प्रधान मंत्री आवास योजना-शहरी
Pradhan Mantri Awas Yojana-Urban

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Ministry of Housing and Urban Affairs
Government of India

Azadi Ka Amrit Mahotsav

bmtpc

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

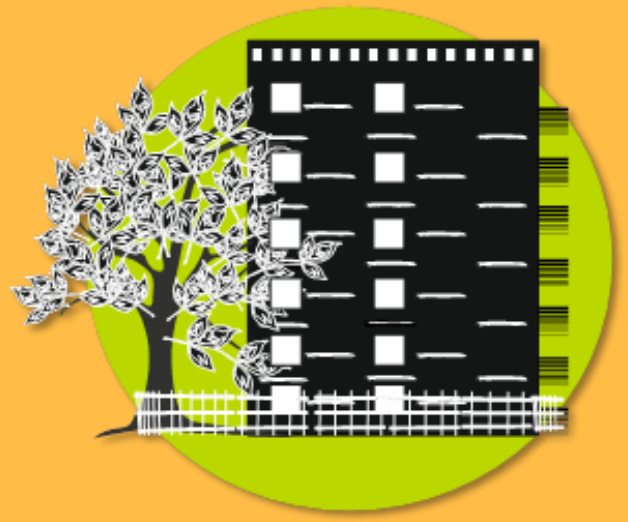
Session 3 – Understanding Passive Design Features

MMM dd, yyyy | Place

eds environmental design solutions

Wuppertal Institut

hunnarshālā FOUNDATION



What is Passive Design

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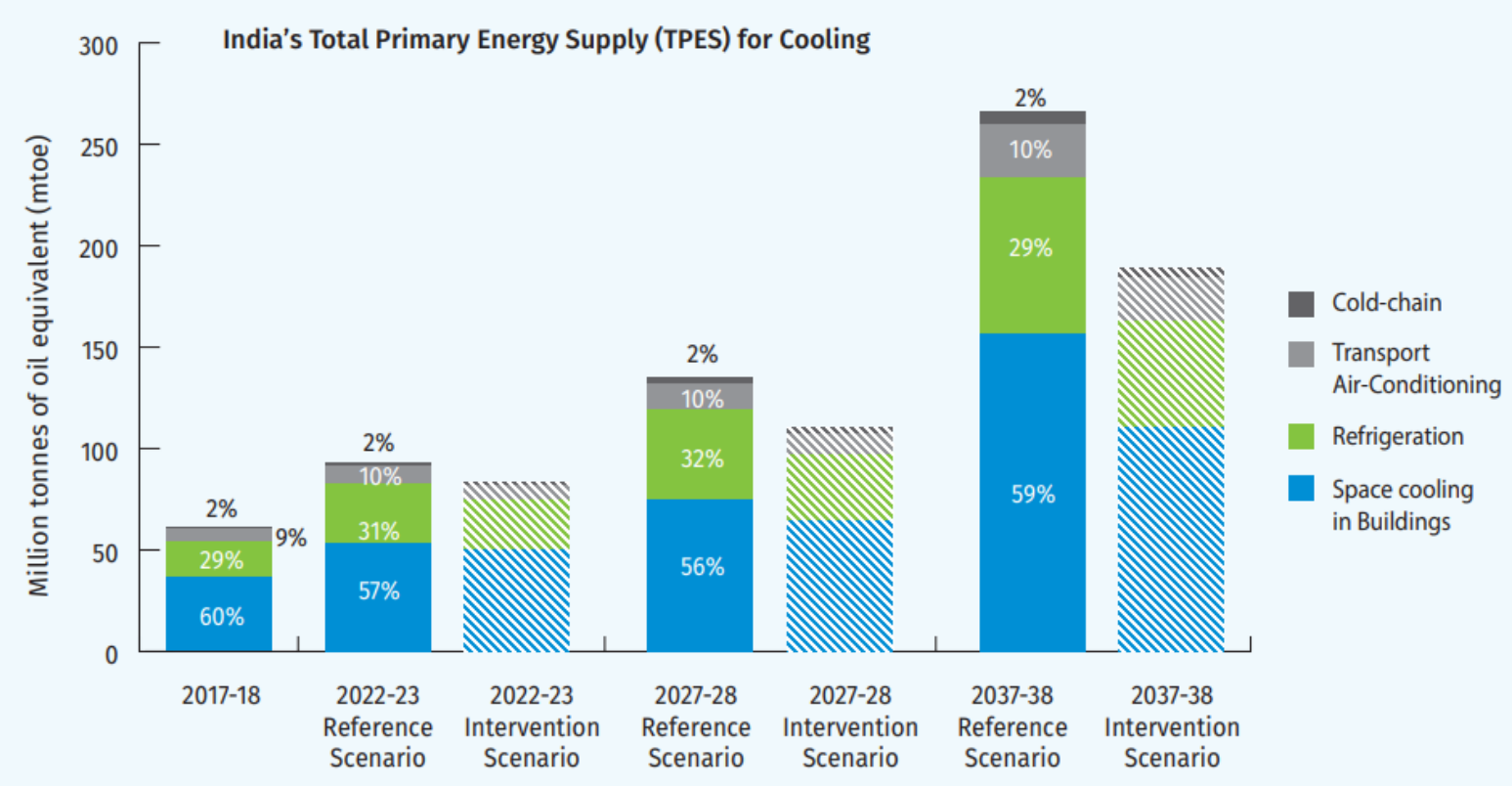
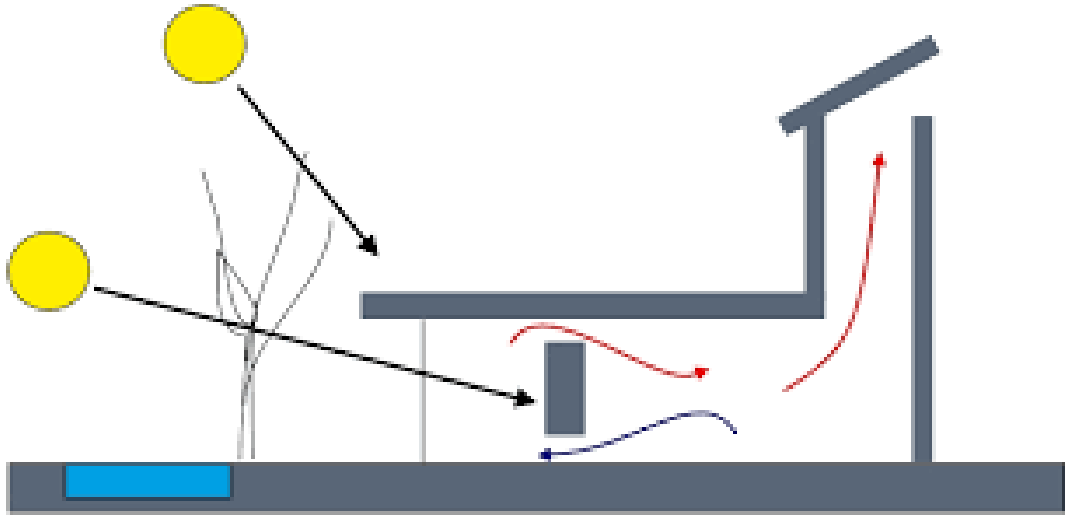


Source – India Cooling Action plan http://ozonecell.nic.in/wp-content/uploads/2019/03/INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf

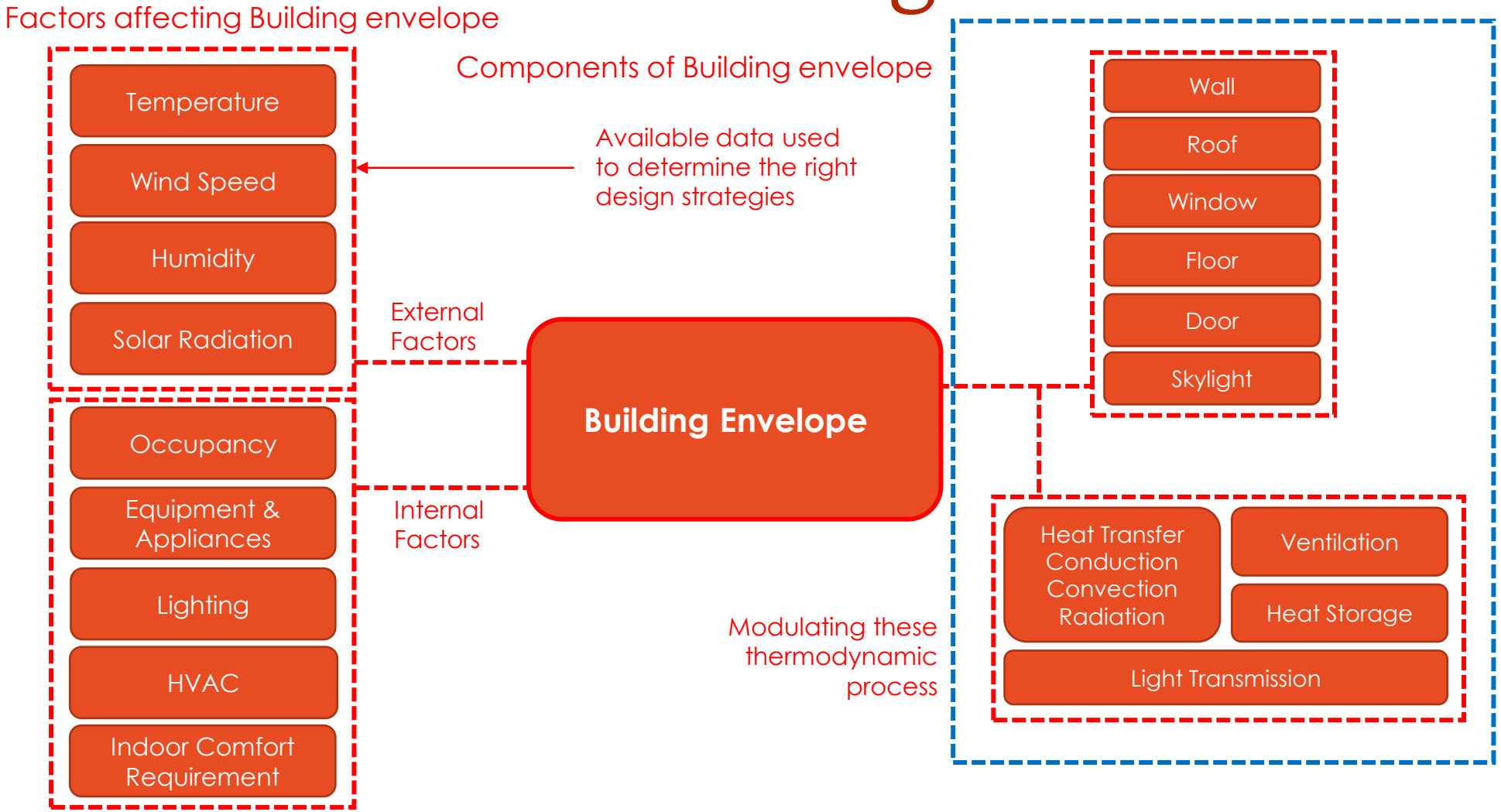
- Total energy needed for cooling is rising significantly.
- An intervention scenario can cut this demand by up to 30%.
- Passive design principles are crucial for sustainable cooling.
- Passive design secures thermal comfort, lowers energy bills, and reduces emissions.
- Benefits last throughout the building's lifespan.

What is Passive Design



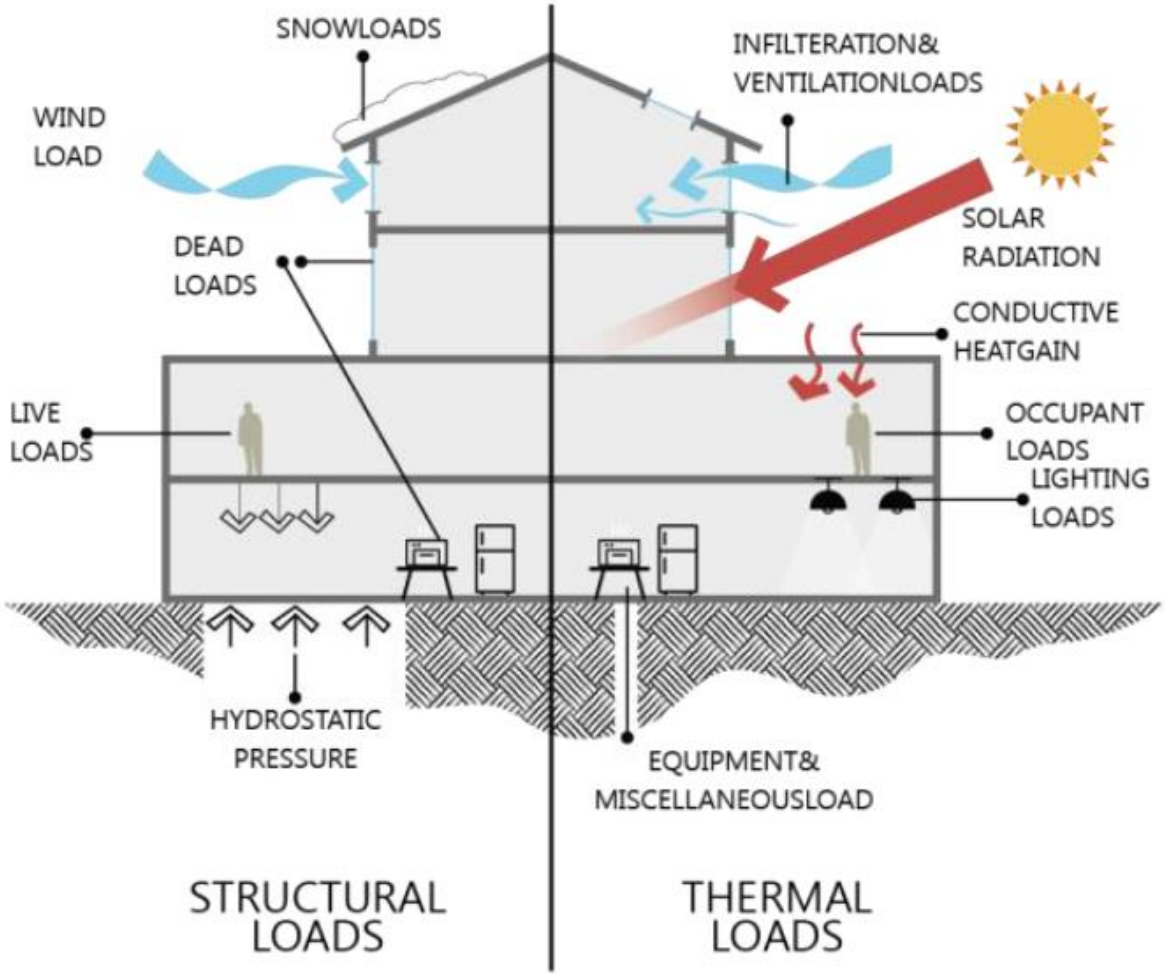
- 'Passive design' is design that takes advantage of the climate to maintain a comfortable temperature range in the home.
- Passive design reduces or eliminates the need for auxiliary heating or cooling, which accounts for about 40-60% (or much more in some climates) of energy use in the average commercial./residential building

What is Passive Design



- Passive design uses natural heating and cooling sources.
- Proper orientation and building envelope design are key.
- Effective design minimizes heat gain and loss.

What is Passive Design



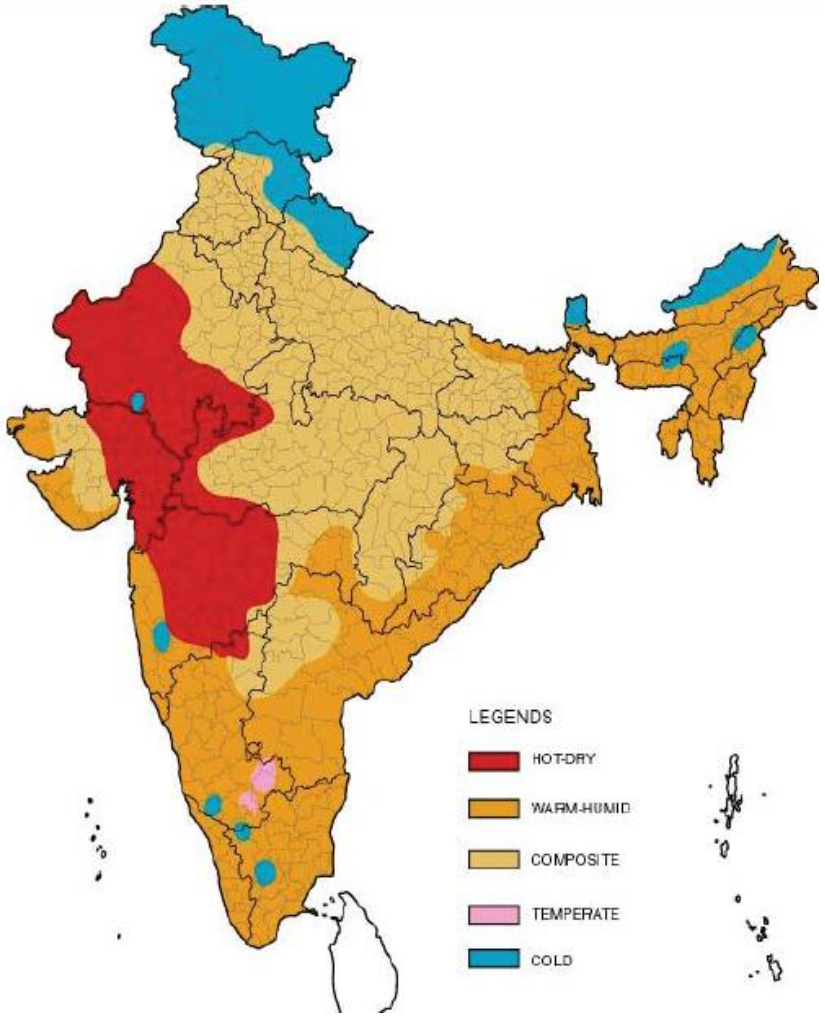
- For best results, 'passive' homes need 'active' users
- People with a basic understanding of how the home works with the daily and seasonal climate, such as when to open or close windows, and how to operate adjustable shading.

What is Passive Design

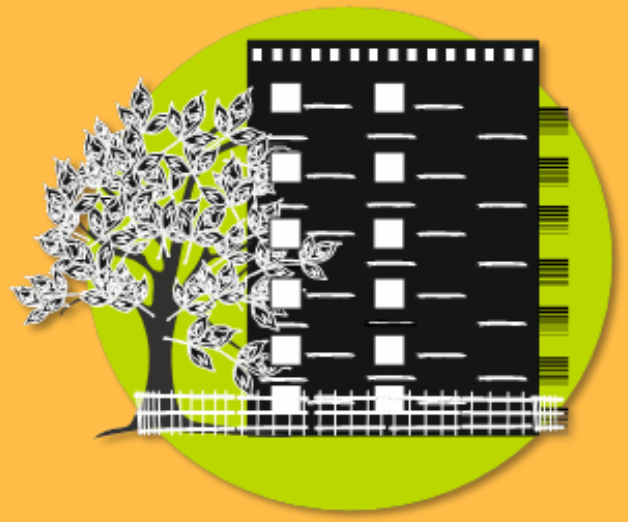
As man moved North, he had to develop different kinds of shelter to be comfortable through the changing seasons.

- Passive design strategies are climate-dependent.
- The right mix of strategies depends on your site's attributes.
- Consider thermal loads while designing the building.

Climate of India

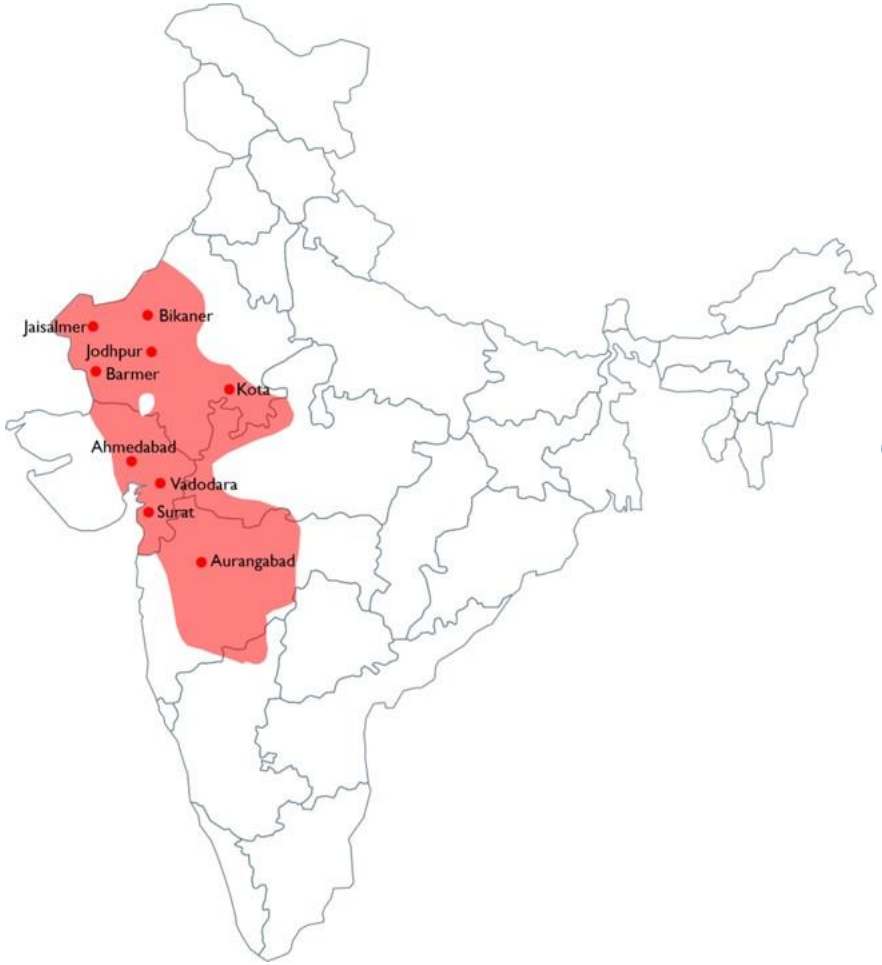


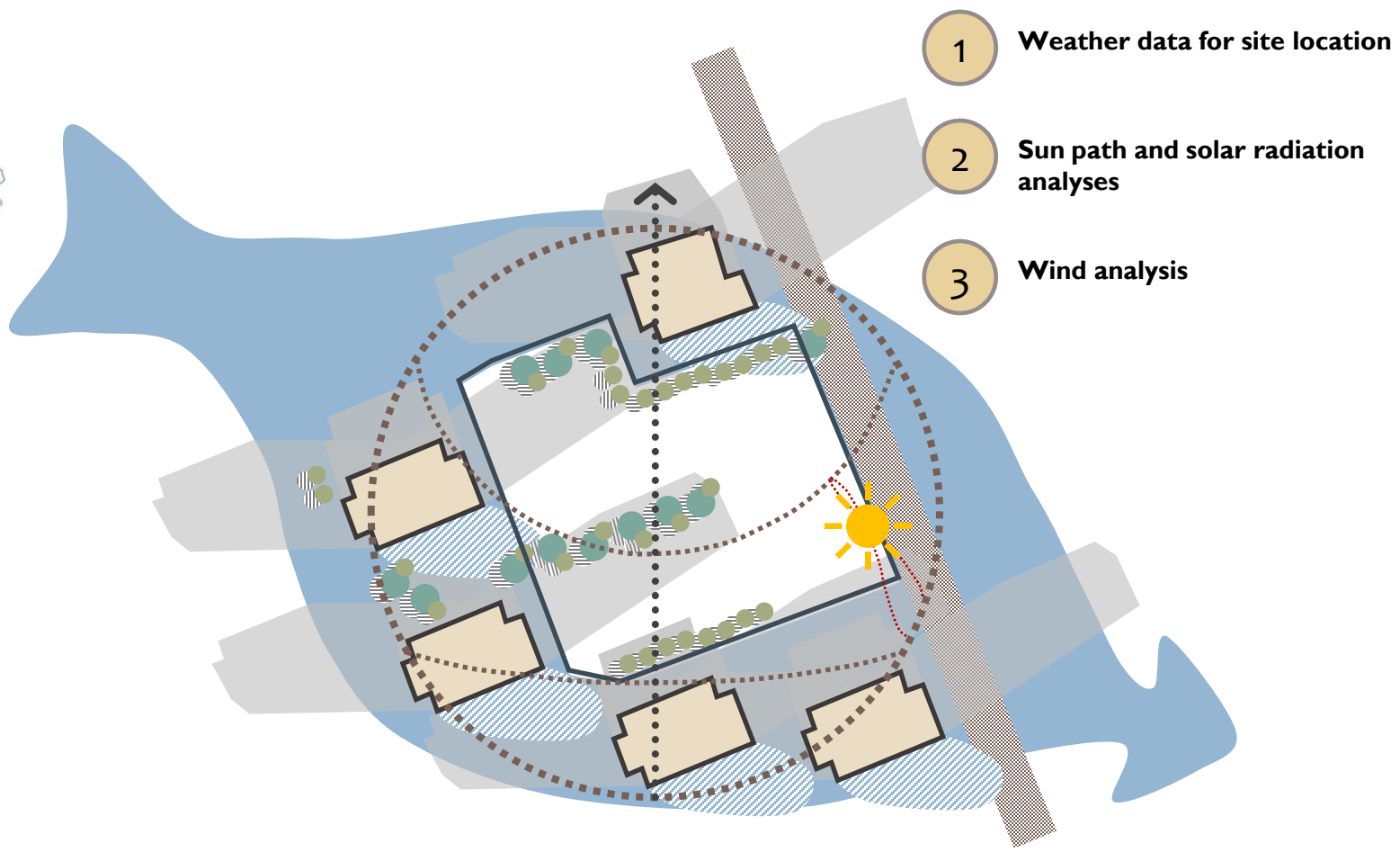
- There are 5 climate zones in India as per NBC
- Each climate zone has its own characteristics
- Building design needs to respond to the climate accordingly



Passive Design features for Hot-Dry Climate

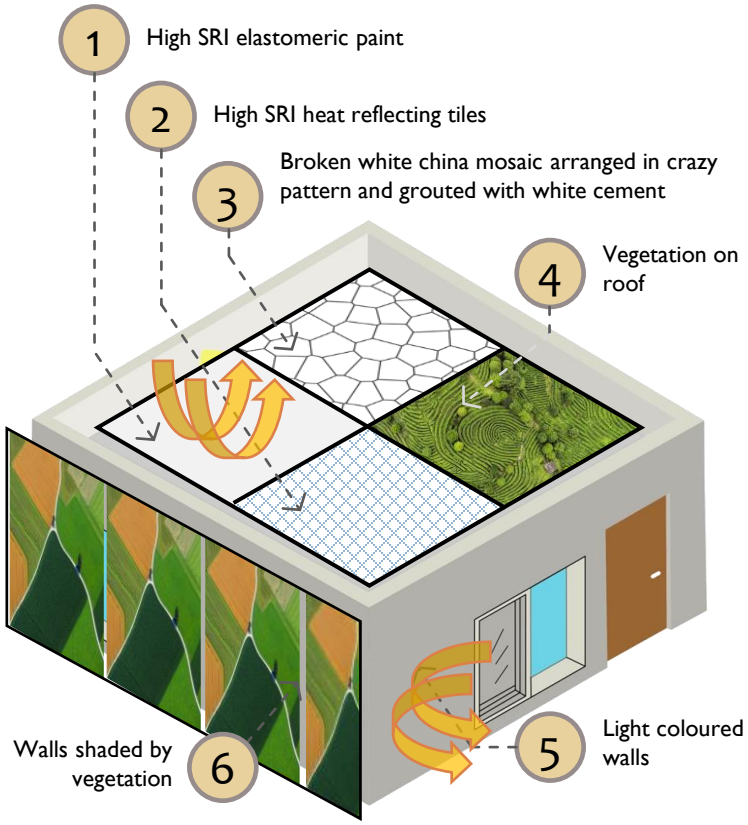
Site Context – Microclimate, Siting & Orientation



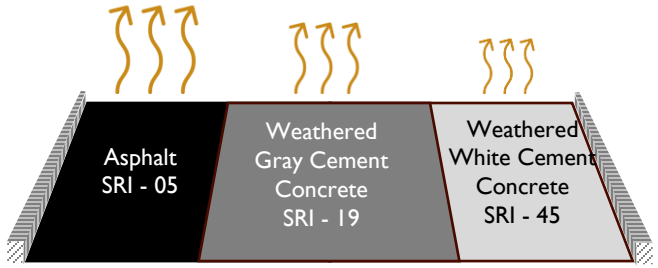


Mitigating Urban Heat Island

Reflective roof & wall surfaces

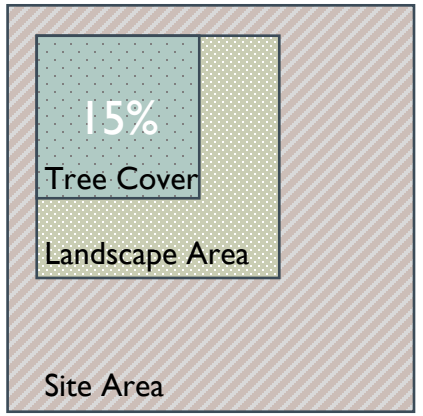


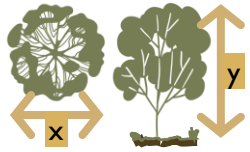
Reducing Paved Surfaces

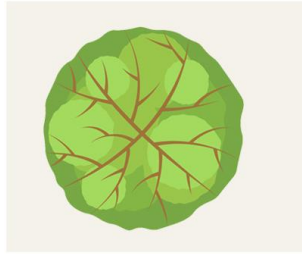


- **Reduce hard paved areas**
- **Shade paved areas**
- **Use reflective and emitting surfaces for pavements**

Tree Canopy







Neem (Azadirachta Indica)
Crown Dia: 10-20m
Tree Height: 15-30m

Gulmohar (Delonix Regia)
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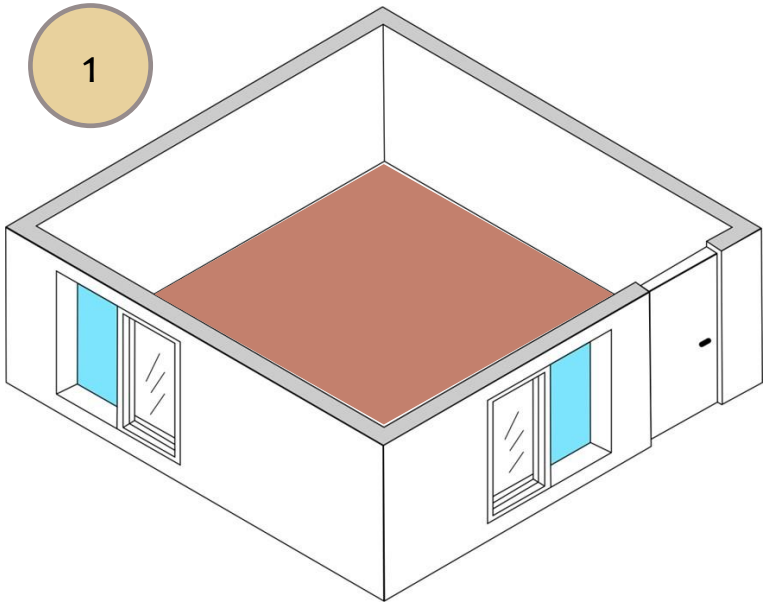
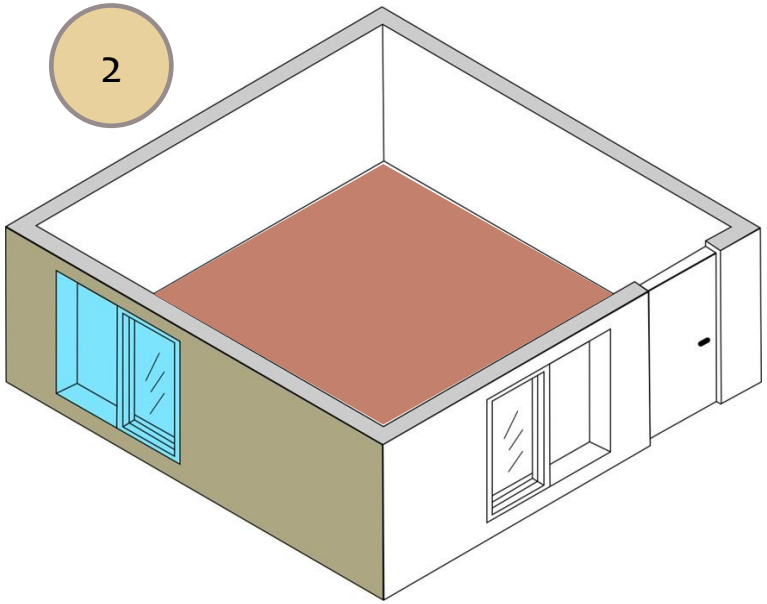
Tree Height: 15-20m

Opening ratios for regulating ventilation & heat gains



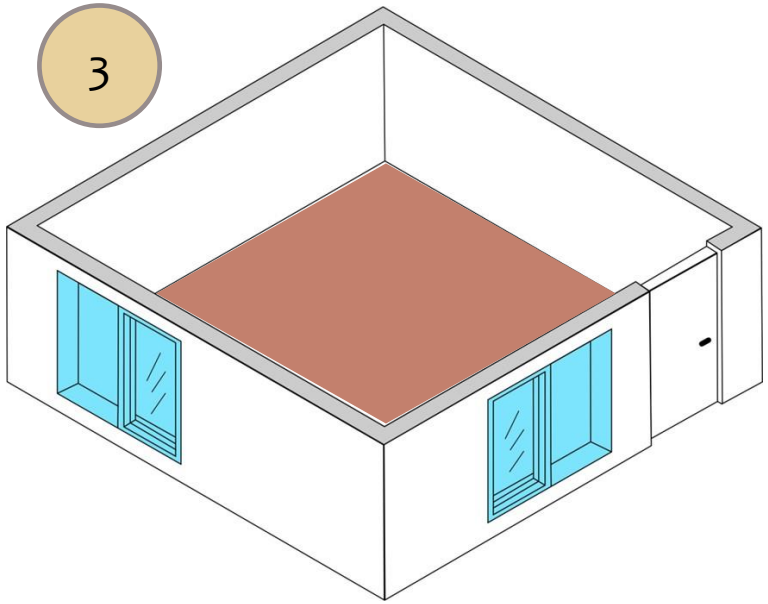
$$Openable\ Window\ Area / Carpet\ Area \geq 1/10$$

Operable window area ratio



$$Window\ Area / Wall\ Area \leq 1/4$$

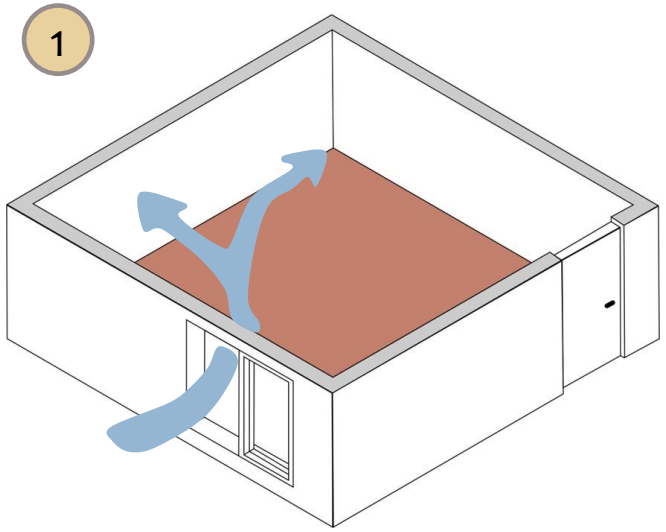
Window to wall area ratio



$$Window\ Area / Carpet\ Area \leq 2/5$$

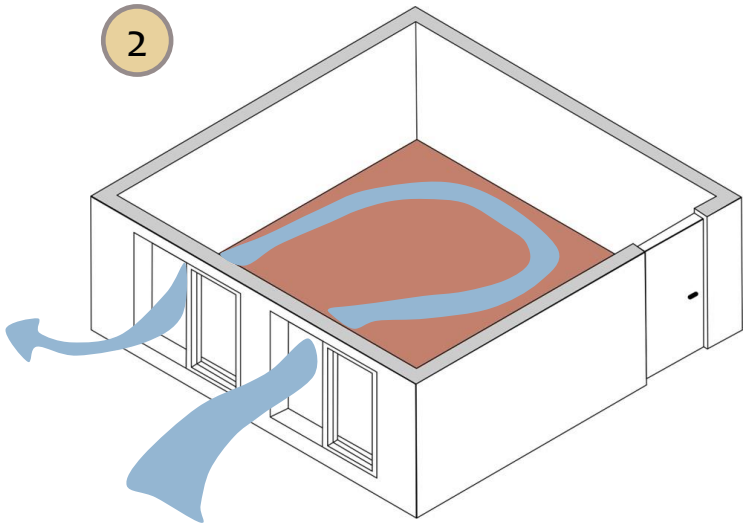
Operable window to wall area ratio

Window openings for enhanced ventilation



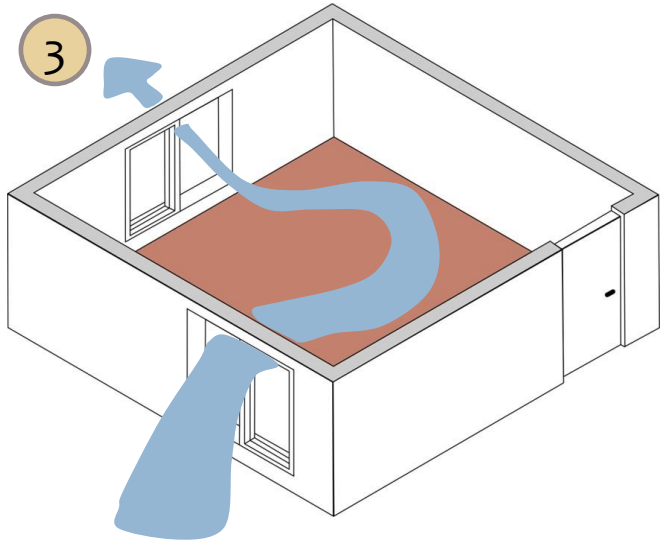
Level A

Single-sided ventilation



Level A+

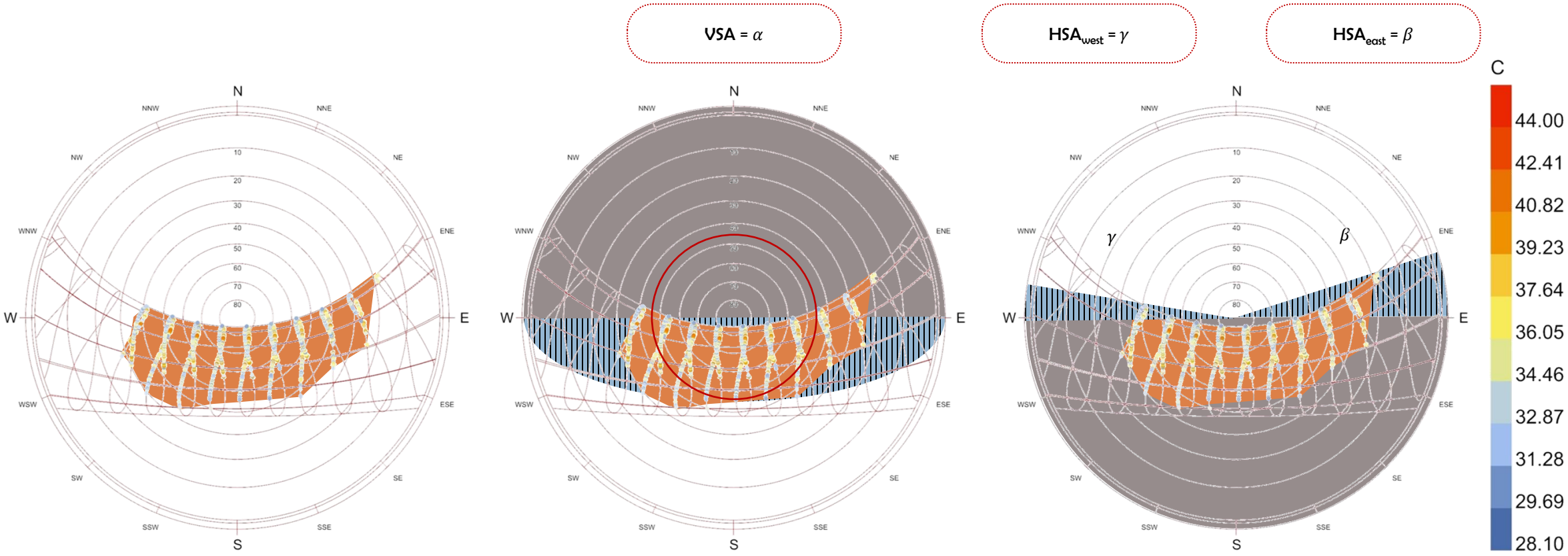
Single sided ventilation: Openings distributed on a single side



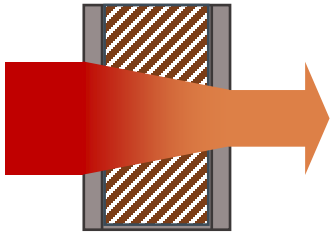
Level A++

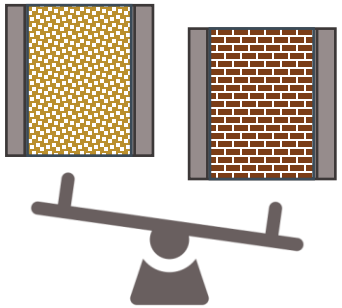
Two (or more)-sided ventilation: Windows on adjacent walls

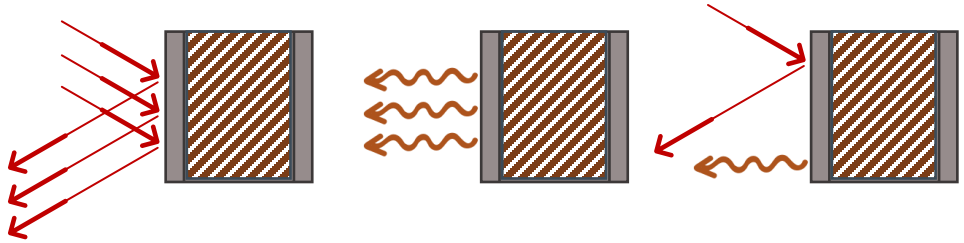
Window Shading



Walls





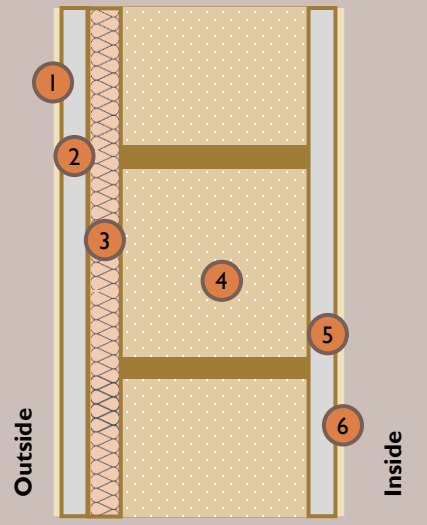


U-factor in W/m²K

	Light-weight assembly	Medium/Heavy-weight assembly
Density (kg/m³)	≥800	<800
Level A	0.80	1.00 or lower
Level A+	0.60	0.80 or lower
Level A++	0.40	0.45 or lower

Reflectance	0.60 or higher
Emittance	0.75 or higher
SRI	29 or higher

Walls



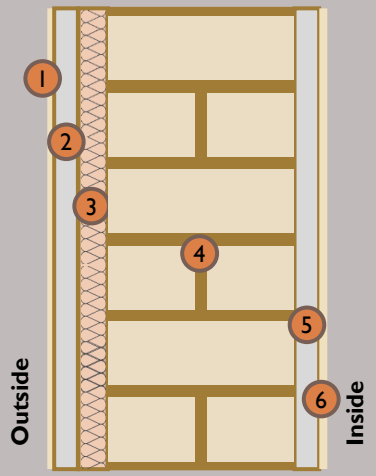
AAC Block Wall with external insulation

1. Exterior paint
2. Cement plaster/base coat (over reinforcing mesh)
3. Rigid insulation board applied with water based adhesive and held in place with PVC fasteners
4. AAC block work
5. Internal plaster (GI chicken wire mesh over block-work and structure joints)
6. Interior paint

AAC Block work 150 mm

XPS/PUF 50 mm

230 mm thick **~0.34 W/m²K**



Fly ash brick wall with external insulation

1. Exterior paint
2. Cement plaster/base Coat (over reinforcing mesh)
3. Rigid insulation board applied with adhesive and held in place with PVC fasteners
4. Fly-ash block work
5. Internal plaster
6. Interior paint

Fly ash brick 230 mm

Expanded Polystyrene 25 mm

285 mm thick **0.89 W/m²K**

Fly ash brick 230 mm

XPS/PUF 25 mm

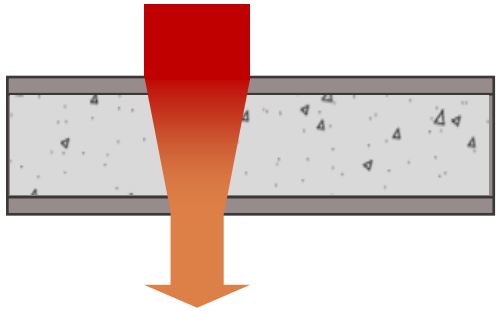
285 mm thick **~0.75 W/m²K**

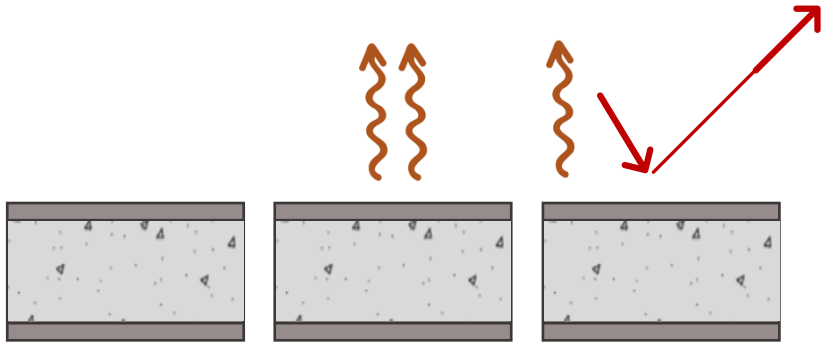
Fly ash brick 230 mm

XPS/PUF 50 mm

315 mm thick **~0.45 W/m²K**

Roof





U-factor in W/m²K

Level A	0.75	or lower
Level A+	0.45	or lower
Level A++	0.25	or lower

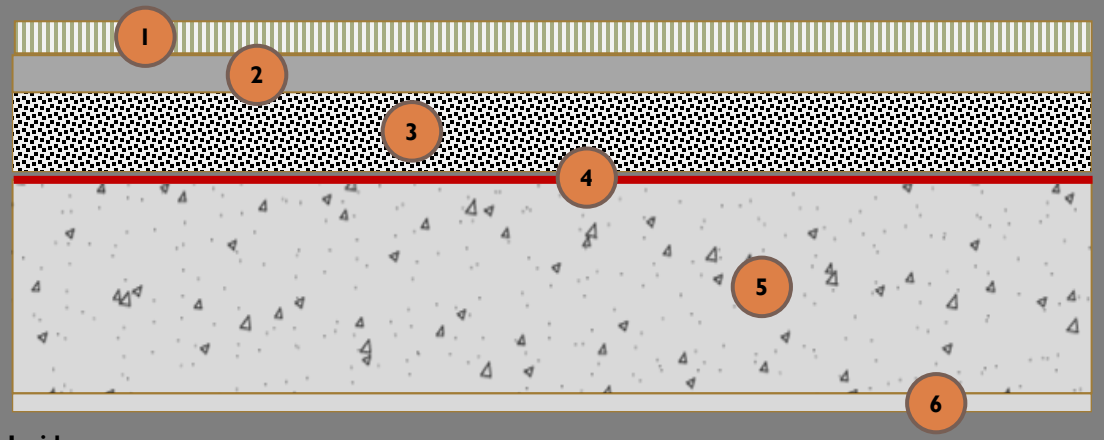
Reflectance **Emittance** **SRI**

Reflectance	0.70 or higher
Emittance	0.75 or higher
SRI	78 or higher

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Roof

Outside



Inside

Foam concrete insulation over RCC slab. Roof assembly finished with broken white china mosaic.

1. Broken china mosaic (white tiles grouted with white cement) applied with cement mortar
2. Plain Cement Concrete (PCC) screed laid to slope
3. Foam concrete
4. Waterproofing layer
5. Reinforced Cement Concrete (RCC) slab (as/structural design)
6. Internal plaster

Foam concrete 75 mm

RCC slab as/design

~280 mm thick | **~0.73 W/m²K**

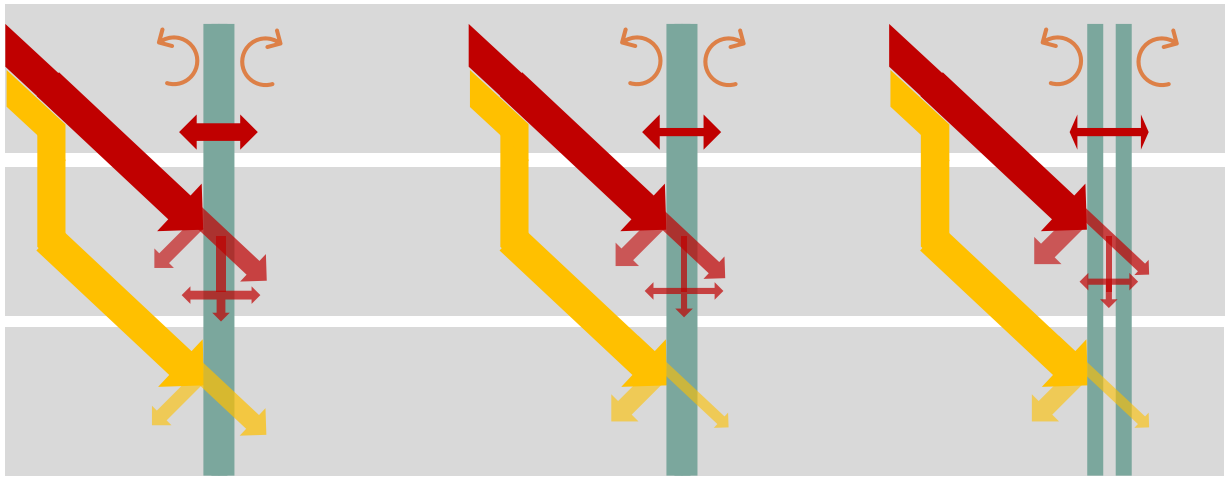
Foam concrete 150 mm

RCC slab as/design

~355 mm thick | **~0.41 W/m²K**

Windows

Glazing assembly



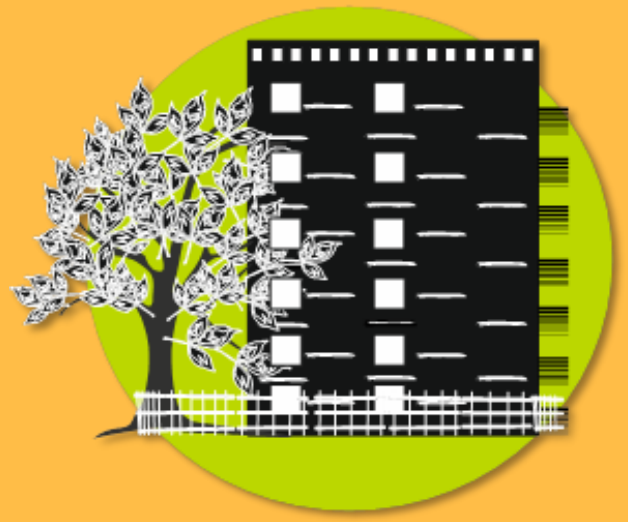
	Level A	Level A+	Level A++
U-factor	5.7 or lower	4.8 or lower	2.8 or lower
SHGC	0.6 or lower	0.4 or lower	
VLT	0.3 or higher		

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Metal frame with thermal break

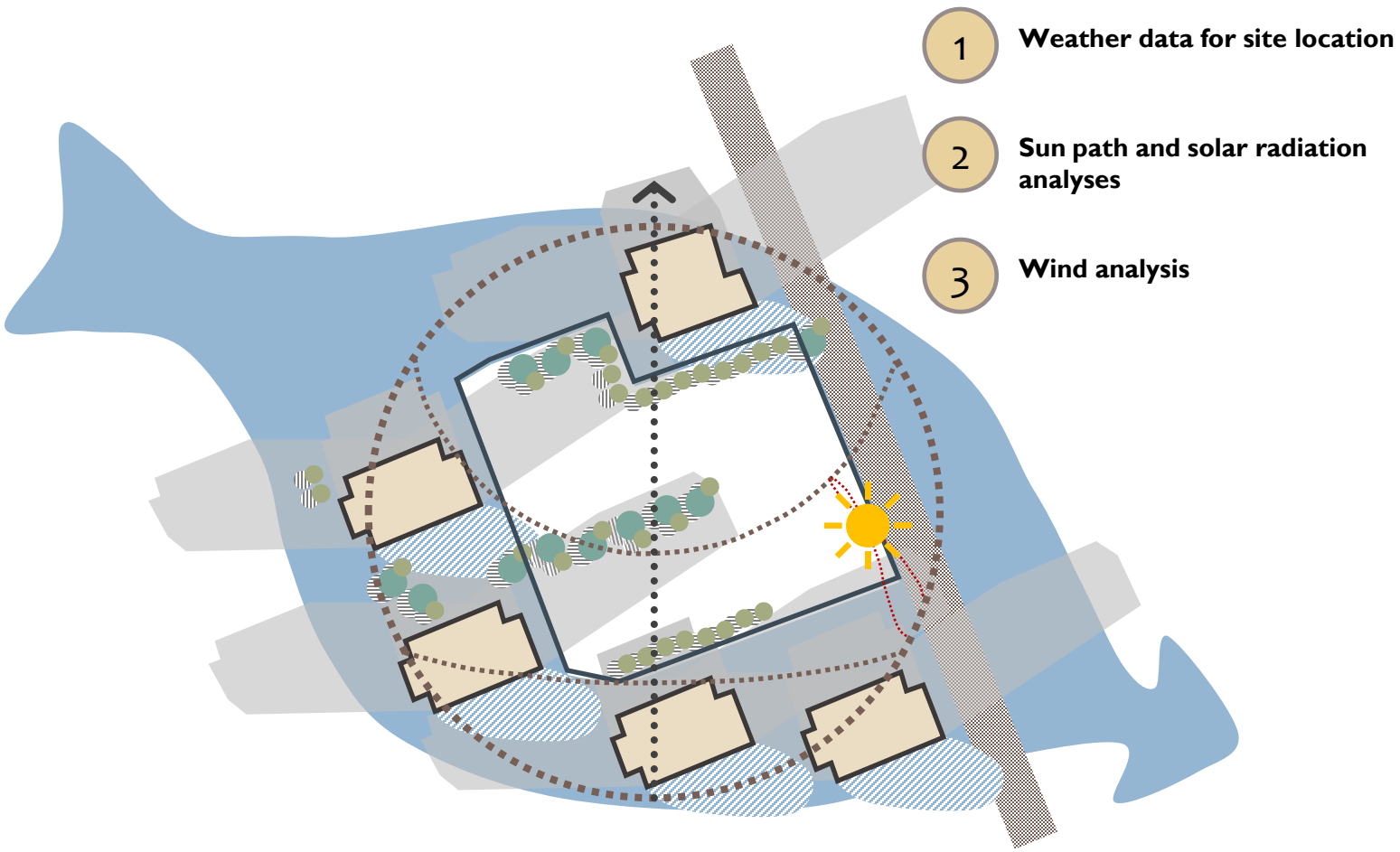
Wooden frame

Vinyl frame



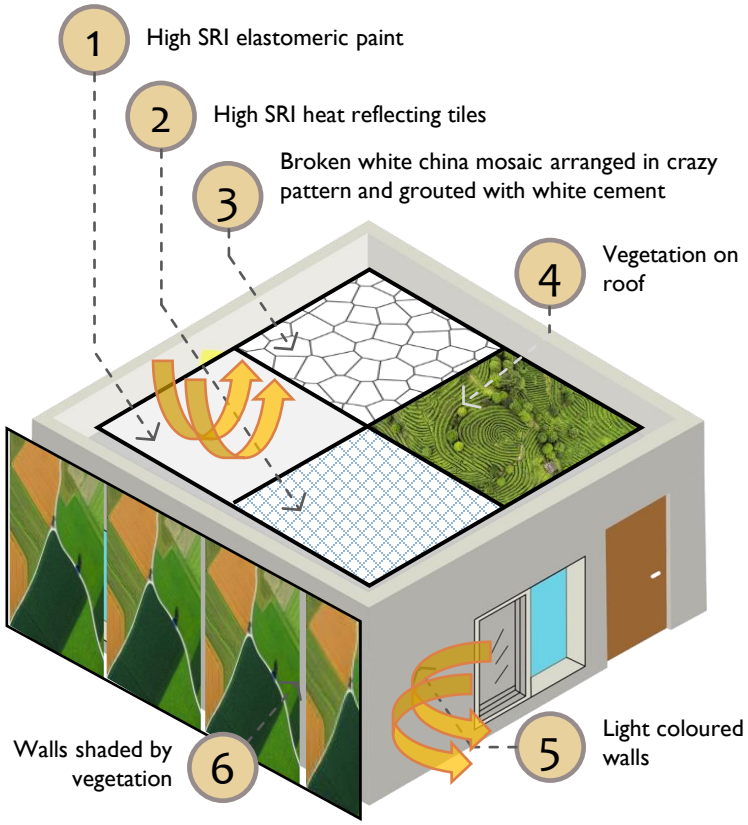
Passive Design features for Warm-Humid Climate

Site Context – Microclimate, Siting & Orientation

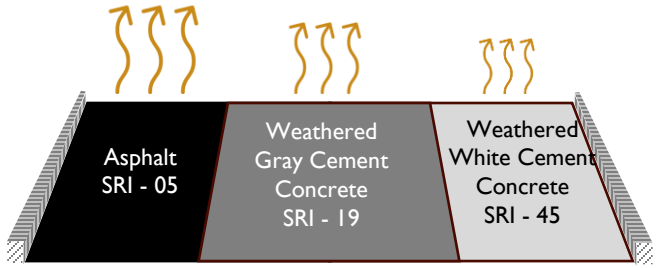


Mitigating Urban Heat Island

Reflective roof & wall surfaces

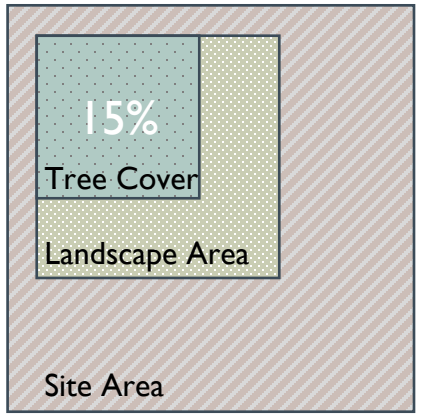


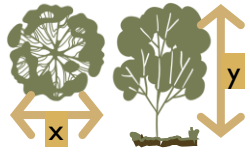
Reducing Paved Surfaces

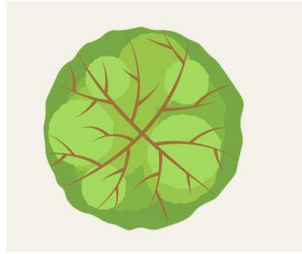


- **Reduce hard paved areas**
- **Shade paved areas**
- **Use reflective and emitting surfaces for pavements**

Tree Canopy







Neem (Azadirachta Indica)
Crown Dia: 10-20m
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Gulmohar (Delonix Regia)
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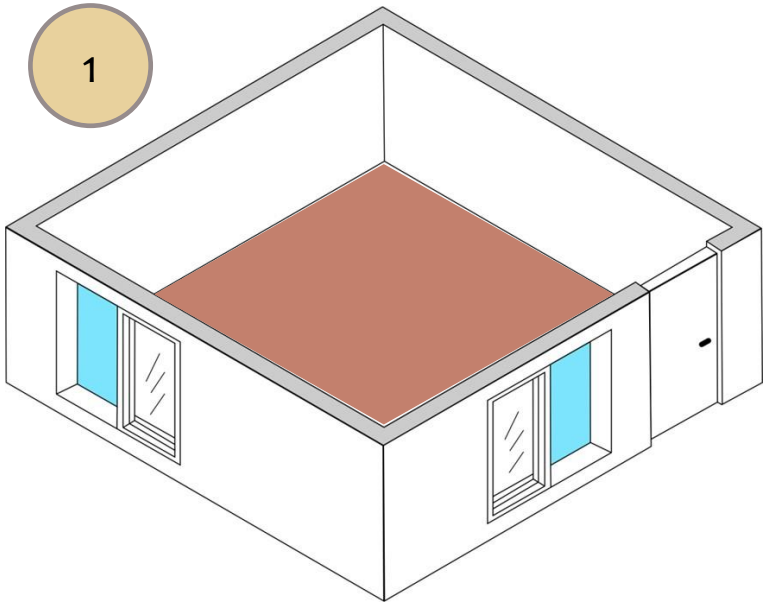
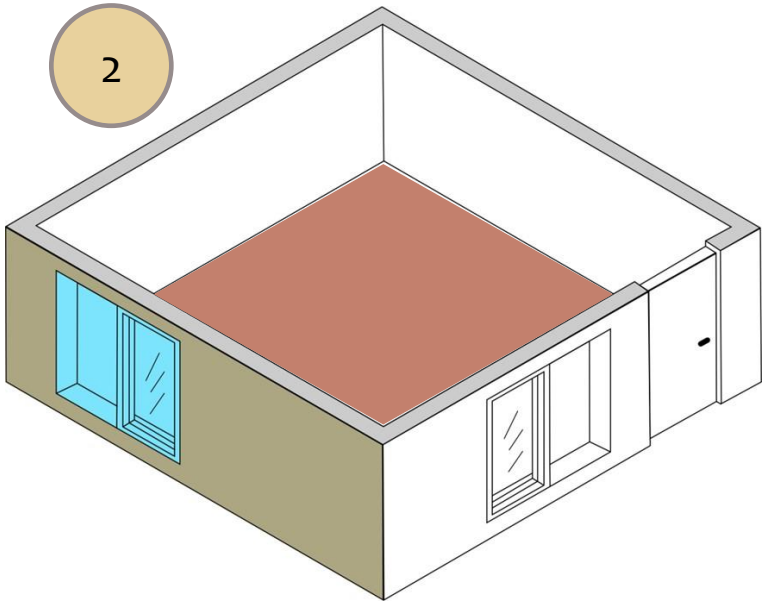
Opening ratios for regulating ventilation & heat gains



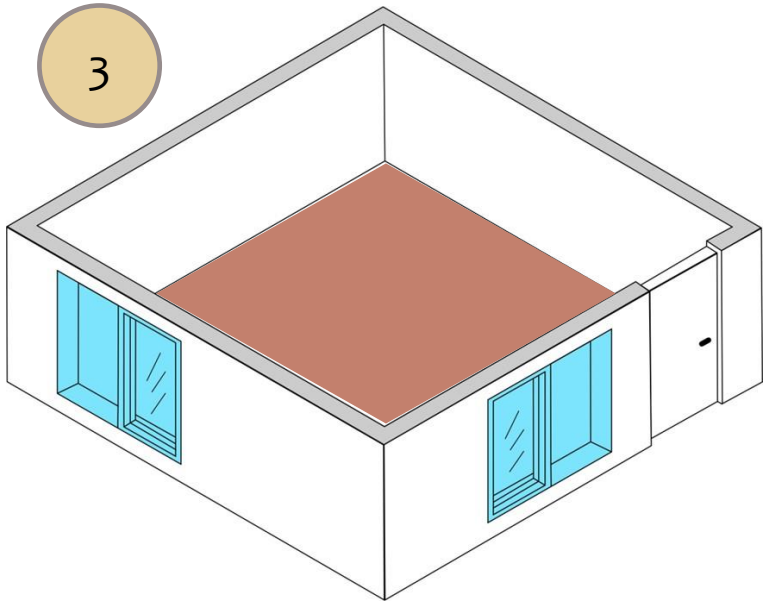
$$Openable\ Window\ Area / Carpet\ Area \geq 1/6$$

Operable window area ratio



$$Window\ Area / Wall\ Area \leq 1/4$$

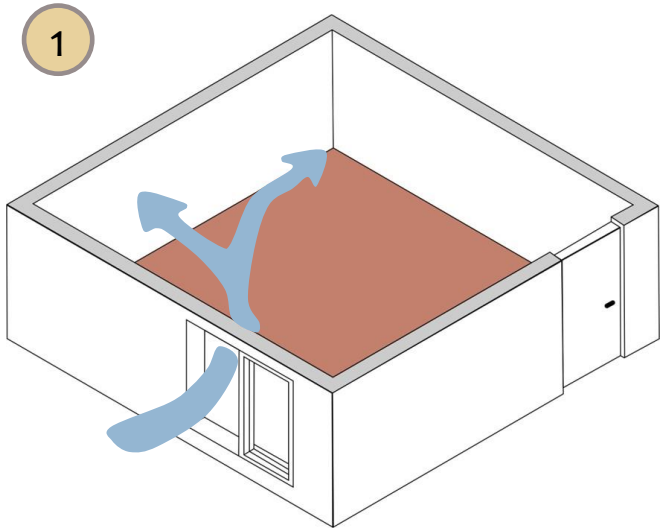
Window to wall area ratio



$$Window\ Area / Carpet\ Area \leq 2/5$$

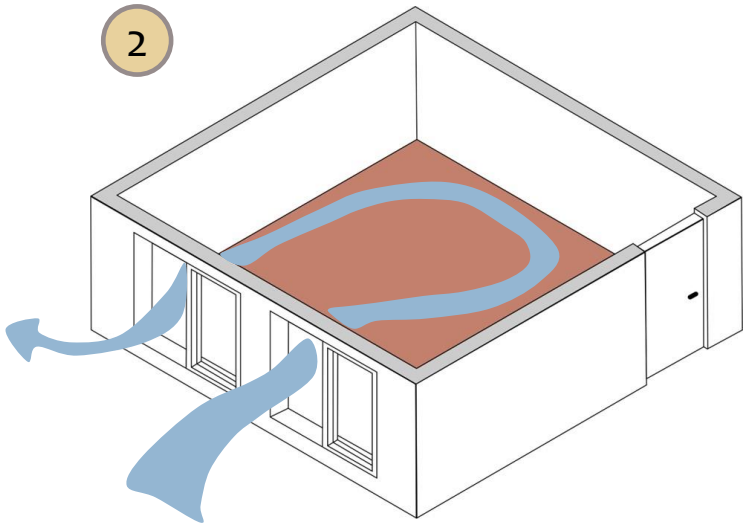
Operable window to wall area ratio

Window openings for enhanced ventilation



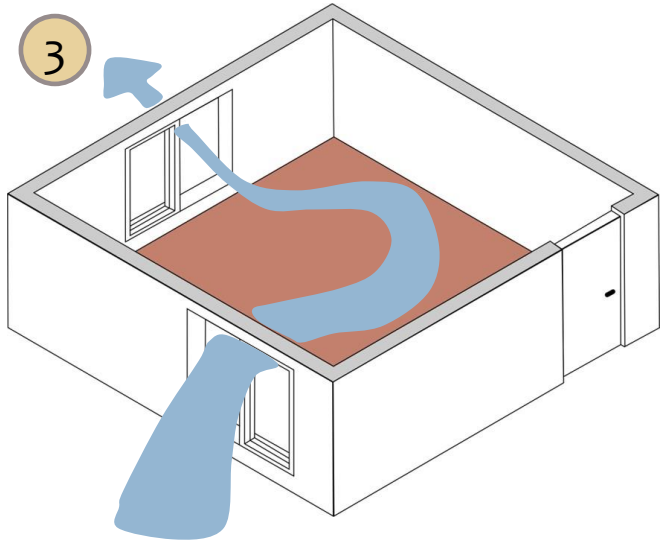
Level A

Single-sided ventilation



Level A+

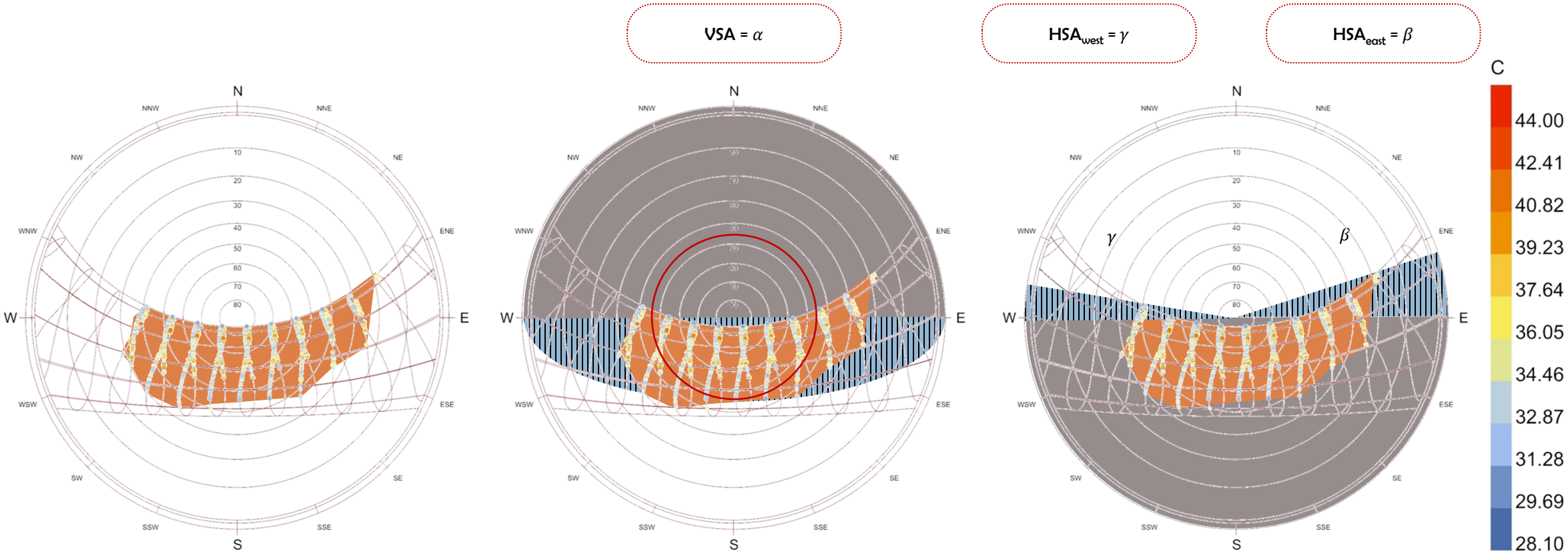
Single sided ventilation: Openings distributed on a single side



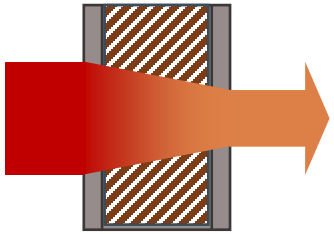
Level A++

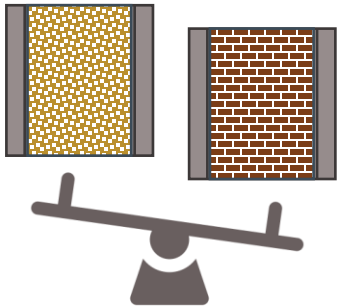
Two (or more)-sided ventilation: Windows on adjacent walls

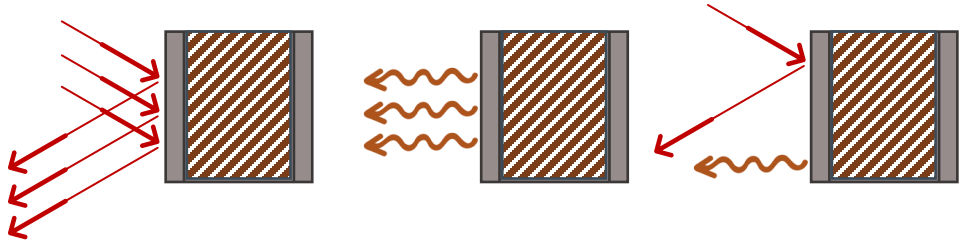
Window Shading



Walls





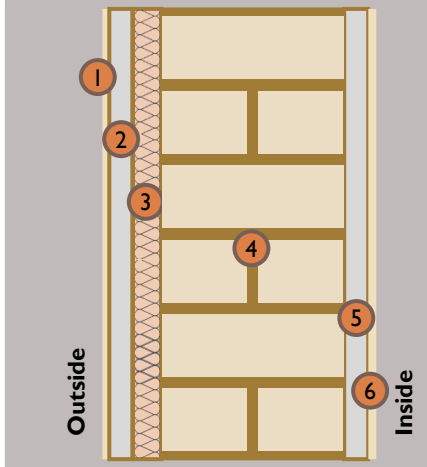


U-factor in W/m²K

Density (kg/m³)	Light-weight assembly ≥800	Medium/Heavy-weight assembly <800
Level A	0.80	1.00 or lower
Level A+	0.60	0.80 or lower
Level A++	0.40	0.45 or lower

	Reflectance	Emittance	SRI
Reflectance	0.60 or higher		
Emittance	0.75 or higher		
SRI	29 or higher		

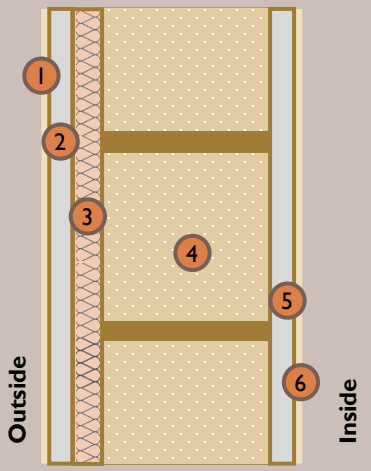
Walls



Fly ash brick wall with external insulation

1. Exterior paint
2. Cement plaster/base Coat (over reinforcing mesh)
3. Rigid insulation board applied with adhesive and held in place with PVC fasteners
4. Fly-ash block work
5. Internal plaster
6. Interior paint

Fly ash brick 230 mm	
Expanded Polystyrene 25 mm	
285 mm thick	**0.89 W/m²K**
Fly ash brick 230 mm	
XPS/PUF 25 mm	
285 mm thick	**~0.75 W/m²K**
Fly ash brick 230 mm	
XPS/PUF 50 mm	
315 mm thick	**~0.45 W/m²K**

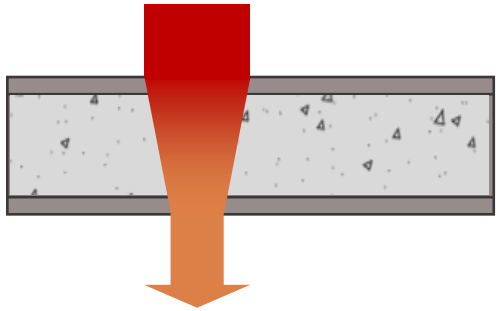


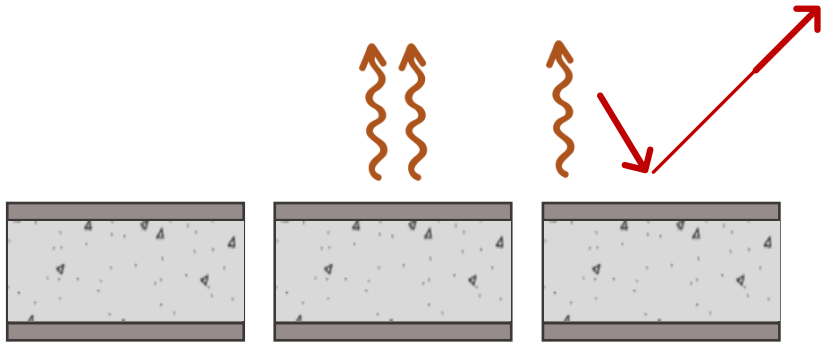
AAC Block Wall with external insulation

1. Exterior paint
2. Cement plaster/base coat (over reinforcing mesh)
3. Rigid insulation board applied with water based adhesive and held in place with PVC fasteners
4. AAC block work
5. Internal plaster (GI chicken wire mesh over block-work and structure joints)
6. Interior paint

AAC Block work 150 mm	
XPS/PUF 50 mm	
230 mm thick	**~0.34 W/m²K**

Roof





U-factor in W/m²K

Level A	0.75	or lower
Level A+	0.45	or lower
Level A++	0.25	or lower

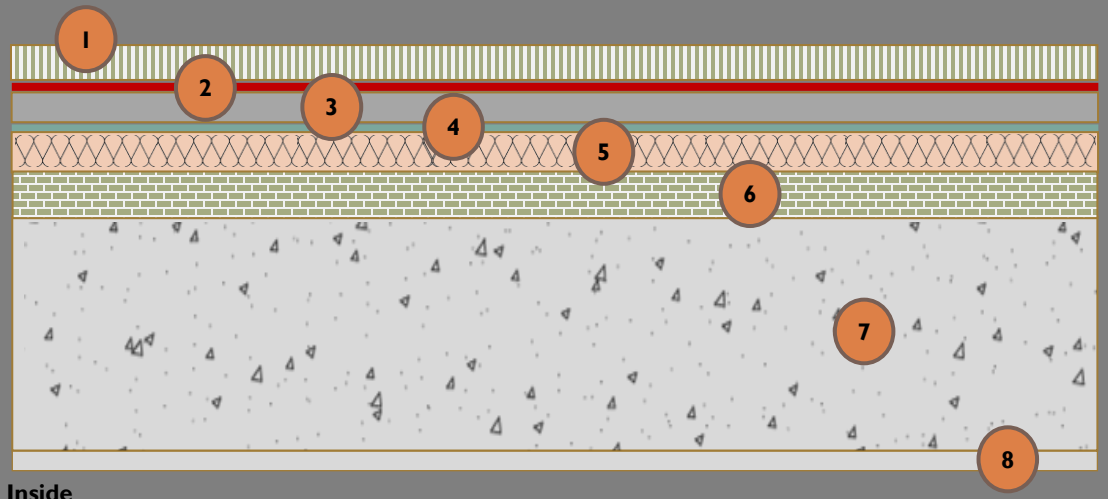
Reflectance **Emittance** **SRI**

Reflectance	0.70 or higher
Emittance	0.75 or higher
SRI	78 or higher

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Roof

Outside



Inside

Rigid foam insulation over RCC slab. Roof assembly finished with broken white china mosaic.

1. Broken china mosaic (white tiles grouted with white cement) applied with cement mortar
2. Water proofing layer
3. Cement screed with welded mesh
4. Polythene sheet/Geo-textile membrane
5. Rigid insulation board applied with water-based adhesive
6. Brick-bats/Plain Cement Concrete (PCC) laid to slope
7. RCC slab (as/structural design)
8. Internal plaster

PUF/XPS 25 mm

RCC slab as/design

~280 mm thick | **~0.73 W/m²K**

PUF/XPS 50 mm

RCC slab as/design

~305 mm thick | **~0.45 W/m²K**

PUF/XPS 75 mm

Foam Concrete 100mm*

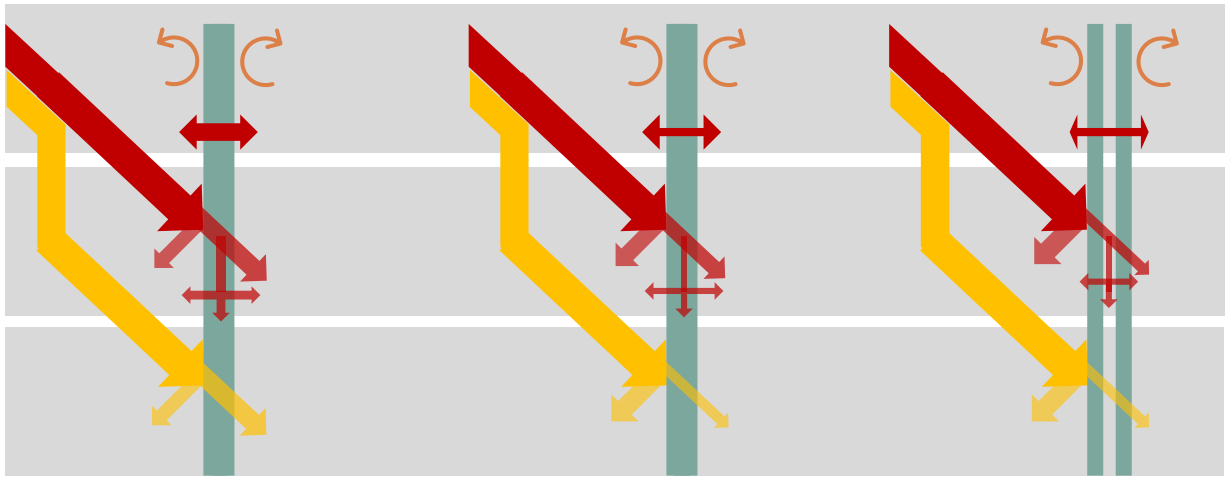
RCC slab as/design

~305 mm thick | **~0.45 W/m²K**

*Replace Brick-bat coba/PCC in #6 with foam concrete – laid to slope.

Windows

Glazing assembly



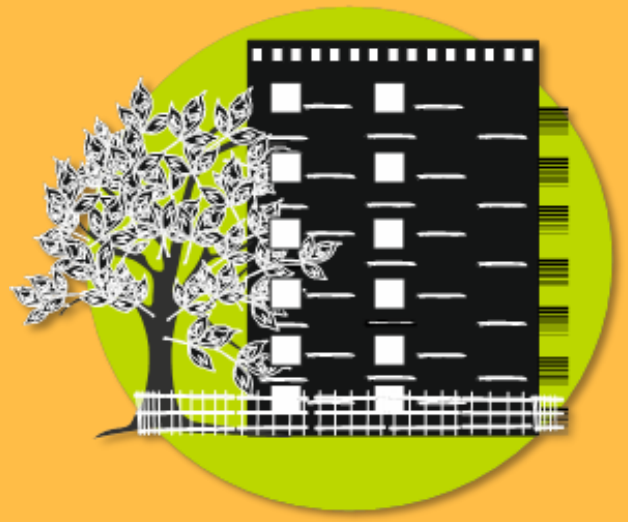
	Level A	Level A+	Level A++
U-factor	5.7 or lower	4.8 or lower	2.8 or lower
SHGC	0.6 or lower	0.4 or lower	
VLT	0.3 or higher		

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Metal frame with thermal break

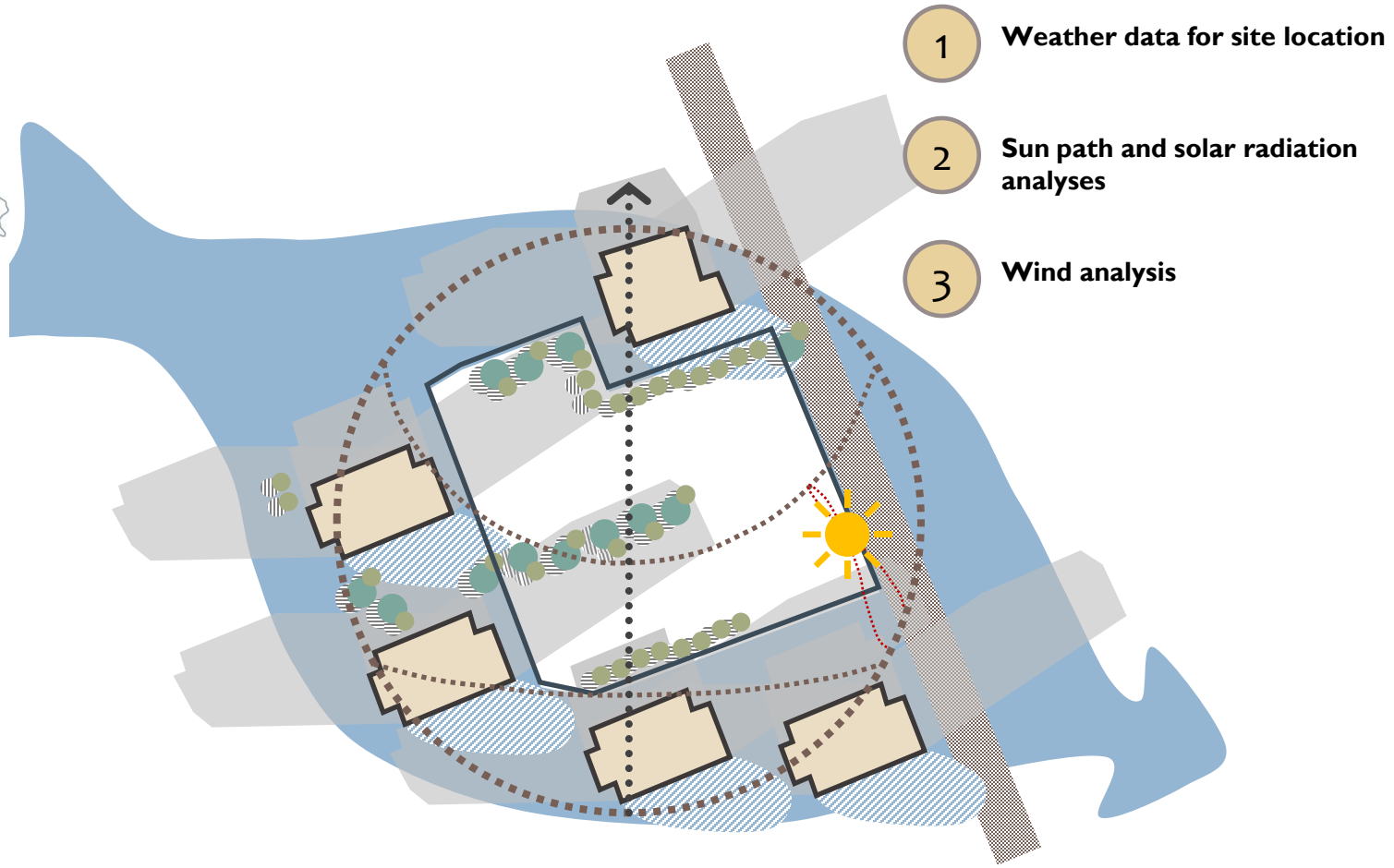
Wooden frame

Vinyl frame



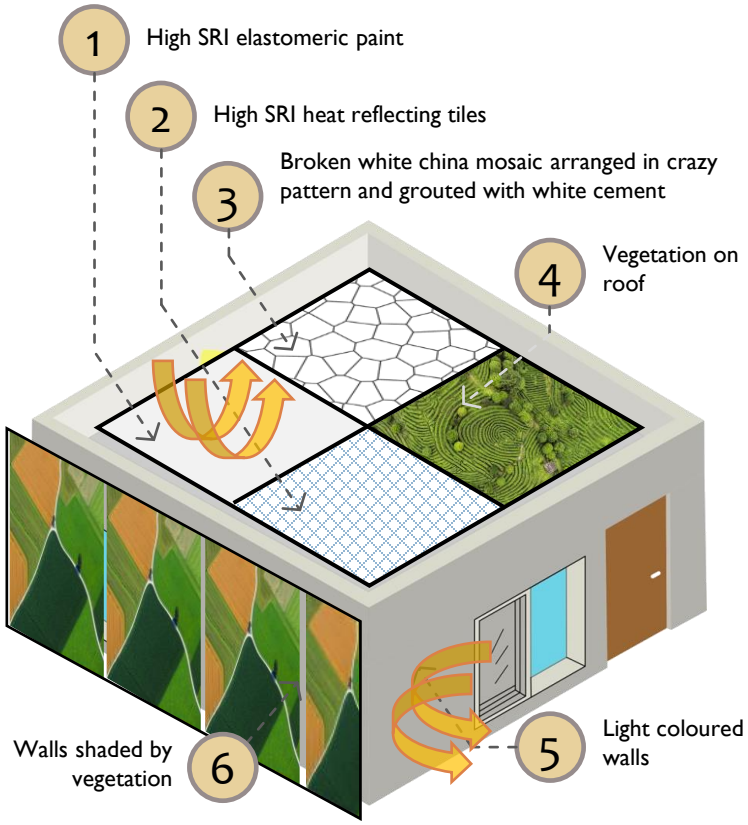
Passive Design features for Composite Climate

Site Context – Microclimate, Siting & Orientation

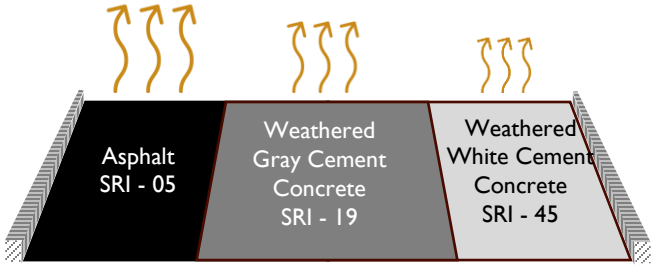


Mitigating Urban Heat Island

Reflective roof & wall surfaces

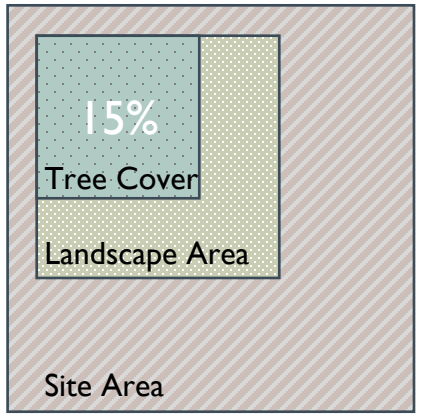


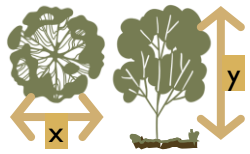
Reducing Paved Surfaces

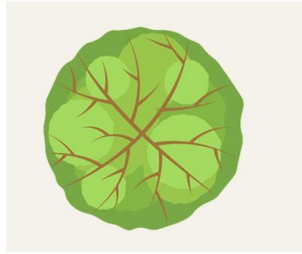


- **Reduce hard paved areas**
- **Shade paved areas**
- **Use reflective and emitting surfaces for pavements**

Tree Canopy



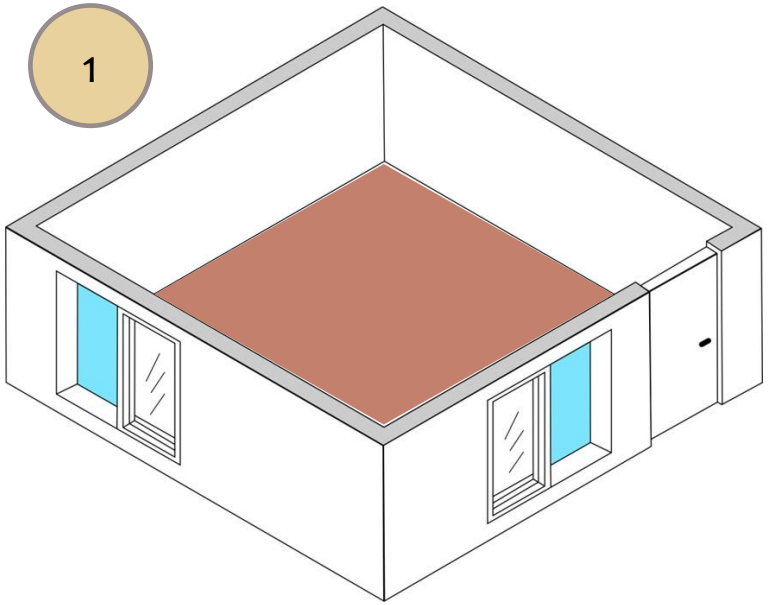




Neem (Azadirachta Indica)
Crown Dia: 10-20m
Tree Height: 15-30m

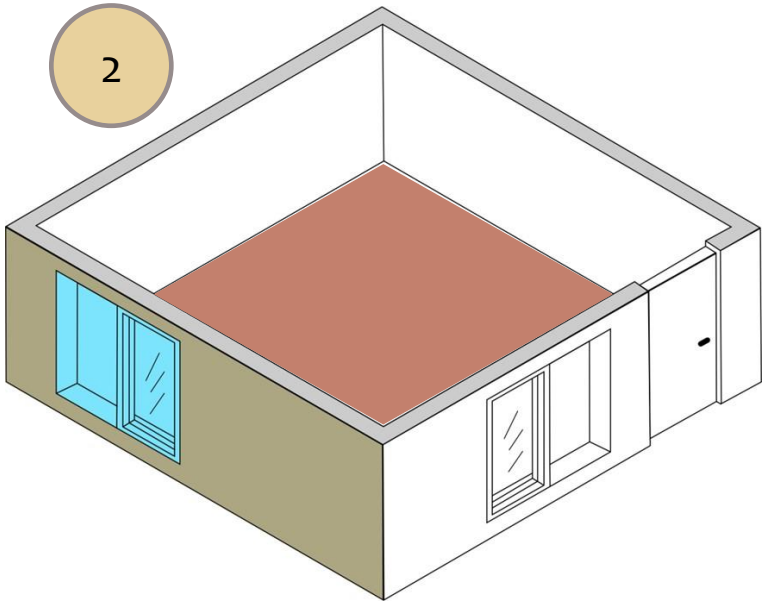
Gulmohar (Delonix Regia)
Crown Dia: 8-12m
Tree Height: 15-20m

Opening ratios for regulating ventilation & heat gains



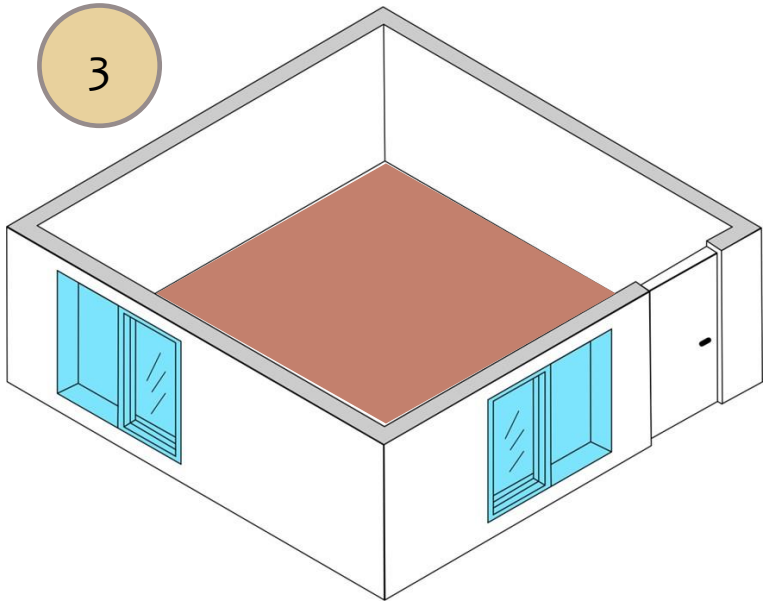
$$Openable\ Window\ Area / Carpet\ Area \geq 1/8$$

Operable window area ratio



$$Window\ Area / Wall\ Area \leq 1/4$$

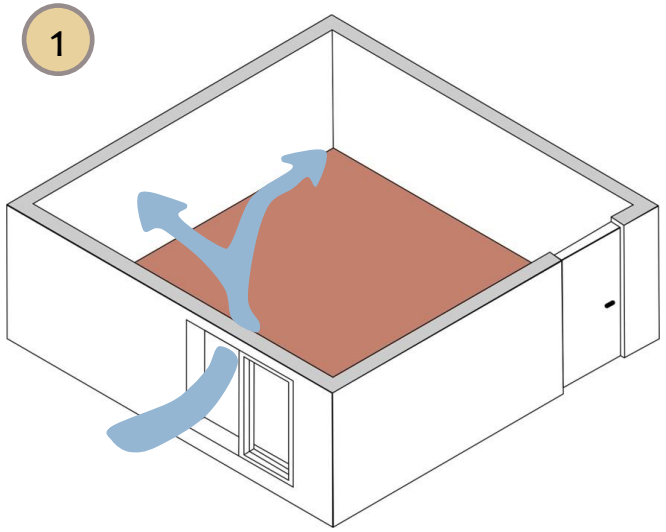
Window to wall area ratio



$$Window\ Area / Carpet\ Area \leq 2/5$$

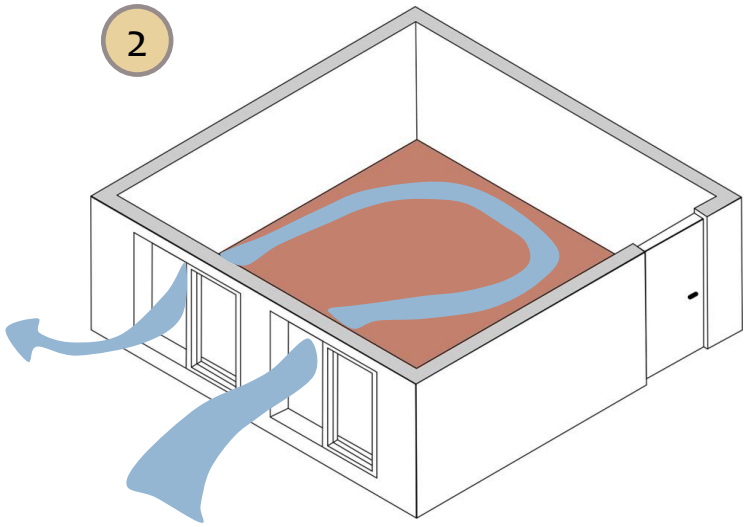
Operable window to wall area ratio

Window openings for enhanced ventilation



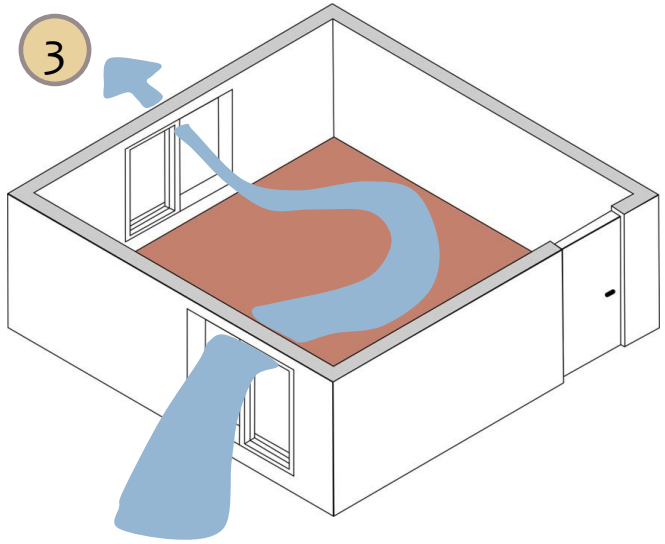
Level A

Single-sided ventilation



Level A+

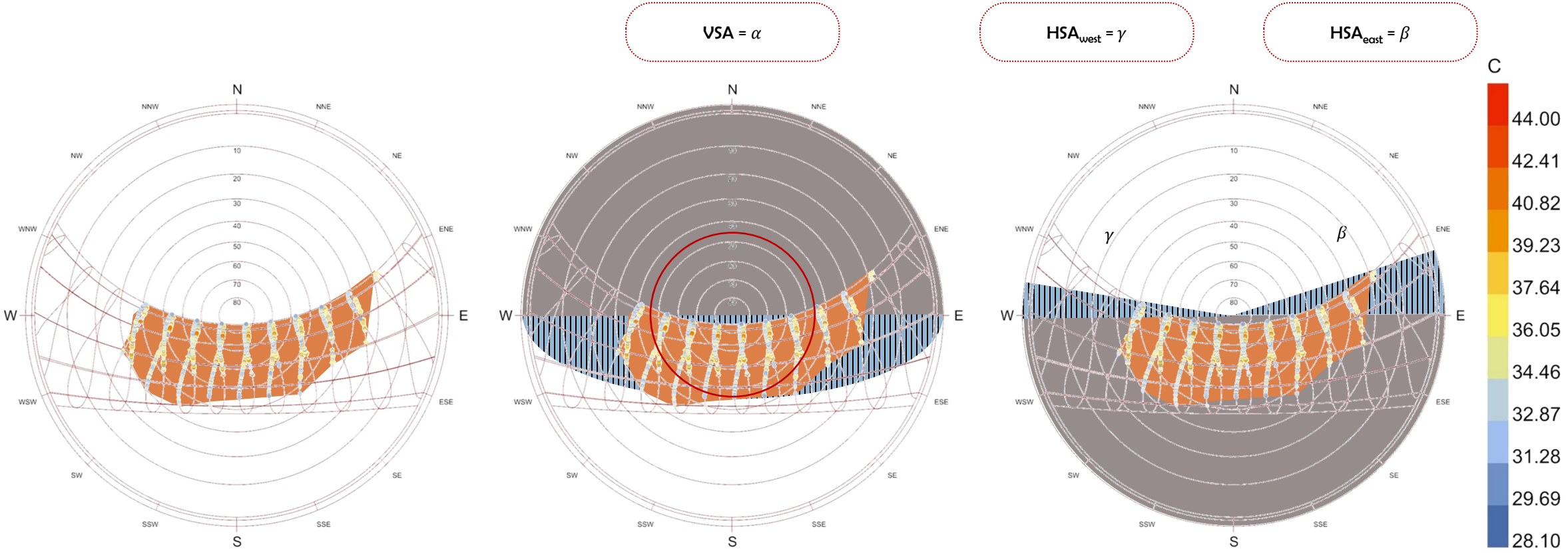
Single sided ventilation: Openings distributed on a single side



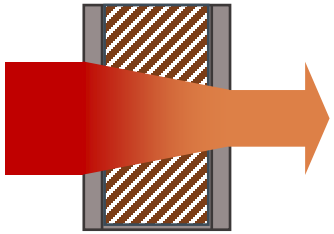
Level A++

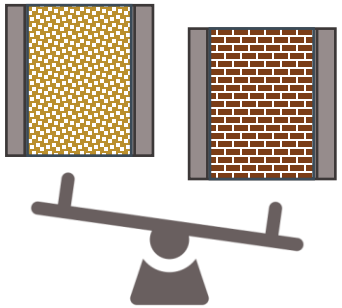
Two (or more)-sided ventilation: Windows on adjacent walls

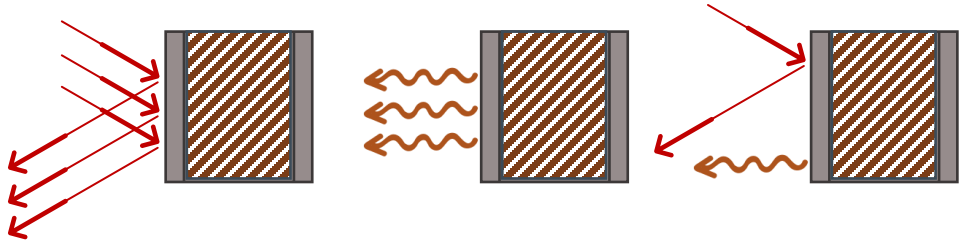
Window Shading



Walls





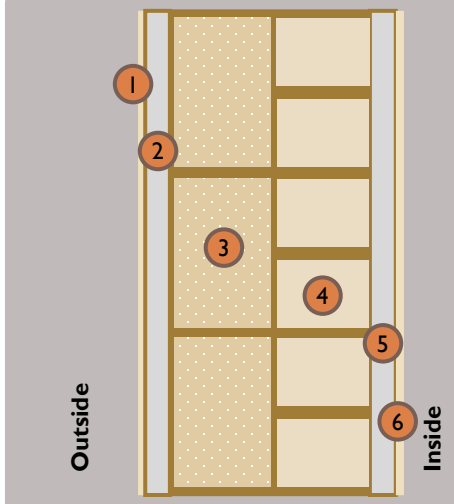


U-factor in W/m²K

	Light-weight assembly	Medium/Heavy-weight assembly
Density (kg/m³)	≥800	<800
Level A	0.80	1.00 or lower
Level A+	0.60	0.80 or lower
Level A++	0.40	0.45 or lower

Reflectance	0.60 or higher
Emittance	0.75 or higher
SRI	29 or higher

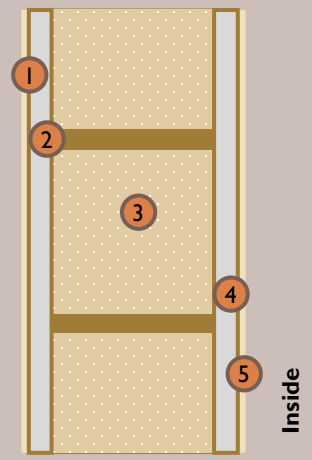
Walls



Fly ash brick wall faced with AAC block outside

1. Exterior paint
2. Cement plaster
3. AAC block work
4. Fly-ash block work
5. Internal plaster
6. Interior paint

Fly ash brick 115 mm	
AAC block 150 mm	
295 mm thick	**0.88 W/m²K**
Fly ash brick 75 mm	
AAC block 200 mm	
305 mm thick	**0.73 W/m²K**

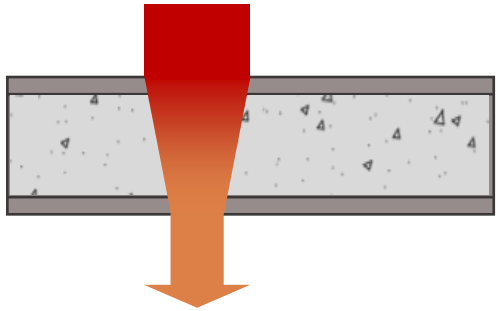


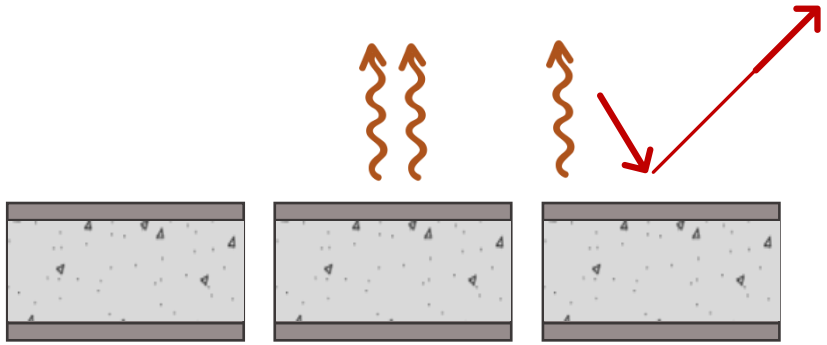
AAC Block Wall

1. Exterior paint
2. External cement plaster (GI chicken wire mesh over block-work and structure joints)
3. AAC block work
4. Internal cement plaster
5. Interior paint

AAC Block work 200 mm	
230 mm thick	**0.78 W/m²K**
AAC Block work 300 mm	
330 mm thick	**0.55 W/m²K**

Roof





U-factor in W/m²K

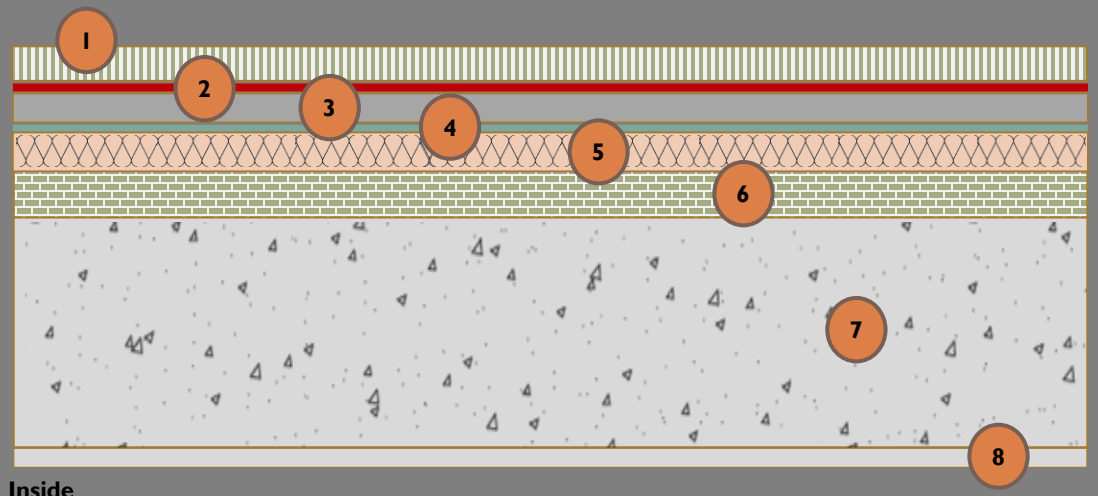
Level A	0.75	or lower
Level A+	0.45	or lower
Level A++	0.25	or lower

Reflectance	0.70	or higher
Emittance	0.75	or higher
SRI	78	or higher

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Roof

Outside



Inside

Rigid foam insulation over RCC slab. Roof assembly finished with broken white china mosaic.

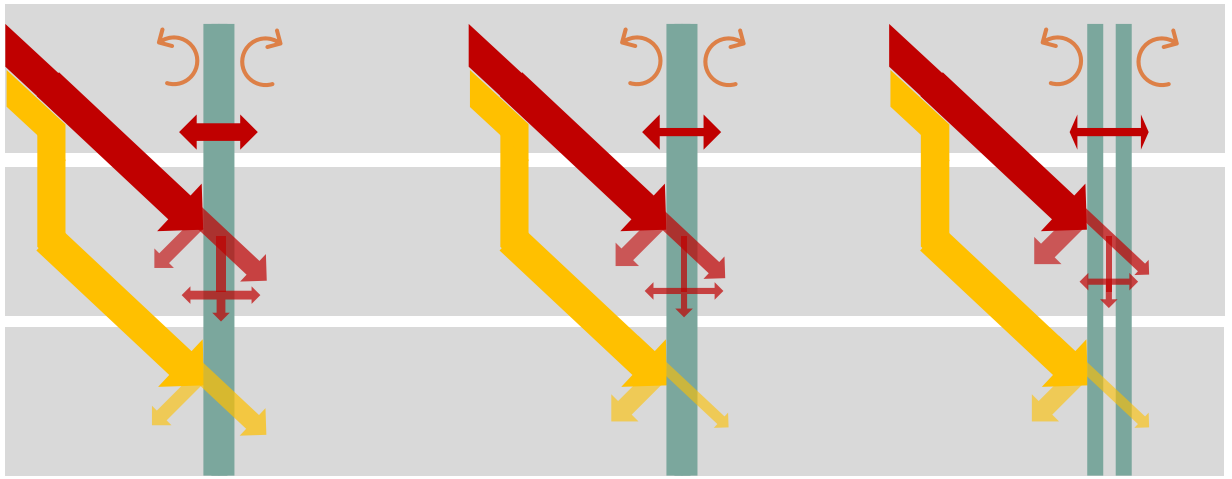
1. Broken china mosaic (white tiles grouted with white cement) applied with cement mortar
2. Water proofing layer
3. Cement screed with welded mesh
4. Polythene sheet/Geo-textile membrane
5. Rigid insulation board applied with water-based adhesive
6. Brick-bats/Plain Cement Concrete (PCC) laid to slope
7. RCC slab (as/structural design)
8. Internal plaster

PUF/XPS 25 mm	
RCC slab as/design	
~280 mm thick	**~0.73 W/m²K**
PUF/XPS 50 mm	
RCC slab as/design	
~305 mm thick	**~0.45 W/m²K**
PUF/XPS 75 mm	
Foam Concrete 100mm*	
RCC slab as/design	
~305 mm thick	**~0.45 W/m²K**

*Replace Brick-bat coba/PCC in #6 with foam concrete – laid to slope.

Windows

Glazing assembly



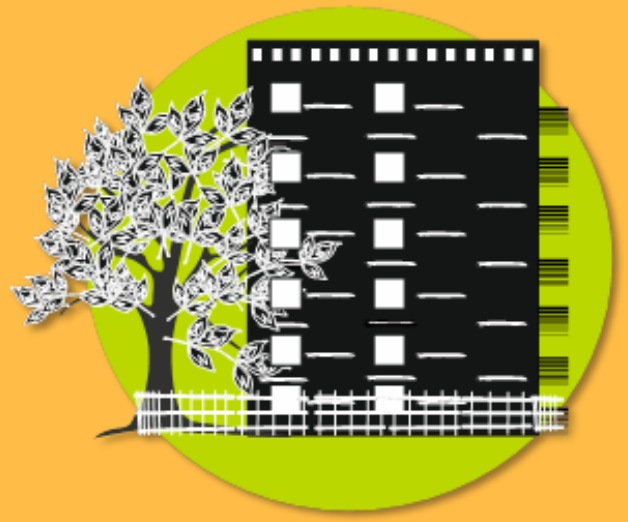
	Level A	Level A+	Level A++
U-factor	5.7 or lower	4.8 or lower	2.8 or lower
SHGC	0.6 or lower	0.4 or lower	
VLT	0.3 or higher		

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Metal frame with thermal break

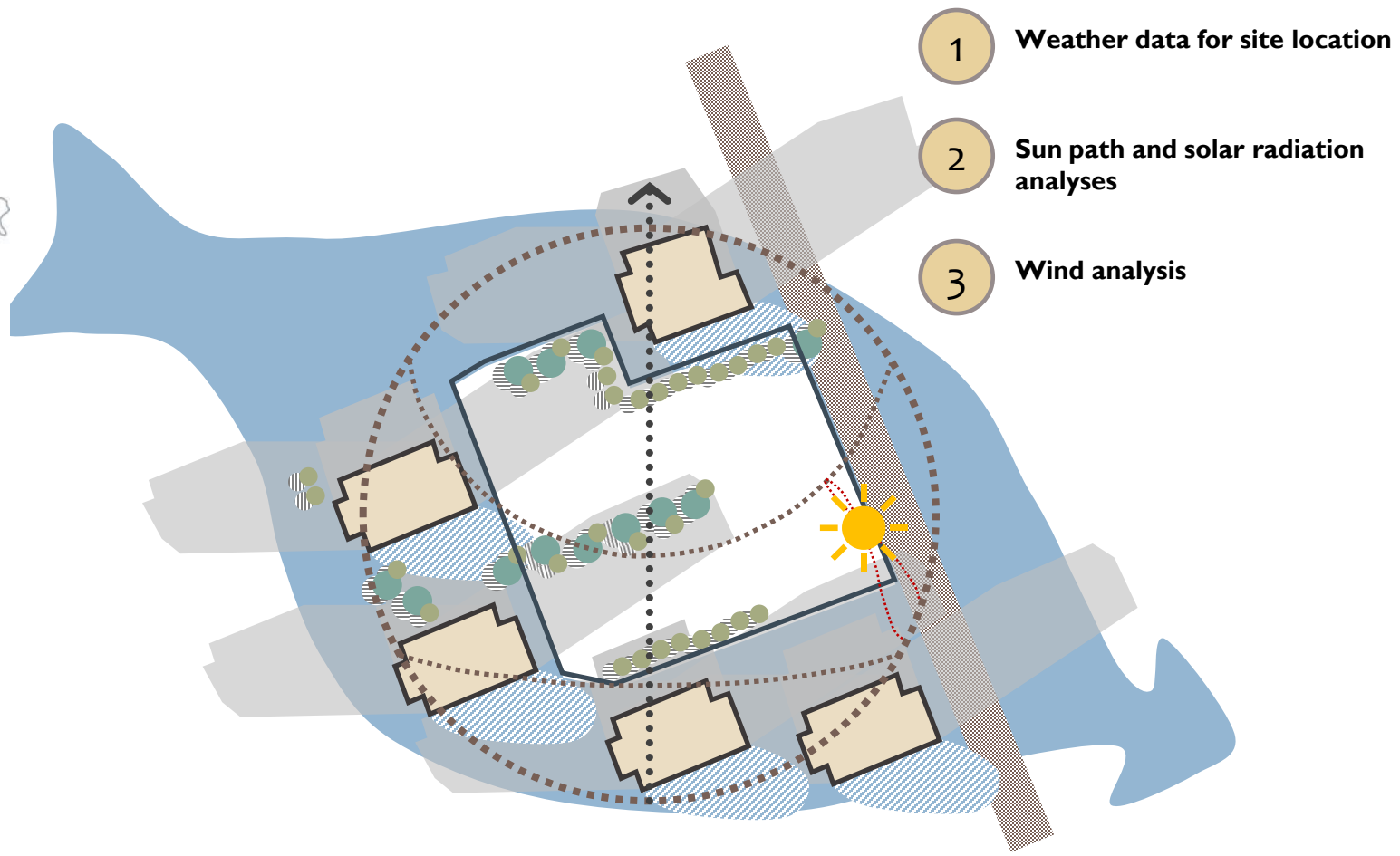
Wooden frame

Vinyl frame



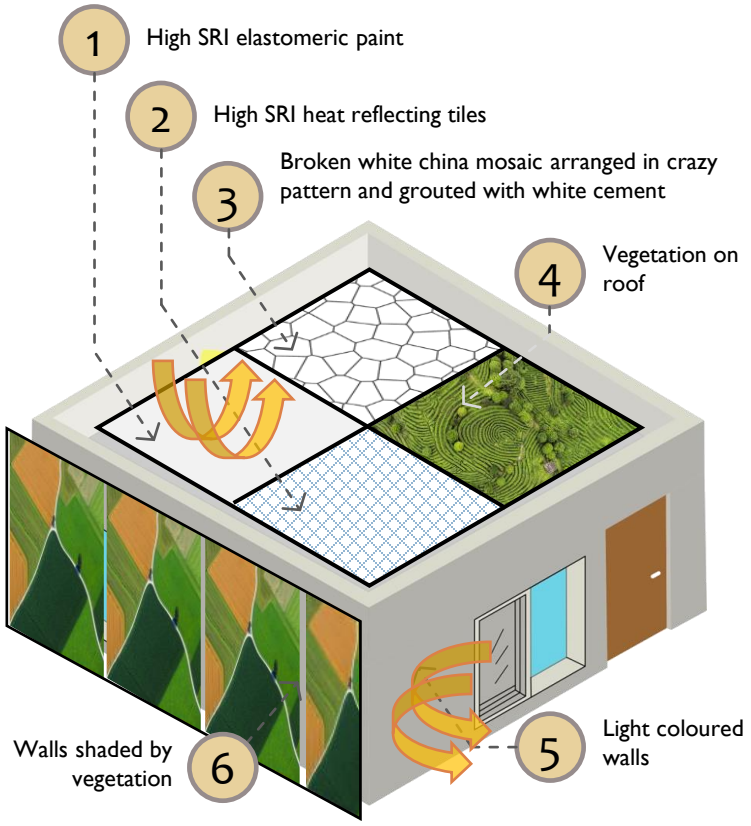
Passive Design features for Temperate Climate

Site Context – Microclimate, Siting & Orientation

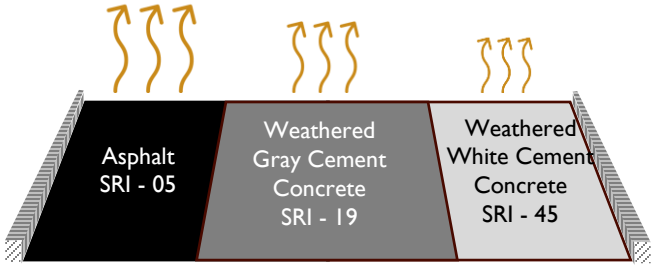


Mitigating Urban Heat Island

Reflective roof & wall surfaces

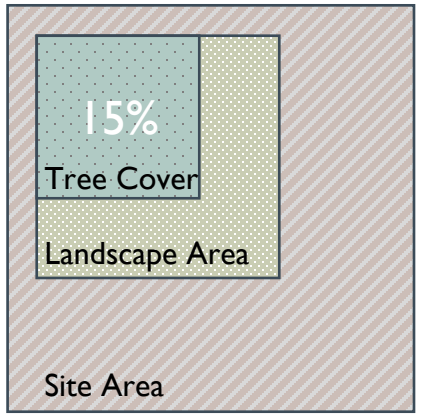


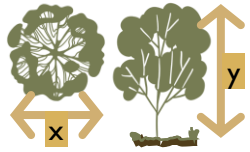
Reducing Paved Surfaces



- **Reduce hard paved areas**
- **Shade paved areas**
- **Use reflective and emitting surfaces for pavements**

Tree Canopy

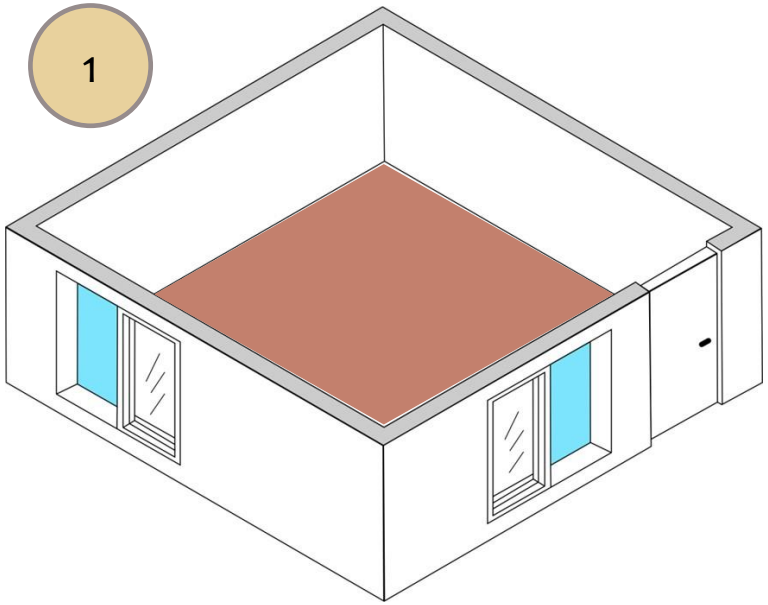




Neem (Azadirachta Indica)
Crown Dia: 10-20m
Tree Height: 15-30m

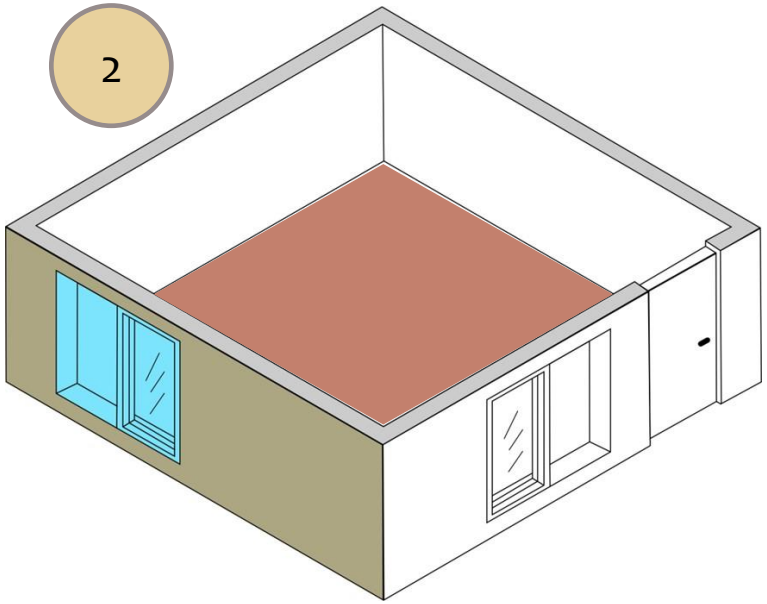
Gulmohar (Delonix Regia)
Crown Dia: 8-12m
Tree Height: 15-20m

Opening ratios for regulating ventilation & heat gains



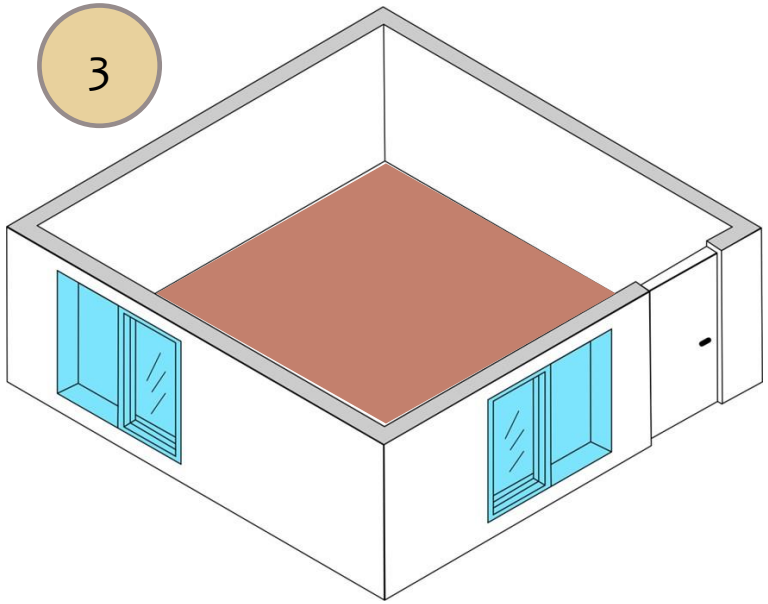
$$Openable\ Window\ Area / Carpet\ Area \geq 1/8$$

Operable window area ratio



$$Window\ Area / Wall\ Area \leq 1/4$$

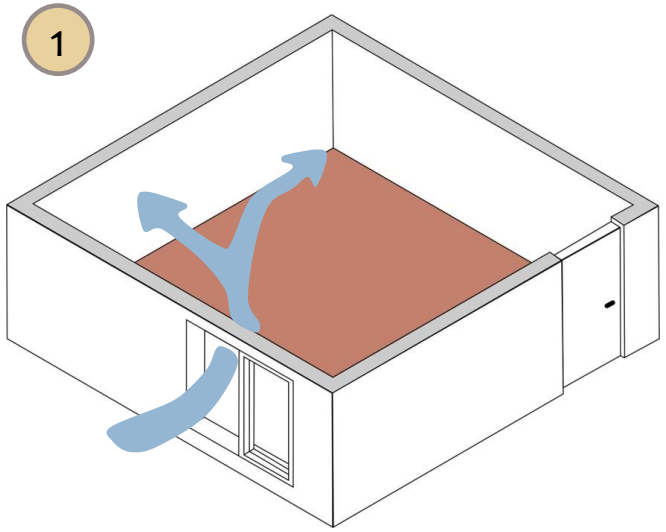
Window to wall area ratio



$$Window\ Area / Carpet\ Area \leq 2/5$$

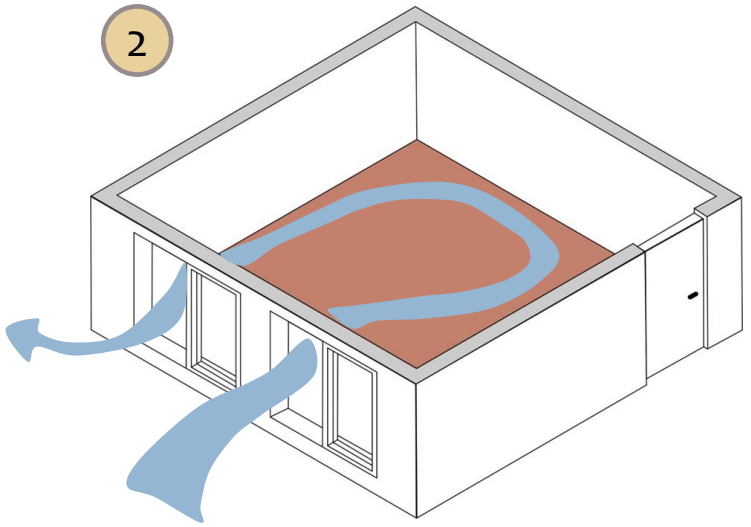
Operable window to wall area ratio

Window openings for enhanced ventilation



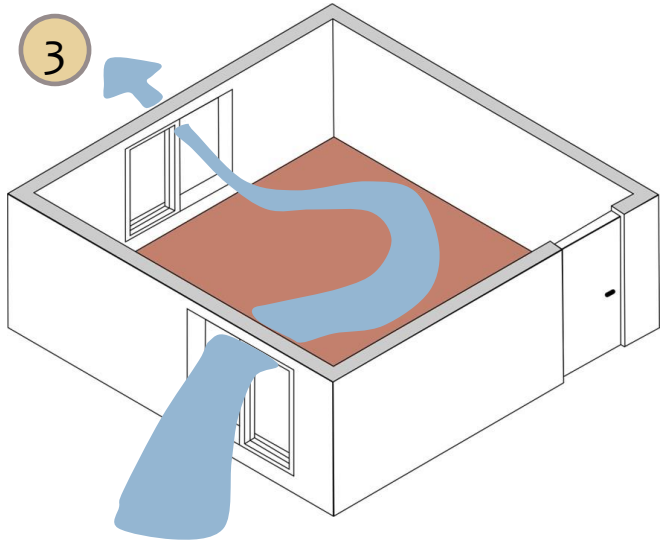
Level A

Single-sided ventilation



Level A+

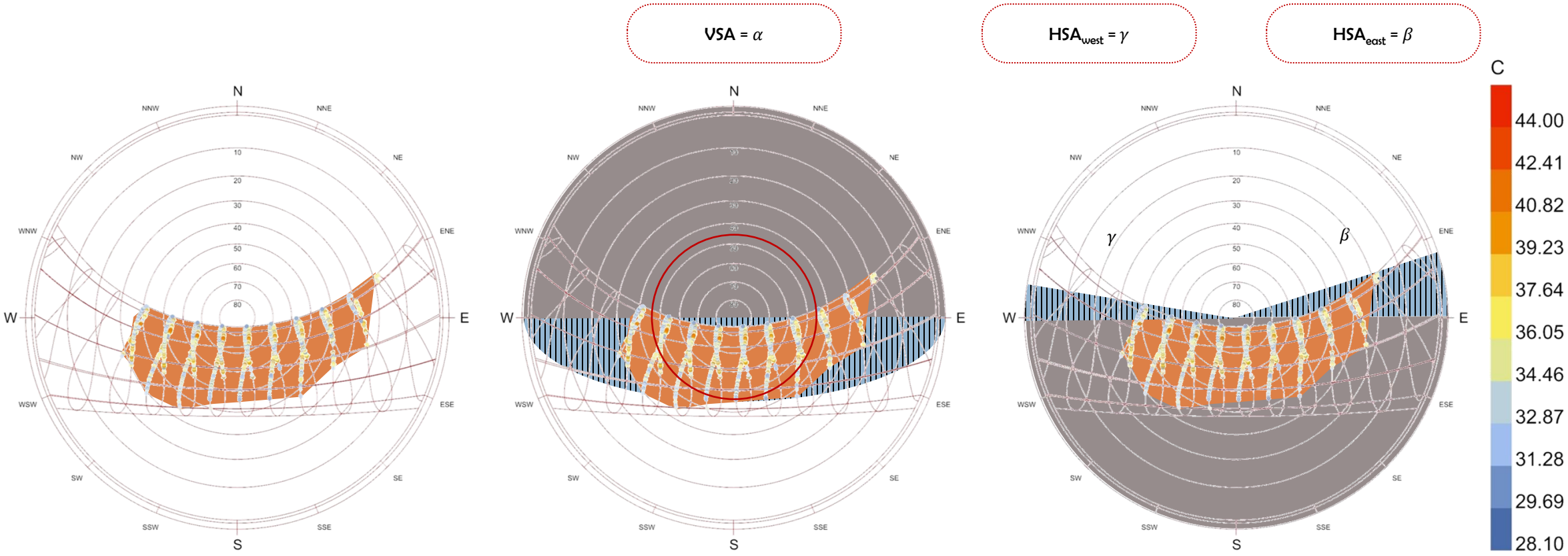
Single sided ventilation: Openings distributed on a single side



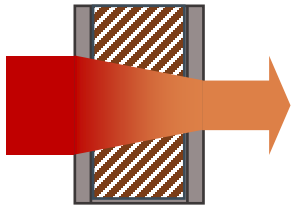
Level A++

Two (or more)-sided ventilation: Windows on adjacent walls

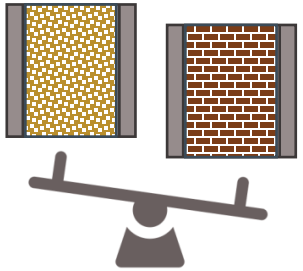
Window Shading

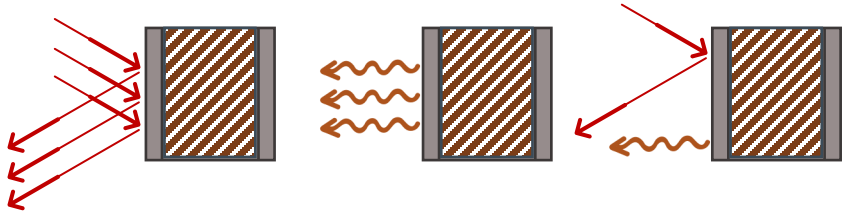


Walls



U-factor in W/m²K



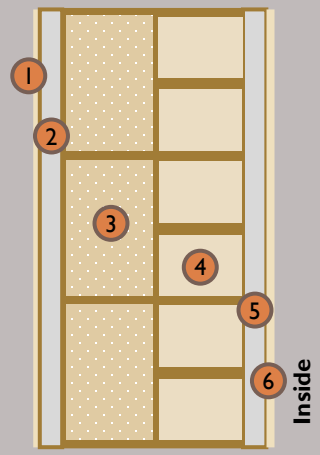


	Light-weight assembly	Medium/Heavy-weight assembly
Density (kg/m³)	≥800	<800
Level A/A+	0.80	1.00 or lower
Level A++	0.40	0.45 or lower

	Reflectance	Emittance	SRI
Reflectance	0.60 or higher		
Emittance	0.75 or higher		
SRI	29 or higher		

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Walls

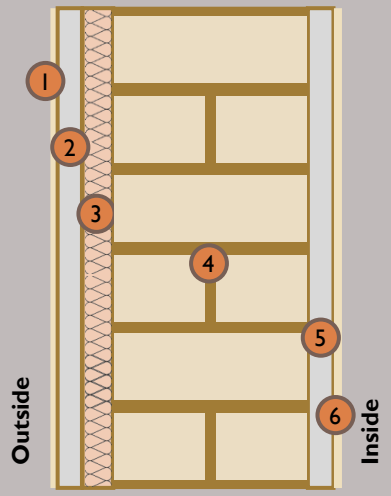


1. Exterior paint
2. Cement plaster
3. AAC block work
4. Fly-ash block work
5. Internal plaster
6. Interior paint

Fly ash brick 115 mm
AAC block 150 mm
295 mm thick | **0.88 W/m²K**

Fly ash brick 75 mm
AAC block 200 mm
305 mm thick | **0.73 W/m²K**

Fly ash brick wall faced with AAC block outside



1. Exterior paint
2. Cement plaster/base Coat (over reinforcing mesh)
3. Rigid insulation board applied with adhesive and held in place with PVC fasteners
4. Fly-ash block work
5. Internal plaster
6. Interior paint

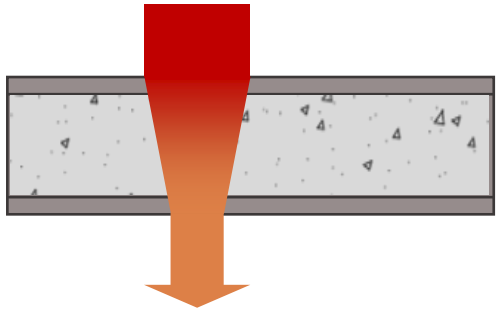
Fly ash brick 230 mm
Expanded Polystyrene 25 mm
285 mm thick | **0.89 W/m²K**

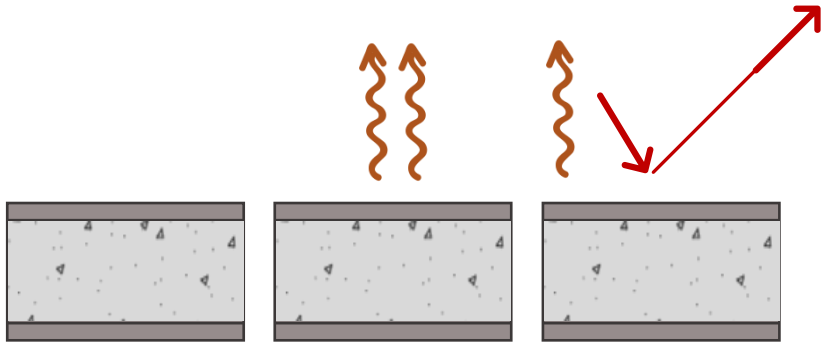
Fly ash brick 230 mm
XPS/PUF 25 mm
285 mm thick | **~0.75 W/m²K**

Fly ash brick 230 mm
XPS/PUF 50 mm
315 mm thick | **~0.45 W/m²K**

Fly ash brick wall with external insulation

Roof





U-factor in W/m²K

Level A	0.75	or lower
Level A+	0.45	or lower
Level A++	0.25	or lower

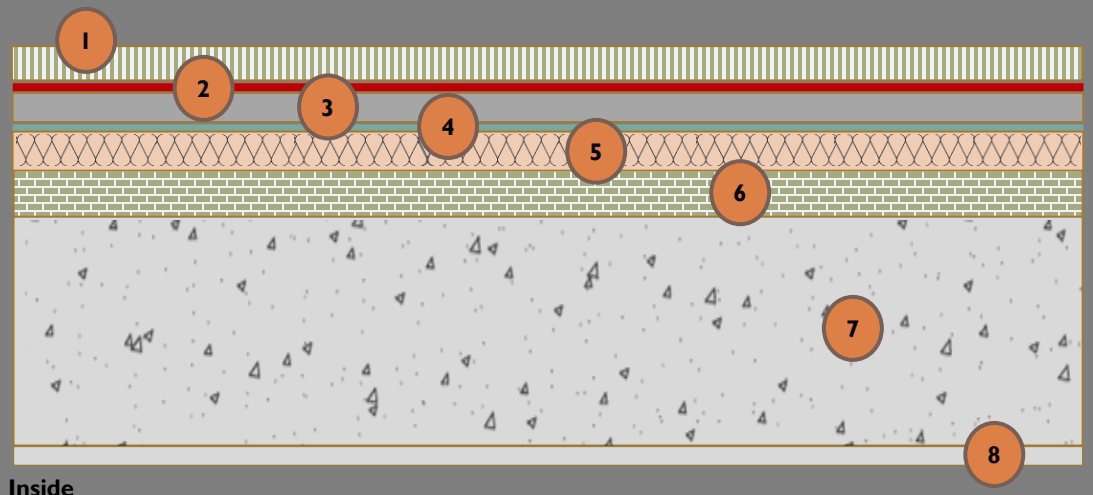
Reflectance **Emittance** **SRI**

Reflectance	0.70 or higher
Emittance	0.75 or higher
SRI	78 or higher

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Roof

Outside



Inside

Rigid foam insulation over RCC slab. Roof assembly finished with broken white china mosaic.

1. Broken china mosaic (white tiles grouted with white cement) applied with cement mortar
2. Water proofing layer
3. Cement screed with welded mesh
4. Polythene sheet/Geo-textile membrane
5. Rigid insulation board applied with water-based adhesive
6. Brick-bats/Plain Cement Concrete (PCC) laid to slope
7. RCC slab (as/structural design)
8. Internal plaster

PUF/XPS 25 mm

RCC slab as/design

~280 mm thick | **~0.73 W/m²K**

PUF/XPS 50 mm

RCC slab as/design

~305 mm thick | **~0.45 W/m²K**

PUF/XPS 75 mm

Foam Concrete 100mm*

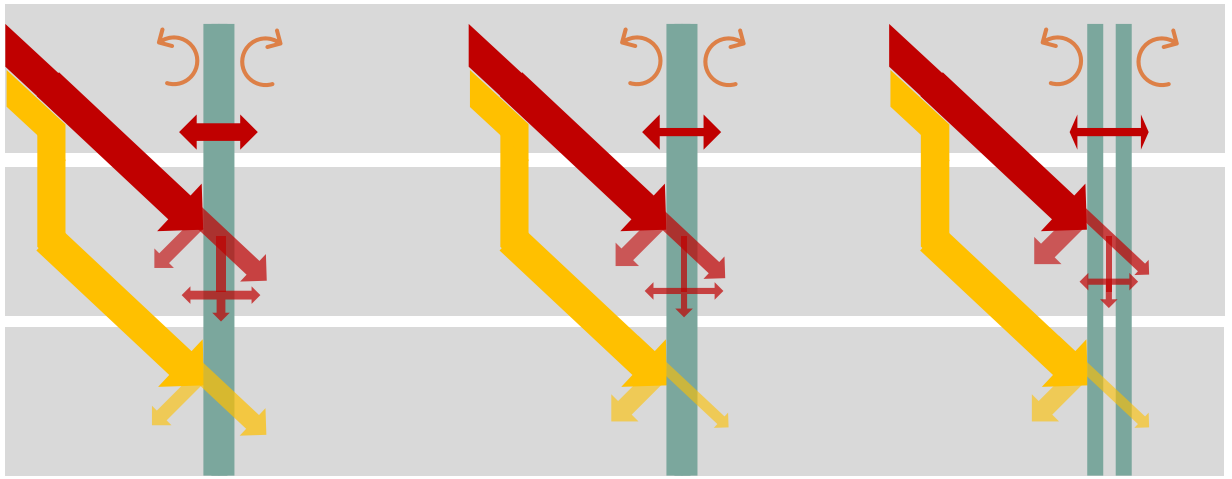
RCC slab as/design

~305 mm thick | **~0.45 W/m²K**

*Replace Brick-bat coba/PCC in #6 with foam concrete – laid to slope.

Windows

Glazing assembly



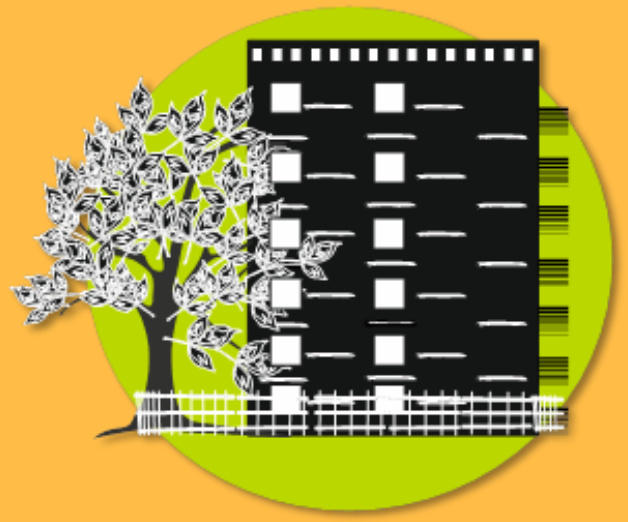
	Level A	Level A+	Level A++
U-factor	5.7 or lower	4.8 or lower	2.8 or lower
SHGC	0.6 or lower	0.4 or lower	
VLT	0.3 or higher		

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Metal frame with thermal break

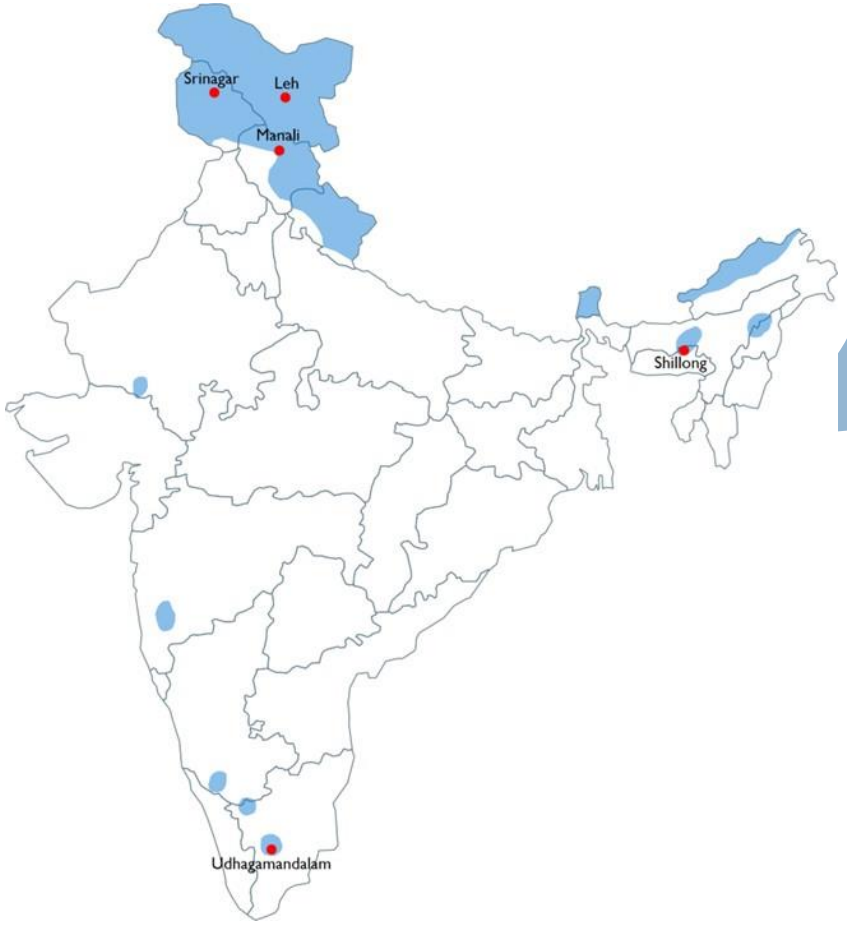
Wooden frame

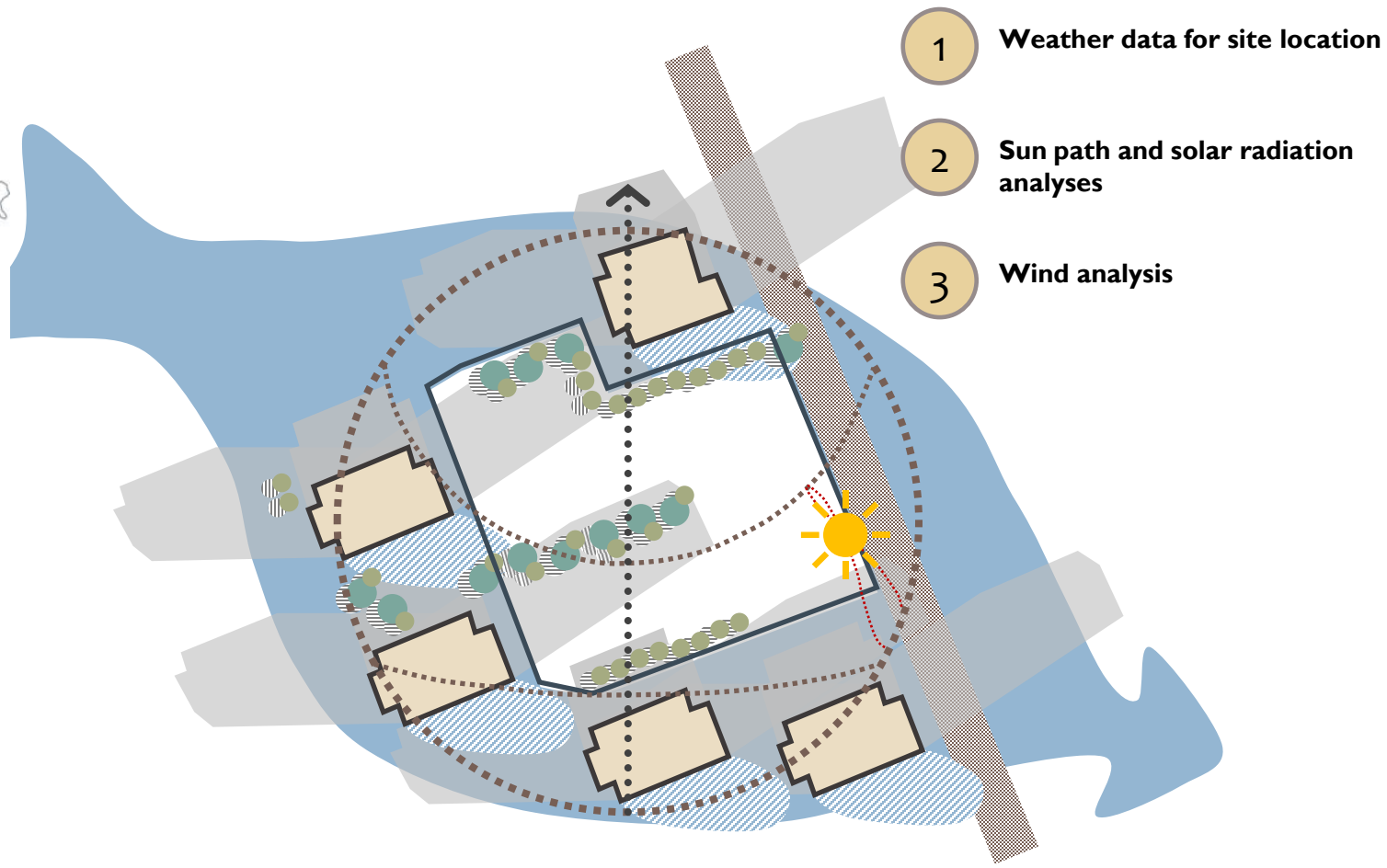
Vinyl frame



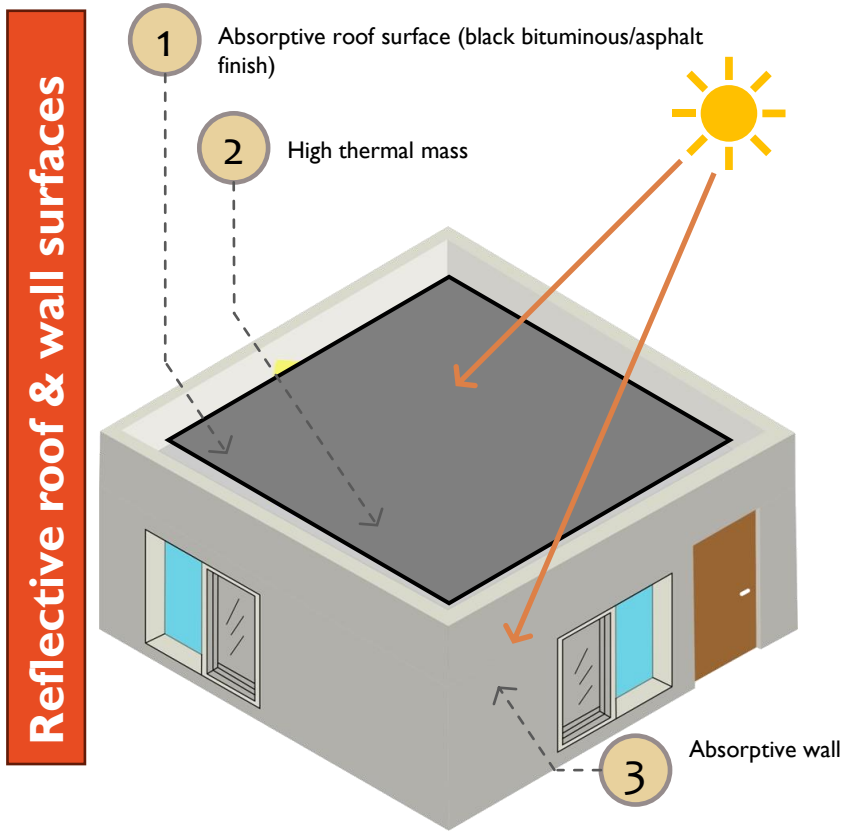
Passive Design features for Cold Climate

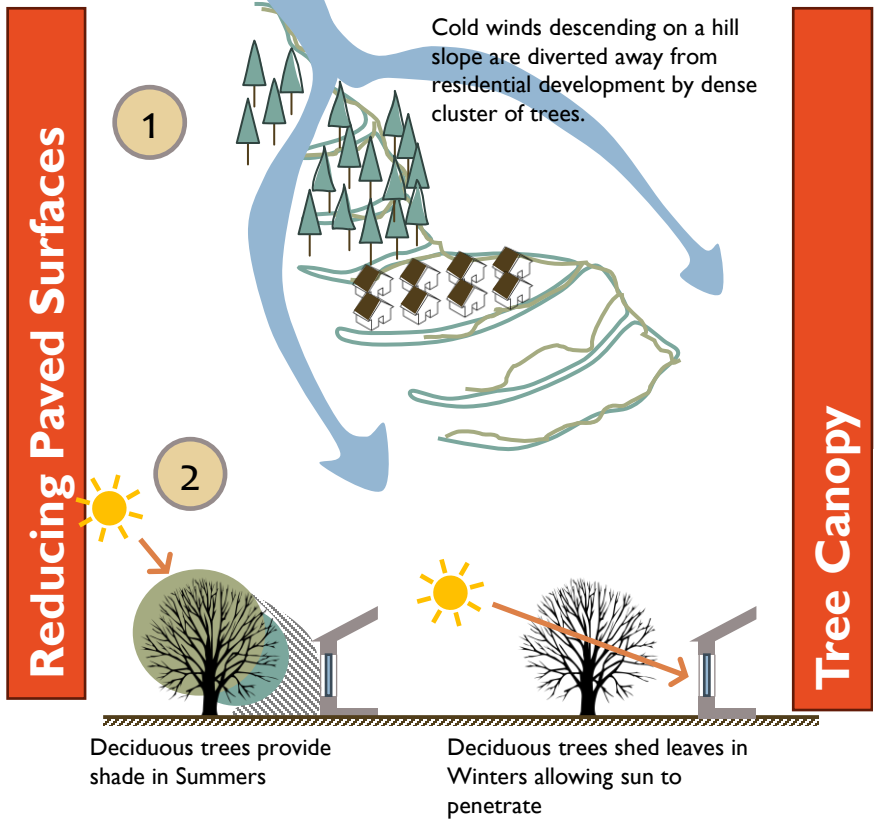
Site Context – Microclimate, Siting & Orientation

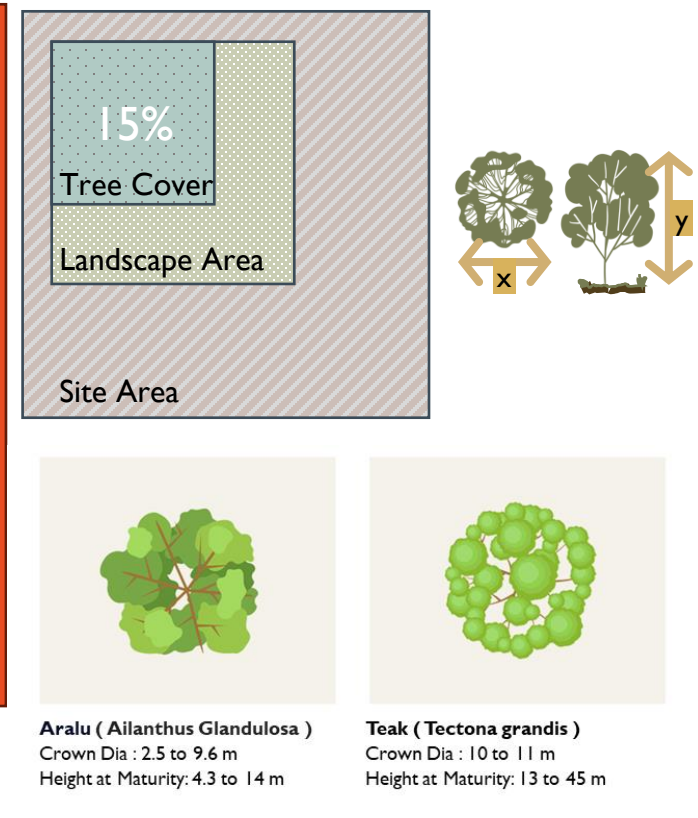




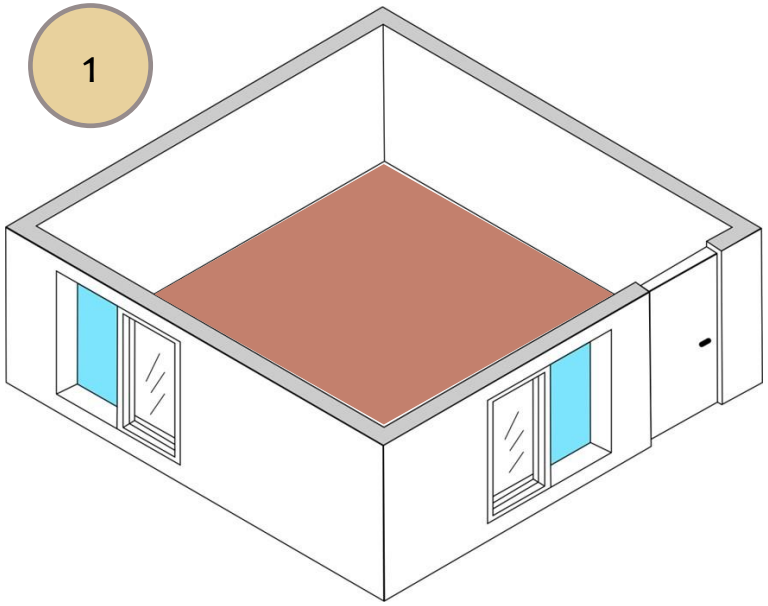
Mitigating Urban Heat Island





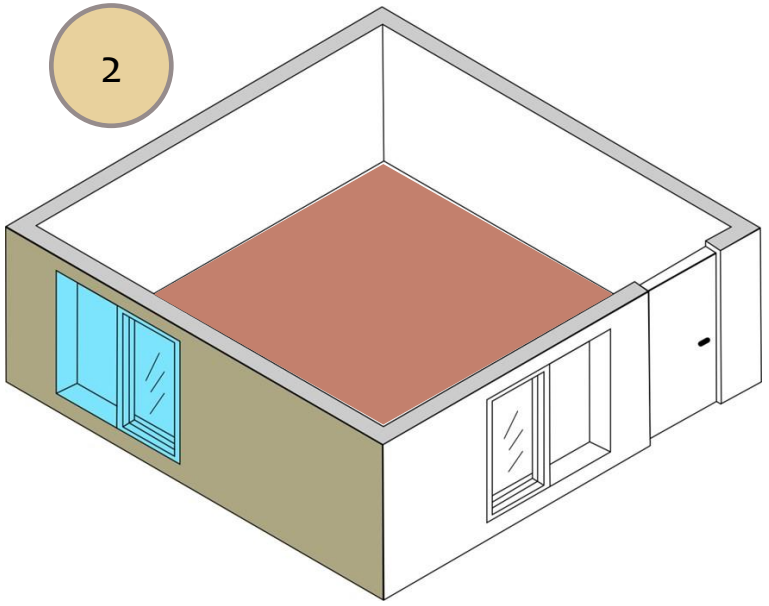


Opening ratios for regulating ventilation & heat gains



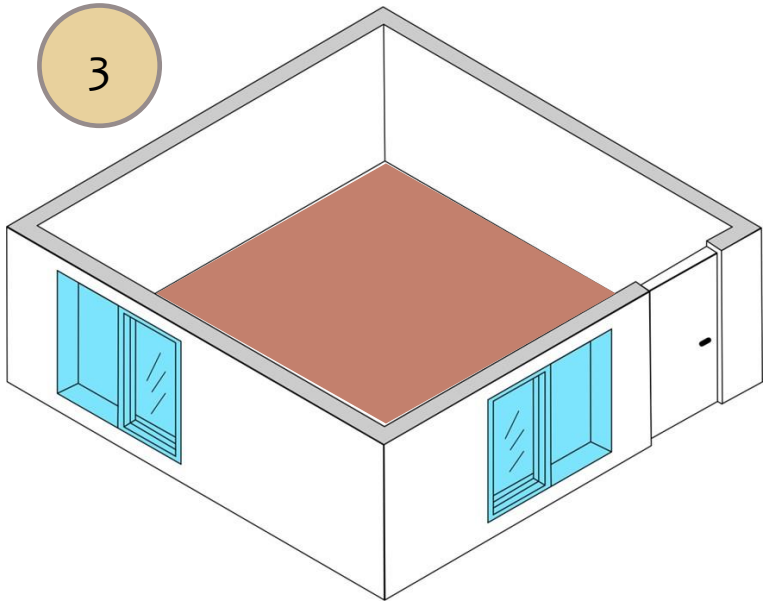
$$Openable\ Window\ Area / Carpet\ Area \geq 1/12$$

Operable window area ratio



$$Window\ Area / Wall\ Area \leq 1/4$$

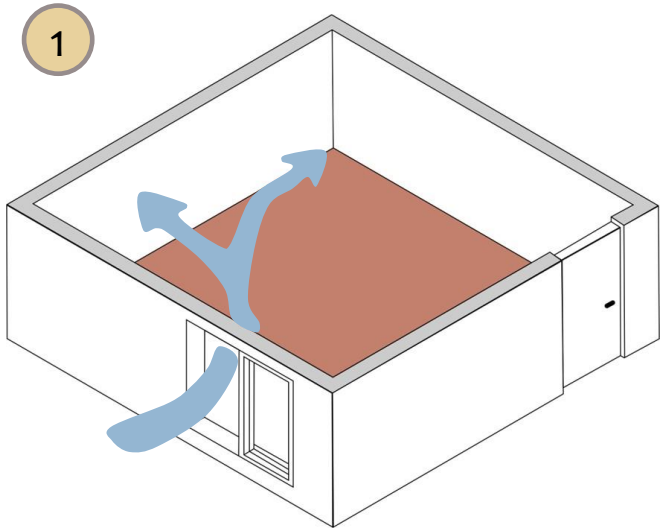
Window to wall area ratio



$$Window\ Area / Carpet\ Area \leq 2/5$$

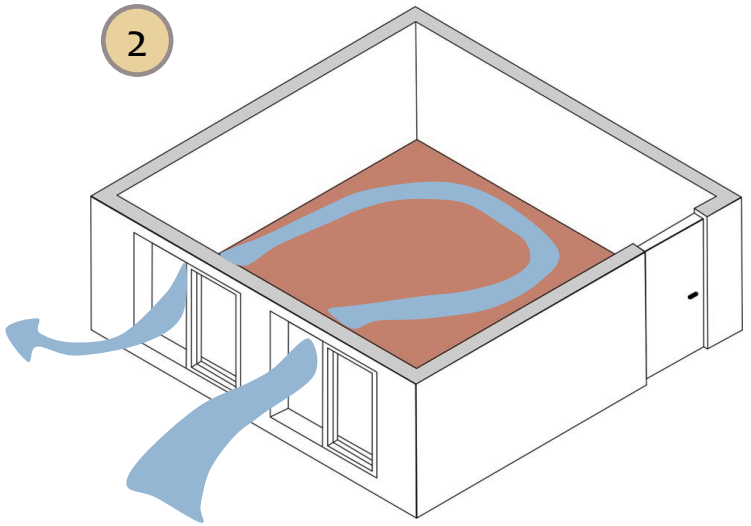
Operable window to wall area ratio

Window openings for enhanced ventilation



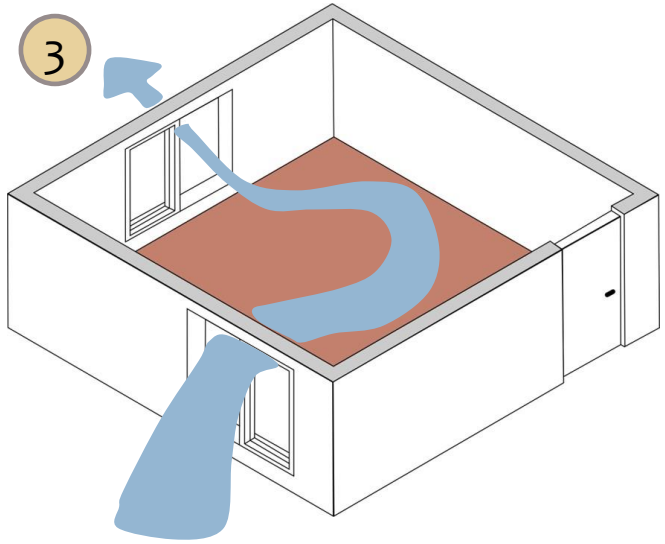
Level A

Single-sided ventilation



Level A+

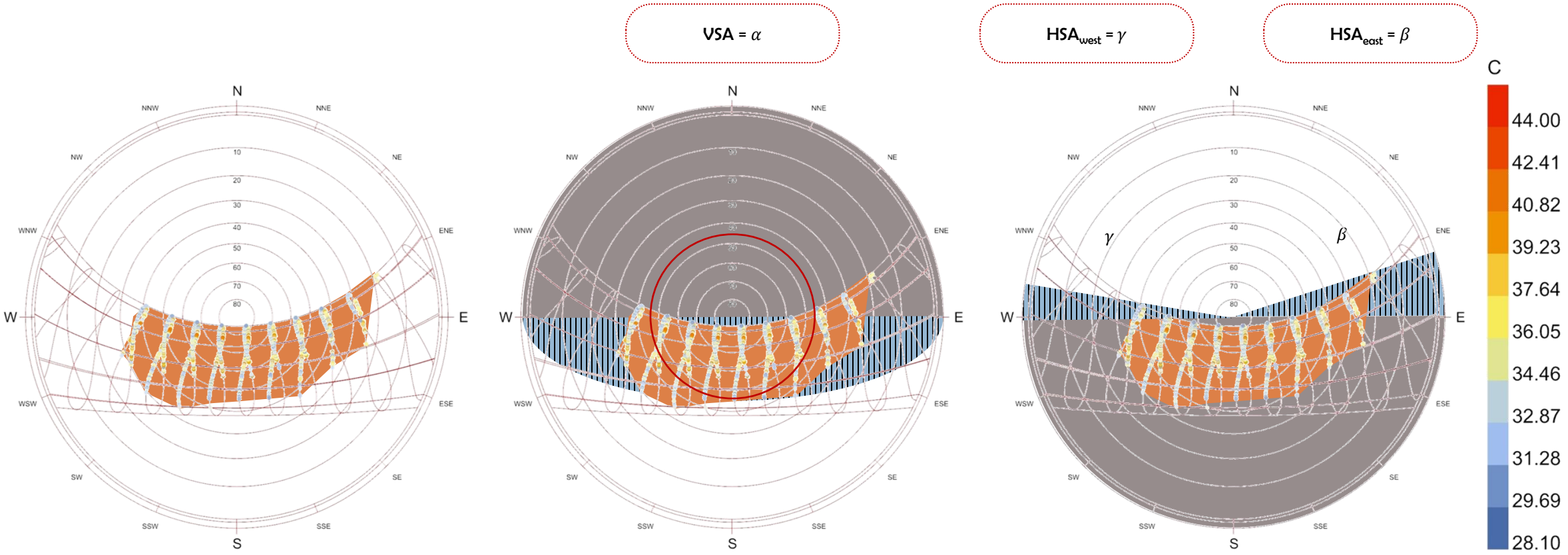
Single sided ventilation: Openings distributed on a single side



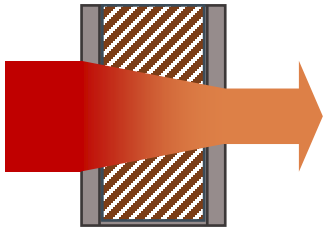
Level A++

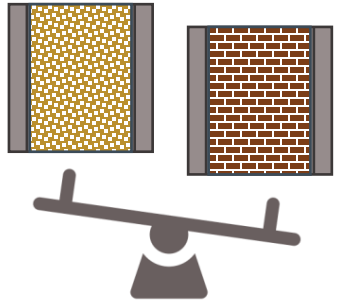
Two (or more)-sided ventilation: Windows on adjacent walls

Window Shading



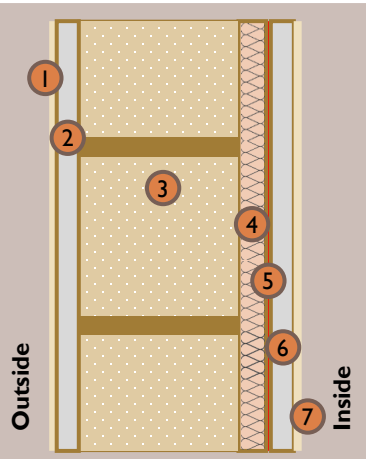
Walls





U-factor in W/m²K	Light-weight assembly	Medium/Heavy-weight assembly
Density (kg/m³)	≥800	<800
Level A	0.80	0.85 or lower
Level A+	0.60	0.50 or lower
Level A++	0.35	0.35 or lower

Walls



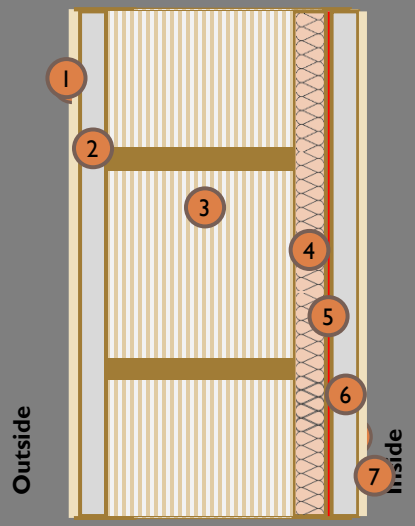
AAC Block Wall with internal insulation

1. Exterior finish (as/design)
2. External cement plaster (GI chicken wire mesh over block-work and structure joints)
3. AAC block work
4. Rigid insulation board applied with water based adhesive and held in place with PVC fasteners
5. Vapour barrier (polythene sheet or any other suitable material)
6. Gypsum plasterboard
7. Interior paint

AAC Block work 150 mm

XPS/PUF 50 mm

230 mm thick | **~0.34 W/m²K**



Solid concrete block with internal insulation

1. Exterior paint
2. External cement plaster
3. Solid Concrete Block
4. Rigid insulation board applied with water based adhesive and held in place with PVC fasteners
5. Vapour barrier (polythene sheet or any other suitable material)
6. Gypsum plasterboard
7. Interior paint

Solid concrete block 200 mm

XPS/PUF 25 mm

255 mm thick | **~0.81 W/m²K**

Solid concrete block 200 mm

XPS/PUF 50 mm

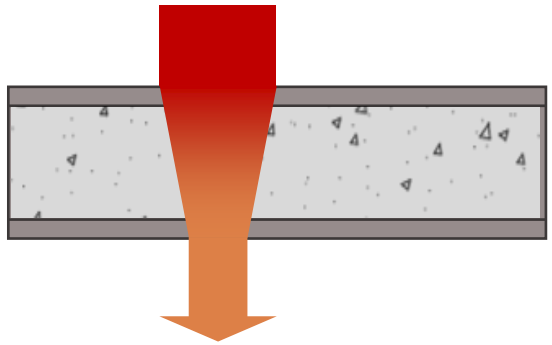
285 mm thick | **~0.45 W/m²K**

Solid concrete block 200 mm

XPS/PUF 50 mm

285 mm thick | **~0.31 W/m²K**

Roof

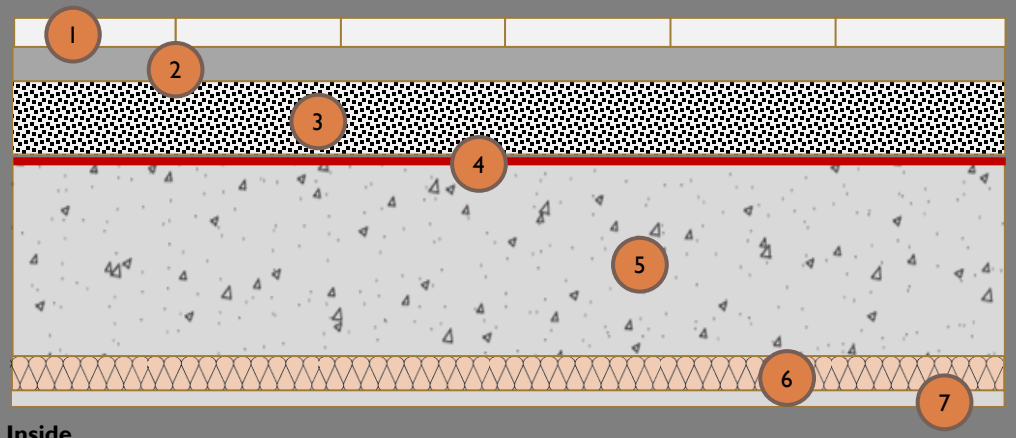


U-factor in W/m²K

Level A	0.75	or lower
Level A+	0.45	or lower
Level A++	0.25	or lower

Roof

Outside



Inside

Foam concrete insulation and rigid foam insulation installed under RCC slab.

1. Finishing surface (tiles, stone, etc.) applied over cement mortar
2. Plain Cement Concrete (PCC) screed laid to slope
3. Foam concrete
4. Waterproofing layer
5. Reinforced Cement Concrete (RCC) slab (as/structural design)
6. Rigid insulation board applied with adhesive, held in place with screws and joints sealed with tape.
7. Internal plaster

PUF/XPS 25 mm

Foam Concrete 100mm

RCC slab as/design

~330 mm thick | **~0.38 W/m²K**

PUF/XPS 75 mm

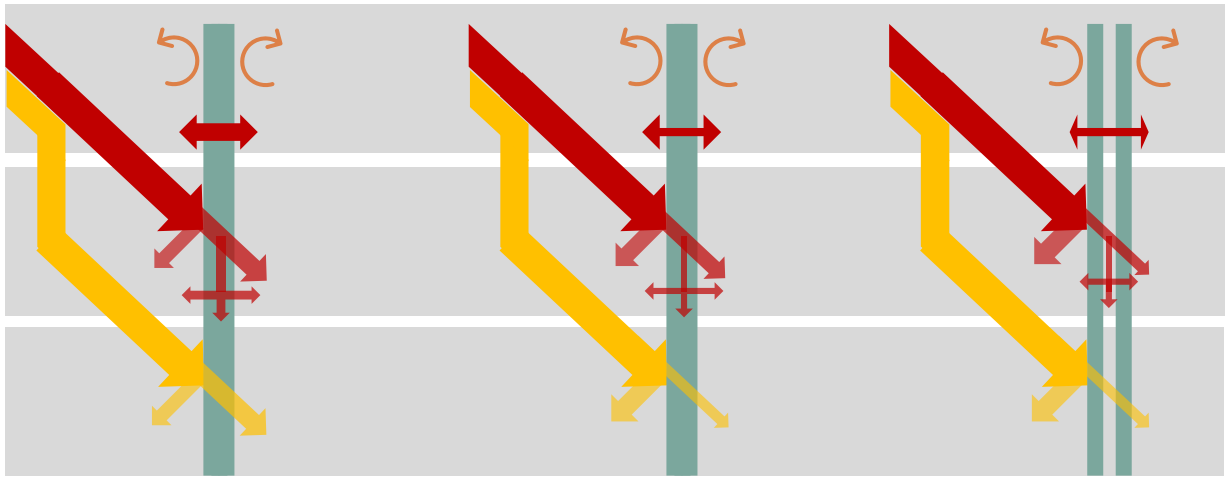
Foam Concrete 100mm*

RCC slab as/design

~305 mm thick | **~0.45 W/m²K**

Windows

Glazing assembly

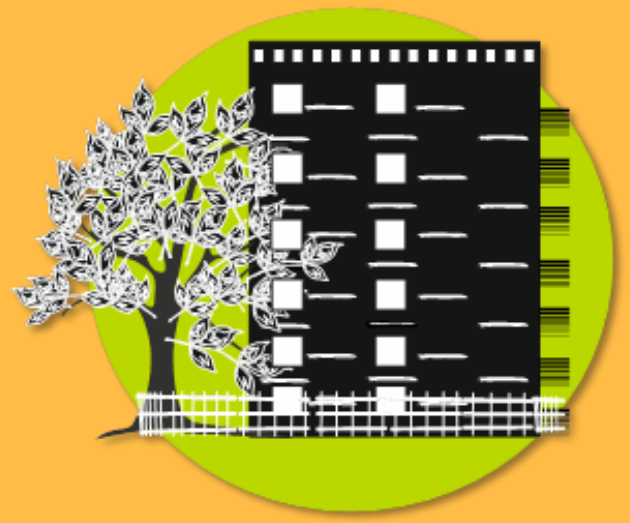


	Level A	Level A+	Level A++
U-factor	3.8 or lower	2.8 or lower	1.8 or lower
SHGC	0.7 or lower	0.6 or lower	
VLT	0.3 or higher		

Note: Level A++ is a mandatory if the residential building is mechanically air-conditioned.

Wooden frame

Vinyl frame



Thanks!