GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Passive Performance Noise Light Heat Vent Cool Services Response

UH RIBA Part 1 Year 2 Lecture 6
Architects & Interior Design Architects

This Presentation on GBE:

- Find this file on GBE website at:
- https://GreenBuildingEcyclopaedia.uk/?P=32048
- Go there for:
  - the latest update
  - versions presented to different audiences
  - the whole presentation all of the hidden slides
  - other file formats:
    - Handout, Show, PDF, PPTX
  - Links to other related GBE CPD and related GBE content

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

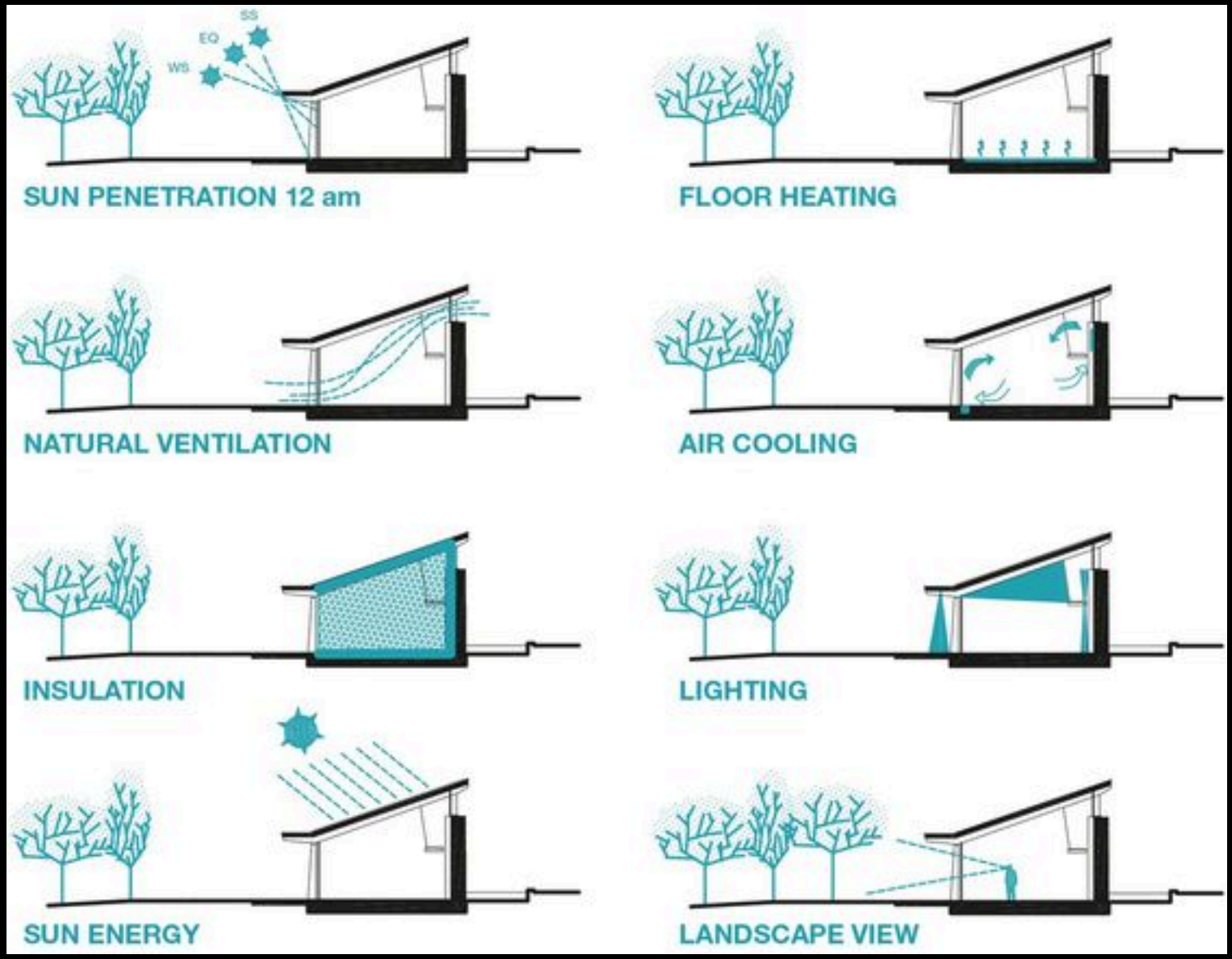
Investing in Opportunities

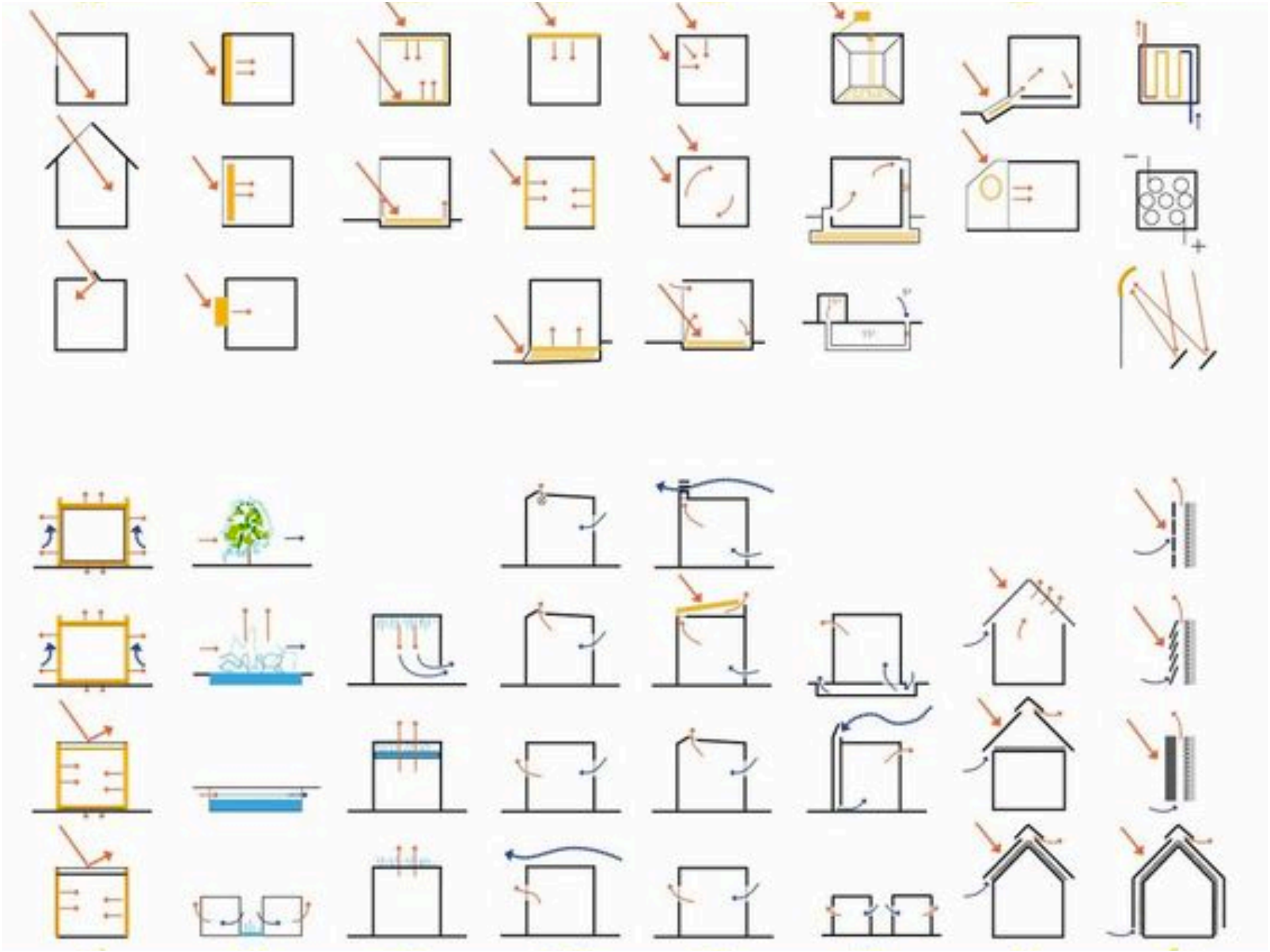
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Scope

- Quotes
- Principles
- Checklists for Task 2 submission in 6 following topics
  - Also in Task 2 Checklist file in Canvas
- Acoustics Noise/Sound
- Lighting
- Heating
- Ventilation
- Cooling
- Services Response





GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Quotes

- Fabric First > Services Last
- Passive > Active > Mechanical/Artificial
- Build Tight > Ventilate Right
- Build Light > Insulate Right > Solar Tight
- Retrofit: No Insulation without Ventilation
- Convection: Hot air rises, cold air falls,
- Eddy currents: circulate to dissipate
- Conductivity: goes from hot to cold

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Principles

- Fabric First
- Make the building do all the work
  - Why make a building that needs to be heated/cooled if you don't need to
- Do not rely on energy intensive services to fix what you did not address
- Use services to only fill the gap that the building could not provide
  - See: Service Response at end

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

nwe

INTERREG IVB

Acoustics

Sound/Noise

Sources, Barriers, Distribution, Refection, Reverberation, Absorption, Dispersion, Attenuation, Shape of Space, Surfaces, Respond to Function, Quiet v Loud

27/11/19

Purpose of Acoustic Control

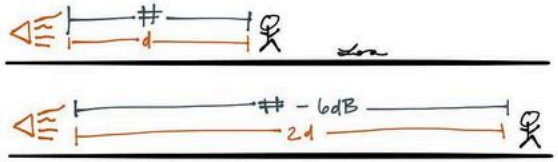
- Noise is sound in the wrong place, too loud, too distracting, etc.
- Noise can get about via air or via materials, direct or indirect by flanking through air gaps in construction
- Very hard surfaces reflect sound to reverberate for long periods making speech difficult to understand
- Highly absorbent surfaces make sounds disappear and not be heard
- Sounds from adjacent spaces may flank around partitions make concentration more difficult
- Excessive noise can create stress in the listener
- Using competent construction noise and sound can be reflected, isolated, absorbed, diffused, transmitted

Acoustics: Noise v Sound

- Consider the Sources:
  - Internal and external, inward and outward
    - External components of building:
      - solar shading, light shelves, ventilation grilles
  - Controllable v uncontrollable
    - On site or off site
  - Mitigate or Adapt?
    - Prevent v deal with consequences
    - Prevent occurrence, prevent passage v absorb noise
  - Caused by other factors:
    - External wind pressure > Air leaky construction
      - Wind whistling through door and window frames or walls
    - Internal Wind Pressure Buffeting
      - Rattling Components: doors, furniture, ironmongery

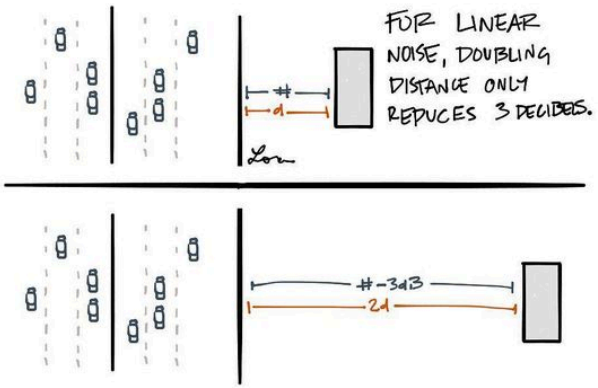
External noise diagrams can apply to internal too

SITE ACOUSTICS



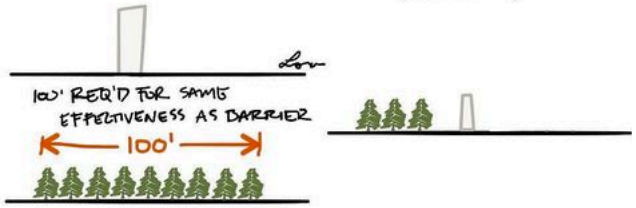
ON AVERAGE, WHEN SPACE DOUBLES, THE AUDIBLE SOUND DECREASES BY 6 DECIBELS.
(ONLY FOR POINT SOURCE)

SITE ACOUSTICS

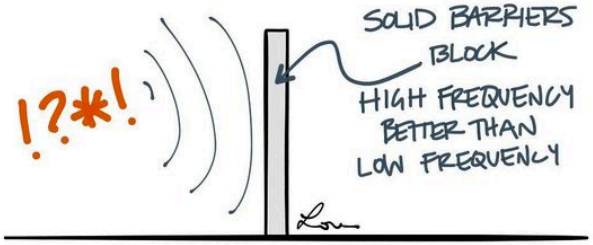


SITE ACOUSTICS

PLANTINGS ARE HARDER TO USE ALONE AS A SOUND BARRIER, BUT CAN ACCOMPANY SOLID BARRIERS.



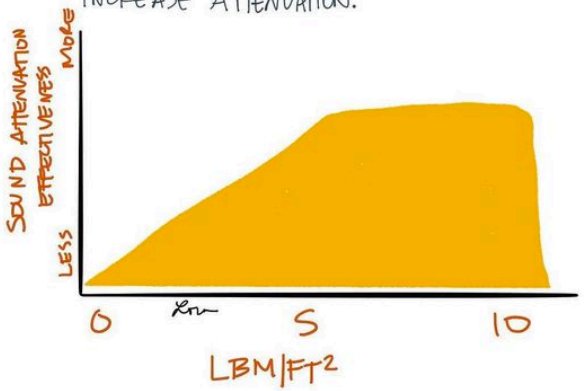
SITE ACOUSTICS



SITE ACOUSTICS

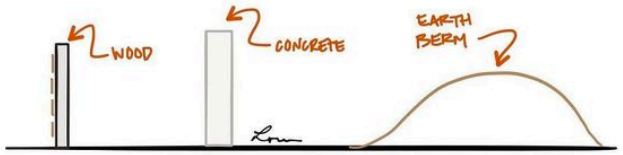
BARRIER DENSITY MIN 5 lbm/ft².

HIGHER DENSITY DOESN'T SIGNIFICANTLY INCREASE ATTENUATION.



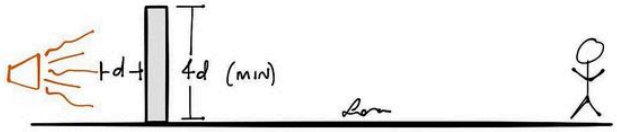
SITE ACOUSTICS

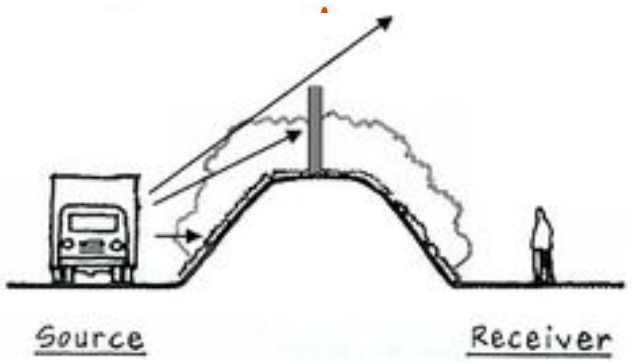
SOLID BARRIERS ARE MOST EFFECTIVE.



SITE ACOUSTICS

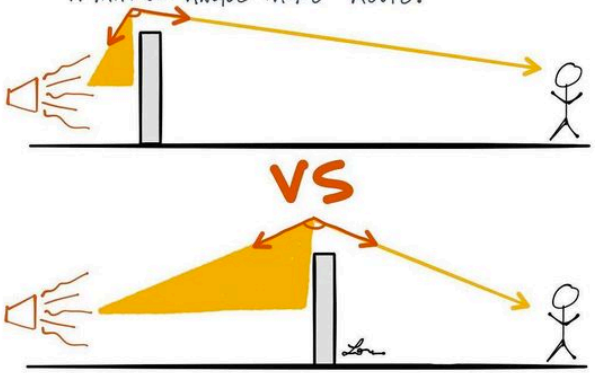
IF BARRIER IS CLOSE TO NOISE SOURCE, IT SHOULD BE 4X AS TALL AS THE DISTANCE TO THE BARRIER IS LONG.





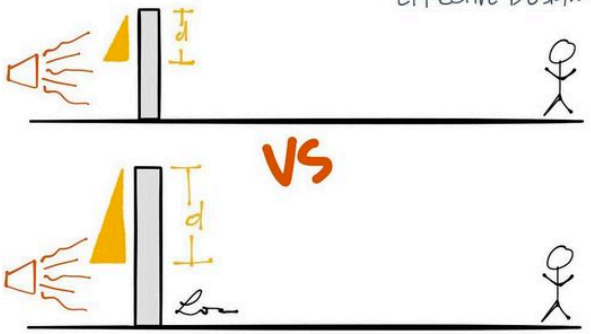
SITE ACOUSTICS

BEST USE FOR BARRIERS IS AS CLOSE TO SOURCE/PROTECTED SPACE AS POSSIBLE. IT MAKES ANGLE MORE ACUTE.



SITE ACOUSTICS

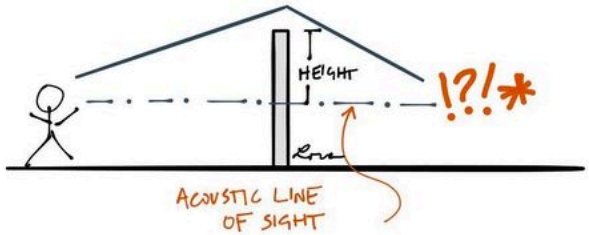
MORE EFFECTIVE HEIGHT = MORE EFFECTIVE DESIGN



SITE ACOUSTICS

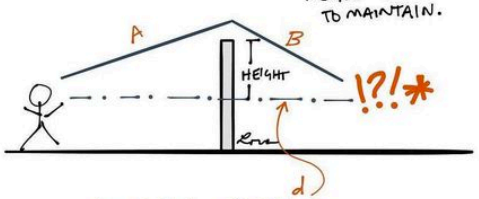
BARRIER EFFECTIVENESS DEPENDS ON:

- HEIGHT OF BARRIER
- DISTANCE
- FREQUENCY OF SOUND



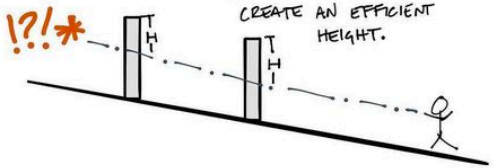
SITE ACOUSTICS

LEVEL GROUND → EFFECTIVE HEIGHT IS EASIER TO MAINTAIN.

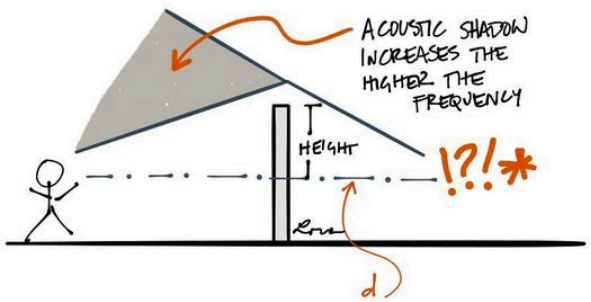


UNEVEN GROUND

CAN BE HARDER TO CREATE AN EFFICIENT HEIGHT.



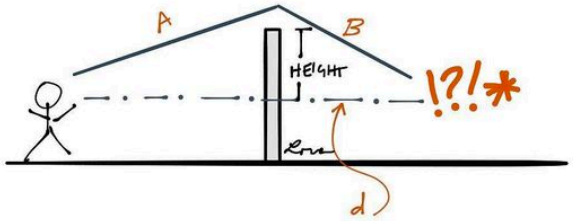
SITE ACOUSTICS



SITE ACOUSTICS

$$N = \left(\frac{f}{565}\right)(A+B-d)$$

DISTANCE IS IMPORTANT!



SITE ACOUSTICS

AN AUDIBLE DECREASE IN SOUND BY HALF TAKES A REDUCTION OF 10 DECIBELS.

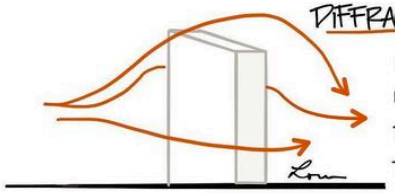
HALF SOUND

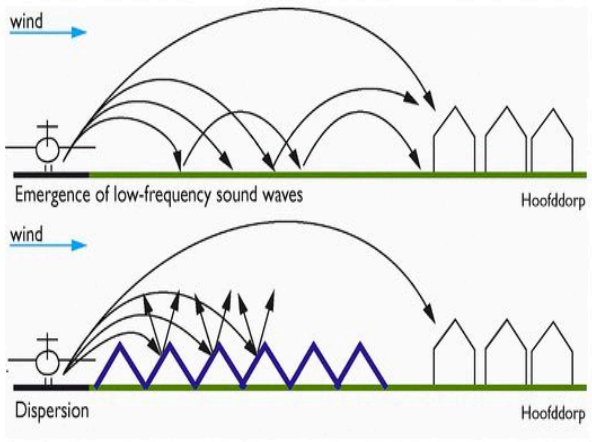
$\neq$ 70 to 35

$=$ 75 to 65
60 to 50 etc.

SITE ACOUSTICS

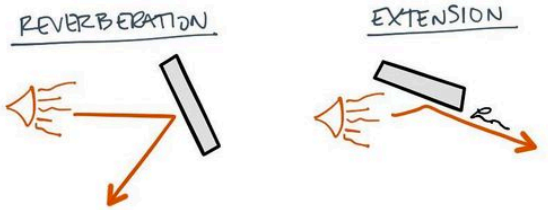
BARRIERS DON'T COMPLETELY STOP SOUND TRANSMISSION.





SITE ACOUSTICS

HARD SURFACES NEAR THE NOISE SOURCE SHOULD BE AVOIDED.



SITE ACOUSTICS

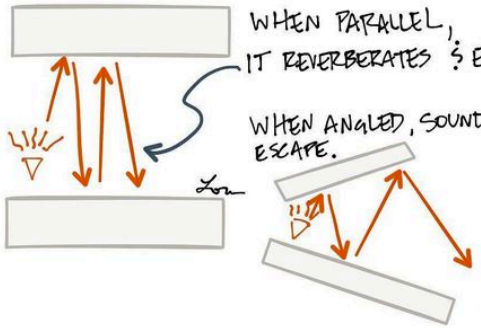
MITIGATING UNWANTED SOUND IS MORE EFFECTIVE THAN COVERING WITH WANTED SOUND.

SITE ACOUSTICS

AVOID PARALLEL HARD SURFACES.

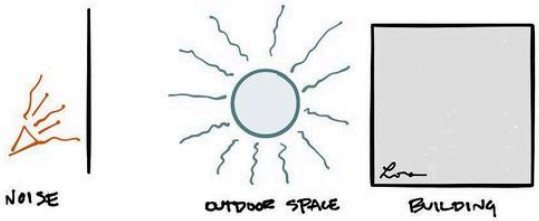
WHEN PARALLEL, IT REVERBERATES & ECHOES.

WHEN ANGLED, SOUND CAN ESCAPE.



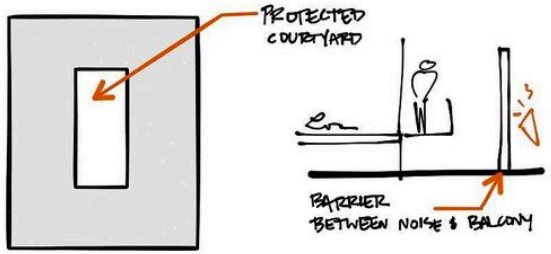
SITE ACOUSTICS

MASKING SOUNDS



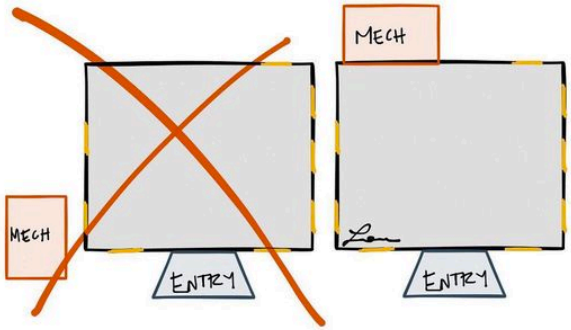
SITE ACOUSTICS

INTEGRATE INTO BUILDING DESIGN



SITE ACOUSTICS

MECHANICAL SPACES, LOADING DOCKS, SERVICE ENTRANCES

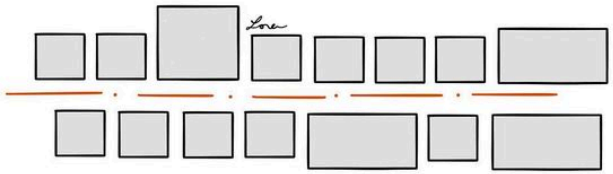


ORGANIZATION

CONCEPTS

[LINEAR]

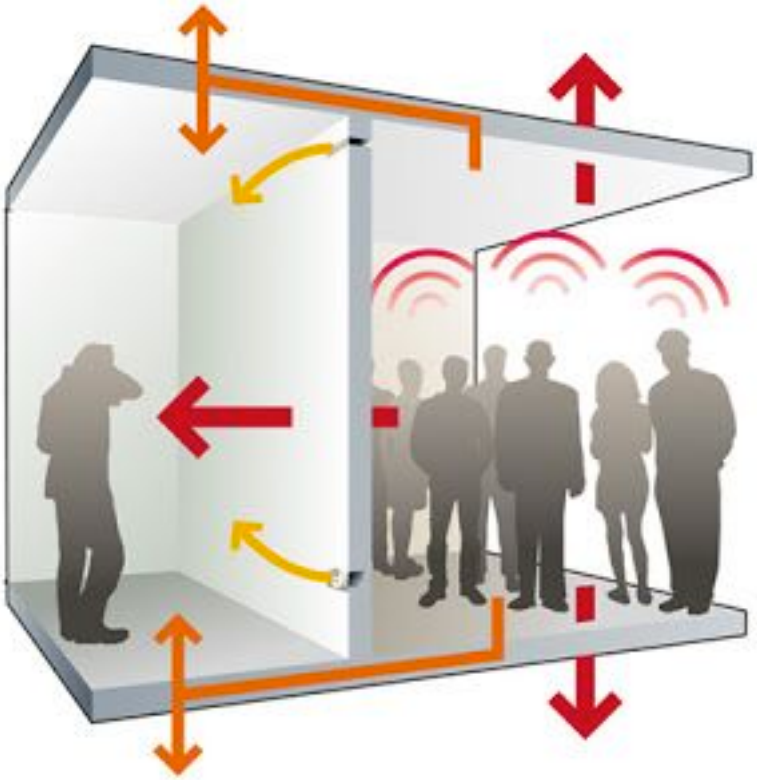
- IDENTICAL OR VARYING SIZE|SHAPE ANCHORED ALONG A SINGULAR LINE.
- CAN BE STRAIGHT, BENT, OR CURVED.
- EASILY MODULAR.



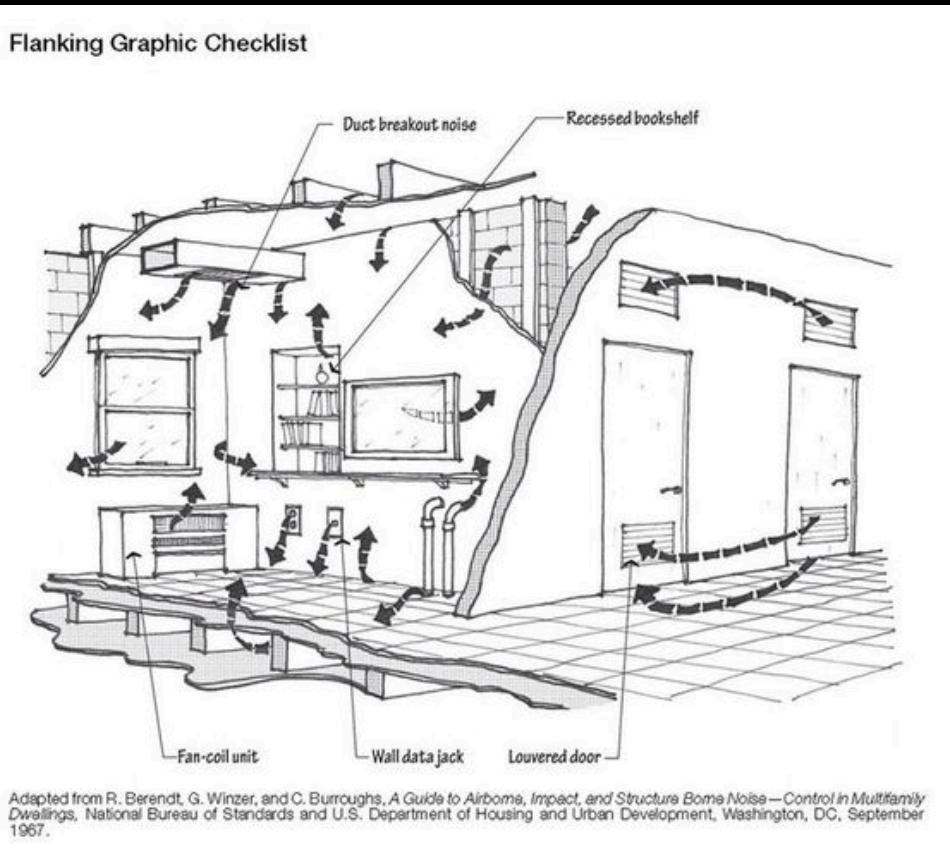
Respond to the Function

- Reading rooms need quiet concentration and contemplation
- Entrance Halls are places of arrival, disrobing, surveillance, orientation, rendezvous,
  - requires conversation: meeting, greeting, questions and answers
  - It will be a noisy space that can be accepted

Internal Acoustics
Source > Route > Problem

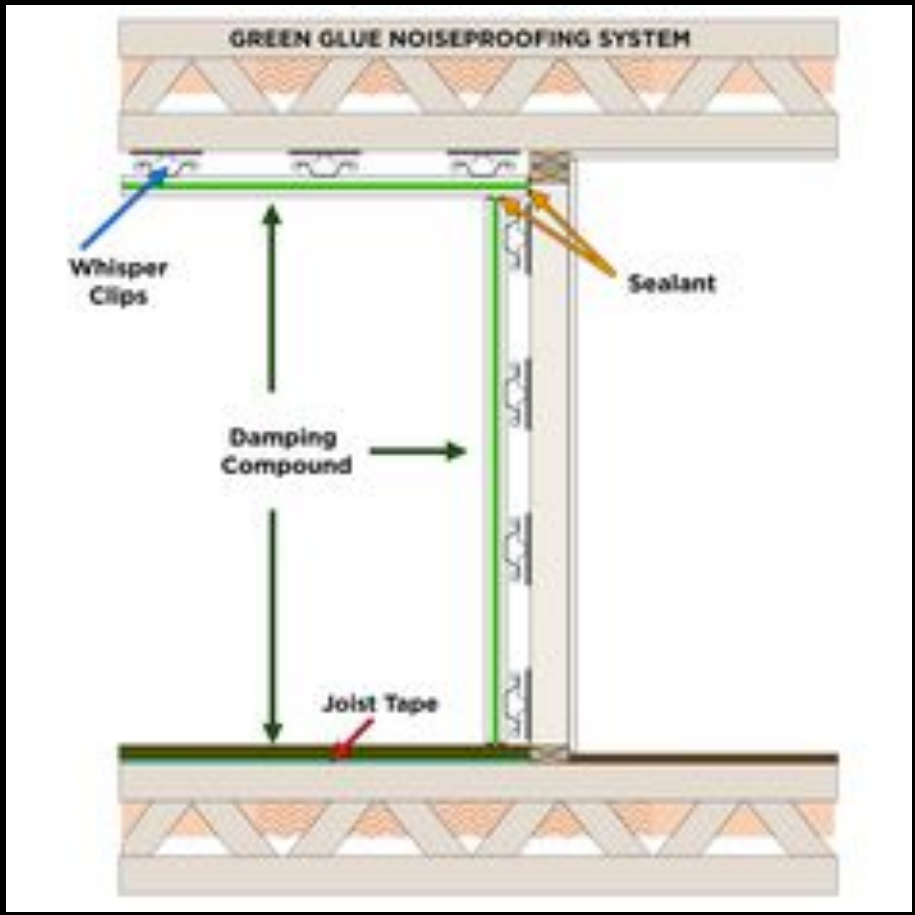


Transmission du bruit : → directe / → indirecte ou latérale / → parasite

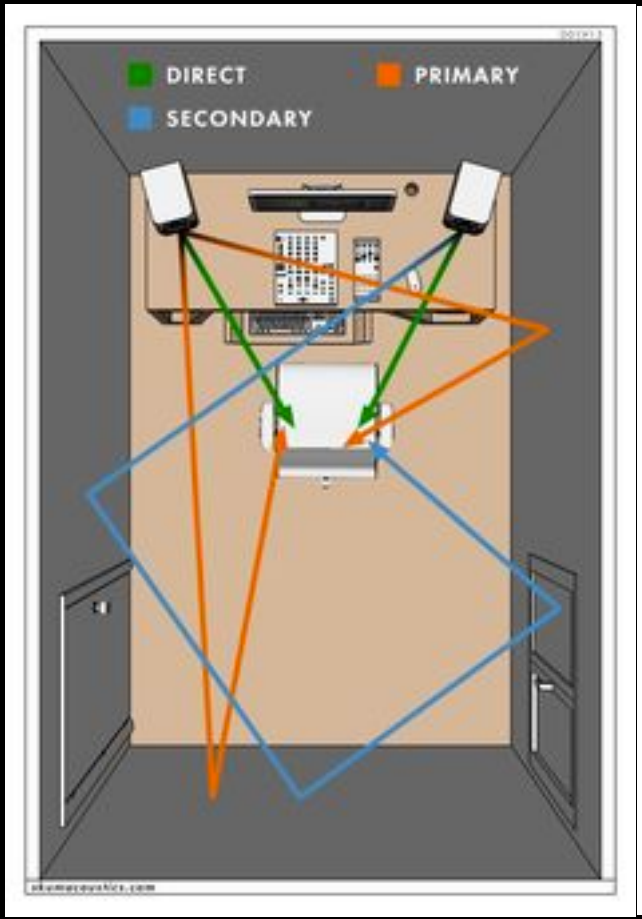


Adapted from R. Berendt, G. Winzer, and C. Burroughs, *A Guide to Airborne, Impact, and Structure Borne Noise—Control in Multifamily Dwellings*, National Bureau of Standards and U.S. Department of Housing and Urban Development, Washington, DC, September 1967.

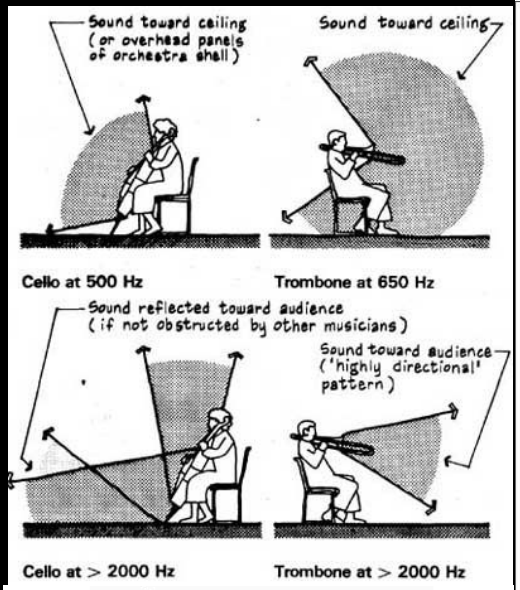
Internal Acoustics
Source > Problem > Solution

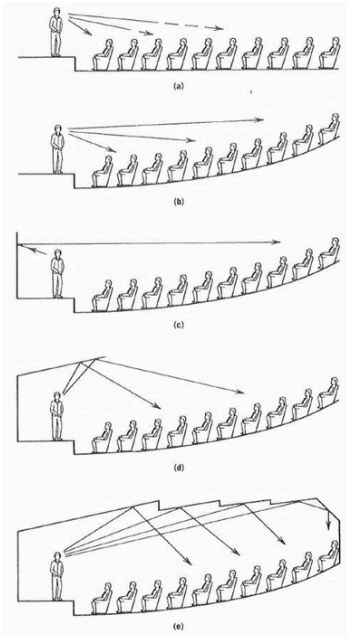


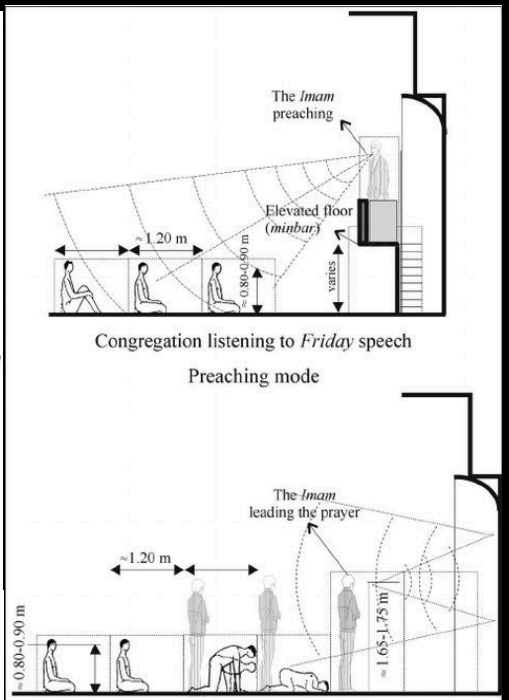
Internal Acoustics
Source > Problem > Solution

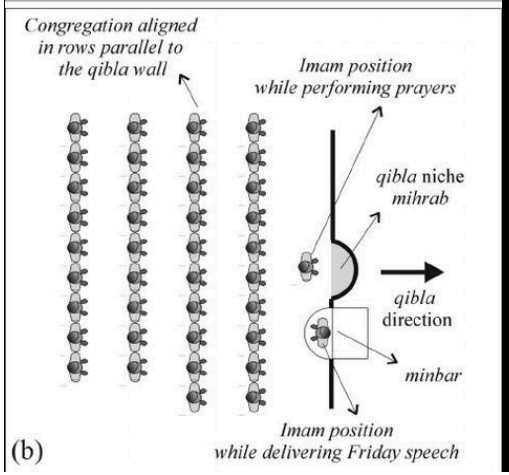


Source of Sound or Noise

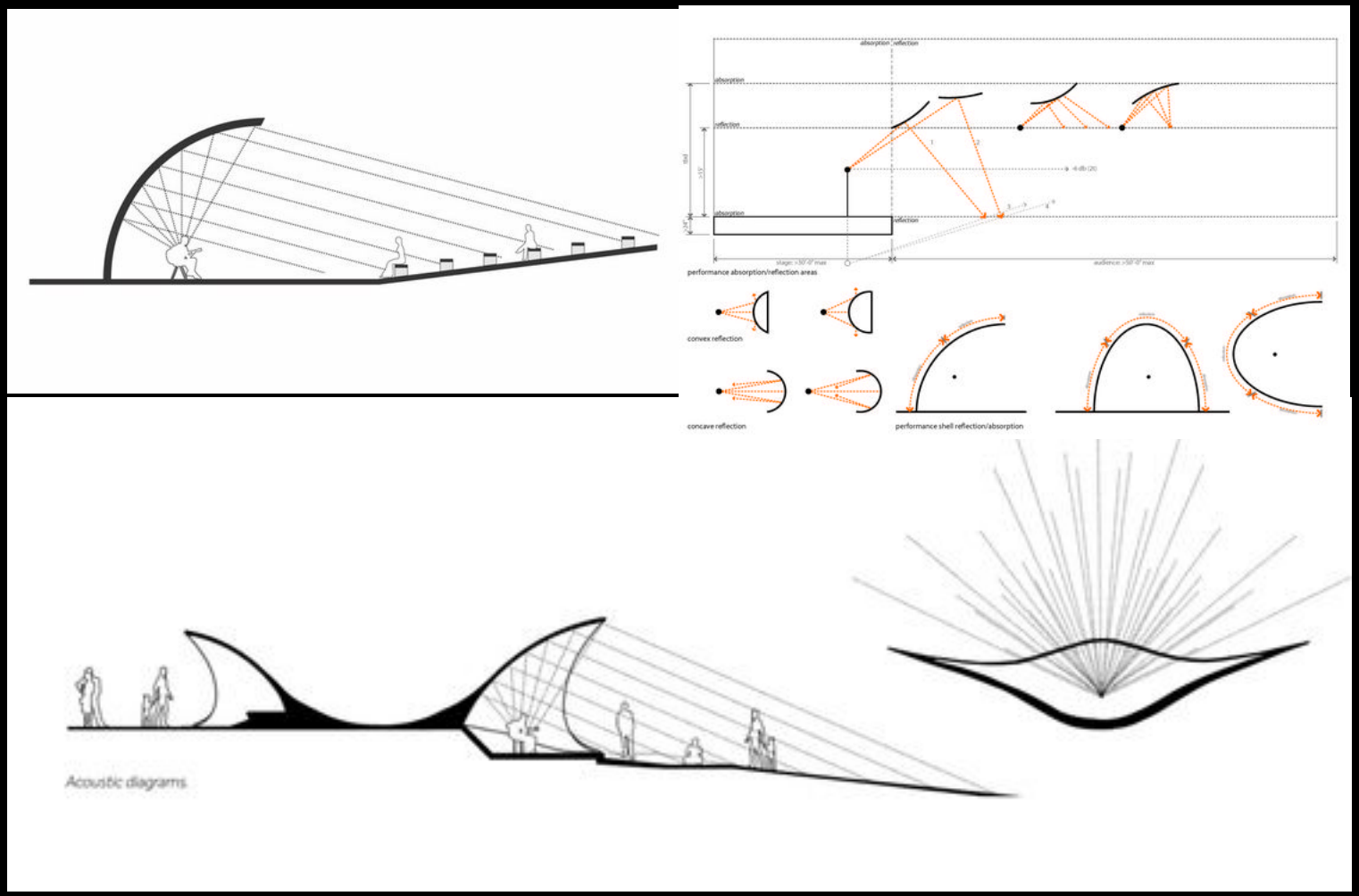




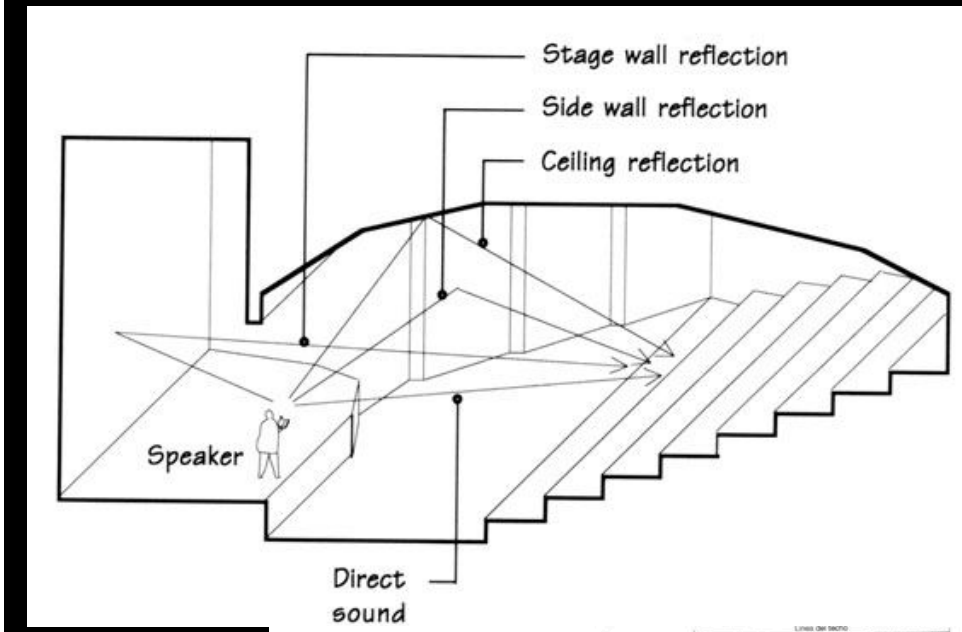


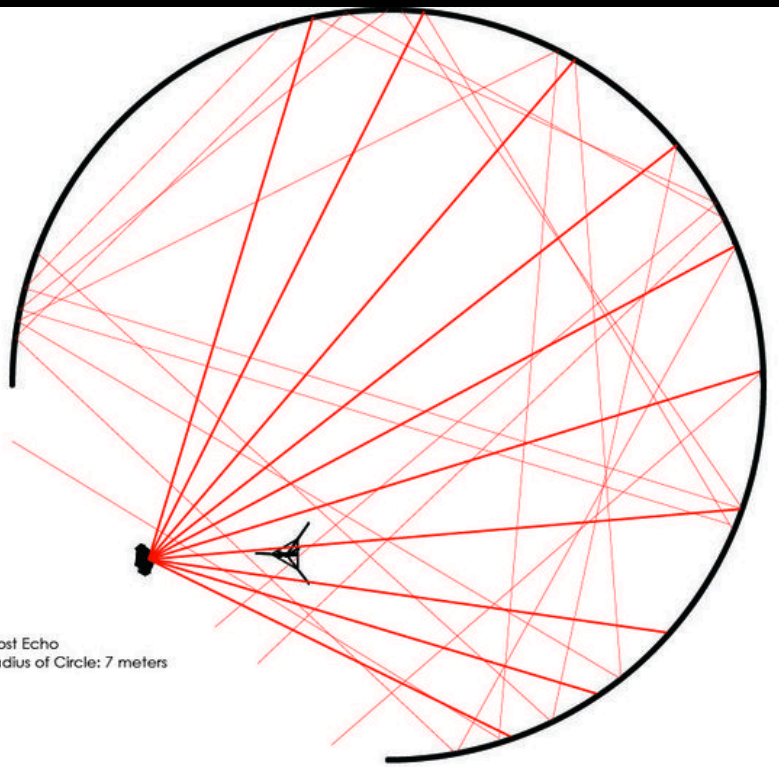


Acoustics of Shaped Spaces

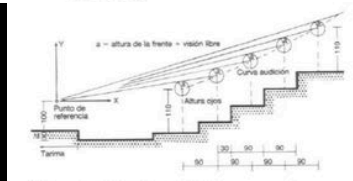


Acoustics of Shaped Spaces

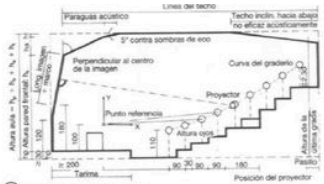




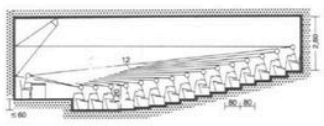
Most Echo
Radius of Circle: 7 meters



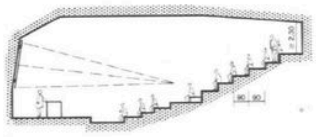
② Determinación gráfica de la curva de audición



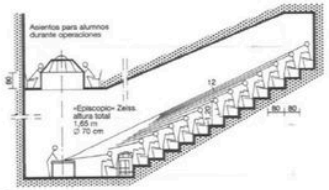
③ Sección longitudinal de un aula



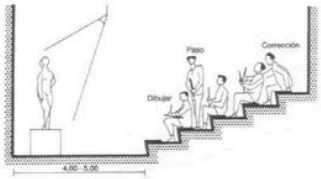
④ Forma normal de un aula



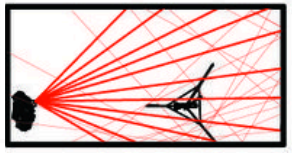
⑤ Aula de gran pendiente



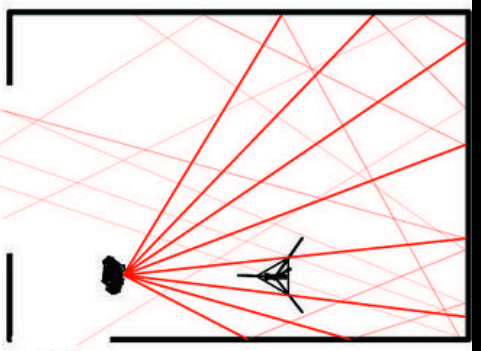
⑥ Aula para conferencias con mesa de demostraciones (Aula de cirugía clínica)



⑦ Escalonamiento en una sala de dibujo al natural, 0,65 m²/alumno

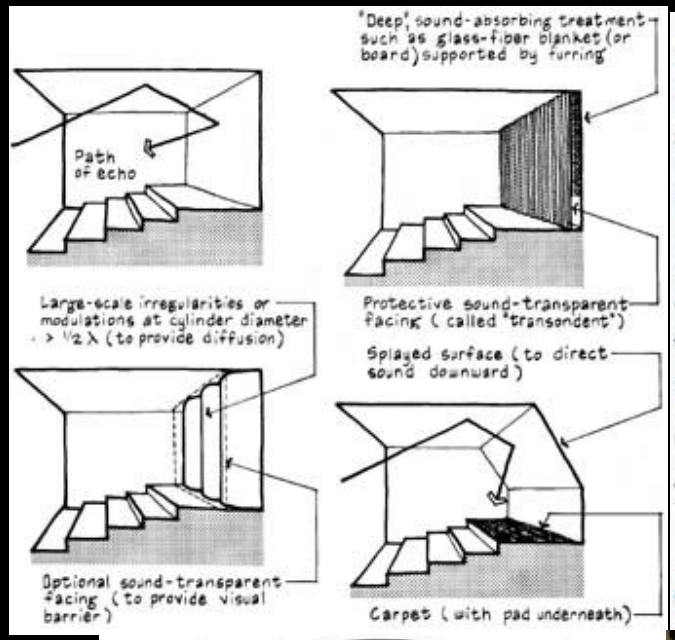


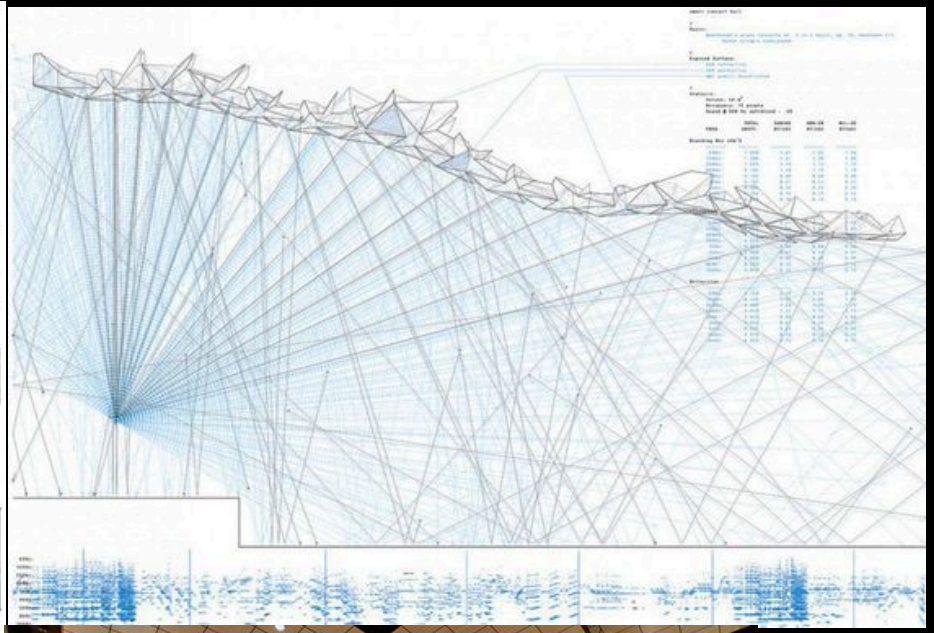
Medium Echo
Length: 4 meters
Width: 2 meters

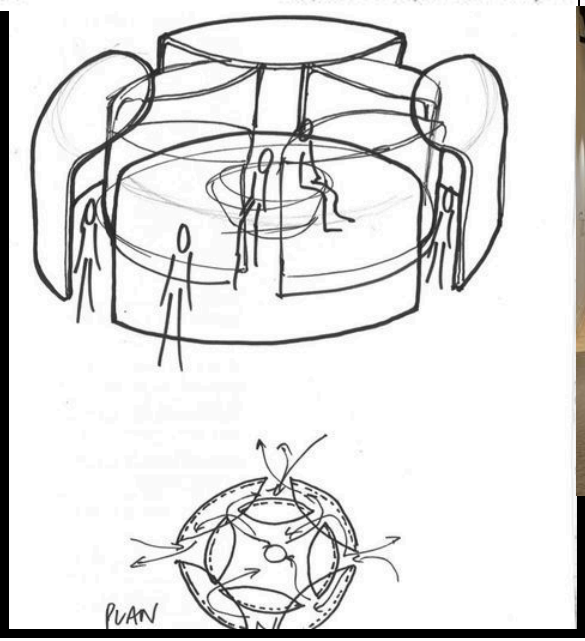


Least Echo
Length: 7 meters
Width: 5 meters

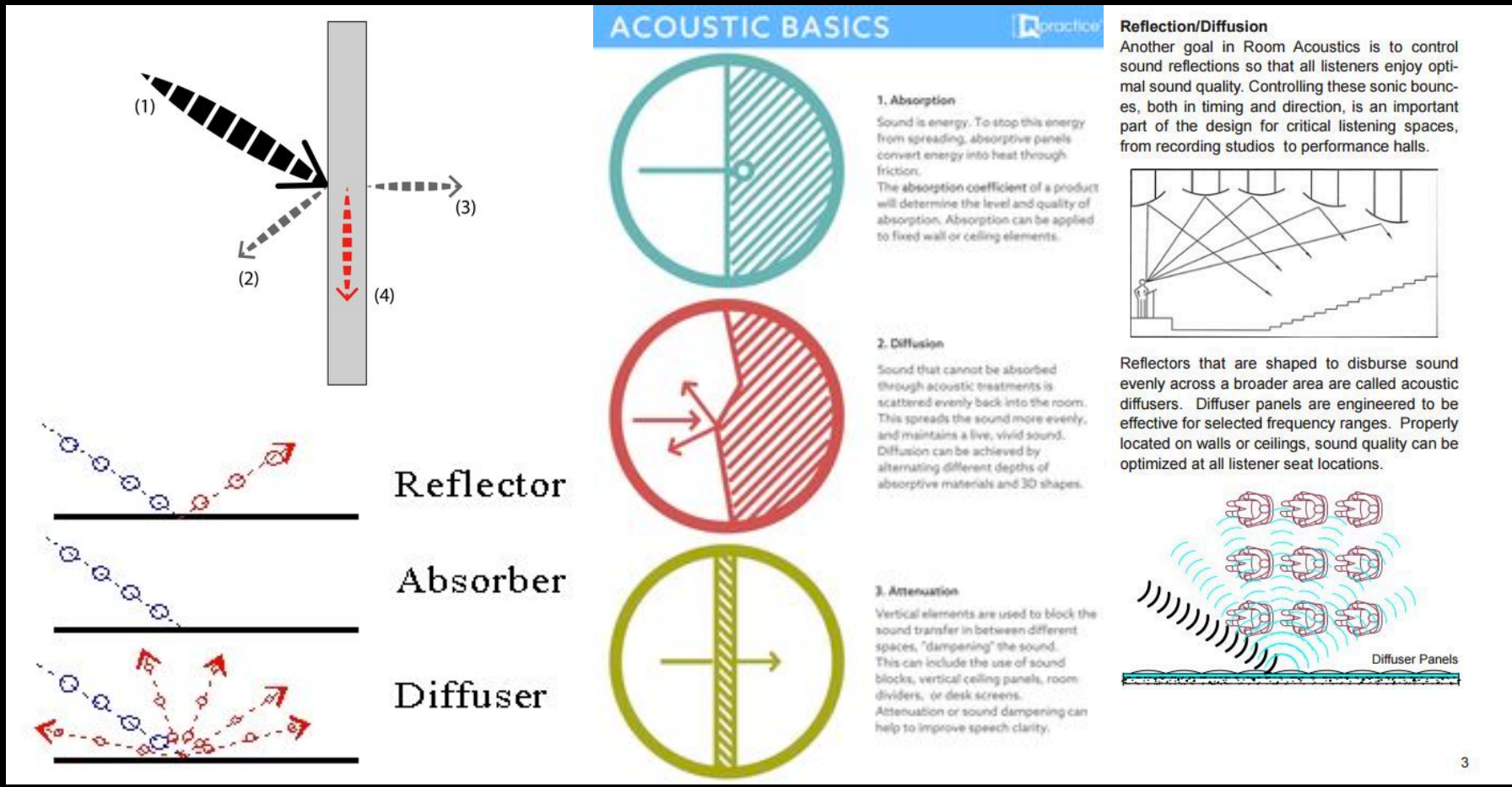
Modifying Acoustics of Spaces







Reflection Absorption Diffusion Attenuation



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Reverberation

- Joe Cilia of FIS demonstrating
- Reverberation room (hard surfaces) Long Reverberation time
- https://twitter.com/AisJoe/status/1130952798856712192
- Anechoic chamber (absorbent surfaces) Zero reverberation time
- https://twitter.com/AisJoe/status/1130952152531316737

Acoustic materials

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Acoustics Assessment

- Regional/Local map and scales essential
- External noise sources: Airports, Roads, Plant
- Plans of whole (site or building) and indicate part
- Building Profile: Section of whole and part
- Source of external and internal noises, volume, distance, topography of route to site,
- Analysis: Plans Sections Elevations:
- Analysis of existing ventilation to be aware of
- Acoustic Analysis and your response
- Any internal enclosure and glazing
- Any interventions by you to provide Acoustic control
  - Background or task acoustics or both

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

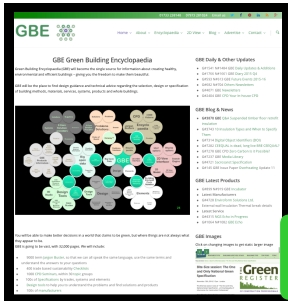
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Light/Dark

Sunlight, Daylight, Moonlight, Artificial light, UV degradation, Dark, Black out, Control, Solar Control, Light Shelves, Reflection, Concentration, Refraction,



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Purpose of Light Control

- Excessive sunlight light contrasting with shade can lead to eye strain and headaches
- Sunlight brings heat which may be undesirable,
  - Receptions in sunlit atria can lead to excess sun tanning, sun-stroke, un-wellness
- Glare: can be distracting, temporary blinding, cause accidents, cause headaches/migraines
- Lights on at night does not mean the place is occupied, it means you did not turn lights off
- Ground floor security is all that is needed upper floors are secure
- Flood lighting helps burglars not deter them
- Store cupboards need to automatically actuate light controls because full hands might not be able to reach the switch
- Cleaner's Contracts must require the to turn the lights off when they leave the floor
- Security Staff reactivate lights, controls need to turn them back off quickly

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
NWE
INTERREG IVB

Sunlight Daylight

- Sunlight Daylight Overcast Moonlight
  - Directional v Diffused v Filtered v Reflected
- Sunlight v Shade v Dark:
  - In spaces, on walls, floors; Outside: facades, paving
  - Surrounding objects: Buildings Trees
  - Sunlight with heat: E>S>W (Northern Hemisphere)
  - Daylight without heat: N (ditto)
- Sundial Effect: Rising Panning Falling
- Shifting Angles: Winter Equinox Summer
- Sunrise/set Timing:
  - Equator 6 am - 6 pm
  - Poles: 24 Hr night or day
- Colours:
  - Red: sunrise sunset, White: Daylight, Grey: Overcast, Blue: Sky
- Heat: Coolest in morning, Hot midday, Warm Evening, Cool night
- Ultra Violet Light degradation of materials
- Concentration: Walkie Scorchie, Concave curved glass/mirror glass

https://GreenBuildingEncyclopaedia.uk

Cycle Assessment Procedure for Eco-impacts of Materials

This project has received European Regional Development Funding through INTERREG IV B.

Glare

- Glare can be by reflections off metallic surfaces, on monitors (CRT in particular) reflective glass worse than matt glass
- Reflective surfaces can be used to advantage in light shelves to disperse light
- Glare can be from light fittings, through windows or solar shading, in peripheral vision
- Excessive light glare can lead to distraction potentially accidents and migraine

https://GreenBuildingEncyclopaedia.uk

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

Ultra violet light

- Ultra violet light can degrade plastics/rubber materials, fading of synthetic colours
- UV filtration can prevent this in laminated glazing PVB interlayers, and surrounds in light fittings
- UV absorbent surfaces remove UV from sunlight on each bounce

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

nwe

INTERREG IVB

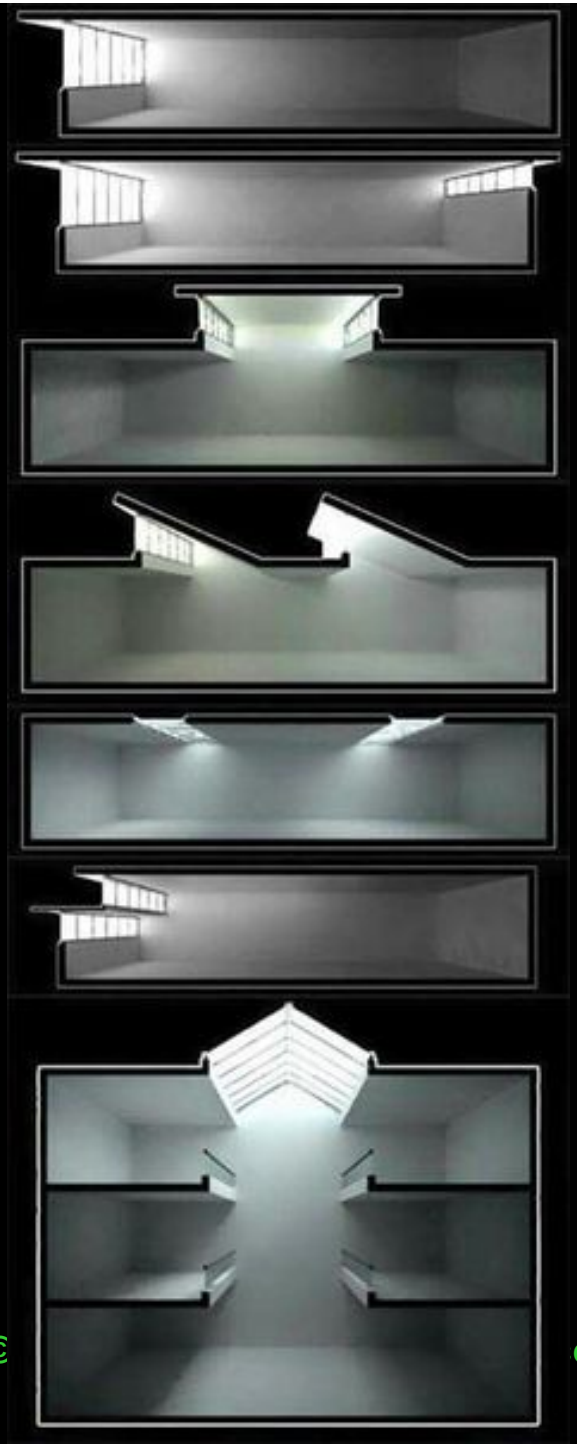
Energy saving light

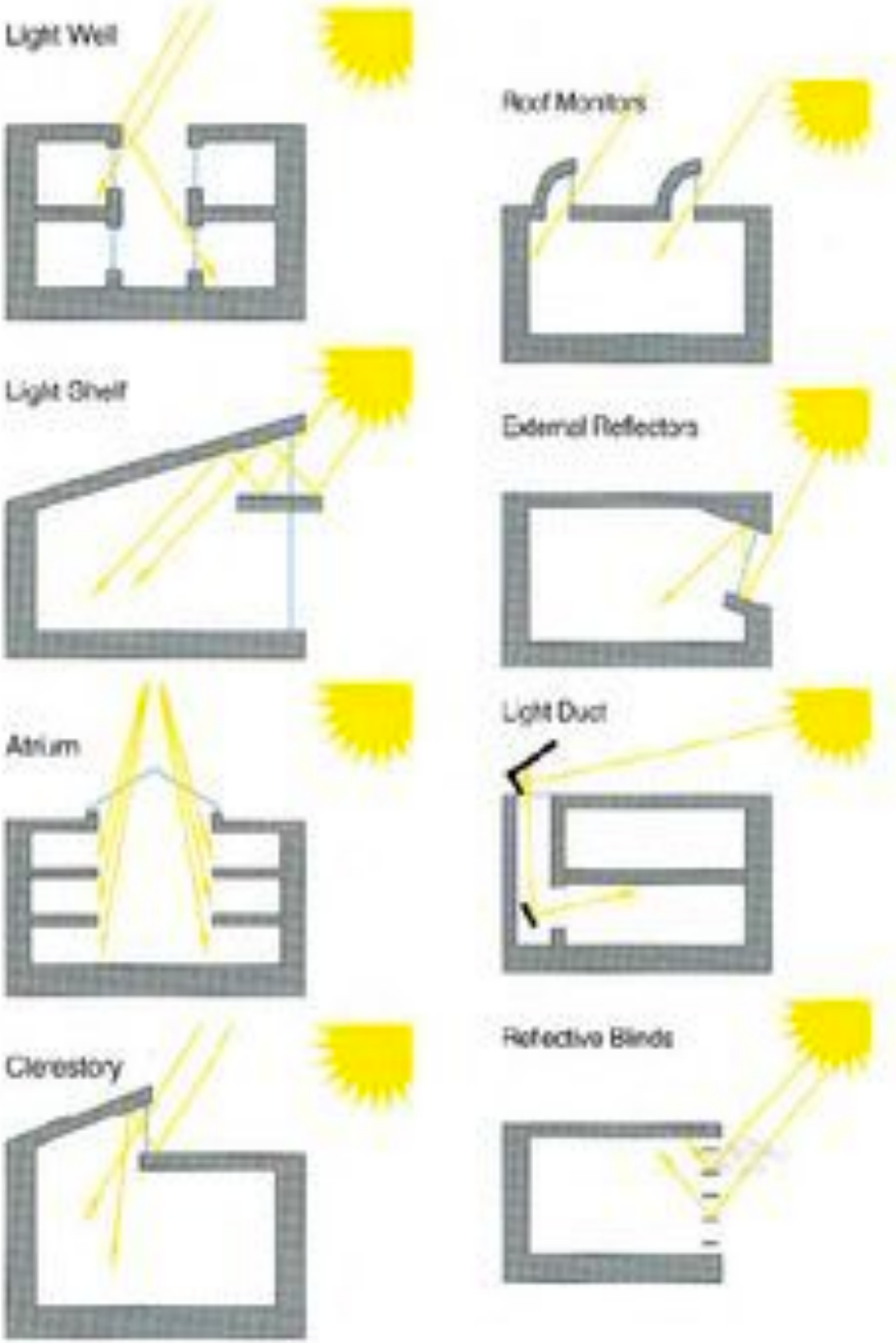
- Good daylight can avoid need for artificial light
- Control of artificial light saves energy,
- Artificial light may not needed closest to windows except late afternoon evening
- Light off if no people present, proximity actuation, individual light controls
- Lights off in daylight, on at night time, only if people present
- Use of sunpipes to bring sun/day/moon light deep into the building (+Vent option)

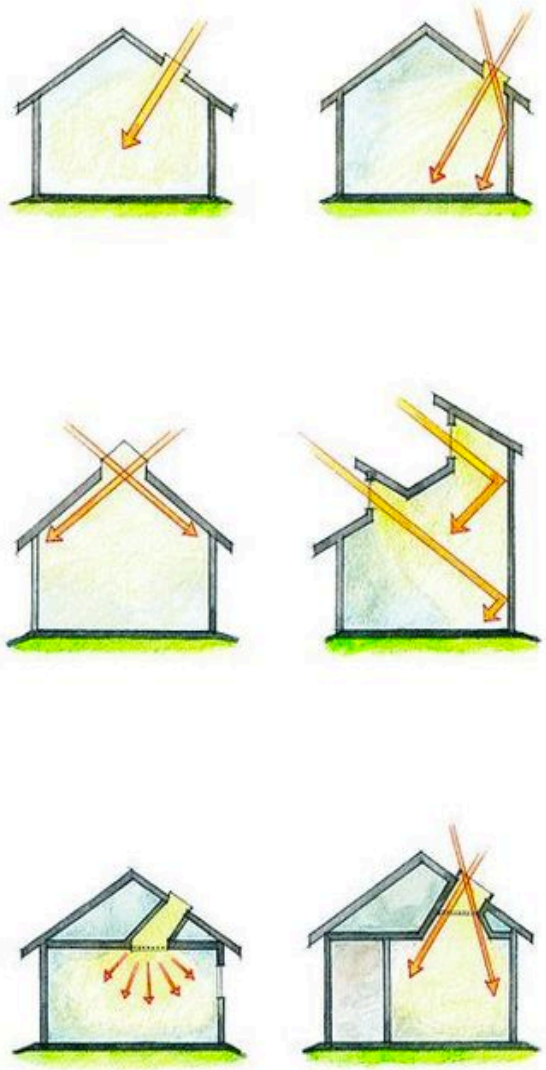
https://GreenBuildingEncyclopaedia.uk

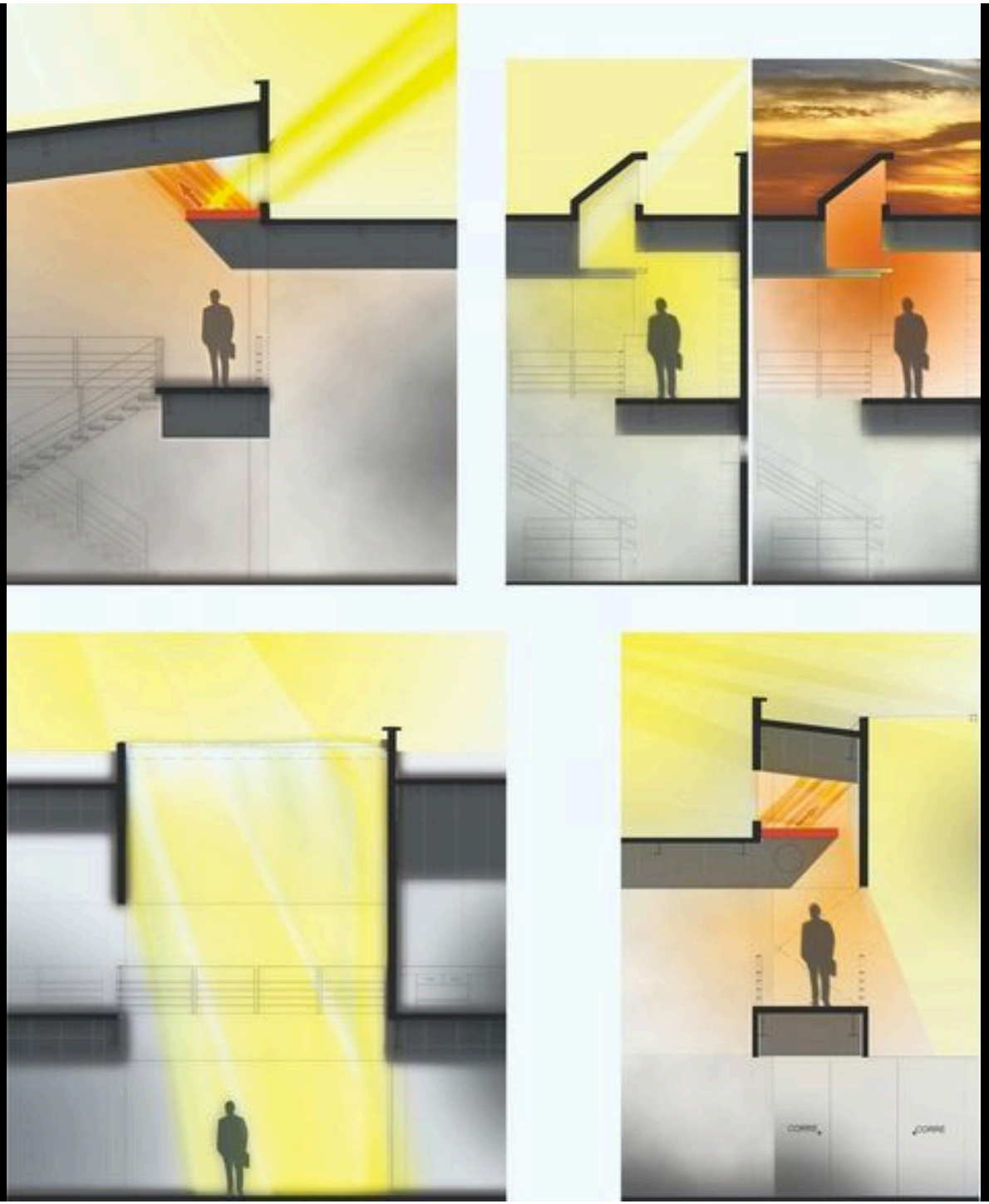
CAP'EM
Cycle Assessment Procedure for Eco-impacts of Materials

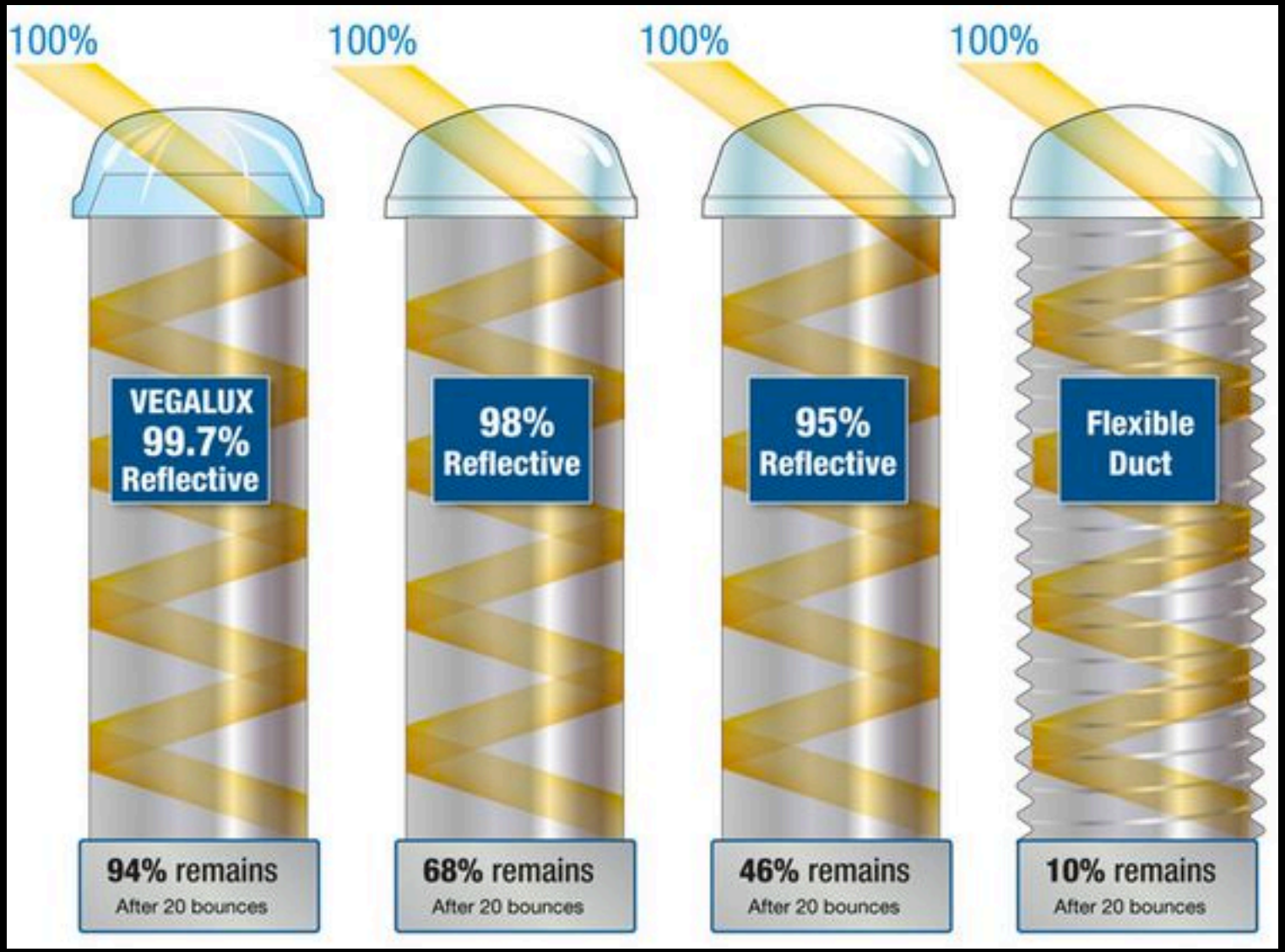
Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB




Light Well
Roof Monitors
Light Shelf
External Reflectors
Atrium
Light Duct
Clerestory
Reflective Blinds







GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

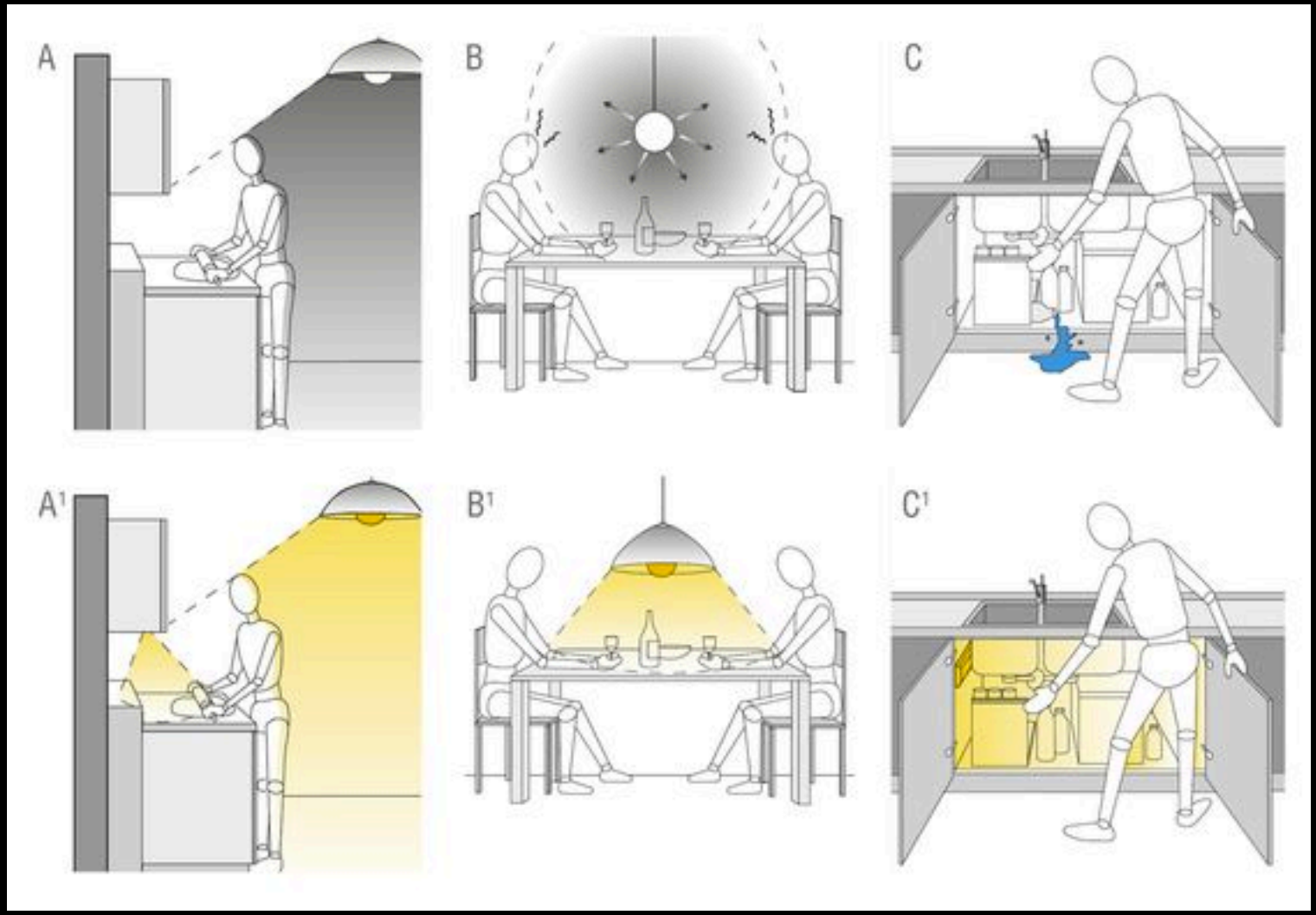
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Artificial Light

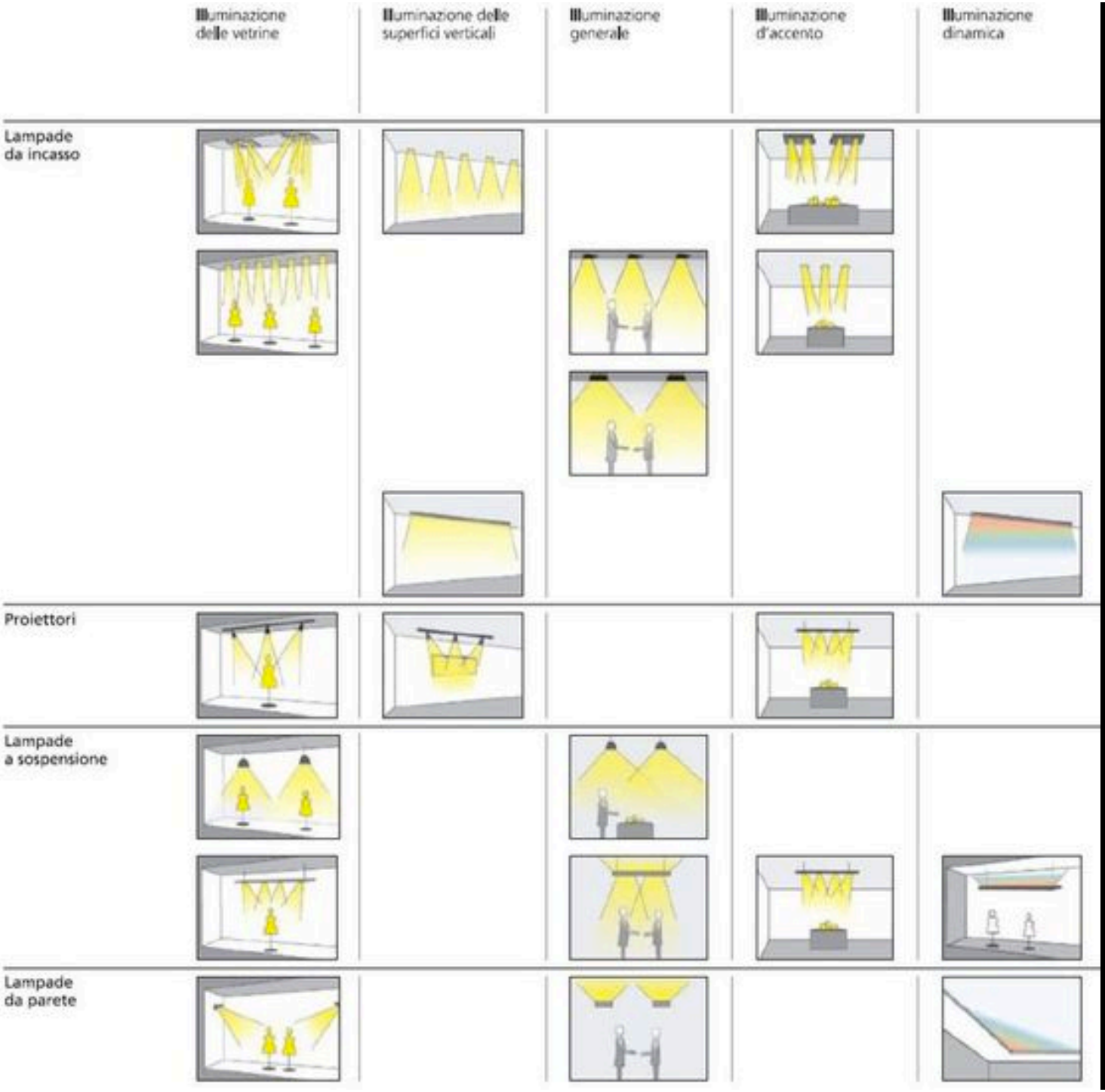
- Choosing lights:
- Room function: Office, Ladies powder room, Kitchen, Theatre Dressing room/makeup, showroom, gallery, Shop, food counter,
- Lighting layout: Reflected ceiling plan, light position, orientation direction,
- Lighting function: Nightlight, Background, Task, Wall-wash, Up-light, Down-light, Floodlight, Uniform office light level, decoration, route, emergency, decoration
  - Luminaire: profile and diffusion dictate polar diagram
  - Polar diagrams: indicate direction, reach, spread and concentration
- Lighting Position: ceiling, coving, skirting, floor, wall,
- Lighting scenarios: mood setting
- White Light: Colour temperature
- Coloured light: White light, Daylight,
- Wattage/Efficiency: High, Low, Mid, Dimming,
- Coloured luminaire: Glass, light, reflector,
- Lamp geometry: Bulb: spherical, LED: Directional, Fluorescent: Linear
- Luminaire geometry: Recessed, Flush, Surface mounted, pendant, Chandelier
- Style: Retro, Modern, Futurist, Scandinavian, Natural,
- Controls: wall switch, dimmer, proximity actuation, timer, scenarios, smartphone


A
B
C
A1
B1
C1

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

ILUMINAÇÃO NO PLANO DO ESPELHO

ILUMINAÇÃO NO TETO


Illuminazione delle vetrine
Illuminazione delle superfici verticali
Illuminazione generale
Illuminazione d'accento
Illuminazione dinamica
Lampade da incasso
Proiettori
Lampade a sospensione
Lampade da parete

GB

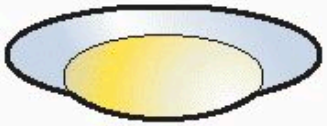
https://GreenBu

Recessed lighting is a bright idea

Use this chart to match a lighting style with the desired bulb style.

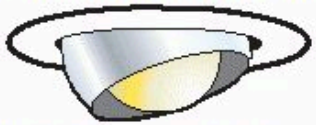
Trims or styles

Baffles can minimize glare in lighting applications.

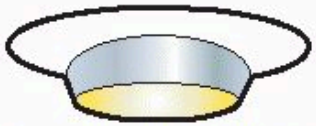


The most economical choice for recessed downlighting in the **Open** style.

Reflectors maximizes light output in residential and commercial environments.



Eyeballs provided adjustable/ directional lighting applications.



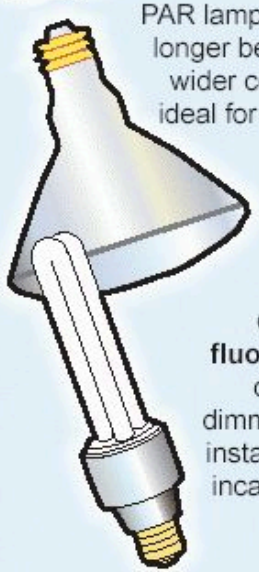
Lens diffuse light, shield the lamp and are deal for closets, bathrooms.

Bulb styles

Standard light bulbs can be used in reflector and lens-fitted trims for general lighting applications.

PAR bulbs

Parabolic aluminized reflector, or **PAR lamps**, have built-in reflectors and are used for general lighting, "wall washing" and display lighting.



PAR lamps provide longer beams and wider coverage - ideal for Task and General lighting.

Compact fluorescents cannot be dimmed when installed in an incandescent can.

Stan Kohler/Special to the AP

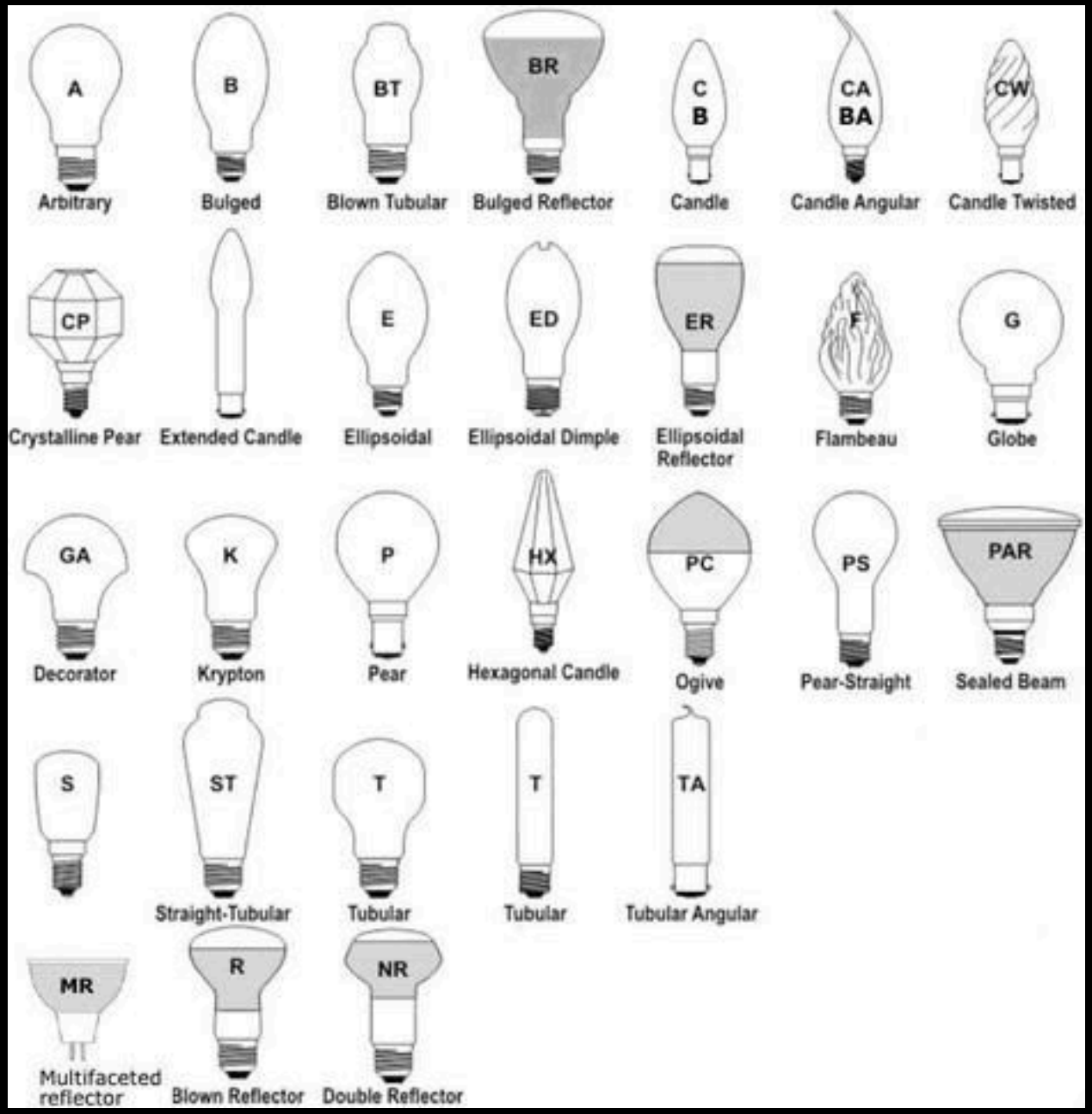
EM

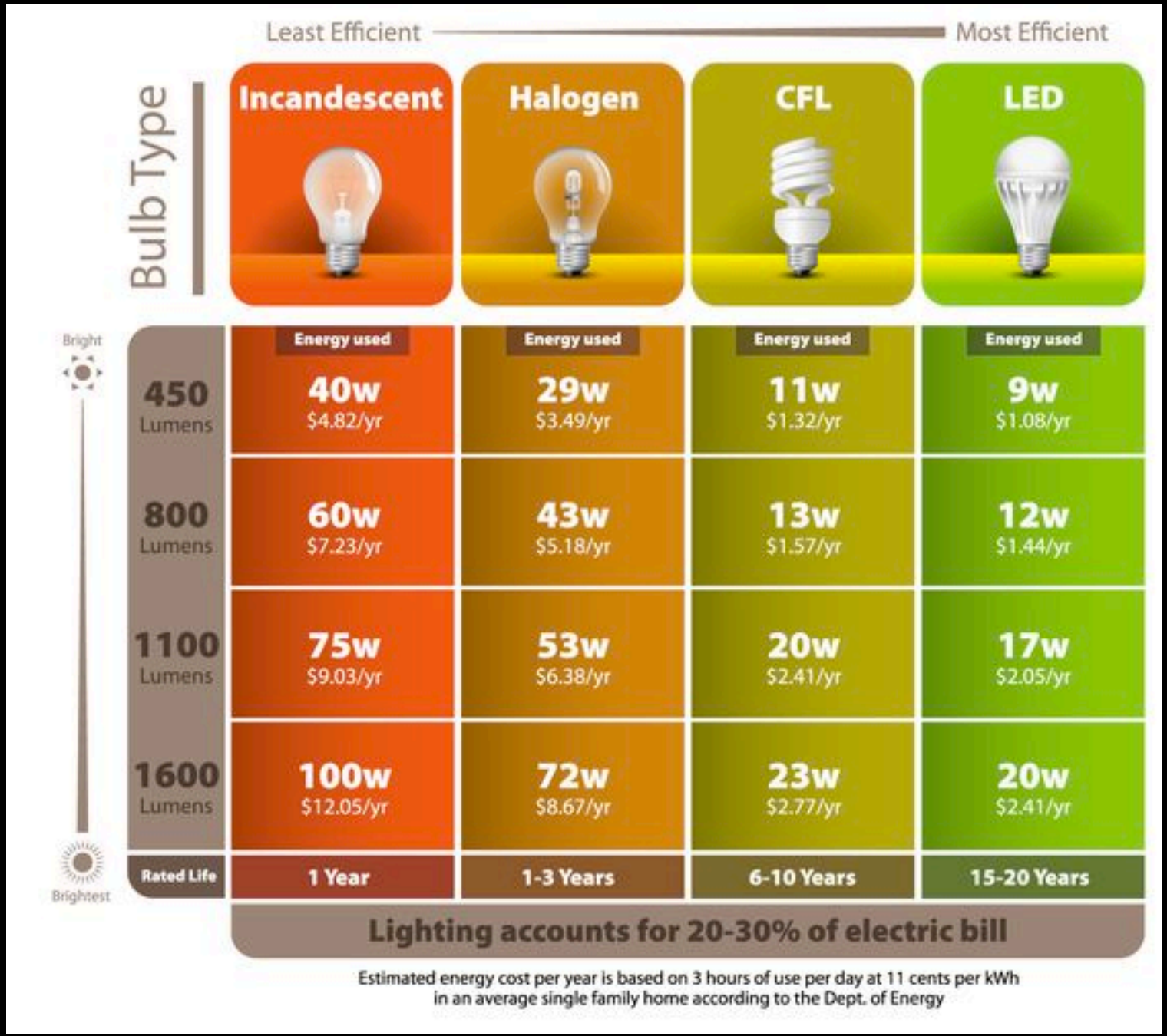
-impacts of Materials

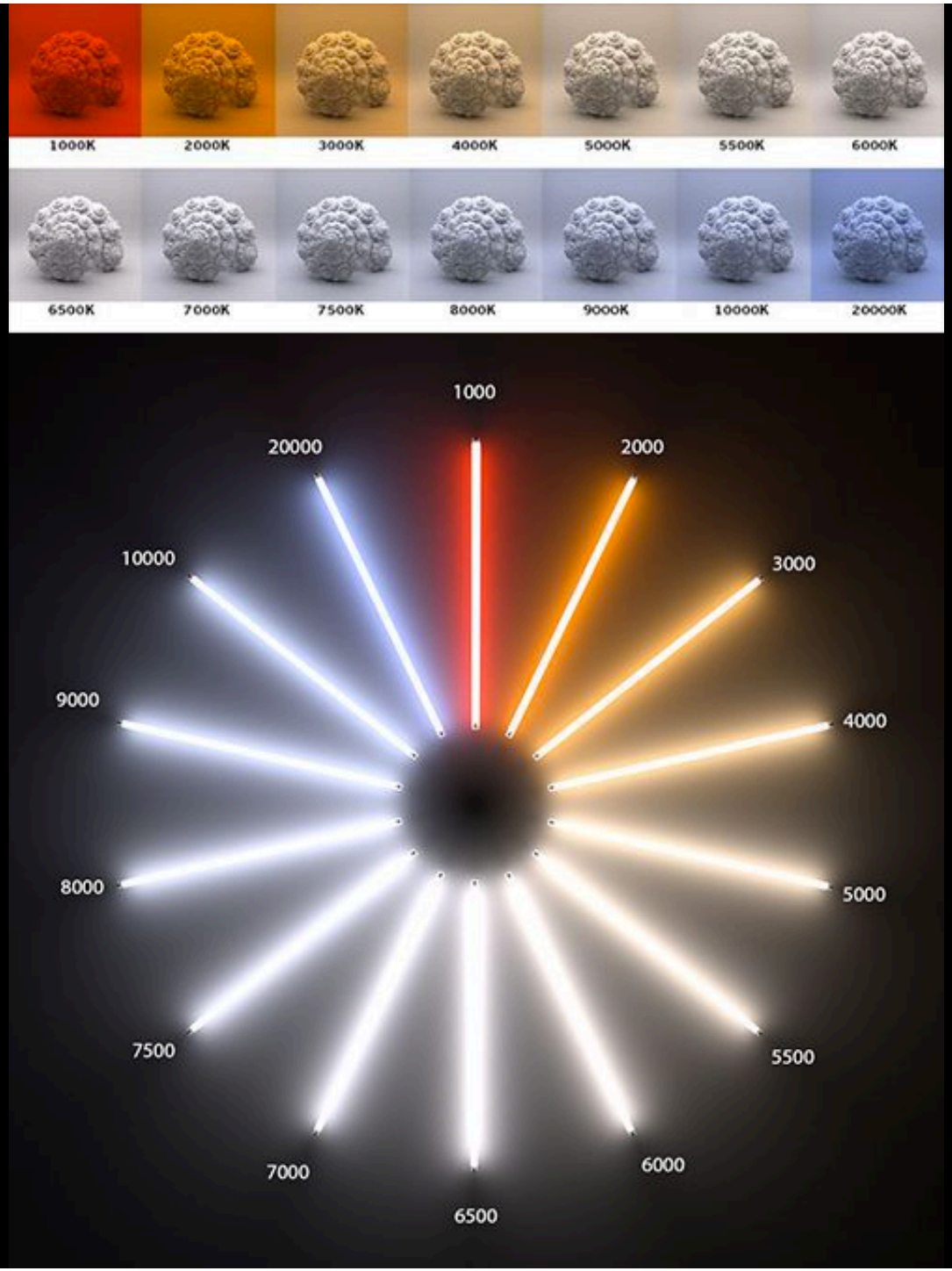
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB


A
Arbitrary
B
Bulged
BT
Blown Tubular
BR
Bulged Reflector
C
B
Candle
CA
BA
Candle Angular
CW
Candle Twisted
CP
Crystalline Pear
Extended Candle
E
Ellipsoidal
ED
Ellipsoidal Dimple
ER
Ellipsoidal Reflector
F
Flambeau
G
Globe
GA
Decorator
K
Krypton
P
Pear
HX
Hexagonal Candle
PC
Ogive
PS
Pear-Straight
PAR
Sealed Beam
S
ST
Straight-Tubular
T
Tubular
T
Tubular
TA
Tubular Angular
MR
Multifaceted reflector
R
Blown Reflector
NR
Double Reflector

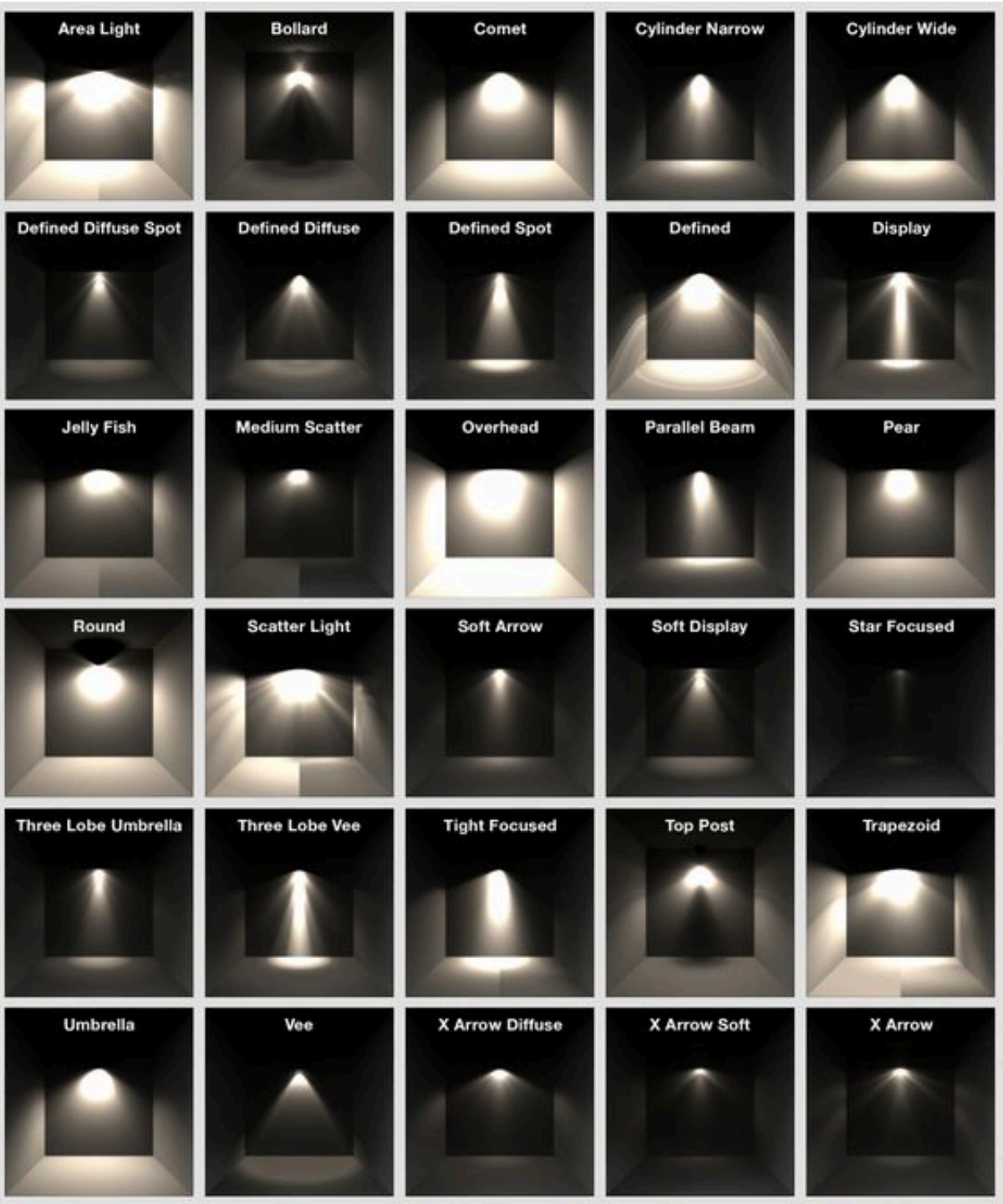

Least Efficient
Most Efficient
Bulb Type
Incandescent
Halogen
CFL
LED
Bright
Brightest
450 Lumens
800 Lumens
1100 Lumens
1600 Lumens
Energy used
40w $4.82/yr
29w $3.49/yr
11w $1.32/yr
9w $1.08/yr
60w $7.23/yr
43w $5.18/yr
13w $1.57/yr
12w $1.44/yr
75w $9.03/yr
53w $6.38/yr
20w $2.41/yr
17w $2.05/yr
100w $12.05/yr
72w $8.67/yr
23w $2.77/yr
20w $2.41/yr
Rated Life
1 Year
1-3 Years
6-10 Years
15-20 Years
Lighting accounts for 20-30% of electric bill
Estimated energy cost per year is based on 3 hours of use per day at 11 cents per kWh
in an average single family home according to the Dept. of Energy

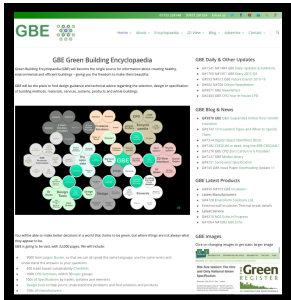

1000K
2000K
3000K
4000K
5000K
5500K
6000K
6500K
7000K
7500K
8000K
9000K
10000K
20000K
1000
2000
3000
4000
5000
5500
6000
6500
7000
7500
8000
9000
10000
20000

http

aterials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
nwe
INTERREG IVB





rials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
nwe
INTERREG IVB

GBE

https://GreenBuildingEncyclopaedia.uk

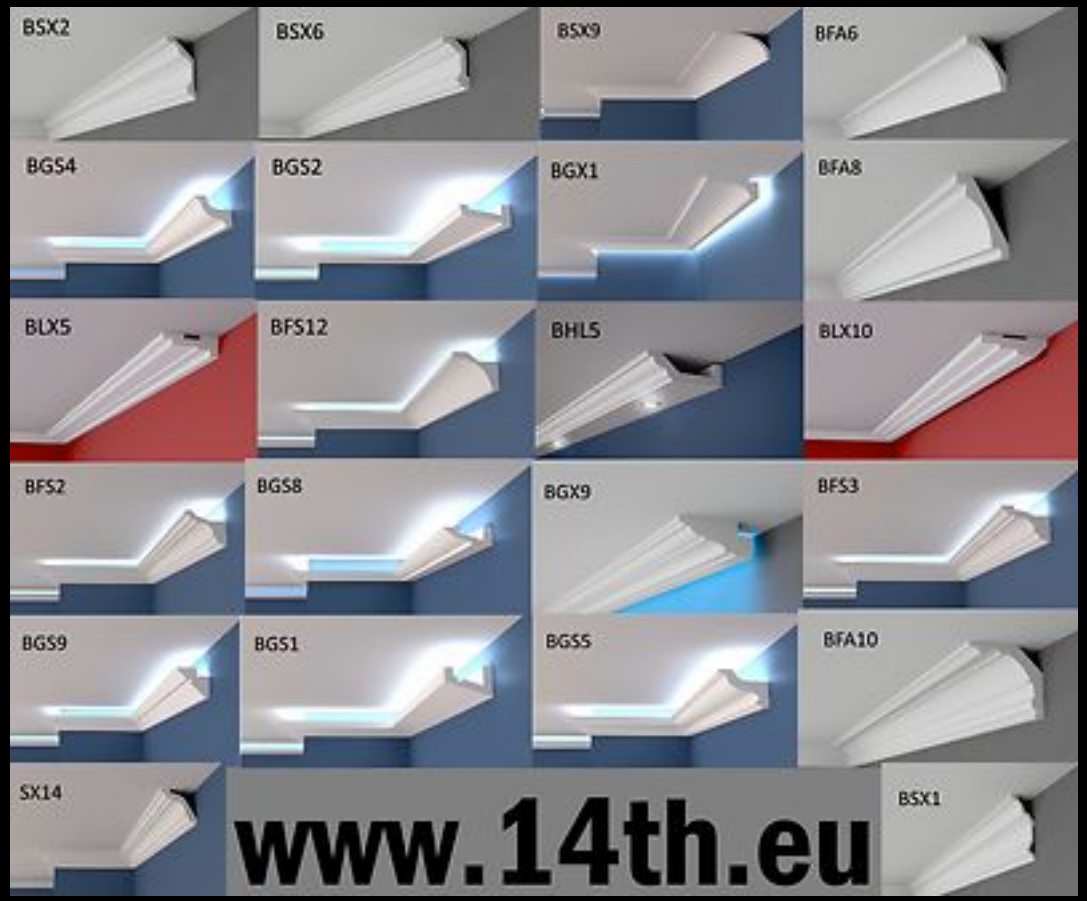
CAP'EM

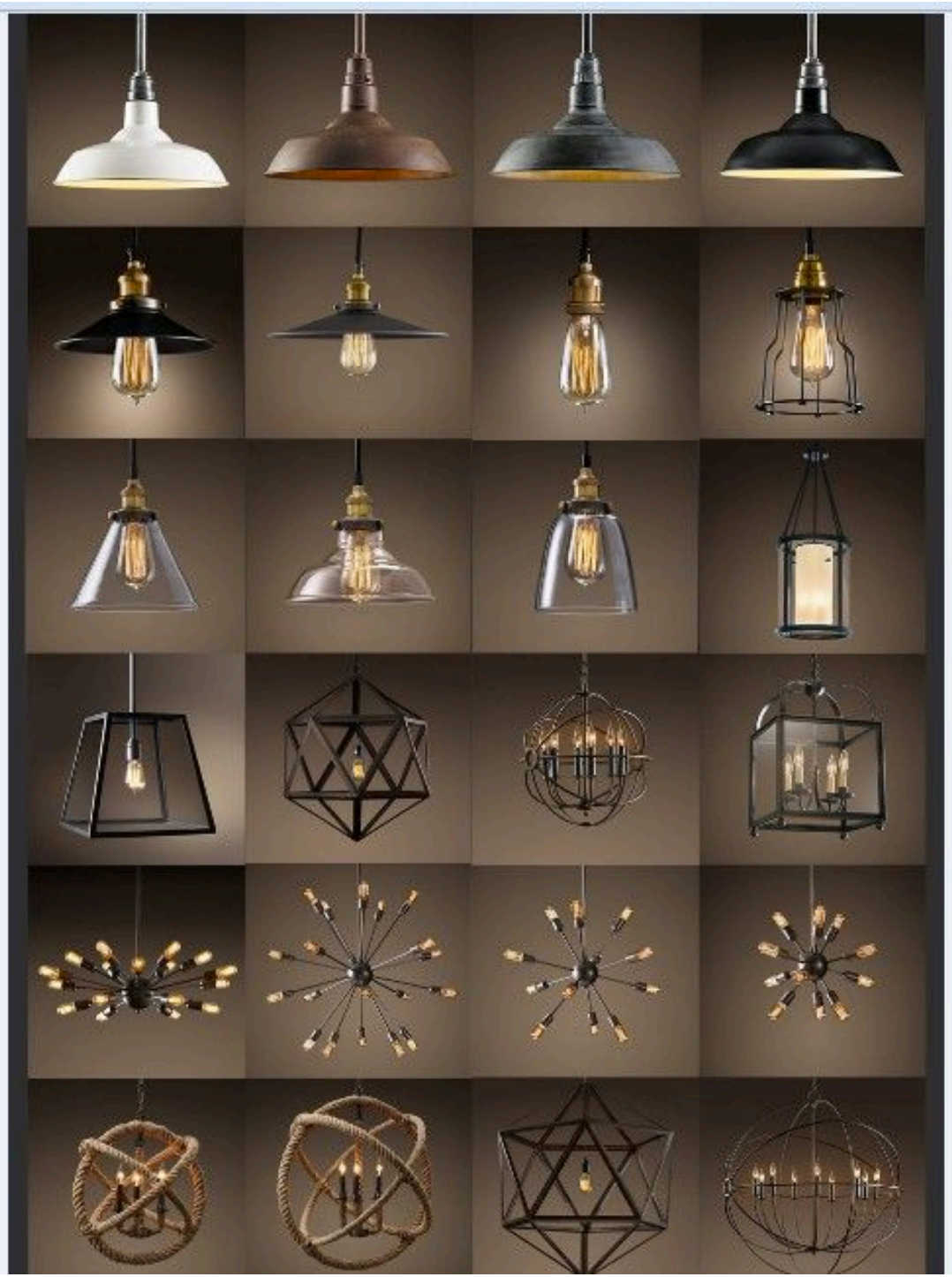
Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB





GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Audio Visual Display

- Highly absorbent matt black surfaces absorbs light
- Too much daylight can make projected images difficult to see
- Coloured surfaces distort the projected colours
- Mid tone grey surfaces are better for projecting images (black to white get = chance)
- High saturation pigmented (grey or silver) paints reflect colours accurately vividly

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Light Assessment

- North Point and scales essential
- Northern or Southern Hemisphere?
- Plans of whole (site or building) and indicate part
- Building Profile: Section of whole and part
- Exiting glazing positions, sized
- Window treatments if any (inside or out)
- Analysis: Plans Sections Elevations: sundial paths
- Shadow analysis: floors and walls, inside and out
- Your response to shadow analysis
- Any internal enclosure and glazing
- Analysis of existing light to be exploited
- Any interventions by you to provide light
  - Background or task lighting or both

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

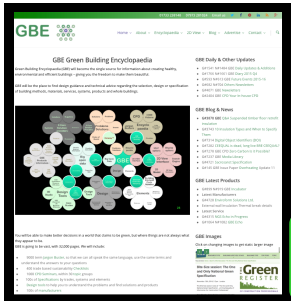
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Heat

Sun paths, Solar Control: internal/external, Sunlight, Sun paths, Shadow, Solar access, Solar heat gain, Surface Thermal Mass, cyclical storage, overnight ventilation purging, Phase Change materials,

27/11/19



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
nwe
INTERREG IVB

Purpose of Heat Control

- Source: Internal or External,
- Movement: sideways, upwards, inwards or outwards
- Excessive heat can kill, 2003 heat wave
  - Sahara temperatures across Europe,
  - 20,000 people died in France,
  - 100s in UK
- 20% of UK homes overheat
  - Higher percentage of new homes overheat
  - MMC homes will choose wrong materials for insulation and overheat
  - Top floors overheat (LRC overheats)
  - District heating overheats corridors and flats/rooms
  - Significantly better insulation needed on all heat pipes
  - Solar Hear gain in glazed staircases over hears flats via corridors
- 80% of UK conservatories are heated squandering energy
- Phase Change Materials are rarely used effectively
- Save energy, save carbon, save costs

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

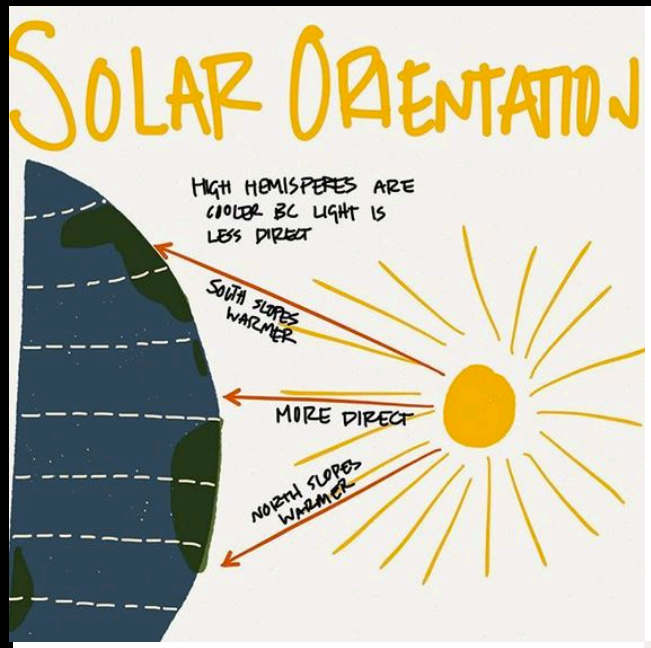
This project has received European Regional Development Funding through INTERREG IV B.

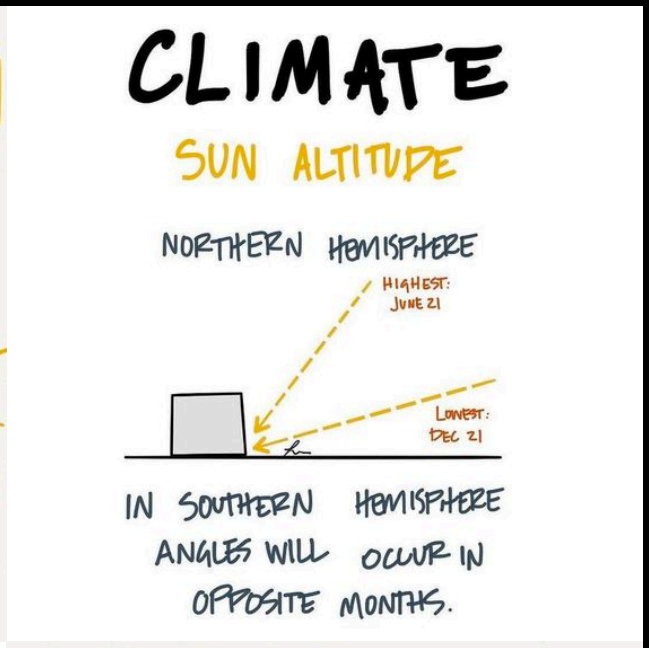
nwe

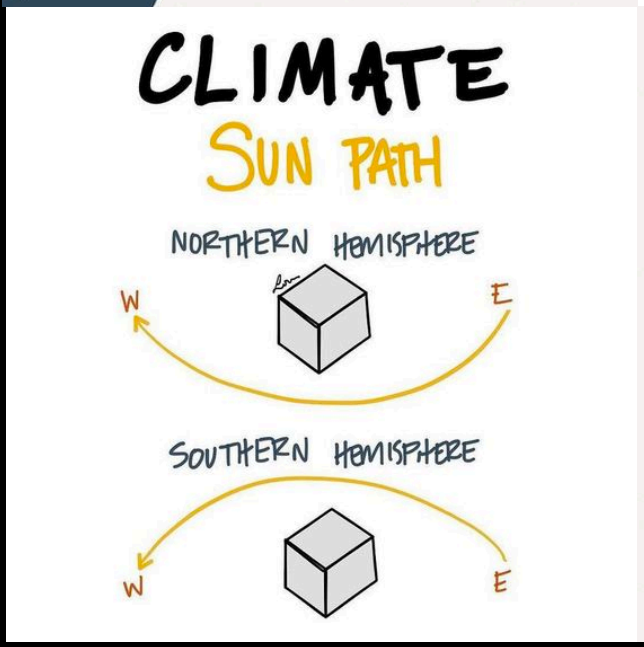
INTERREG IVB

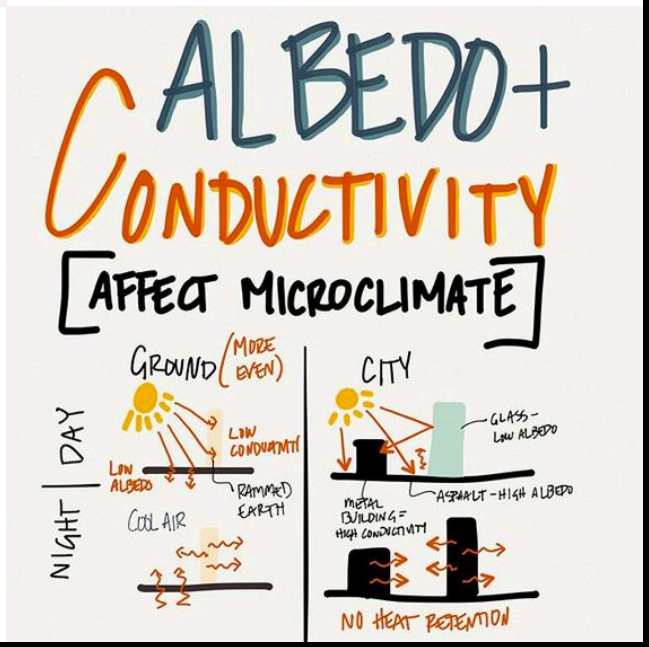
Passive Heat

- Sunlight:
  - Sunlight with heat: E>S>W (N Hemisphere)
  - Daylight without heat: N (ditto)
- Directional v Diffused v Filtered v Reflected
- Sunlight v Shade v Dark:
  - In spaces, on walls, floors; outside: facades, paving
- Sundial Effect: Rising Panning Falling
- Shifting: Winter Equinox Summer
- Timing: Equator 6am-6pm Poles: 24hr night or day
- Colours: Red White Grey Blue
- Heat:
  - Light coloured roofs are used for albedo effect for solar reflection and avoidance of solar absorption (effective all the way down to equator)
  - Dark Colours (near poles) absorb some heat

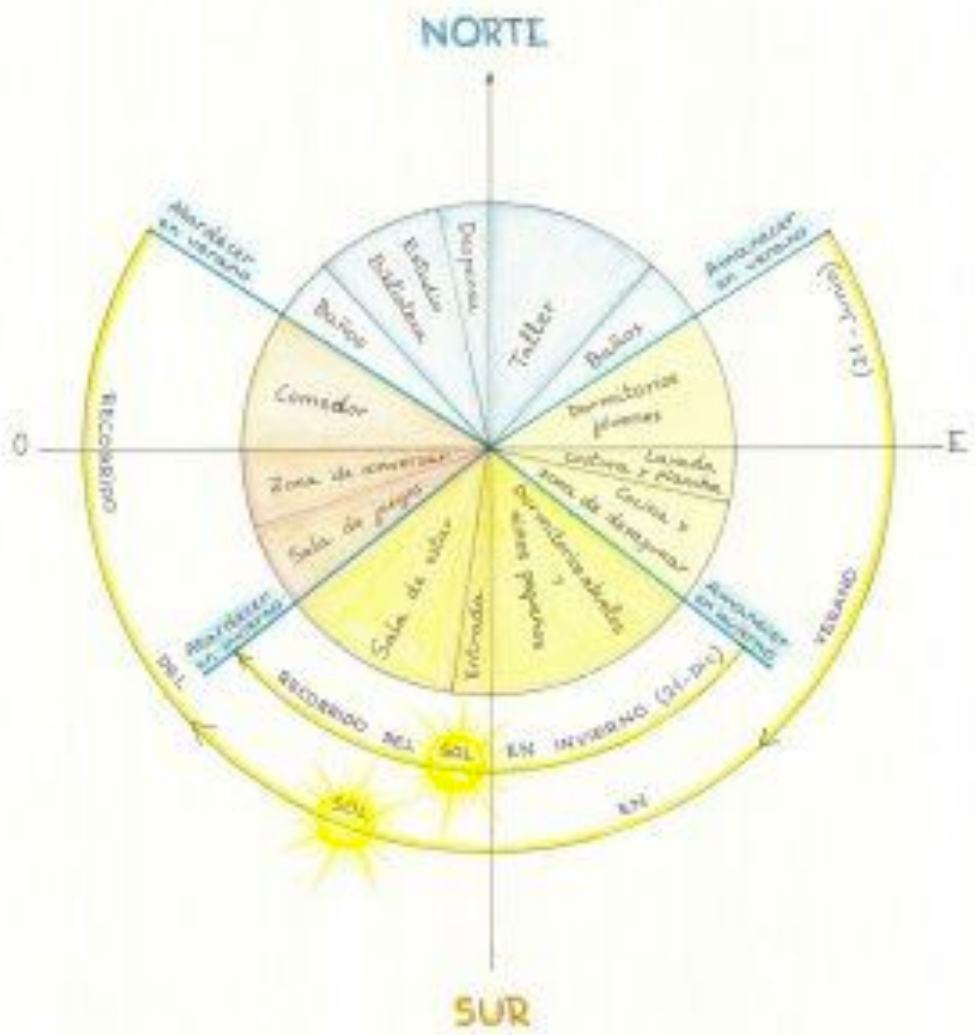




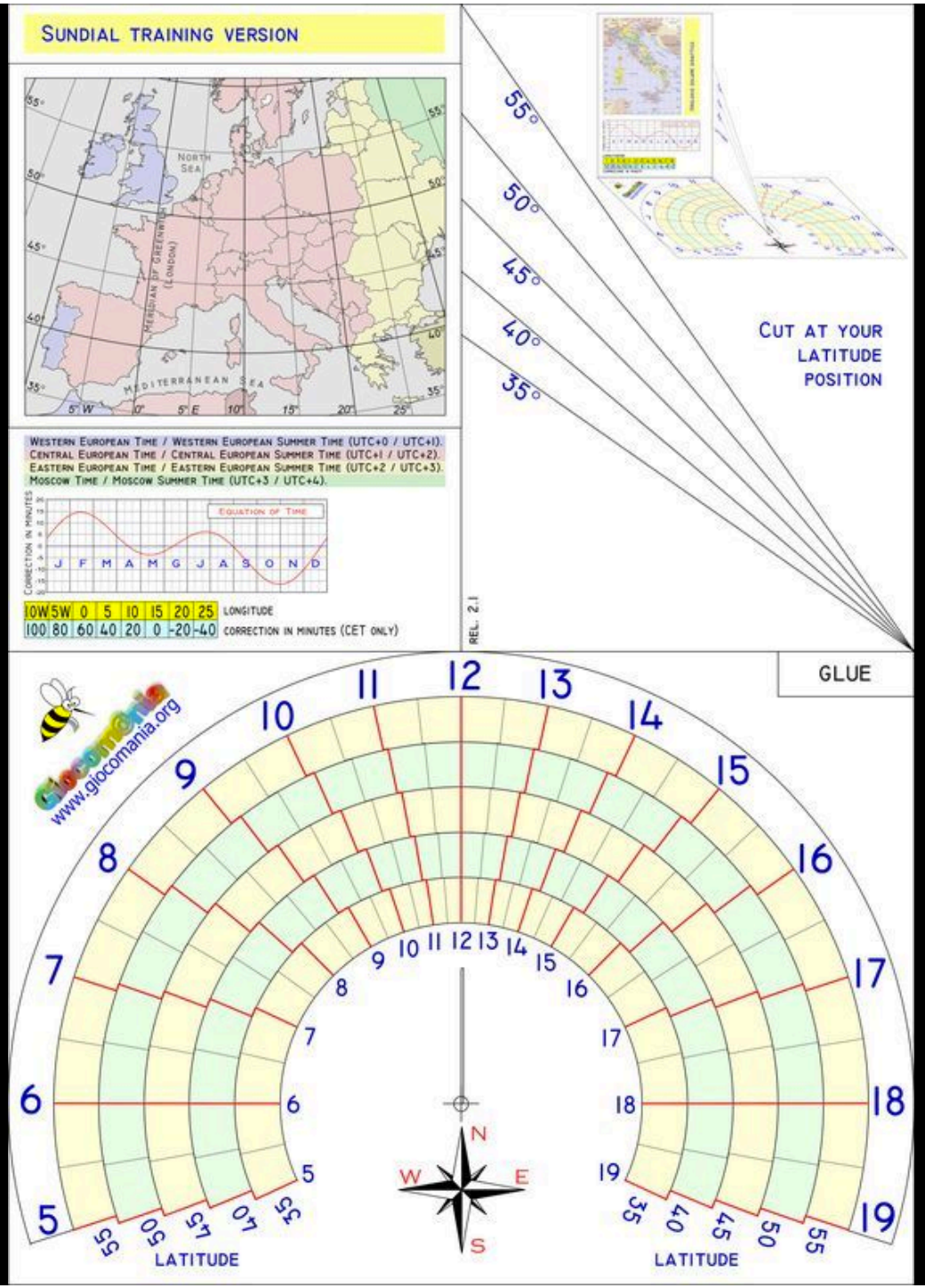




DISTRIBUCIÓN DE ESPACIOS EN LA CASA BIOCLIMÁTICA
DE ZONAS TEMPLADAS



LATITUD : 43° NORTE


SUNDIAL TRAINING VERSION
NORTH SEA
MERIDIAN OF GREENWICH (LONDON)
MEDITERRANEAN SEA
WESTERN EUROPEAN TIME / WESTERN EUROPEAN SUMMER TIME (UTC+0 / UTC+1).
CENTRAL EUROPEAN TIME / CENTRAL EUROPEAN SUMMER TIME (UTC+1 / UTC+2).
EASTERN EUROPEAN TIME / EASTERN EUROPEAN SUMMER TIME (UTC+2 / UTC+3).
MOSCOW TIME / MOSCOW SUMMER TIME (UTC+3 / UTC+4).
EQUATION OF TIME
CORRECTION IN MINUTES
J F M A M G J A S O N D
10W 5W 0 5 10 15 20 25 LONGITUDE
100 80 60 40 20 0 -20 -40 CORRECTION IN MINUTES (CET ONLY)
55°
50°
45°
40°
35°
CUT AT YOUR LATITUDE POSITION
REL. 2.1
GLUE
www.giocomania.org
LATITUDE
LATITUDE
N
W
E
S

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

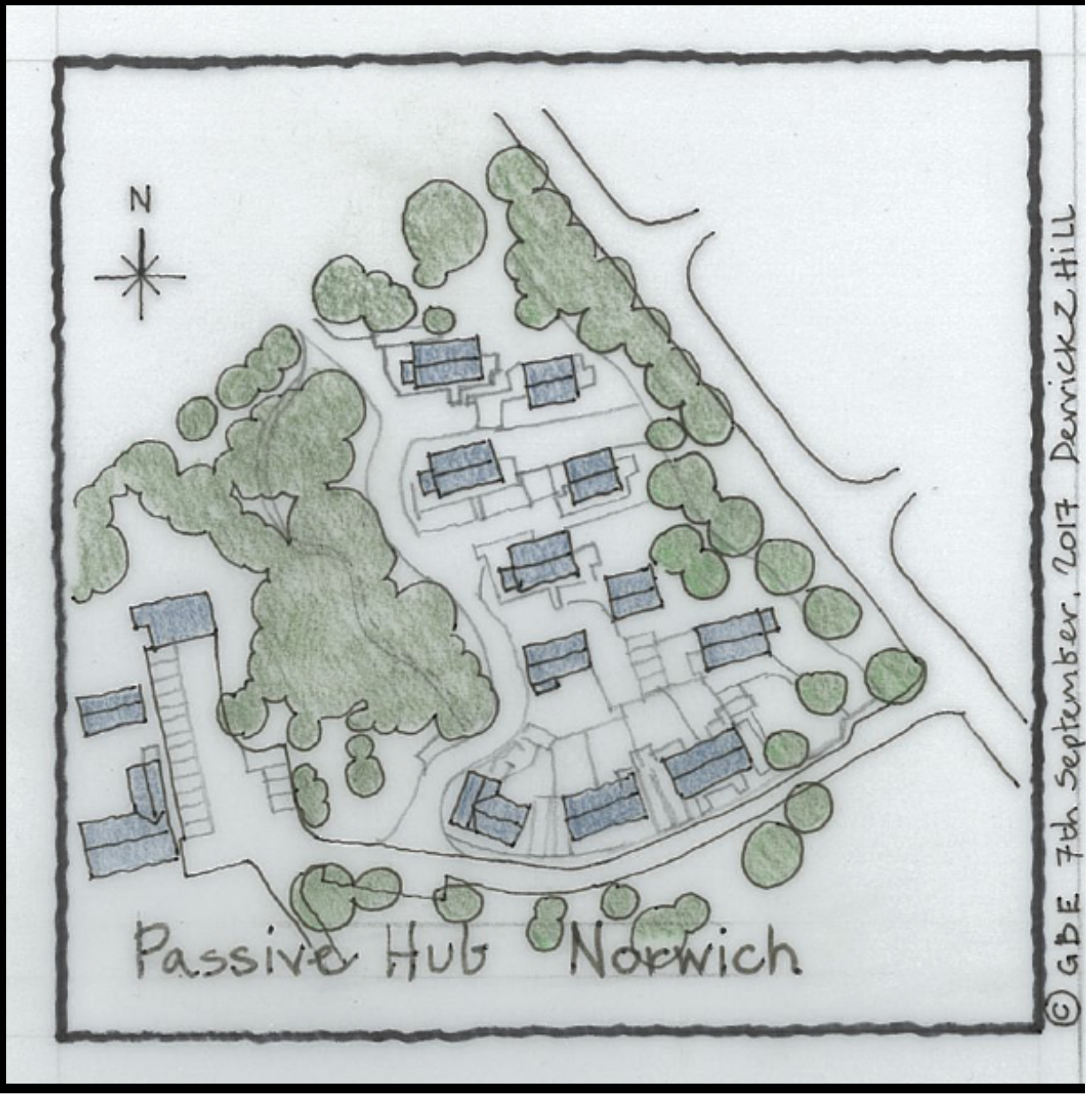
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

South facing for winter solar gains

And summer overheating?

Needs summer solar shading and winter solar penetration



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

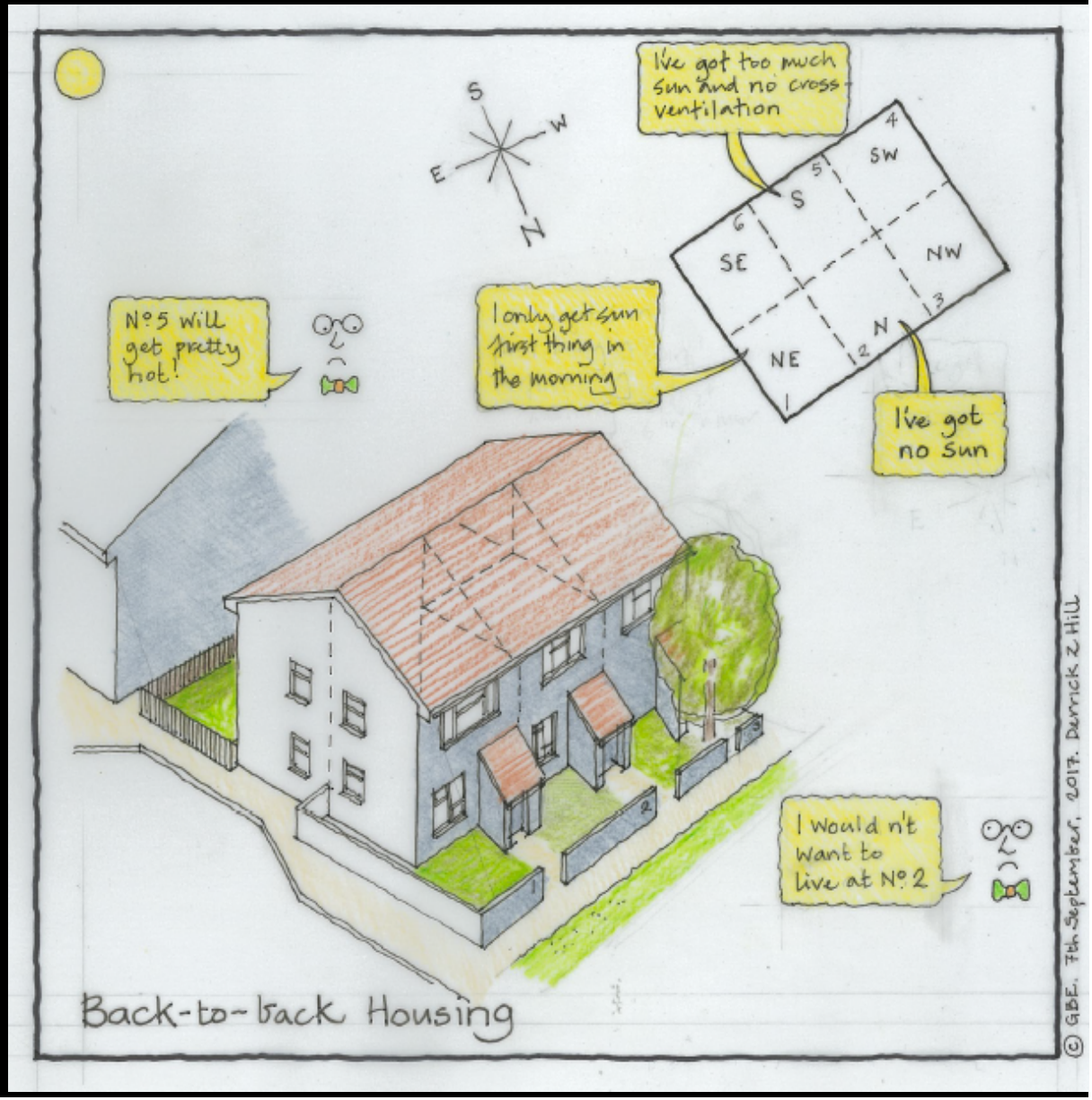
Back to back

19th Century design relic

What is it still doing here in the 21st C?

Fiduciary Rules?

Cheap and profitable



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

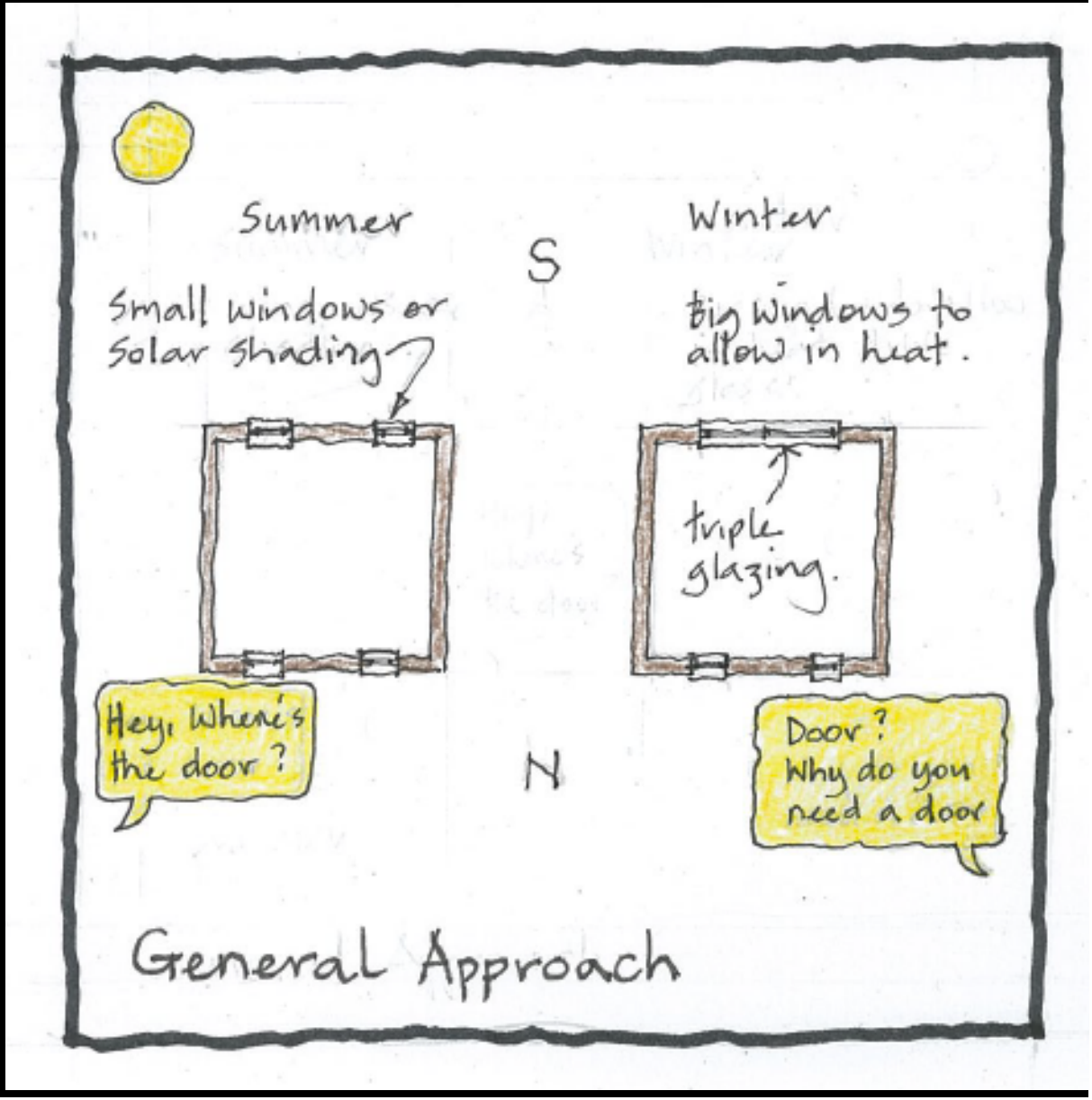
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Winter: Small windows to the north, big windows to the south

Summer: Small windows to the south or solar shading needed



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

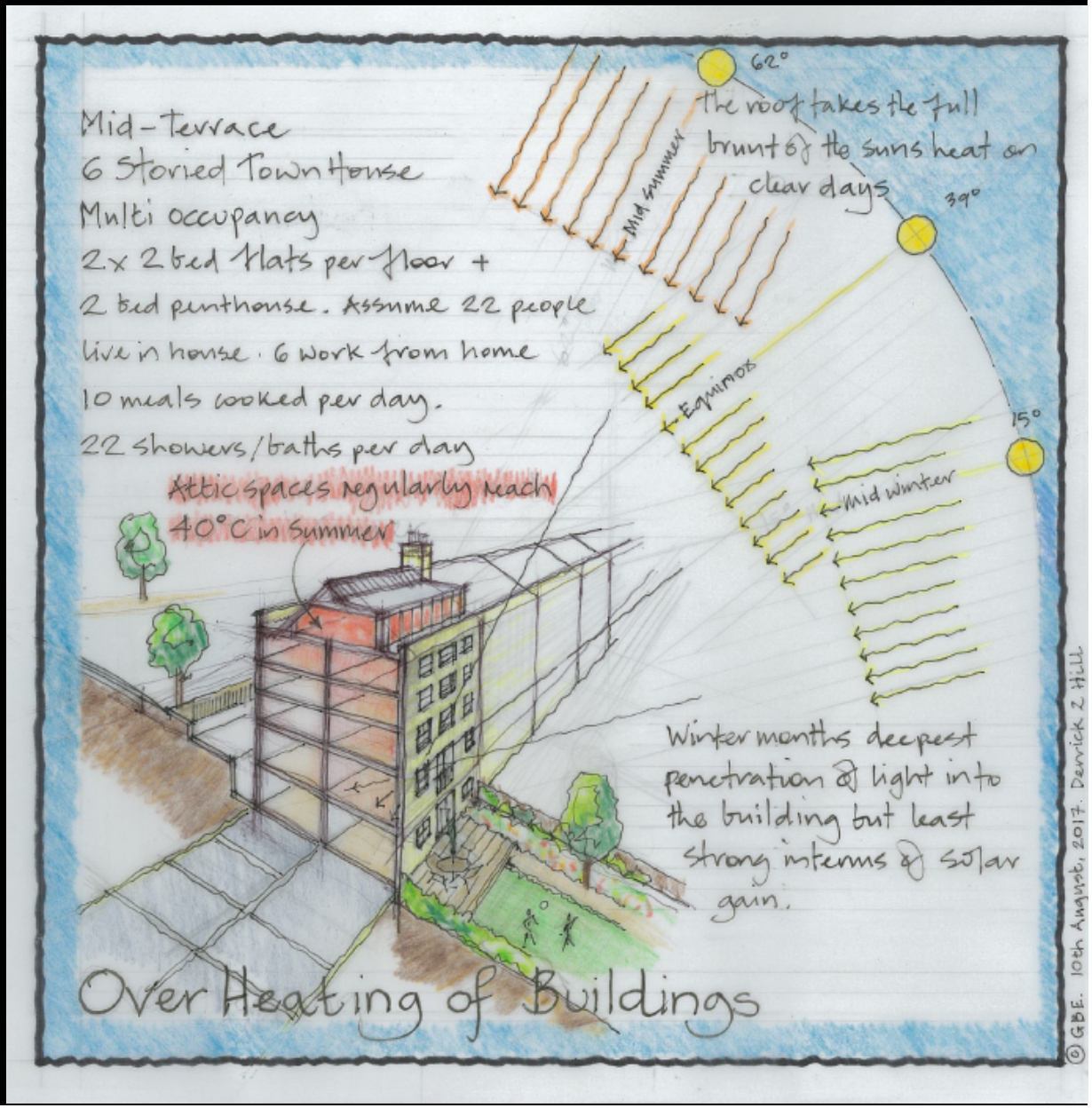
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Top floors and south facing rooms get sunny and overheat

Not just through the glass, but through the opaque fabric too

Roofs and walls



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

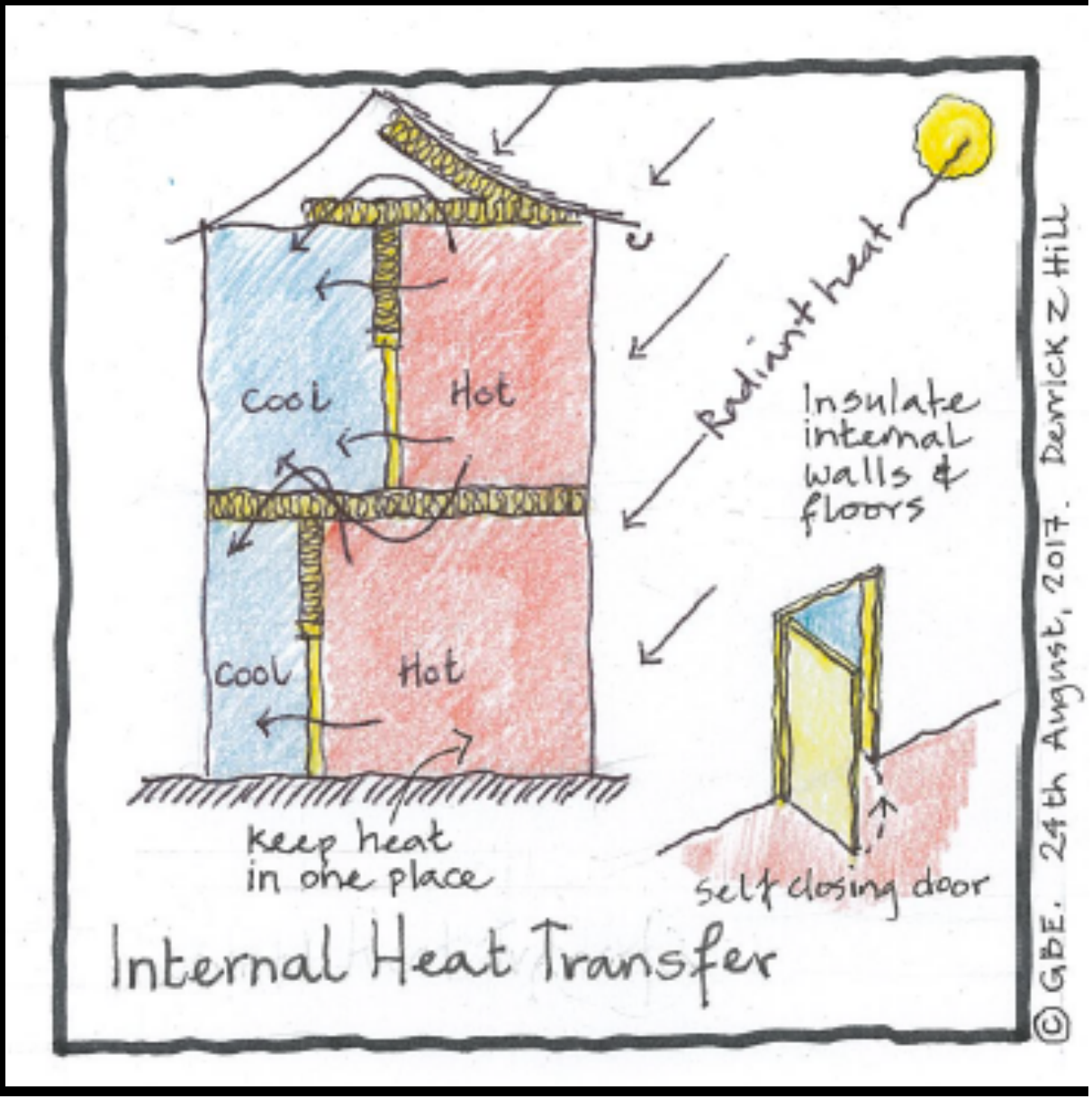
Keep heat in its place of arrival

Maintain safe refuge on the cooler side

Insulate internal floors and partitions

Close doors

Promoted by BedZED



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

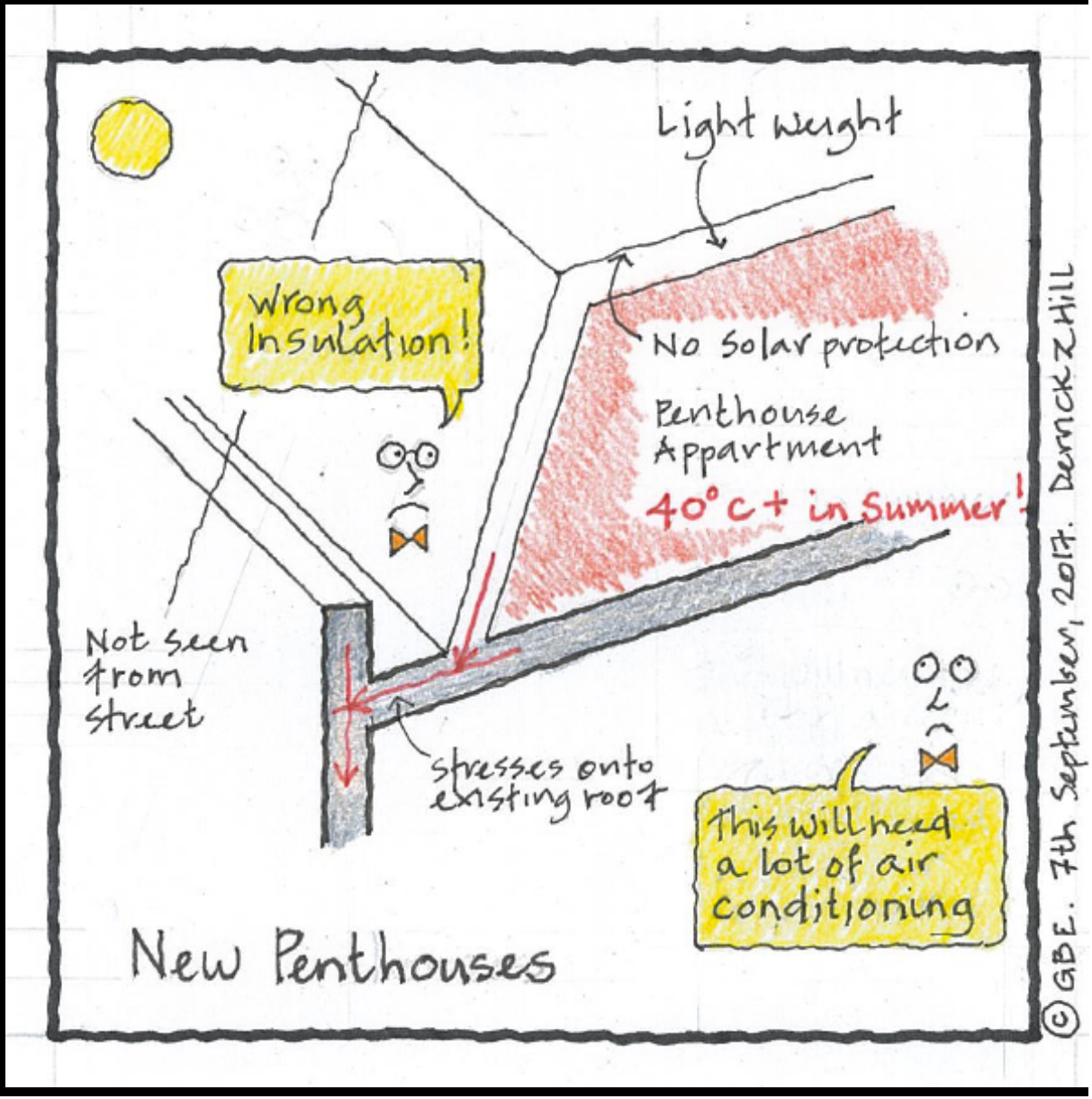
Planners insist on top floor additions set-back

Structure needs lightweight construction

Comes with with wrong insulation

Will overheat

Needs air-con



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

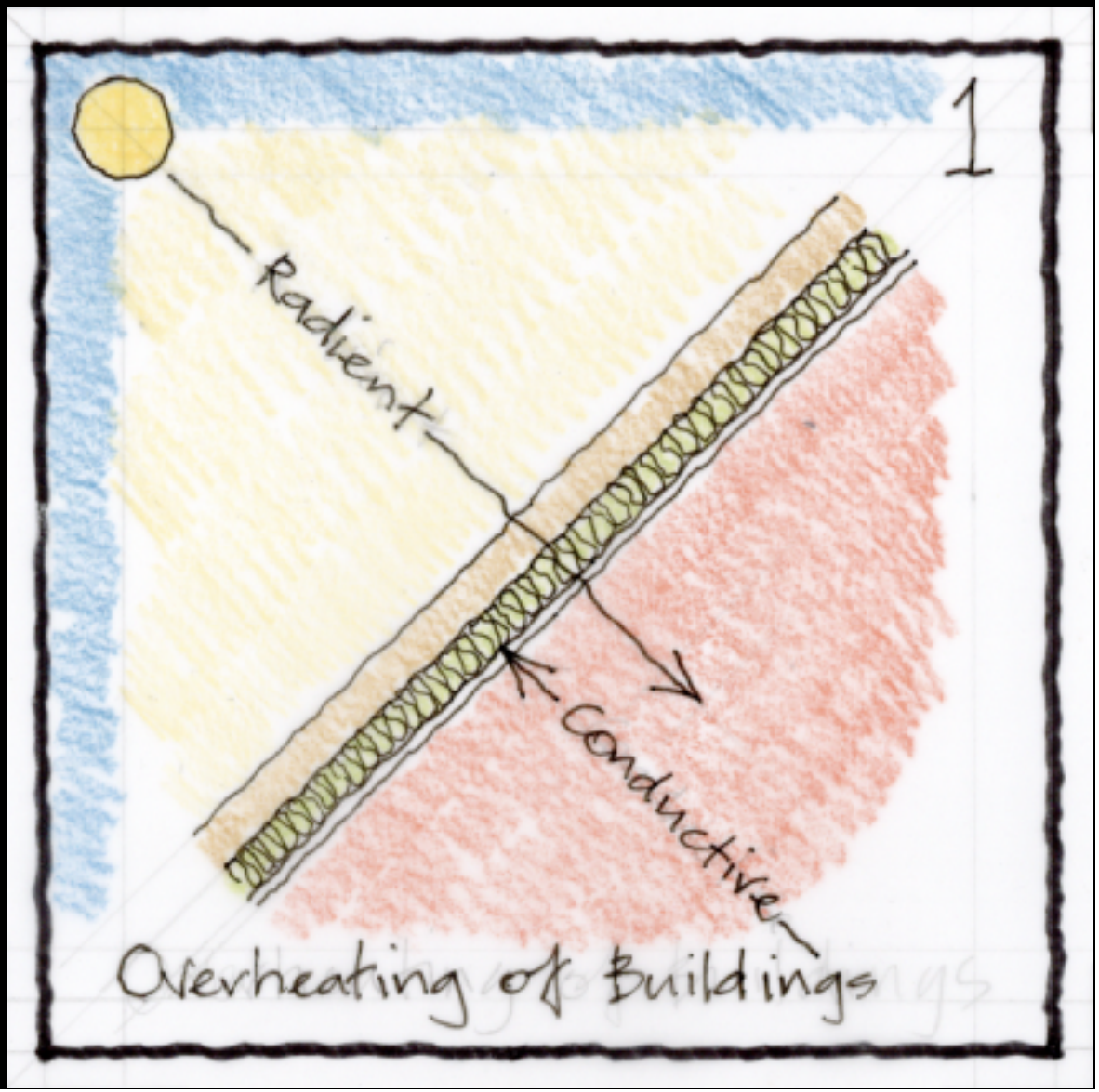
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Radiant verses Conductive heat flows

Insulation needs to resist both or overheating occurs



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

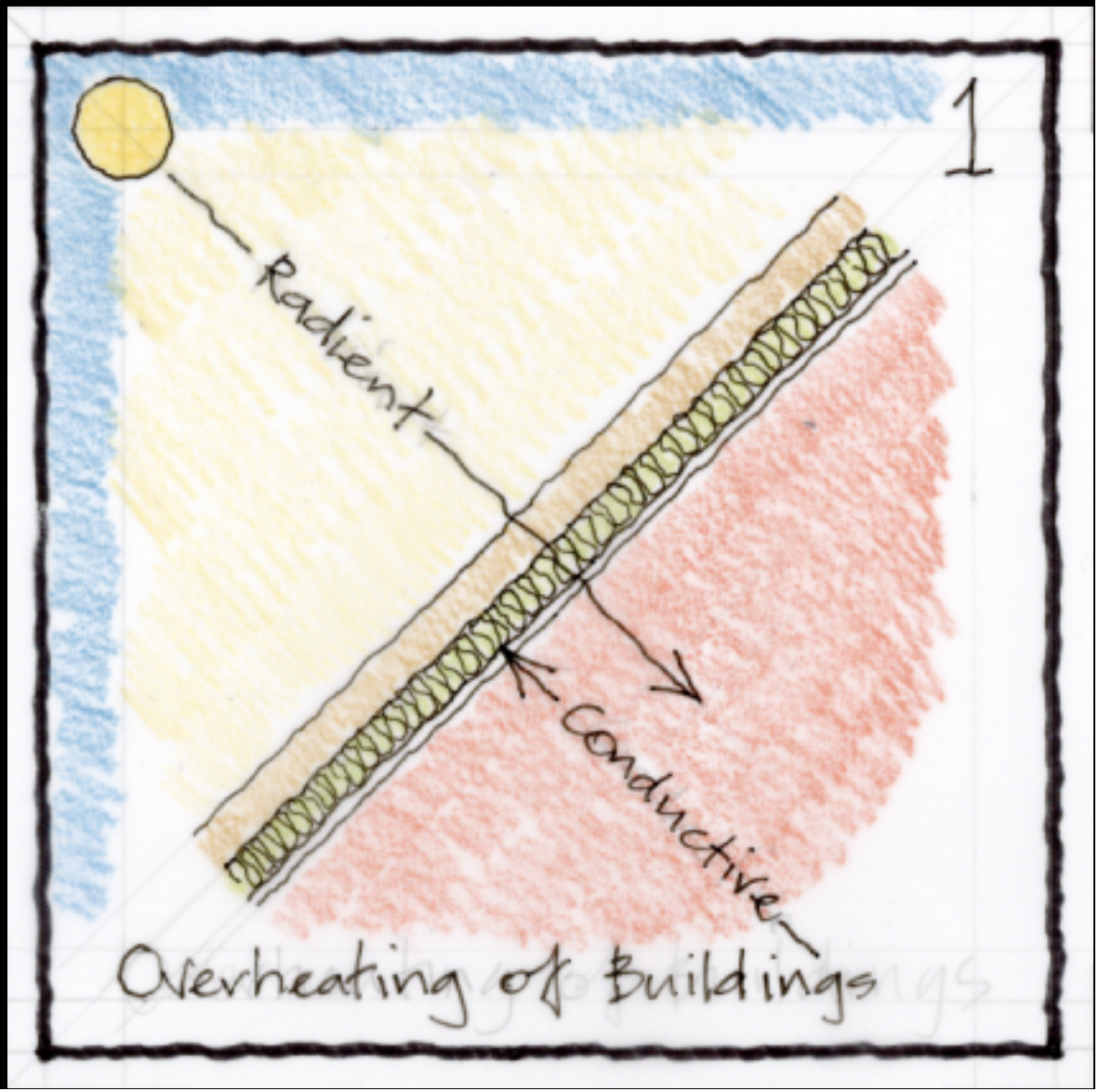
Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Once radiant heat gets in it warms the space and the warmth cannot get out through conductivity insulation



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

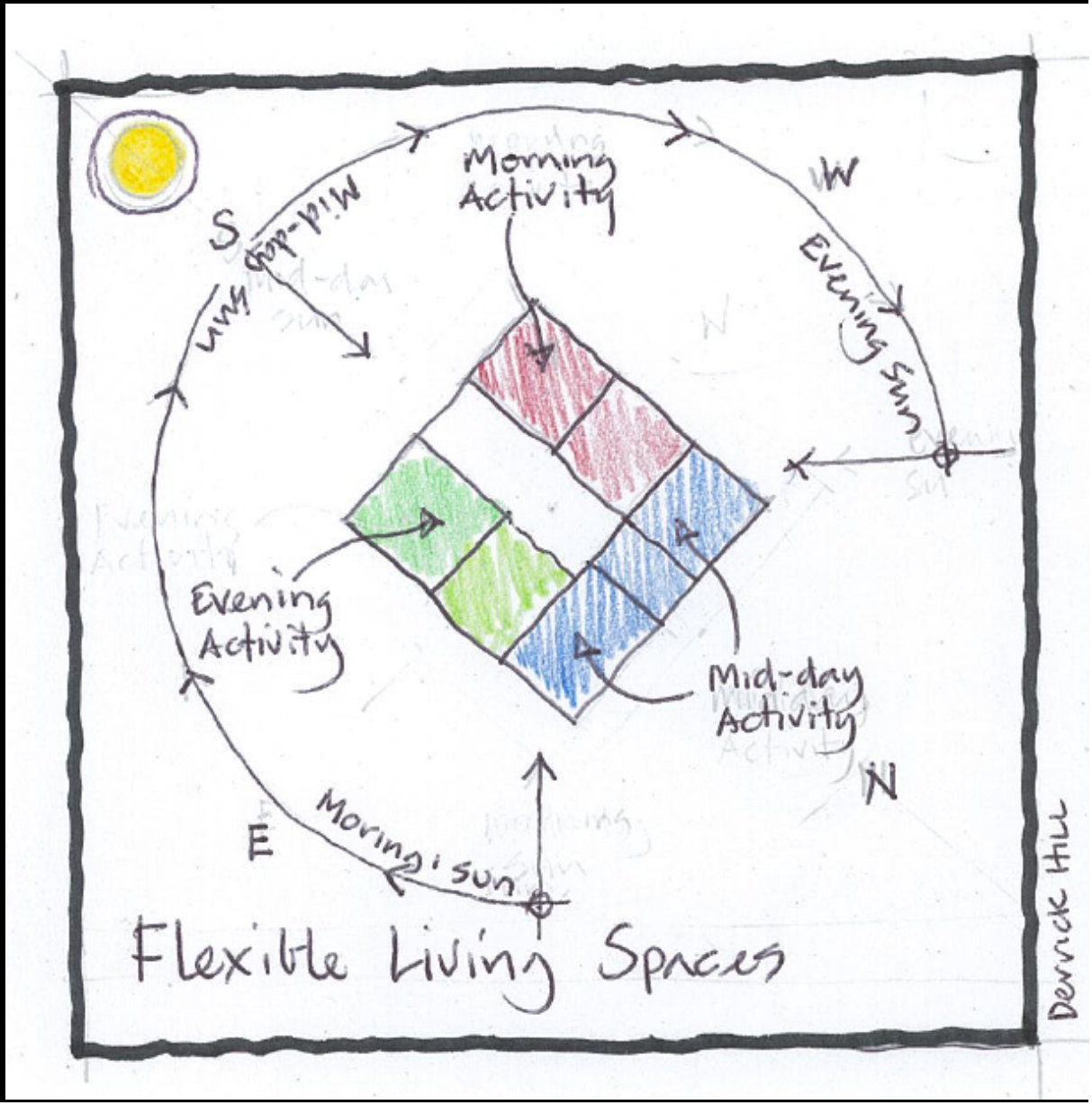
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

The sun moves around the building

In big buildings you can move away from the heat to cooler parts on extreme days



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
nwe
INTERREG IVB

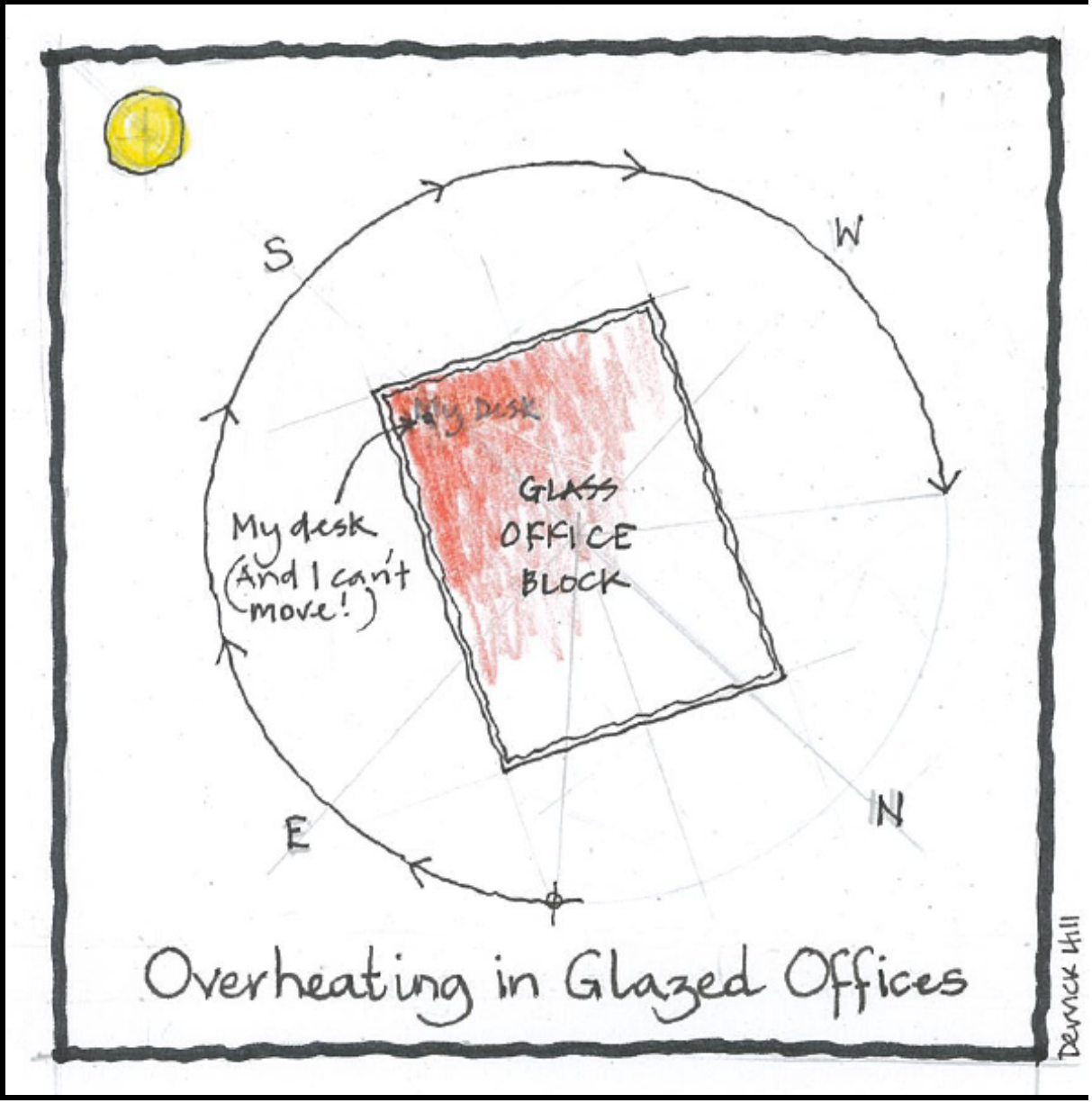
100% Glass facades

20th century construction

Fuel poverty (cooling) or wellbeing might stop it

We need solar shading

Agile working might help share the burden



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

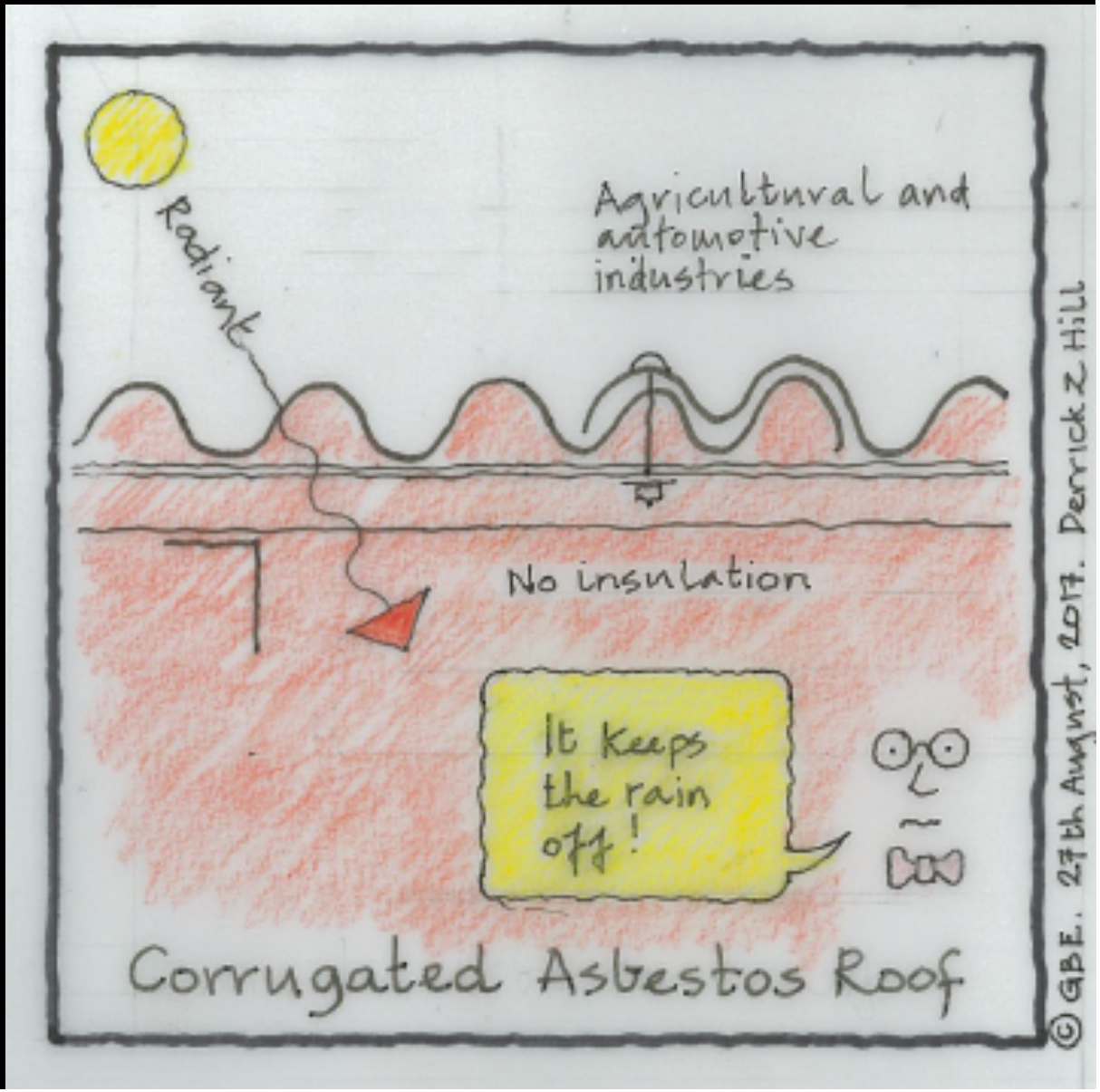
Investing in Opportunities

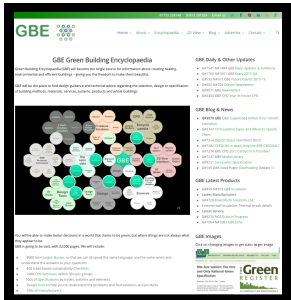
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Thin lightweight coverings offer no protection from solar radiation heat gains

And rainstorm water noise





GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

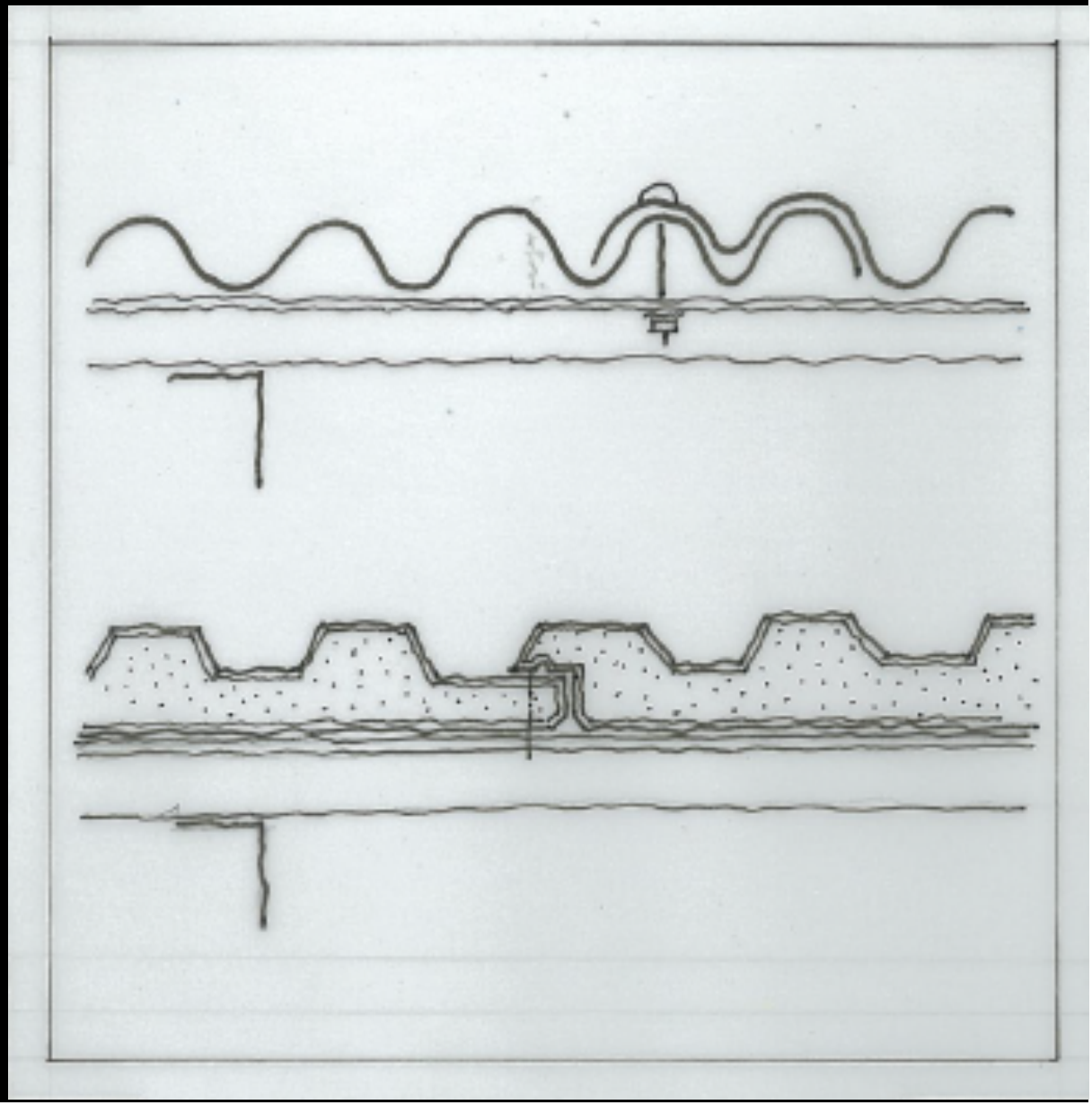
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Profiled Metal roof cladding

No insulation or plastic sandwich panel

Both ineffective against solar gains



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

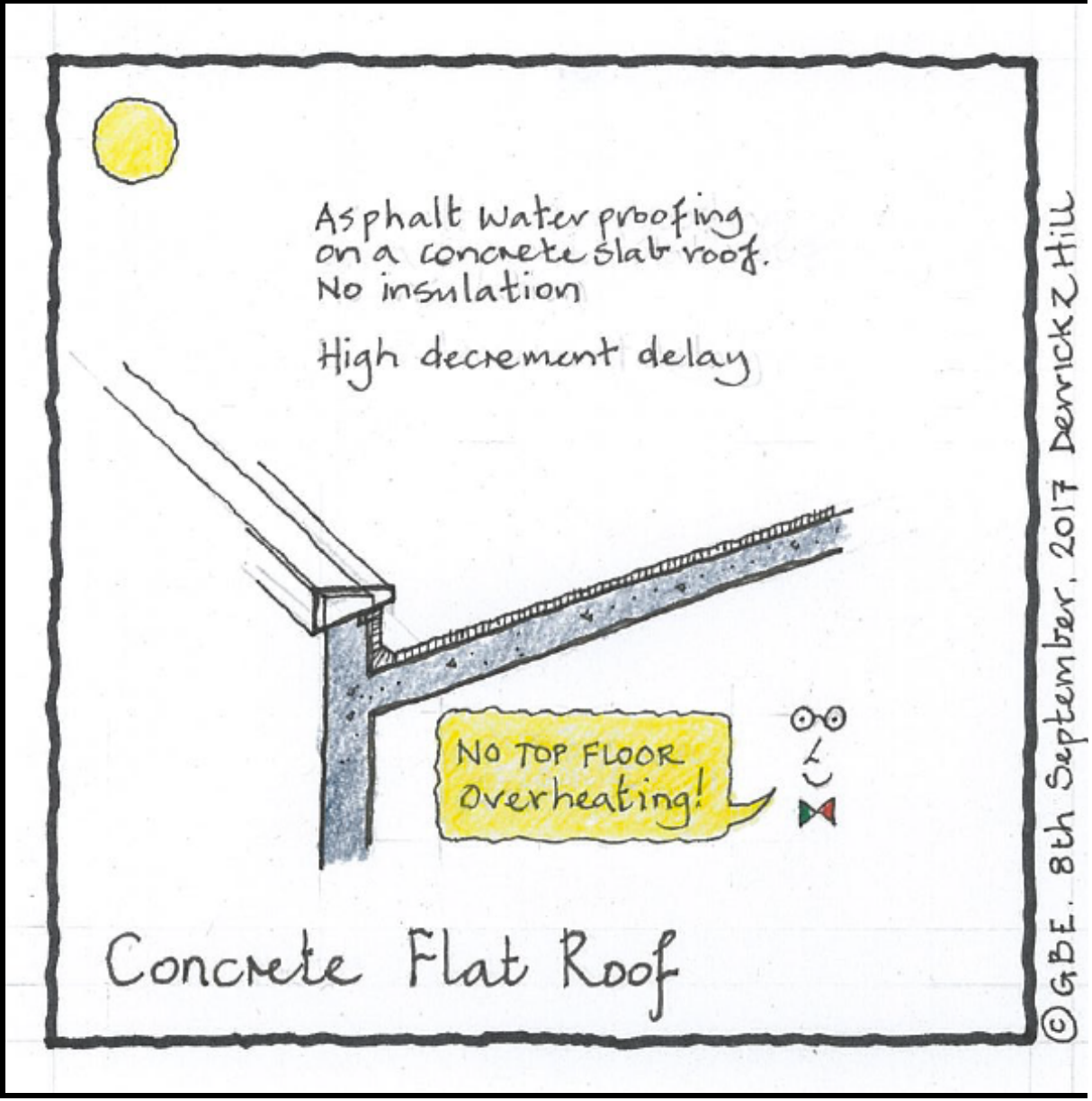
Concrete and Asphalt Flat Roof

No Insulation

High Decrement Delay concrete

No overheating

Well eventually



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

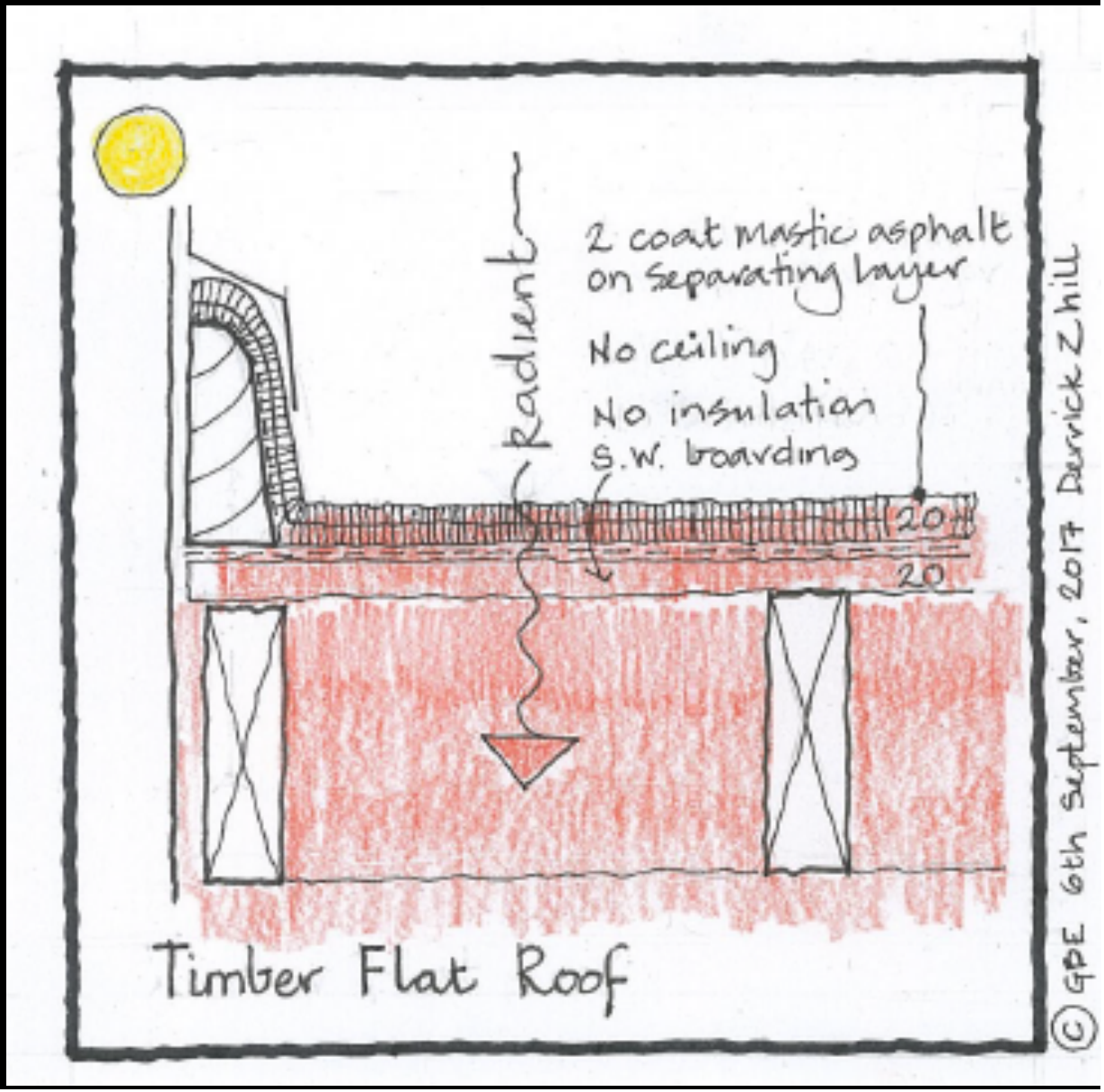
Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Old timber and asphalt roofs keep you roasting in summer



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Active Heat

- Lighting: lower wattage lamps, common today
- Hot water: cylinder constant or as required, uninsulated pipes
- Heating: 16 hours of 24 hour day
- Cooking: Intermittent
- TV ITC Equipment
  - Standby modes 80%
- Fridge/Freezer: 24 hours
- Humans at rest 100 watts, some animals and babies less
- Olympic Athlete 2000 watts at peak
- Passivhaus: exploits it all, recycles heat only to warm fresh air coming in
- Mechanical Ventilation with Heat Recovery MVHR

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

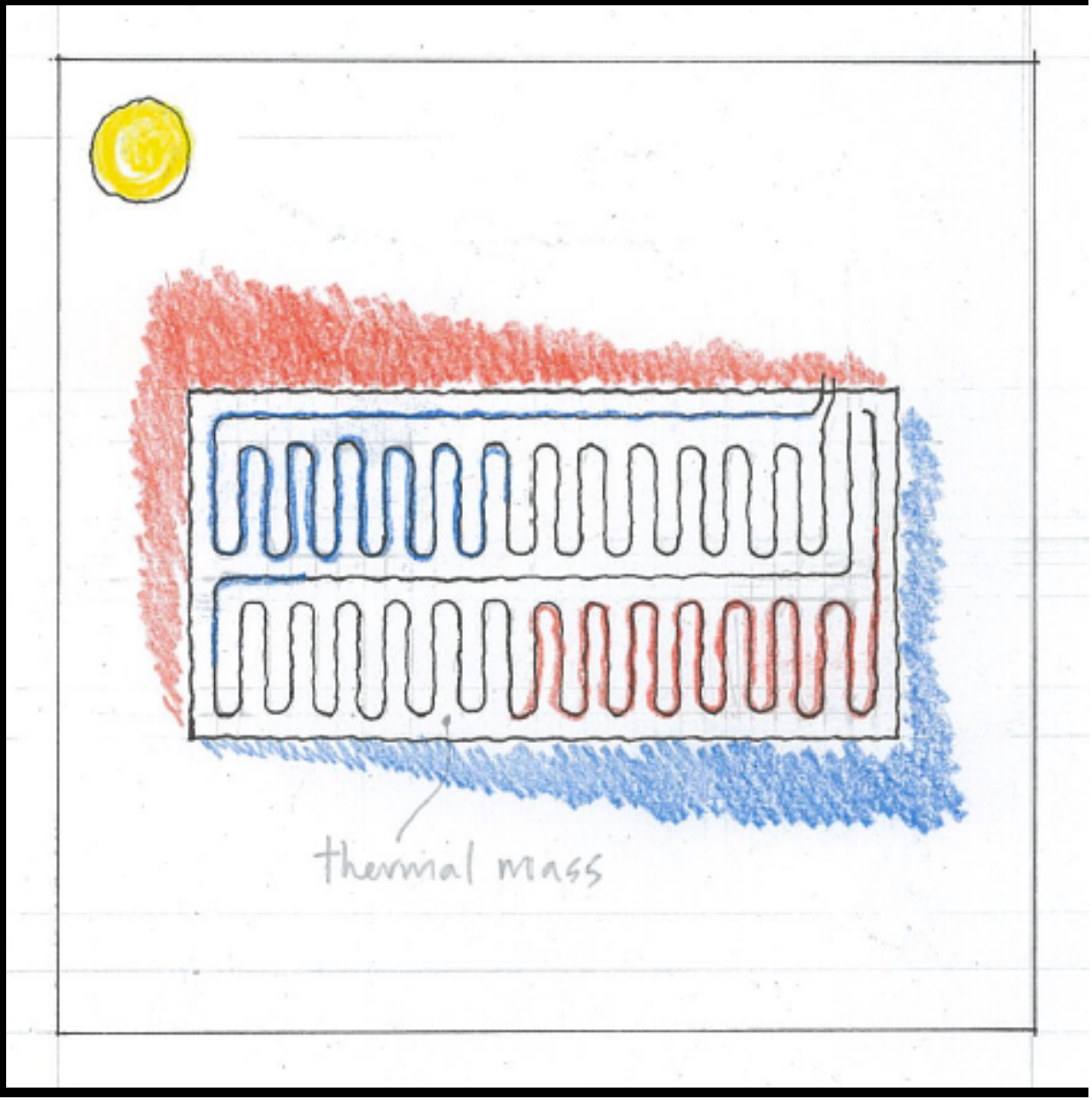
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Hot floor slabs fitted with under floor heating pipes can move heat to the colder parts

Suffolk CC in Ipswich



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

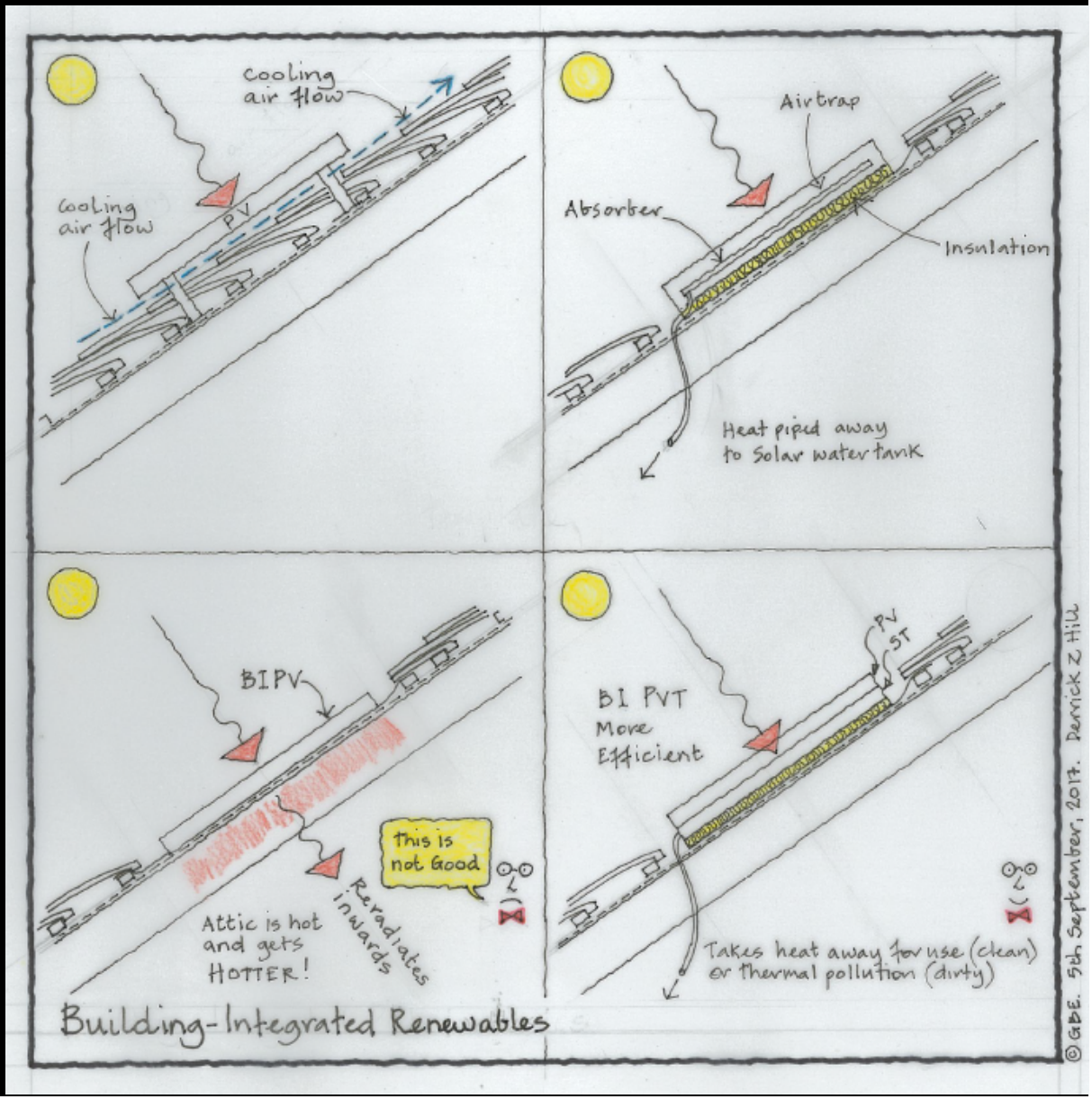
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Building Integrated Renewables

Is it really a good idea?

I don't think so



GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

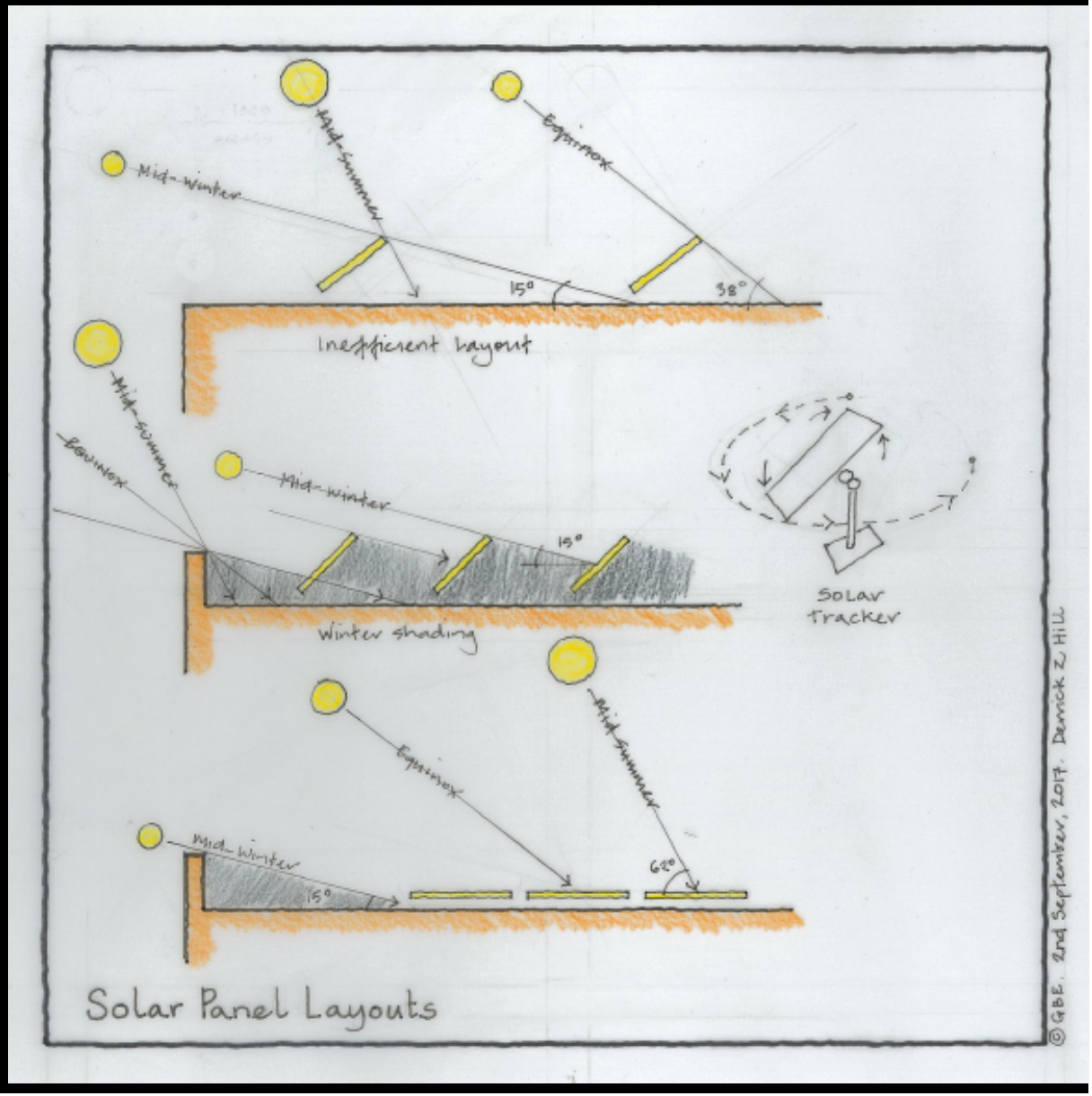
Cycle Assessment Procedure for Eco-impacts of Materials

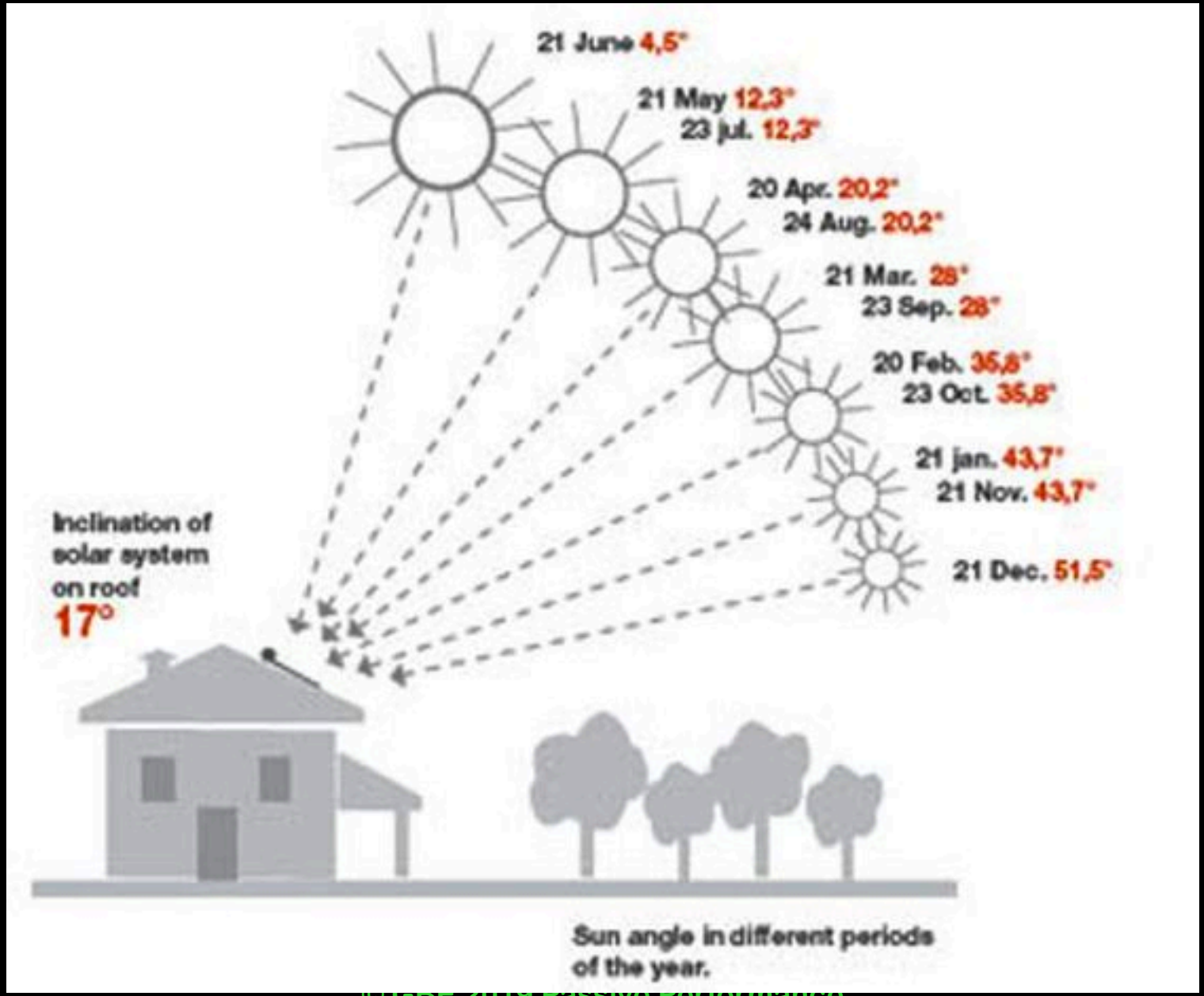
Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
nwe
INTERREG IVB

Solar panel layout to avoid overshadowing by one panel on another

Winter is worse

Get your angles right




21 June 4,5°
21 May 12,3°
23 jul. 12,3°
20 Apr. 20,2°
24 Aug. 20,2°
21 Mar. 28°
23 Sep. 28°
20 Feb. 35,8°
23 Oct. 35,8°
21 jan. 43,7°
21 Nov. 43,7°
21 Dec. 51,5°
Inclination of solar system on roof
17°
Sun angle in different periods of the year.

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

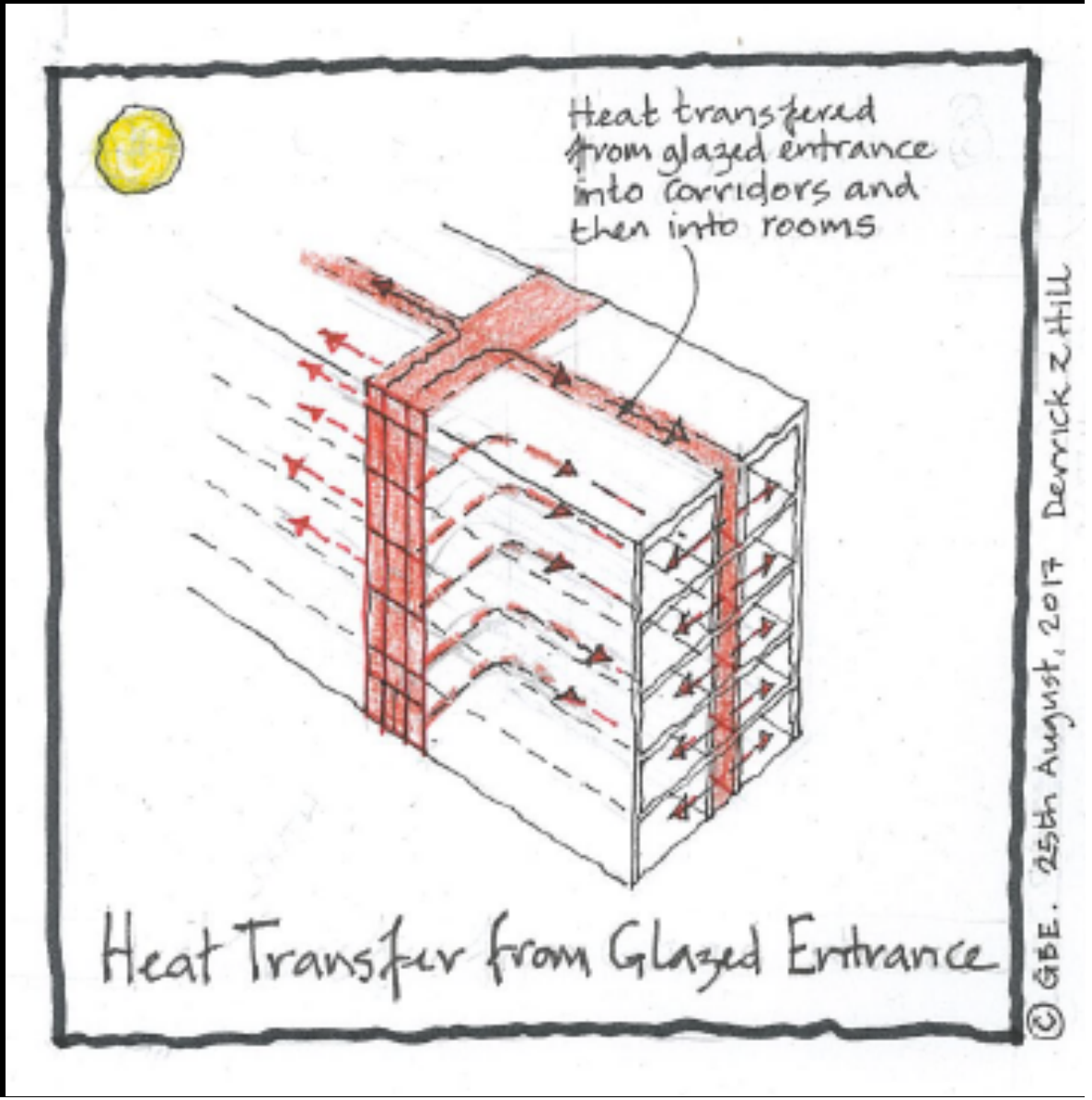
Investing in Opportunities

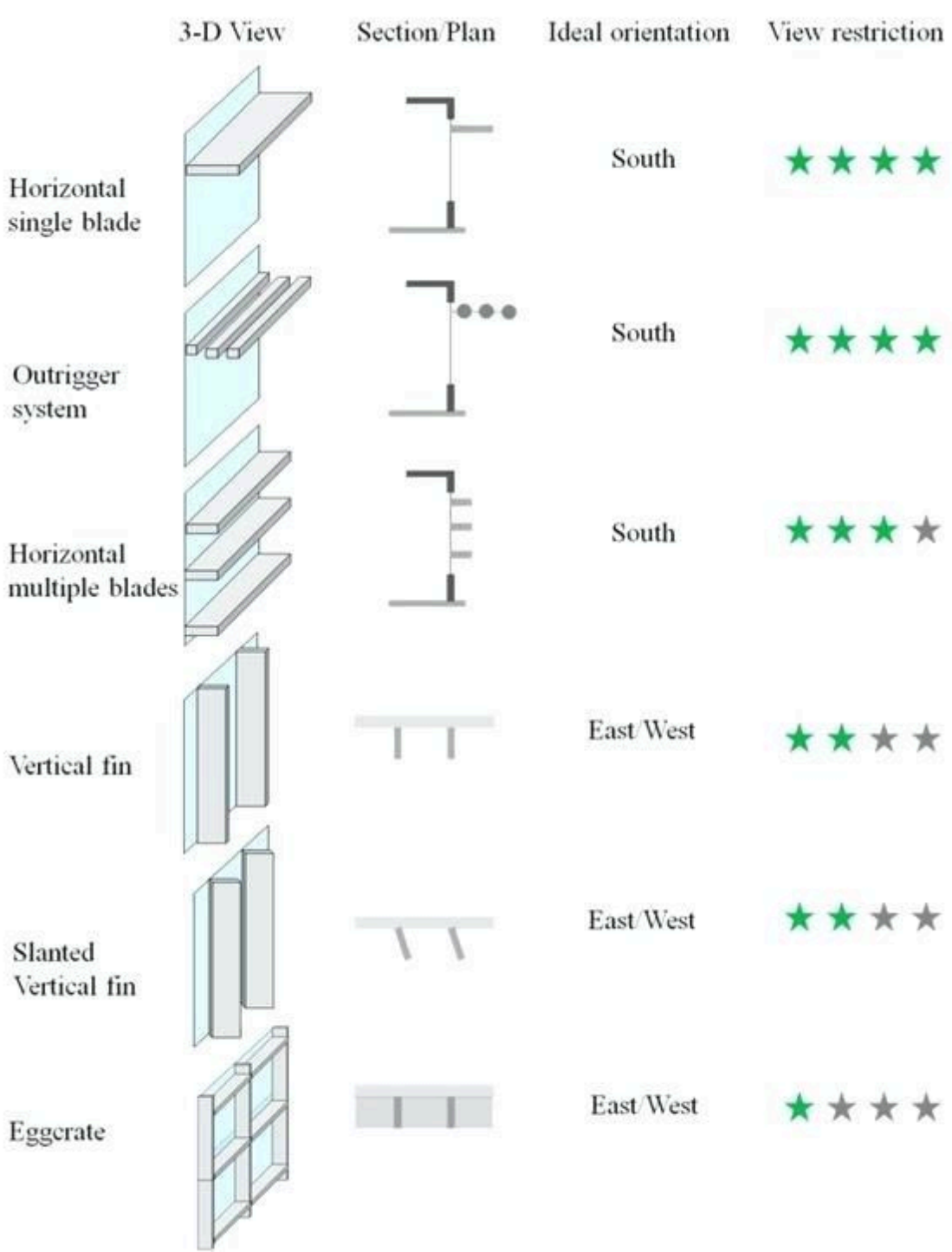
This project has received European Regional Development Funding through INTERREG IV B.

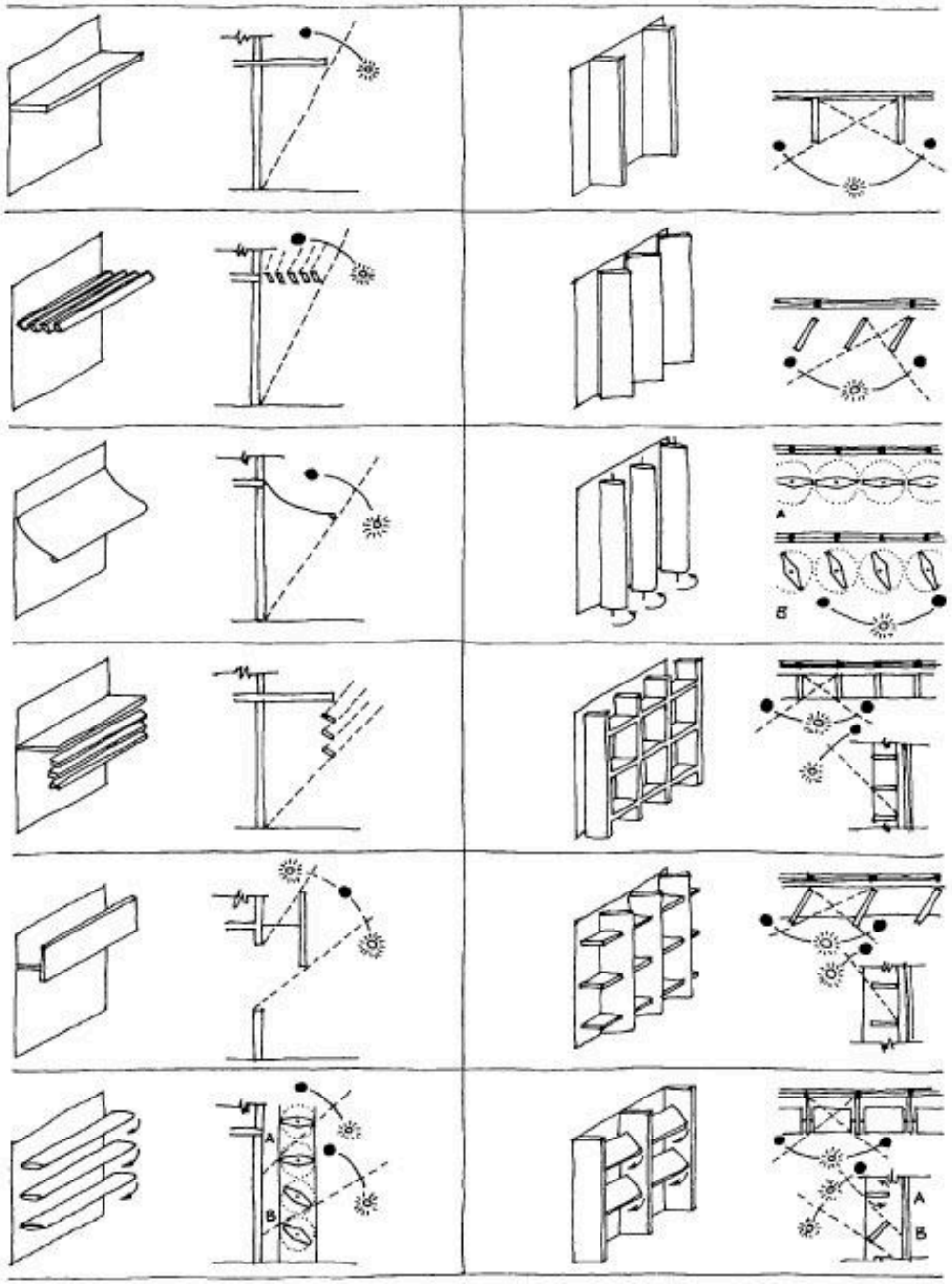
INTERREG IVB

Glazed communal stairs and corridors serving apartments student accommodation

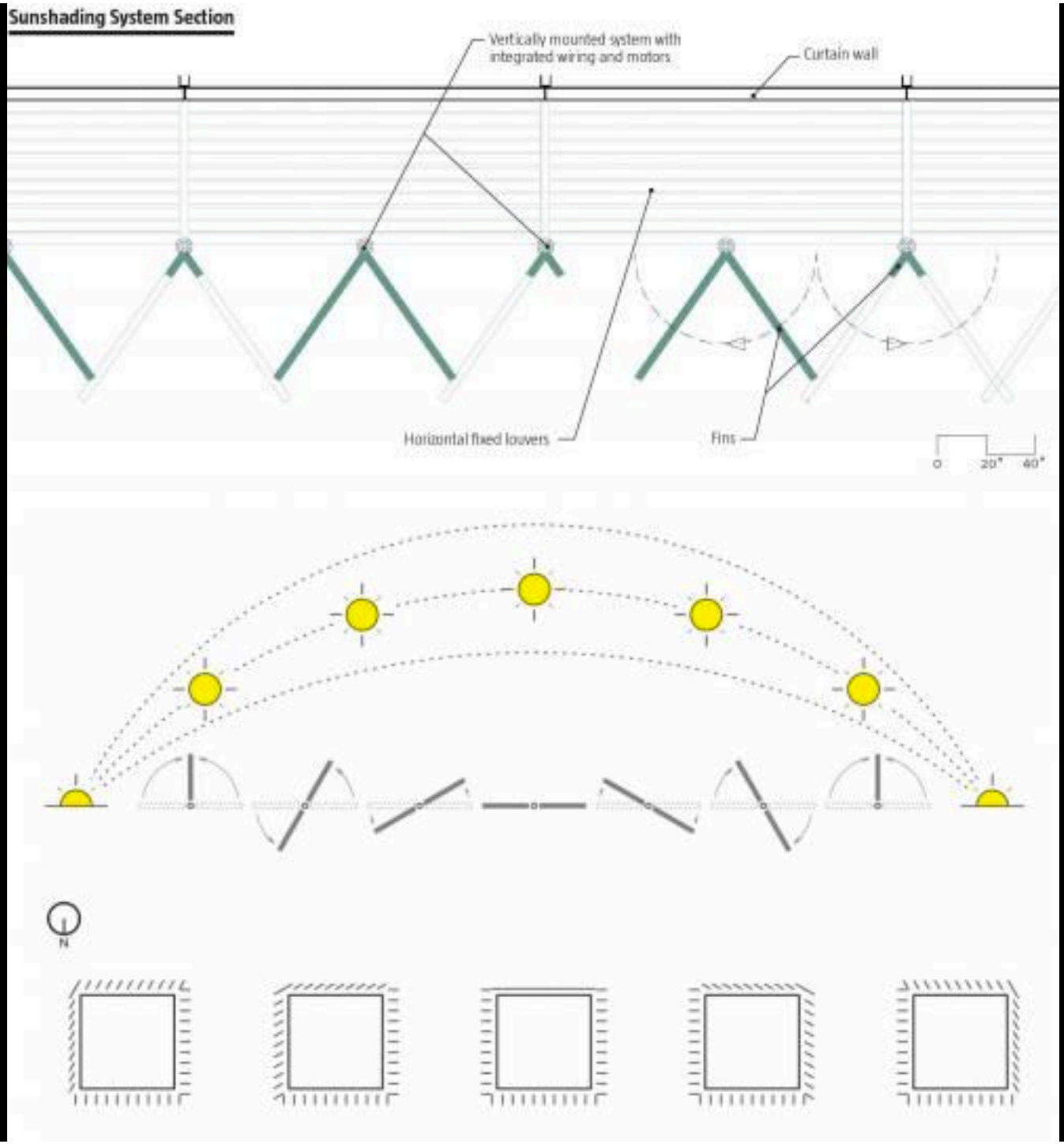
Everything overheats




3-D View
Section/Plan
Ideal orientation
View restriction
Horizontal single blade
South
Outrigger system
South
Horizontal multiple blades
South
Vertical fin
East/West
Slanted Vertical fin
East/West
Eggcrate
East/West



WINDOW SHADING DEVICES


Sunshading System Section
Vertically mounted system with integrated wiring and motors
Curtain wall
Horizontal fixed louvers
Fins
0
20°
40°
N

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

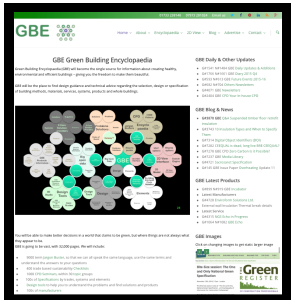
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Heat Assessment

- North Point and scales essential
- Northern or Southern Hemisphere?
- Plans of whole (site or building) and indicate part
- Building Profile: Section of whole and part
- Exiting glazing positions, sized
- Window treatments if any (inside or out)
- Analysis: Plans Sections Elevations: sundial paths
- Shadow analysis: floors and walls, inside and out
- Your response to shadow analysis
- Any internal enclosure and glazing
- Construction Assemblies showing insulation and mass
- Analysis of existing heat to be exploited
- Any interventions by you to provide heat



https://GreenBuildingEncyclopaedia.uk

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

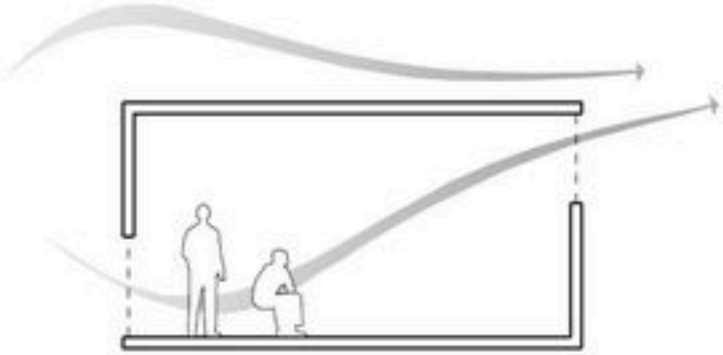
Ventilation

Passive Active Mechanical

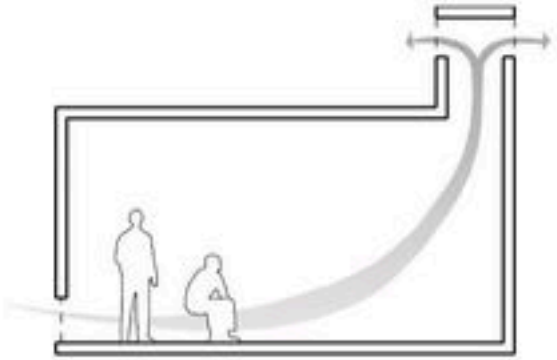
Avoiding Air conditioning "Comfort Cooling"

NATURAL VENTILATION

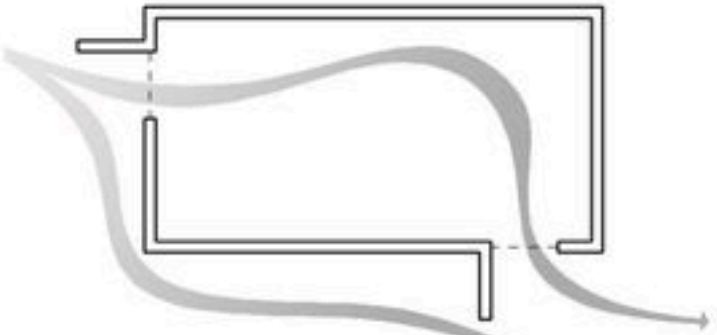
is a passive strategy using both wind and temperature differences to cool or ventilate spaces. The benefits from natural ventilation include improved air quality and increased energy efficiency. Adding an active component can enhance the effectiveness of these strategies shown.



CROSS VENTILATION SECTION, maximum performance when inlet and outlet are placed at diagonal in both plan and section



STACK VENTILATION, maximum performance when inlet and outlet areas are equal, and minimum stack height is 11 feet



CROSS VENTILATION PLAN, wind wall size should be .5 - 1 x width of window

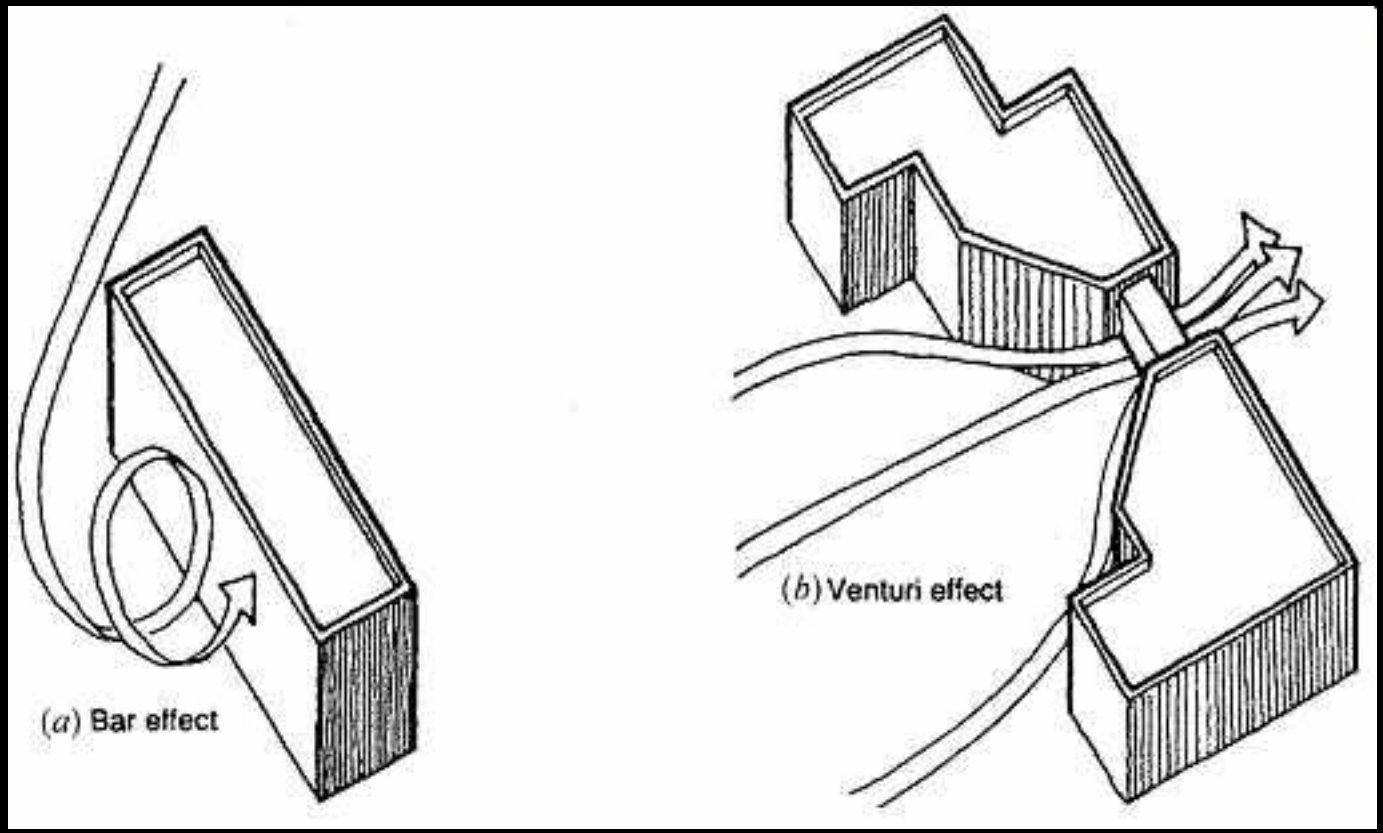
Purpose of Ventilation Control

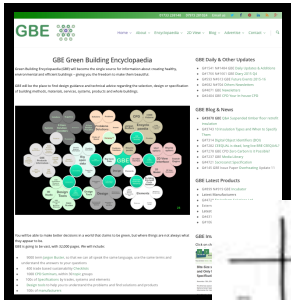
- Control Indoor Air Quality IAQ
- Control Humidity levels, Moisture Content of materials, minimise risk of mould
- Control Temperature
  - Remove solar heat gain warmed air
  - Cross ventilation
  - Overnight purging of thermal mass heat
- Control release or remove Smells
- Control VOC levels (off-gassing from plastics, synthetics, adhesives, paints)
- Maintain Life: Airtightness levels below 3 need deliberate and dedicated ventilation

https://GreenBuildingEncyclopaedia.uk

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB





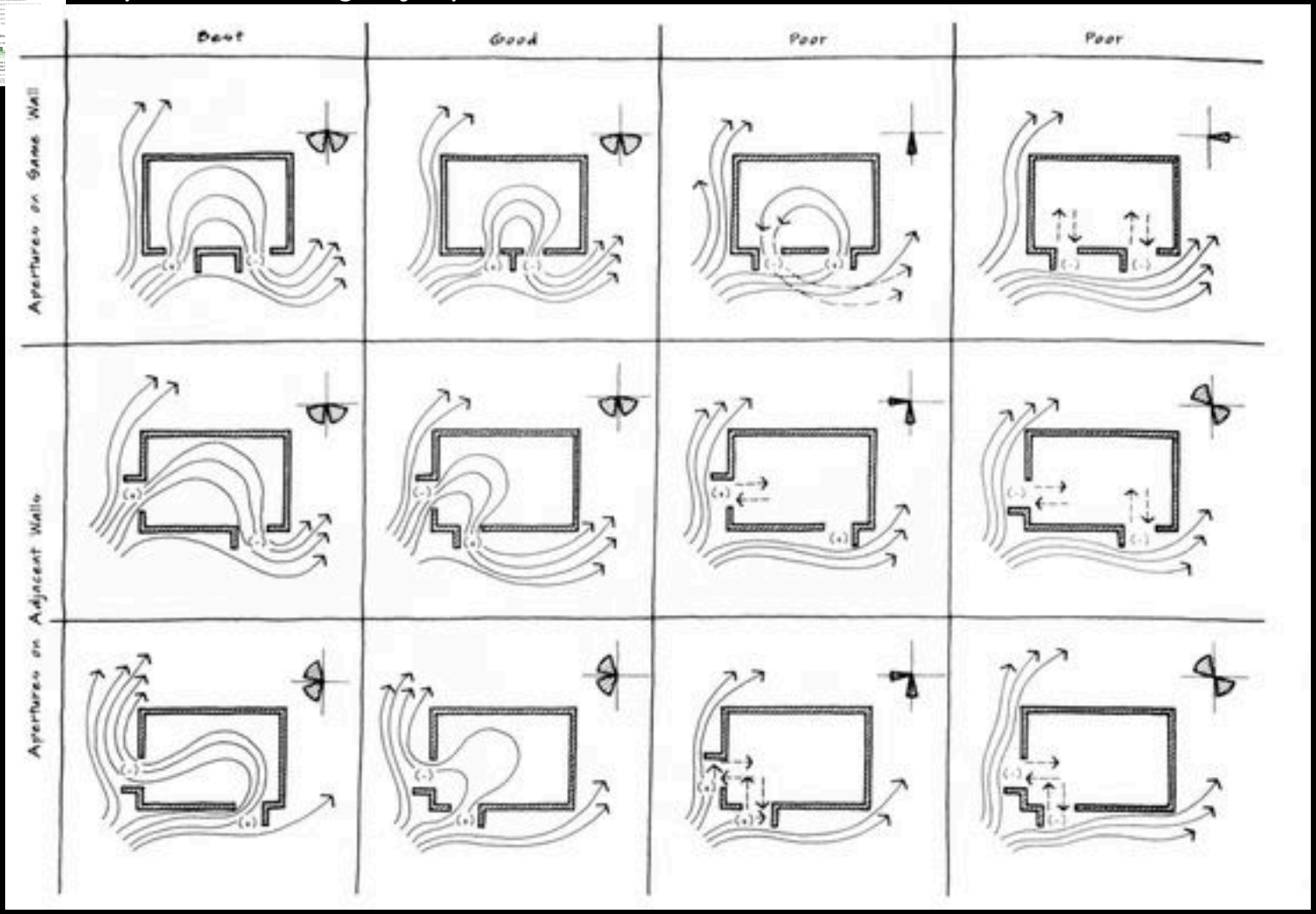
https://GreenBuildingEncyclopaedia.uk

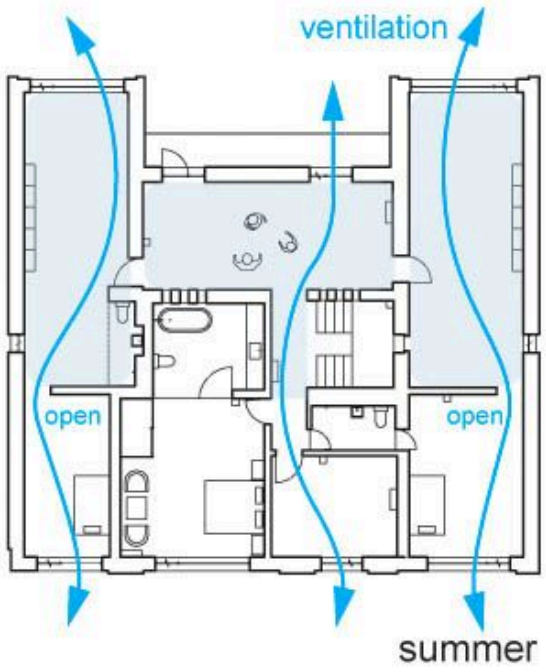
Cycle Assessment Procedure for Eco-impacts of Materials

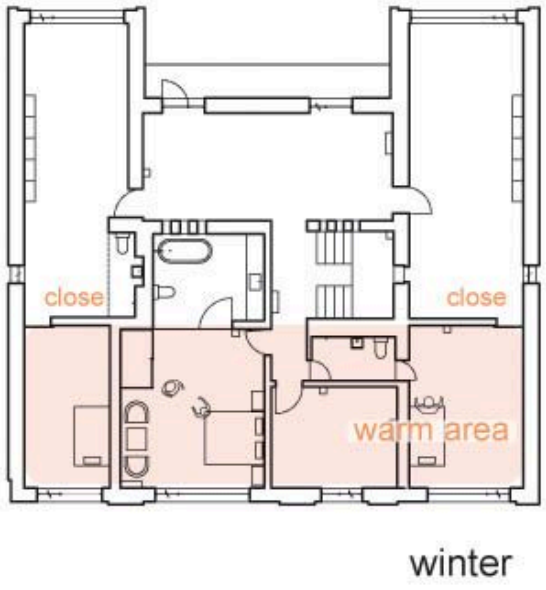
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB




ventilation
open
open
summer


close
close
warm area
winter

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

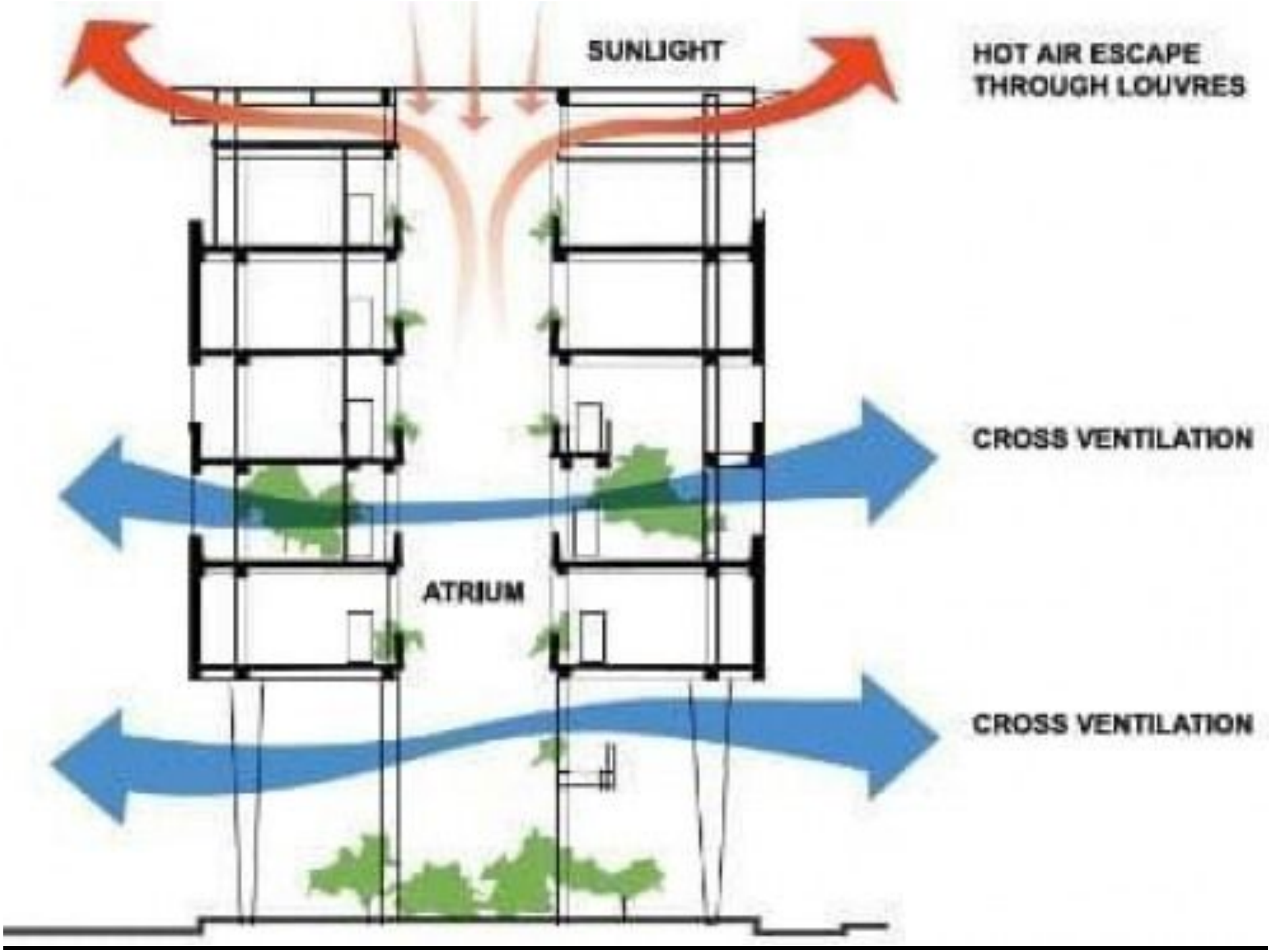
Investing in Opportunities

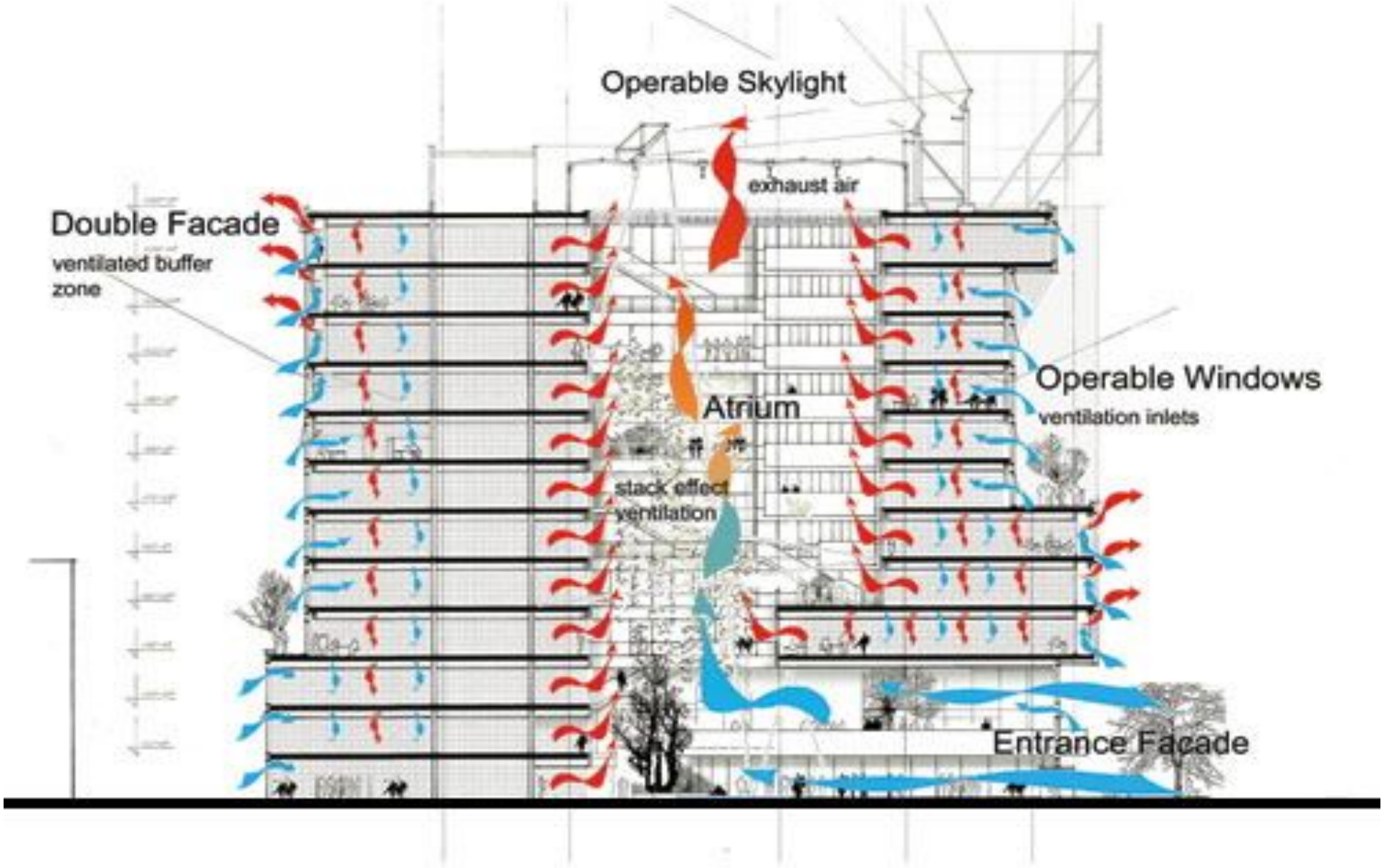
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

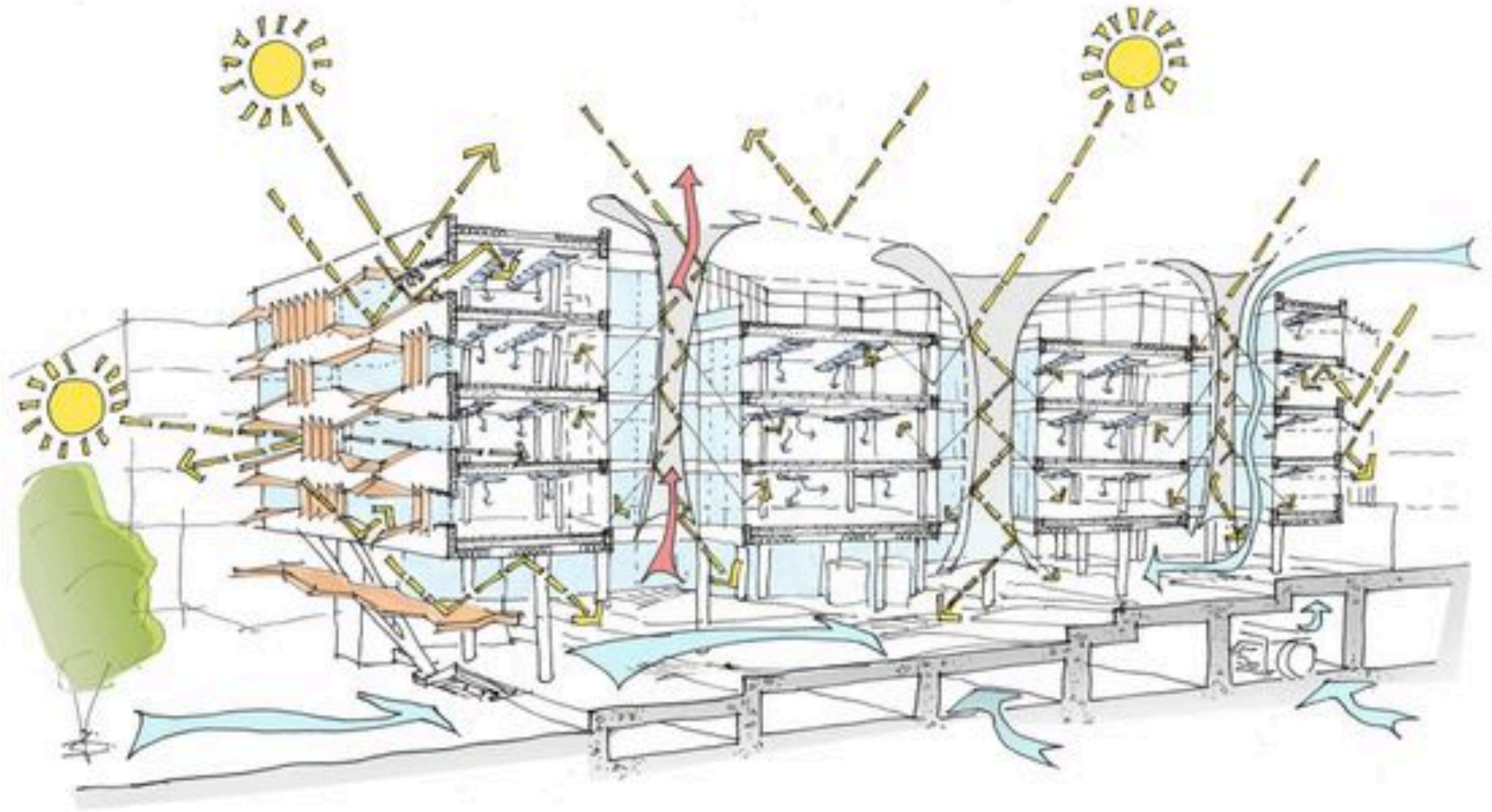
Passive Vent

- Open Windows and doors let fresh air in, to cross flow ventilate building
- Open roof lights/roof vents
- Stack effect up stairwells in summer
  - Need doors to close in winter
- Passivhaus: can be ventilated by opening windows but turn off the MVHR
- Conservatories attached to house need ventilation top and bottom and be closed from house (Building Regulations)


SUNLIGHT
HOT AIR ESCAPE
THROUGH LOUVRES
CROSS VENTILATION
ATRIUM
CROSS VENTILATION

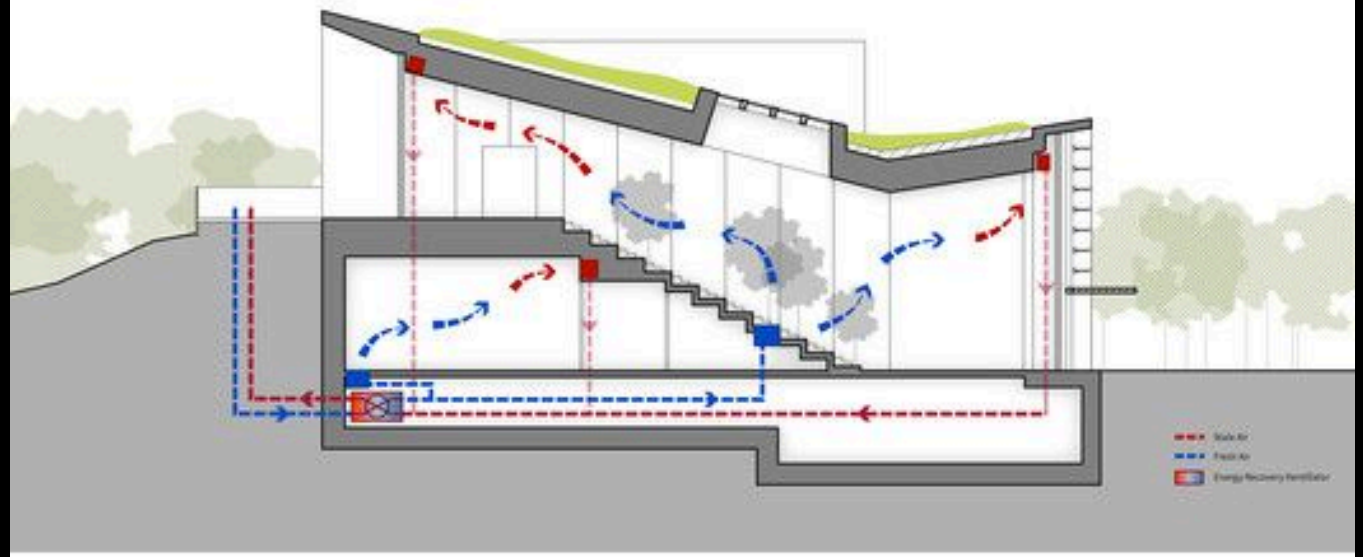


Bloomberg by Fosters

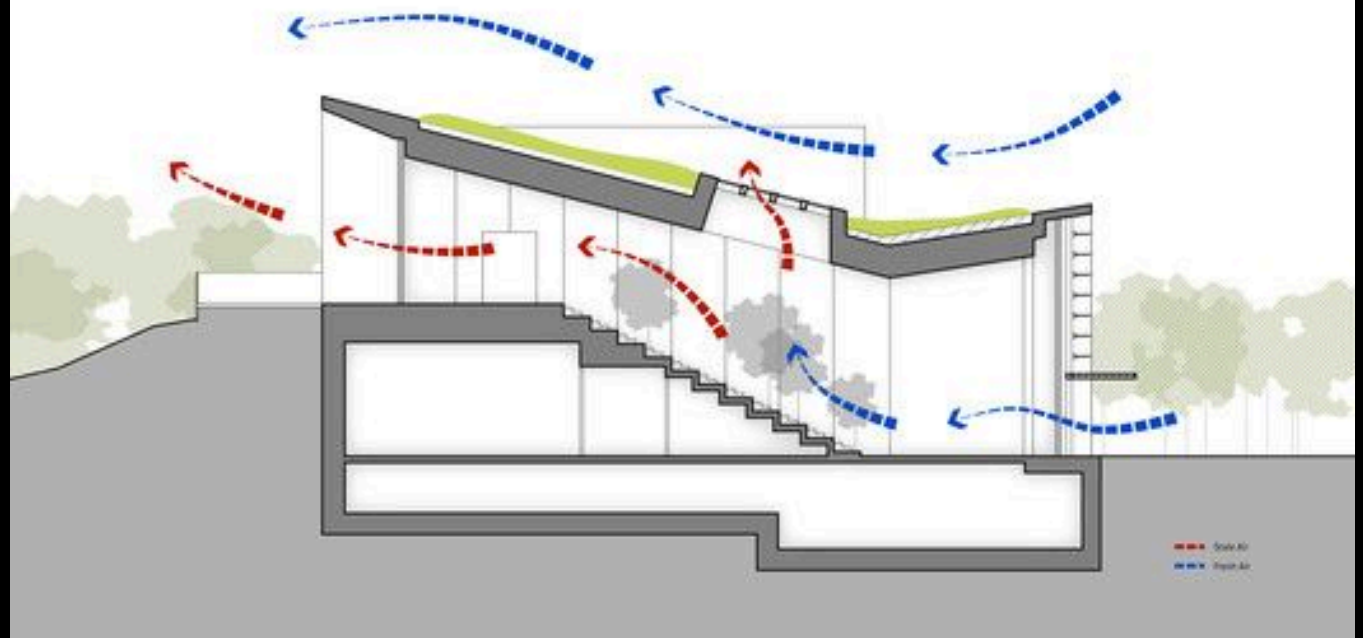


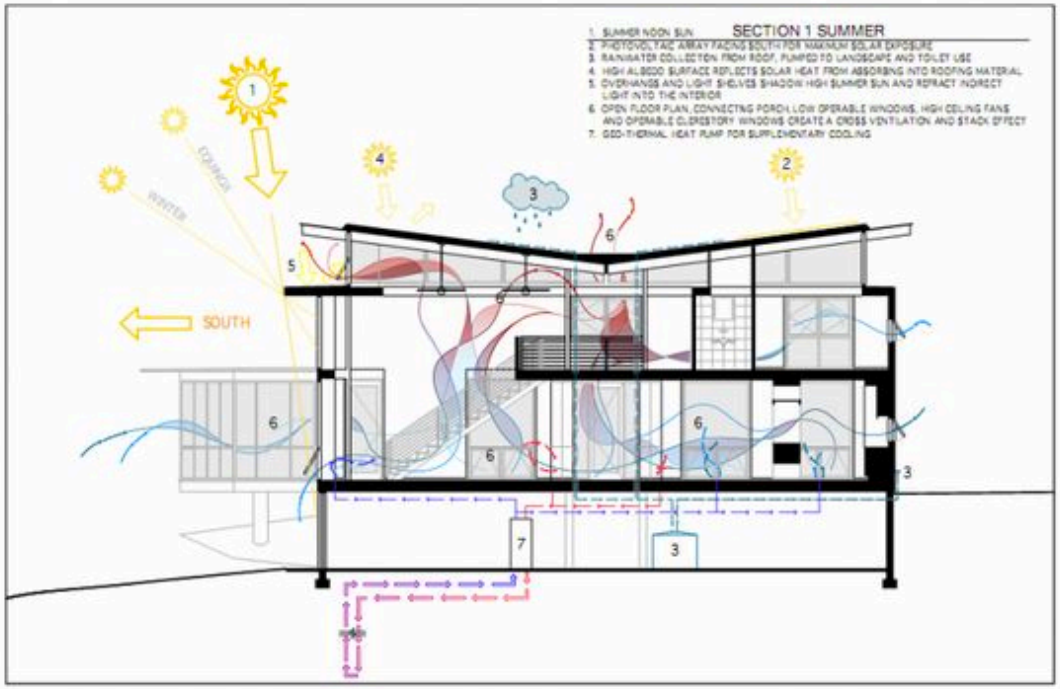
Siemens HQ in Masdar City / Sheppard Robson

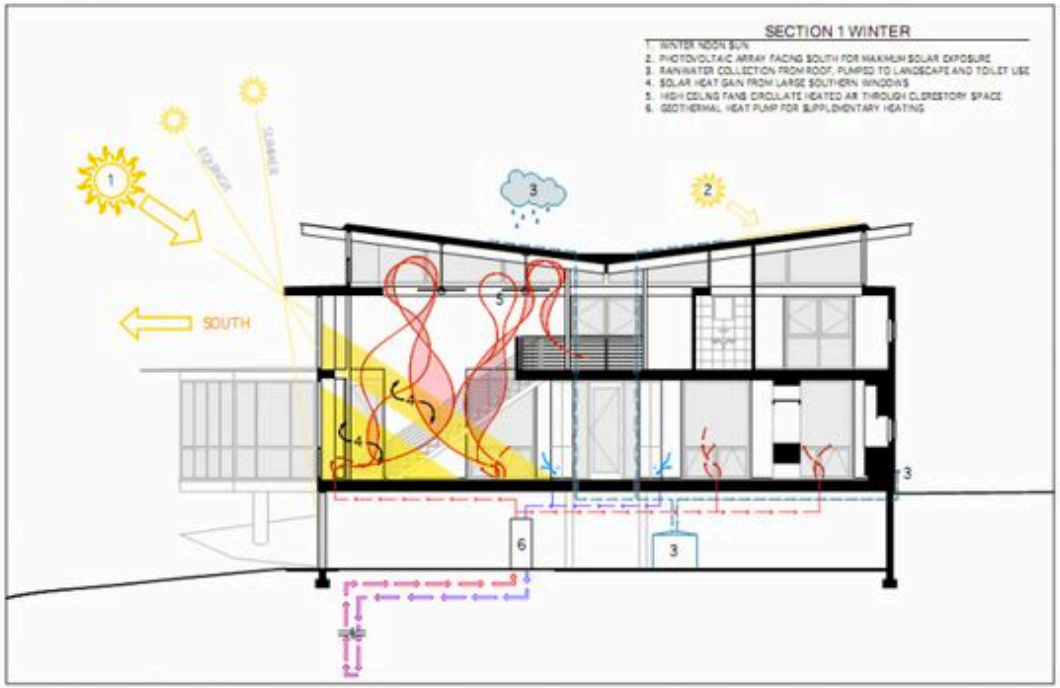
冬、夏季通风策略
Winter / Summer Ventilation



春、秋季通风策略
Spring / Autumn Ventilation




SECTION 1 SUMMER
1. SUMMER NOON SUN
2. PHOTOVOLTAIC ARRAY FACING SOUTH FOR MAXIMUM SOLAR EXPOSURE
3. RAINWATER COLLECTION FROM ROOF, PUMPED TO LANDSCAPE AND TOILET USE
4. HIGH ALBEDO SURFACE REFLECTS SOLAR HEAT FROM ABSORBING INTO ROOFING MATERIAL
5. OVERHANGS AND LIGHT SHELVES SHADOW HIGH SUMMER SUN AND REFRACT INDIRECT LIGHT INTO THE INTERIOR
6. OPEN FLOOR PLAN, CONNECTING PORCH, LOW OPERABLE WINDOWS, HIGH CEILING FANS AND OPERABLE CLERESTORY WINDOWS CREATE A CROSS VENTILATION AND STACK EFFECT
7. GEO-THERMAL HEAT PUMP FOR SUPPLEMENTARY COOLING
SUMMER
EQUINOX
WINTER
SOUTH


SECTION 1 WINTER
1. WINTER NOON SUN
2. PHOTOVOLTAIC ARRAY FACING SOUTH FOR MAXIMUM SOLAR EXPOSURE
3. RAINWATER COLLECTION FROM ROOF, PUMPED TO LANDSCAPE AND TOILET USE
4. SOLAR HEAT GAIN FROM LARGE SOUTHERN WINDOWS
5. HIGH CEILING FANS CIRCULATE HEATED AIR THROUGH CLERESTORY SPACE
6. GEOTHERMAL HEAT PUMP FOR SUPPLEMENTARY HEATING
SUMMER
EQUINOX
SOUTH

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

nwe

INTERREG IVB

Passive Interventions

- Passive vents actuated by humidity do not open for smells
- Clay finishes absorb smells and moisture
- High Titanium Dioxide coatings clean the air
  - But extremely high environmental impact to make it
- Essence of Cherry eats bacteria in the air
- Opening opaque vents in walls becoming popular
  - (insect grilles and security essential)
- Passive Ventilation with Heat Recovery
  - Existing Fireplace and Chimney
  - New duct inserted with PVHR cowl on top

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

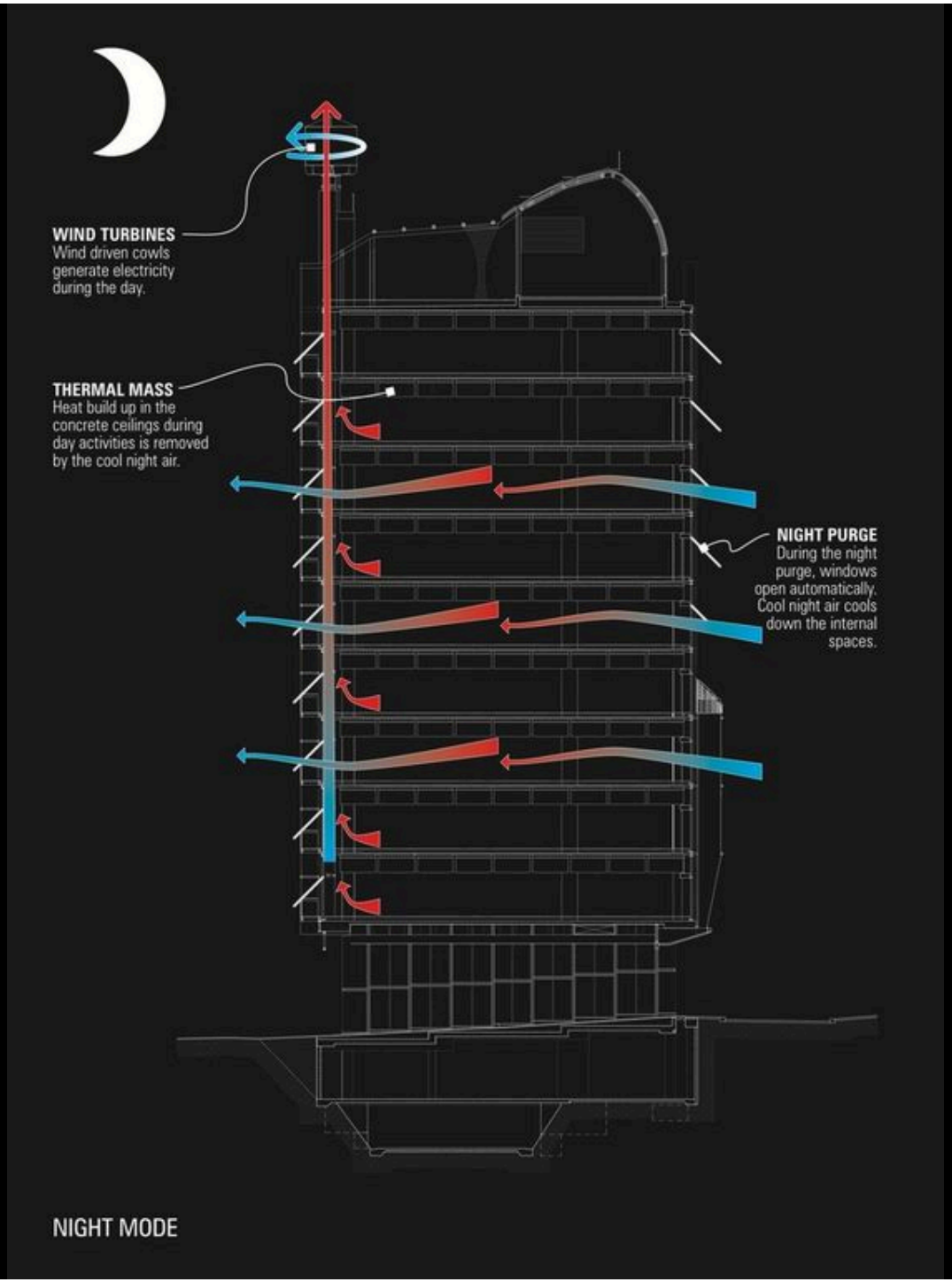
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Active Vent

- BedZED cowels
  - Wind pressure drives fresh air in
  - Pushes stale air out
  - Transfers heat-only from outgoing to incoming air
- Night time Purging of heat
  - Thermal mass heated during day
  - Thermal mass cooled at night
  - Cooled thermal mass exposed to soak up heat during following day


WIND TURBINES
Wind driven cowls generate electricity during the day.
THERMAL MASS
Heat build up in the concrete ceilings during day activities is removed by the cool night air.
NIGHT PURGE
During the night purge, windows open automatically. Cool night air cools down the internal spaces.

NIGHT MODE

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

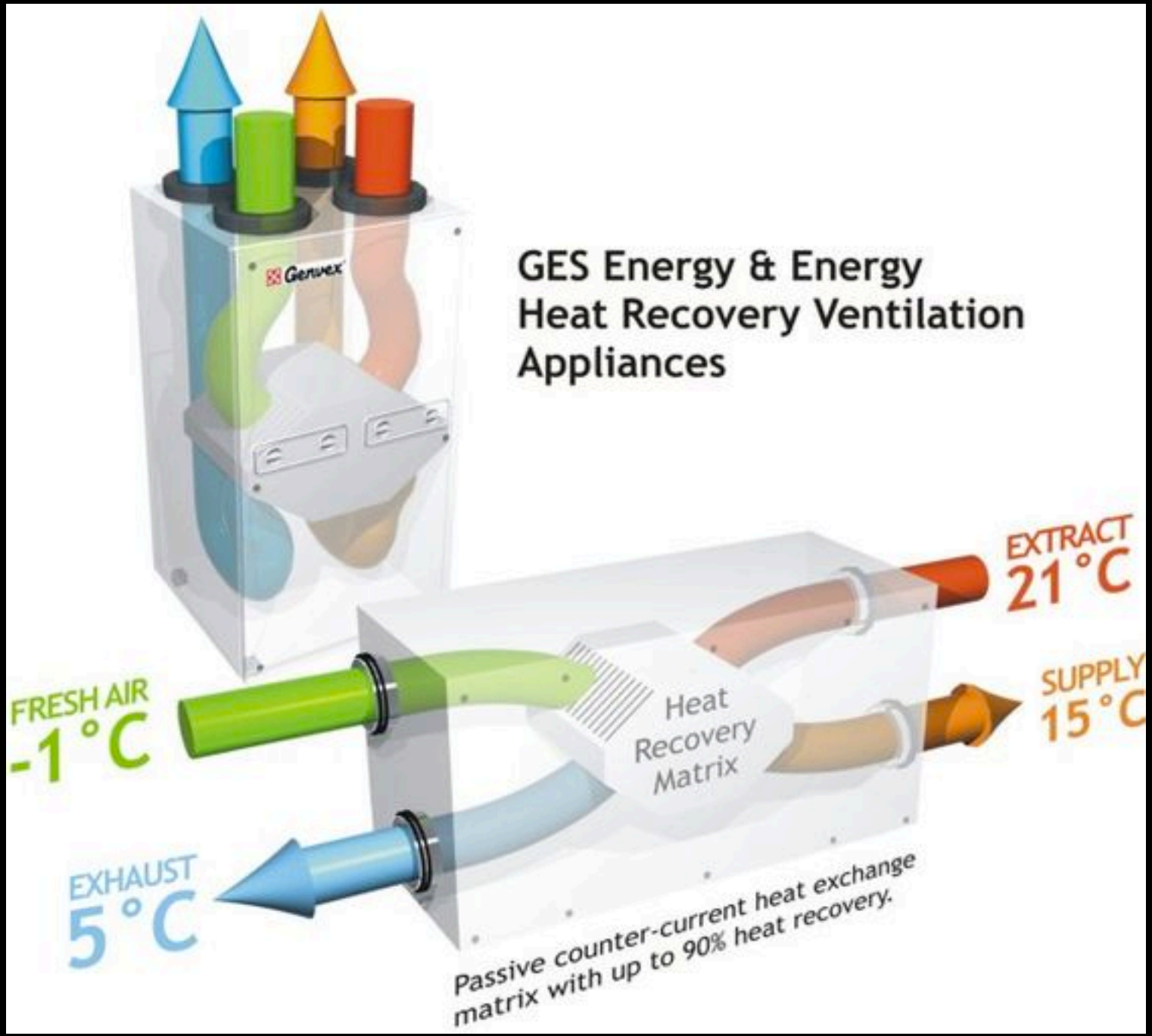
Investing in Opportunities

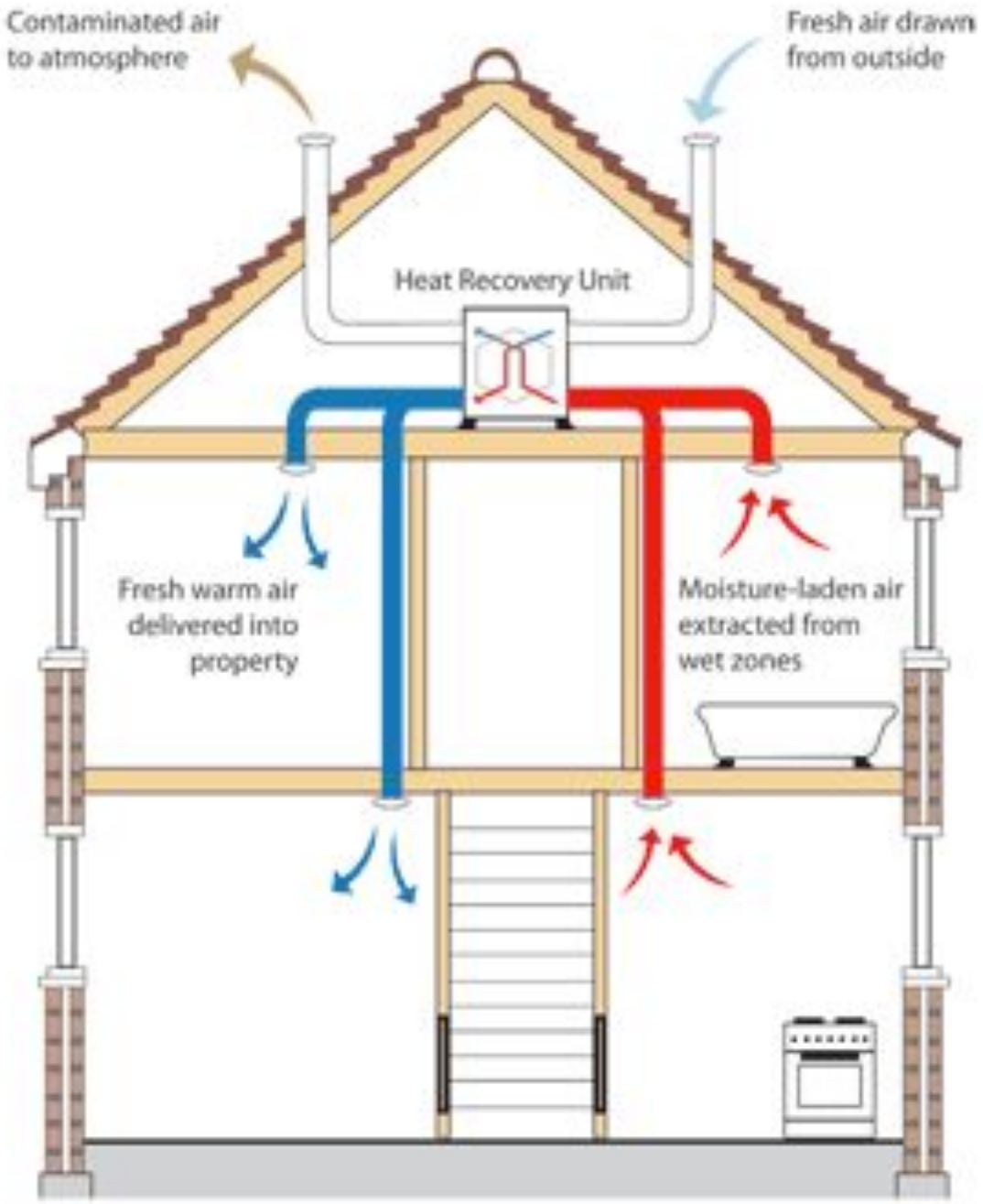
This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

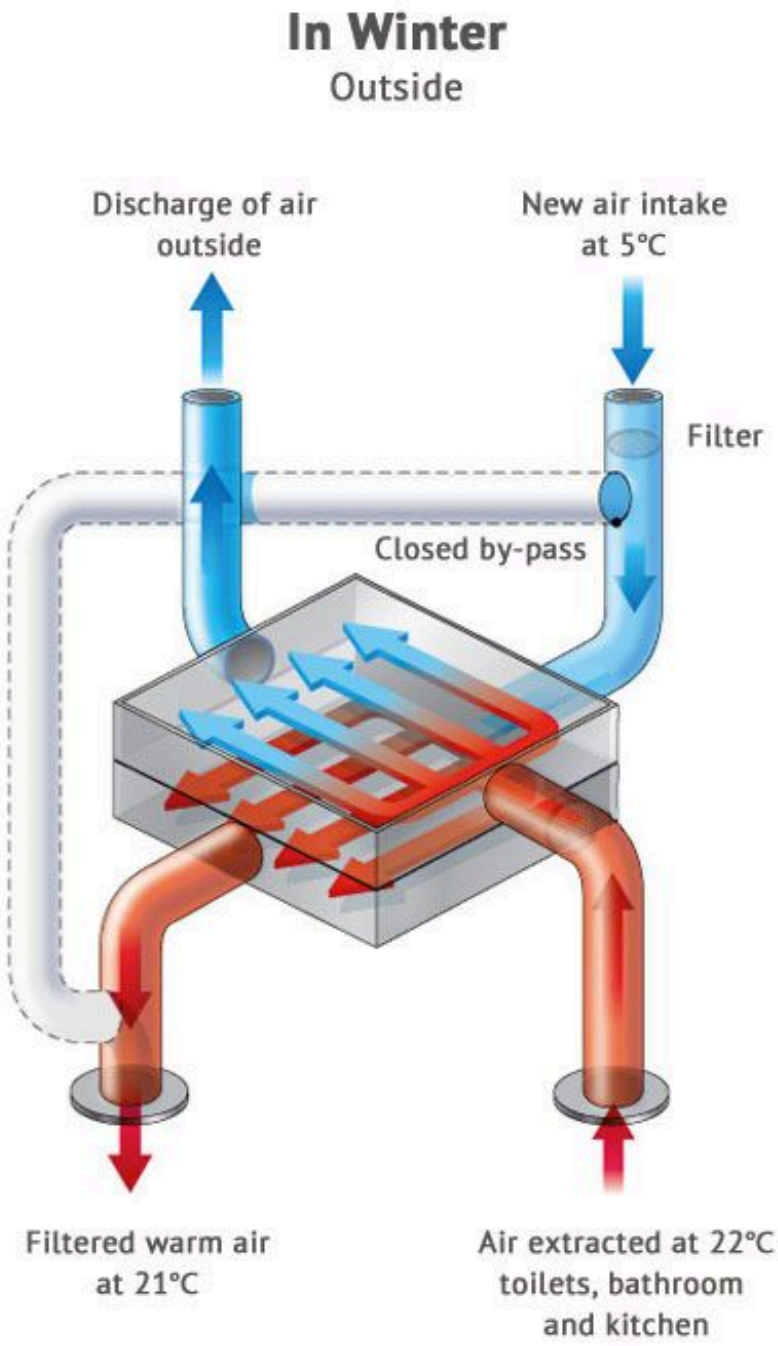
Mechanical Ventilation

- Passivhaus: MVHR whole house system
  - Extract from Kitchen and Bathrooms
  - Input into Living and bedrooms
  - Circulate via corridor
- Extractors in Bathrooms and Kitchen (humidity smells removed but heat lost)
  - MVHR through walls are available too


GES Energy & Energy
Heat Recovery Ventilation
Appliances
Genvex
EXTRACT
21 °C
SUPPLY
15 °C
FRESH AIR
-1 °C
Heat
Recovery
Matrix
EXHAUST
5 °C
Passive counter-current heat exchange
matrix with up to 90% heat recovery.



- Do not put MVHR in attic
- The attic is 50 degrees C in Summer
- Ventilation will deliver hot air in summer



- Summer: MVHR needs a bypass so heat is not recovered and recycled
- Ventilation should not deliver hot air in summer


Click to browse items

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

nwe

INTERREG IVB

Ventilation Assessment

- North Point and scales essential
- Prevailing wind rose
- Plans of whole (site or building) and indicate part
- Building Profile: Section of whole and part
- Wind access to site, shadows, urban climate issues if applicable
- Analysis: Plans Sections Elevations:
- Your response to wind and shade analysis
- Any internal enclosure and glazing
- Analysis of existing ventilation to be exploited
- Any interventions by you to provide ventilation
  - Background or task ventilation or both

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Cooling

Choose Passive Active Mechanical Ventilation

Avoiding Air Conditioning wherever possible

"Comfort Cooling"

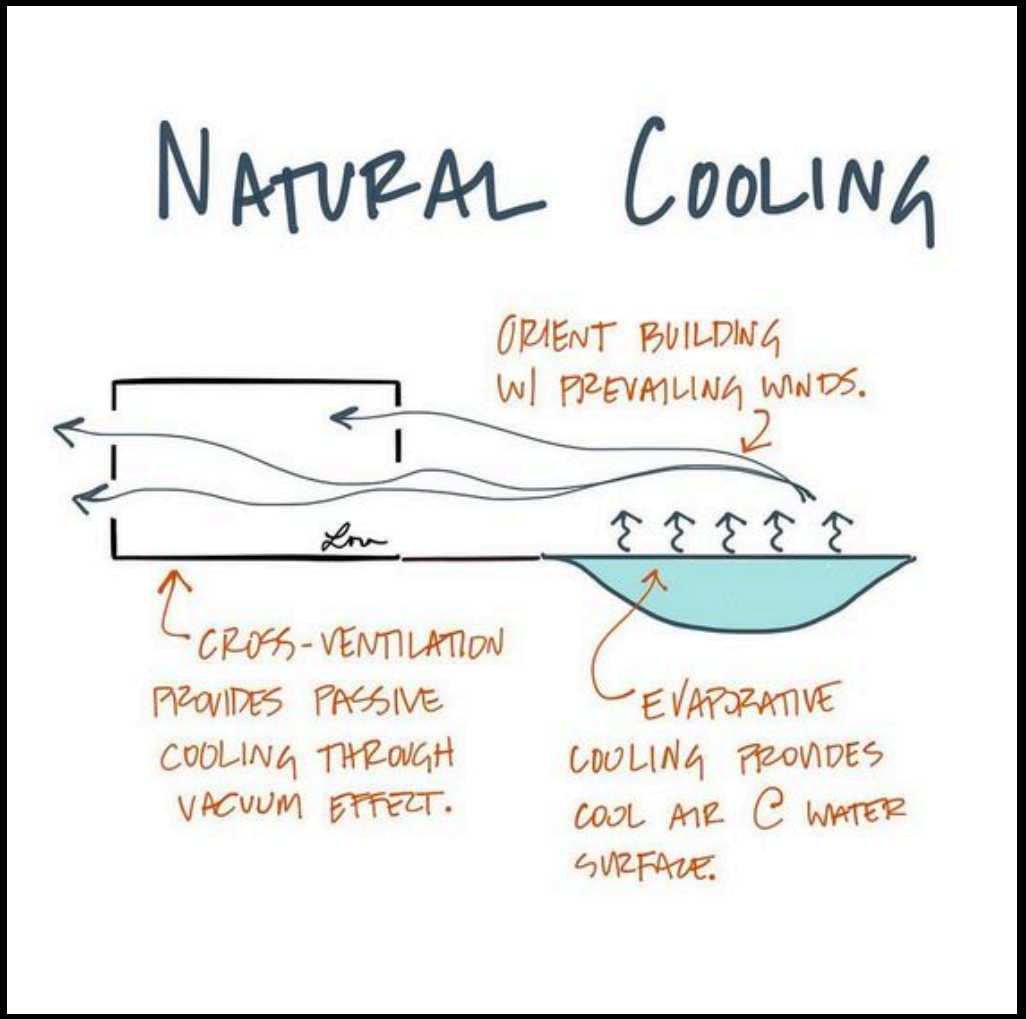
Purpose of Cooling Control

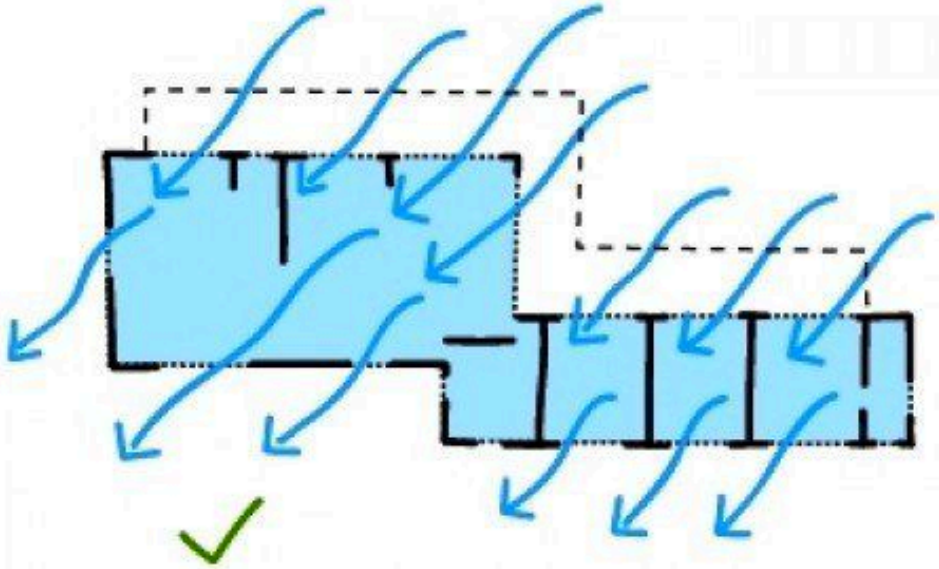
- Remove excess heat and humidity
- Air conditioning is energy intensive to heat, cool and change relative humidity
- Depending on fuel source also carbon intensive, and probably 24 hours
- Rare books, photographic collections, exhibits, art or sculpture
- May need to be kept at a low temperatures and humidity to avoid mould growth
- Laboratories or chemical stores may need to be kept cool to avoid spontaneous combustion
- Food storage mountains need to be kept cool
- If the building fabric lets in solar radiation heat by using wrong materials with wrong decrement delay in the roof and E>S>W facades
  - the building will need to be cooled more on sunny days
- 100% fixed glazed facades need 100% air conditioning to control: heat and humidity from people, equipment and solar heat gains
  - Canary Wharf Tower: 1 million watts from people alone

https://GreenBuildingEncyclopaedia.uk

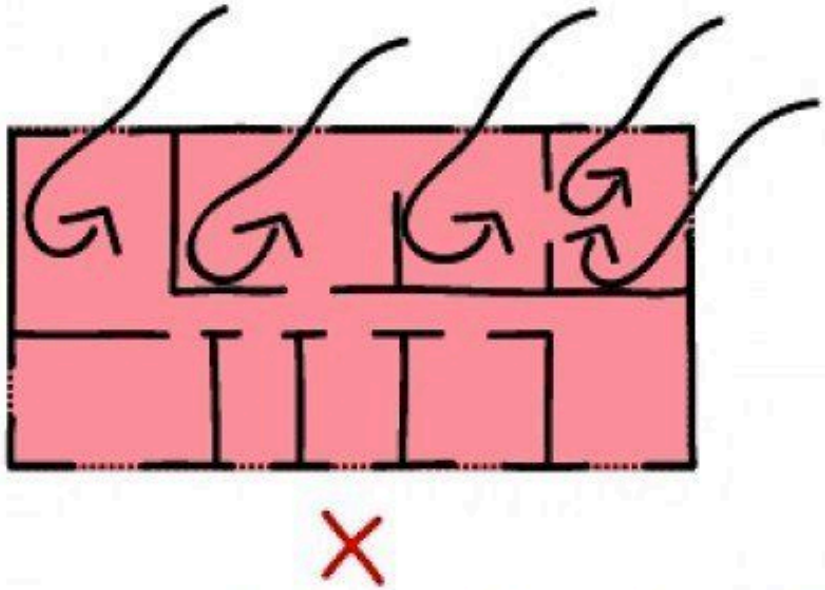
Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

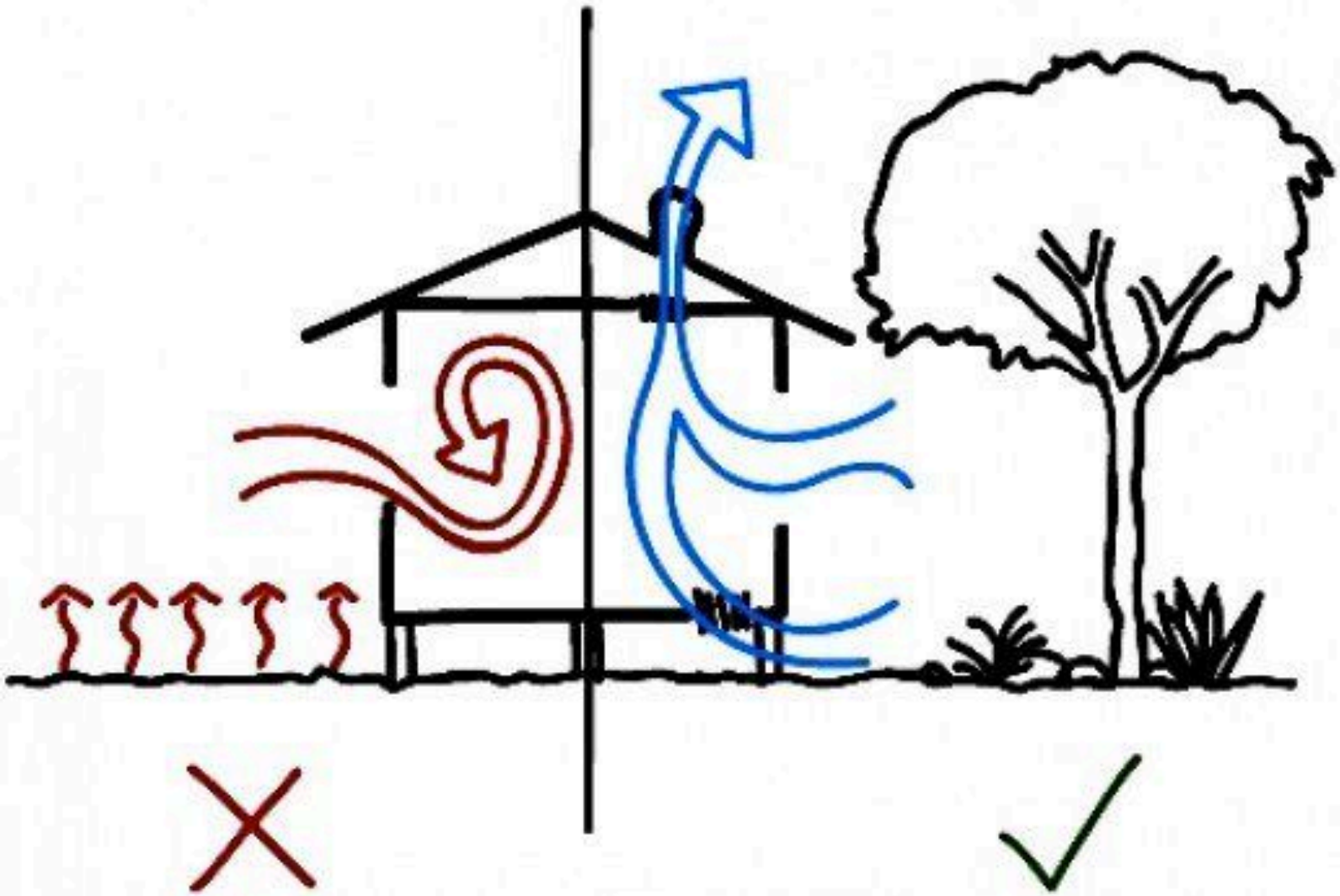




A well designed home with single room



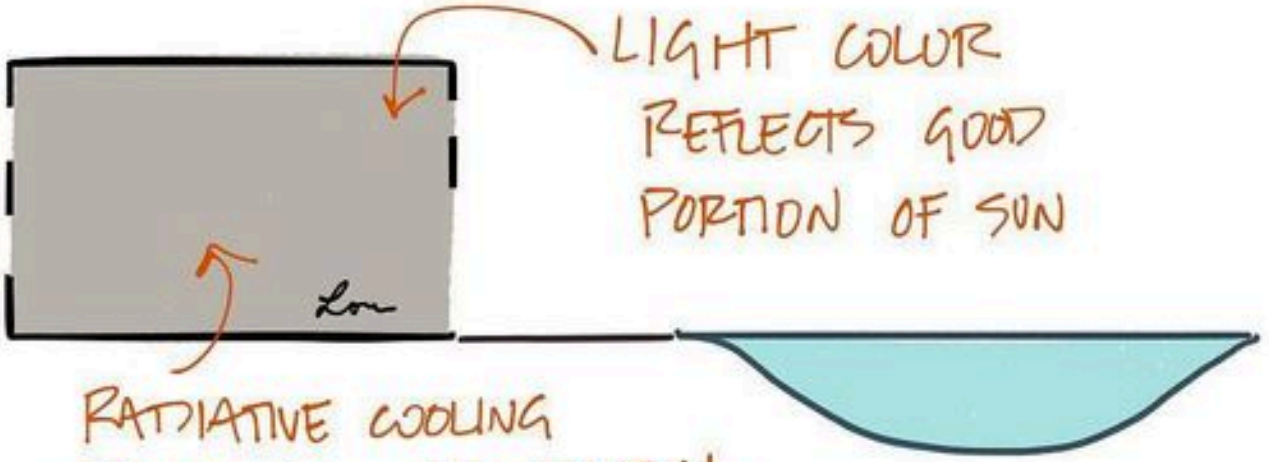
A poorly designed home that will create hot stagnant areas.

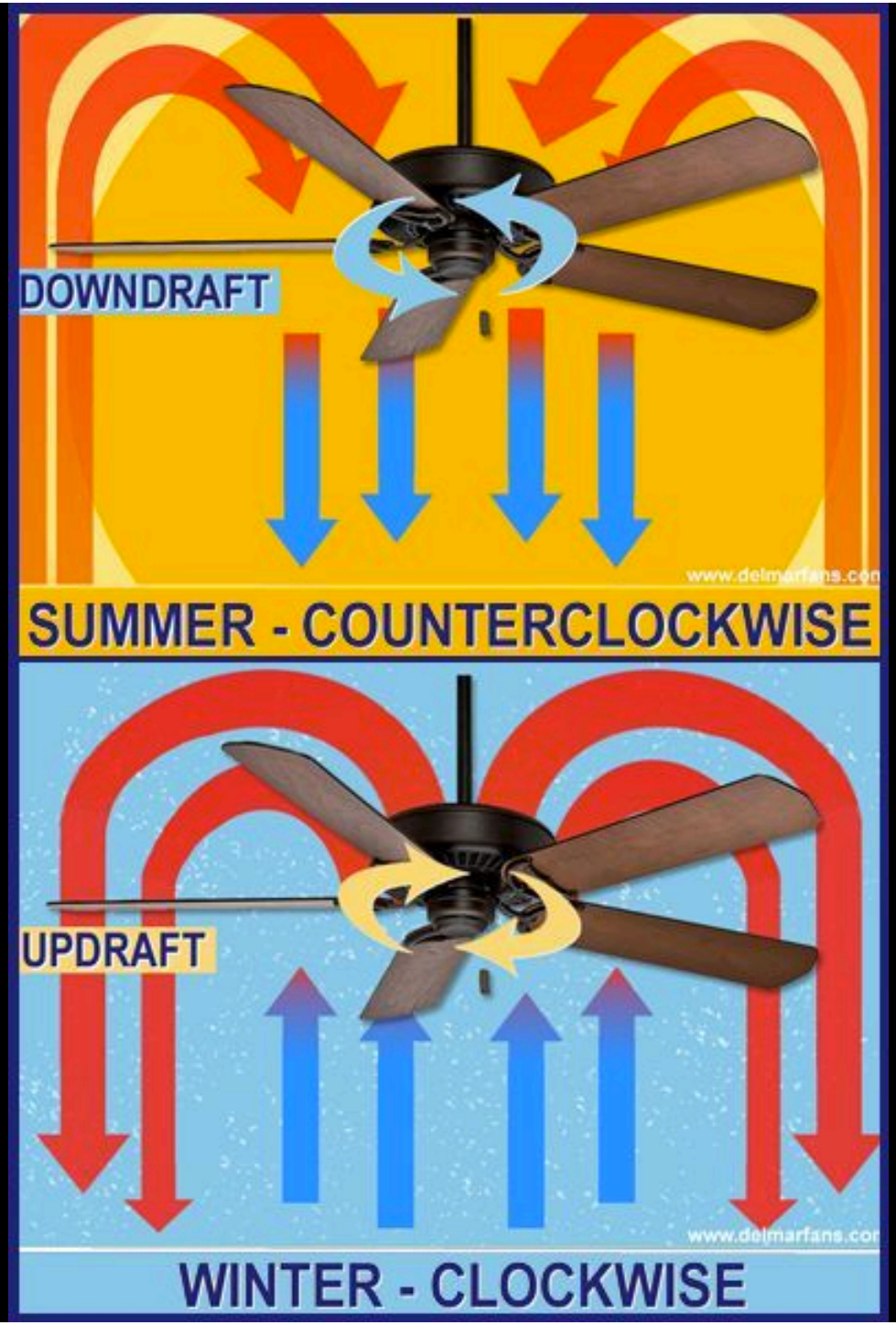


On the right, hot air escapes though a roof vent and draws cool air in by convection.

On the left, a lack of ventilation contributes to stagnation of hot air.

NATURAL COOLING




DOWNDRAFT
SUMMER - COUNTERCLOCKWISE
UPDRAFT
WINTER - CLOCKWISE

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Cooling Assessment

- Previous Light/Heat/Wind assessments
  - (combine as 1 diagram?)
  - Heat sources than need to be cooled
  - Wind access to site, shadows, urban climate issues if applicable
- North Point and scales essential
- Plans of whole (site or building) and indicate part
- Building Profile: Section of whole and part
- Analysis: Plans Sections Elevations:
- Your response to:
  - Heat/Wind and shade analysis
  - Any internal enclosure and glazing
  - Analysis of existing ventilation to be exploited for cooling
- Any interventions by you to provide cooling
  - Background or task cooling or both

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Services Response

- Halve Demand: Improve passive measures: 50% reduction
- Double efficiency: effective controls: 75%
- Halve the carbon: Obtain energy from renewable sources: 87.5% reduction
- If your proposals cannot meet all the requirements in a passive way
- Provide the remainder by mechanical or artificial means

GBE

https://GreenBuildingEncyclopaedia.uk

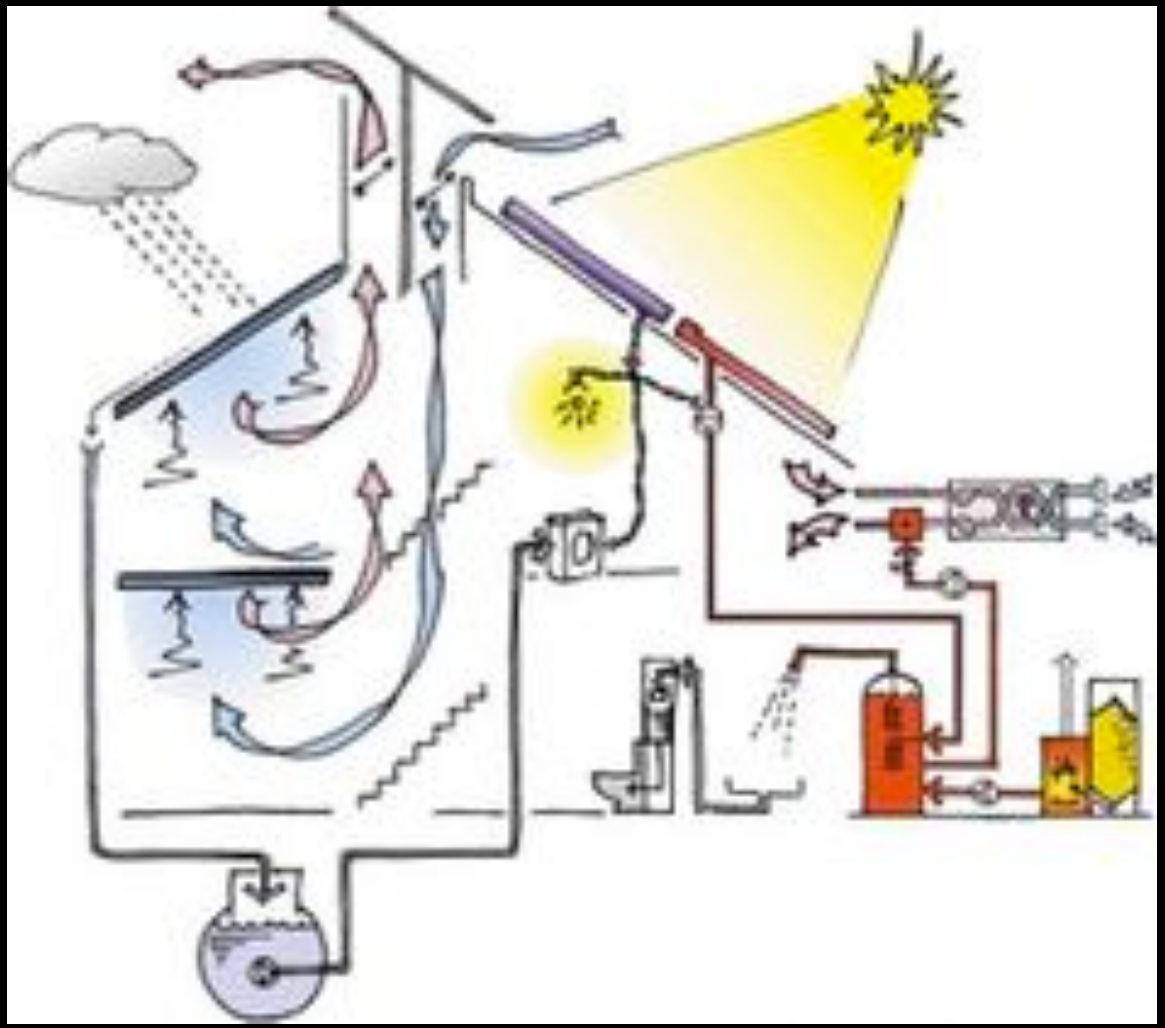
CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

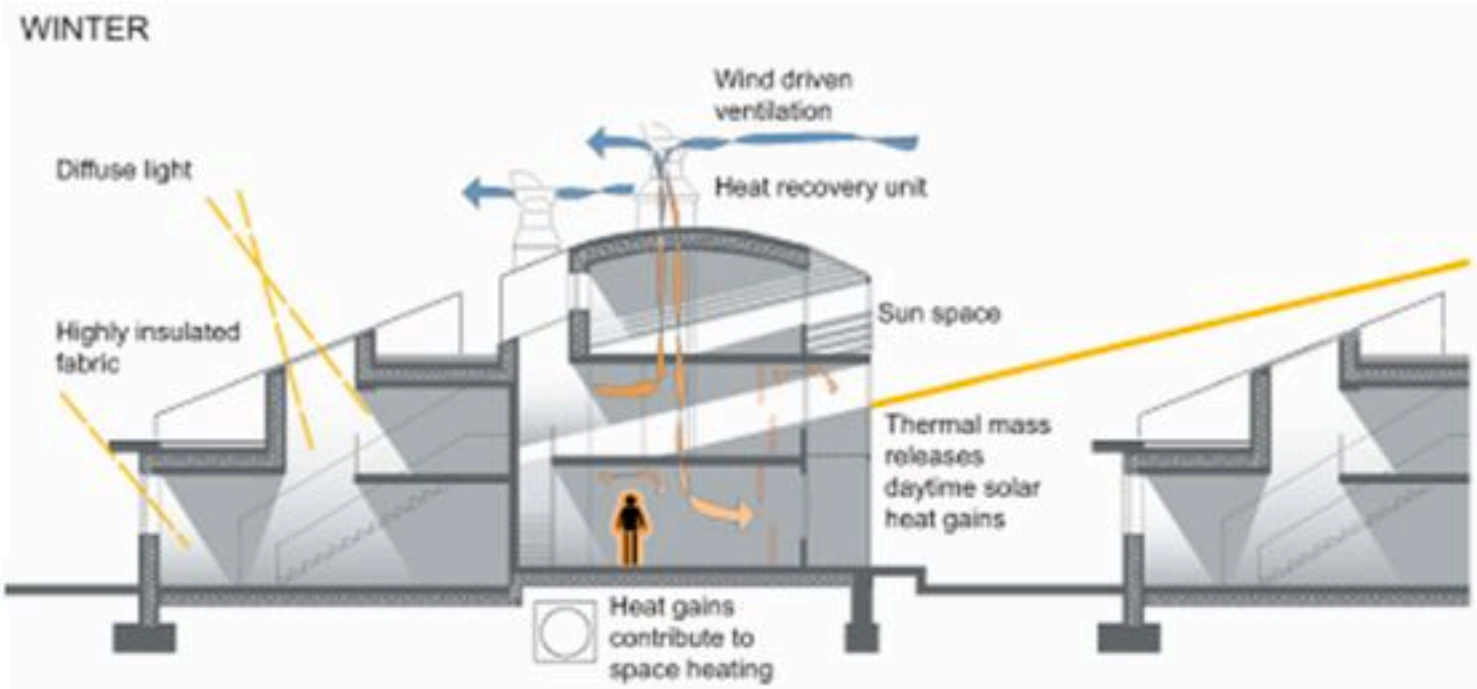
This project has received European Regional Development Funding through INTERREG IV B.

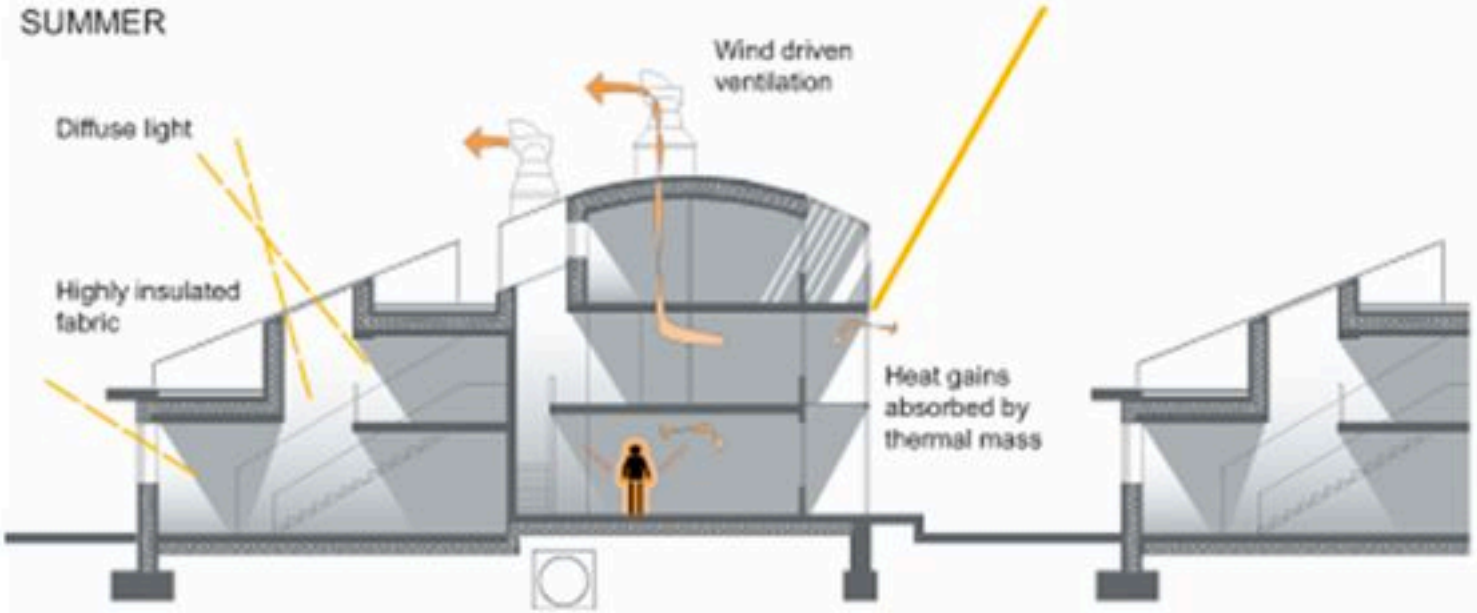
INTERREG IVB



Purpose of Services Response

- Provide comfort conditions for occupants
- Reduce Energy Demand
- Reduce Carbon in that energy
- Fuel Autonomy
  - Reduce reliance upon external energy sources and their escalating costs
- Reduce Costs
  - Reduce Business Overheads
  - Reduce Home running costs


WINTER
Wind driven ventilation
Diffuse light
Heat recovery unit
Highly insulated fabric
Sun space
Thermal mass releases daytime solar heat gains
Heat gains contribute to space heating


SUMMER
Wind driven ventilation
Diffuse light
Highly insulated fabric
Heat gains absorbed by thermal mass

GBE

https://GreenBuildingEncyclopaedia.uk

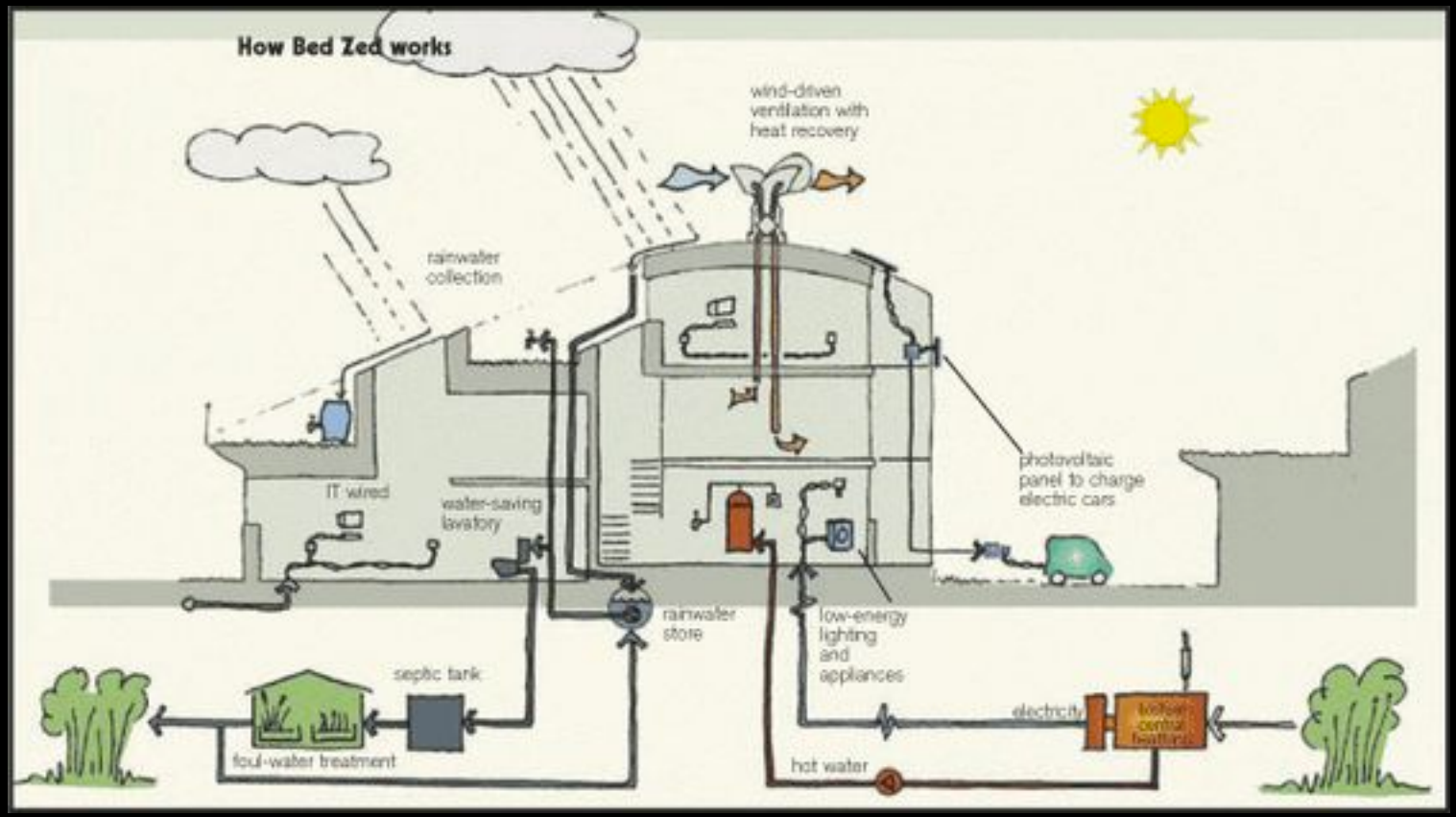
CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB



Services Response Assessment

- Justify their need
- Propose services needed to meet residual demand
- Ensure the services acknowledge each other and are integrated where important to do so
- Waste from one may be a resource for another
- Describe systems and their controls
- Describe their locations is scheme
- Integrate in floors and reflected ceiling plans, room elevations and roof if required

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Feedback

- These files are created by generalists with a big dollop of green flavour
- These files are updated from time to time
- We are not experts so from time to time these file may get out of date or may be wrong.
- If you feel that we have got it wrong please let us know so we can put it right

GBE

https://GreenBuildingEncyclopaedia.uk

CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

© GBE 2019

- Brian Murphy BSc Dip Arch (Hons+Dist)
  - Technician and Architect by Training
  - Specification Writer by Choice
  - Environmentalist by Actions
- Greening up my act since 1999
- Founded National Green Specification 2001
- Launched www.greenspec.co.uk 2003
- Created: GBE at https://greenbuildingencyclopaedia.uk 2012 - 2019
- E BrianSpecMan@icloud.com
- Twitter: http://twitter.com/brianspecman
- LinkedIn: BrianSpecMan
- Facebook: BrianSpecMan http://www.facebook.com/brianspecman
- GoogleMyBusiness: National Green Specification
- Slide Share:
- Pinterest: https://www.pinterest.co.uk/bmurphy1390/
- National Green Specification