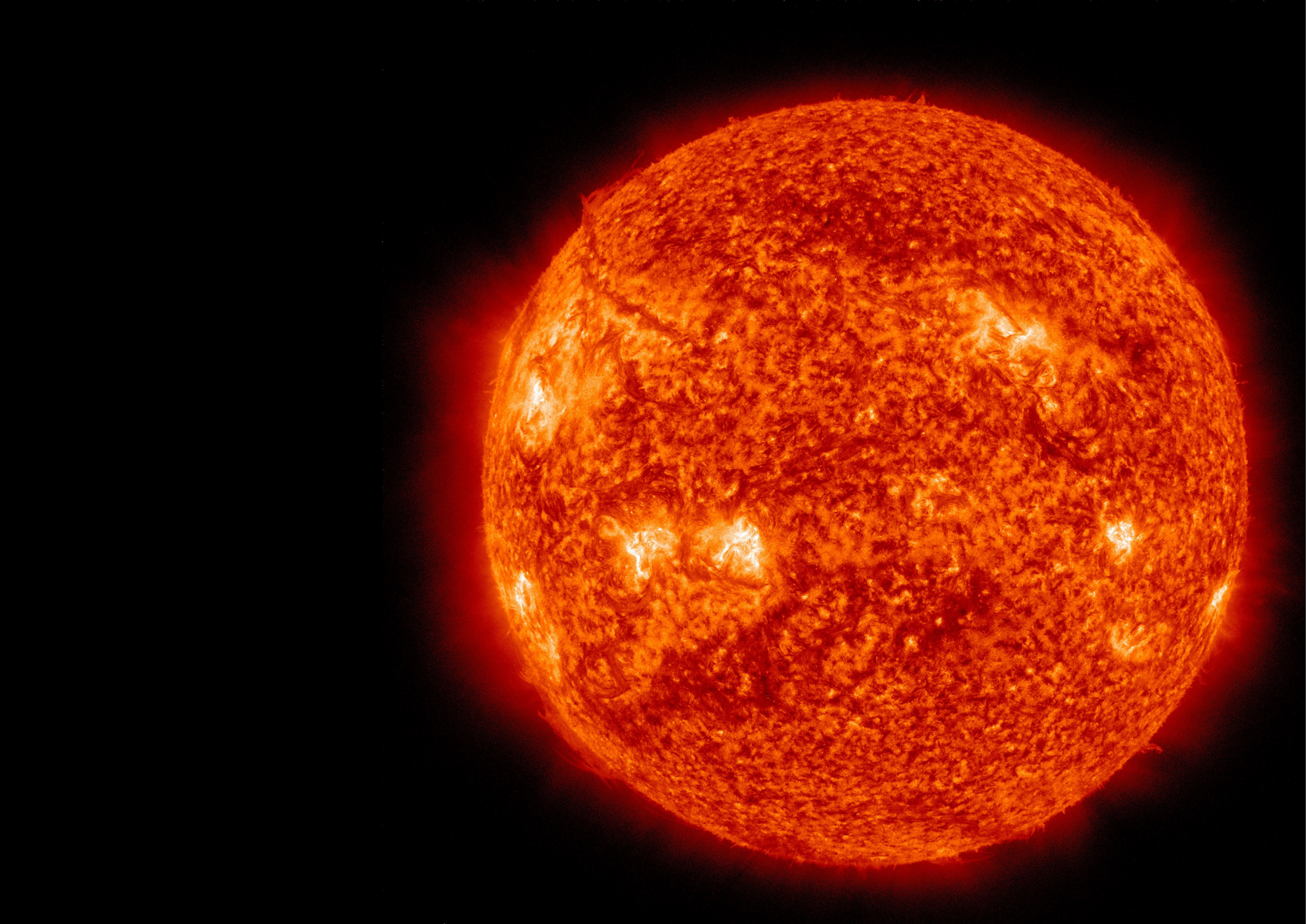
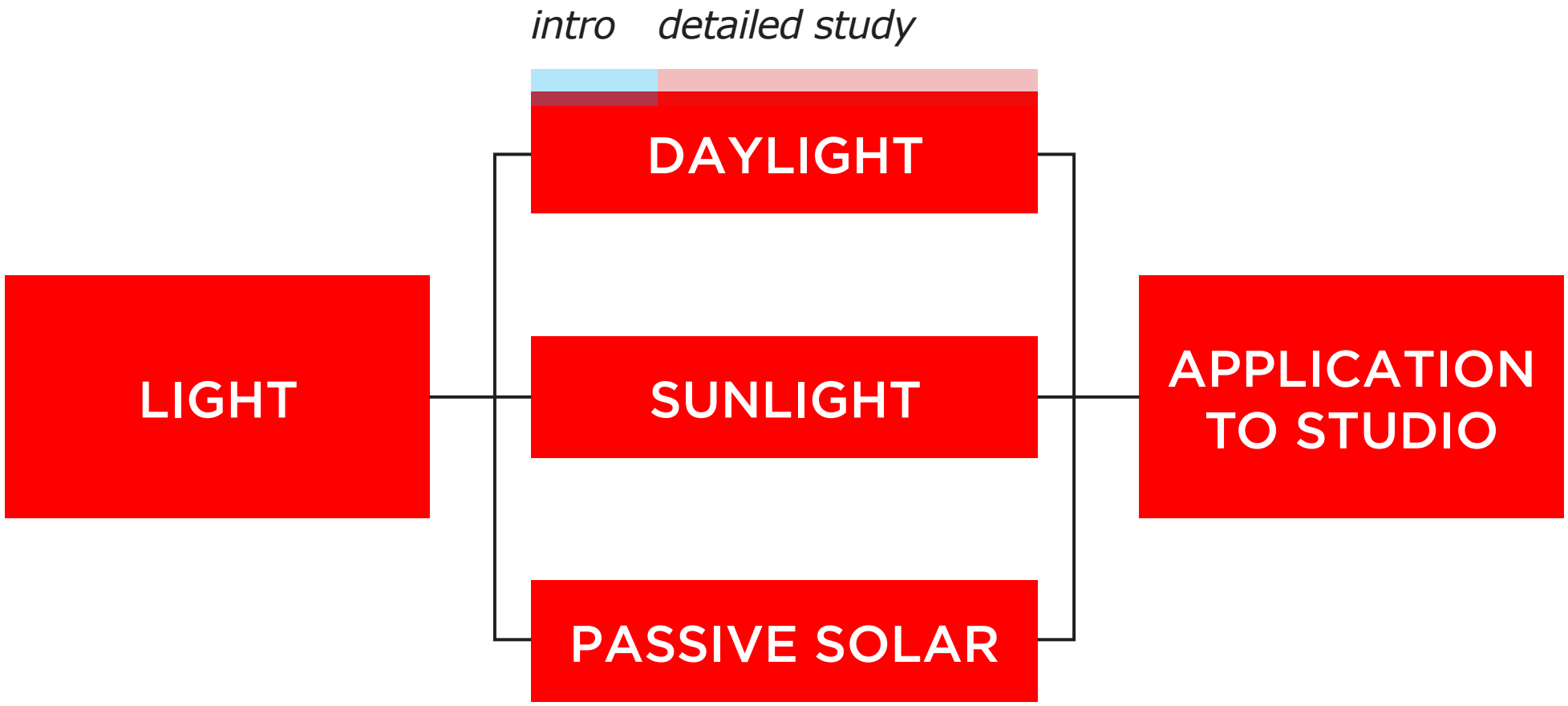
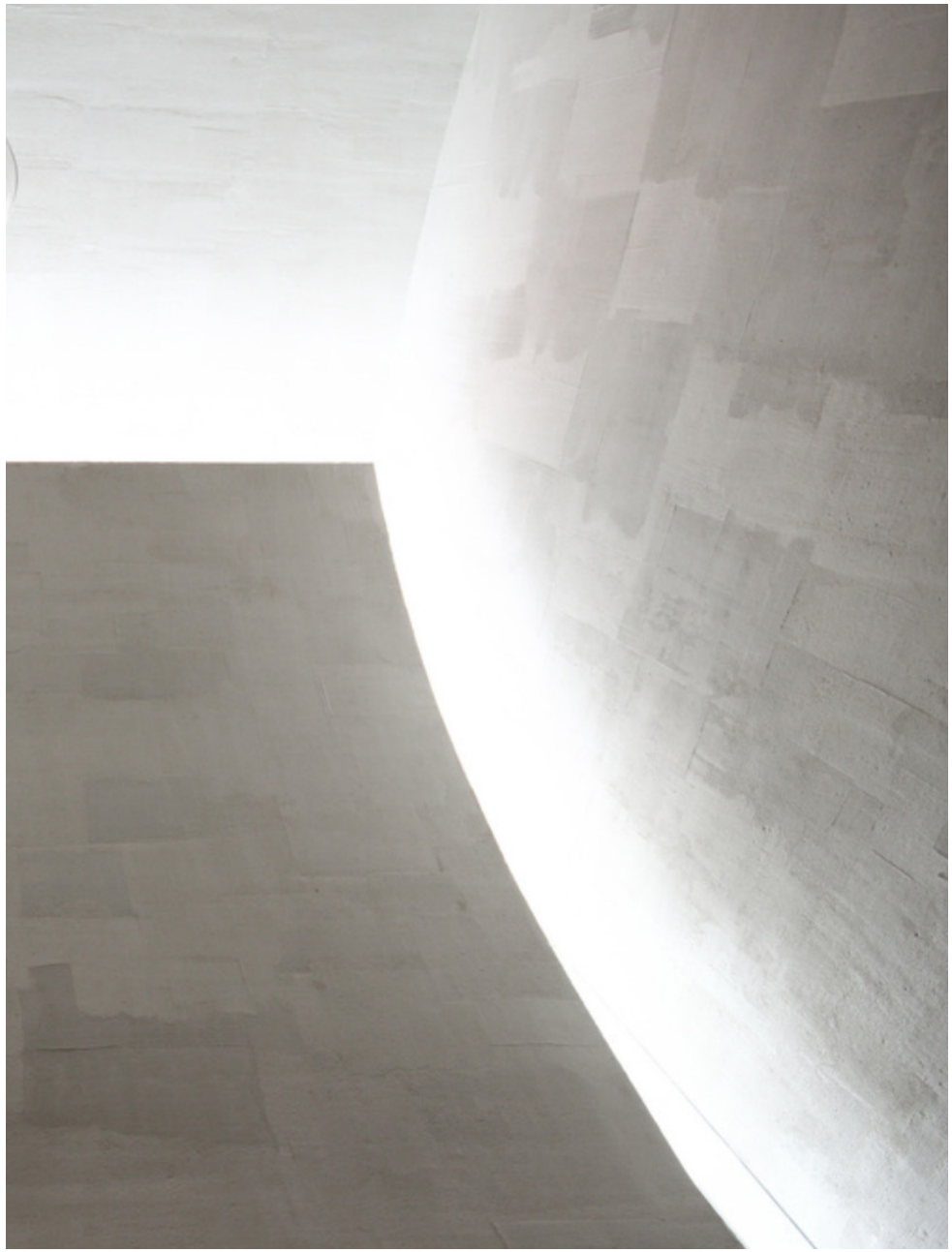



intro
detailed study
DAYLIGHT
LIGHT
SUNLIGHT
APPLICATION TO STUDIO
PASSIVE SOLAR



DAY LIGHTING

AN AMALGAMATION

Illuminance from radiation in the visible spectrum from the diffuse sky, reflected light and direct sun that lights a room.

TOOLS

DAYLIGHT FACTOR

A simple tool to quantify the amount of light present in a room relative to the external conditions.

$$DF = 100 \times \frac{\text{Internal Illuminance}}{\text{External Illuminance}}$$

QUANTIFYING

DAYLIGHT FACTOR

In the UK we might typically design for an average daylight factor of 5%

Below 2% rooms in the UK can feel dim

$$DF\ AVG = \frac{\Sigma\ (W\ T\Phi\ M)}{A\ (1\text{-}R^2)}$$

W = Area of each window

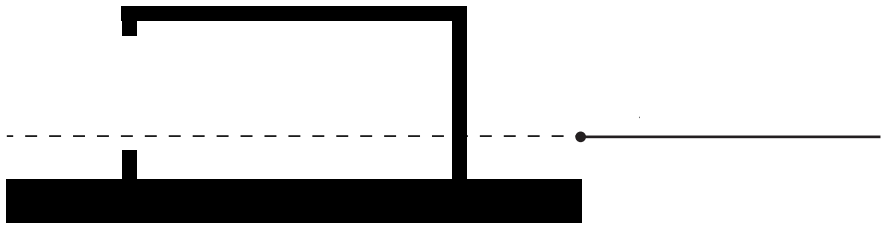
T = Light transmittance of each glazing

∅ = Vertical angle of the sky visible from the centre of each window pane

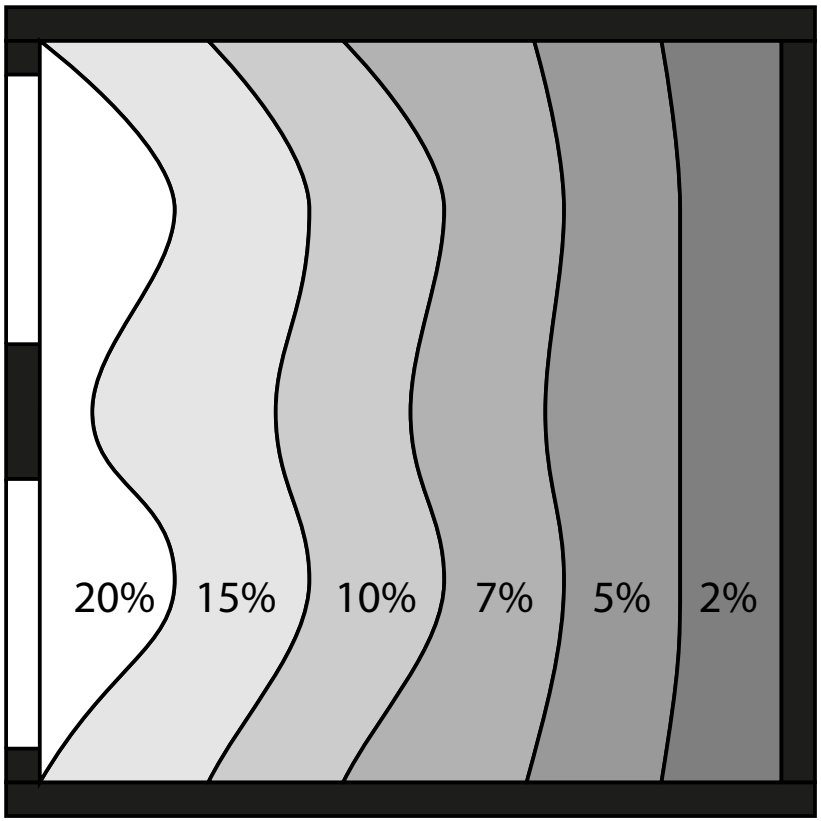
M = Maintenance factor based on the position of the glazing and the location of the site

A = Total internal surface of the space, including walls, floors, ceilings and windows

R = Area-weighted average reflectance of all surfaces



REFERENCE
POINT
DESK HEIGHT

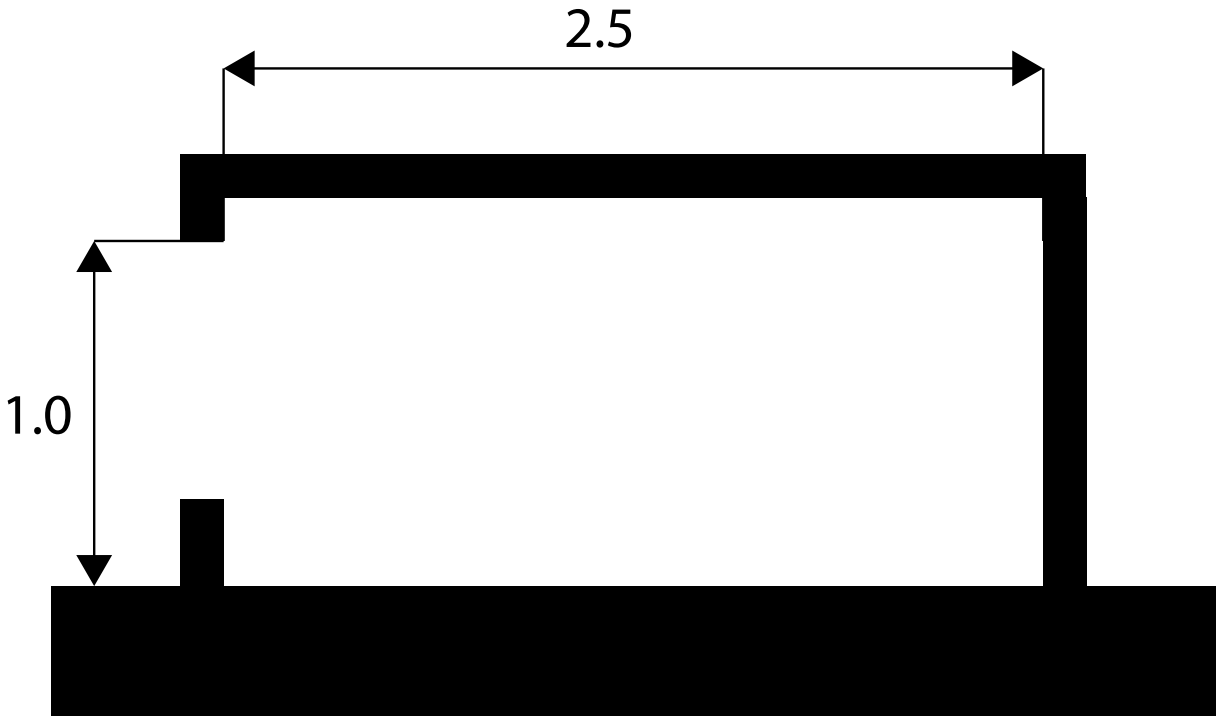


GRADATION

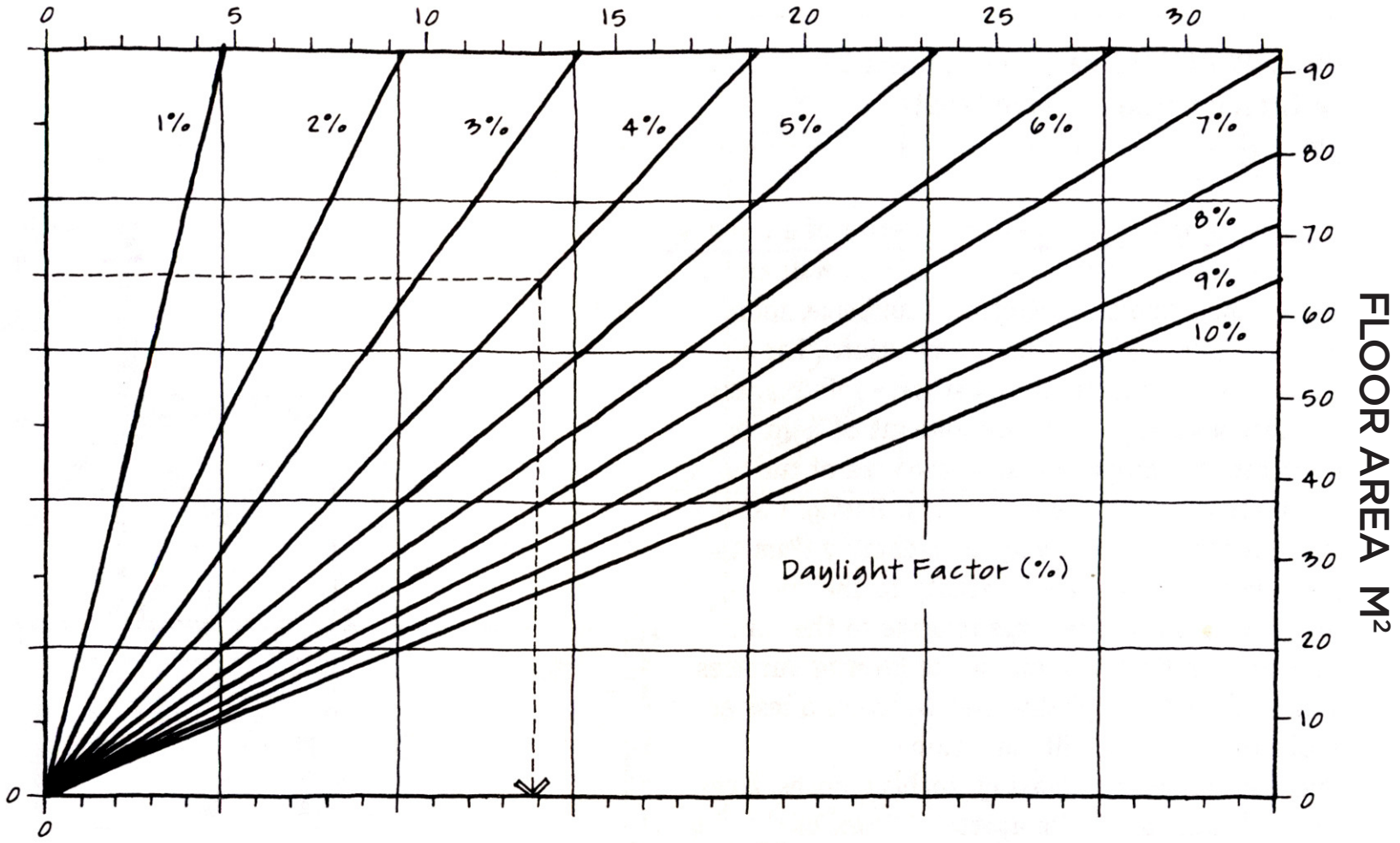
Day light factor contour lines; an average day light factor needs to be considered along with how the light will drop in intensity though the depth of a room.

SIDE LIT

Rule of thumb for minimum DF
of greater than or equal to 2%

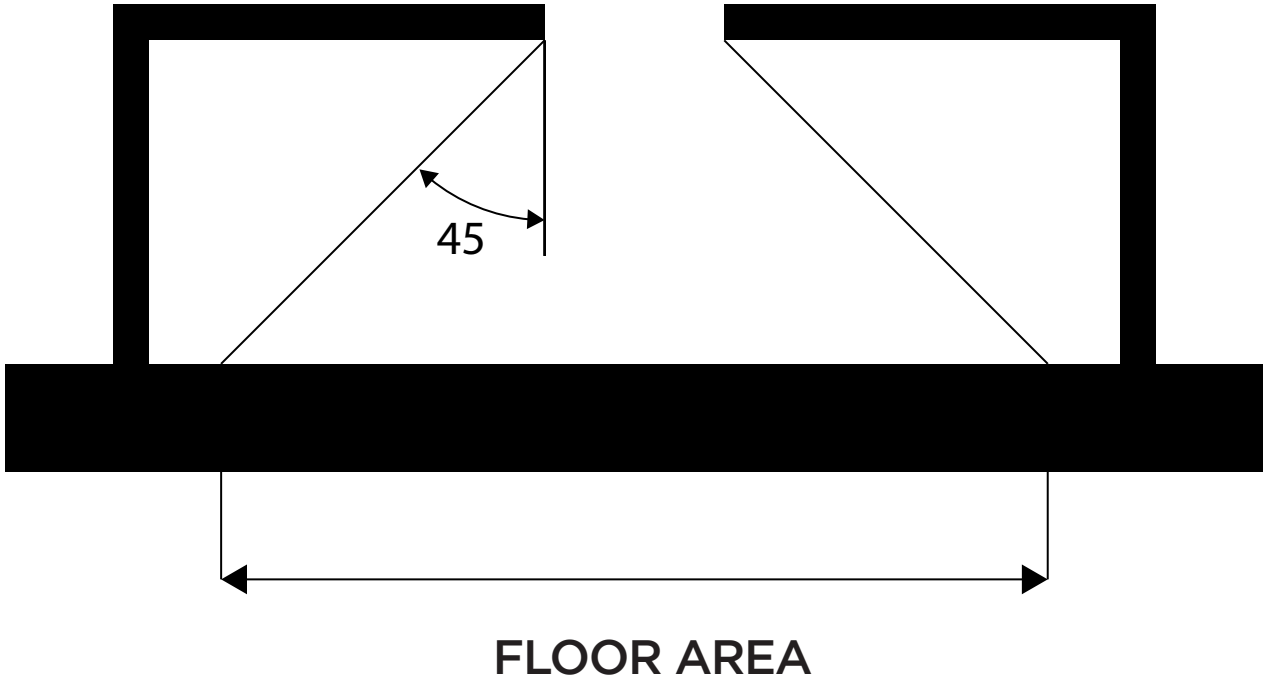


UNOBSTRUCTED GLAZED AREA



TOP LIT

Affected floor area

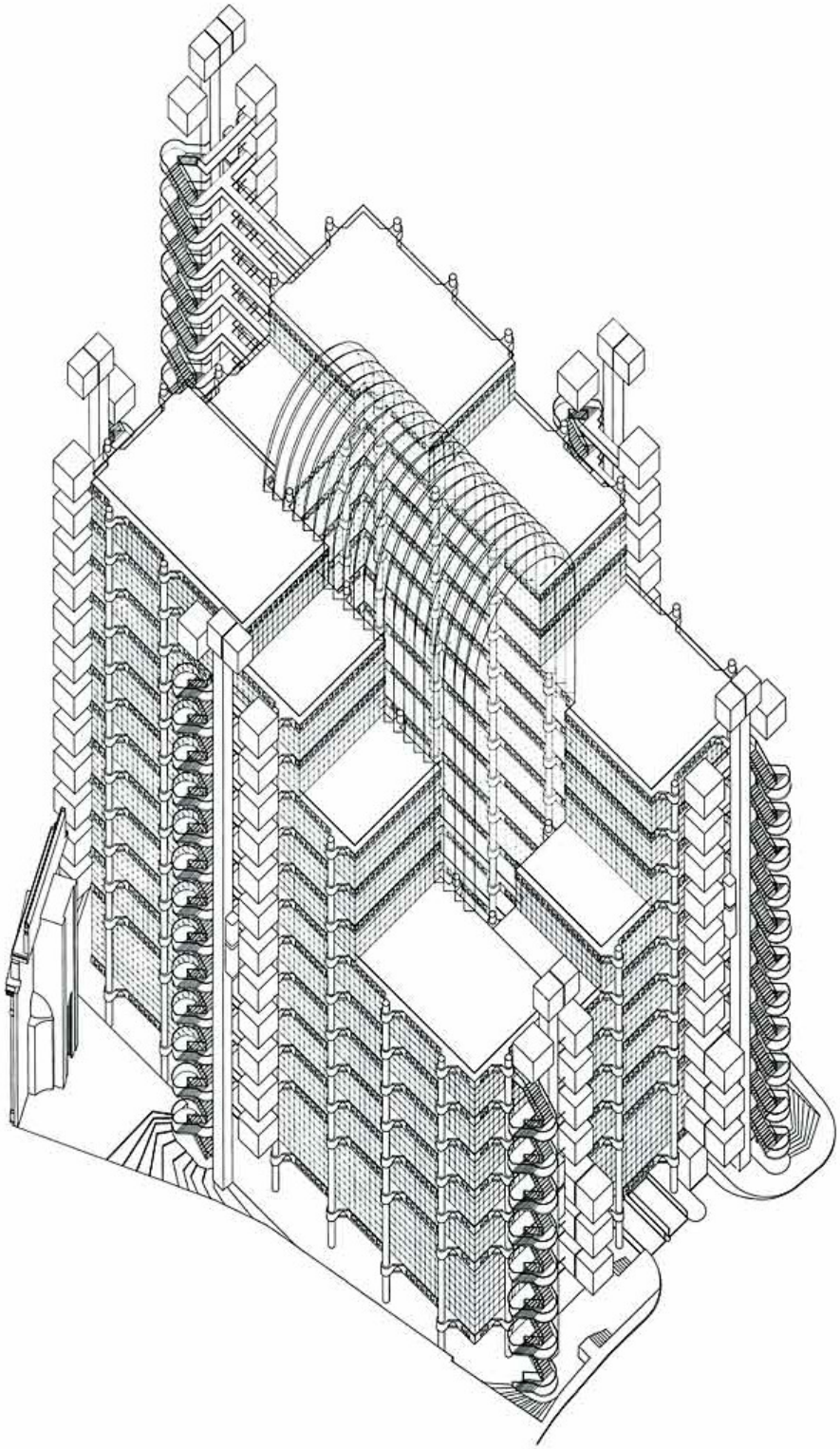


DEFINITION

PRINCIPLES

TECHNICAL

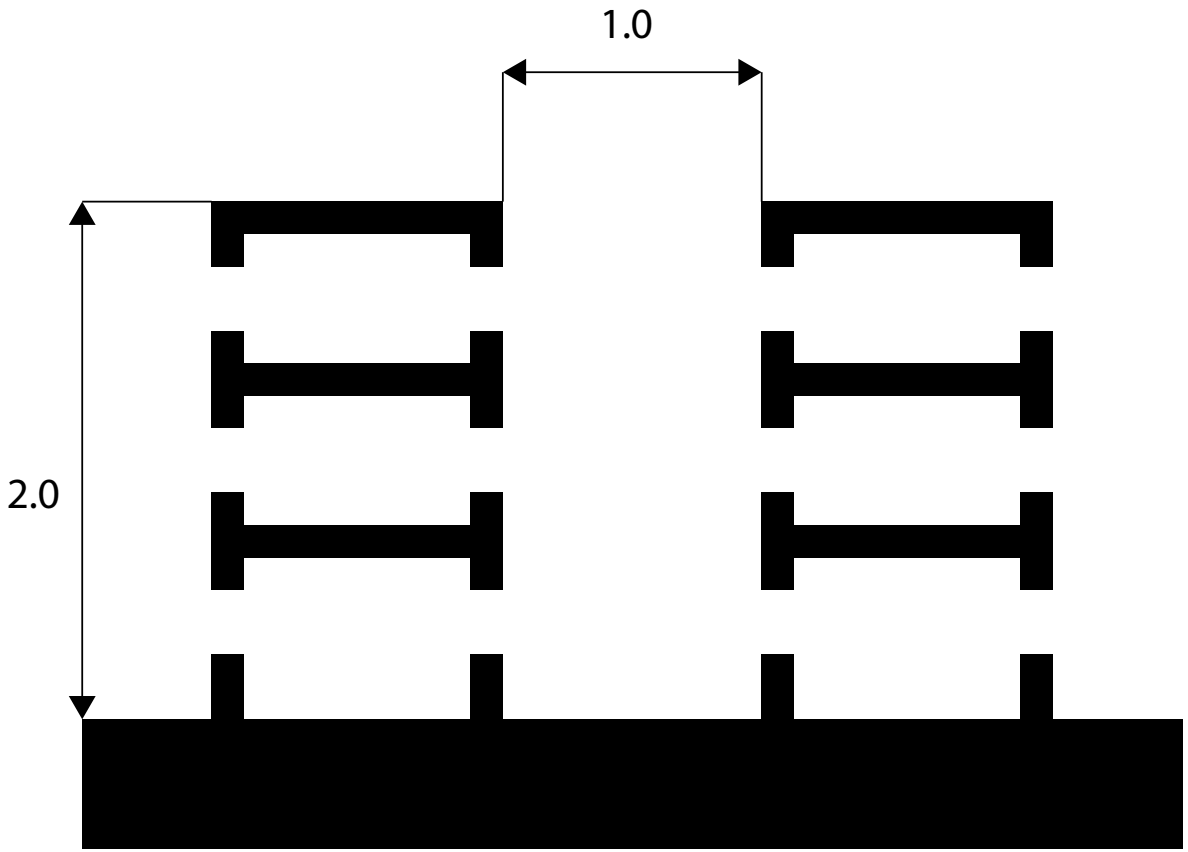
ARCHITECTURAL



LLOYDS BUILDING RICHARD ROGERS

ATRIUM RATIO

Design rule of thumb

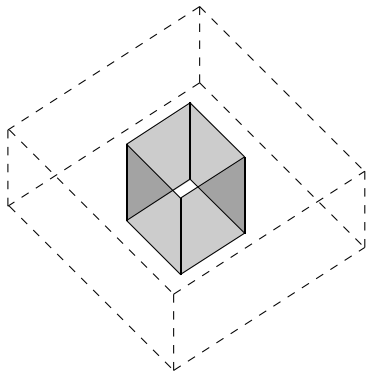


DEFINITION

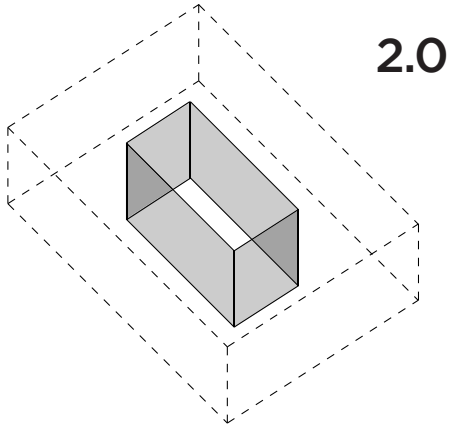
PRINCIPLES

TECHNICAL

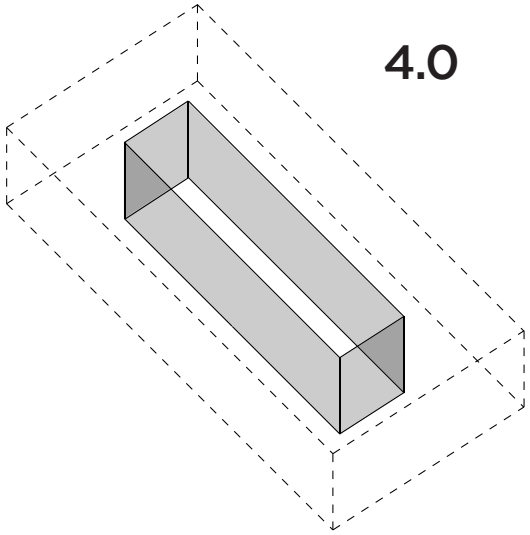
ARCHITECTURAL



1.0



2.0



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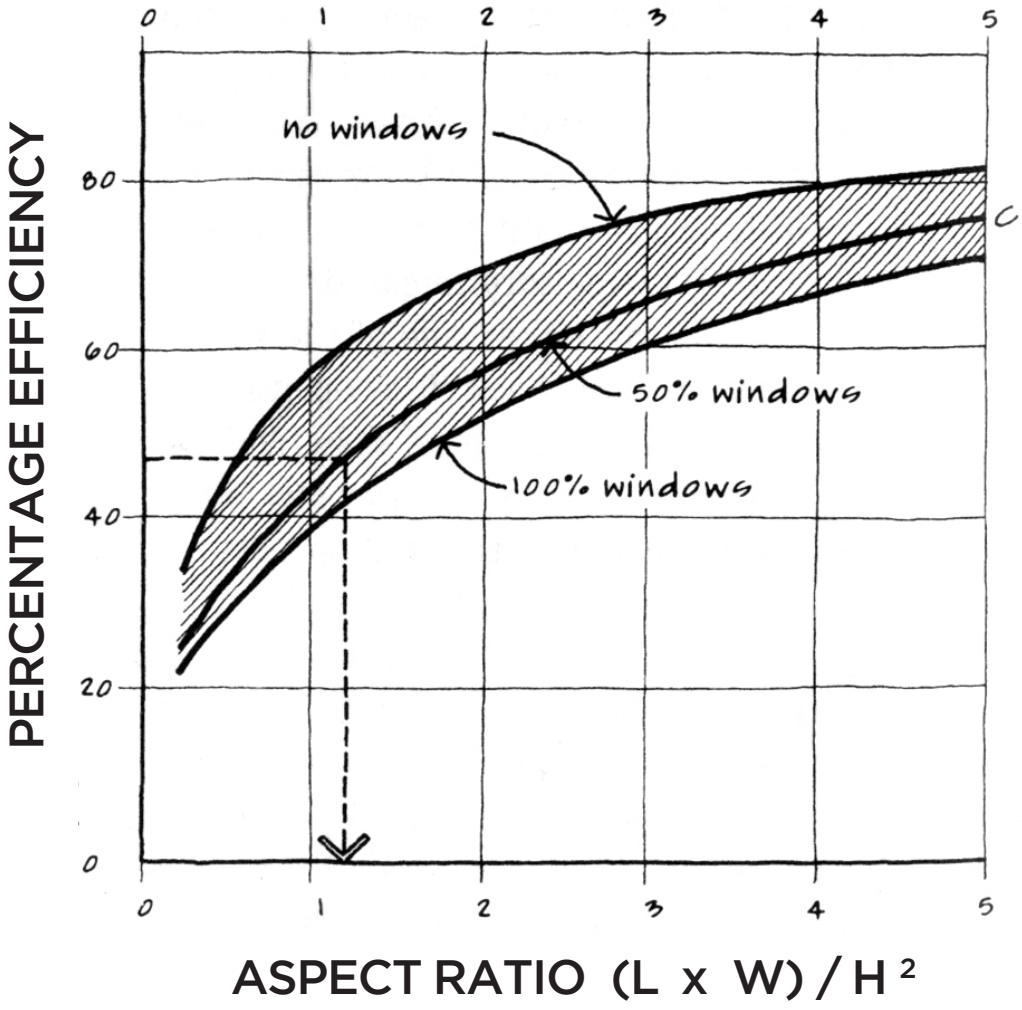
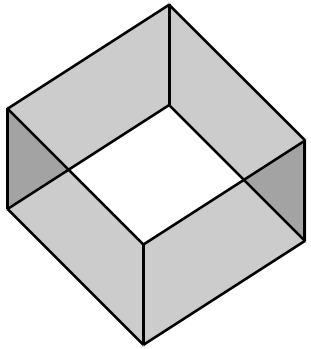
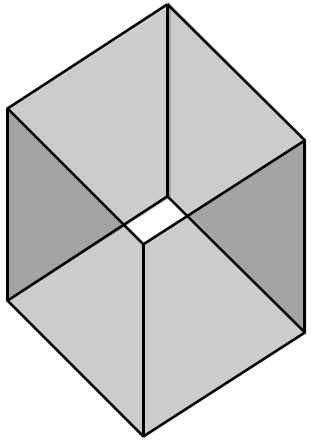
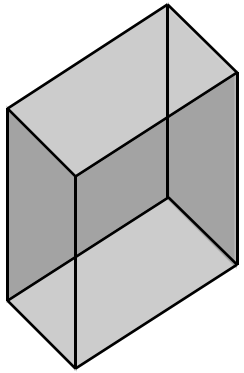




0.25



1.0



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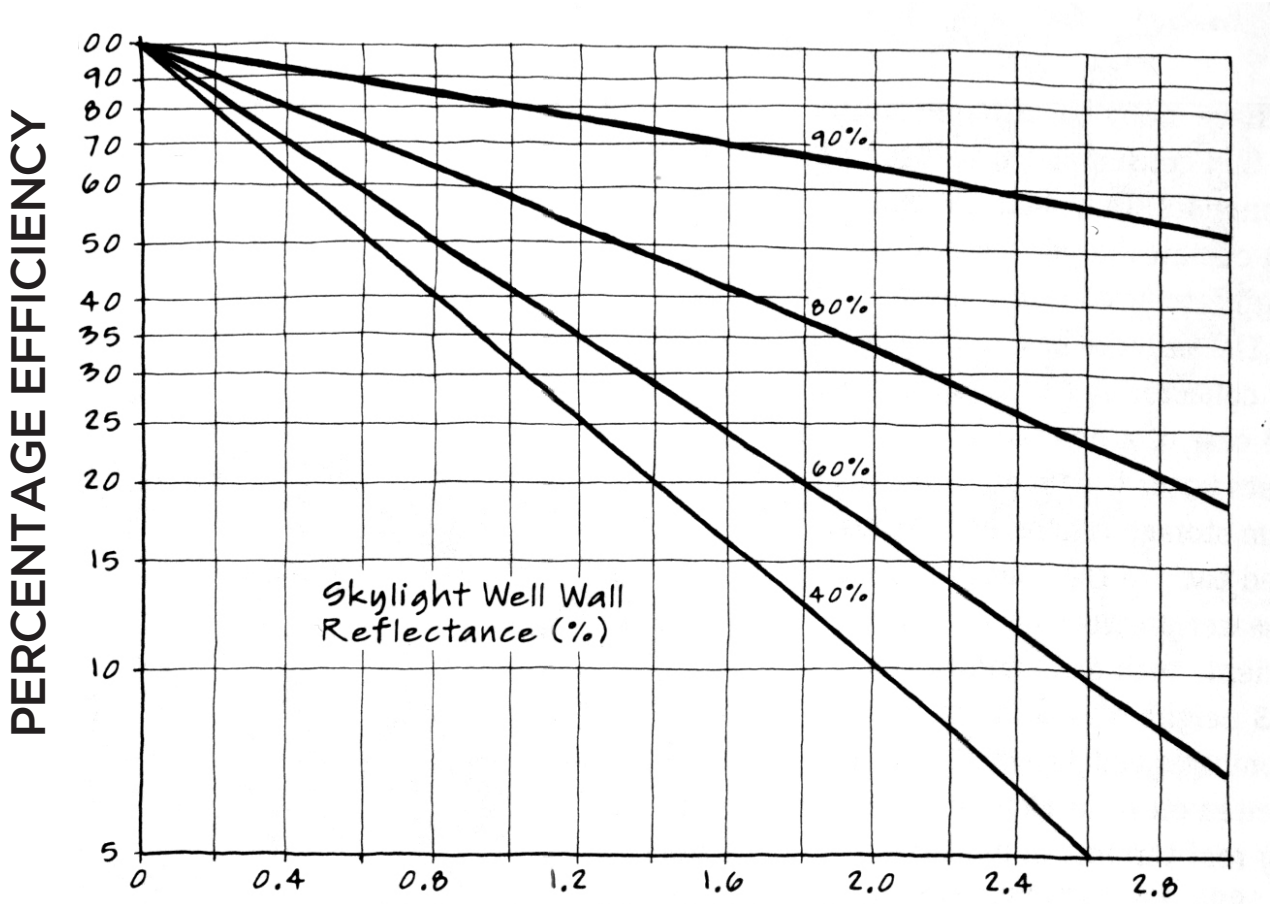
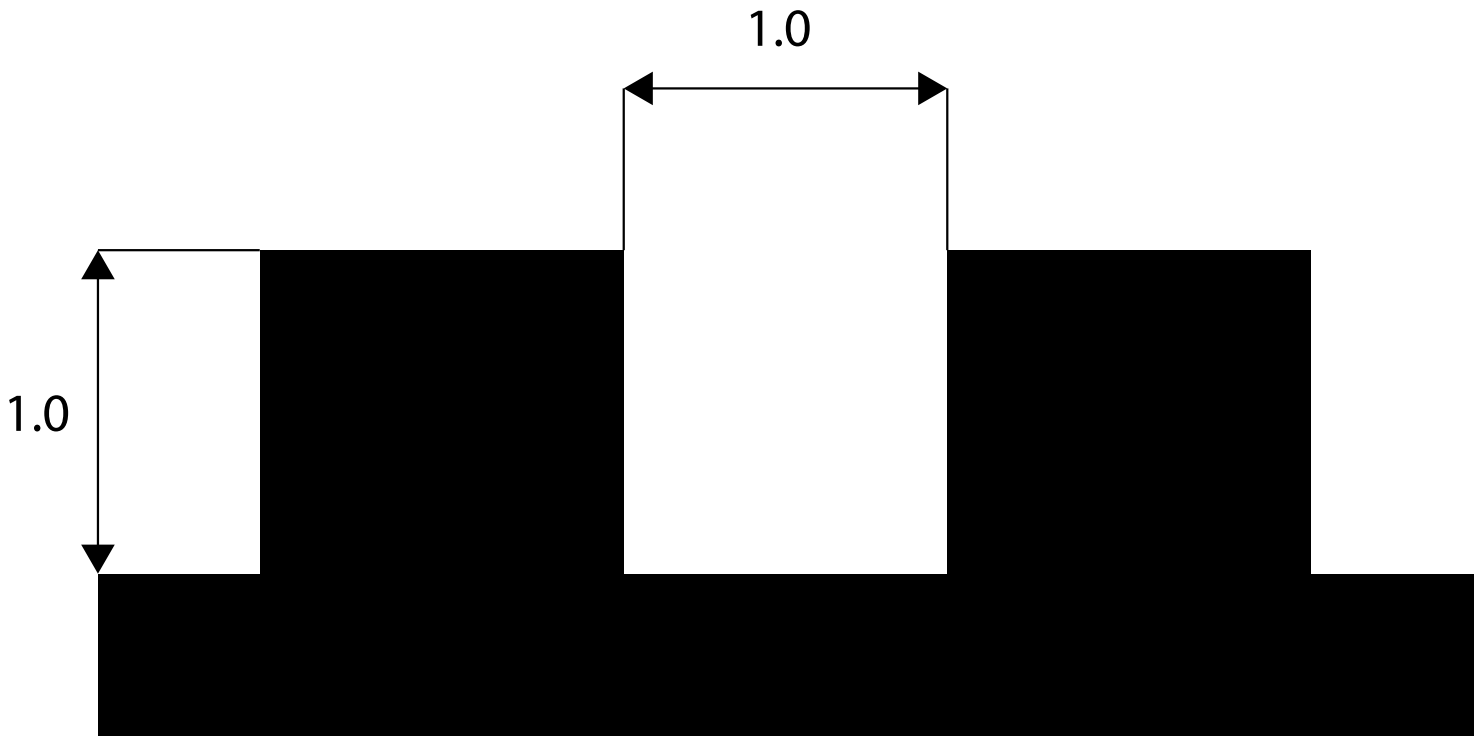


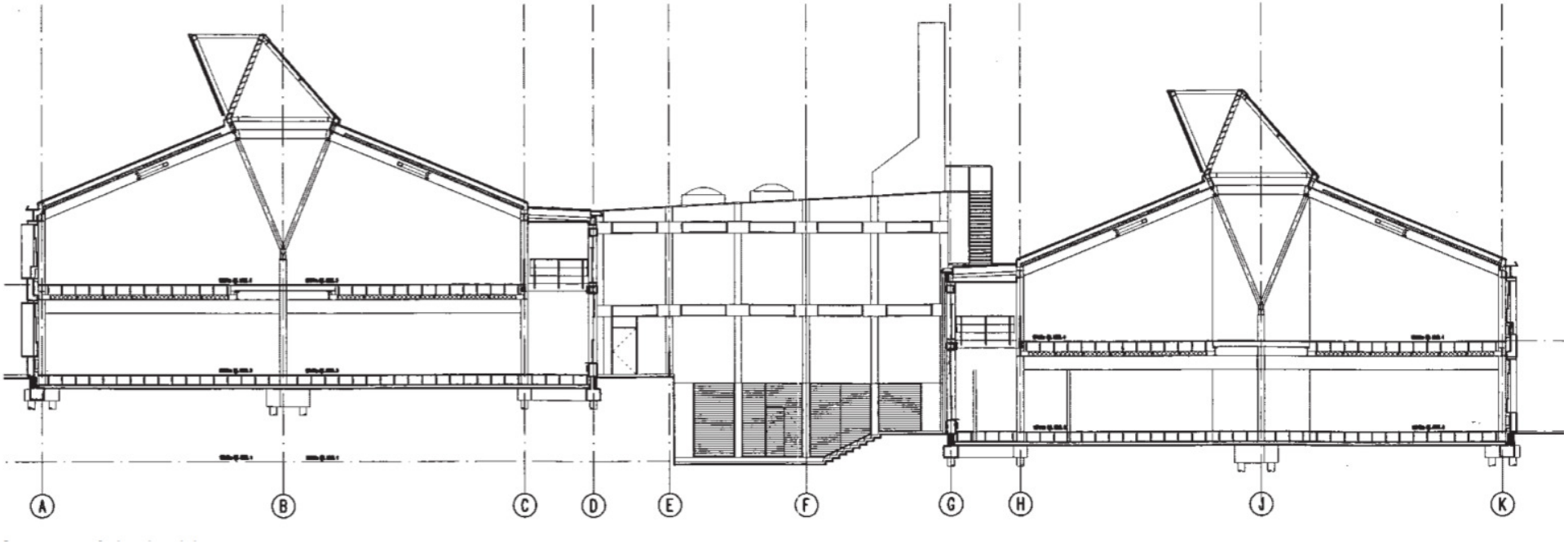
LIGHT WELL INDEX = H (W + L) / (2W x L)

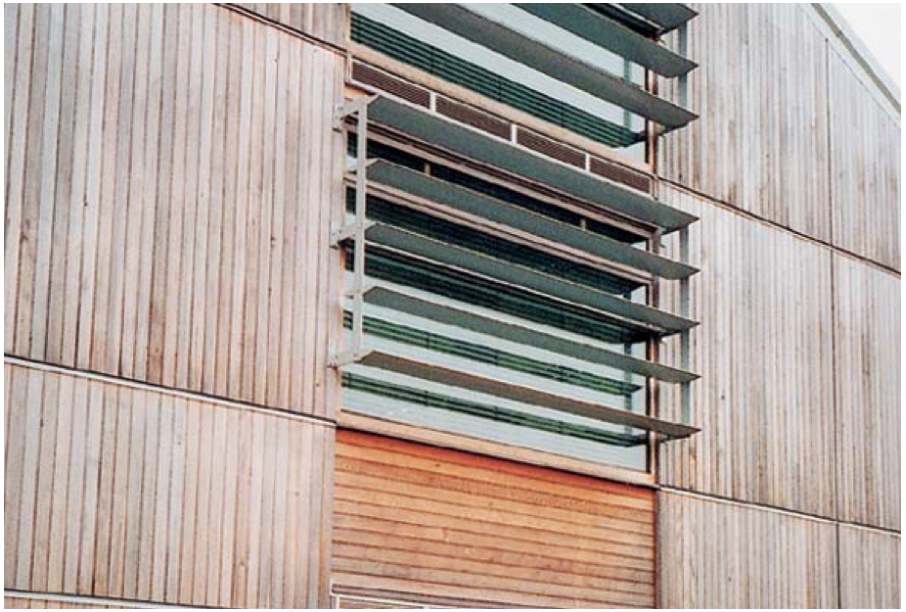
COURTYARD RATIO

Design rule of thumb



ARUP CAMPUS, SOLIHULL





SUNLIGHT

DEFINITION

Sunlight is the term we use to describe direct solar radiation.

We experience this direct radiation as light and radiant heat.

Sunlight falling on Mr. Blundy and the Nottingham H.O.U.S.E.

SUNLIGHT

KEY ISSUES

- Lighting Strategies
- Shading Strategies
- Solar Gains
- Control

SCENARIO

- Calculating the effect of Solar Radiation
- Worst Case Cooling Scenario
- BTU/h, ft^2 or W/m^2

Sunlight falling on Mr. Blundy and the Nottingham H.O.U.S.E.

DEFINITION

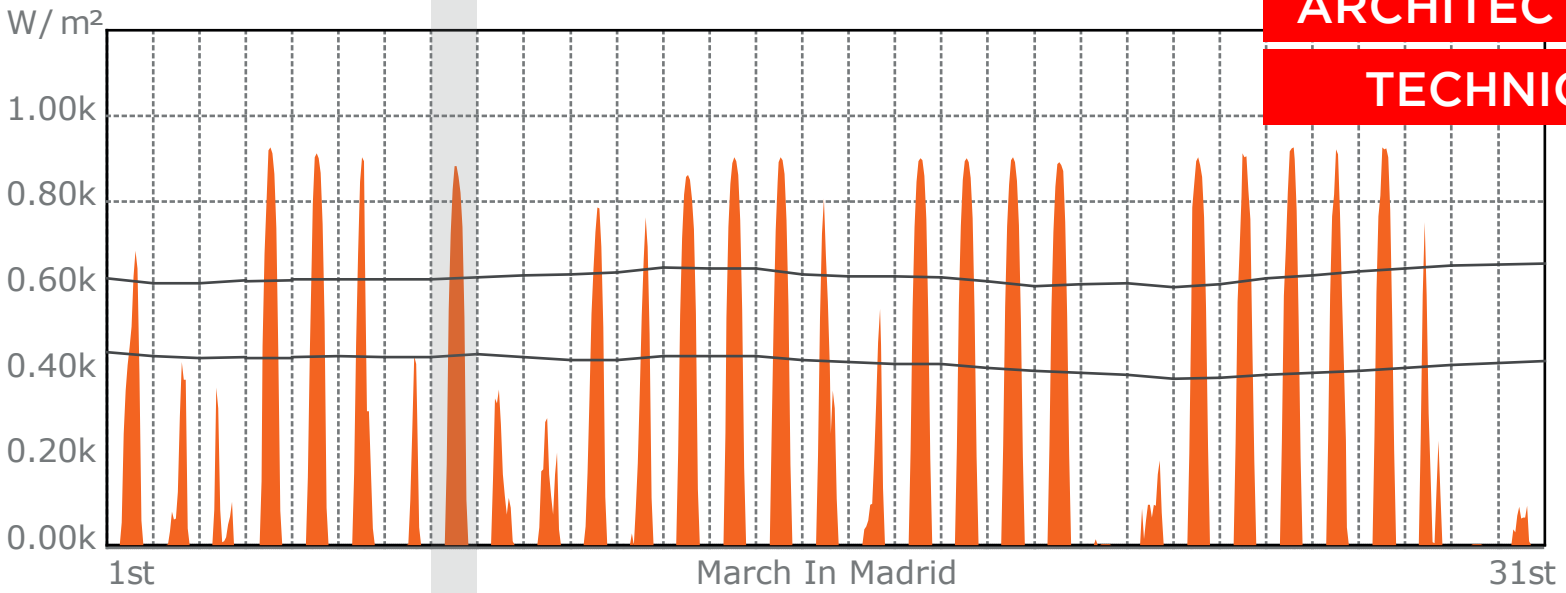
PRINCIPLES

ARCHITECTURAL

TECHNICAL

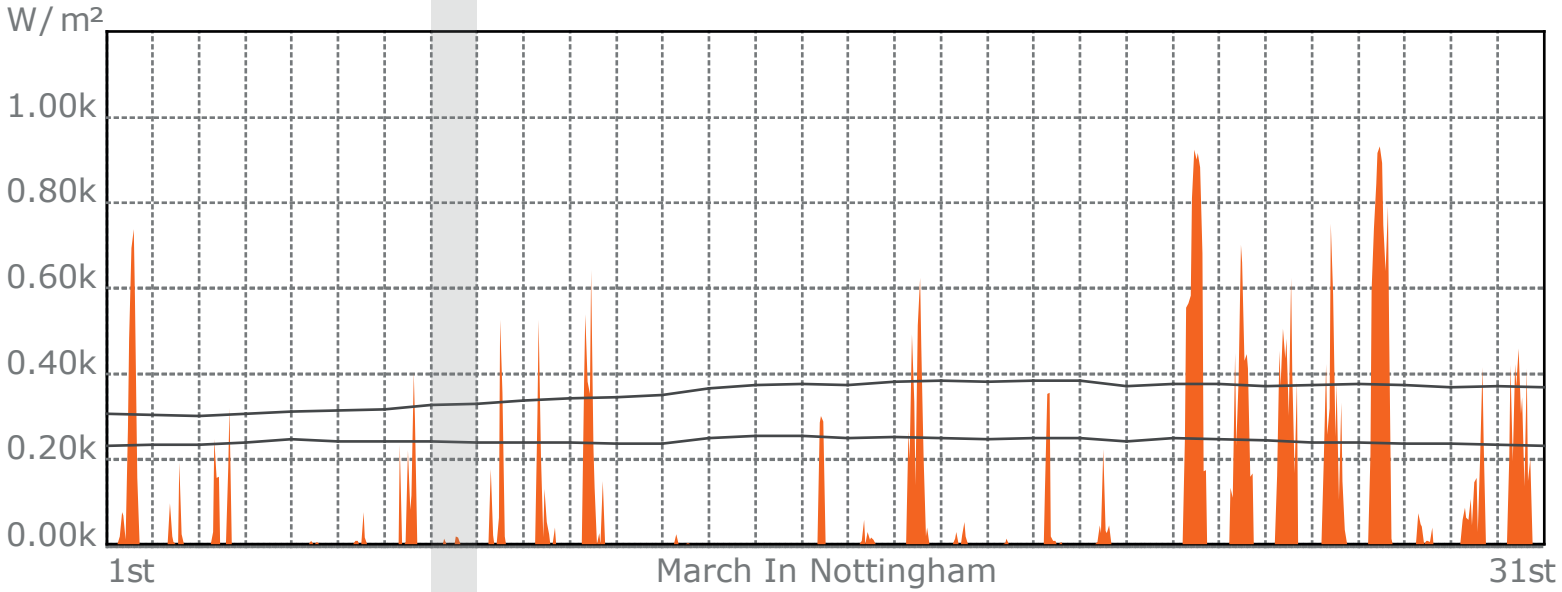
6479
Wh/m²

8.71
W/m²



2735
Wh/m²

3.68
W/m²



DEFINITION

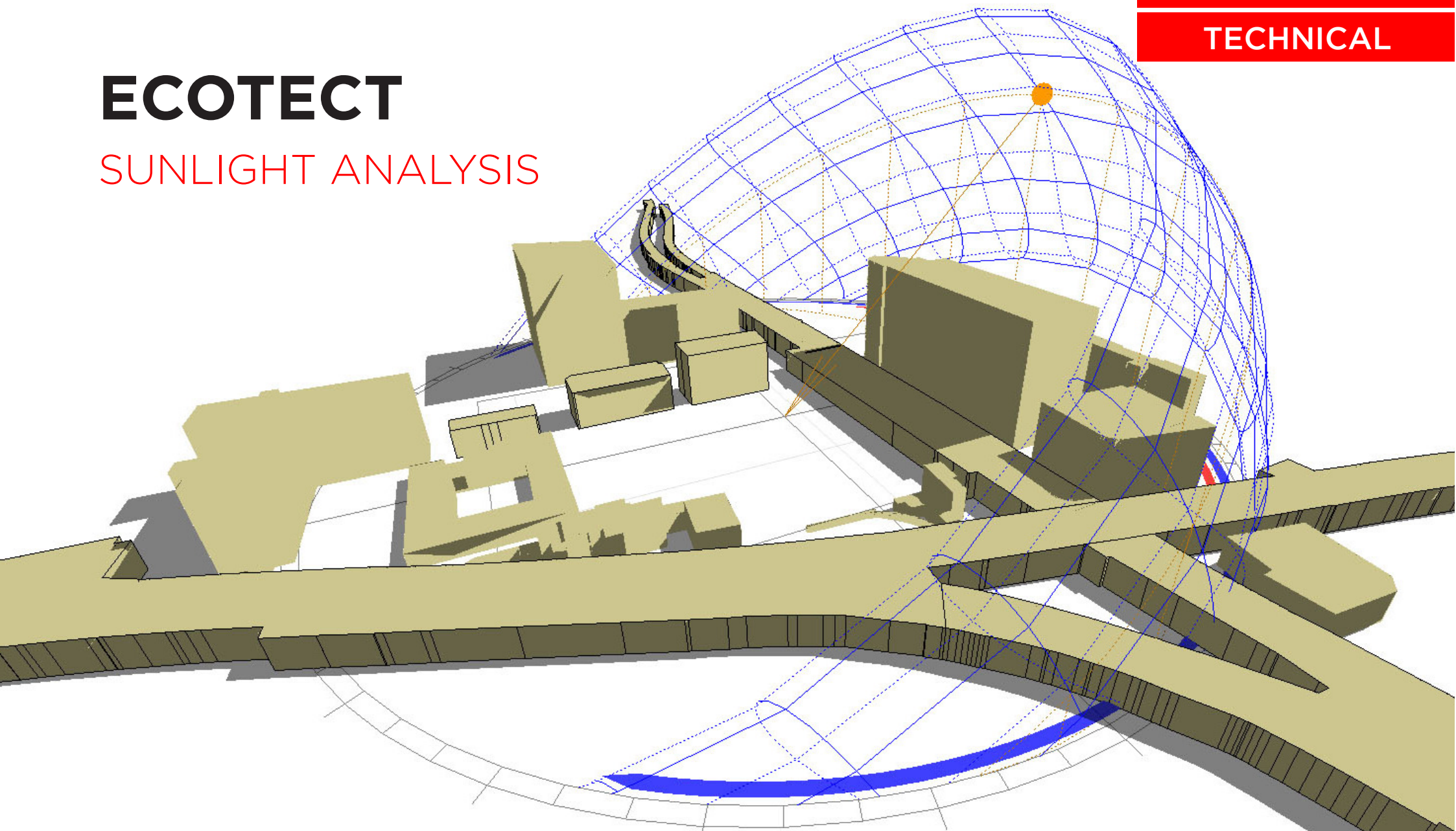
PRINCIPLES

ARCHITECTURAL

TECHNICAL

ECOTECT

SUNLIGHT ANALYSIS



ECOTECT

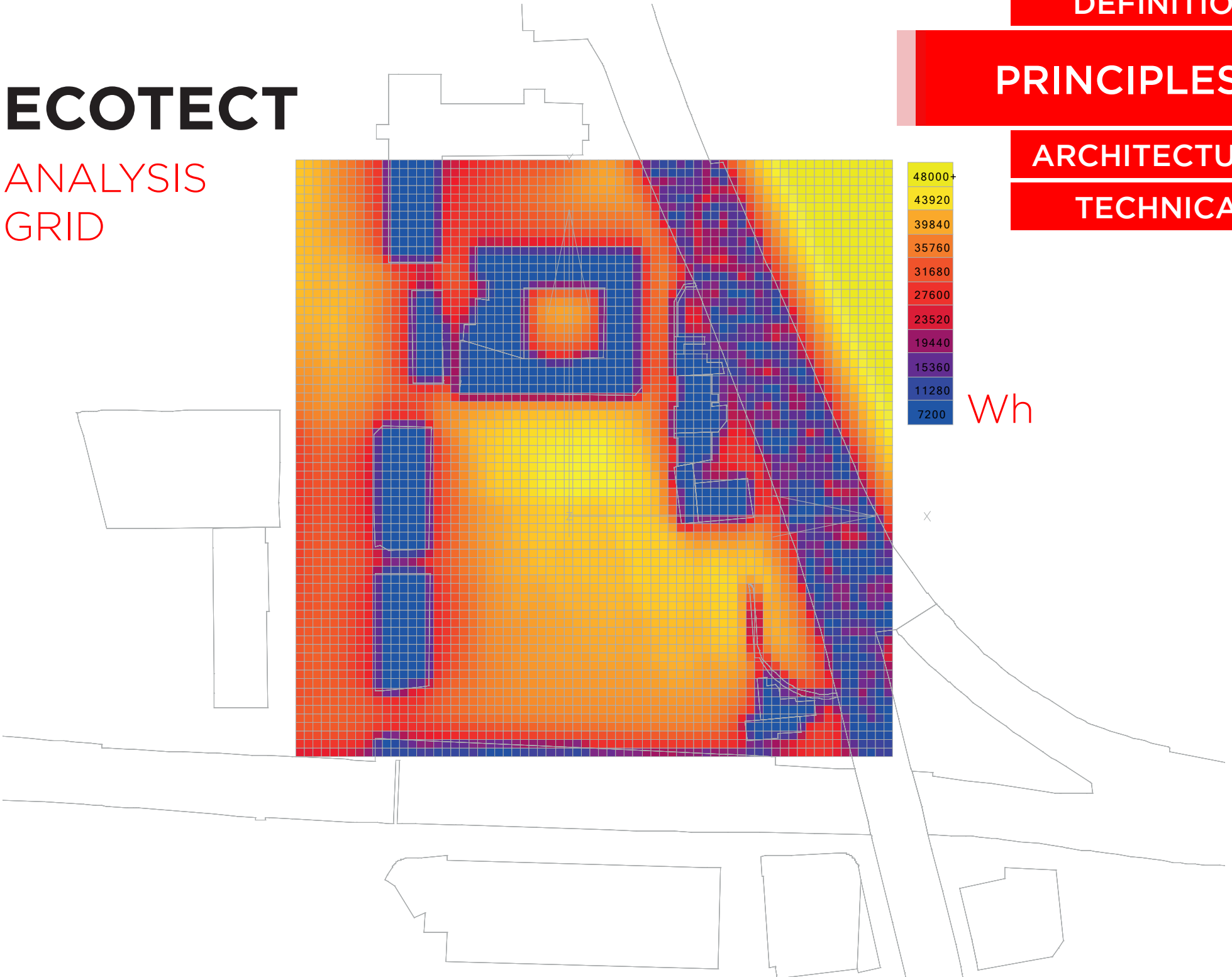
ANALYSIS GRID

DEFINITION

PRINCIPLES

ARCHITECTURAL

TECHNICAL



DEFINITION

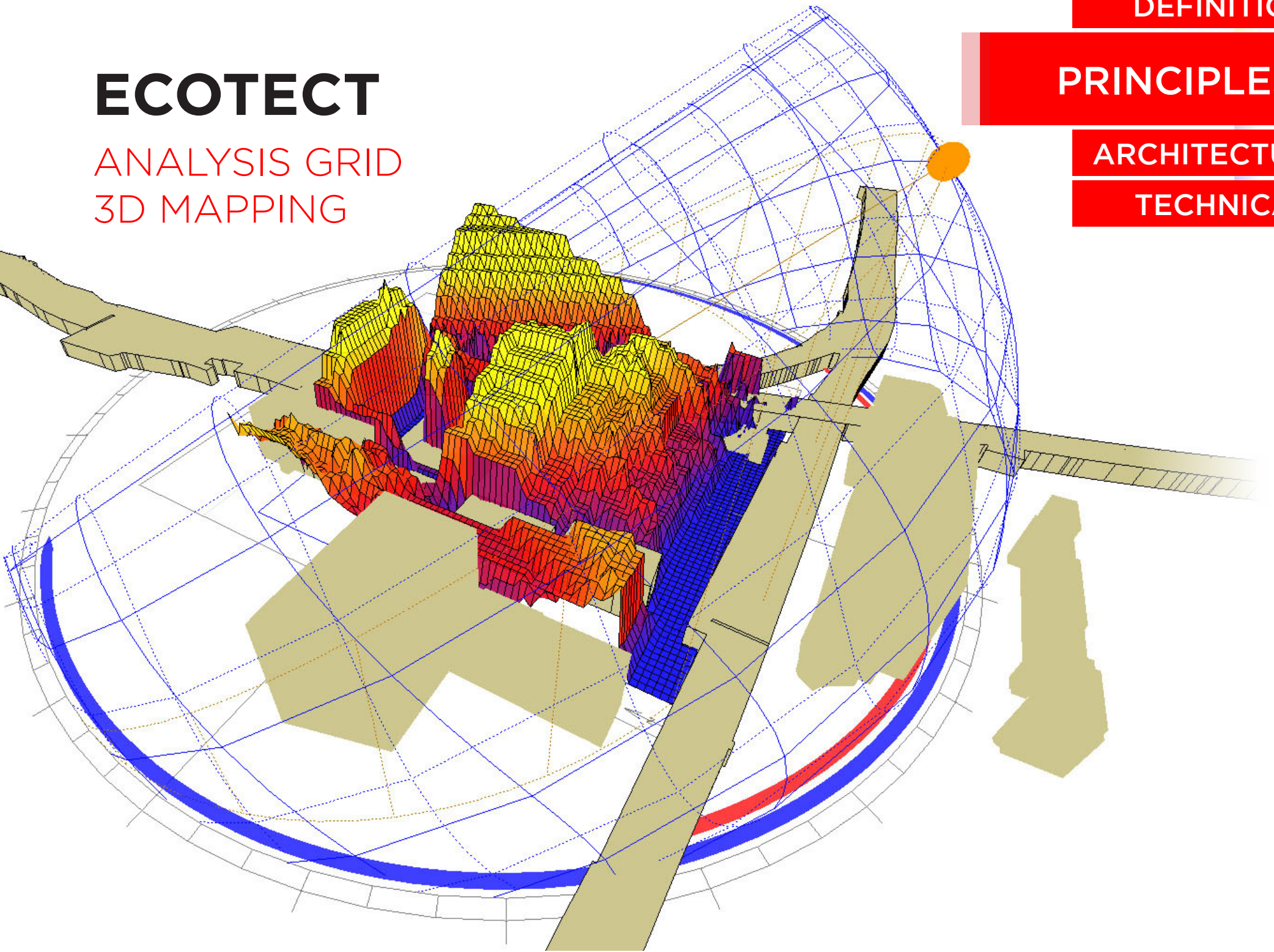
PRINCIPLES

ARCHITECTURAL

TECHNICAL

ECOTECT

ANALYSIS GRID
3D MAPPING



SOLAR RADIATION

CALCULATING GAINS

- Orientation and Slope
- Time Period
- Time of the Year
- Location

- Solar Radiation From Ecotect
- Apertures' Area
- Glazing Coefficient (0.65)
- Shading Coefficient

Monthly Average Irradiance (W/m^2)

Month	N	NE	E	SE	S	SW	W	NW	Horiz
Jan	7	7	14	26	30	20	10	7	22
Feb	13	14	24	40	45	33	19	13	44
Mar	20	26	42	57	59	46	31	22	73
Apr	36	45	61	74	77	72	59	43	132
May	48	54	80	83	77	79	73	57	167
June	52	71	87	84	73	75	71	58	178
July	49	65	80	80	73	79	76	60	175
Aug	38	55	75	83	79	76	66	49	153
Sept	27	34	49	63	70	64	48	32	102
Oct	16	19	33	49	54	41	25	17	57
Nov	9	9	16	30	36	27	13	9	30
Dec	5	5	9	23	28	20	7	5	16

CANVAS AWNING

0.20 - 0.35
SHADING
COEFFICIENT

OVERHANG

0.20 - 0.50
SHADING
COEFFICIENT

LOUVRES

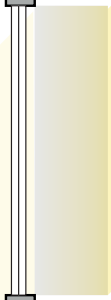
0.10 - 0.15
SHADING
COEFFICIENT

ADJUSTED LOUVRES

0.10 - 0.15
SHADING
COEFFICIENT

VERTICAL FINS

0.10 - 0.30
SHADING
COEFFICIENT

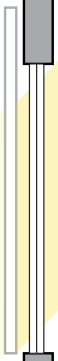


LIGHT SHELF

0.39 - 0.81
SHADING
COEFFICIENT

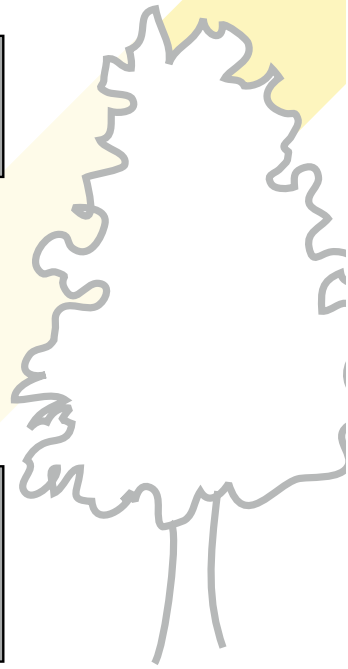
INTERNAL BLINDS

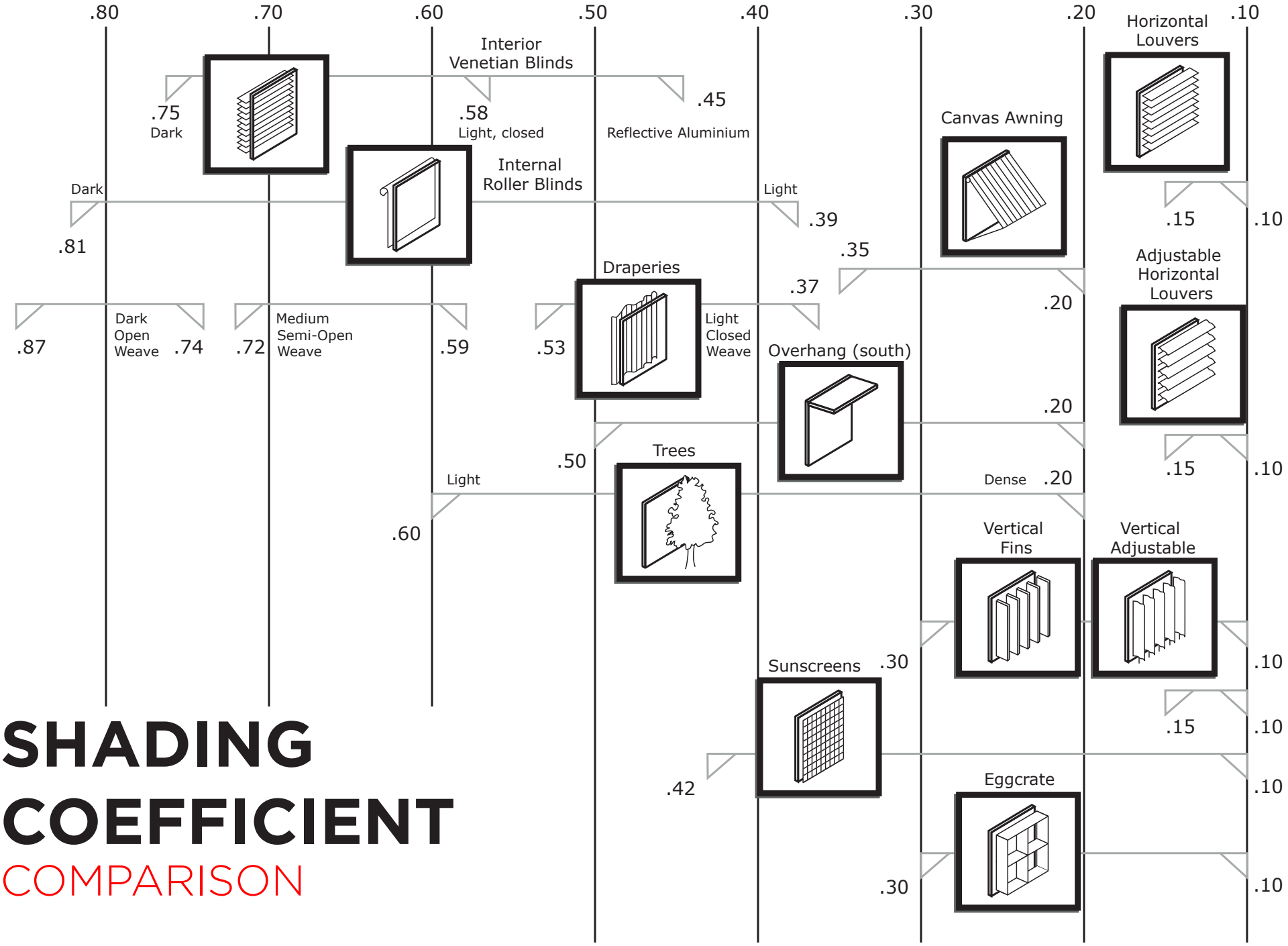
0.39 - 0.81
SHADING
COEFFICIENT



TREES

0.20 - 0.60
SHADING
COEFFICIENT





SHADING COEFFICIENT

COMPARISON

REICHSTAG RECONSTRUCTION

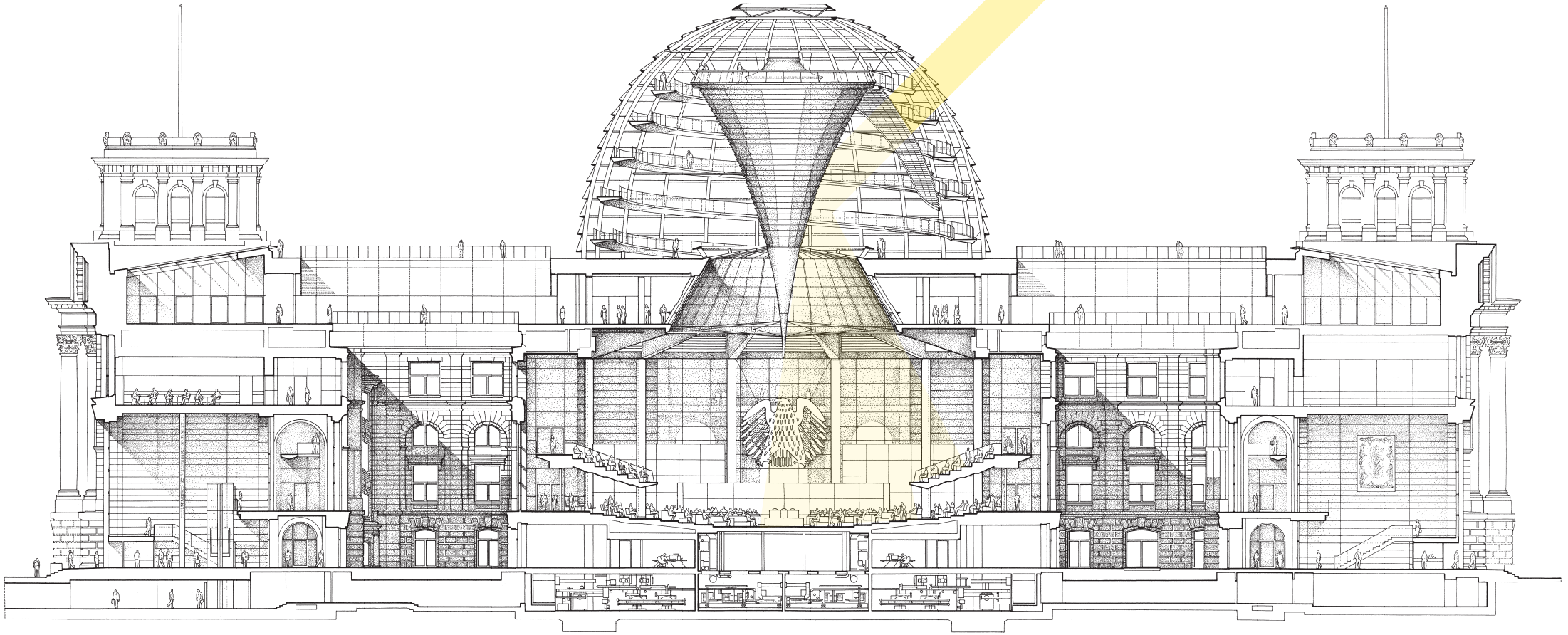
FOSTER + PARTNERS

DEFINITION

PRINCIPLES

ARCHITECTURAL

TECHNICAL

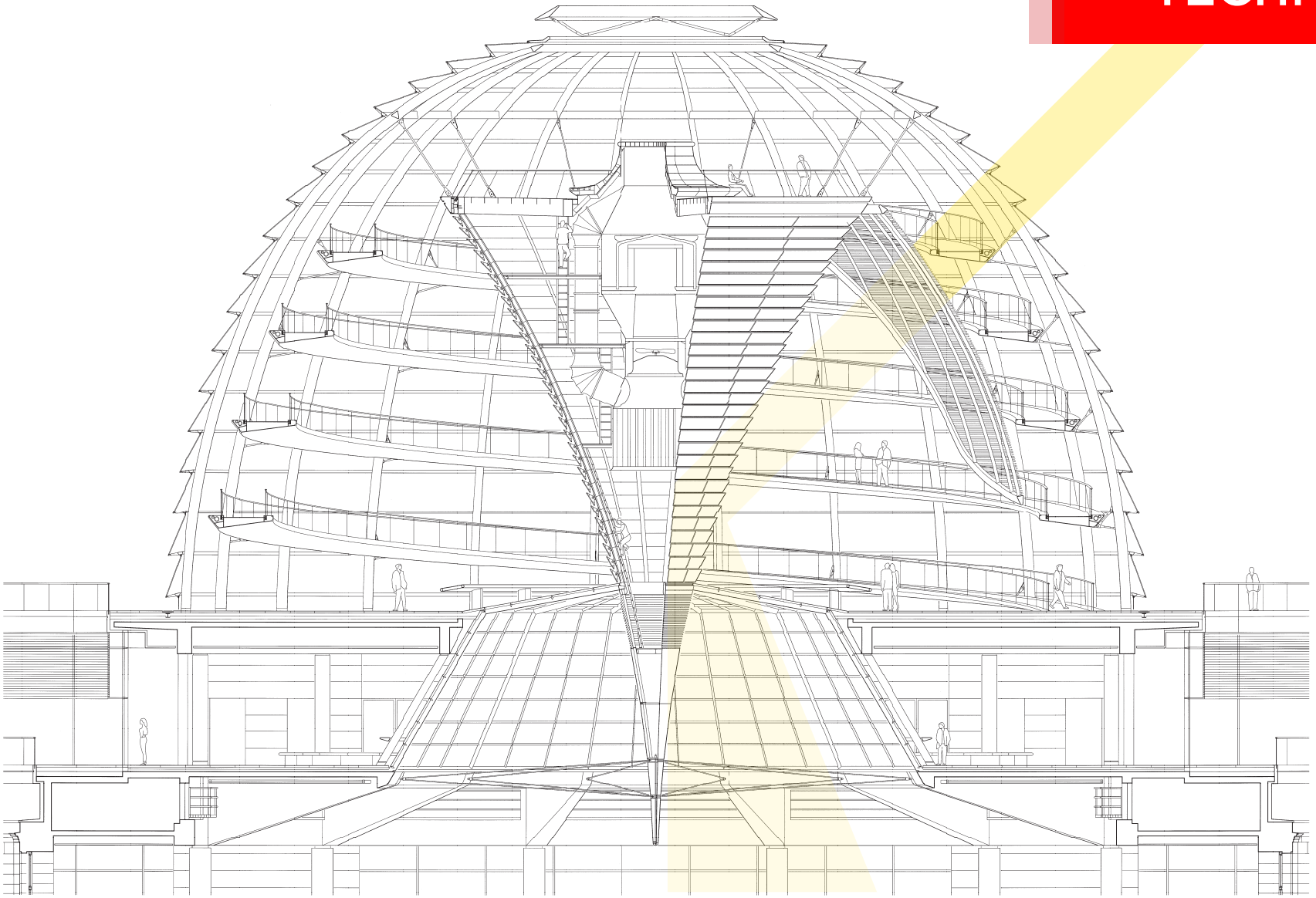


DEFINITION

PRINCIPLES

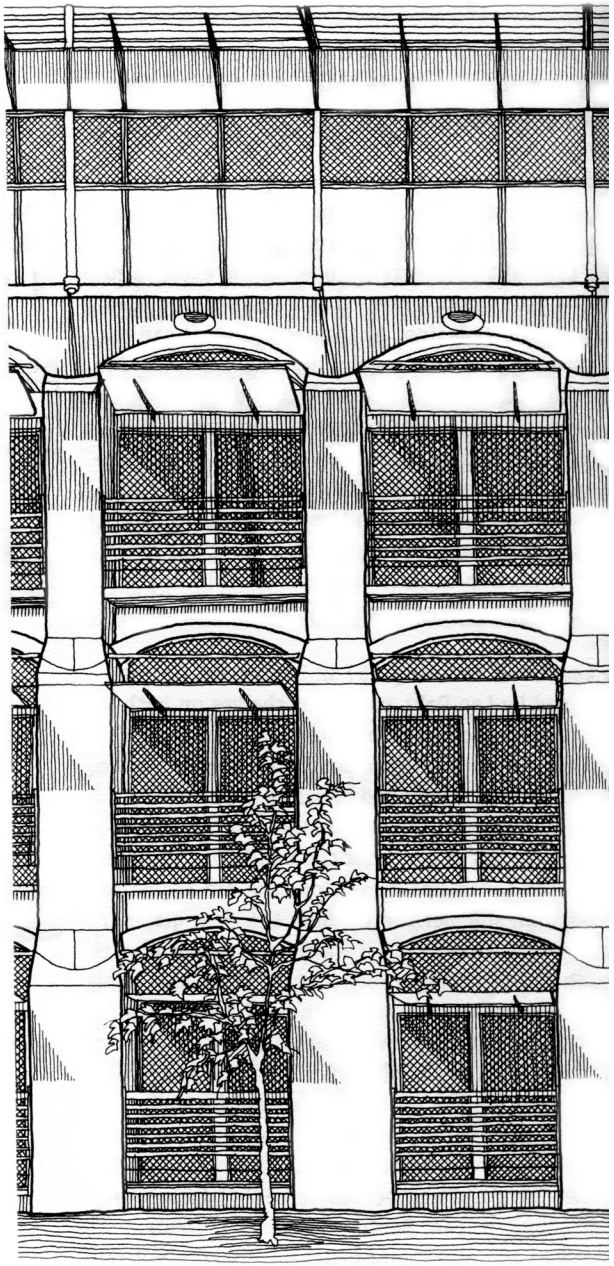
ARCHITECTURAL

TECHNICAL



NOTTINGHAM INLAND REVENUE CENTRE

HOPKINS ARCHITECTS

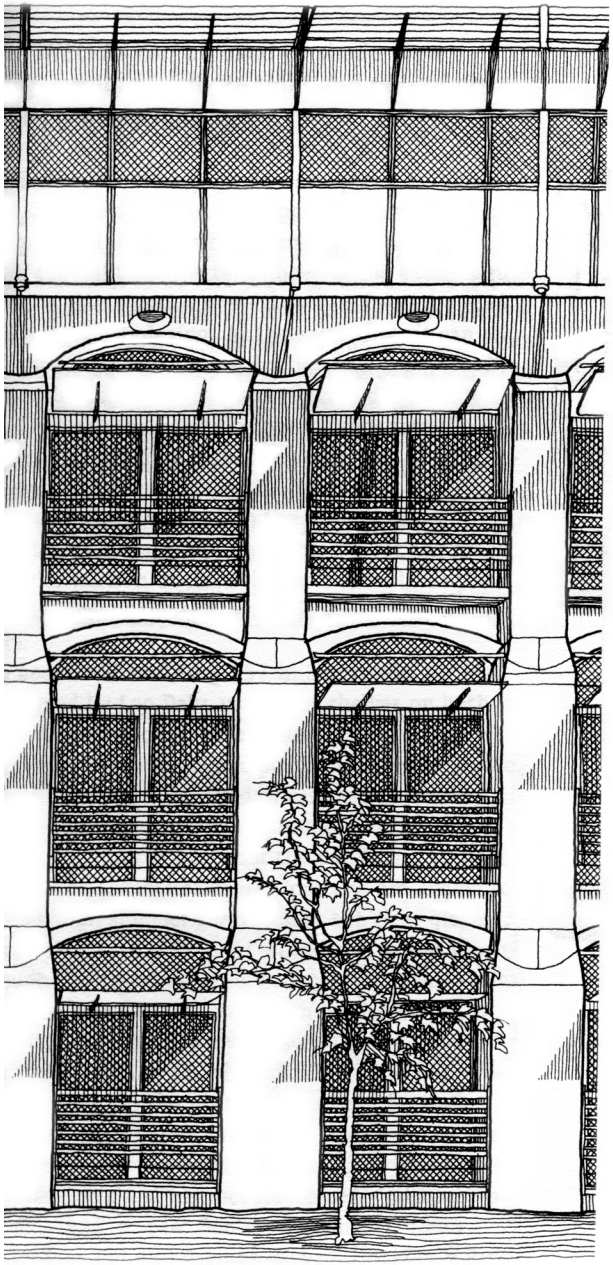


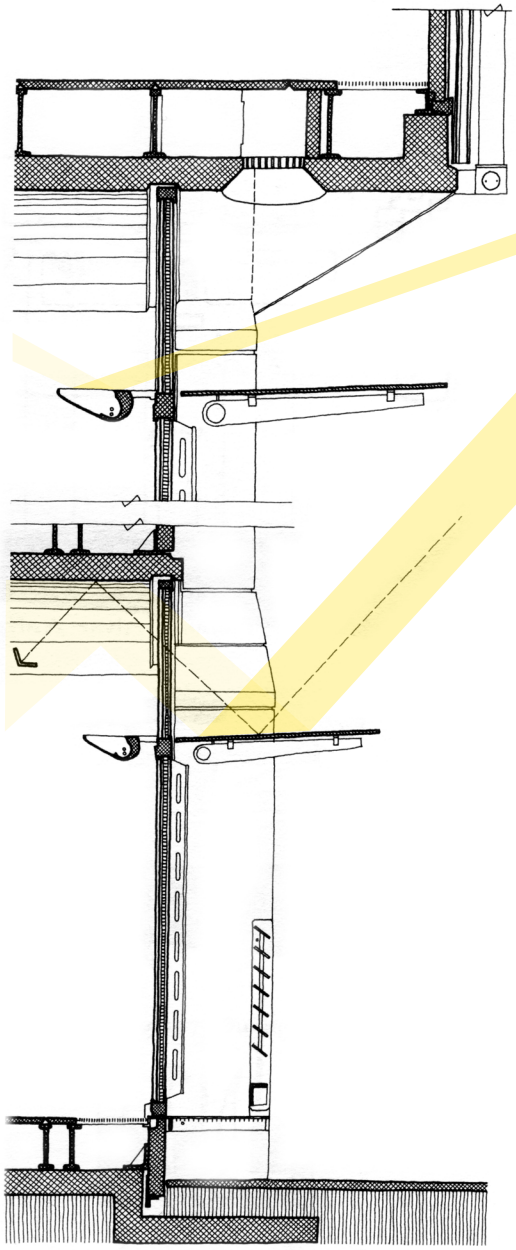
DEFINITION

PRINCIPLES

ARCHITECTURAL

TECHNICAL





PASSIVE SOLAR DESIGN

DEFINITION

In passive solar design, the architecture is orchestrated to best control and harness heat energy provided naturally by the sun, in order to replace active space heating solutions.

The building fabric is instrumental in the process of collecting, storing and distributing this heat energy.

DEFINITION

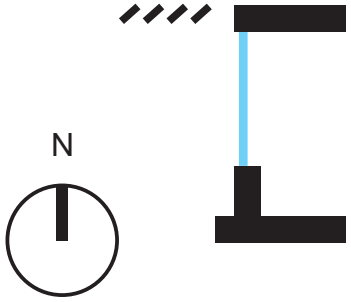
PRINCIPLES

ARCHITECTURAL

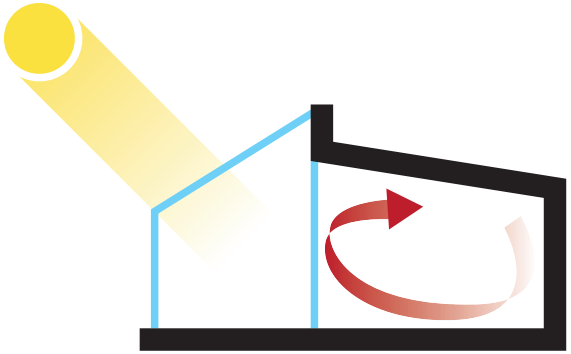
TECHNICAL

1.

RADIATION

2. 

CONTROL ENTRY

3. 

CAPTURE, STORE, RELEASE, HARNESS

DEFINITION

PRINCIPLES

ARCHITECTURAL

TECHNICAL

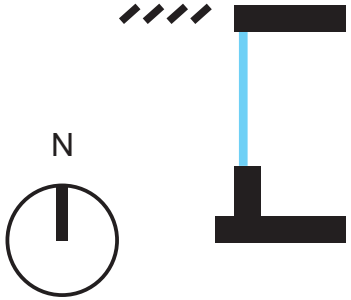
1.

RADIATION

NATURAL

- The UK gets 2.9 KWh/m^2/day

2.

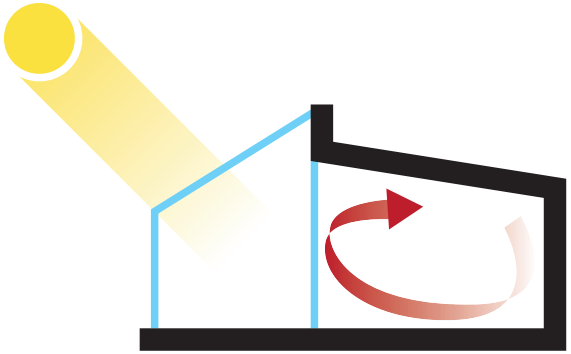


CONTROL ENTRY

SUNLIGHT

- Orientation/Overshadowing
- Apertures
- Shading Devices

3.



CAPTURE, STORE, RELEASE, HARNESS

CAPTURE

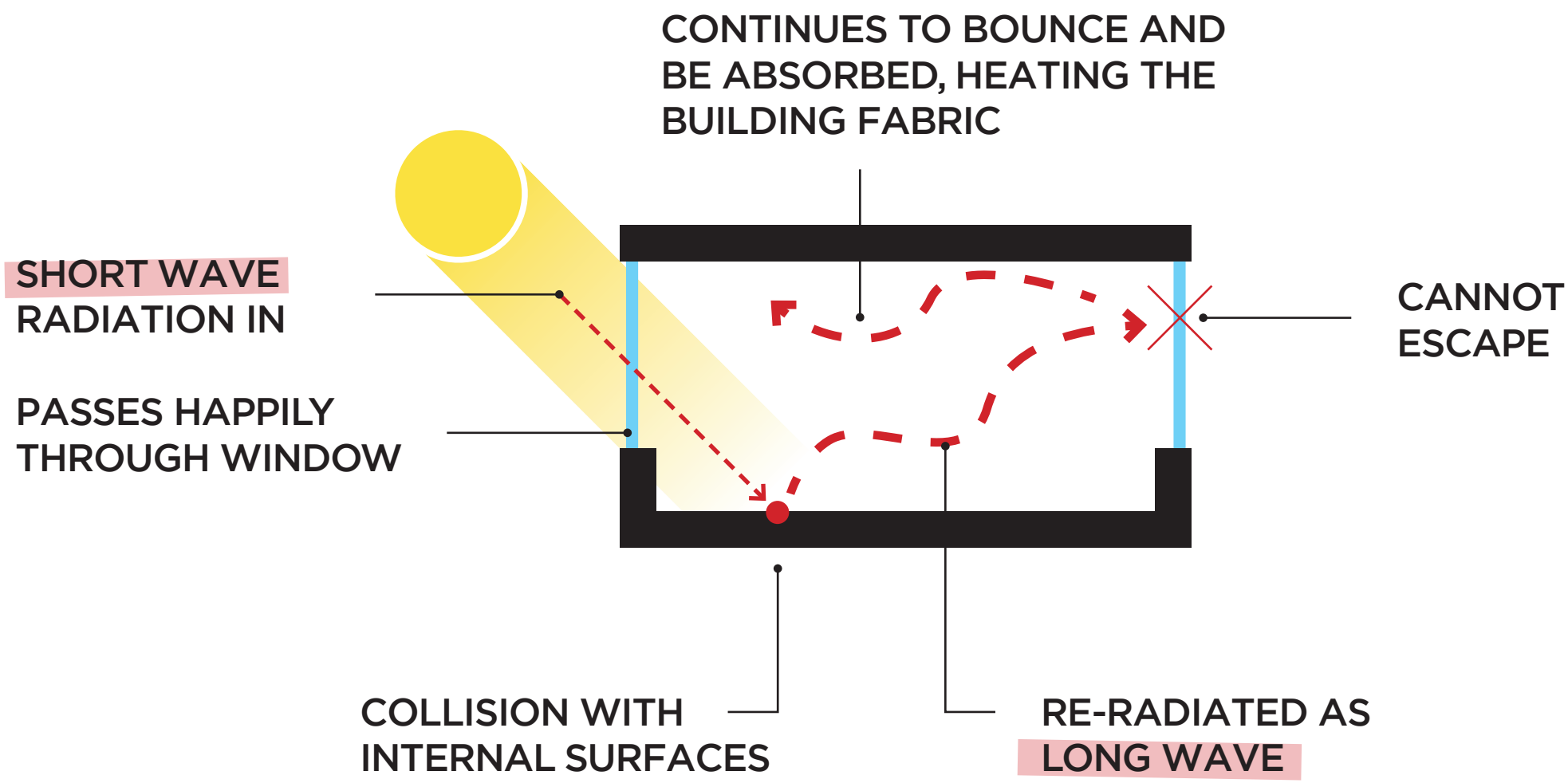
DIRECT SOLAR RADIATION

To capture solar radiation for use as space heating, we require access to **direct** sunlight. The energy potential in indirect light is negligible and insufficient for space heating.

We can capture solar radiation energy through glazed openings and —to a lesser extent— though solid elements of the building fabric.

HOW WE CAPTURE. WHY IT WORKS.

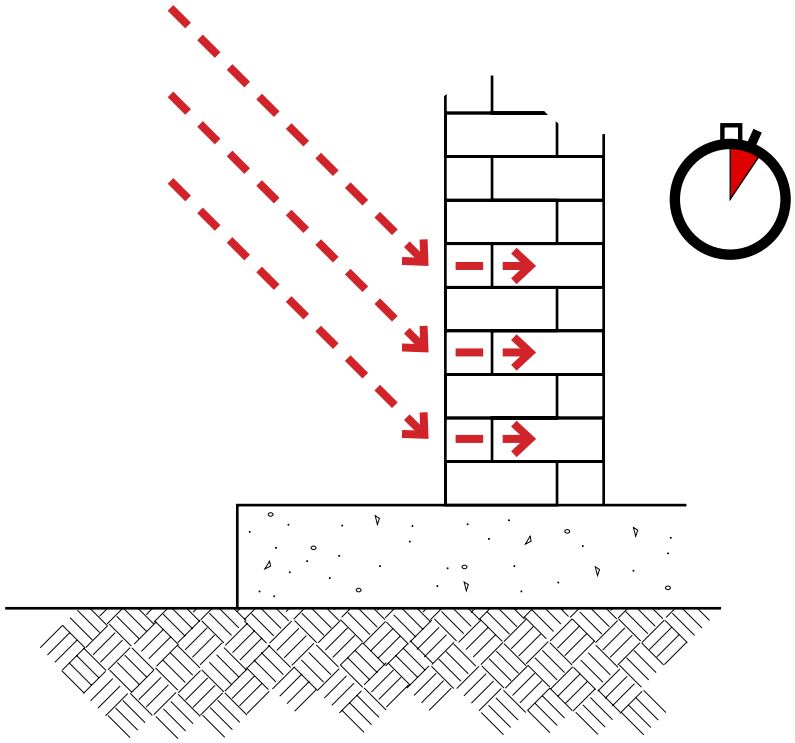
[THROUGH GLASS]



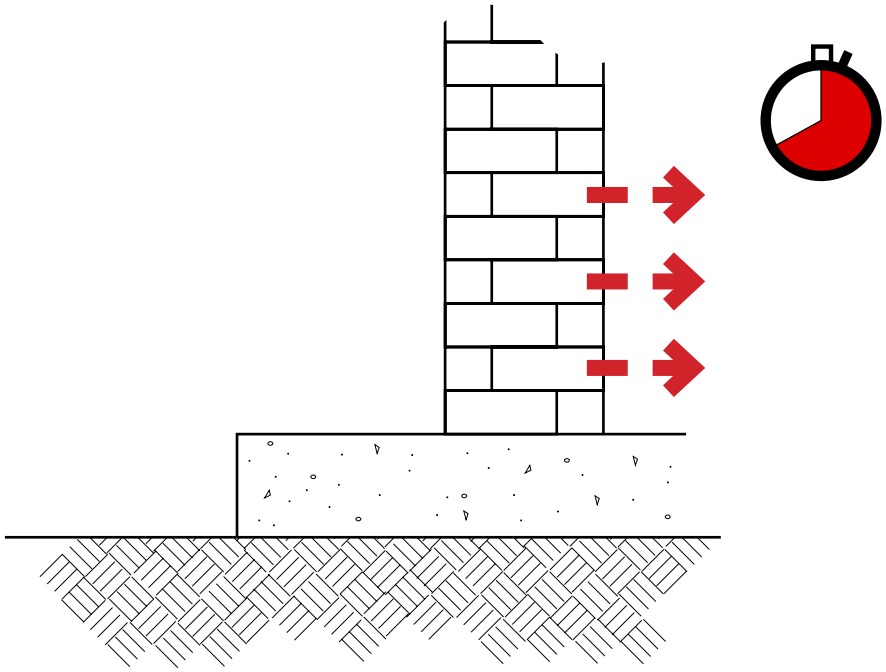
HOW WE CAPTURE. WHY IT WORKS.

[THROUGH SOLID ELEMENTS]

SHORT WAVE
RADIATION ABSORBED

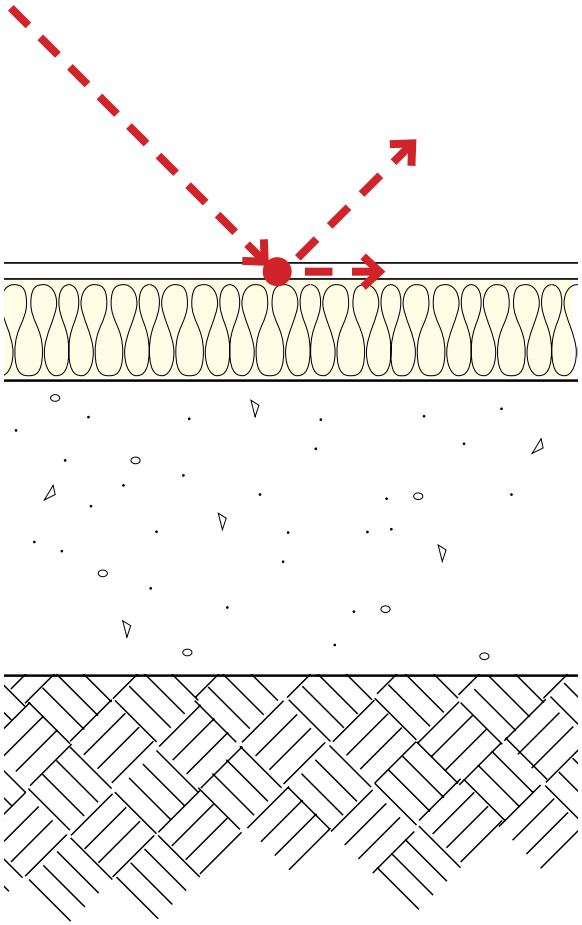


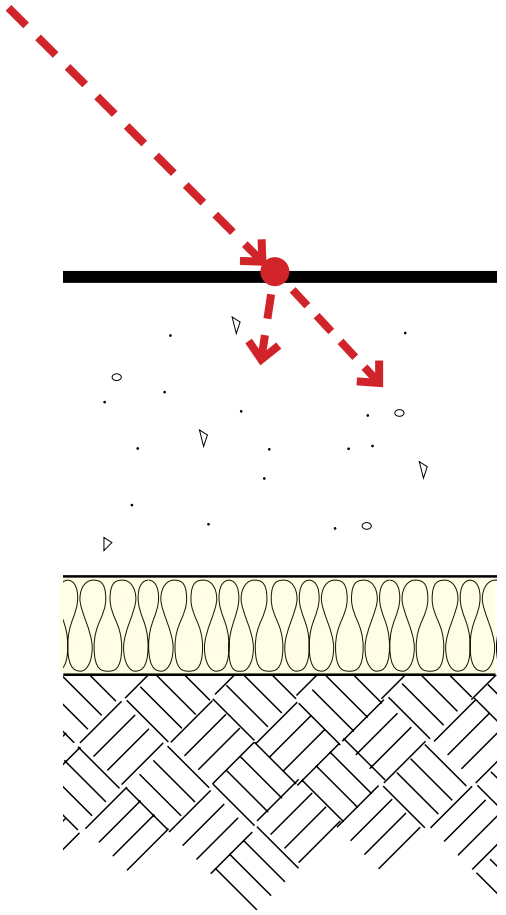
MITIGATES TROUGH SECTION,
RE-RADIATED AS LONG WAVE



HOW WE CAPTURE. WHY IT WORKS.

[INSULATION PLACEMENT]



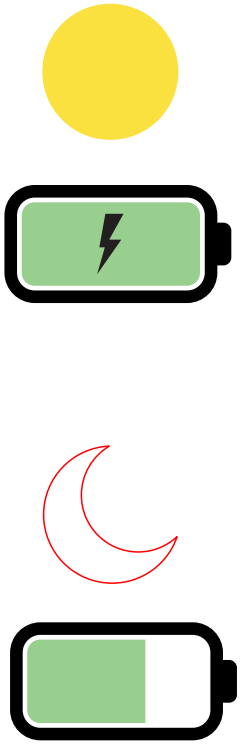


STORE/RELEASE

THERMAL MASS

After capture, the heat energy needs to be stored for later release. This is achieved using thermally massive elements.

Whether a material is thermally massive or not depends on a balance of physical properties.



HOW THERMAL MASS WORKS.

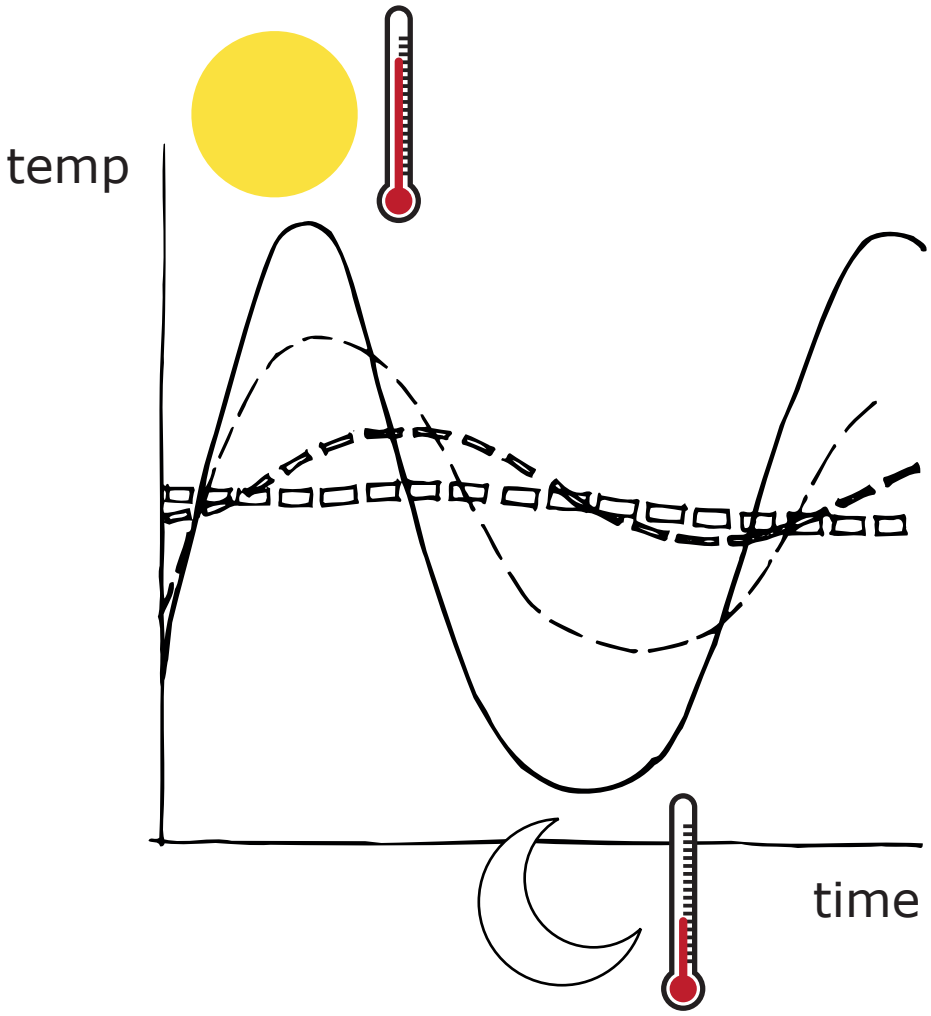
Thermal mass works because of the following basic principle of physics; **heat moves from warmer surfaces to cooler surfaces**.

When direct solar radiation enters a room and it's surfaces are colder than the air temperature, the heat is absorbed by said surfaces.

How much energy they store depends on their specific heat capacity.

How effective they are as part of a passive solar design depends on a **balance of their specific heat capacity and conductivity**. (Case in point, metal… Very high SHC but useless as thermal mass in building design because of quick transfer of energy)

WHY WE NEED TO STORE THE ENERGY.



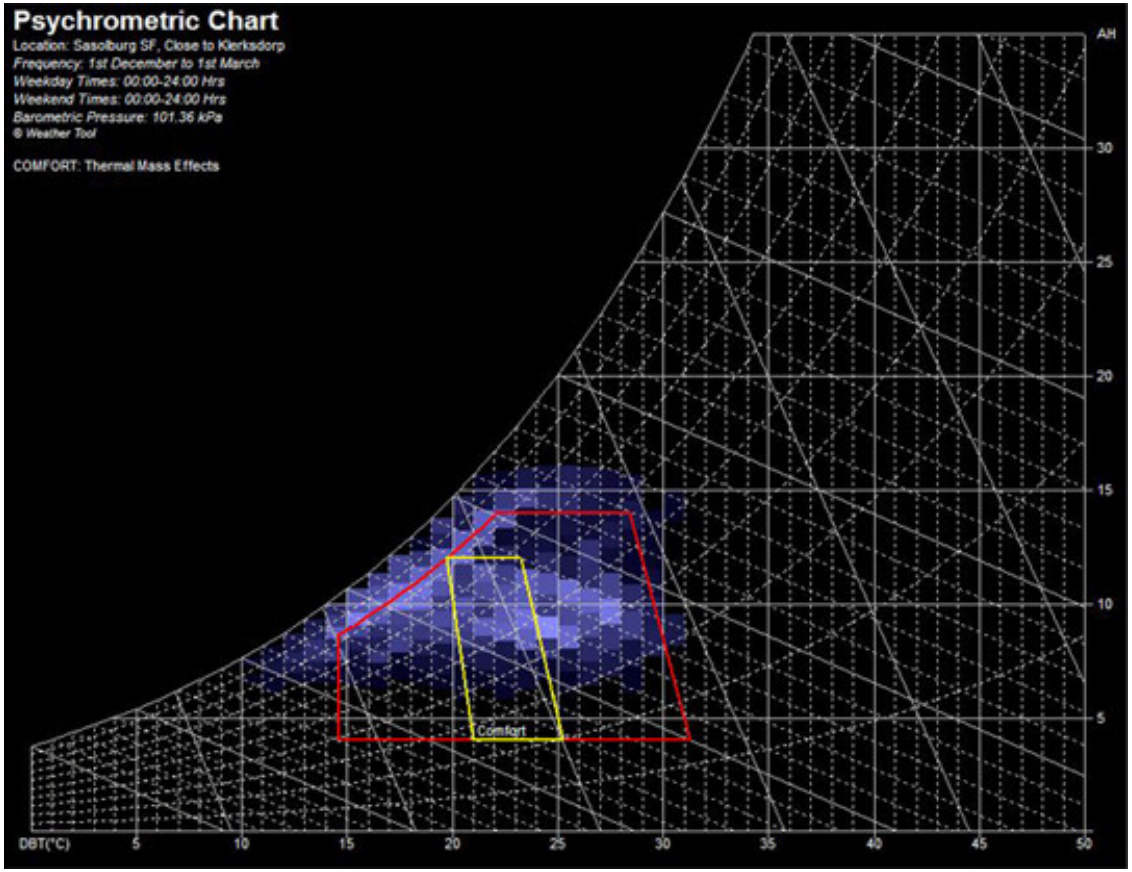
Outdoor Temp

Light Timber-Framed Building

Heavy Building, External Insulation

Heavy Building, Partially Covered With Earth

WHY WE NEED TO STORE THE ENERGY.



HOCKERTON HOUSING

CASE STUDY

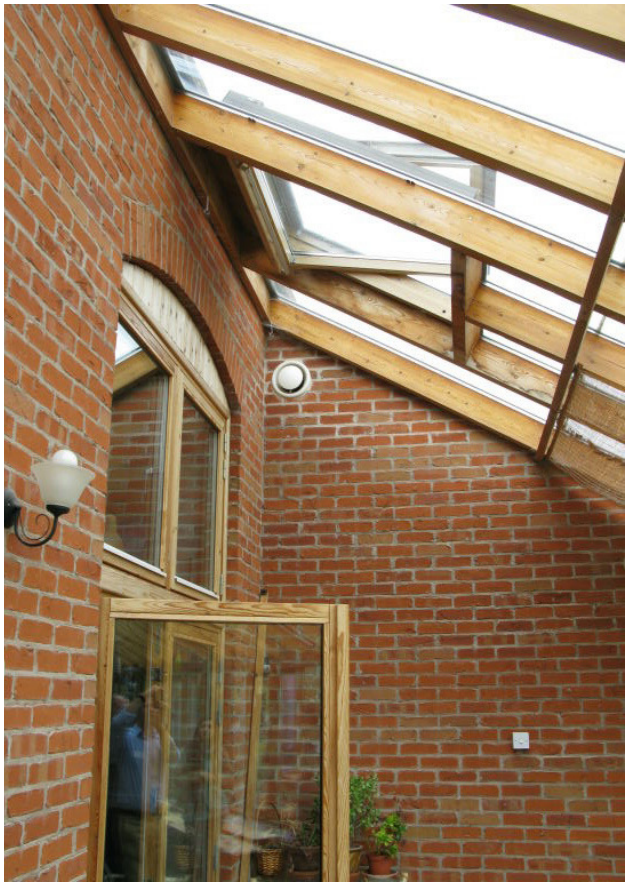
The Hockerton Housing Project employs passive solar design to maintain a comfortable living temperature of 19-21ºC all year round with **no central heating system**.

DEFINITION

PRINCIPLES

ARCHITECTURAL

TECHNICAL



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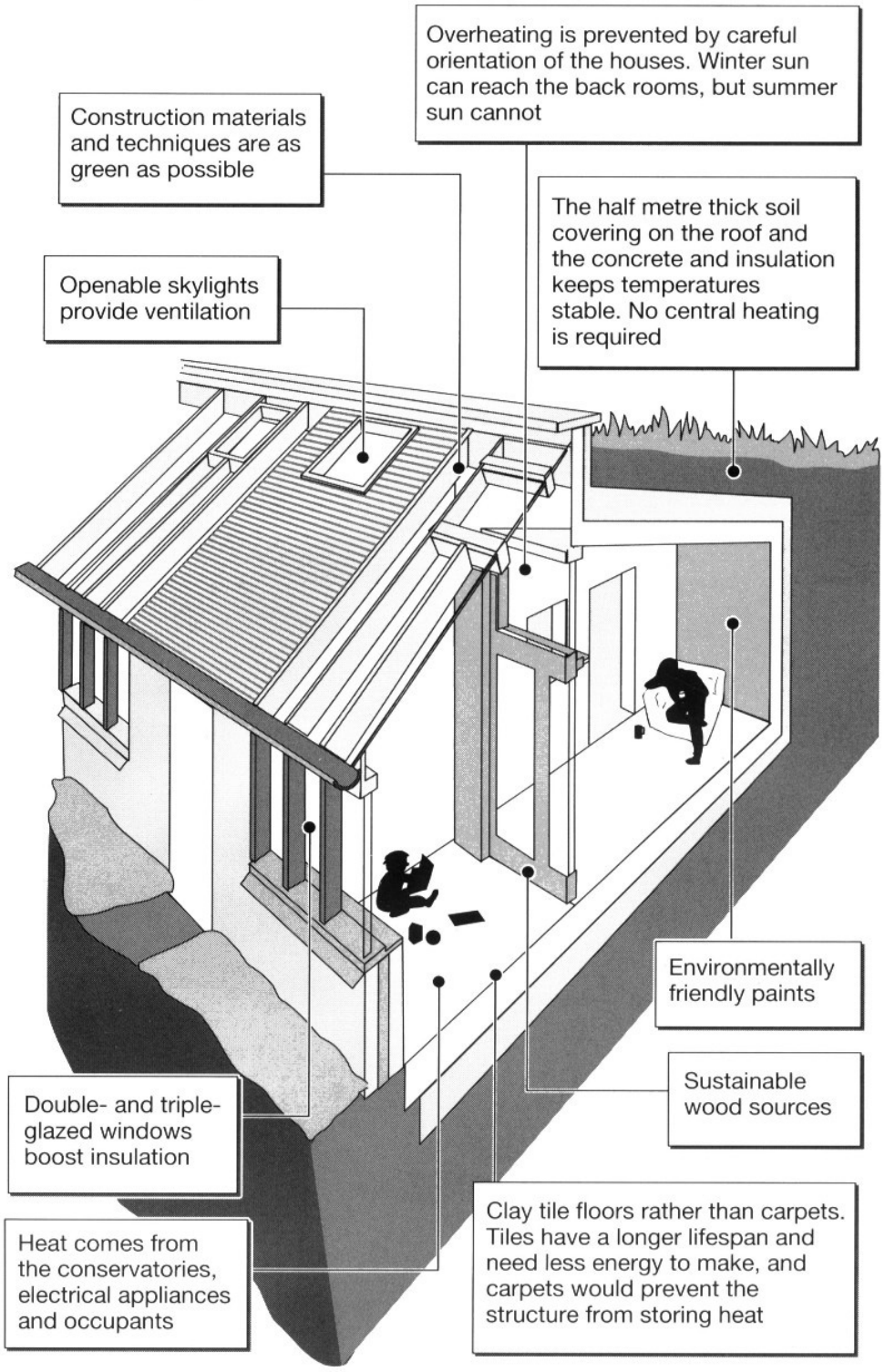

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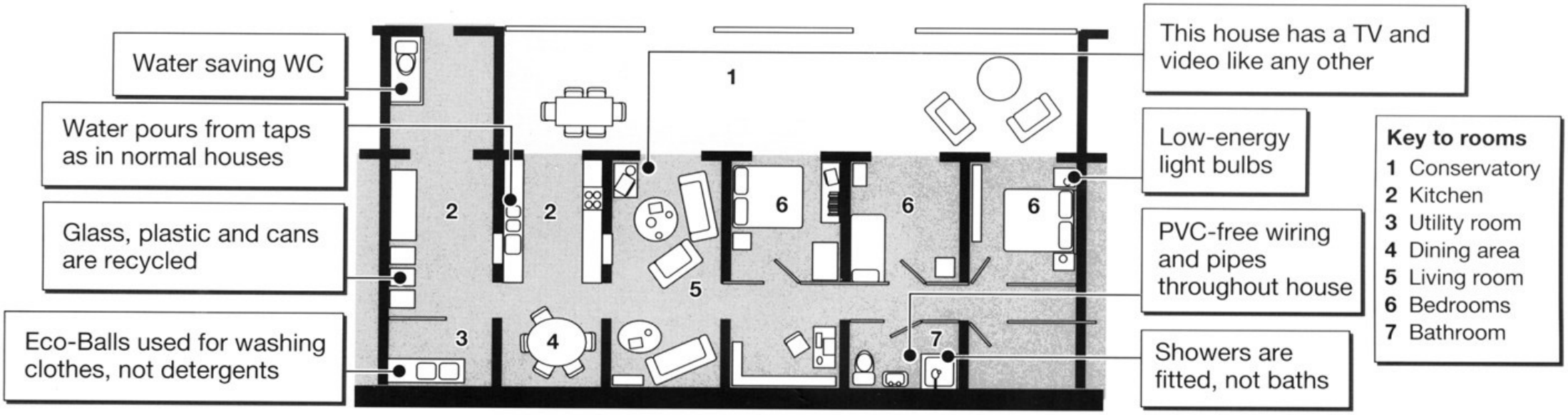
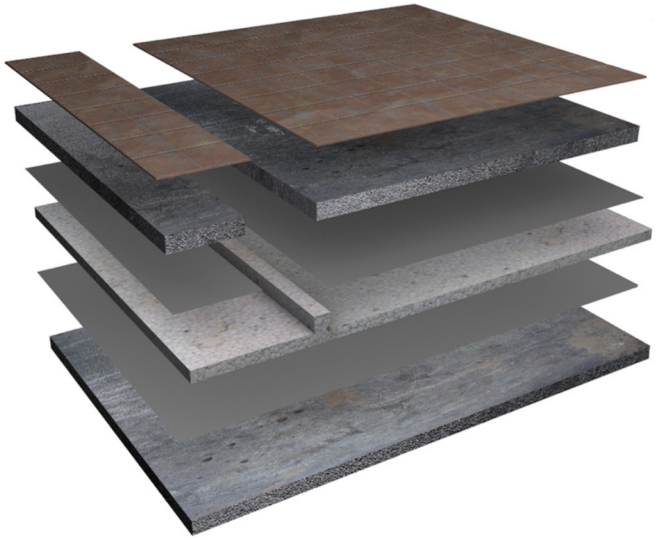


BUILDING FABRIC

DETAIL

In the Hockerton housing project, a holistic and ‘back-to-basics’ approach to passive solar design has resulted in buildings that employ very cheap materials and a simple construction to heat and cool the building completely passively very effectively, maintaining very comfortable temperatures all year round.



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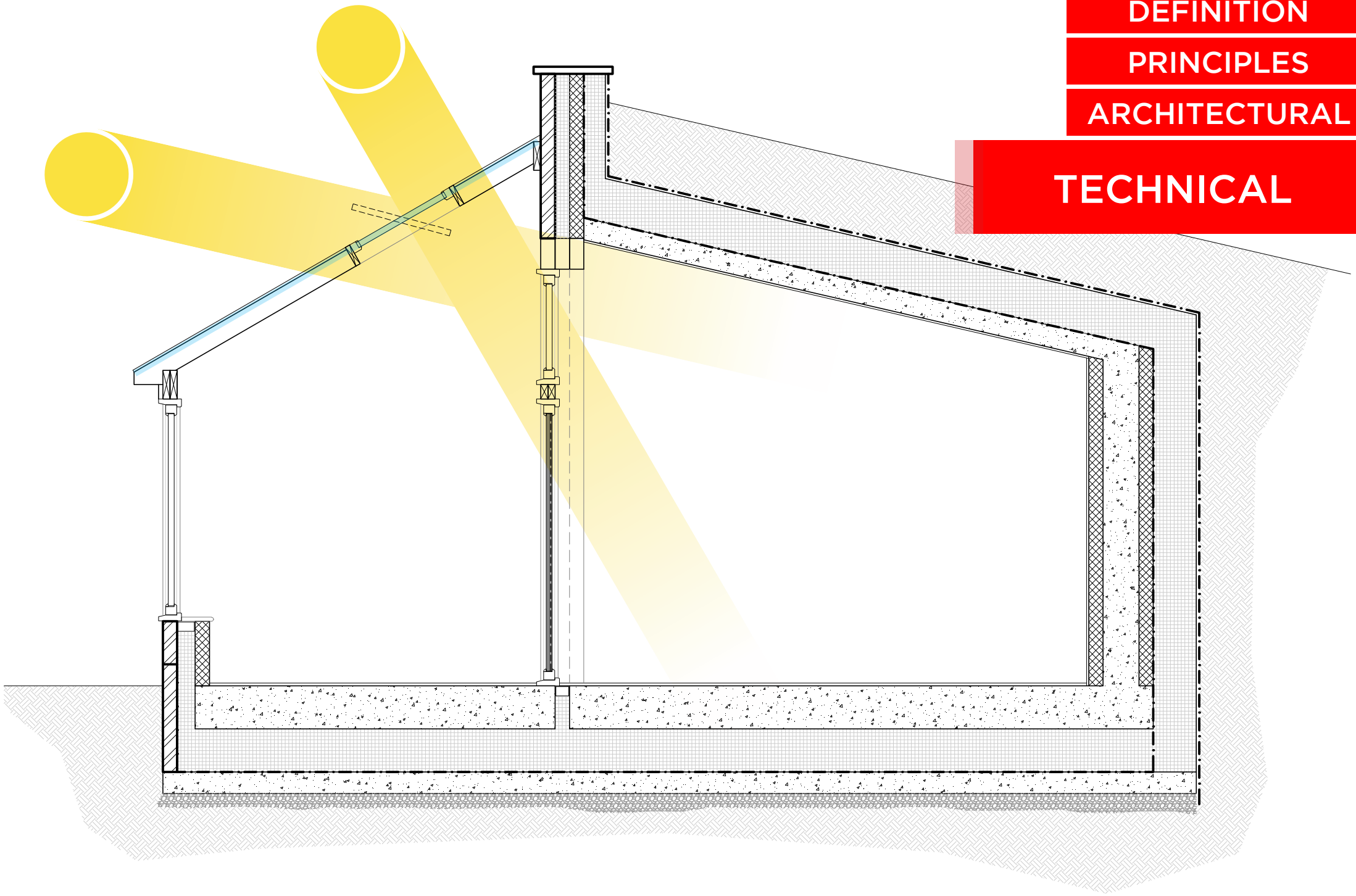

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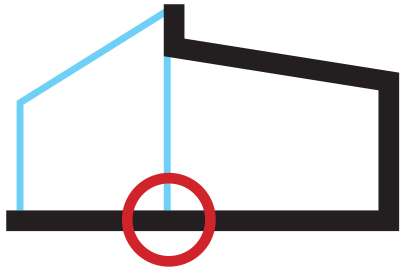

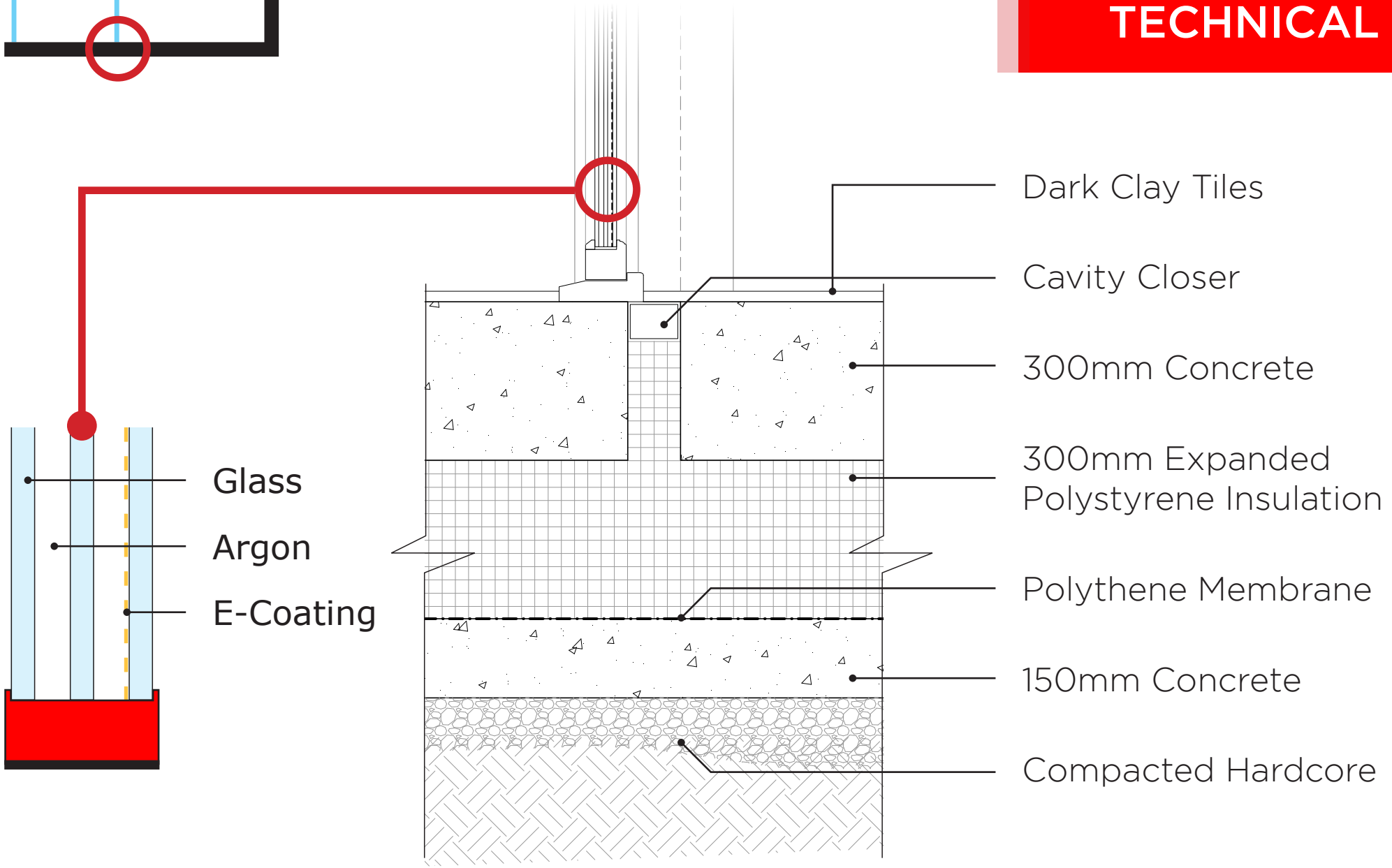

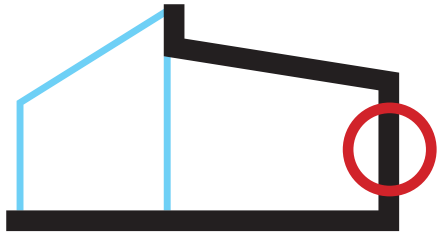

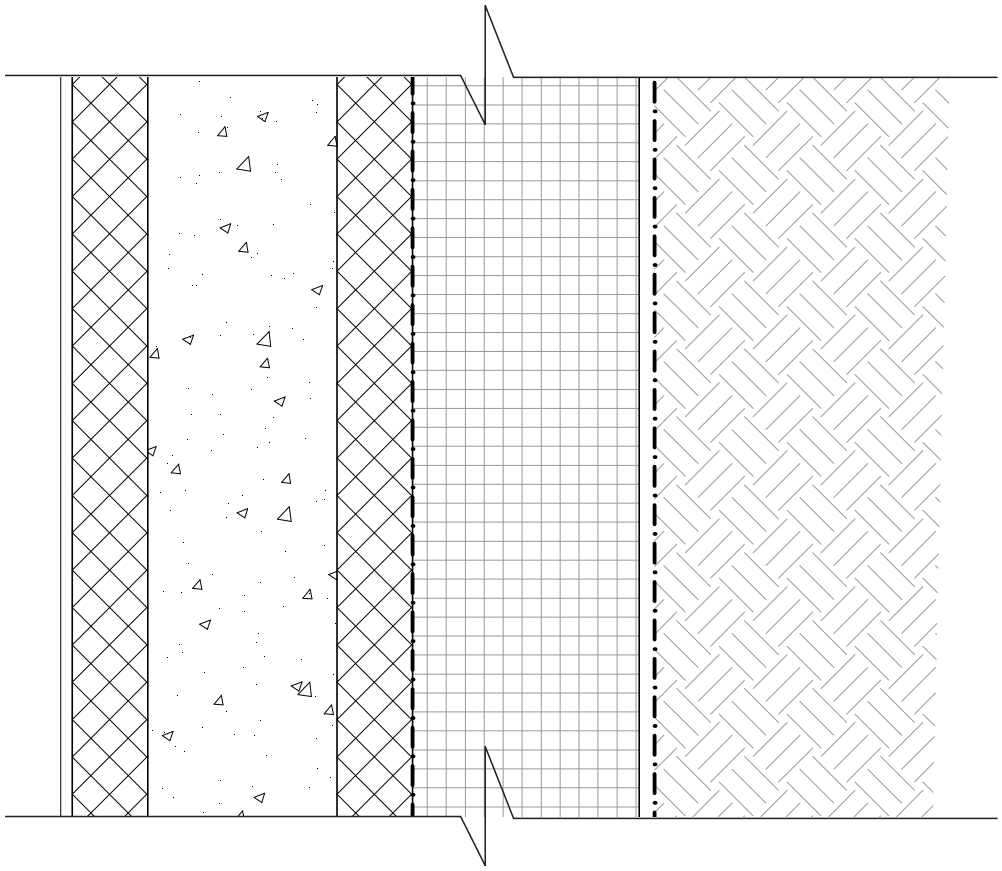

Plaster Finish

Heavyweight Concrete Blockwork

300mm Concrete

Heavyweight Concrete Blockwork

Polythene Membrane

300mm Expanded Polystyrene Insulation

‘Geofin’ Moisture protection barrier

DEFINITION

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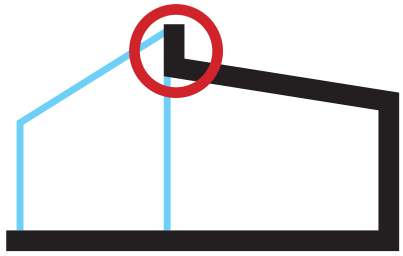

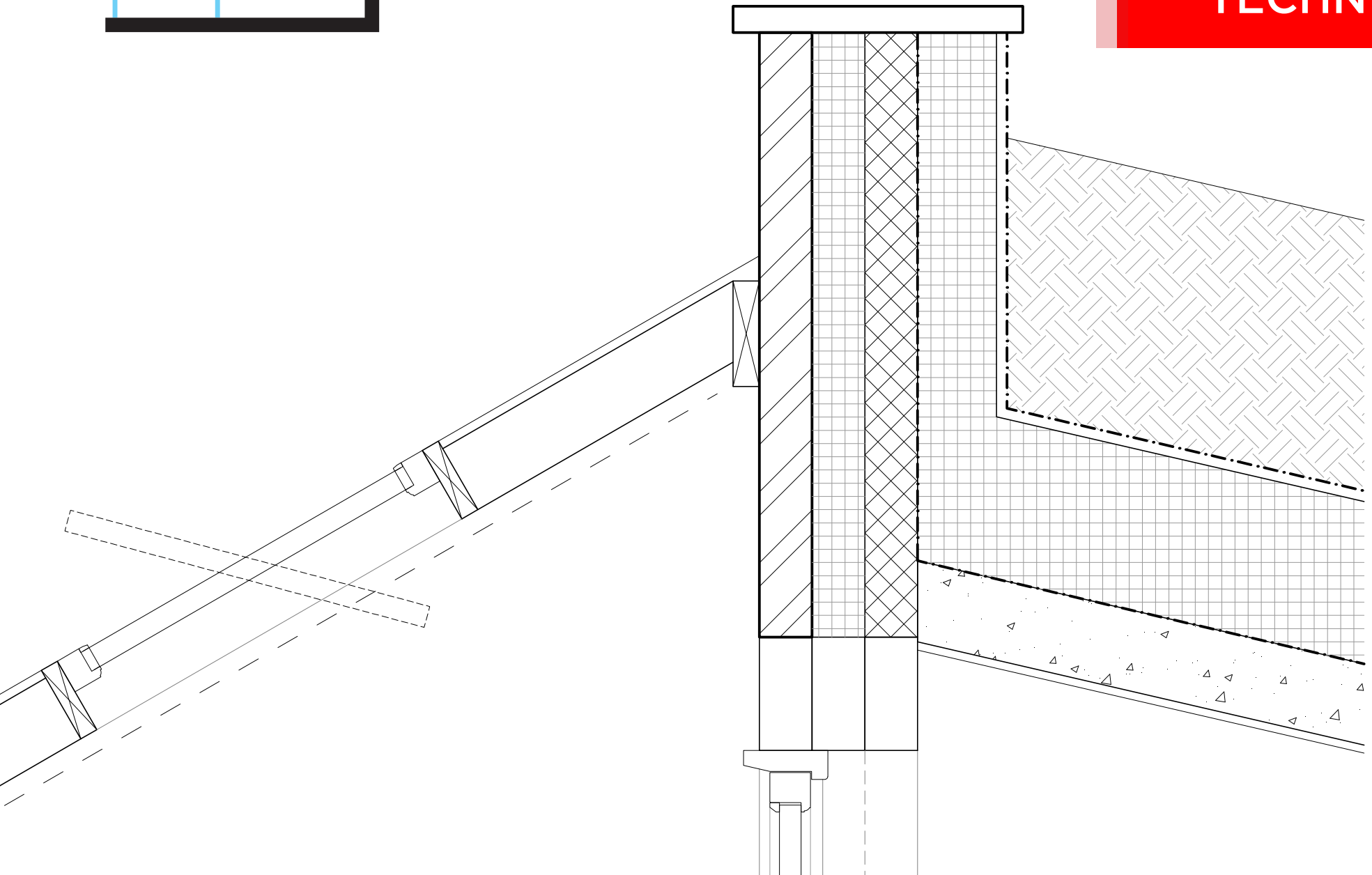

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