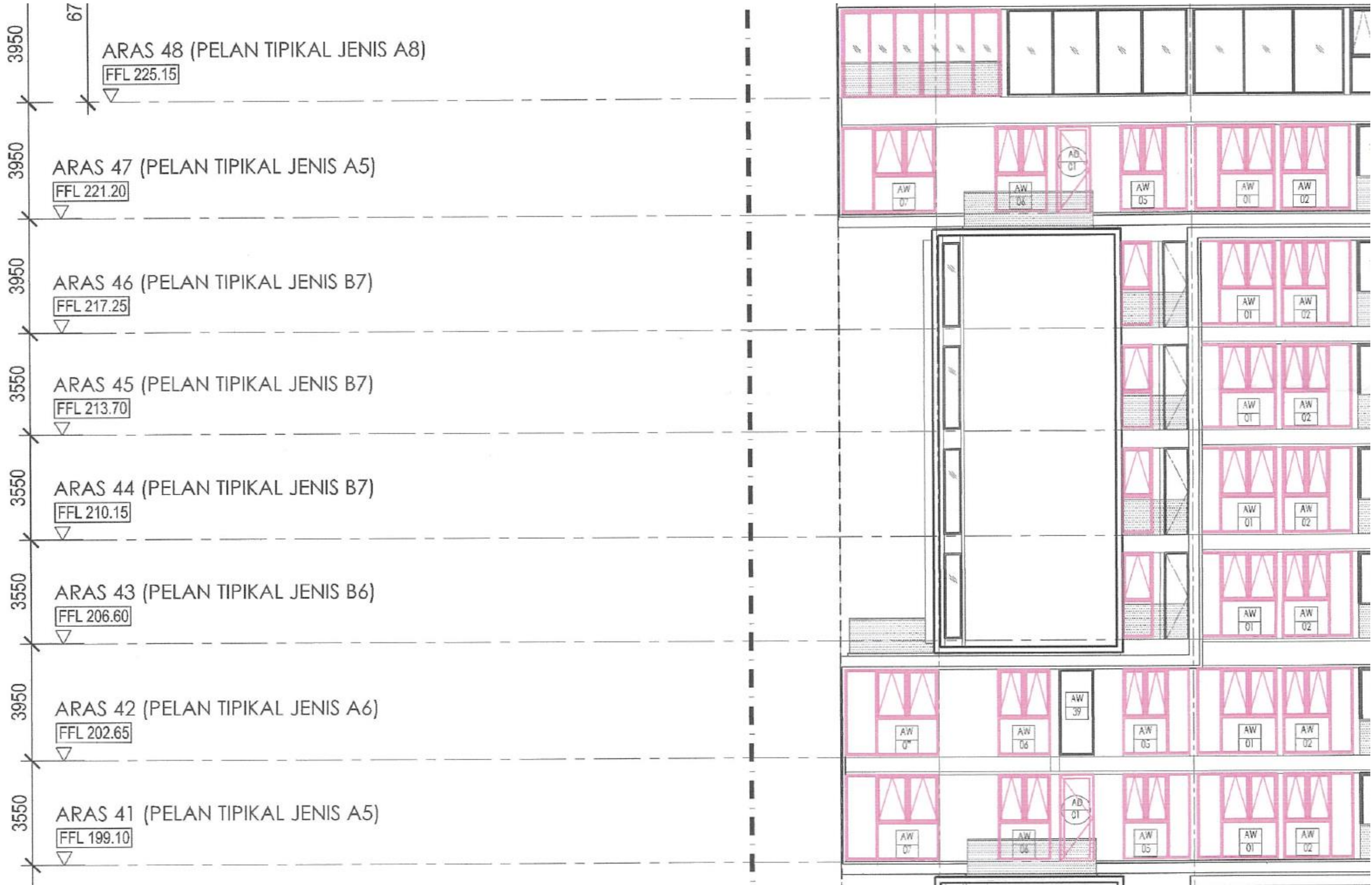
OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

1. Orientation Factor

2. Window-to-Wall Ratio

2. Window-to-Wall (WWR) Ratio



2. Window-to-Wall (WWR) Ratio

OTTV = 51.30 W/m² (Non Low-E)

10 Stonor

OTTV 51.30 w/m²K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	U _v glazing	SC _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	U _v Wall	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION _STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	U _v wall	Constant _{window}	WWR	U _v glazing	Constant _{shading}	CF	SC _{glazing}	SC _{device}	SC _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	5.36	194.00	0.92	0.52	1.00	1.00	0.52	103.60	6024.49
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	5.36	194.00	0.92	0.52	0.78	1.00	0.40	85.79	3075.90
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	5.36	194.00	0.92	0.52	1.00	1.00	0.52	70.71	3186.47
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	5.36	194.00	0.92	0.52	1.00	1.00	0.52	94.73	12258.14
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	5.36	194.00	0.92	0.52	0.79	1.00	0.41	79.70	6359.61

2. Window-to-Wall (WWR) Ratio

OTTV = 44.56 W/m² (Non Low-E + WWR15% Reduction)

10 Stonor

OTTV 44.56 w/m2K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	9263.14
WWR	0.27 R15%

	Materials	U _v glazing	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	U _v Wall	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION_STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	U _v wall	Constant _{window}	WWR	U _v glazing	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	37.40	24.49	15.00	0.40	0.36	2.66	6.00	0.64	3.76	194.00	0.92	0.52	1.00	1.00	0.52	79.90	4646.15
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	22.66	15.46	15.00	0.40	0.37	2.66	6.00	0.63	3.76	194.00	0.92	0.52	0.78	1.00	0.40	65.76	2357.67
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	18.11	26.96	15.00	0.40	0.60	2.66	6.00	0.40	3.85	194.00	0.92	0.52	1.00	1.00	0.52	56.12	2528.98
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	74.80	54.60	15.00	0.40	0.42	2.66	6.00	0.58	3.76	194.00	0.92	0.52	1.00	1.00	0.52	73.42	9501.46
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	45.31	34.48	15.00	0.40	0.43	2.66	6.00	0.57	3.76	194.00	0.92	0.52	0.79	1.00	0.41	61.50	4907.38

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

1. Orientation Factor

2. Window-to-Wall Ratio

- a. What is the effective WWR ?
- b. Can WWR >1 or <0 ?

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF} \times \text{WWR} \times \text{SC})$$

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

$$\text{SC} = \text{SC1} \times \text{SC2} \times \text{SC3}$$

SC1: Glass Shading Property

SC2: Shading Devices

(Horizontal and/or Vertical)

SC3: Sunscreen

Note: SC value is the ratio of solar heat gain (radiation) through a glass unit to the solar energy which passes through 3mm Clear Float Glass

3. Shading Coefficient (SC)

SC1: Glass Shading Property

No	Glass	Thk (mm)		VLT	U-Value	SC-Value	OTTV (W/m ²)
Base	Light Clear Tempered Float with Heat Soaked	10.00		87.00%	5.70	0.90	102.84
a	Light Green Tempered Float with Heat Soaked	10.00		70.00%	5.10	0.59	72.80
b	Light Green Annealed Float + Clear PVB + Clear Annealed Float	10.38	5.00 + 0.38 + 5.00	78.00%	5.10	0.69	81.79
c	Light Green Annealed Float + Clear PVB + Clear Annealed Hard Coated Low-E#4	10.38	5.00 + 0.38 + 5.00	71.00%	2.90	0.57	63.08
d	No Information						
e	Light Green Heat Strengthened Float + Clear PVB + Clear Heat Strengthened Hard Coated Low-E#4	13.52	6.00 + 1.52 + 6.00	68.00%	2.80	0.52	58.22
f	(Clear Heat Strengthened Float + Clear PVB + SV 40T Clear Heat Strengthened Soft Coated Low-E#4) + A12 + Clear Heat Strengthened Float	31.52	6.00 + 1.52 + 6.00 + 12.00 (air) + 6.00	39.00%	1.50	0.24	28.36
g	(Clear Heat Strengthened Float + Clear PVB + SV 52T Clear Heat Strengthened Soft Coated Low-E#4) + A12 + Clear Heat Strengthened Float	31.52	6.00 + 1.52 + 6.00 + 12.00 (air) + 6.00	48.00%	1.50	0.30	33.75
h	Solar Control Silver Grey Tempered with Heat Soaked Soft Coated Reflective V1#2	6.00		19.00%	4.30	0.35	48.33
i	Solar Control Silver Green Tempered with Heat Soaked Soft Coated Reflective V2#2	6.00		13.00%	4.00	0.27	40.05
j	Solar Control Silver Grey Annealed Soft Coated V1#2 + Clear PVB + Clear Heat Annealed Hard Coated Low-E#4	10.38	5.00 + 0.38 + 5.00	20.00%	2.80	0.28	36.63



3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)



3. Shading Coefficient (SC)

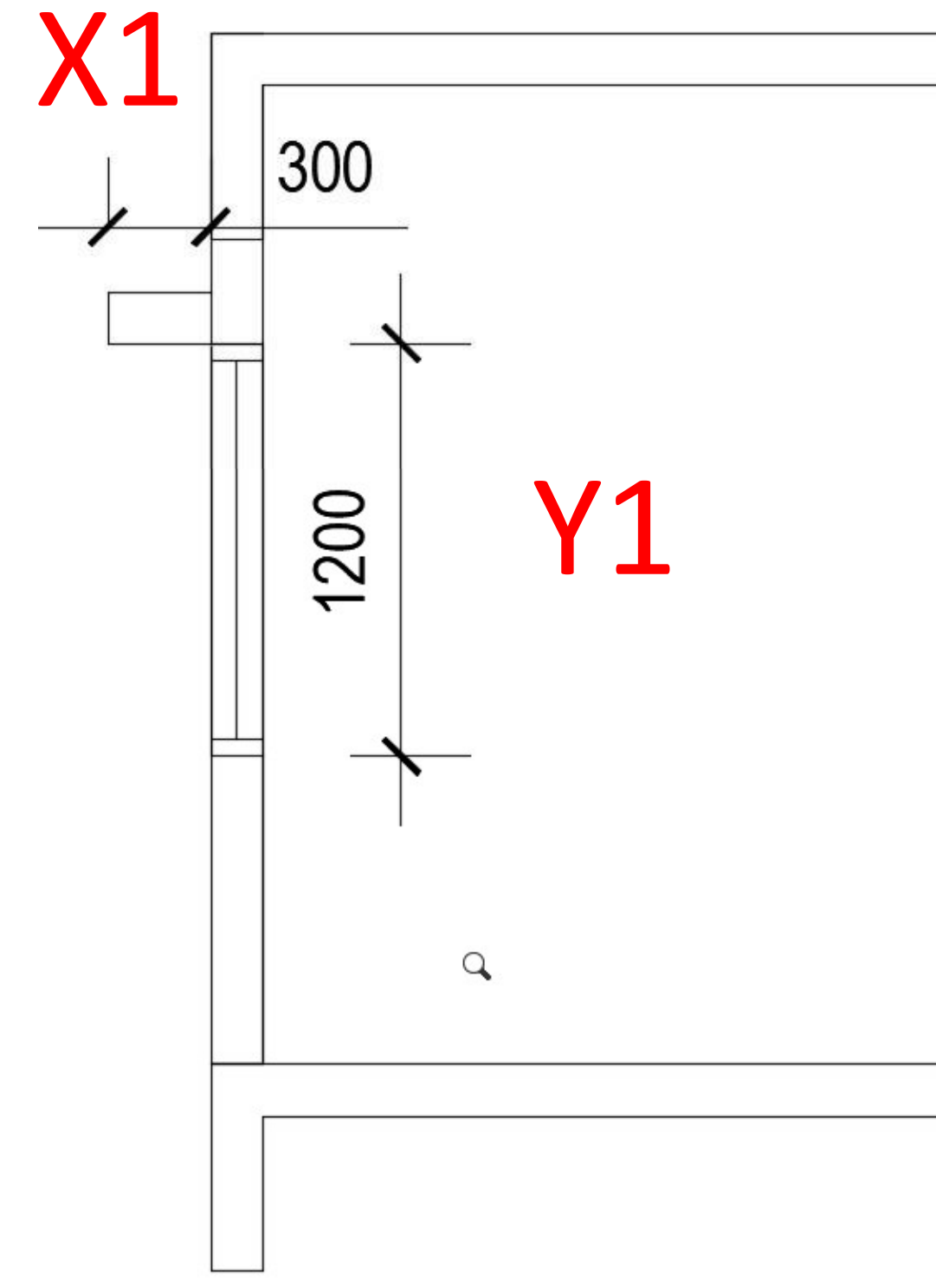
SC2: Shading Devices (Horizontal or Vertical)

Horizontal Projection (R1)

$$\begin{aligned} R1 &= X1 / Y1 \\ &= 300 / 1200 \\ &= 0.25 \end{aligned}$$

Not consider Horizontal Shading
because $R1 < 0.3$

Therefore $SC2 = 1$



R1	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0
North/South	0.77	0.71	0.67	0.65
East	0.77	0.68	0.6	0.55
West	0.79	0.71	0.65	0.61
NE/SW	0.77	0.69	0.63	0.6
NW/SE	0.79	0.72	0.66	0.63

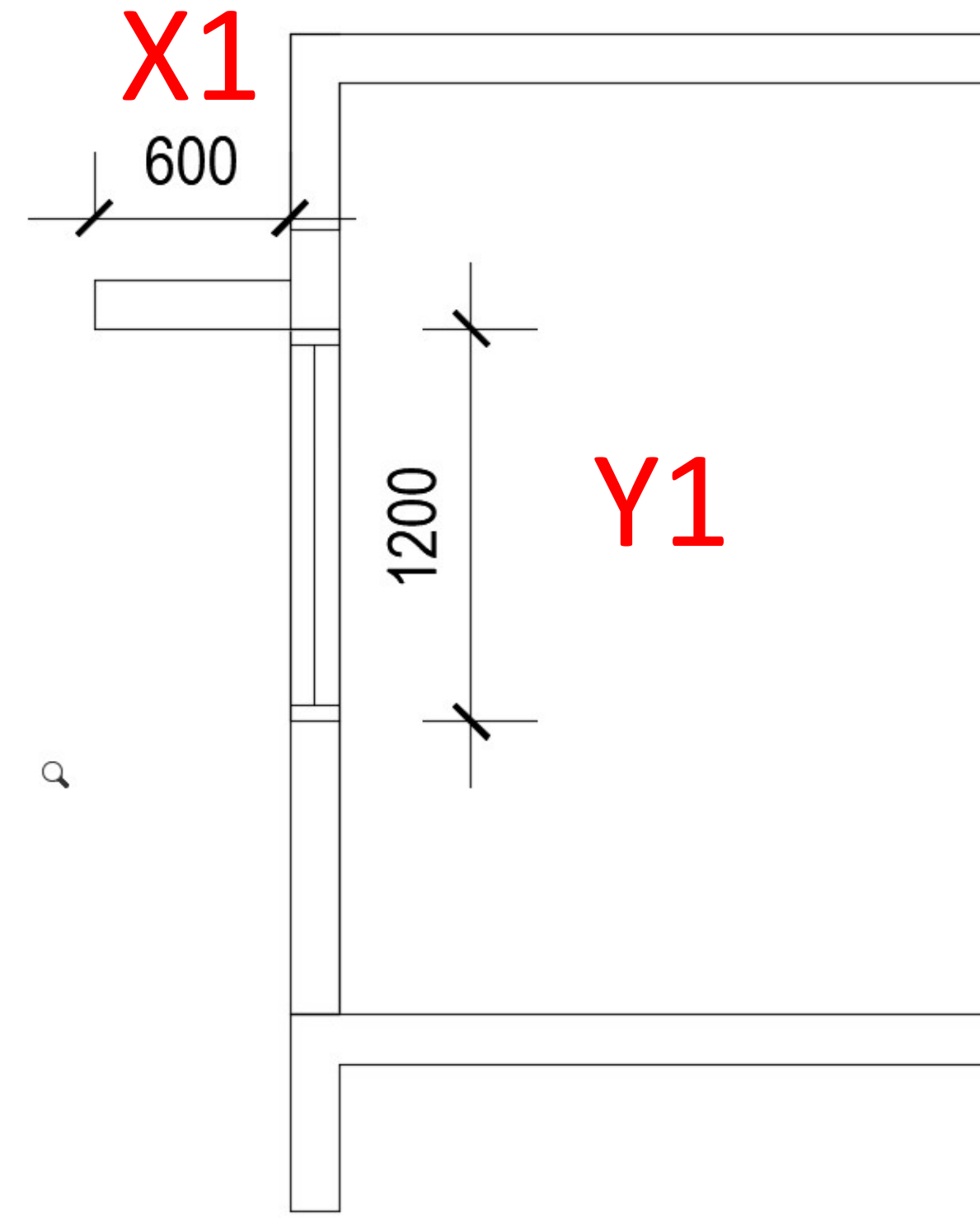
Figure 5. Horizontal projection shading coefficients

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

Horizontal Projection (R1)

$$\begin{aligned} R1 &= X1 / Y1 \\ &= 600 / 1200 \\ &= 0.5 \end{aligned}$$



R1	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0
North/South	0.77	0.71	0.67	0.65
East	0.77	0.68	0.6	0.55
West	0.79	0.71	0.65	0.61
NE/SW	0.77	0.69	0.63	0.6
NW/SE	0.79	0.72	0.66	0.63

Figure 5. Horizontal projection shading coefficients

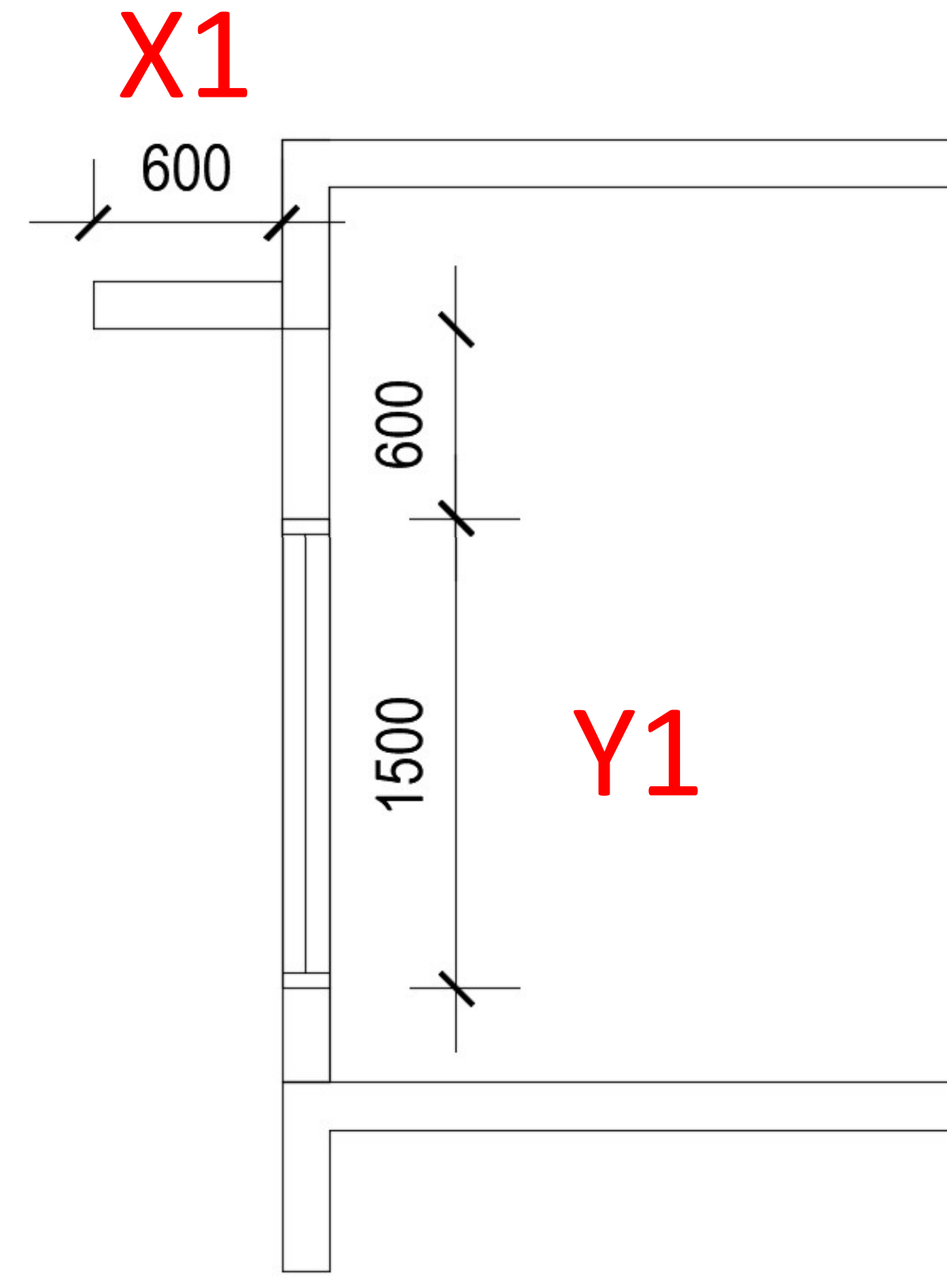
3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

Horizontal Projection (R1)

$$\begin{aligned} R1 &= X1 / Y1 \\ &= 300 / 2100 \\ &= 0.28 \end{aligned}$$

Therefore SC2 = 1



R1	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0
North/South	0.77	0.71	0.67	0.65
East	0.77	0.68	0.6	0.55
West	0.79	0.71	0.65	0.61
NE/SW	0.77	0.69	0.63	0.6
NW/SE	0.79	0.72	0.66	0.63

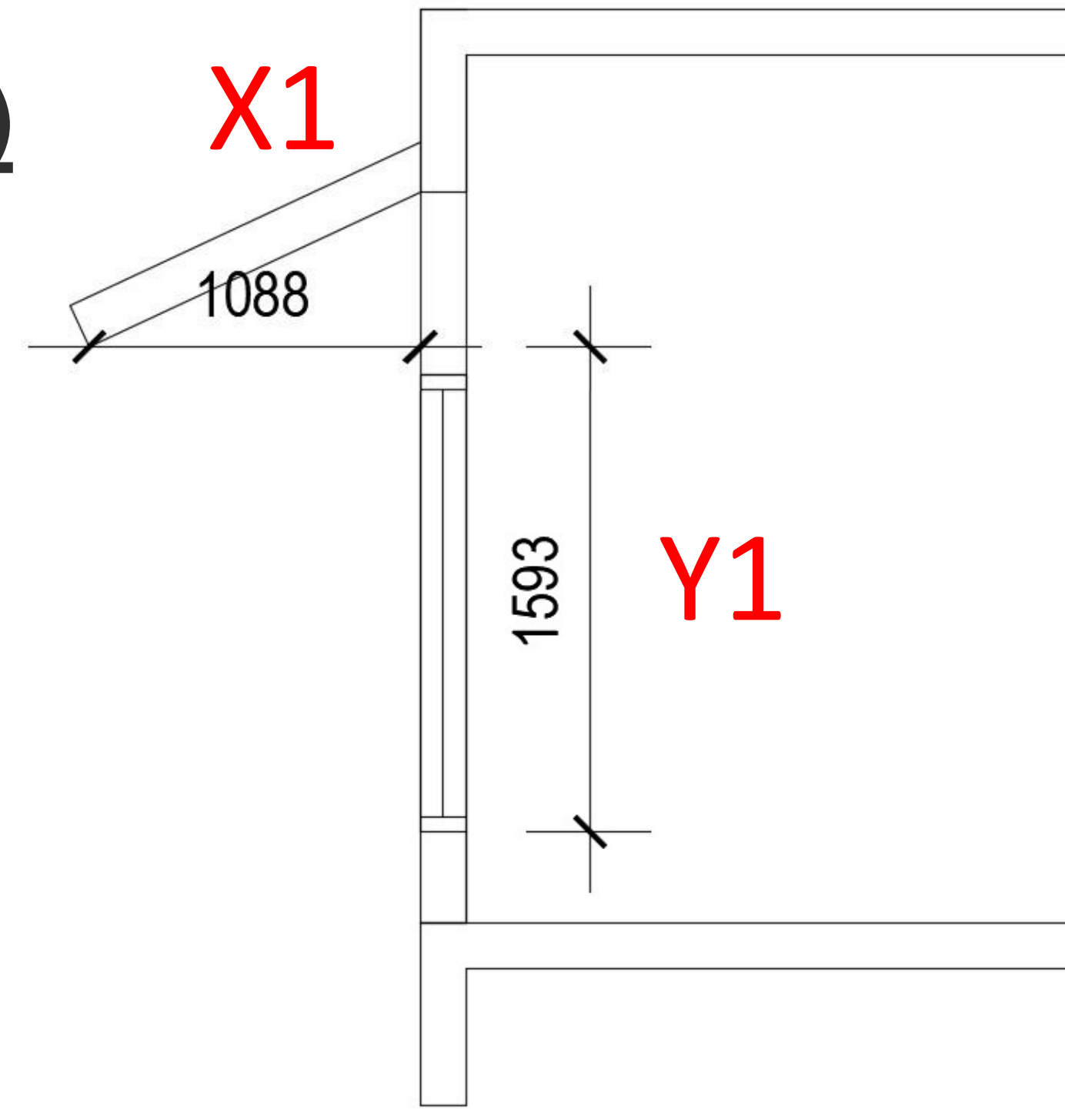
Figure 5. Horizontal projection shading coefficients

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

Horizontal Projection (R1)

$$\begin{aligned} R1 &= X1 / Y1 \\ &= 10880 / 1593 \\ &= 0.68 \end{aligned}$$

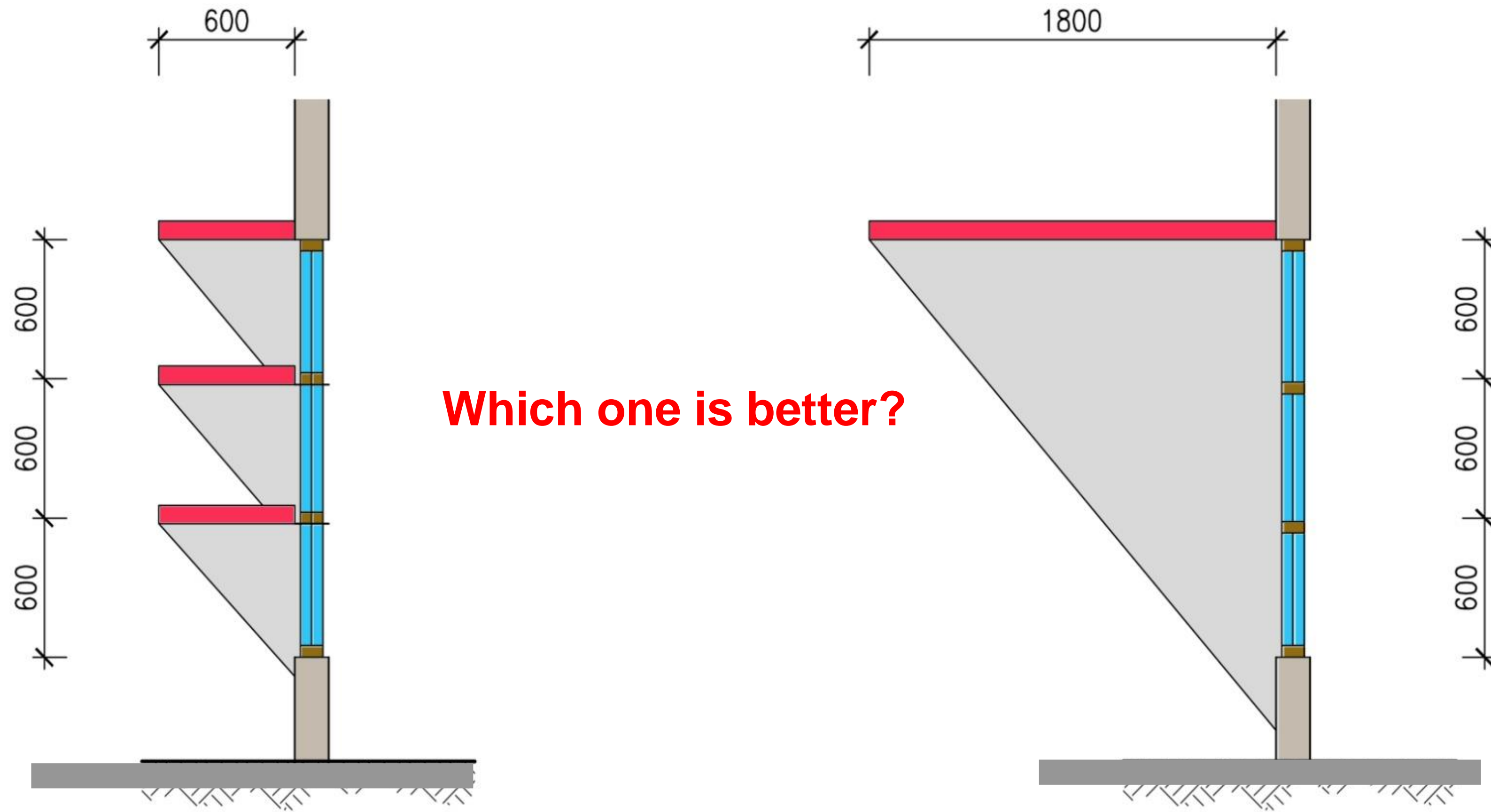


R1	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0
North/South	0.77	0.71	0.67	0.65
East	0.77	0.68	0.6	0.55
West	0.79	0.71	0.65	0.61
NE/SW	0.77	0.69	0.63	0.6
NW/SE	0.79	0.72	0.66	0.63

Figure 5. Horizontal projection shading coefficients

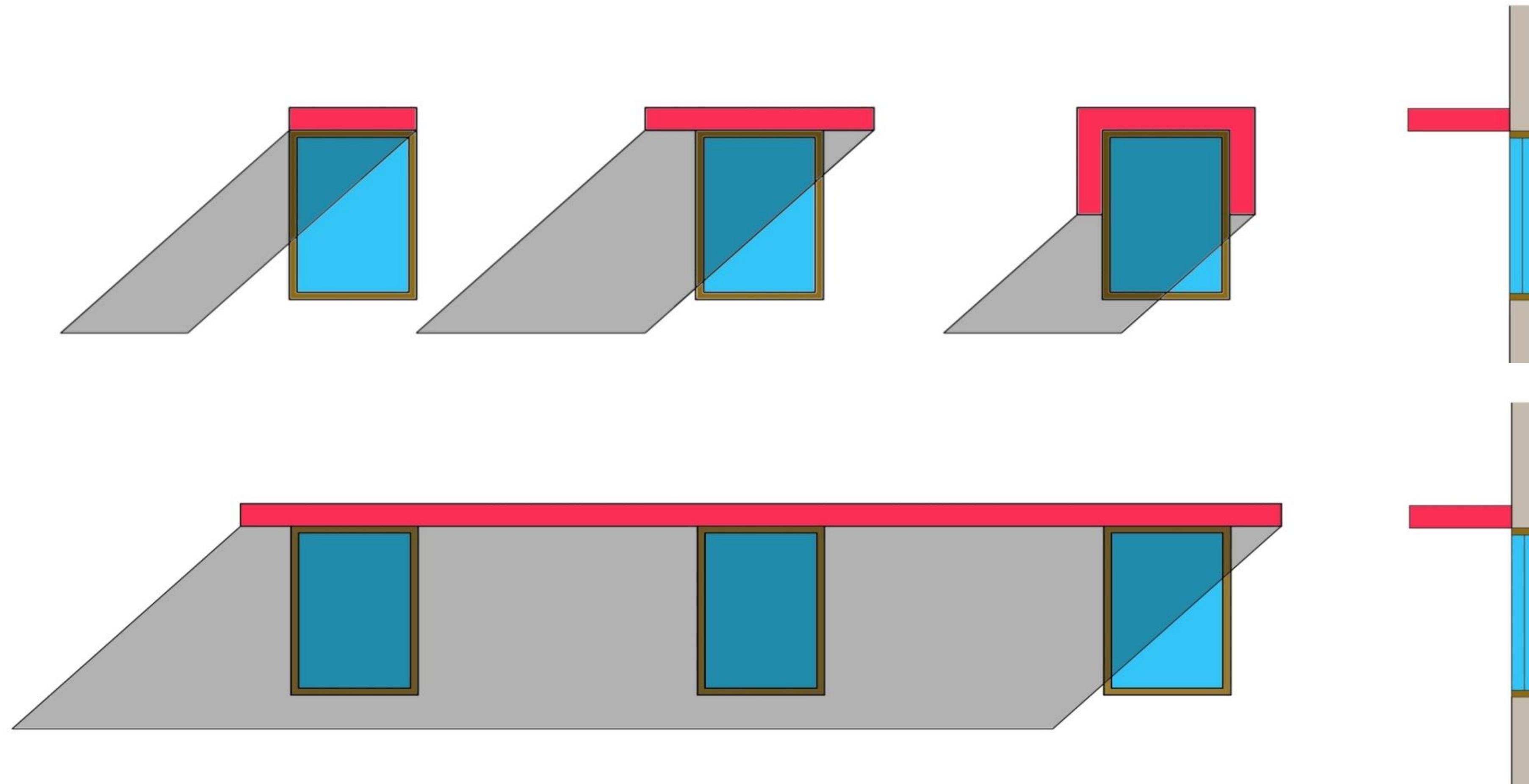
3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)



3. Shading Coefficient (SC)

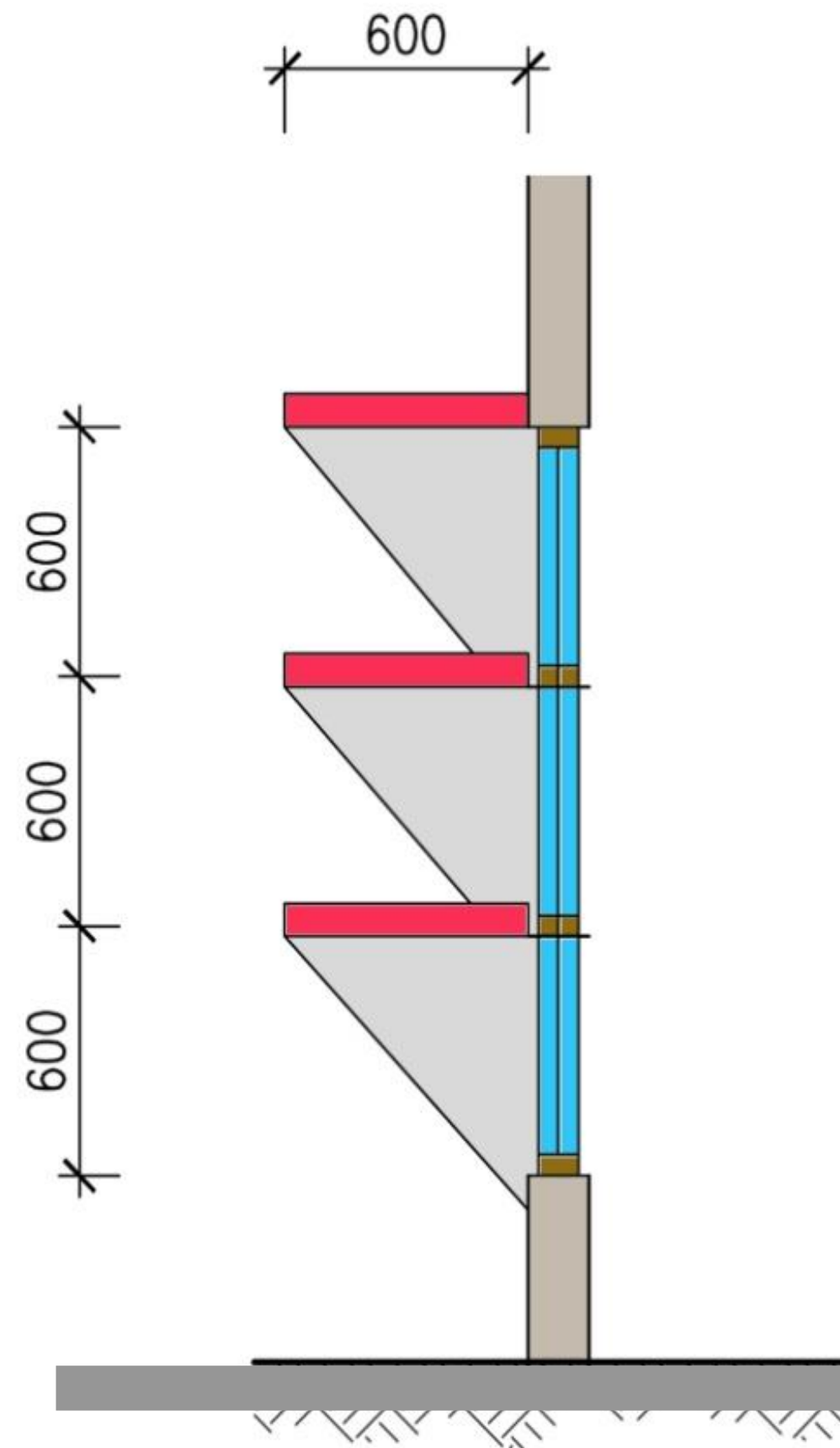
SC2: Shading Devices (Horizontal or Vertical)



Which one is better?

3. Shading Coefficient (SC)

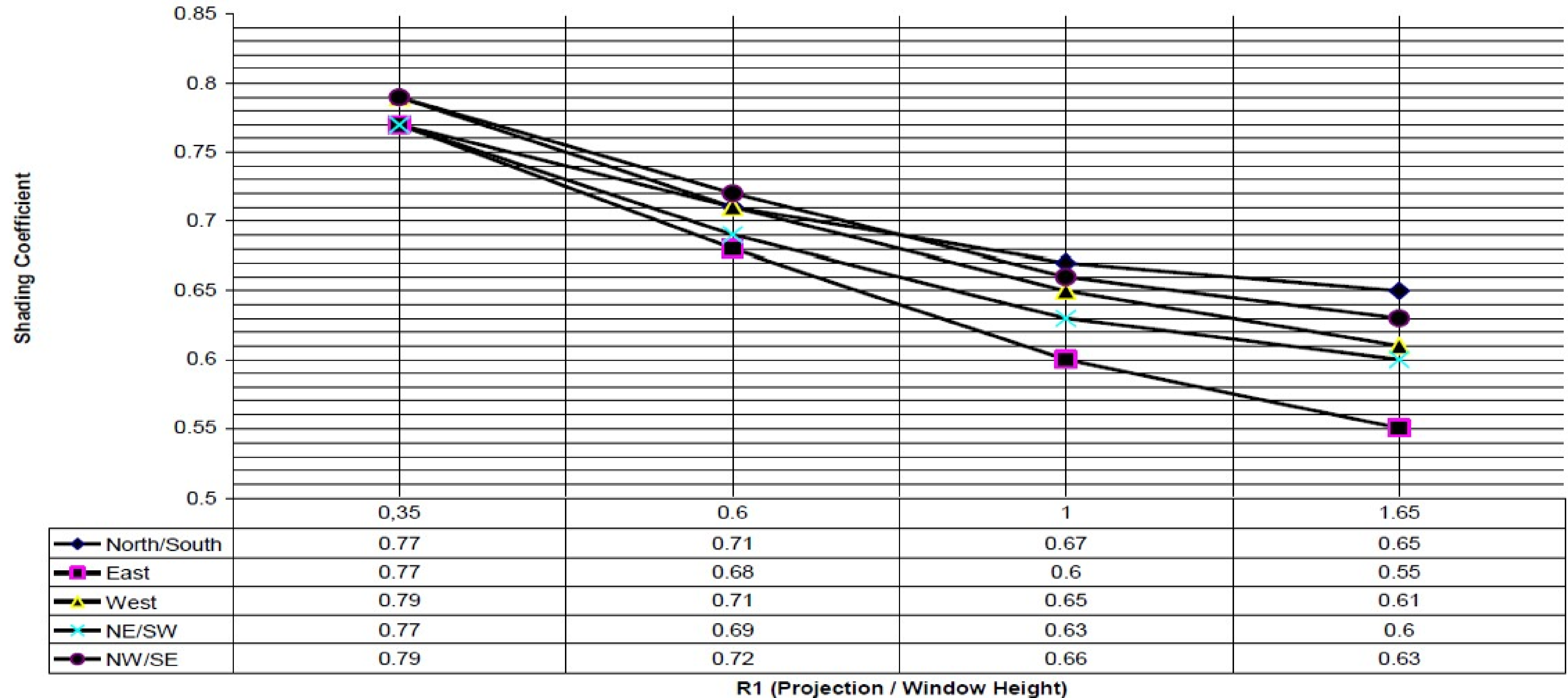
SC2: Shading Devices (Horizontal or Vertical)



3. Shading Coefficient (SC)

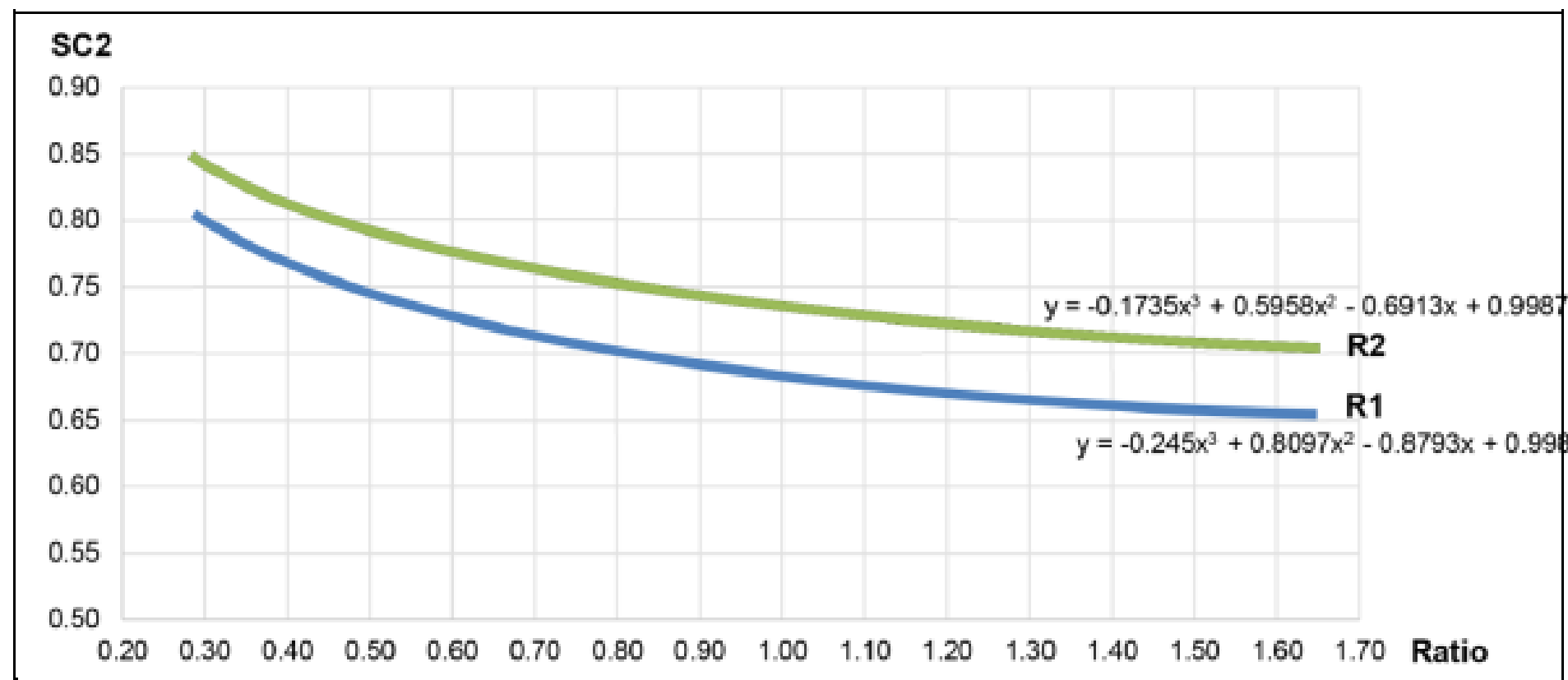
SC2: Shading Devices (Horizontal or Vertical)

HORIZONTAL PROJECTION SHADING COEFFICIENTS

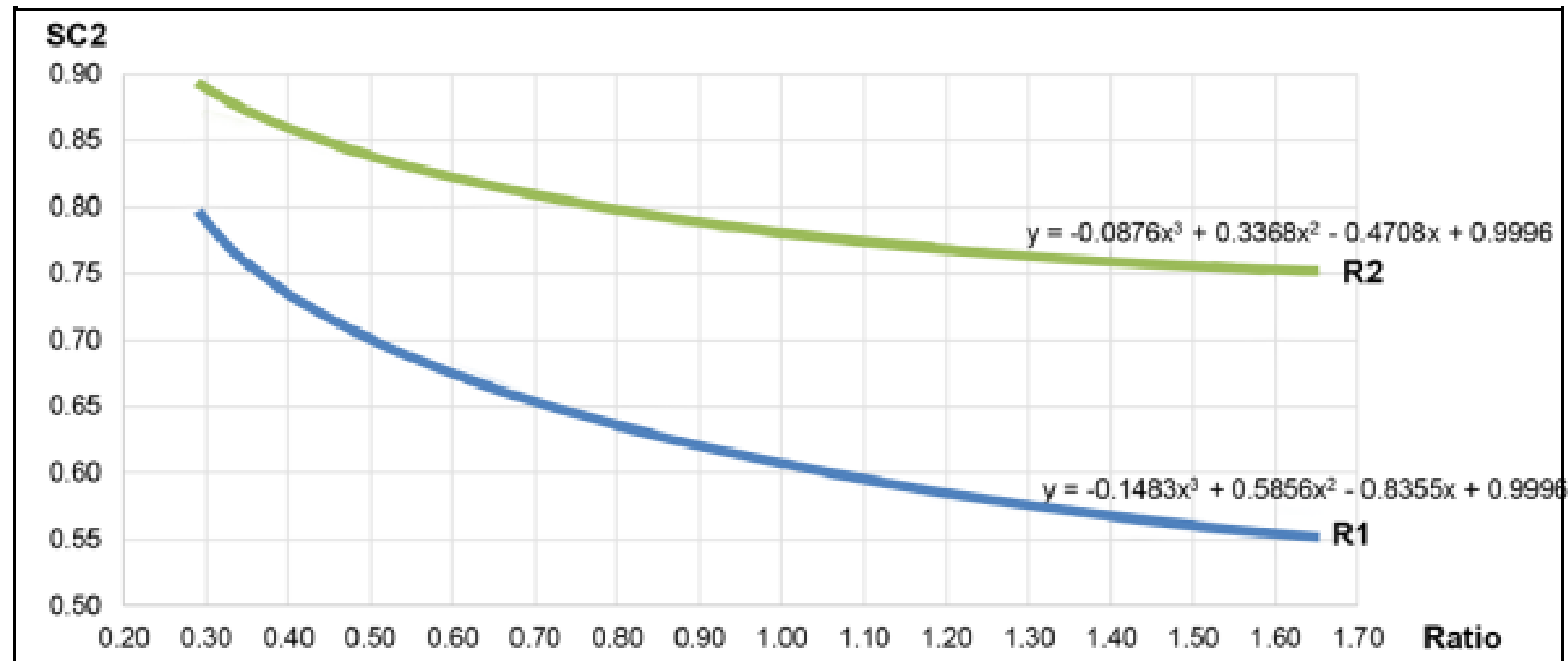


3. Shading Coefficient (SC)

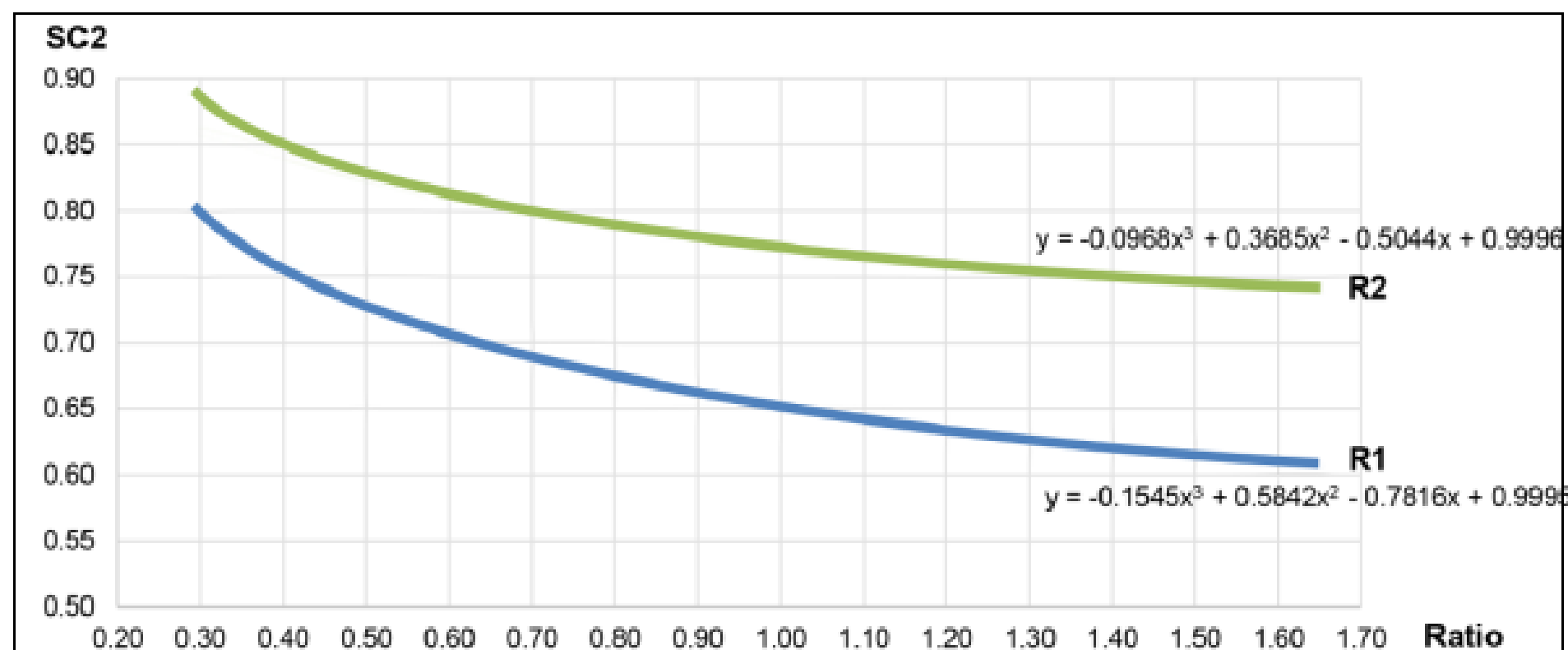
SC2: Shading Devices (Horizontal or Vertical)



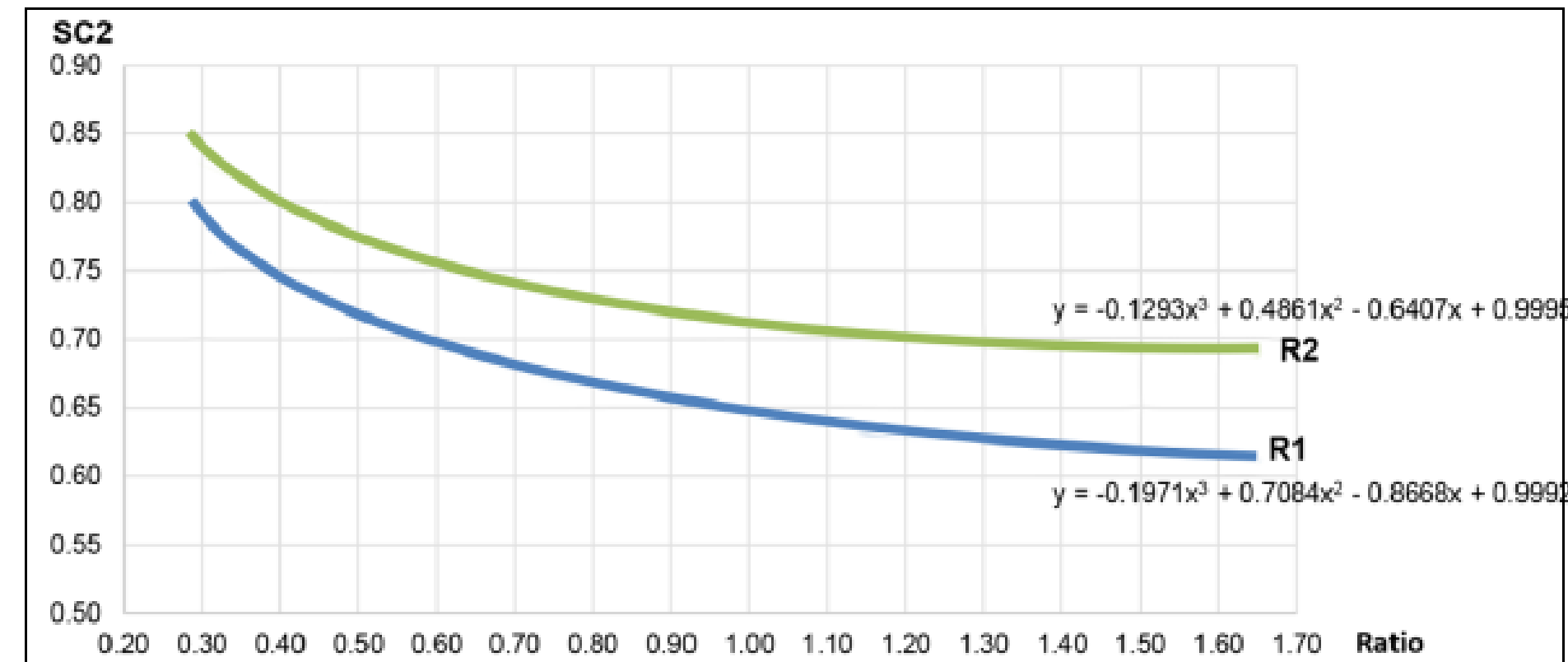
a) North/South



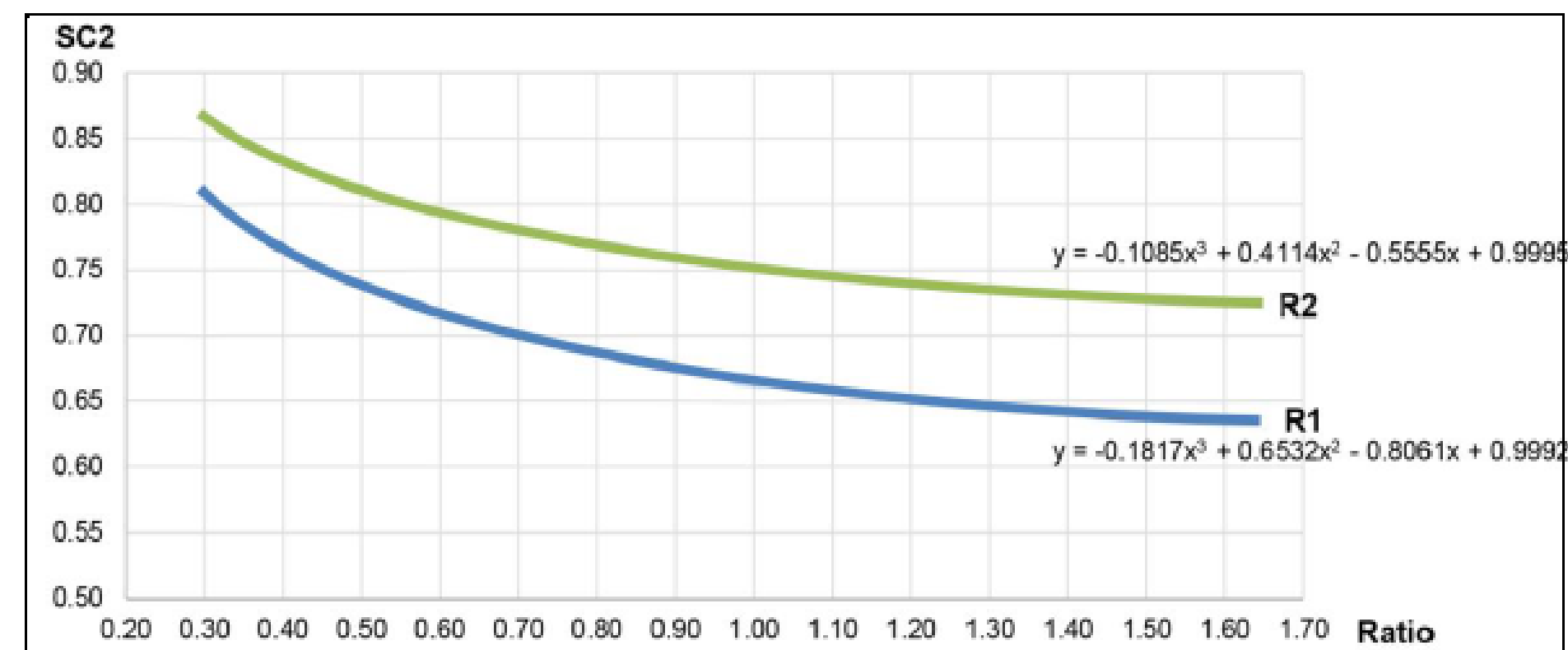
b) East



c) West



d) North-East/South-East



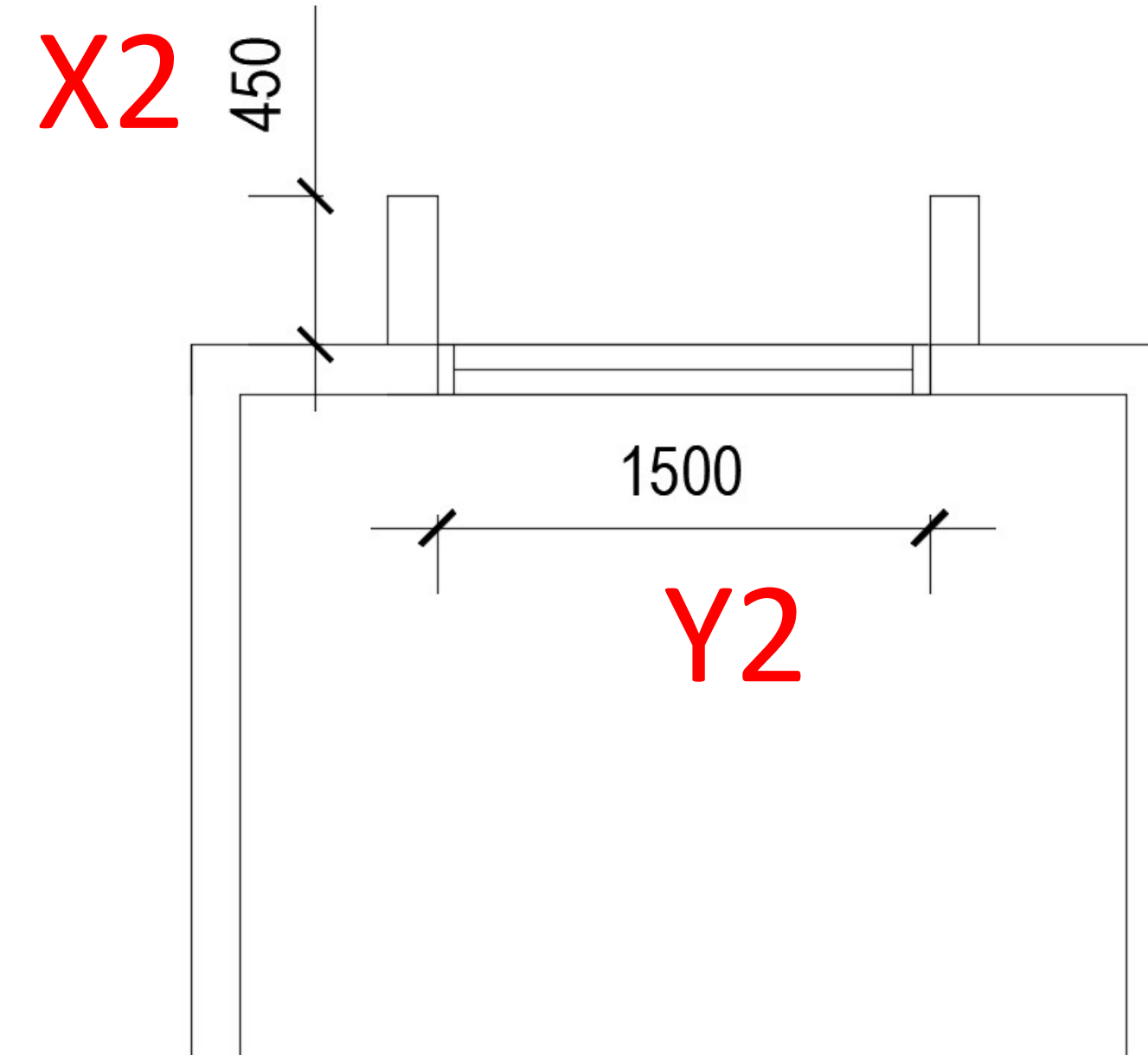
e) North-West/South-West

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

Vertical Projection (R2)

$$\begin{aligned} R2 &= X2 / Y2 \\ &= 450 / 1500 \\ &= 0.3 \end{aligned}$$



VERTICAL PROJECTIONS SHADING COEFFICIENTS

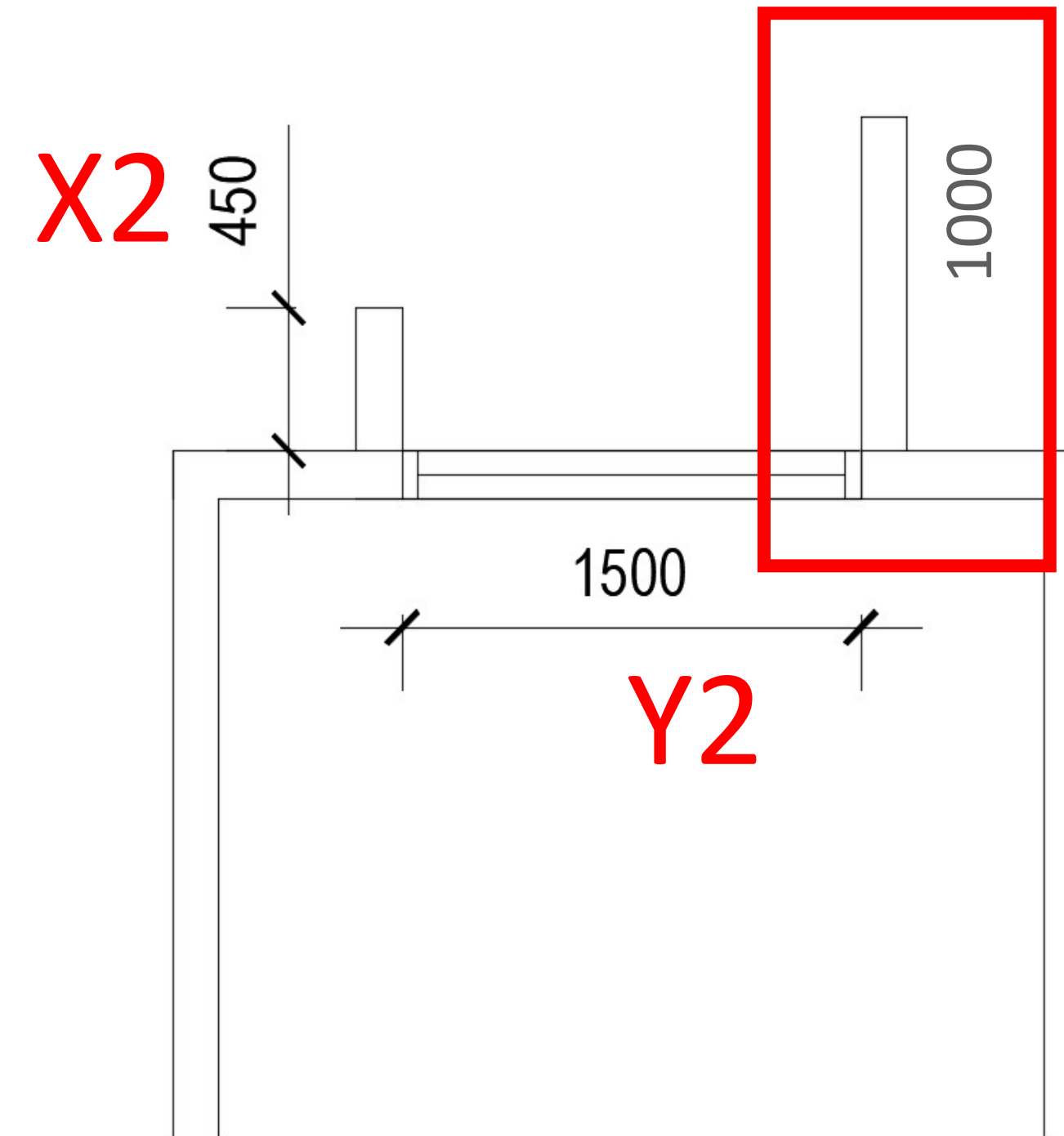
R2	0.3 to 0.4	0.5 to 0.7	0.8 to 0.12	1.3 to 2.0
North/South	0.82	0.77	0.73	0.7
East	0.87	0.82	0.78	0.75
West	0.86	0.81	0.77	0.74
NE/SW	0.83	0.77	0.72	0.69
NW/SE	0.84	0.79	0.74	0.71

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

Vertical Projection (R2)

$$\begin{aligned} R2 &= X2 / Y2 \\ &= 450 / 1500 \\ &= 0.3 \end{aligned}$$



VERTICAL PROJECTIONS SHADING COEFFICIENTS

R2	0.3 to 0.4	0.5 to 0.7	0.8 to 0.12	1.3 to 2.0
North/South	0.82	0.77	0.73	0.7
East	0.87	0.82	0.78	0.75
West	0.86	0.81	0.77	0.74
NE/SW	0.83	0.77	0.72	0.69
NW/SE	0.84	0.79	0.74	0.71

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

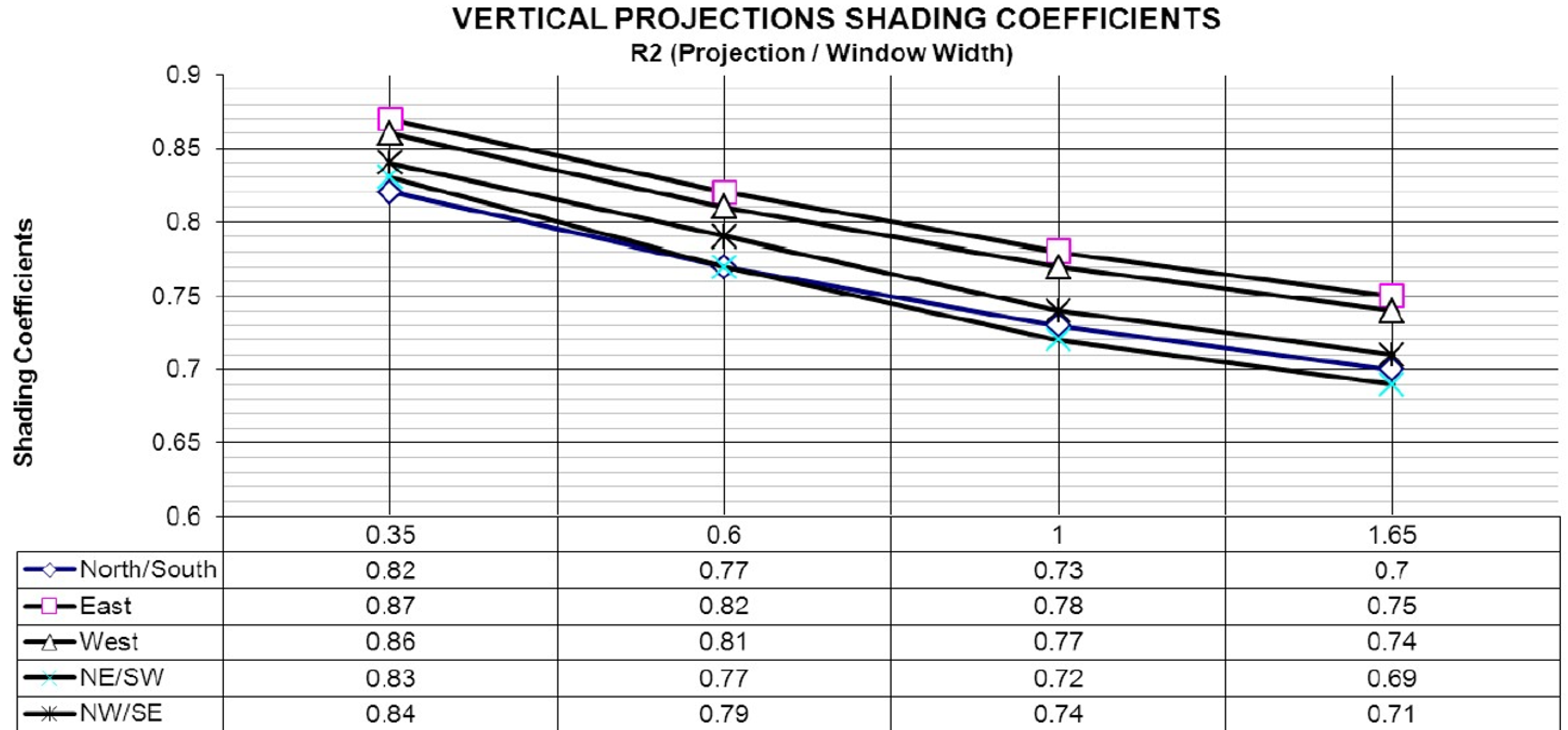


Figure 6. Vertical projection shading coefficients

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

SC2: Horizontal or Vertical Shading
Devices better?

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

Horizontal or Vertical Shading Devices better?

VERTICAL PROJECTIONS SHADING COEFFICIENTS

R2	0.3 to 0.4	0.5 to 0.7	0.8 to 0.12	1.3 to 2.0
North/South	0.82	0.77	0.73	0.7
East	0.87	0.82	0.78	0.75
West	0.86	0.81	0.77	0.74
NE/SW	0.83	0.77	0.72	0.69
NW/SE	0.84	0.79	0.74	0.71

R1	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0
North/South	0.77	0.71	0.67	0.65
East	0.77	0.68	0.6	0.55
West	0.79	0.71	0.65	0.61
NE/SW	0.77	0.69	0.63	0.6
NW/SE	0.79	0.72	0.66	0.63

Figure 5. Horizontal projection shading coefficients

Horizontal Shading Devices: Around 10% More Efficient

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)



3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

OTTV = 51.30 W/m² (Non Low-E)

10 Stonor

OTTV = 51.30 w/m²K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION_STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	5.36	194.00	0.92	0.52	1.00	1.00	0.52	103.60	6024.49
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	5.36	194.00	0.92	0.52	0.78	1.00	0.40	85.79	3075.90
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	5.36	194.00	0.92	0.52	1.00	1.00	0.52	70.71	3186.47
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	5.36	194.00	0.92	0.52	1.00	1.00	0.52	94.73	12258.14
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	5.36	194.00	0.92	0.52	0.79	1.00	0.41	79.70	6359.61

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal or Vertical)

OTTV = 47.98 W/m² (Non Low-E + HD:1000)

10 Stonor

OTTV 47.98 w/m²K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION_STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	5.36	194.00	0.92	0.52	0.77	1.00	0.40	86.44	5026.51
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	5.36	194.00	0.92	0.52	0.78	1.00	0.40	85.79	3075.90
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	5.36	194.00	0.92	0.52	0.77	1.00	0.40	59.99	2703.34
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	5.36	194.00	0.92	0.52	0.77	1.00	0.40	79.30	10262.18
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	5.36	194.00	0.92	0.52	0.79	1.00	0.41	79.70	6359.61

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal **and** Vertical)

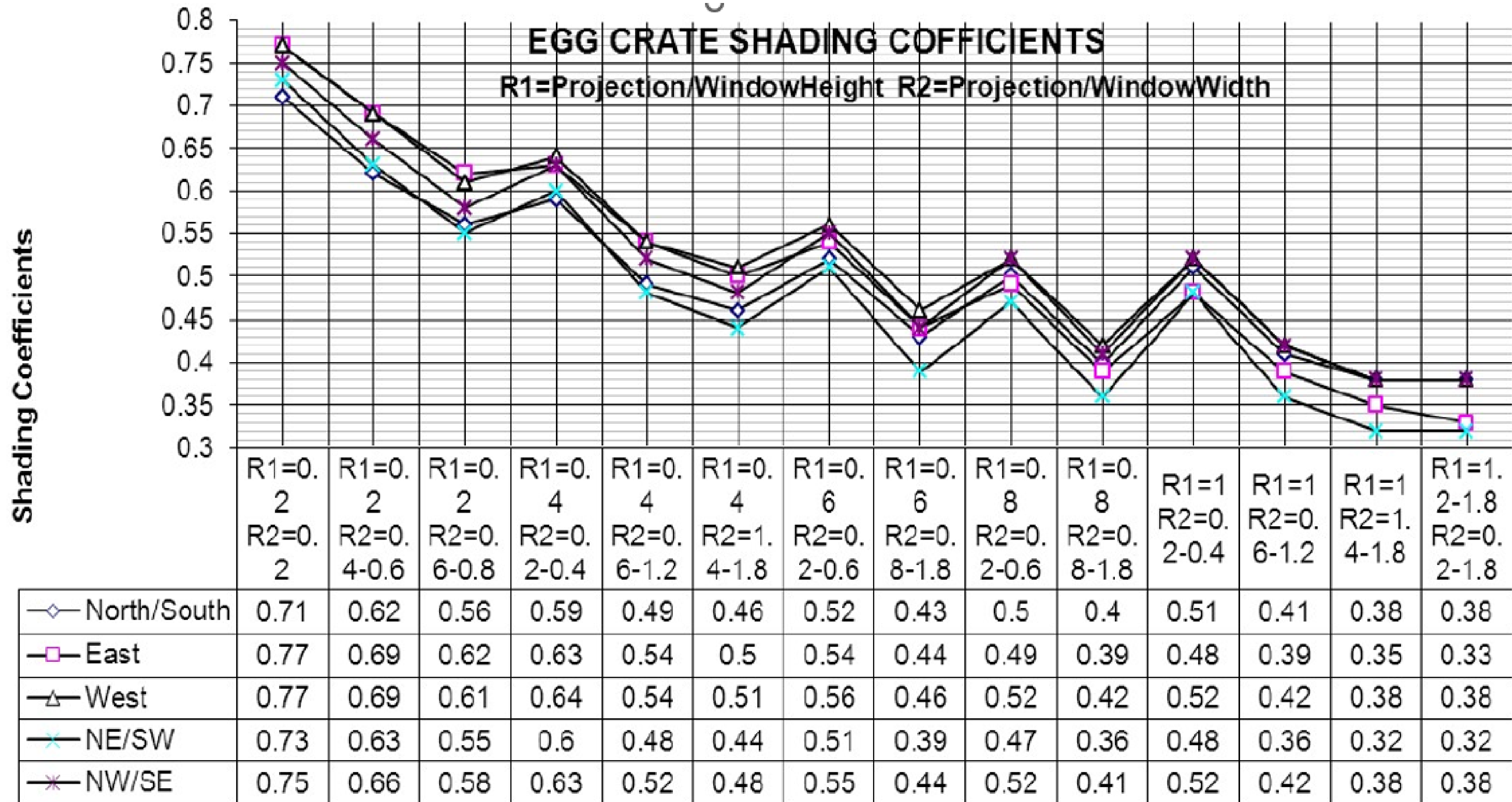


Figure 7. Egg crate shading coefficients

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal **and** Vertical)

VERTICAL PROJECTIONS SHADING COEFFICIENTS

R2	0.3 to 0.4	0.5 to 0.7	0.8 to 0.12	1.3 to 2.0
North/South	0.82	0.77	0.73	0.7
East	0.87	0.82	0.78	0.75
West	0.86	0.81	0.77	0.74
NE/SW	0.83	0.77	0.72	0.69
NW/SE	0.84	0.79	0.74	0.71

R1	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0
North/South	0.77	0.71	0.67	0.65
East	0.77	0.68	0.6	0.55
West	0.79	0.71	0.65	0.61
NE/SW	0.77	0.69	0.63	0.6
NW/SE	0.79	0.72	0.66	0.63

Figure 5. Horizontal projection shading coefficients

R1&R2	R1=0.2 R2=0.2	R1=0.2 R2=0.4-0.6	R1=0.2 R2=0.6-0.8	R1=0.4 R2=0.2-0.4	R1=0.4 R2=0.6-1.2	R1=0.4 R2=1.4-1.8	R1=0.6 R2=0.2-0.6	R1=0.6 R2=0.8-1.8	R1=0.8 R2=0.2-0.6	R1=0.8 R2=0.8-1.8	R1=1 R2=0.2-0.4	R1=1 R2=0.6-1.2	R1=1 R2=1.4-1.8	1.8 R2=0.2-1.8
North/South	0.71	0.62	0.56	0.59	0.49	0.46	0.52	0.43	0.5	0.4	0.51	0.41	0.38	0.38
East	0.77	0.69	0.62	0.63	0.54	0.5	0.54	0.44	0.49	0.39	0.48	0.39	0.35	0.35
West	0.77	0.69	0.61	0.64	0.54	0.51	0.56	0.46	0.52	0.42	0.52	0.42	0.38	0.38
NE/SW	0.73	0.63	0.55	0.6	0.48	0.44	0.51	0.39	0.47	0.36	0.48	0.36	0.32	0.32
NW/SE	0.75	0.66	0.58	0.63	0.52	0.48	0.55	0.44	0.52	0.41	0.52	0.42	0.38	0.38

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal **and** Vertical)



3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal and Vertical)

OTTV = 47.98 W/m² (Non Low-E + HD:1000)

10 Stonor

OTTV 47.98 w/m2K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION_STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	5.36	194.00	0.92	0.52	0.77	1.00	0.40	86.44	5026.51
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	5.36	194.00	0.92	0.52	0.78	1.00	0.40	85.79	3075.90
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	5.36	194.00	0.92	0.52	0.77	1.00	0.40	59.99	2703.34
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	5.36	194.00	0.92	0.52	0.77	1.00	0.40	79.30	10262.18
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	5.36	194.00	0.92	0.52	0.79	1.00	0.41	79.70	6359.61

3. Shading Coefficient (SC)

SC2: Shading Devices (Horizontal and Vertical)

OTTV = 44.37 W/m² (Non Low-E + HD:1000 + VD:600)

10 Stonor

OTTV 44.37 w/m2K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION_STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	5.36	194.00	0.92	0.52	0.59	1.00	0.31	73.01	4245.49
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	5.36	194.00	0.92	0.52	0.59	1.00	0.31	72.01	2581.77
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	5.36	194.00	0.92	0.52	0.59	1.00	0.31	51.60	2325.24
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	5.36	194.00	0.92	0.52	0.59	1.00	0.31	67.23	8700.13
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	5.36	194.00	0.92	0.52	0.59	1.00	0.31	66.33	5292.49

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

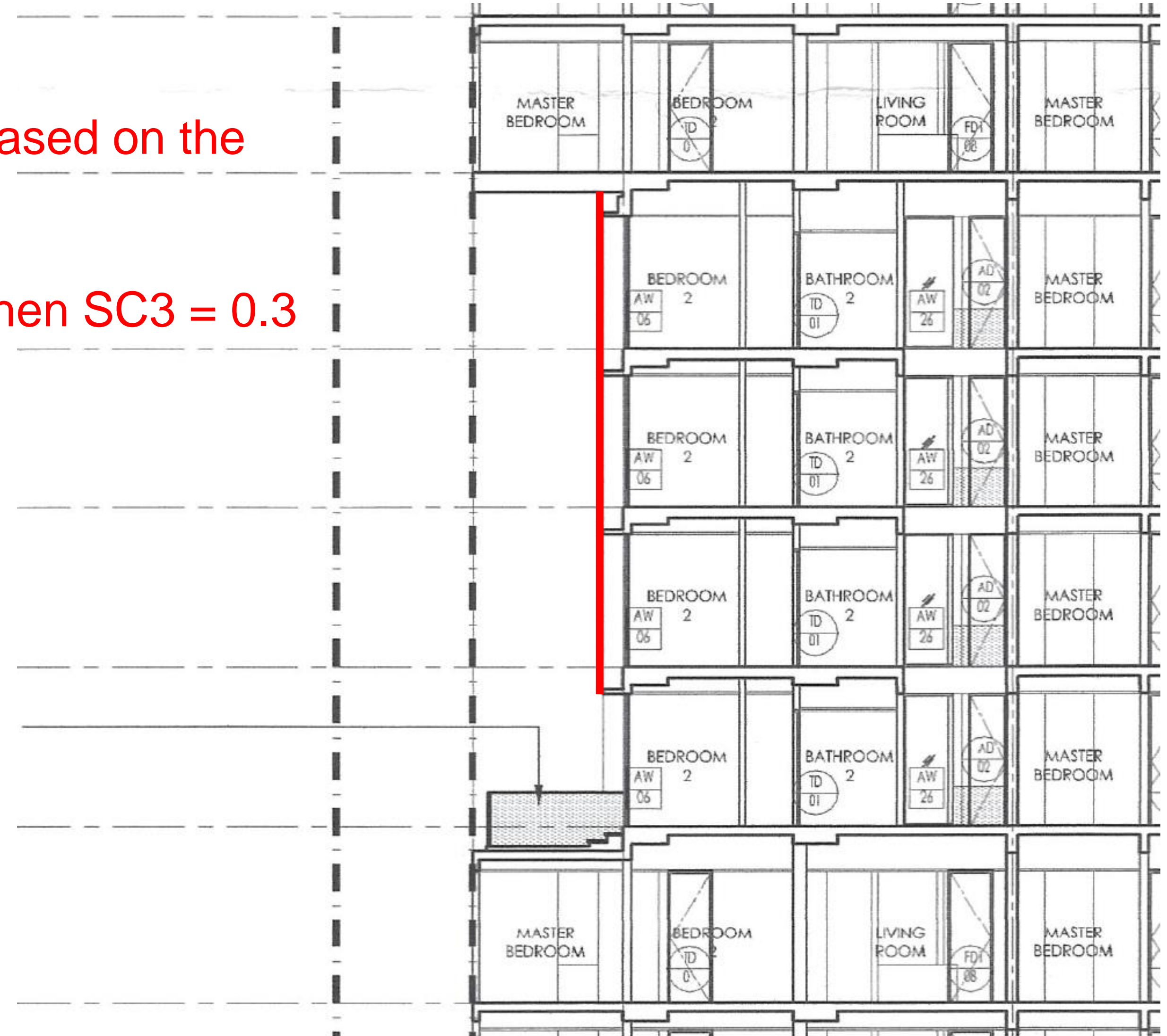
SC3: Sunscreen

3. Shading Coefficient (SC)

SC3: Sunscreen

SC3 is calculated based on the percentage of void

If the void is 30%, then $SC3 = 0.3$



3. Shading Coefficient (SC)

SC3: Sunscreen

OTTV = 44.93 W/m² (Non Low-E + Sunscreen 70% Void)

10 Stonor

OTTV 44.93 w/m2K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
Glazing Specification			
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION _STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	5.36	194.00	0.92	0.52	1.00	0.70	0.36	81.22	4722.78
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	5.36	194.00	0.92	0.52	0.78	0.70	0.28	68.68	2462.44
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	5.36	194.00	0.92	0.52	1.00	0.70	0.36	56.72	2556.30
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	5.36	194.00	0.92	0.52	1.00	0.70	0.36	74.61	9654.72
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	5.36	194.00	0.92	0.52	0.79	0.70	0.29	64.03	5109.03

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

SC2: Which Shading Devices is more

a. Effective ?

b. Cheaper ?

3. Shading Coefficient (SC)

SC3: Sunscreen

VERTICAL PROJECTIONS SHADING COEFFICIENTS

R2	0.3 to 0.4	0.5 to 0.7	0.8 to 0.12	1.3 to 2.0
North/South	0.82	0.77	0.73	0.7
East	0.87	0.82	0.78	0.75
West	0.86	0.81	0.77	0.74
NE/SW	0.83	0.77	0.72	0.69
NW/SE	0.84	0.79	0.74	0.71

R1	0.3 to 0.4	0.5 to 0.7	0.8 to 1.2	1.3 to 2.0
North/South	0.77	0.71	0.67	0.65
East	0.77	0.68	0.6	0.55
West	0.79	0.71	0.65	0.61
NE/SW	0.77	0.69	0.63	0.6
NW/SE	0.79	0.72	0.66	0.63

Figure 5. Horizontal projection shading coefficients

R1&R2	R1=0.2 R2=0.2	R1=0.2 R2=0.4-0.6	R1=0.2 R2=0.6-0.8	R1=0.4 R2=0.2-0.4	R1=0.4 R2=0.6-1.2	R1=0.4 R2=1.4-1.8	R1=0.6 R2=0.2-0.6	R1=0.6 R2=0.8-1.8	R1=0.8 R2=0.2-0.6	R1=0.8 R2=0.8-1.8	R1=1 R2=0.2-0.4	R1=1 R2=0.6-1.2	R1=1 R2=1.4-1.8	1.8 R2=0.2-1.8
North/South	0.71	0.62	0.56	0.59	0.49	0.46	0.52	0.43	0.5	0.4	0.51	0.41	0.38	0.38
East	0.77	0.69	0.62	0.63	0.54	0.5	0.54	0.44	0.49	0.39	0.48	0.39	0.35	0.35
West	0.77	0.69	0.61	0.64	0.54	0.51	0.56	0.46	0.52	0.42	0.52	0.42	0.38	0.38
NE/SW	0.73	0.63	0.55	0.6	0.48	0.44	0.51	0.39	0.47	0.36	0.48	0.36	0.32	0.32
NW/SE	0.75	0.66	0.58	0.63	0.52	0.48	0.55	0.44	0.52	0.41	0.52	0.42	0.38	0.38

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

4. U-value of Fenestration (Glass)

Note: U-value is insulating performance (Conduction).

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

4. U-value of Glass

No	Glass	Thk (mm)		VLT	U-Value	SC-Value	OTTV (W/m ²)
Base	Light Clear Tempered Float with Heat Soaked	10.00		87.00%	5.70	0.90	102.84
a	Light Green Tempered Float with Heat Soaked	10.00		70.00%	5.10	0.59	72.80
b	Light Green Annealed Float + Clear PVB + Clear Annealed Float	10.38	5.00 + 0.38 + 5.00	78.00%	5.10	0.69	81.79
c	Light Green Annealed Float + Clear PVB + Clear Annealed Hard Coated Low-E#4	10.38	5.00 + 0.38 + 5.00	71.00%	2.90	0.57	63.08
d	No Information						
e	Light Green Heat Strengthened Float + Clear PVB + Clear Heat Strengthened Hard Coated Low-E#4	13.52	6.00 + 1.52 + 6.00	68.00%	2.80	0.52	58.22
f	(Clear Heat Strengthened Float + Clear PVB + SV 40T Clear Heat Strengthened Soft Coated Low-E#4) + A12 + Clear Heat Strengthened Float	31.52	6.00 + 1.52 + 6.00 + 12.00 (air) + 6.00	39.00%	1.50	0.24	28.36
g	(Clear Heat Strengthened Float + Clear PVB + SV 52T Clear Heat Strengthened Soft Coated Low-E#4) + A12 + Clear Heat Strengthened Float	31.52	6.00 + 1.52 + 6.00 + 12.00 (air) + 6.00	48.00%	1.50	0.30	33.75
h	Solar Control Silver Grey Tempered with Heat Soaked Soft Coated Reflective V1#2	6.00		19.00%	4.30	0.35	48.33
i	Solar Control Silver Green Tempered with Heat Soaked Soft Coated Reflective V2#2	6.00		13.00%	4.00	0.27	40.05
j	Solar Control Silver Grey Annealed Soft Coated V1#2 + Clear PVB + Clear Heat Annealed Hard Coated Low-E#4	10.38	5.00 + 0.38 + 5.00	20.00%	2.80	0.28	36.63

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

4. U-value of Fenestration (Glass)

Glass U-Value or SC-Value more important?

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

5. U-value of Wall

Note: U-value is insulating performance (Conduction).

4. U-value of Fenestration (Glass)

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

5. U-value of Wall

LIGHTWEIGHT BLOCK WALL			
Component (outside to inside)	Thickness	Conductivity	Resistance
	mm	w/(m.K)	T/C
Outside Surface Resistance			0.040
Cement sand plaster	12	0.533	0.023
Lightweight Blocks 64 kg/m ³	150	0.144	1.042
Cement sand plaster	12	0.533	0.023
Inside Surface Resistance			0.130
Total Thermal resistance			1.257
U-value (W/m²K)			0.796

BRICK WALL			
Component (outside to inside)	Thickness	Conductivity	Resistance
	mm	w/(m.K)	T/C
Outside Surface Resistance			0.040
Cement sand plaster	12	0.533	0.023
Brickwall (dry)	115	0.807	0.143
Cement sand plaster	12	0.533	0.023
Inside Surface Resistance			0.130
Total Thermal resistance			0.358
U-value (W/m²K)			2.797

CONCRETE BEAM / WALL			
Component (outside to inside)	Thickness	Conductivity	Resistance
	mm	w/(m.K)	T/C
Outside Surface Resistance			0.040
Cement sand plaster	12	0.533	0.023
Reinforced Concrete	250	1.442	0.173
Cement sand plaster	12	0.533	0.023
Inside Surface Resistance			0.130
Total Thermal resistance			0.388
U-value (W/m²K)			2.575

ALUMINIUM COMPOSITE PANELS & BRICK WALL			
Component (outside to inside)	Thickness	Conductivity	Resistance
	mm	w/(m.K)	T/C
Outside Surface Resistance			0.040
Aluminium Composite	4	211	0.000
Air gap			0.160
Brickwall (dry)	115	0.807	0.143
Cement sand plaster	12	0.533	0.023
Inside Surface Resistance			0.130
Total Thermal resistance			0.495
U-value (W/m²K)			2.020

ALUMINIUM COMPOSITE PANEL WITH INSIDE INSULATION			
Component (outside to inside)	Thickness	Conductivity	Resistance
	mm	w/(m.K)	T/C
Outside Surface Resistance			0.040
Aluminium Composite	4	211	0.000
Air gap			0.160
Fiberglass	75	0.035	2.143
Gypsum Board	12	0.17	0.071
Inside Surface Resistance			0.130
Total Thermal resistance			2.543
U-value (W/m²K)			0.393

What is the U-value to Cavity Brick Wall?

OTTV

$$\text{OTTV} = 15\alpha(1-\text{WWR})U_w + 6(\text{WWR})U_f + 194(\text{OF}\times\text{WWR}\times\text{SC})$$

6. Solar Absorptivity
of Wall (Color)

5. U-value of Wall

4. U-value of Fenestration (Glass)

1. Orientation Factor

2. Window-to-Wall Ratio

3. Shading Coefficient

6. Wall Color

a : 95%	a : 78%	a : 72%	a : 64%	a : 58%
QC 8262 Black	QC 8641 Sable	QC 8308 Charcoal	QC 8730 Regent Grey	QC 8305 Stone Grey
a : 76%	a : 75%	a : 74%	a : 74%	a : 71%
QC 8229 Dark Brown	QC 8326 Black Coffee	QC 8228 Metro Brown	QC 8643 Cordovan	QC 8719 Mahogany Brown
a : 71%	a : 67%	a : 66%		
QC 8014 Cannerys Brown	QC 8315 Tan	QC 8055 Buckskin		
a : 90%	a : 89%	a : 76%	a : 73%	a : 56%
QC 8330 Heron Blue	QC 8107 Navy Blue	QC 8790 Royal Blue	QC 8280 Slate Blue	QC 8261 Sapphire Blue
a : 91%	a : 78%	a : 74%	a : 73%	a : 72%
QC 8307 Melcher's Green	QC 8684 Deep Water Green	QC 8329 Green	QC 8258 Pacific Turquoise	QC 8310 Turquoise
a : 76%	a : 69%	a : 67%	a : 54%	a : 65%
QC 8250 Dark Red	QC 8259 Tile Red	QC 8388 Bright red	QC 8234 International Orange	QC 8256 Mist Green
a : 55%	a : 47%	a : 45%	a : 44%	a : 42%
QC 8276 Gold	QC 8076 Putnam Ivory	QC 8021 Beige	QC 8696 Antique Linen	QC 8802 Ivory
a : 48%	a : 42%			
QC 8119 Biscuit	QC 8784 Bamboo Ivory			
a : 52%	a : 45%	a : 41%	a : 38%	a : 34%
QC 8273 Bone white	QC 8317 White white	QC 8464 USDA White	QC 8695 Cambridge white	QC 8783 Bright white

6. Wall Color

OTTV = 44.65 W/m² (CVA)

10 Stonor

OTTV 44.65 w/m²K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.4

OTTV CALCULATION _STONOR

Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3061.93
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.40	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	61.83	3400.82
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.40	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	74.05	2036.50
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.40	1.00	2.66	6.00	0.00								15.96	3573.52
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.40	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.40	1.00	2.66	6.00	0.00								15.96	985.85
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.40	0.20	2.66	6.00	0.80	3.76	194.00	0.92	0.41	1.00	1.00	0.41	80.10	4657.80
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.40	0.21	2.66	6.00	0.79	3.76	194.00	0.92	0.41	0.78	1.00	0.32	66.14	2371.46
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.40	0.50	2.66	6.00	0.50	3.85	194.00	0.92	0.41	1.00	1.00	0.41	56.30	2537.06
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	3.76	194.00	0.92	0.41	1.00	1.00	0.41	73.60	9524.75
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	3.76	194.00	0.92	0.41	0.79	1.00	0.33	61.84	4934.05

6. Wall Color

OTTV = 52.78 W/m² (Dark Grey Facade)

10 Stonor

OTTV 52.78 w/m2K

Total Façade Area (m2)	34001.73
Total Window Area (m2)	10883.02
WWR	0.32

	Materials	Uv _{glazing}	Sc _{glazing}
	Glazing Specification		
Glass-01	6 + 1.14 + 6 dark blue	4.90	0.59
Glass-02	6 + 0.38 + 6 dark blue	5.36	0.52
Glass-03	breezeway 6 tempered	6.20	0.74
Glass-04	6 + 0.38 + 6 arctic blue low-e	3.76	0.41
Glass-05	6 arctic blue tempered low-e	3.85	0.41
Glass-06	6 dark blue tempered	5.20	0.66

Wall Specification		
Materials	Uv _{Wall}	(α)
110mm Thk. Brick Wall with 20mm thick plaster on both side	2.66	
Colour of Walls - Light Grey		0.7

OTTV CALCULATION _STONOR

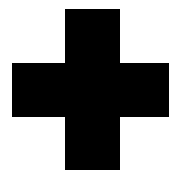
Location	Façade (m2)	Window (m2)	Wall (m2)	Constant _{wall}	α	(1-WWR)	Uv _{wall}	Constant _{window}	WWR	Uv _{glazing}	Constant _{shading}	CF	Sc _{glazing}	Sc _{device}	Sc _{screen}	SC	OTTV	OTTV x AREA
Orientation : South																		
Level : Ground Floor																		
SOUTH_Ground Floor	191.85	0.00	191.85	15.00	0.70	1.00	2.66	6.00	0.00								27.93	5358.37
SOUTH_Ground Floor (6 + 1.14 + 6 dark blue) (sc = 0.722)	55.00	28.20	26.80	15.00	0.70	0.49	2.66	6.00	0.51	4.90	194.00	0.92	0.59	0.72	1.00	0.43	67.67	3721.62
SOUTH_Ground Floor (6 + 0.38 + 6 dark blue) (sc = 0.722)	27.50	19.20	8.30	15.00	0.70	0.30	2.66	6.00	0.70	5.36	194.00	0.92	0.52	0.72	1.00	0.38	77.67	2135.85
Level : 8th Floor																		
SOUTH_8th Floor	223.91	0.00	223.91	15.00	0.70	1.00	2.66	6.00	0.00								27.93	6253.67
SOUTH_8th Floor (6 + 1.14 + 6 dark blue) (sc = 0.664)	38.48	38.48	0.00	15.00	0.70	0.00	2.66	6.00	1.00	4.90	194.00	0.92	0.59	0.66	1.00	0.39	99.32	3821.88
Level : 9th Floor																		
SOUTH_9th Floor	61.77	0.00	61.77	15.00	0.70	1.00	2.66	6.00	0.00								27.93	1725.24
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e)	58.15	46.75	11.40	15.00	0.70	0.20	2.66	6.00	0.80	3.76	194.00	0.92	0.41	1.00	1.00	0.41	82.45	4794.23
SOUTH_9th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.778)	35.86	28.32	7.54	15.00	0.70	0.21	2.66	6.00	0.79	3.76	194.00	0.92	0.41	0.78	1.00	0.32	68.66	2461.65
SOUTH_9th Floor (6 arctic blue tempered low-e)	45.07	22.63	22.43	15.00	0.70	0.50	2.66	6.00	0.50	3.85	194.00	0.92	0.41	1.00	1.00	0.41	62.26	2805.59
Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.70	1.00	2.66	6.00	0.00								27.93	3839.26
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.70	0.28	2.66	6.00	0.72	3.76	194.00	0.92	0.41	1.00	1.00	0.41	76.93	9954.49
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.70	0.29	2.66	6.00	0.71	3.76	194.00	0.92	0.41	0.79	1.00	0.33	65.31	5211.15

OTTV

$$OTTV = 15\alpha(1-WWR)U_w + 6(WWR)U_f + 194(OF \times WWR \times SC)$$

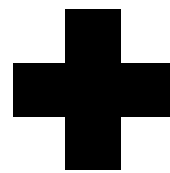
**Heat
Conduction
through
Walls**

8% to 10%



**Heat
Conduction
through
Windows**

32% to 40%



**Solar Heat
Gain
through
Windows**

50% to 60%

Level : 10th & 16th Floor																		
SOUTH_10th & 16th Floor	137.46	0.00	137.46	15.00	0.40	1.00	2.66	6.00	0.00								15.96	2193.86
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e)	129.41	93.50	35.90	15.00	0.40	0.28	2.66	6.00	0.72	3.76	194.00	0.92	0.41	1.00	1.00	0.41	73.60	9524.75
SOUTH_10th & 16th Floor (6 + 0.38 + 6 arctic blue low-e) (sc = 0.793)	79.79	56.64	23.15	15.00	0.40	0.29	2.66	6.00	0.71	3.76	194.00	0.92	0.41	0.79	1.00	0.33	61.84	4934.05

Summary

No	Options	OTTV	Percentage	GBI Points
1	Base	51.30 W/m ²	100.00%	0
1	Low-E	44.65 W/m ²	87.04%	2
2	Non Low-E + WWR 15%R	44.56 W/m ²	86.86%	2
4	Non Low-E + HD1000	47.98 W/m ²	93.53%	1
5	Non Low-E + HD1000 + VD600	44.37 W/m ²	86.49%	2
6	Non Low-E + Sunscreen 70% Void	44.93 W/m ²	87.58%	2
7	Low-E + Dark Grey Façade	52.78 W/m ²	102.88%	0



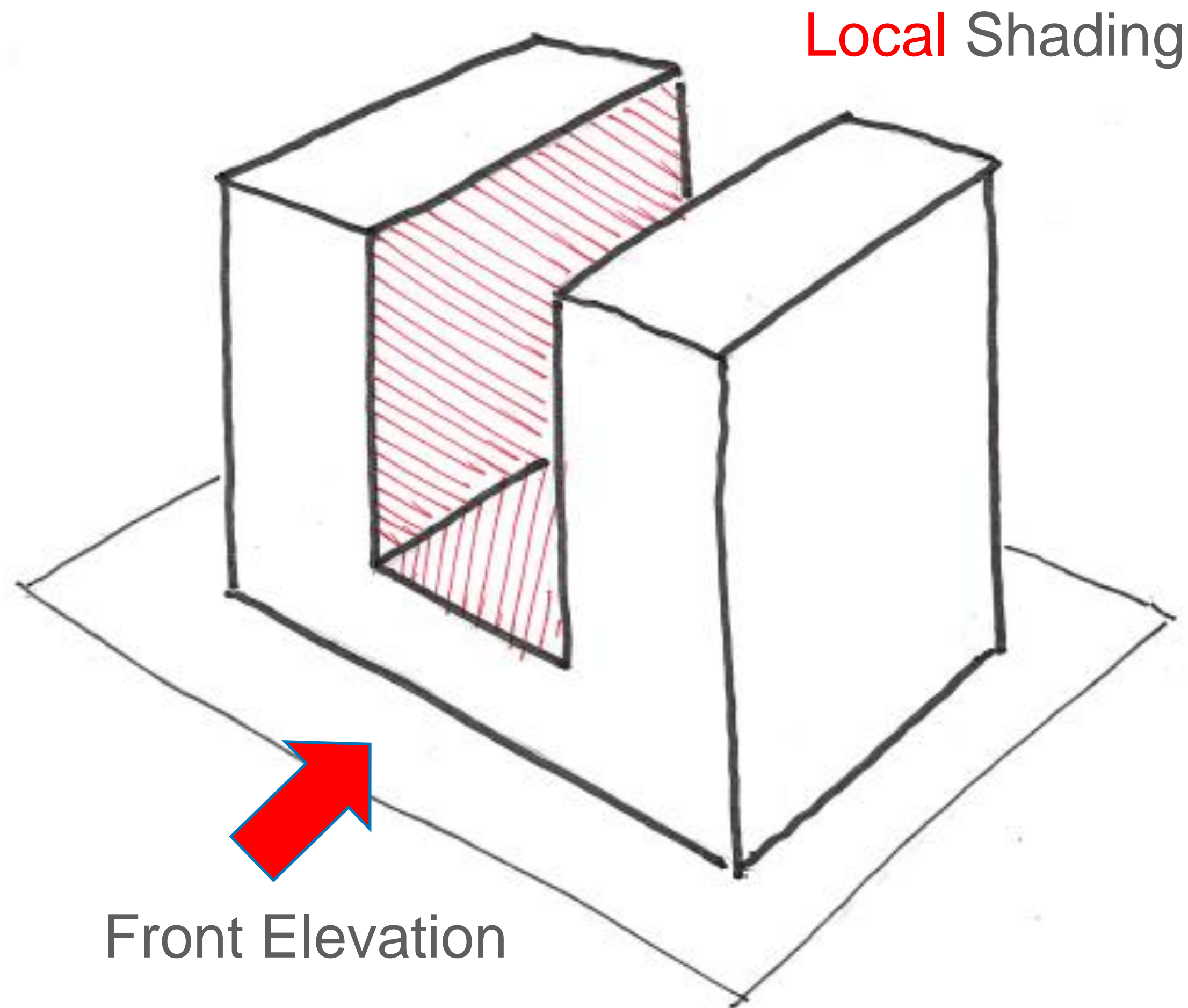
Advance OTTV



Case Studies

Advance OTTV

1. Self Shade

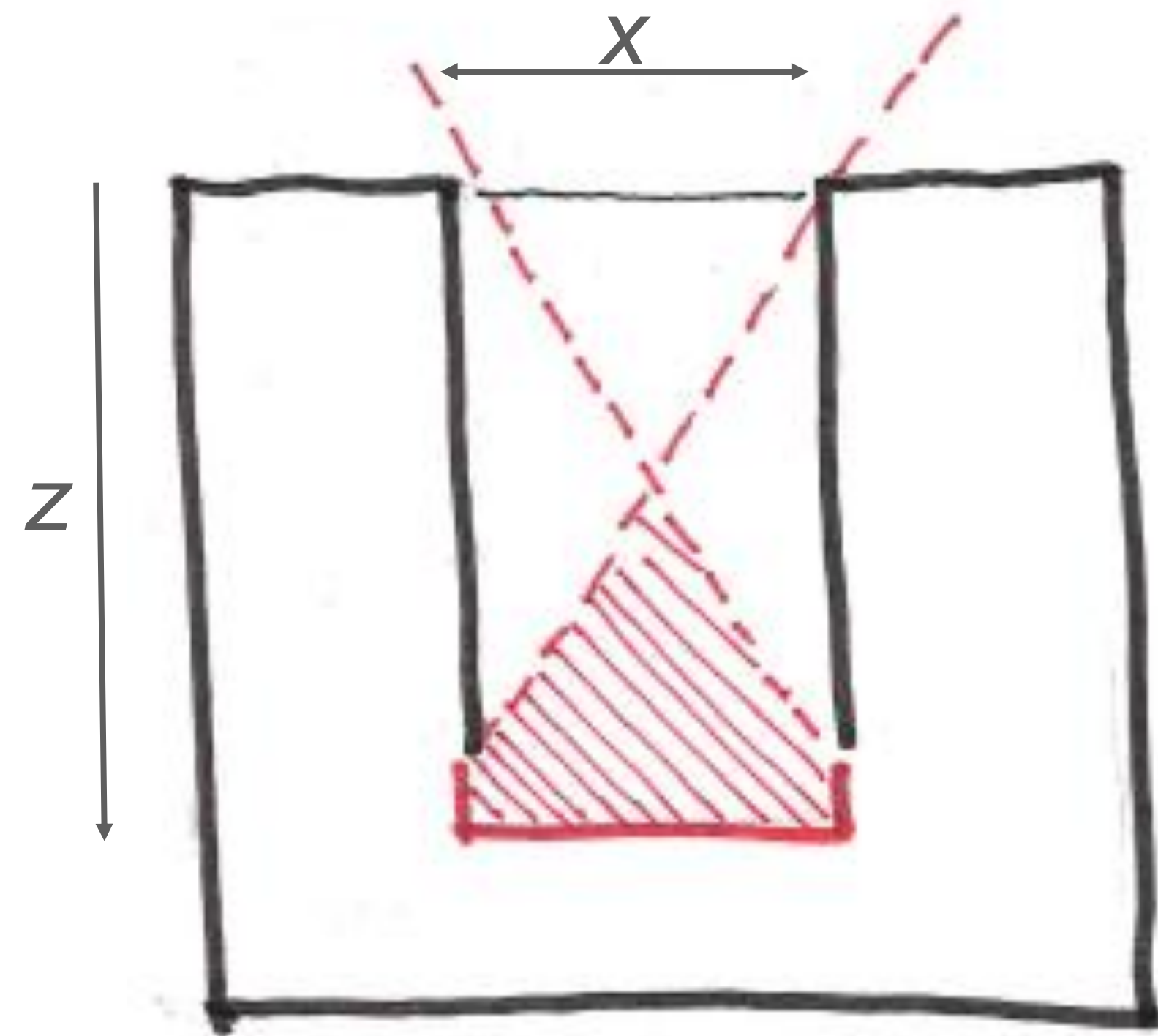


Use of **Local** Shading, within the same development

Introduce **Rv (Vertical)** and **Rh (Horizontal)** to calculation complex external façade and internal courtyard

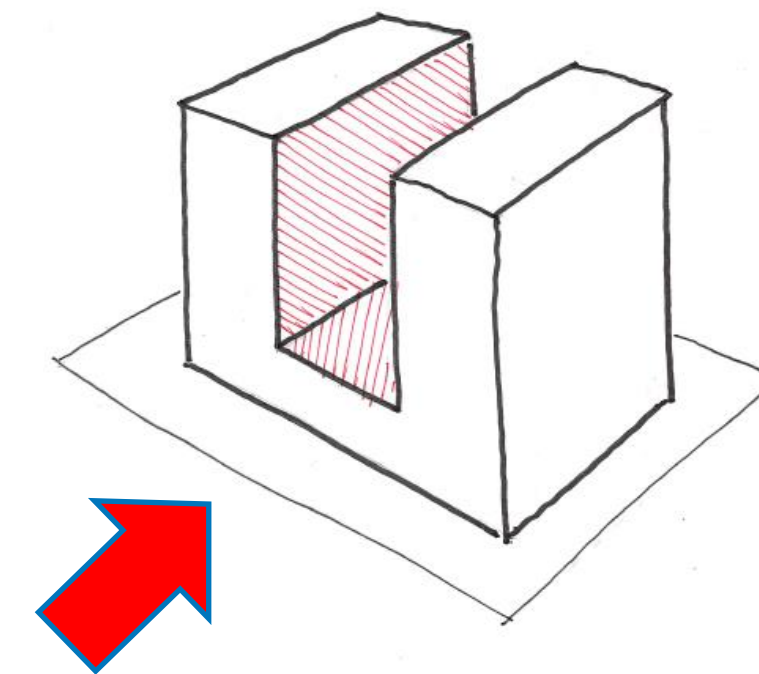
Advance OTTV

1. Self Shade



$$R_v = \frac{z}{x}$$

Front Elevation



x = opening width U-shaped building

z = distance from the unshaded surface due to vertical depth

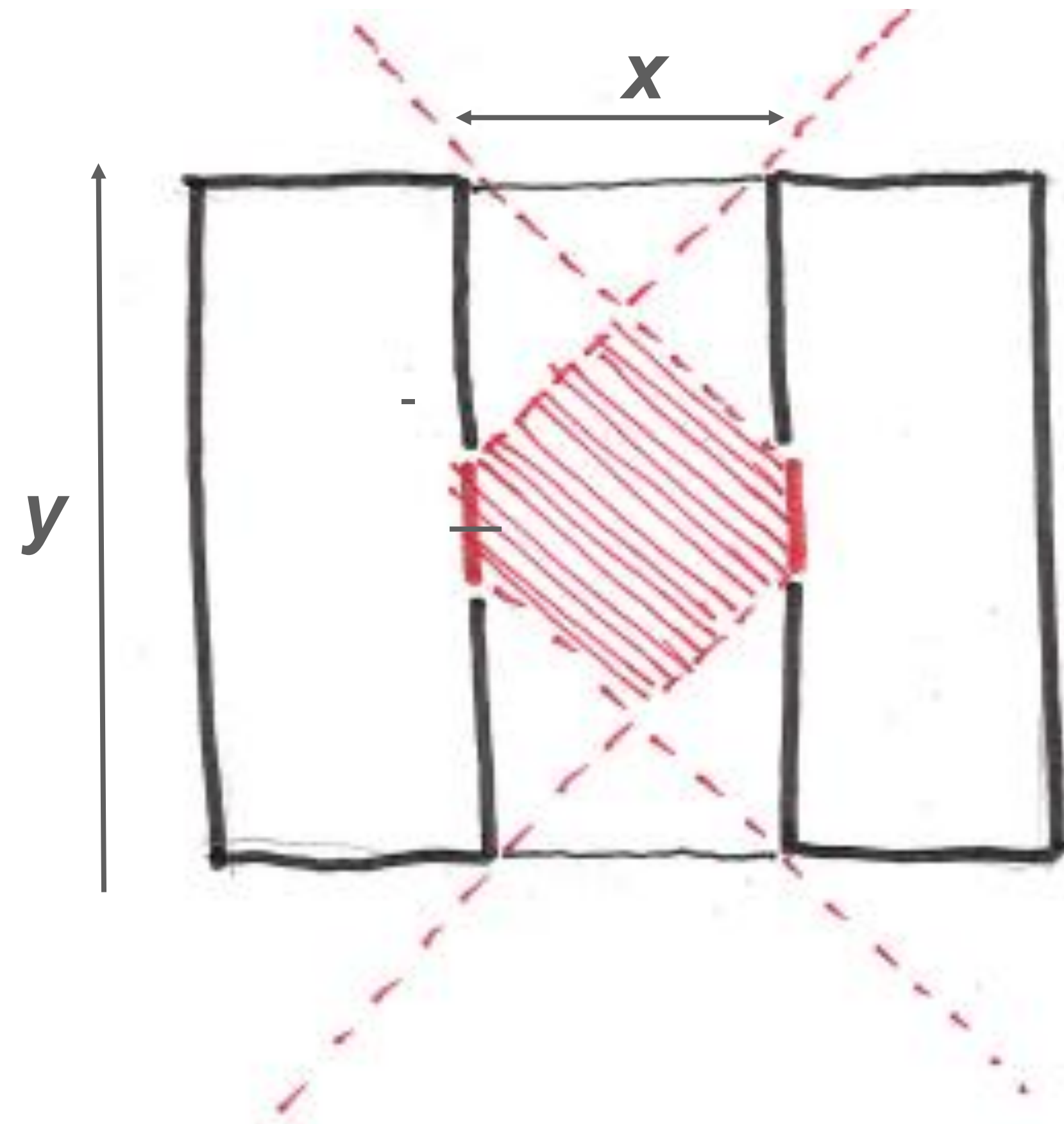
Vertical Shading of U-shaped Building,

$R_v \geq 3$, Local shading peaked; shading coefficient, SC2 range from 0.35 to 0.5 depending on orientation and facing. To assume all the affected internal façades as wall in the OTTV calculation.

$R_v < 3$, No local shading; shading coefficient, SC2 = 1. To include all the internal façades (both glaze and wall) in the OTTV calculation.

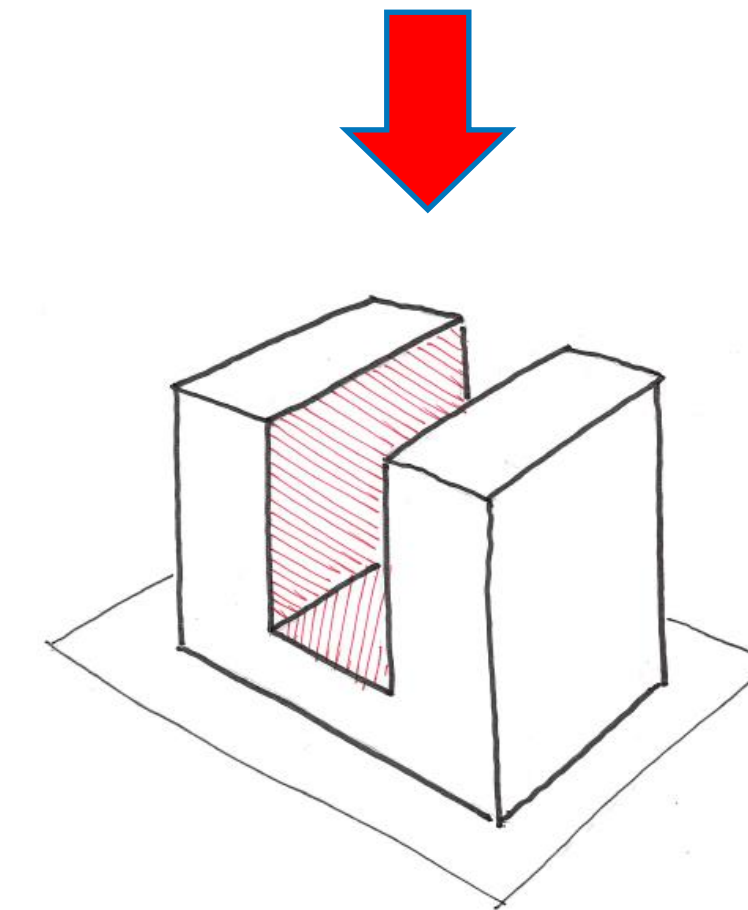
Advance OTTV

1. Self Shade



$$Rh = \frac{y}{x}$$

Plan



x = opening width of U-shaped building

y = distance from the unshaded surface due to horizontal depth

Horizontal Shading of U-shape Building,

$R_h \geq 1$, Local shading peaked; shading coefficient, SC2 range from 0.35 to 0.5 depending on orientation and facing. To assume all the affected internal façades as wall in the OTTV calculation.

$R_h < 1$, No local shading; shading coefficient, SC2 = 1. To include all the internal façades (both glaze and wall) in the OTTV calculation.

Advance OTTV

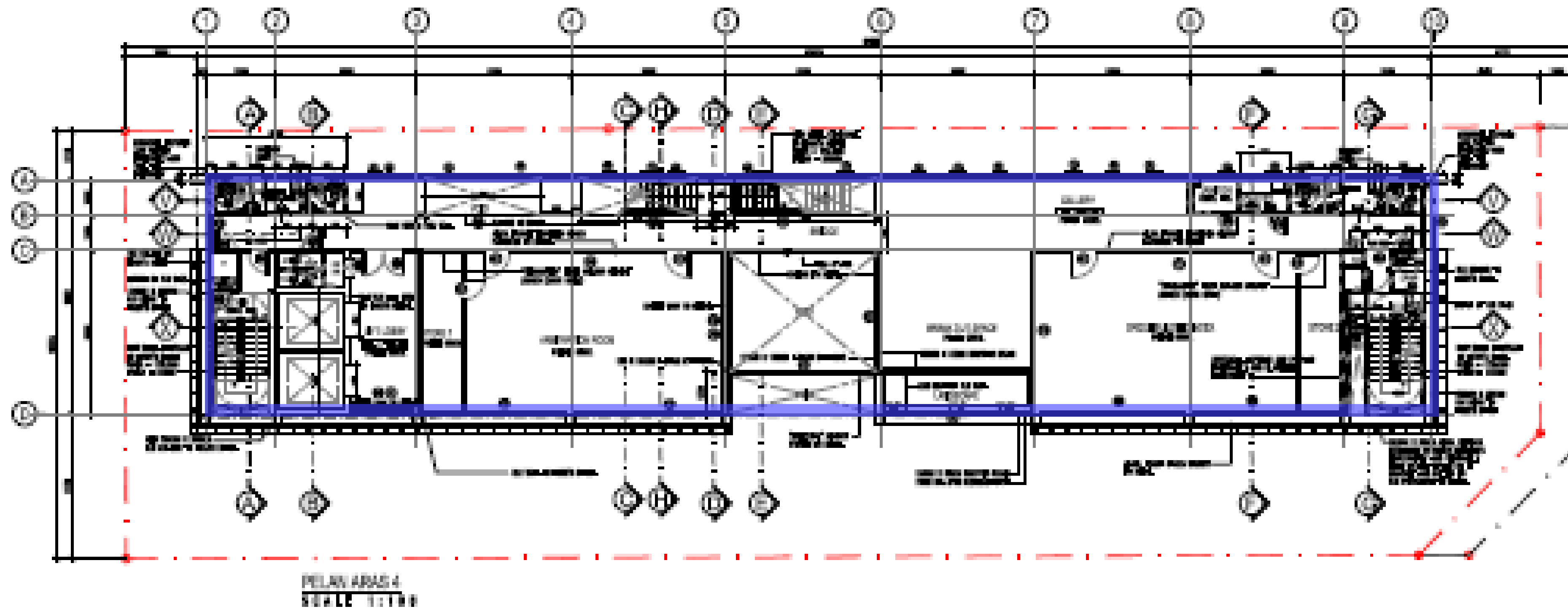
1. Self Shade



PAM Center @ KL

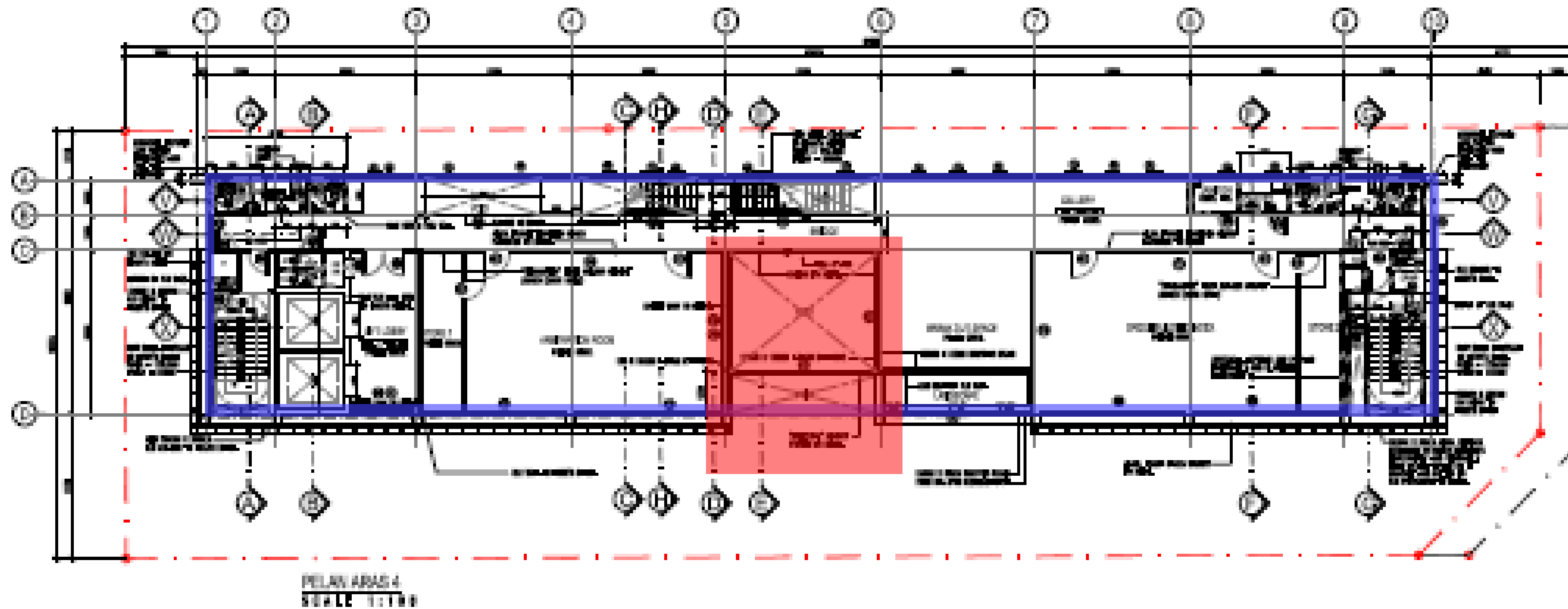
Advance OTTV

1. Self Shade



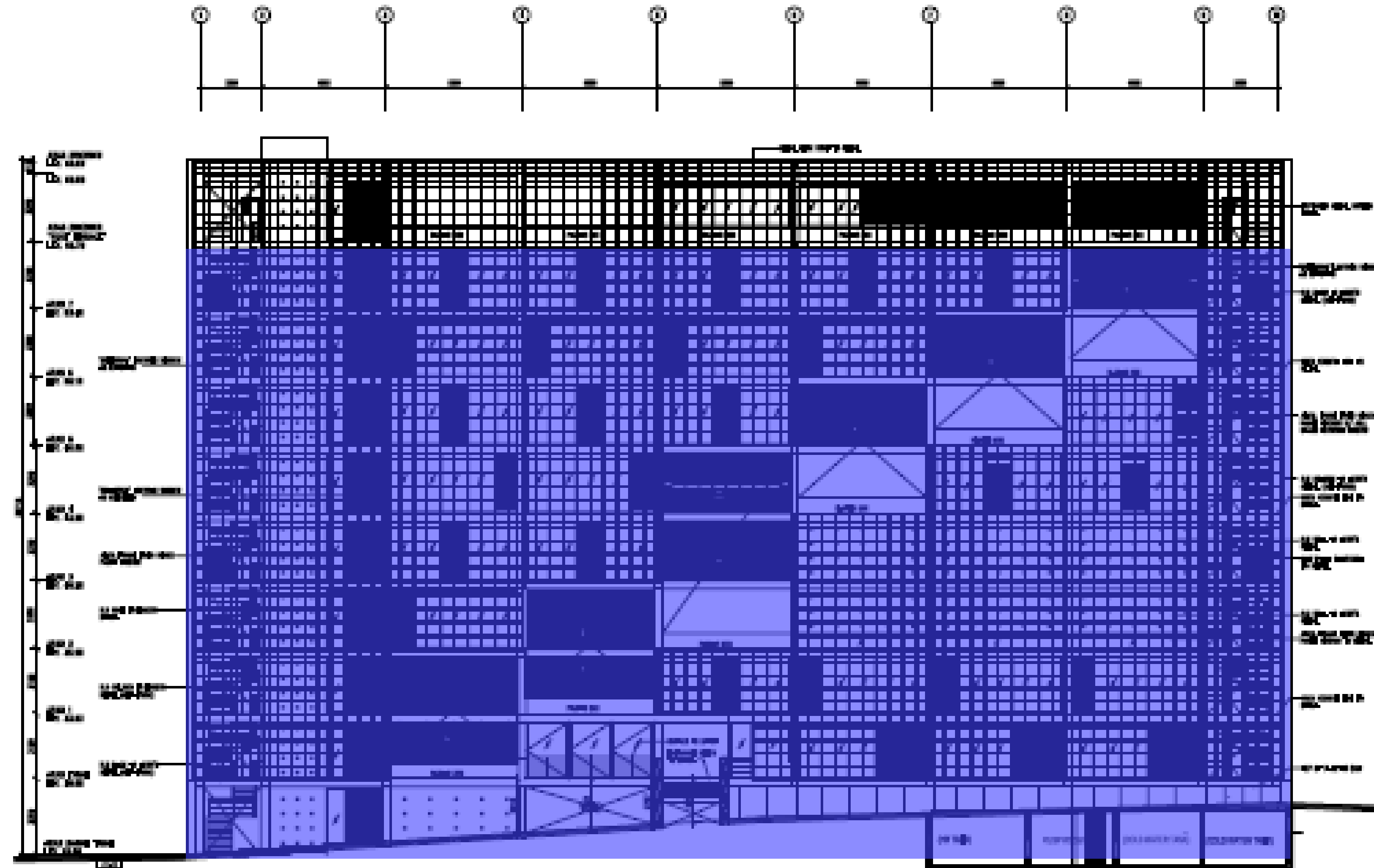
Advance OTTV

1. Self Shade



Advance OTTV

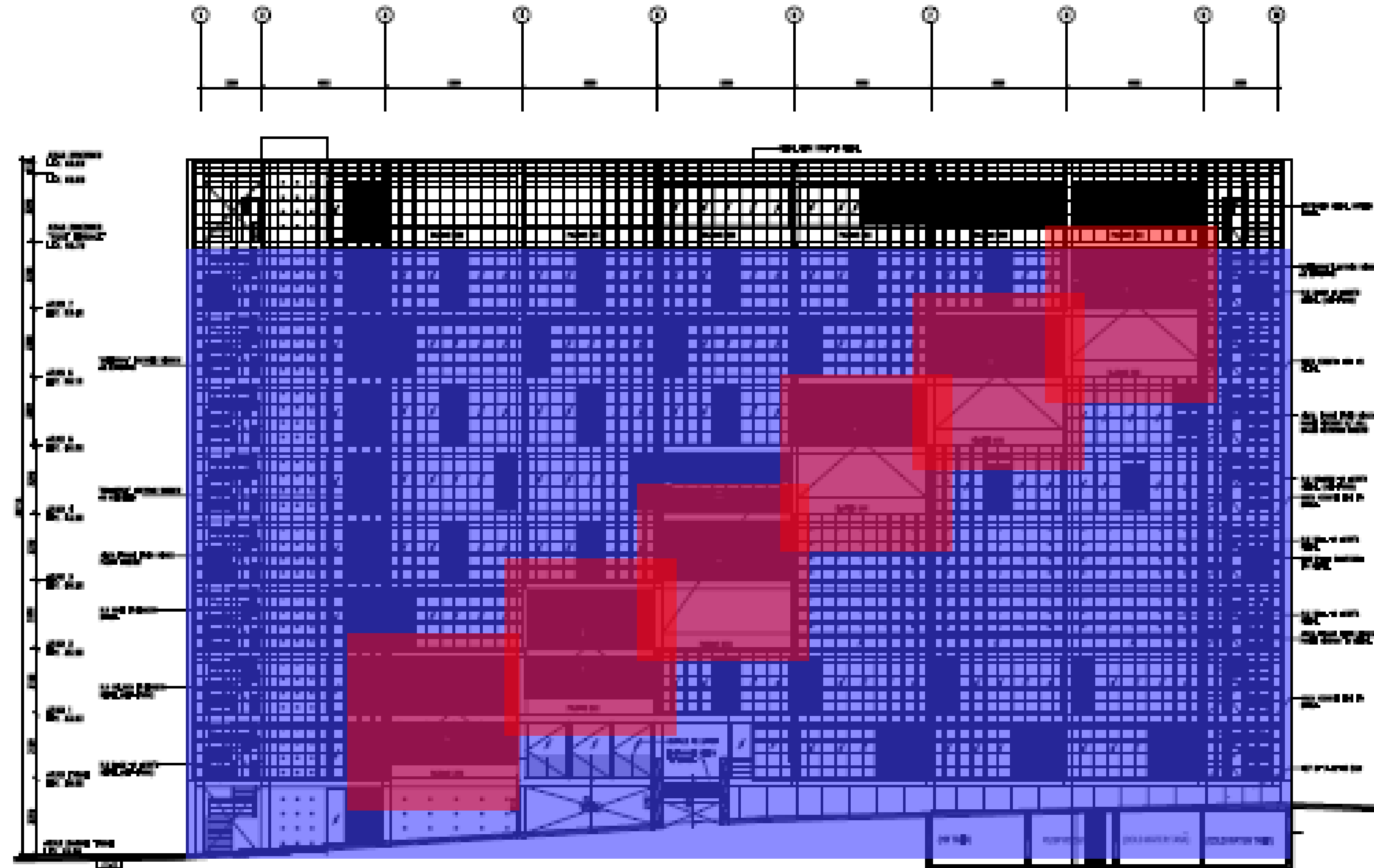
1. Self Shade



FRONT ELEVATION WITH SCREEN
Scale: 1/4"

Advance OTTV

1. Self Shade



FRONT ELEVATION WITH SCREEN
Sheet 7/10

Advance OTTV

1. Self Shade

PAM Centre OTTV CALCULATION
Design Case

OTTV (w/m²K) =

45.02

OTTV FORMULA =

$15\alpha(1-WWR)U_{vwall} + 6(WWR)U_{vgazing} + 194(WWR)(SC)(CF)$

OTTV CALCULATION_IPOH KECHIL RESIDENCES RNC DA																		
Location	Area(m ²)	Window	Wall	Heat Conduction Through Wall				Heat Conduction Through Windows			Solar Heat Gain Through Windows					OTTV	OTTV x AREA	
				Constant _{wall}	α	(1-WWR)	U _{vwall}	Constant _{window}	WWR	U _{vgazing}	Constant _{shading}	CF	WWR	SC _{gazing}	SC _{shading}			SC
NORTH WEST_LG (double 3mm ASG float)	186.54	70.77	115.77	15.00	0.40	0.62	3.04	6.00	0.38	4.00	194.00	0.90	0.38	0.62	1.00	0.62	61.50	11471.81
NORTH WEST_GF (double 3mm ASG float)	37.90	25.28	12.62	15.00	0.40	0.33	3.04	6.00	0.67	4.00	194.00	0.90	0.67	0.62	1.00	0.62	94.29	3573.52
NORTH WEST_GF (double 3mm ASG float w/ shading)	37.90	33.48	4.42	15.00	0.40	0.12	3.04	6.00	0.88	4.00	194.00	0.90	0.88	0.62	0.38	0.24	59.67	2261.39
NORTH WEST_GF (tempered 6mm float)	37.90	17.14	20.76	15.00	0.40	0.55	3.04	6.00	0.45	5.70	194.00	0.90	0.45	0.96	1.00	0.96	101.26	3837.79
NORTH WEST_GF (tempered 6mm float w/shading)	37.90	25.42	12.48	15.00	0.40	0.33	3.04	6.00	0.67	5.70	194.00	0.90	0.67	0.96	0.38	0.36	71.66	2716.10
NORTH WEST_1F (tempered 6mm float)	45.17	34.28	10.89	15.00	0.40	0.24	3.04	6.00	0.76	5.70	194.00	0.90	0.76	0.96	1.00	0.96	157.56	7116.89
NORTH WEST_1F (tempered 6mm float w/shading)	45.17	20.01	25.16	15.00	0.40	0.56	3.04	6.00	0.44	5.70	194.00	0.90	0.44	0.96	0.38	0.36	53.53	2417.93
NORTH WEST_1F (double 3mm ASG float w/ shading)	60.00	36.03	3.97	15.00	0.40	0.07	3.04	6.00	0.93	4.00	194.00	0.90	0.93	0.62	0.38	0.24	62.03	3721.97
NORTH WEST_2F (tempered 6mm float)	55.78	18.07	37.71	15.00	0.40	0.68	3.04	6.00	0.32	5.70	194.00	0.90	0.32	0.96	1.00	0.96	77.71	4334.65
NORTH WEST_2F (tempered 6mm float w/shading)	55.78	8.61	47.17	15.00	0.40	0.85	3.04	6.00	0.15	5.70	194.00	0.90	0.15	0.96	0.38	0.36	30.54	1703.53
NORTH WEST_2F (double 3mm ASG float w/ shading)	55.78	21.83	33.95	15.00	0.40	0.61	3.04	6.00	0.39	4.00	194.00	0.90	0.39	0.62	0.38	0.24	36.59	2041.16
NORTH WEST_3F (tempered 6mm float)	55.16	18.07	37.09	15.00	0.40	0.67	3.04	6.00	0.33	5.70	194.00	0.90	0.33	0.96	1.00	0.96	78.38	4323.34
NORTH WEST_3F (tempered 6mm float w/shading)	55.16	13.18	41.98	15.00	0.40	0.76	3.04	6.00	0.24	5.70	194.00	0.90	0.24	0.96	0.38	0.36	37.28	2056.21
NORTH WEST_3F (double 3mm ASG float w/ shading)	55.16	30.82	24.34	15.00	0.40	0.44	3.04	6.00	0.56	4.00	194.00	0.90	0.56	0.62	0.38	0.24	44.44	2451.43
NORTH WEST_4F (tempered 6mm float)	45.33	18.07	27.26	15.00	0.40	0.60	3.04	6.00	0.40	5.70	194.00	0.90	0.40	0.96	1.00	0.96	91.42	4144.04
NORTH WEST_4F (tempered 6mm float w/shading)	45.33	19.53	25.80	15.00	0.40	0.57	3.04	6.00	0.43	5.70	194.00	0.90	0.43	0.96	0.38	0.36	52.56	2382.62
NORTH WEST_4F (double 3mm ASG float w/ shading)	70.00	60.61	9.39	15.00	0.40	0.13	3.04	6.00	0.87	4.00	194.00	0.90	0.87	0.62	0.38	0.24	58.85	4119.15
NORTH WEST_5F (tempered 6mm float)	45.33	18.07	27.26	15.00	0.40	0.60	3.04	6.00	0.40	5.70	194.00	0.90	0.40	0.96	1.00	0.96	91.42	4144.04
NORTH WEST_5F (tempered 6mm float w/shading)	45.33	20.72	24.61	15.00	0.40	0.54	3.04	6.00	0.46	5.70	194.00	0.90	0.46	0.96	0.38	0.36	54.65	2477.40
NORTH WEST_5F (double 3mm ASG float w/ shading)	70.00	59.42	10.58	15.00	0.40	0.15	3.04	6.00	0.83	4.00	194.00	0.90	0.83	0.62	0.38	0.24	58.05	4063.35
NORTH WEST_6F (tempered 6mm float)	45.33	18.07	27.26	15.00	0.40	0.60	3.04	6.00	0.40	5.70	194.00	0.90	0.40	0.96	1.00	0.96	91.42	4144.04
NORTH WEST_6F (tempered 6mm float w/shading)	45.33	20.72	24.61	15.00	0.40	0.54	3.04	6.00	0.46	5.70	194.00	0.90	0.46	0.96	0.38	0.36	54.65	2477.40
NORTH WEST_6F (double 3mm ASG float w/ shading)	70.00	59.42	10.58	15.00	0.40	0.15	3.04	6.00	0.83	4.00	194.00	0.90	0.83	0.62	0.38	0.24	58.05	4063.35
NORTH WEST_7F (tempered 6mm float)	39.12	18.07	21.05	15.00	0.40	0.54	3.04	6.00	0.46	5.70	194.00	0.90	0.46	0.96	1.00	0.96	103.04	4030.77
NORTH WEST_7F (tempered 6mm float w/shading)	39.12	25.06	14.06	15.00	0.40	0.36	3.04	6.00	0.64	5.70	194.00	0.90	0.64	0.96	0.38	0.36	69.27	2709.76
NORTH WEST_7F (double 3mm ASG float w/ shading)	80.00	73.16	6.84	15.00	0.40	0.09	3.04	6.00	0.91	4.00	194.00	0.90	0.91	0.62	0.38	0.24	61.13	4890.09
Total Area	1461.52	803.91	0.55														66.83	97673.73
NORTH EAST_LG (RC)	28.90	0.00	28.90	15.00	0.40	1.00	3.04	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	18.24	527.14
NORTH EAST_LG (brick)	10.54	0.00	10.54	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	129.39
NORTH EAST_GF (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	1.09	0.14	0.96	1.00	0.96	48.78	1430.72
NORTH EAST_GF (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	52.17
NORTH EAST_1F (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	1.09	0.14	0.96	1.00	0.96	48.78	1430.72
NORTH EAST_1F (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	52.17
NORTH EAST_2F to 7F (RC)	180.83	26.19	154.64	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	1.09	0.14	0.96	1.00	0.96	48.95	9032.94
NORTH EAST_2F to 7F (brick)	26.73	0.00	26.73	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	328.14
Total Area	312.98	34.47	0.11														41.48	12983.39
SOUTH WEST_LG (RC)	28.90	0.00	28.90	15.00	0.40	1.00	3.04	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	18.24	527.14
SOUTH WEST_LG (brick)	10.54	0.00	10.54	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	129.39
SOUTH WEST_GF (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	0.90	0.14	0.96	1.00	0.96	44.68	1284.22
SOUTH WEST_GF (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	52.17
SOUTH WEST_1F (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	0.90	0.14	0.96	1.00	0.96	44.68	1284.22
SOUTH WEST_1F (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	52.17
SOUTH WEST_2F to 7F (RC)	180.83	26.19	154.64	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	0.90	0.14	0.96	1.00	0.96	44.83	8106.19
SOUTH WEST_2F to 7F (brick)	26.73	0.00	26.73	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	328.14
Total Area	312.98	34.47	0.11														37.59	11763.63
SOUTH EAST	1569.49	64.80	1504.69	15.00	0.40	0.96	3.04	6.00	0.04	5.50	194.00	1.13	0.04	0.89	1.00	0.89	26.90	42226.80
Total Area	1569.49	64.80	0.04														26.90	42226.80

OTTV for Ipoh Kechil Residences

3656.97 937.63

0.26

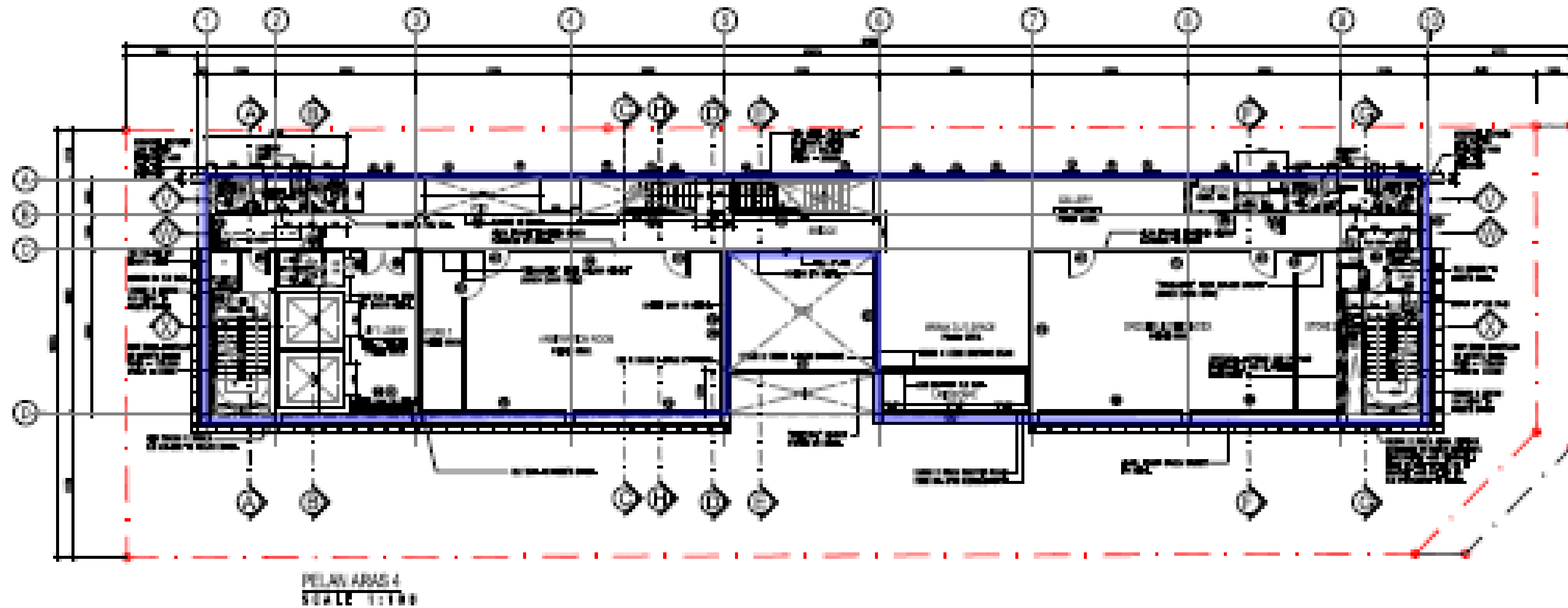
164647.57

45.02

OTTV = 45.02 w/m²

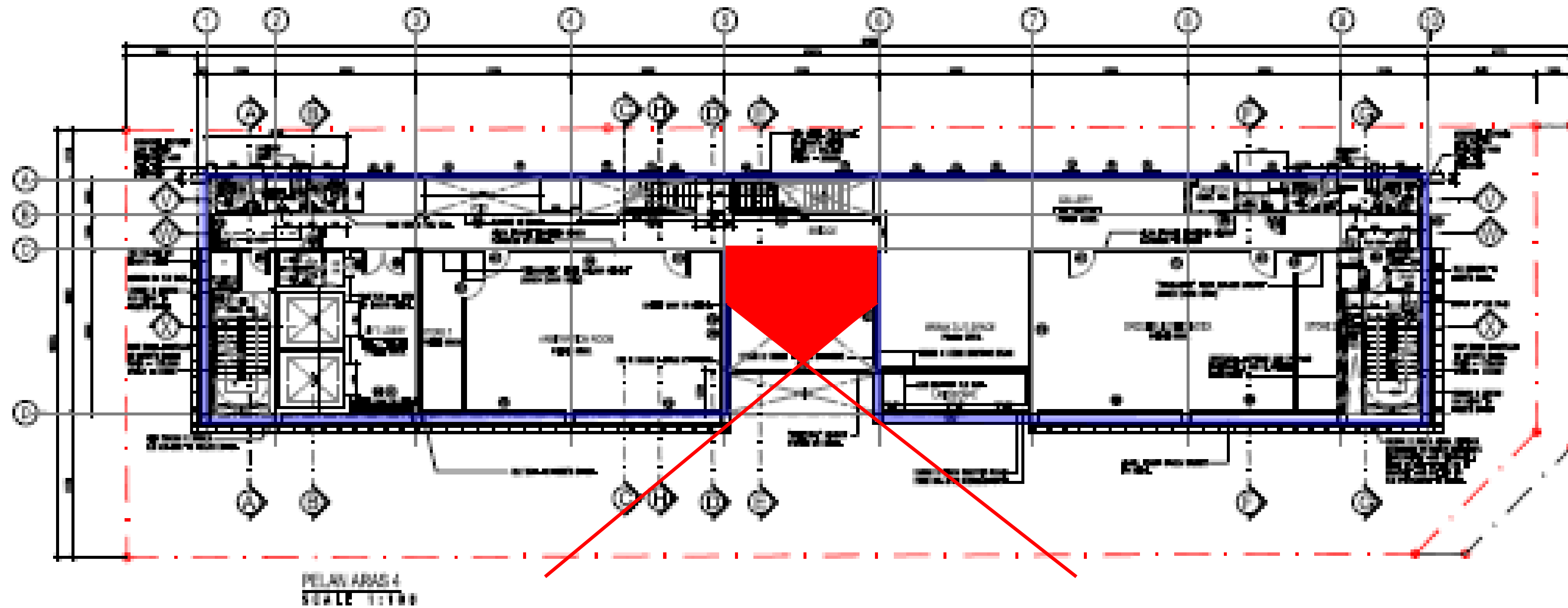
Advance OTTV

1. Self Shade



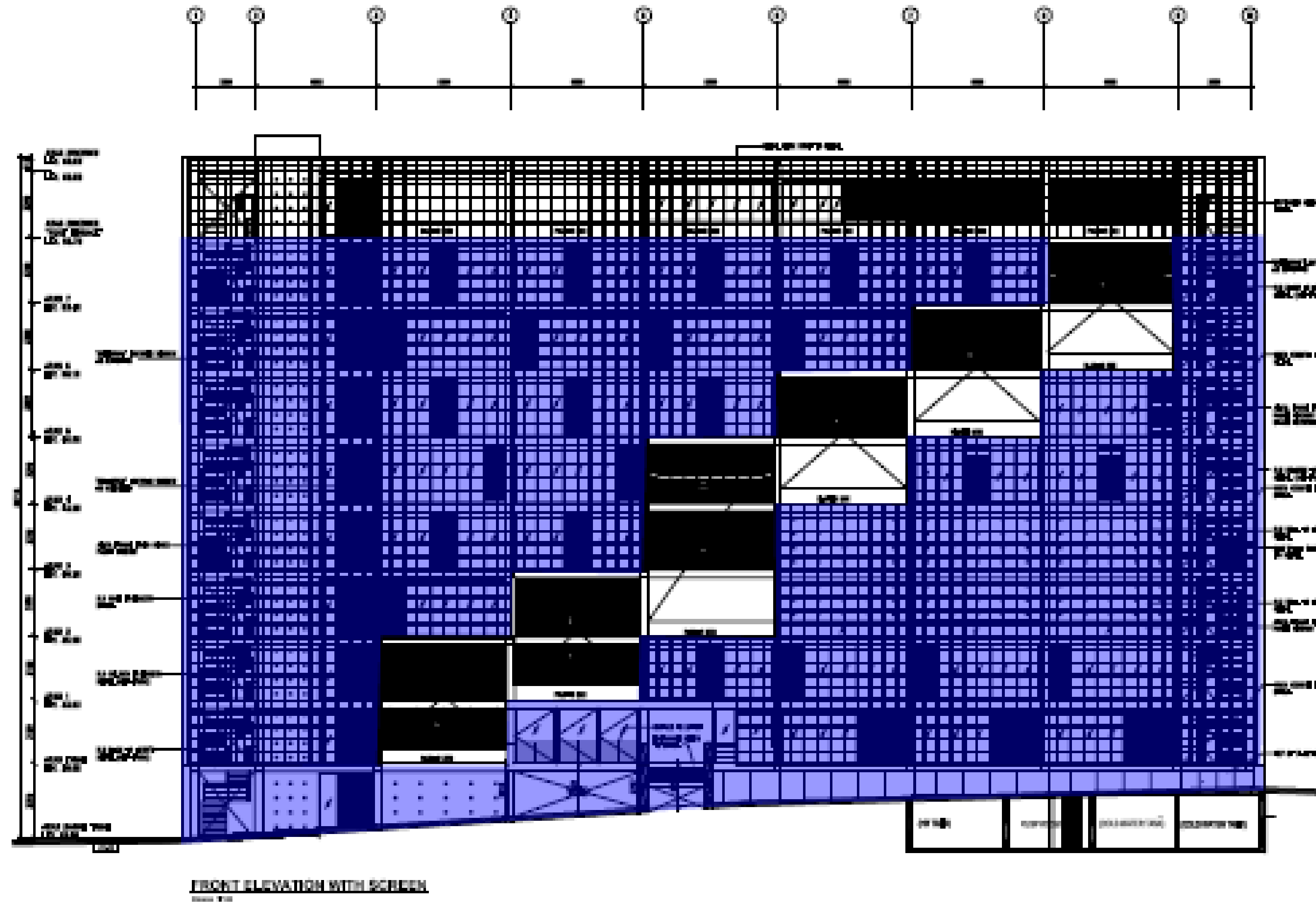
Advance OTTV

1. Self Shade



Advance OTTV

1. Self Shade



Advance OTTV

f Shade

PAM Centre OTTV CALCULATION
Design Case

Proposed OTTV (w/m²K) =

42.49

OTTV FORMULA =

$$15a(1-WWR)U_{wall} + 6(WWR)U_{glazing} + 194(WWR)(SC)(CF)$$

OTTV CALCULATION_IPOH KECHIL RESIDENCES RINC DA																		
Location	Area(m ²)	Window	Well	Heat Conduction Through Wall				Heat Conduction Through Windows			Solar Heat Gain Through Windows					OTTV	OTTV x AREA	
				Constant _{wall}	a	(1-WWR)	U _{wall}	Constant _{window}	WWR	U _{glazing}	Constant _{gazing}	CF	WWR	SC _{glazing}	SC _{crater}			SC
NORTH WEST_LG (double 5mm ASG float)	186.94	70.77	115.77	15.00	0.40	0.62	3.04	6.00	0.98	4.00	194.00	0.90	0.38	0.62	1.00	0.62	61.90	11471.81
NORTH WEST_GF (double 5mm ASG float)	37.90	25.28	12.62	15.00	0.40	0.33	3.04	6.00	0.67	4.00	194.00	0.90	0.67	0.62	1.00	0.62	94.29	3573.52
NORTH WEST_GF (double 5mm ASG float w/ shading)	37.90	33.48	4.42	15.00	0.40	0.12	3.04	6.00	0.88	4.00	194.00	0.90	0.88	0.62	0.38	0.24	59.67	2261.89
NORTH WEST_GF (tempered 6mm float)	37.90	17.14	20.76	15.00	0.40	0.35	3.04	6.00	0.45	5.70	194.00	0.90	0.45	0.96	1.00	0.96	101.26	3837.79
NORTH WEST_GF (tempered 6mm float w/shading)	37.90	25.42	12.48	15.00	0.40	0.33	3.04	6.00	0.67	5.70	194.00	0.90	0.67	0.96	0.38	0.36	71.66	2716.10
NORTH WEST_1F (tempered 6mm float)	45.17	34.28	10.89	15.00	0.40	0.34	3.04	6.00	0.76	5.70	194.00	0.90	0.76	0.96	1.00	0.96	157.96	7116.89
NORTH WEST_1F (tempered 6mm float w/shading)	45.17	20.01	25.16	15.00	0.40	0.36	3.04	6.00	0.44	5.70	194.00	0.90	0.44	0.96	0.38	0.36	53.53	2417.93
NORTH WEST_1F (double 5mm ASG float w/ shading)	60.00	56.03	3.97	15.00	0.40	0.07	3.04	6.00	0.93	4.00	194.00	0.90	0.93	0.62	0.38	0.24	62.03	3721.97
NORTH WEST_2F (tempered 6mm float)	55.78	18.07	37.71	15.00	0.40	0.68	3.04	6.00	0.32	5.70	194.00	0.90	0.32	0.96	1.00	0.96	77.71	4334.65
NORTH WEST_2F (tempered 6mm float w/shading)	55.78	8.61	47.17	15.00	0.40	0.25	3.04	6.00	0.15	5.70	194.00	0.90	0.15	0.96	0.38	0.36	30.54	1703.53
NORTH WEST_2F (double 5mm ASG float w/ shading)	55.78	21.83	33.95	15.00	0.40	0.61	3.04	6.00	0.39	4.00	194.00	0.90	0.39	0.62	0.38	0.24	36.59	2041.16
NORTH WEST_3F (tempered 6mm float)	55.16	18.07	37.09	15.00	0.40	0.67	3.04	6.00	0.33	5.70	194.00	0.90	0.33	0.96	1.00	0.96	78.38	4323.34
NORTH WEST_3F (tempered 6mm float w/shading)	55.16	13.18	41.98	15.00	0.40	0.76	3.04	6.00	0.24	5.70	194.00	0.90	0.24	0.96	0.38	0.36	37.28	2056.21
NORTH WEST_3F (double 5mm ASG float w/ shading)	55.16	30.82	24.34	15.00	0.40	0.44	3.04	6.00	0.96	4.00	194.00	0.90	0.96	0.62	0.38	0.24	44.44	2451.43
NORTH WEST_4F (tempered 6mm float)	45.33	18.07	27.26	15.00	0.40	0.60	3.04	6.00	0.40	5.70	194.00	0.90	0.40	0.96	1.00	0.96	91.42	4144.04
NORTH WEST_4F (tempered 6mm float w/shading)	45.33	18.53	25.80	15.00	0.40	0.57	3.04	6.00	0.43	5.70	194.00	0.90	0.43	0.96	0.38	0.36	52.56	2382.62
NORTH WEST_4F (double 5mm ASG float w/ shading)	70.00	60.61	9.39	15.00	0.40	0.13	3.04	6.00	0.87	4.00	194.00	0.90	0.87	0.62	0.38	0.24	58.85	4119.15
NORTH WEST_5F (tempered 6mm float)	45.33	18.07	27.26	15.00	0.40	0.60	3.04	6.00	0.40	5.70	194.00	0.90	0.40	0.96	1.00	0.96	91.42	4144.04
NORTH WEST_5F (tempered 6mm float w/shading)	45.33	20.72	24.61	15.00	0.40	0.54	3.04	6.00	0.46	5.70	194.00	0.90	0.46	0.96	0.38	0.36	54.65	2477.40
NORTH WEST_5F (double 5mm ASG float w/ shading)	70.00	59.42	10.58	15.00	0.40	0.15	3.04	6.00	0.85	4.00	194.00	0.90	0.85	0.62	0.38	0.24	58.05	4063.33
NORTH WEST_6F (tempered 6mm float)	45.33	18.07	27.26	15.00	0.40	0.60	3.04	6.00	0.40	5.70	194.00	0.90	0.40	0.96	1.00	0.96	91.42	4144.04
NORTH WEST_6F (tempered 6mm float w/shading)	45.33	20.72	24.61	15.00	0.40	0.54	3.04	6.00	0.46	5.70	194.00	0.90	0.46	0.96	0.38	0.36	54.65	2477.40
NORTH WEST_6F (double 5mm ASG float w/ shading)	70.00	59.42	10.58	15.00	0.40	0.15	3.04	6.00	0.85	4.00	194.00	0.90	0.85	0.62	0.38	0.24	58.05	4063.33
NORTH WEST_7F (tempered 6mm float)	39.12	18.07	21.05	15.00	0.40	0.54	3.04	6.00	0.46	5.70	194.00	0.90	0.46	0.96	1.00	0.96	103.04	4030.77
NORTH WEST_7F (tempered 6mm float w/shading)	39.12	25.06	14.06	15.00	0.40	0.36	3.04	6.00	0.64	5.70	194.00	0.90	0.64	0.96	0.38	0.36	69.27	2709.76
NORTH WEST_7F (double 5mm ASG float w/ shading)	80.00	73.16	6.84	15.00	0.40	0.09	3.04	6.00	0.91	4.00	194.00	0.90	0.91	0.62	0.38	0.24	61.13	4890.09
Total Area	1461.52	803.91	0.55														66.83	97673.73
NORTH EAST_LG (RC)	28.90	0.00	28.90	15.00	0.40	1.00	3.04	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	18.24	527.14
NORTH EAST_LG (brick)	10.54	0.00	10.54	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	129.39
NORTH EAST_GF (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	1.09	0.14	0.96	1.00	0.96	49.78	1430.72
NORTH EAST_GF (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	52.17
NORTH EAST_1F (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	1.09	0.14	0.96	1.00	0.96	49.78	1430.72
NORTH EAST_1F (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	52.17
NORTH EAST_2F to 7F (RC)	180.83	26.19	154.64	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	1.09	0.14	0.96	1.00	0.96	49.95	9092.94
NORTH EAST_2F to 7F (brick)	26.73	0.00	26.73	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	328.14
NORTH EAST U CRATER (RC)	21.99	0.00	21.99	15.00	0.40	1.00	3.40	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	20.40	448.60
NORTH EAST U CRATER (brick)	155.21	0.00	155.21	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	1.09	0.00	1.00	1.00	1.00	12.28	1905.36
Total Area	480.18	34.47	0.07														31.29	15337.34
SOUTH WEST_LG (RC)	28.90	0.00	28.90	15.00	0.40	1.00	3.04	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	18.24	527.14
SOUTH WEST_LG (brick)	10.54	0.00	10.54	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	129.39
SOUTH WEST_GF (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	0.90	0.14	0.96	1.00	0.96	44.68	1284.22
SOUTH WEST_GF (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	52.17
SOUTH WEST_1F (RC)	28.74	4.14	24.60	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	0.90	0.14	0.96	1.00	0.96	44.68	1284.22
SOUTH WEST_1F (brick)	4.25	0.00	4.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	52.17
SOUTH WEST_2F to 7F (RC)	180.83	26.19	154.64	15.00	0.40	0.86	3.04	6.00	0.14	5.70	194.00	0.90	0.14	0.96	1.00	0.96	44.83	8106.19
SOUTH WEST_2F to 7F (brick)	26.73	0.00	26.73	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	328.14
SOUTH WEST U CRATER (brick)	135.25	0.00	135.25	15.00	0.40	1.00	2.05	6.00	0.00	5.70	194.00	0.90	0.00	1.00	1.00	1.00	12.28	1660.33
Total Area	448.23	34.47	0.08														29.95	13423.98
SOUTH EAST	1569.49	64.80	1504.69	15.00	0.40	0.96	3.04	6.00	0.04	5.50	194.00	1.13	0.04	0.89	1.00	0.89	26.90	42226.80
Total Area	1569.49	64.80	0.04														26.90	42226.80
OTTV for Ipoh Kechil Residences																		42.49

3969.42 937.63

0.24

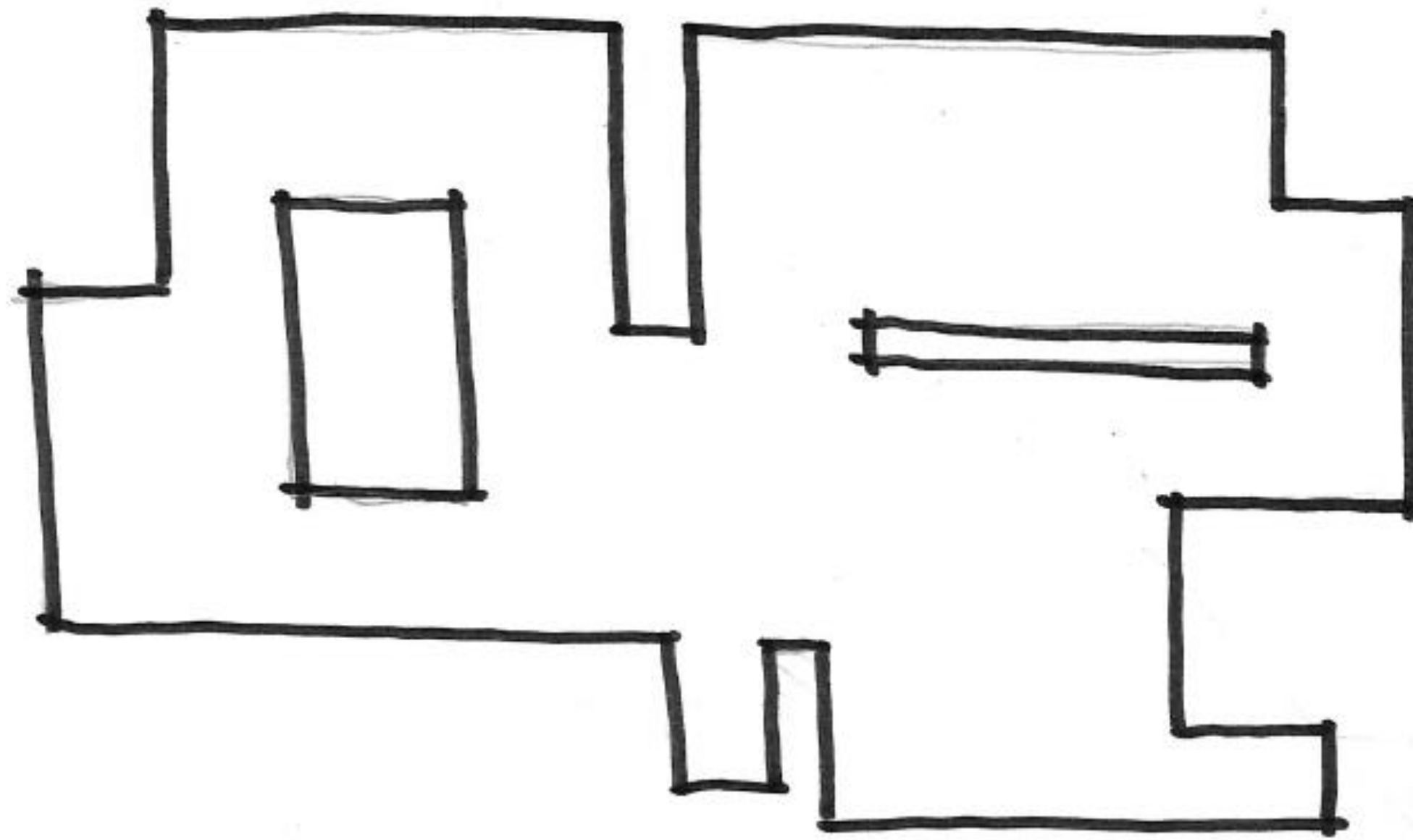
168661.85

42.49

OTTV = 42.49 w/m² (-6%)

Advance OTTV

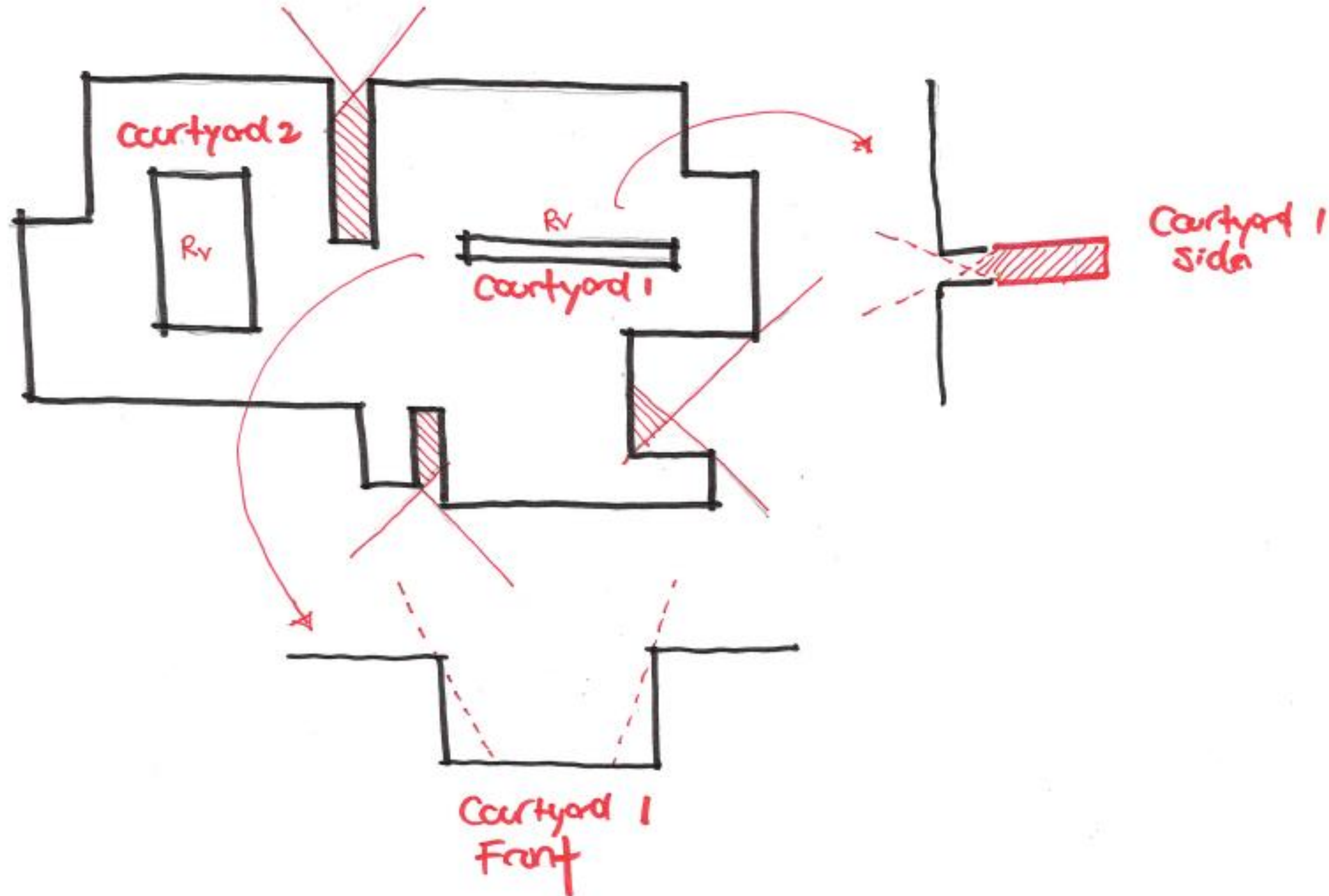
1. Self Shade



Open vs **Close** Loop for OTTV Calculation

Advance OTTV

1. Self Shade



Advance OTTV

2. Vertical Green



Creeper by gravity



Creeper with mesh



Creeper with steel cable

Advance OTTV

2. Vertical Green



H2O panel



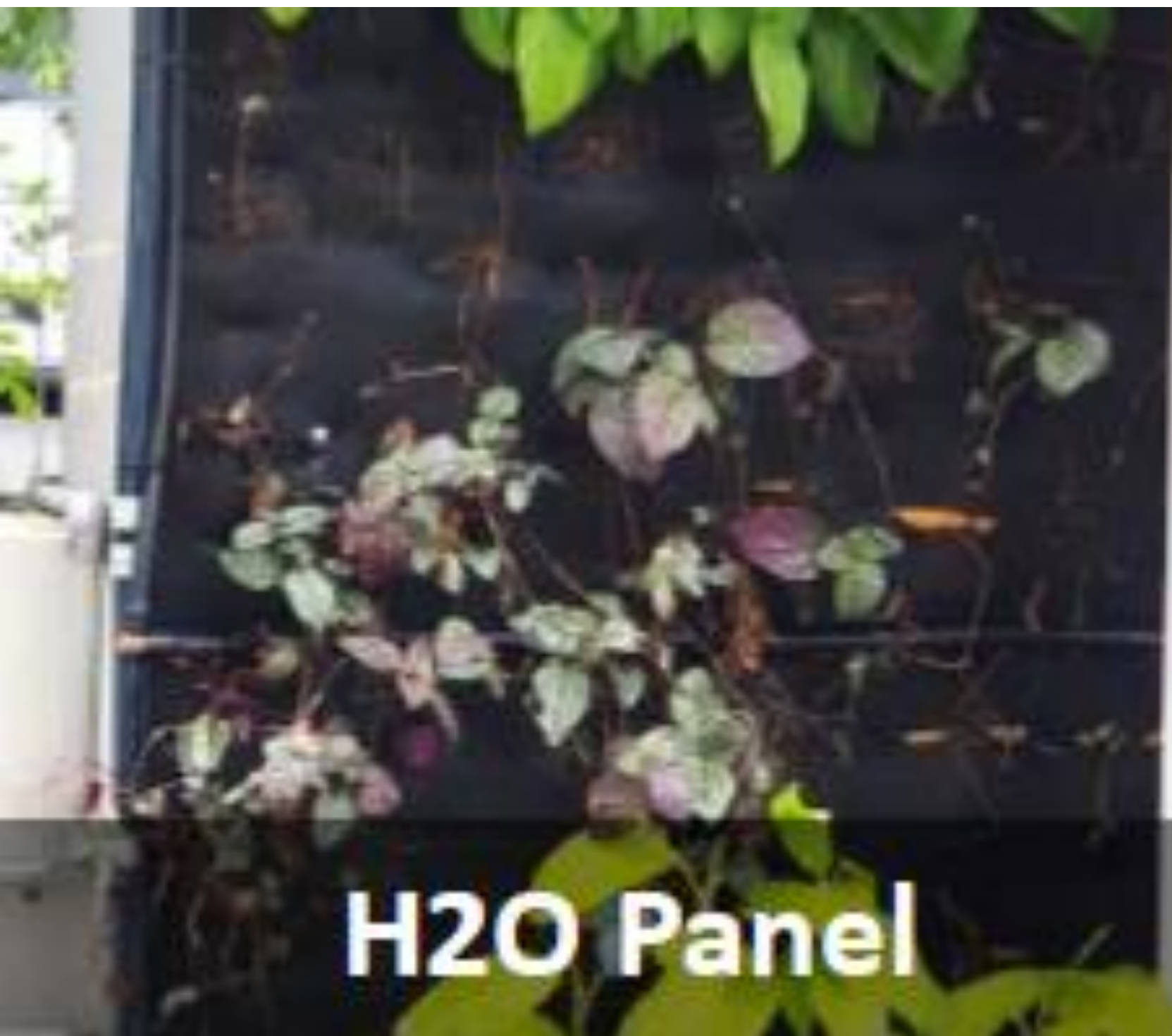
Felt



Pot

Advance OTTV

2. Vertical Green



Advance OTTV

2. Vertical Green



Advance OTTV

2. Vertical Green



Advance OTTV

3. BIPV



Glassbel @ Klaipeda, Lithuania

Advance OTTV

3. BIPV



Glassbel @ Klaipeda, Lithuania

Advance OTTV

4. Water



Advance OTTV

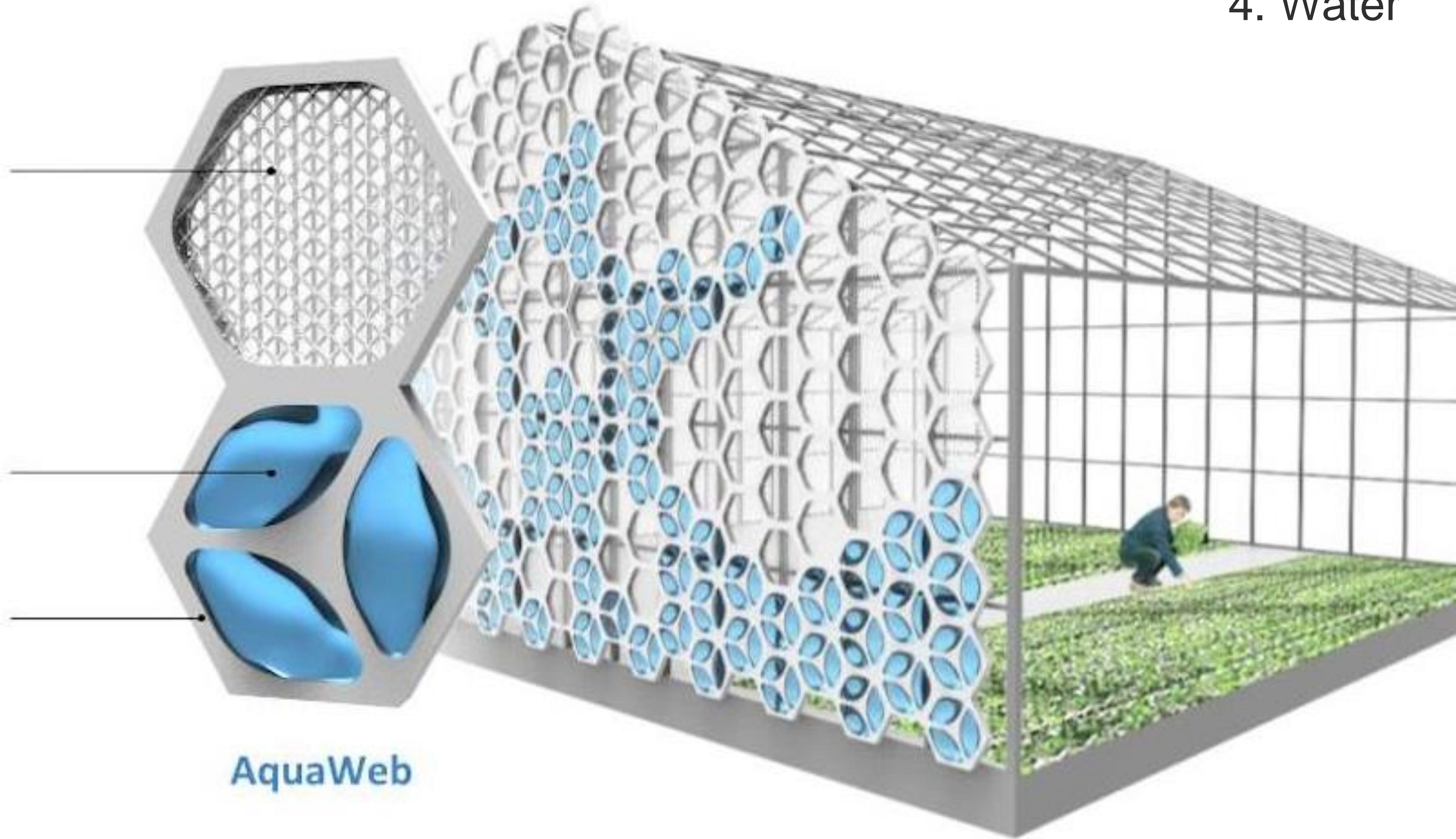
4. Water

FUNCTION

CAPTURE & FILTER

STORE

DISTRIBUTE



AquaWeb

Advance OTTV

4. Water



Digital Image 11
Hydroponic Wall

CH&I
CONSTRUCTION

Advance OTTV

4. Water



BMW Group Pavilion @ London, UK

Advance OTTV

4. Water



BMW Group Pavilion @ London, UK

Advance OTTV

5. Recycle



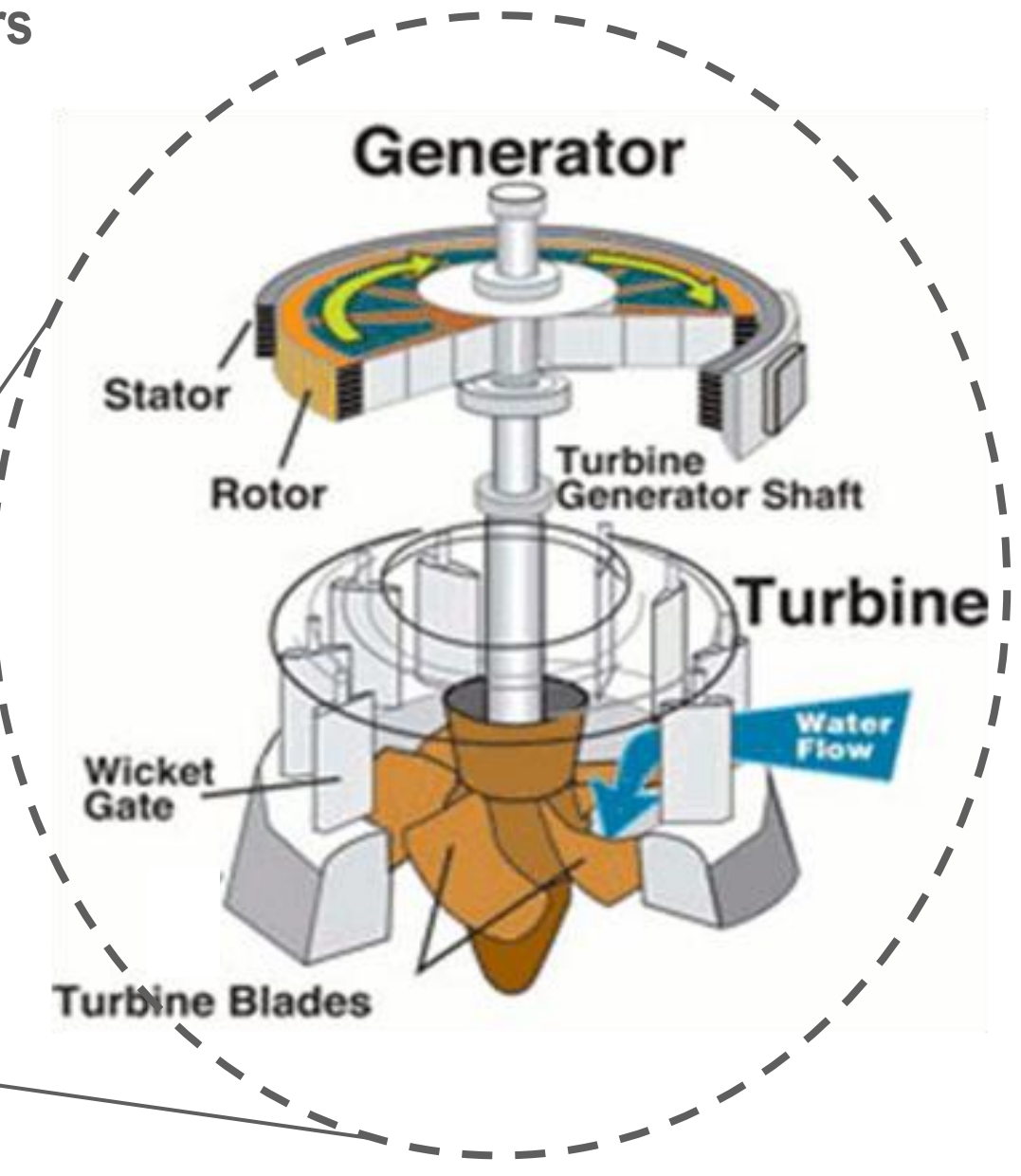
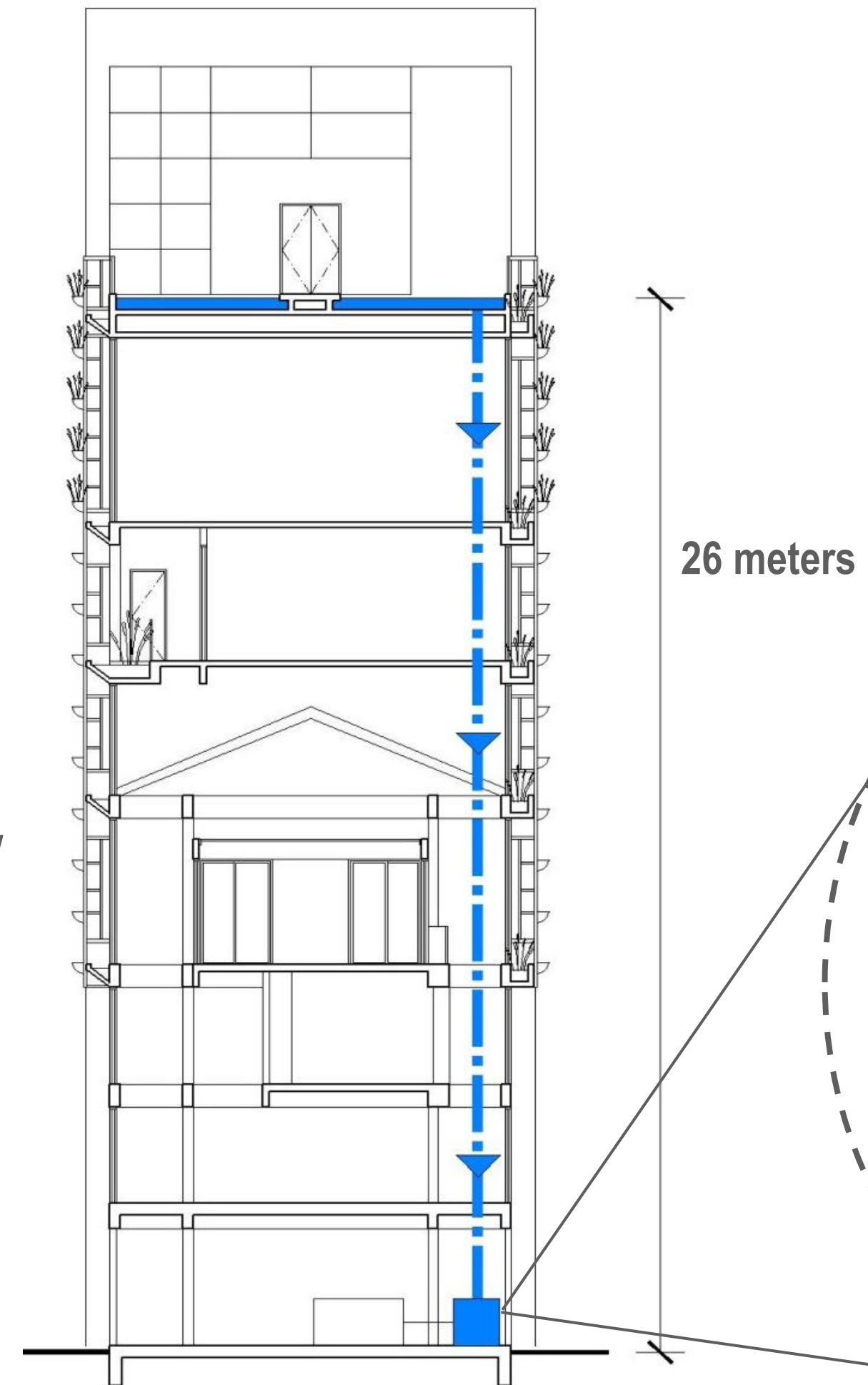
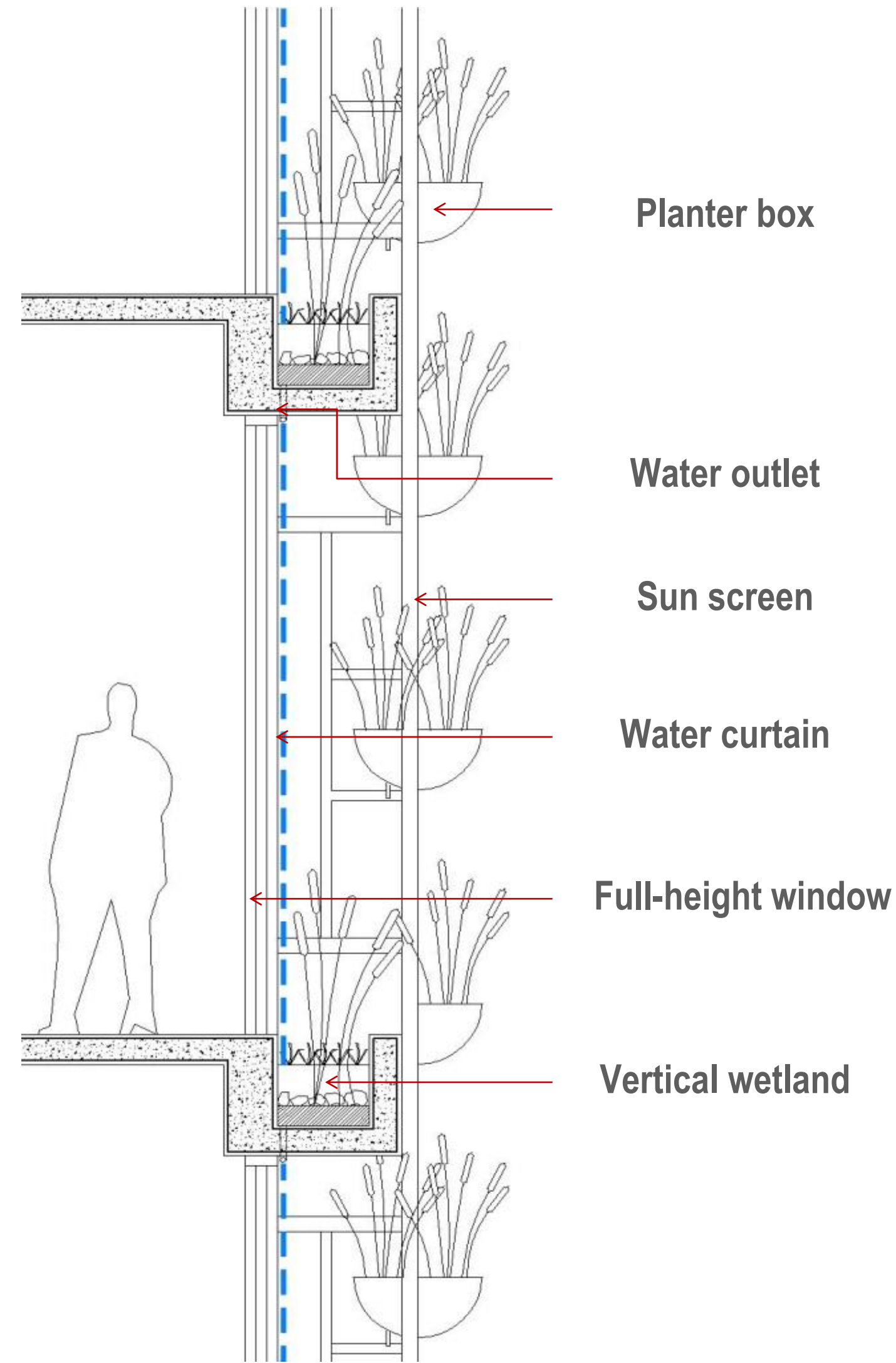
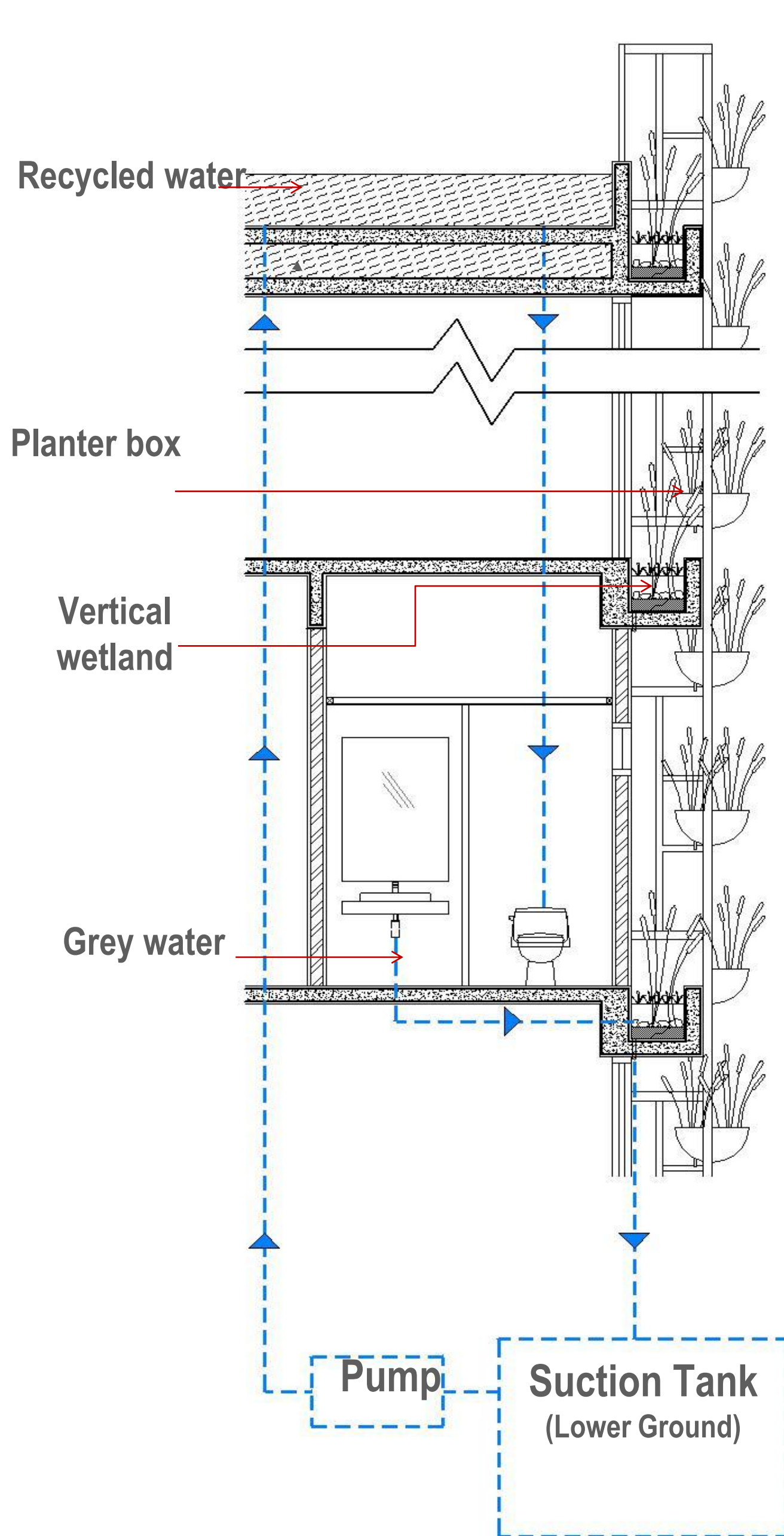
Advance OTTV

5 Aces



Advance OTTV

5 Aces





Green Roof

Types & Suitability

Roof Insulation

TYPE OF ROOF INSUATION



Double Roof
Lift Core / Staircase

Double Roof
Secondary Roof.
Top finish with
glass/canvas.
Common material
of canvas are PVC,
acrylic and
polyethylene

Insulation
Turf as insulation

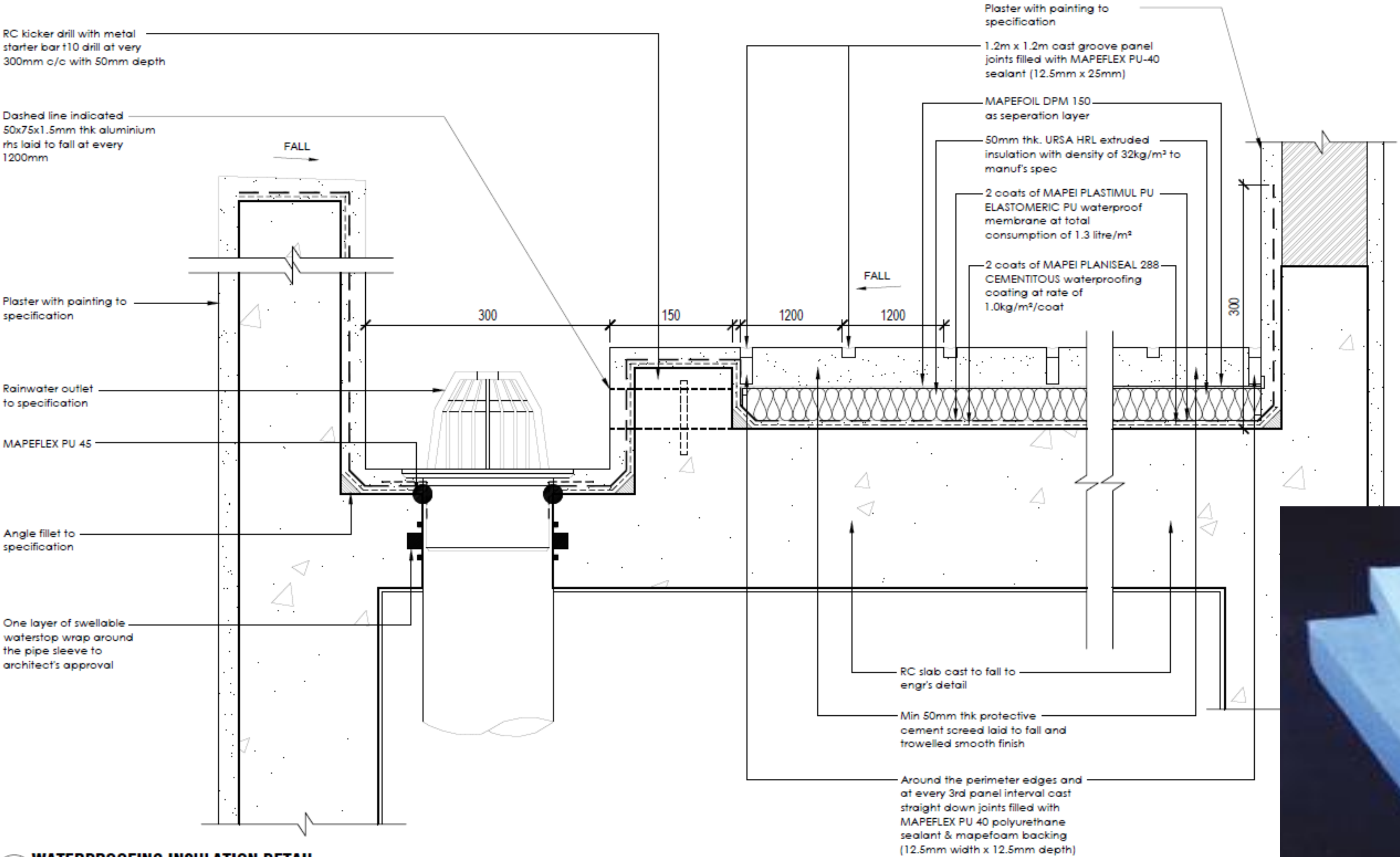
Insulation
Water Feature/Pool
as insulation

Double Roof
Raise Deck

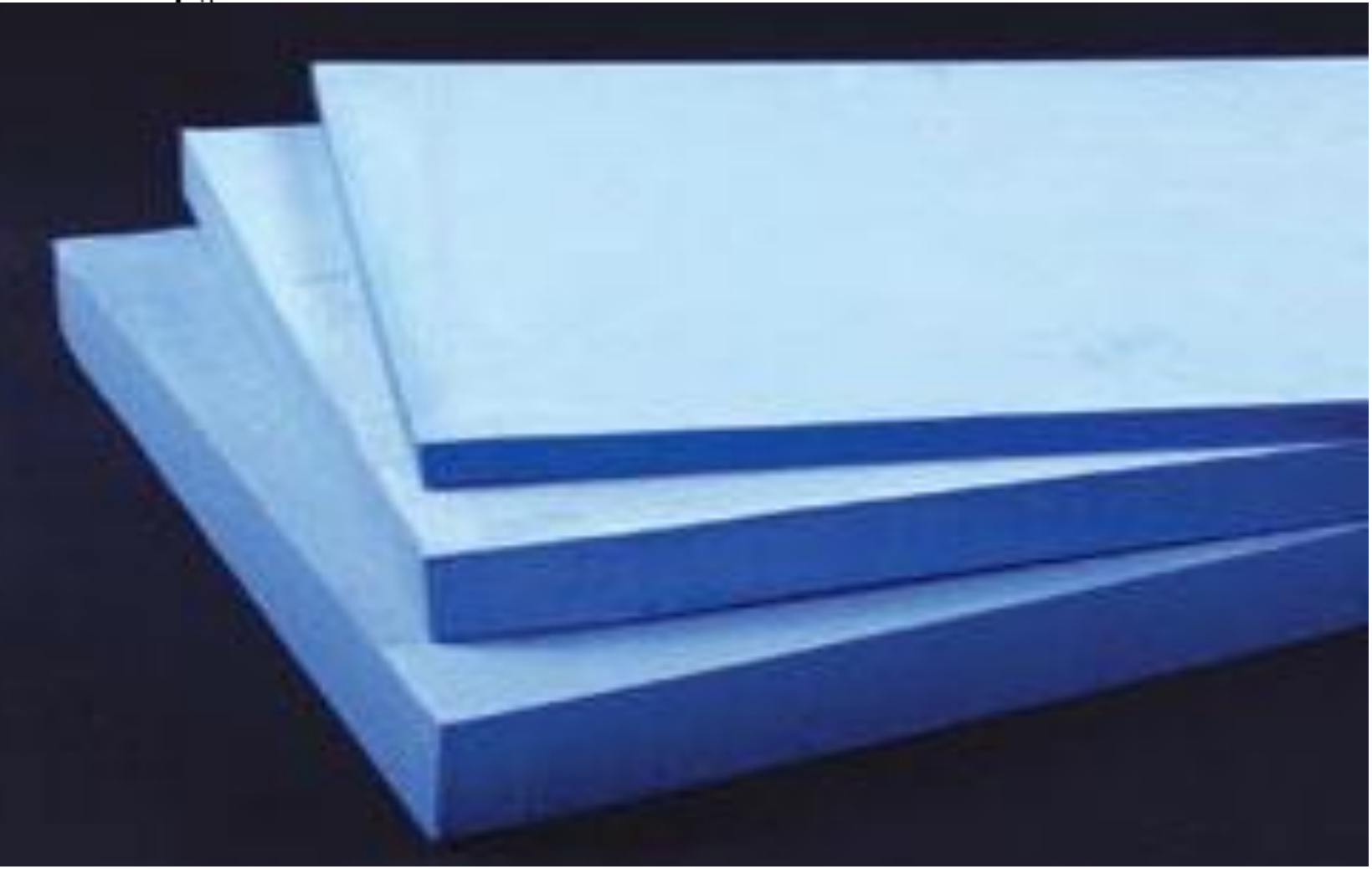
Insulation
Rigid Form

Roof Insulation

1. Rigid Foam (Board)



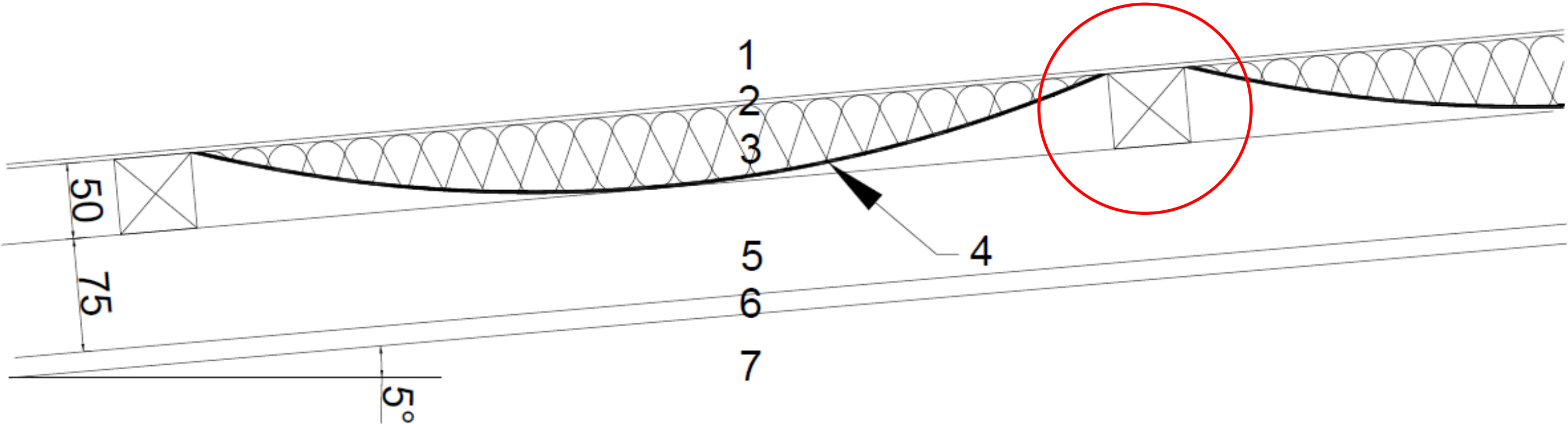
1 WATERPROOFING INSULATION DETAIL
SCALE 1:5



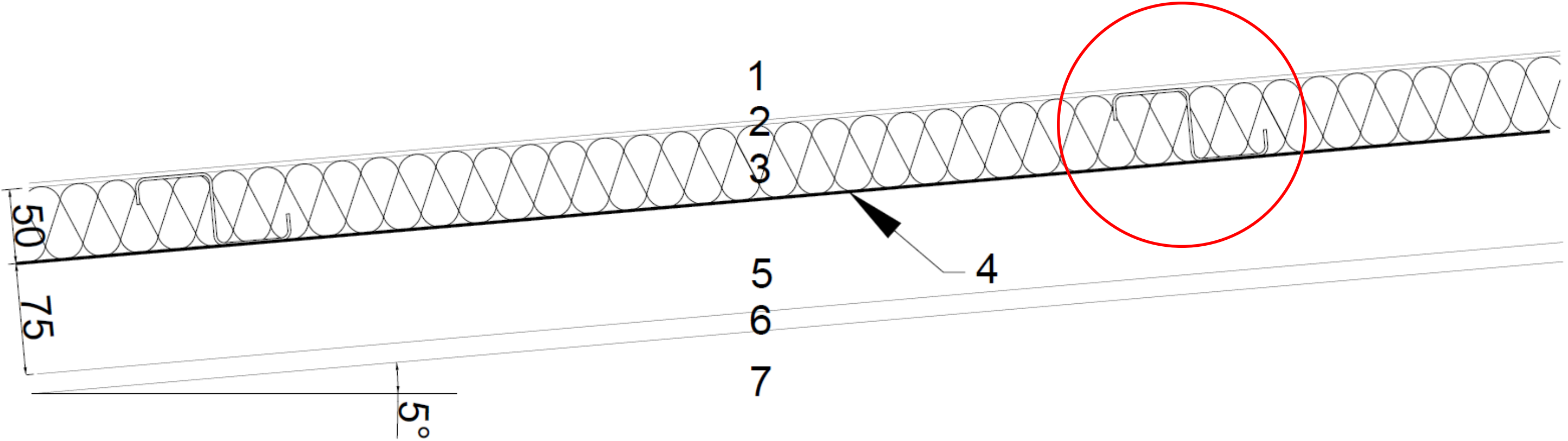
Roof Insulation

2. Bulk

Compressed



'Z or C' Spacer



Roof Insulation

3. Reflective / Radiant Barrier

MS 2095:2014 section 3.5 and section 3.6

Radiant Barrier

Reflective surface within an enclosed air space



Reflective Insulation

Reflective surface laminated onto woven, foam, etc which has a resisted conductive element



Roof Insulation

3. Reflective / Radiant Barrier

Have an emittance rating < 0.05
(Reflect $> 95\%$ of heat radiation)

Note: Emittance is a ratio of energy or heat that is intercepted by the insulation and radiated outwards.

Reflective Insulation and Radiant barriers are **not insulators** and therefore have **low R-value**.

When they are used within **enclosed air spaces** as part of an insulating system, it reduces the heat emitted through the roof and enable the insulation to perform near its intended R-value.



Roof Insulation

3. Reflective / Radiant Barrier

Caution

In order to perform properly, reflective insulation and radiant barriers must be installed **facing (single or double sided) an enclosed air space of appropriate dimensions** to work as part of an insulating system.

Roof attics are not considered as appropriate air spaces because of the **convection** air movement within them.

When placed **directly against another material**, these barriers can transfer heat by conduction, instead of blocking or reflecting it.



Roof Insulation

4. Spray

Can applied to both heavyweight and lightweight roofs.
Can fill even the smallest of cavities, thus creating an effective insulation.

Ability to conform to irregular roof shapes.

Caution

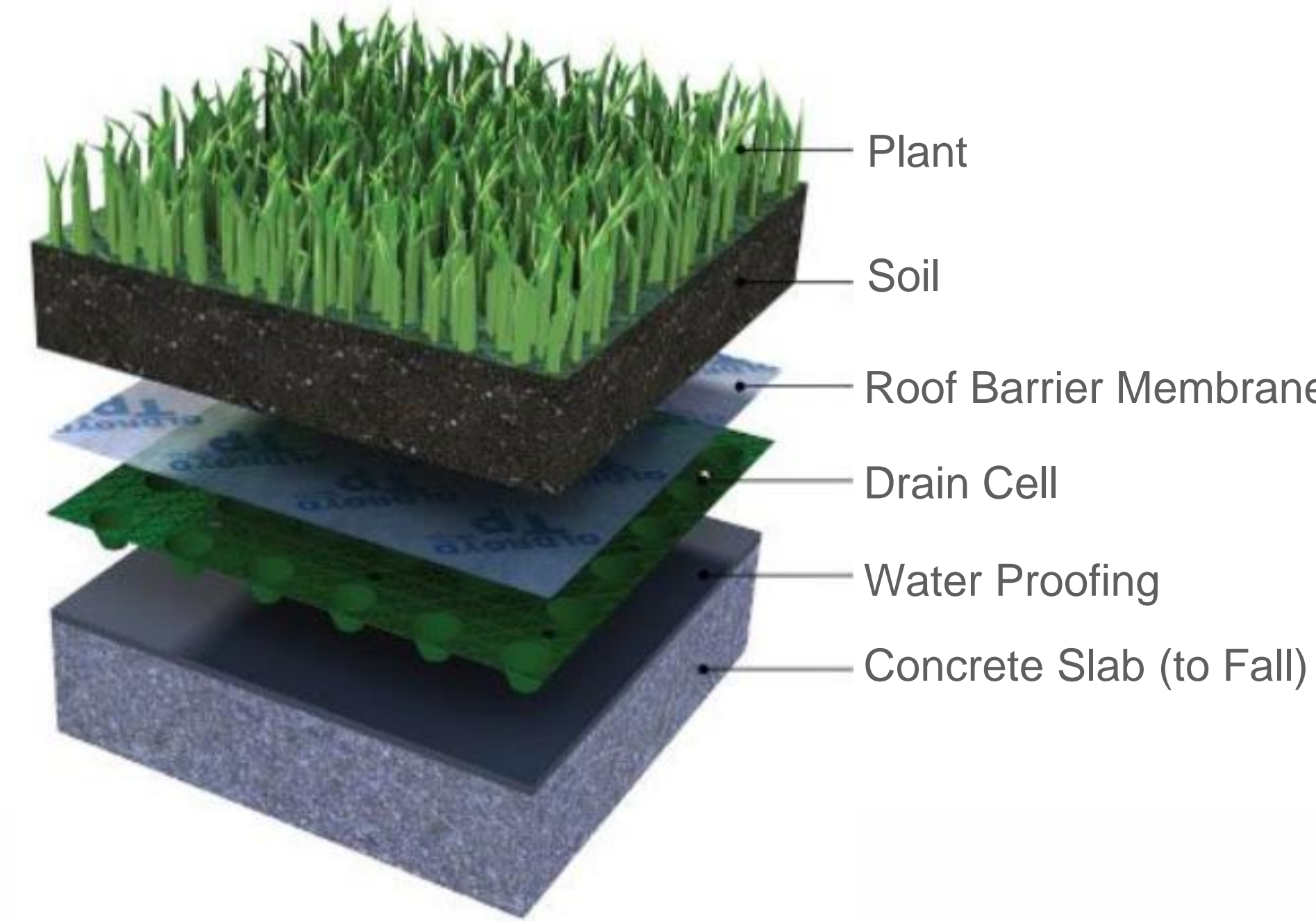
Difficult to maintain the **consistent thickness** hence affect the R-value property.



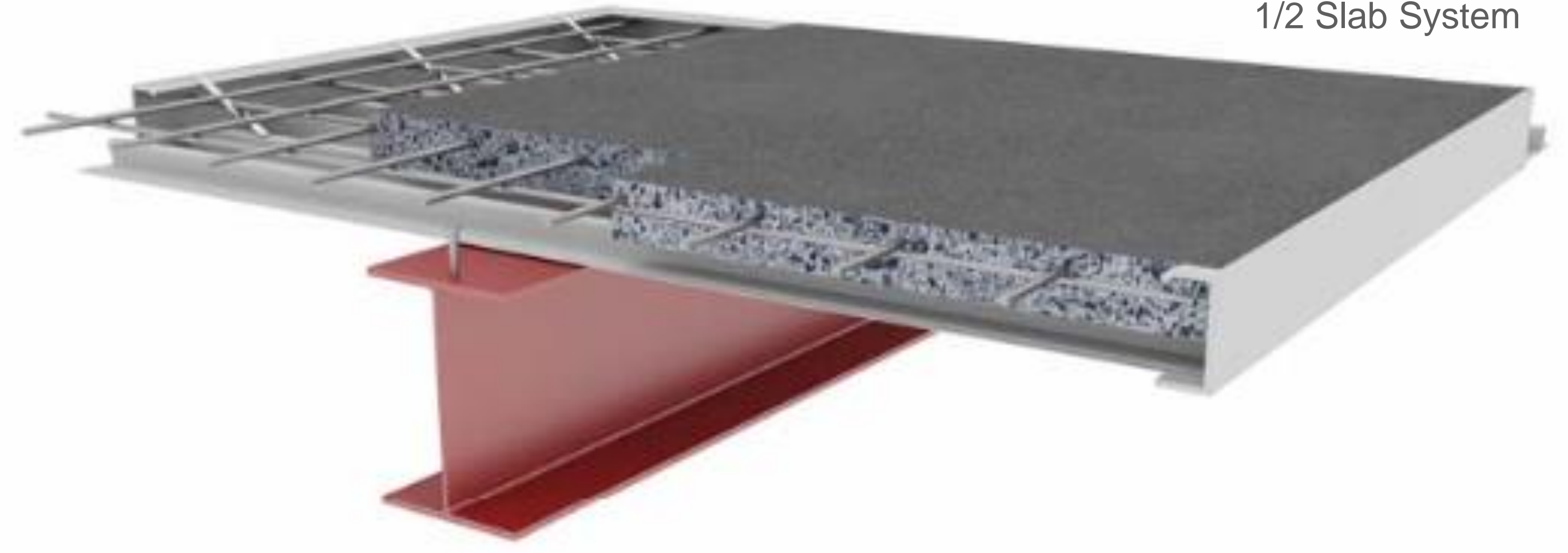


Roof Insulation

5. Turf

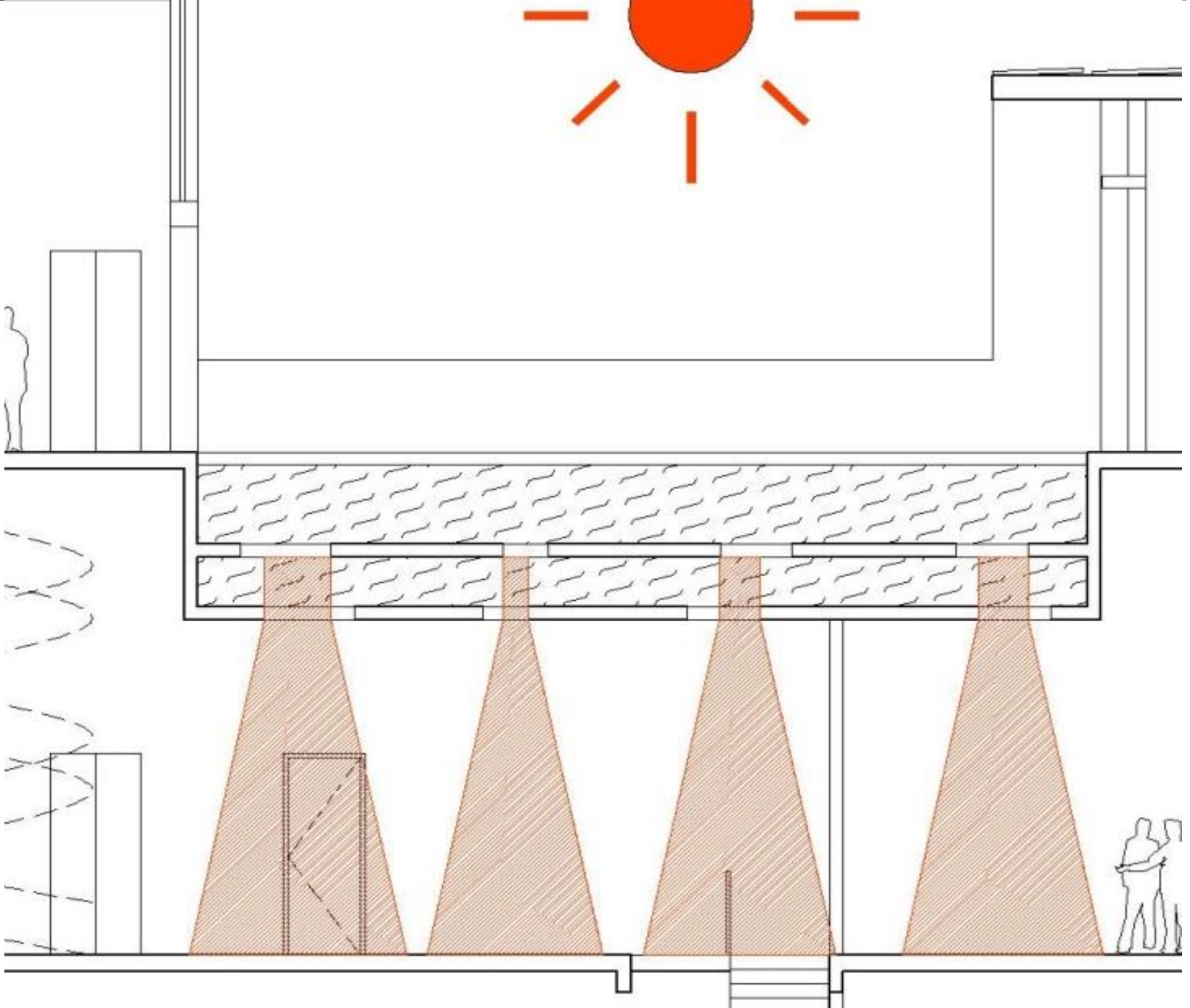
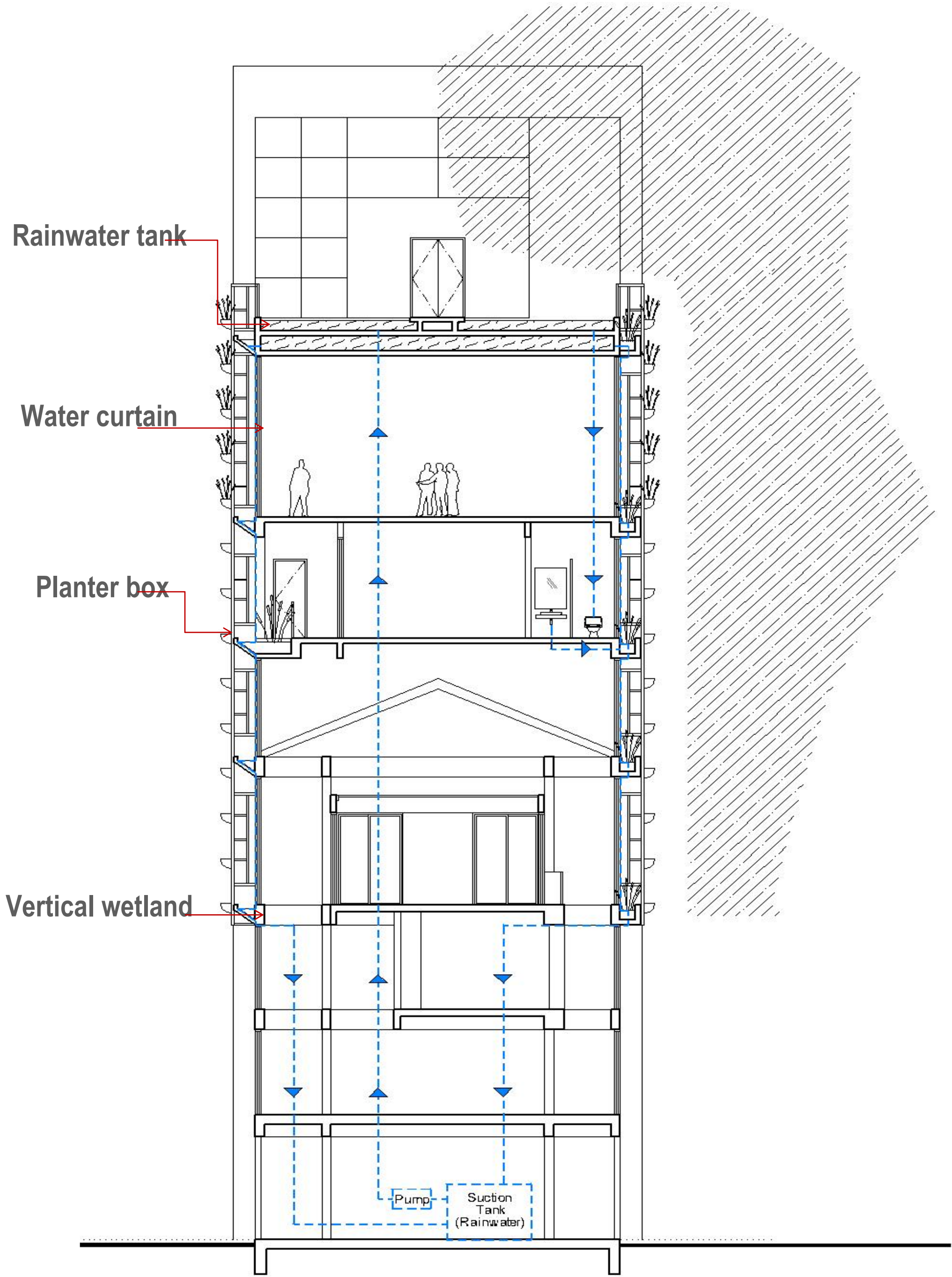


1/2 Slab System



Roof Insulation

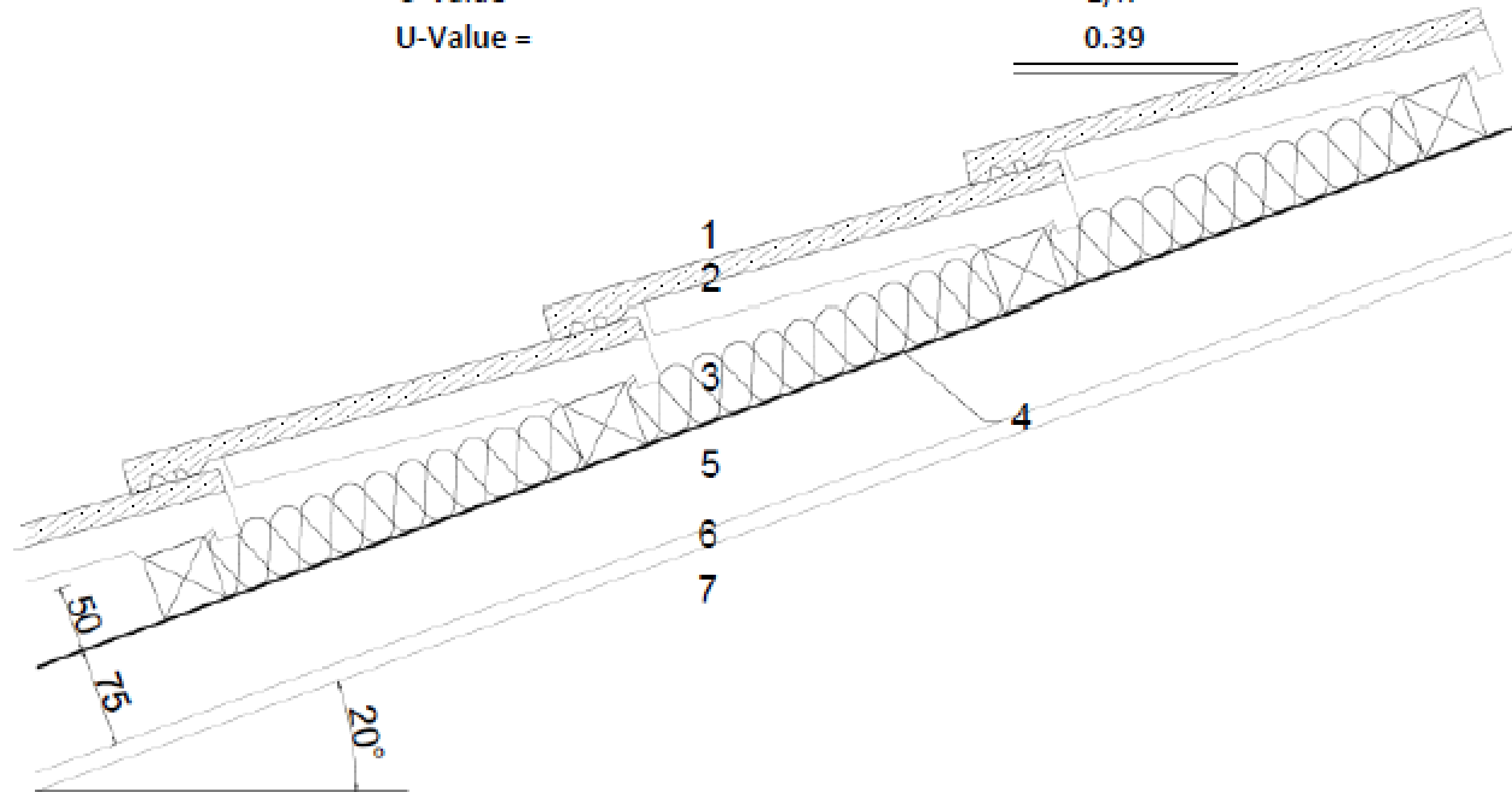
6. Water



EXAMPLE 8

Layers	Thermal Conductivity	Thermal Resistance
	(W/mK)	(m ² K/W)
1 External Air Film	-	0.044
2 12mm Roof Tile	0.836	0.014
3 50mm 40kg/m ³ Mass Insulation	0.036	1.388
4 Radiant Barrier Single Sided (facing down)	-	0.000
5 75mm Rafter + Enclosed Air Space	-	0.943
6 Plasterboard 13mm thk	0.250	0.048
7 Internal Air Film	-	0.160

Total R = 2.597
 U-Value = 1/R
 U-Value = 0.39



Roof Insulation

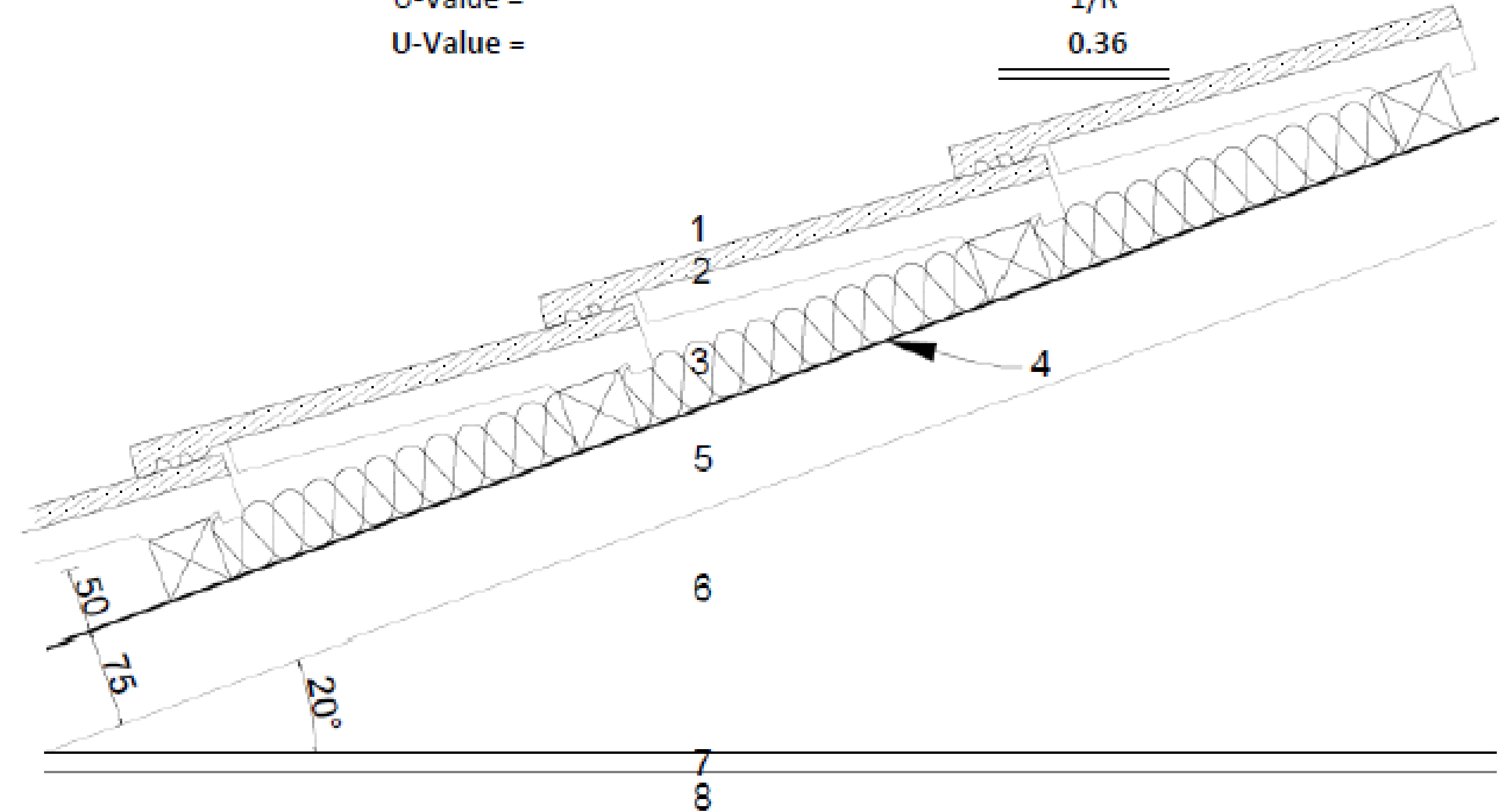
7. Combination

Roof	Lightweight (rLW)
Material	Tile (mT)
Insulation	Mass (iM) + Radiant Barrier Single Sided (iRBSS) facing down
Ceiling	Inclined (cl)
Attic	No (aNO)
Code	rLW_mT_iM+iRBSS_cl_aNO

EXAMPLE 11

Layers	Thermal Conductivity	Thermal Resistance
	(W/mK)	(m ² K/W)
1 External Air Film	-	0.044
2 12mm Roof Tile	0.836	0.014
3 50mm 40kg/m ³ Mass Insulation	0.036	1.388
4 Radiant Barrier Single Sided (facing down)	-	0.000
5 75mm Rafter	-	0.000
6 Attic Space (unventilated)	-	1.090
7 Plasterboard 13mm thk	0.250	0.048
8 Internal Air Film	-	0.160

Total R = 2.744
 U-Value = 1/R
 U-Value = 0.36



Roof Insulation

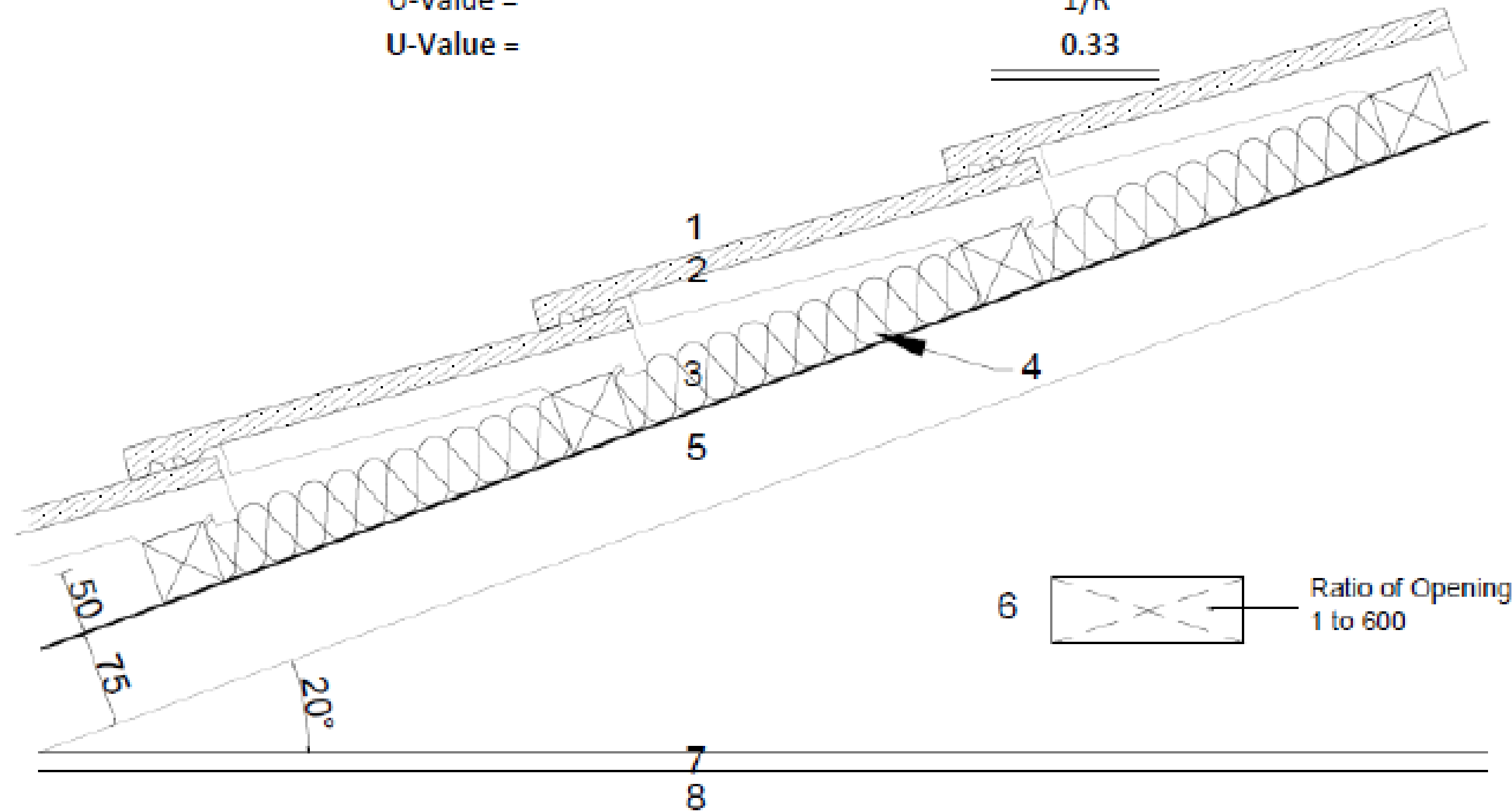
7. Combination

Roof	Lightweight (rLW)
Material	Tile (mT)
Insulation	Mass (iM) + Radiant Barrier Single Sided (iRBSS) facing down
Ceiling	Horizontal (cH)
Attic	Unventilated (aUV)
Code	rLW_mT_iM + iRBSS_cH_aUV

EXAMPLE 12

Layers	Thermal Conductivity	Thermal Resistance
	(W/mK)	(m ² K/W)
1 External Air Film	-	0.044
2 12mm Roof Tile	0.836	0.014
3 50mm 40kg/m ³ Mass Insulation	0.036	1.388
4 Radiant Barrier Single Sided (facing down)	-	0.000
5 75mm Rafter	-	0.000
6 Attic Space (ventilated)	-	1.360
7 Plasterboard 13mm thk	0.250	0.048
8 Internal Air Film	-	0.160

Total R = 3.014
 U-Value = 1/R
 U-Value = 0.33



Roof	Lightweight (rLW)
Material	Tile (mT)
Insulation	Mass (iM) + Radiant Barrier Single Sided (iRBSS) facing down
Ceiling	Horizontal (cH)
Attic	Ventilated (aV)
Code	rLW_mT_iM + iRBSS_cH_aV

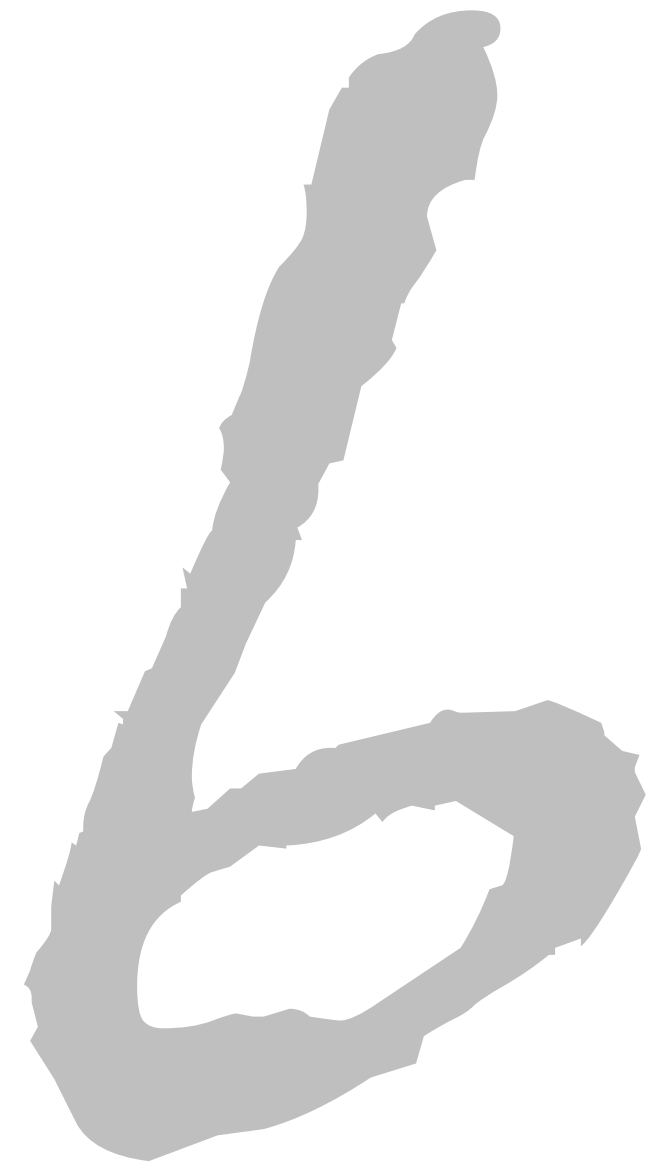
Roof Insulation

7. Combination



Roof Insulation

7. Combination



EECA

Energy Efficiency & Conservation Act

ENERGY EFFICIENCY AND CONSERVATION BILL 2023

ARRANGEMENT OF CLAUSES

PART I

PRELIMINARY

Clause

1. Short title and commencement
2. Interpretation
3. Application

PART II

FUNCTIONS AND POWERS OF THE COMMISSION

4. Functions and powers of the Commission

PART III

DUTIES OF ENERGY CONSUMER

5. Appointment of registered energy manager
6. Energy management system
7. Energy efficiency and conservation report
8. Energy audit
9. Energy audit report

PART IV

DUTIES OF PERSON IN CHARGE OF BUILDING

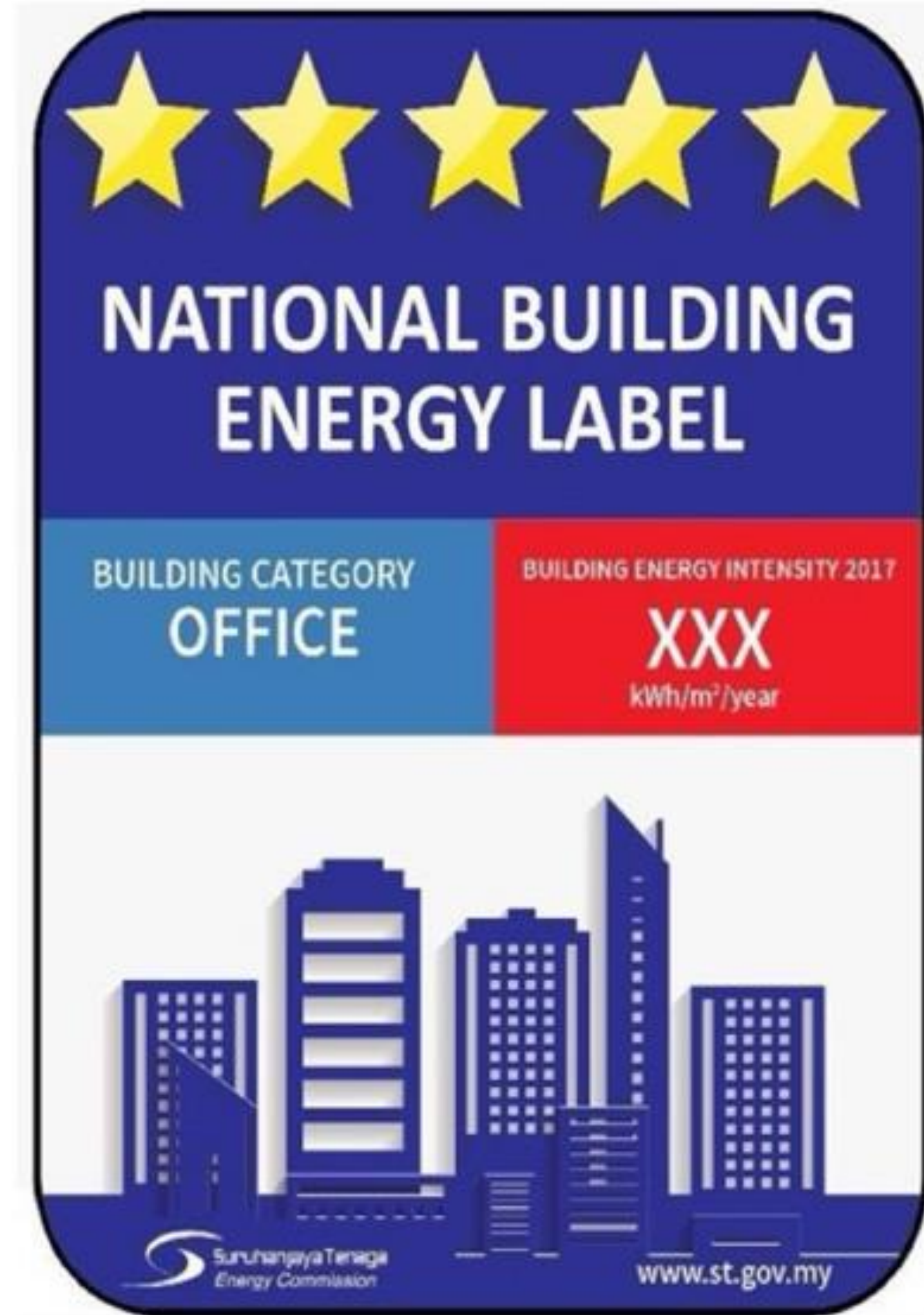
10. Energy intensity label
11. Display of energy intensity label
12. Alteration, forgery, etc., of energy intensity label
13. Energy intensity performance
14. Energy audit report in respect of building
15. Energy efficiency improvement plan
16. Non-application of sections 13, 14 and 15

- Applicable > 8000m²
- Up to RM100,000 Fine

BEI

★ Star Rating

STAR RATING	BEI RANGE VALUE
5-Star	$BEI \leq 100$
4-Star	$100 < BEI \leq 130$
3-Star	$130 < BEI \leq 160$
2-Star	$160 < BEI \leq 250$
1-Star	$BEI > 250$





Educational Institute



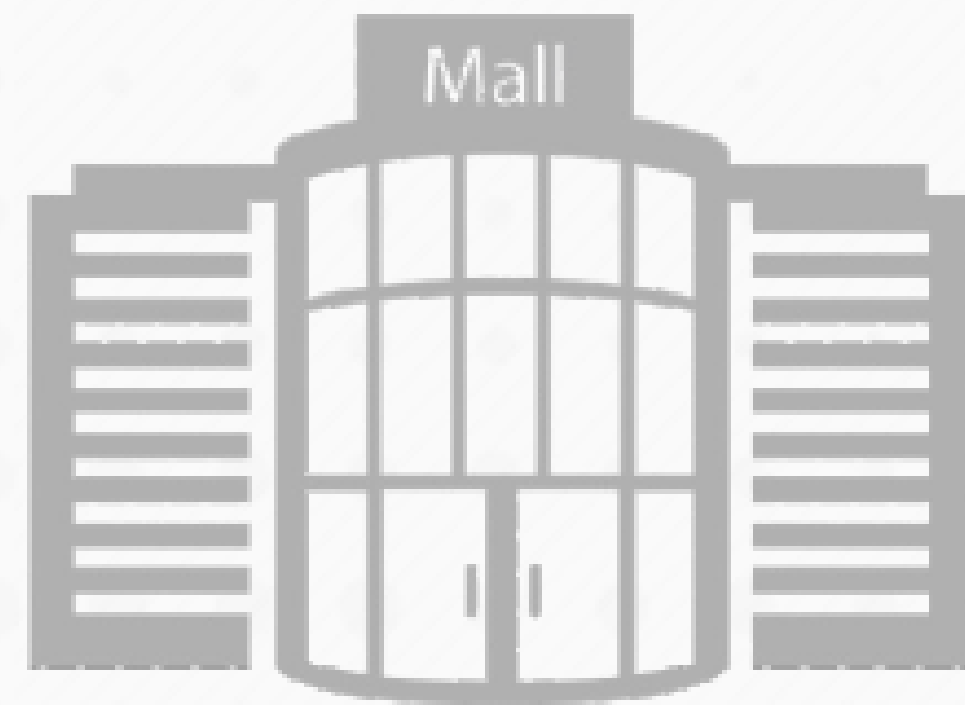
Office Building



Hotel



Healthcare



Retail



Data Centers

Technical Expert Working Group Members

1. **Ar Michael, Ching Chee Hong** - Malaysia Green Building Council
2. **Mr Tan Tze Meng** - Malaysia Digital Economy Corporation Sdn. Bhd
3. **Ir Chen Thiam Leong** - PRIMETECH Engineers Sdn. Bhd. Malaysia
4. **Mr Gregers Rehman** - IEN Consultants Sdn. Bhd.
5. **Ts. Steve Anthony Lojuntin** - Sustainable Energy Development Authority (SEDA)
6. **Assoc. Prof. Ir. Dr Nofri Yenita Dahlan** - Universiti Teknologi MARA (UiTM)
7. **Ir. Lum Youk Lee** - Persatuan Pengurusan Kompleks Malaysia (PPKM)



MPPP

GBI Silver/Gold, RE50%



THEME D

Invest in the built environment to improve resilience

D3: Integrate municipal services with smart technologies

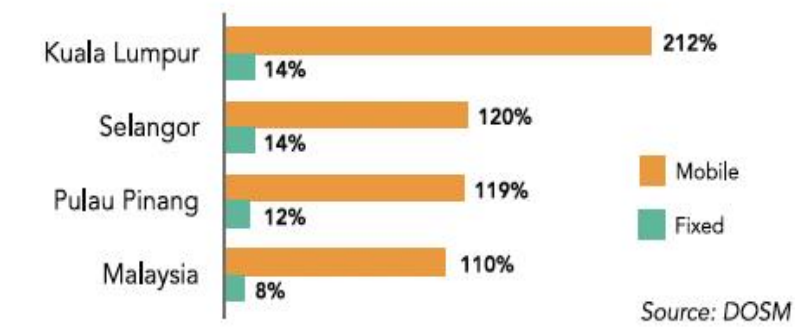
To improve the delivery of municipal and government services, smart technologies will be deployed by Penang Island City Council (MBPP), the Seberang Perai Municipal Council (MPSP) and other government agencies.

Sensors and other connected devices to collect data are to be installed to enable dynamic management for real-time monitoring and response. Community apps will be developed in parallel. This will extend to traffic management, electricity provision, water supply, lighting, parking and disaster management.

Energy production is to be diversified through the development of a solar industry – smaller-scale devices fitted to existing buildings and larger-scale solar farms. The local government, working together with Tenaga Nasional Berhad, can introduce development guidelines to encourage existing buildings to be retrofitted for solar energy or waste-to-energy production.

There are 1.2 mobile broadband subscriptions for every 1 person in Penang

Percentage of Population Subscribed to Broadband Services



Cities in Penang have the highest potential for solar power generation in Peninsular Malaysia

Yearly Average Values of Solar Irradiance (kWh/m²)



KEY INITIATIVES

1. Mandatory adoption of smart technologies for the delivery of municipal services
2. Collaborating with local communities and NGOs on smart city initiatives
3. Implementing a smart reporting dashboard of key Penang indicators
4. Investing in renewable energy

TARGETS

100%
of government agencies using smart technologies

100%
green and smart government buildings

100%
of new development deploying smart city technology

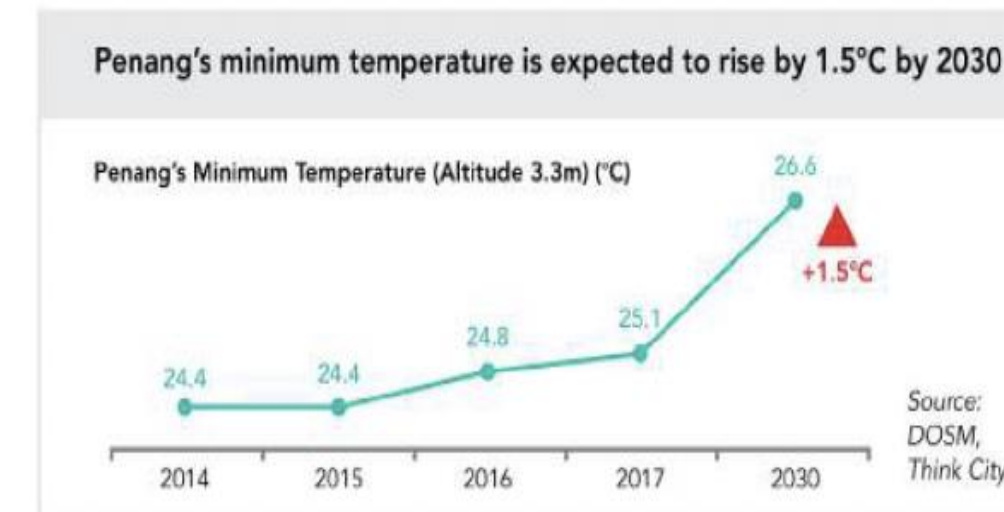


Despite its reputation as the state that manages its water resources most effectively, Penang nevertheless faces serious challenges in coming decades where water security is concerned. Plans are therefore being laid to secure steady sources for clean water.

Penang is very vulnerable to climate change. The average temperature in urban Penang is predicted to rise by 1.5°C by 2030. A combination of increased temperature and flooding will affect the wellbeing of citizens and lead to cumulative economic losses of up to RM 6 billion by 2030.

Penang intends to lead the nation by developing Malaysia's first climate adaptation plan. This will be followed by initiatives focused on cooling urban areas through greening and flood-risk mitigation. Adoption of a 'sponge city model' – one that absorbs water naturally through more permeable surfaces – will go a long way towards reducing floods.

Existing disaster mitigation and management strategies will also be updated to incorporate the latest predictions on temperature and flooding associated with climate change.



KEY INITIATIVES

1. Partnering with international organisations to develop and implement climate adaptation plans
2. Piloting nature-based urban cooling initiatives
3. Adopting a sponge city approach to reduce flood risk
4. Updating disaster mitigation and management strategies to incorporate weather and flood risk

TARGETS

ALL new developments with GBI Gold certified from 2020 onwards	30% of infrastructure construction materials recycled	100% hotels in Penang to be green	20% reduction in domestic water consumption per capita per day	100% LED street lights with smart pole functions	200,000 additional trees planted in Penang
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Rujukan Kami : MBPP.JB.100-5/1/25
Tarikh : 13 Mac 2024

SEPERTI SENARAI EDARAN

YBhg. Dato' / Datuk / Datin / Tuan / Puan,

MAKLUMAN SYARAT TAMBAHAN YANG DIKENAKAN DI PERINGKAT KELULUSAN PERMOHONAN MERANCANG DAN PELAN BANGUNAN

Dengan segala hormatnya, saya diarah merujuk kepada perkara di atas.

2. Ingin dimaklumkan bahawa pihak Majlis Bandaraya Pulau Pinang (Majlis) ingin memperjelaskan bahawa syarat berikut yang dikenakan diperingkat kelulusan Permohonan Merancang dan Pelan Bangunan iaitu :

'Cadangan pembangunan ini hendaklah menggunakan ciri-ciri 'Renewable Energy' terutamanya penggunaan 'Solar Energy' sekurang-kurangnya 50% dan memperoleh sekurang-kurangnya pengiktirafan 'Green Building Index (GBI)' pada tahap kategori 'Gold / Silver'.

adalah hanya tertakluk kepada penggunaan 'Solar Energy' sekurang-kurangnya 50% untuk kemudahan ruang-ruang hakmilik bersama (*common area*) sahaja.

Untuk makluman. Sekian, terima kasih.

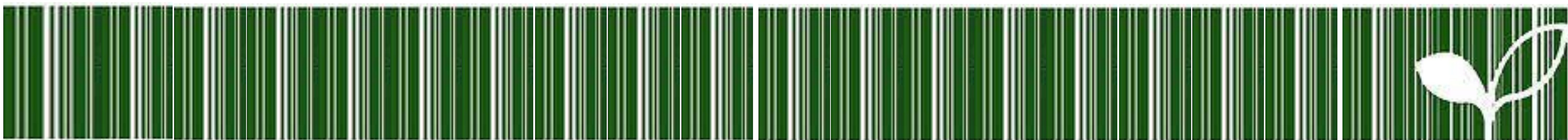
"MALAYSIA MADANI"
"BERKHIDMAT UNTUK NEGARA"
"CEKAP, AKAUNTABILITI, TELUS"

Saya yang menjalankan amanah,

(HAJI RIZUWAN BIN SALLEH)
Pengarah Kawalan Bangunan
Majlis Bandaraya Pulau Pinang



Thank You



BGREEN
RIVERSTONE
ELITE