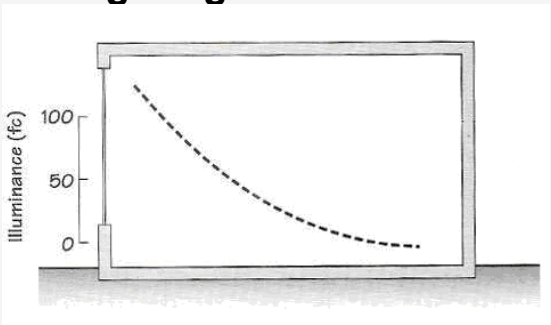
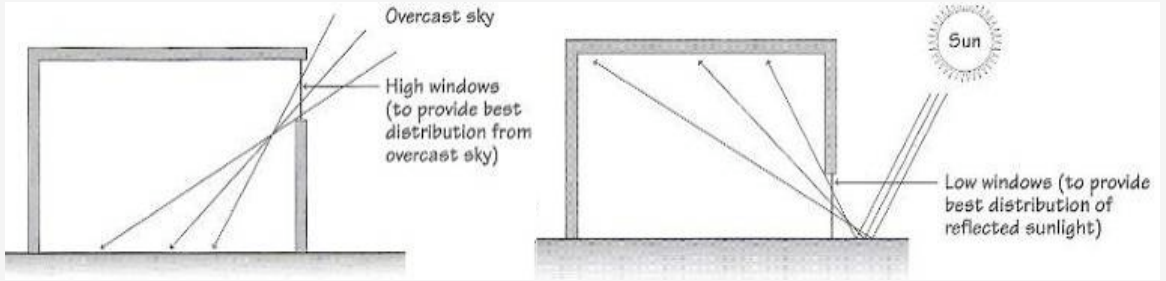
Daylighting

Sidelighting - Windows

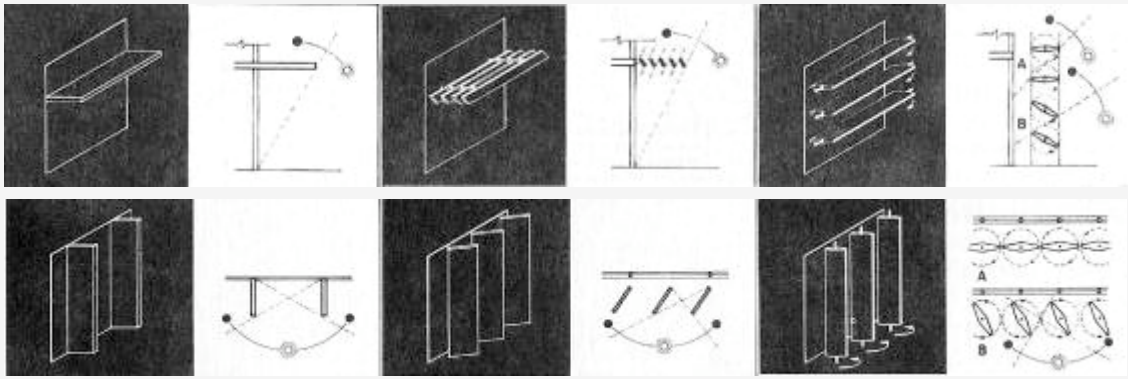


Upper and lower section



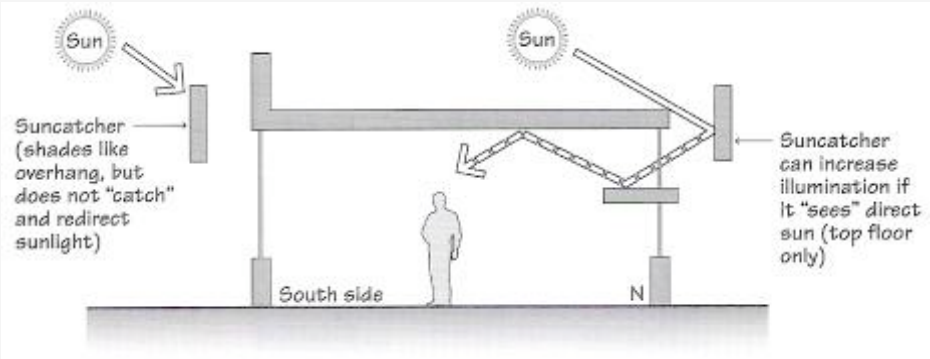
Shading devices

- Horizontal
- Vertical

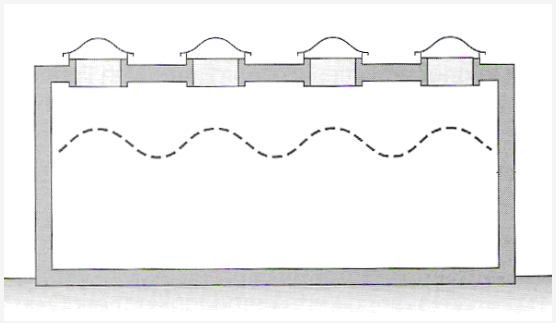


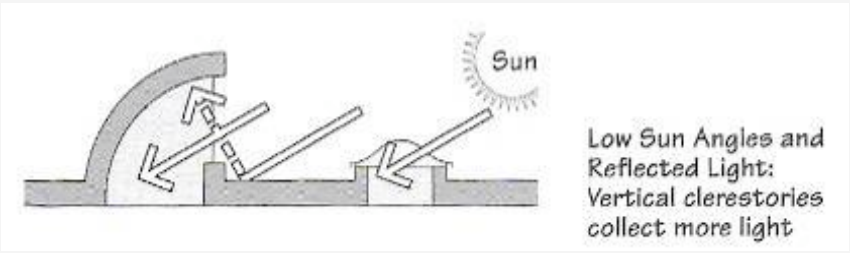
Redirecting devices

- Light Shelves
- Suncatchers

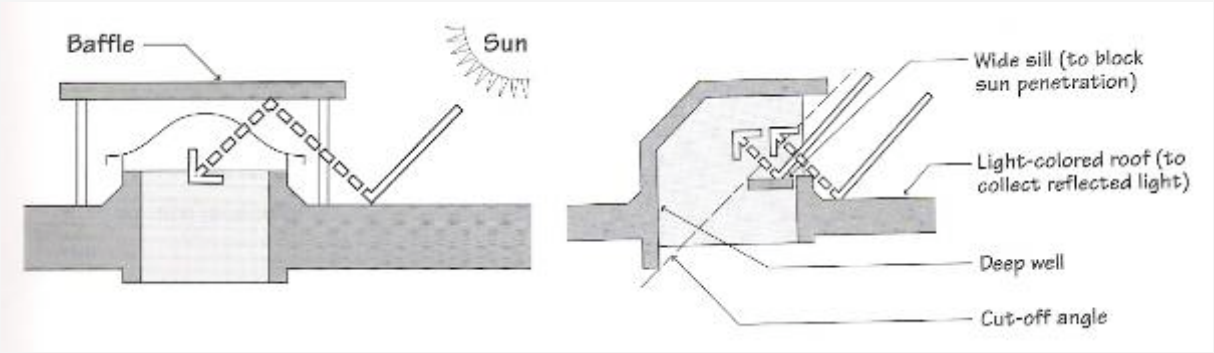


Skylight

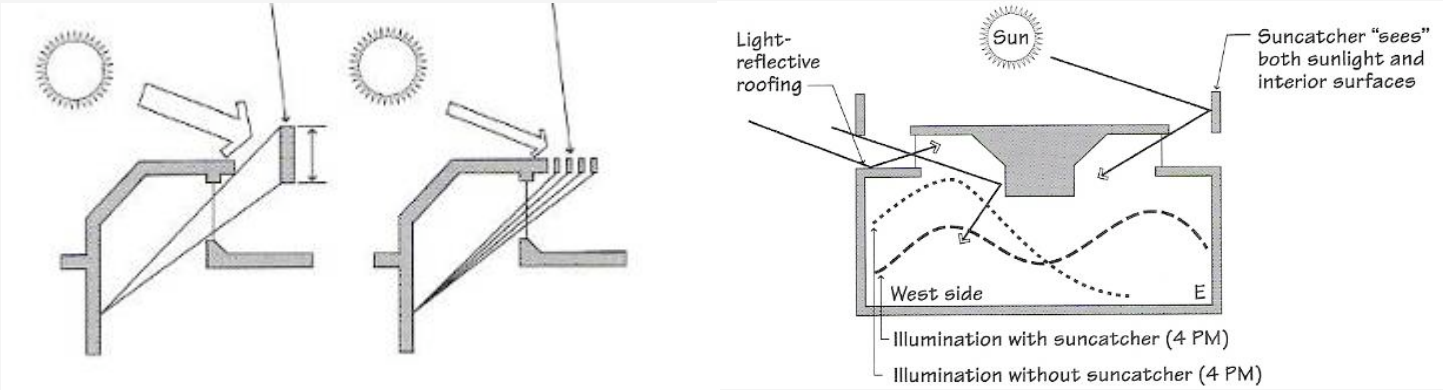




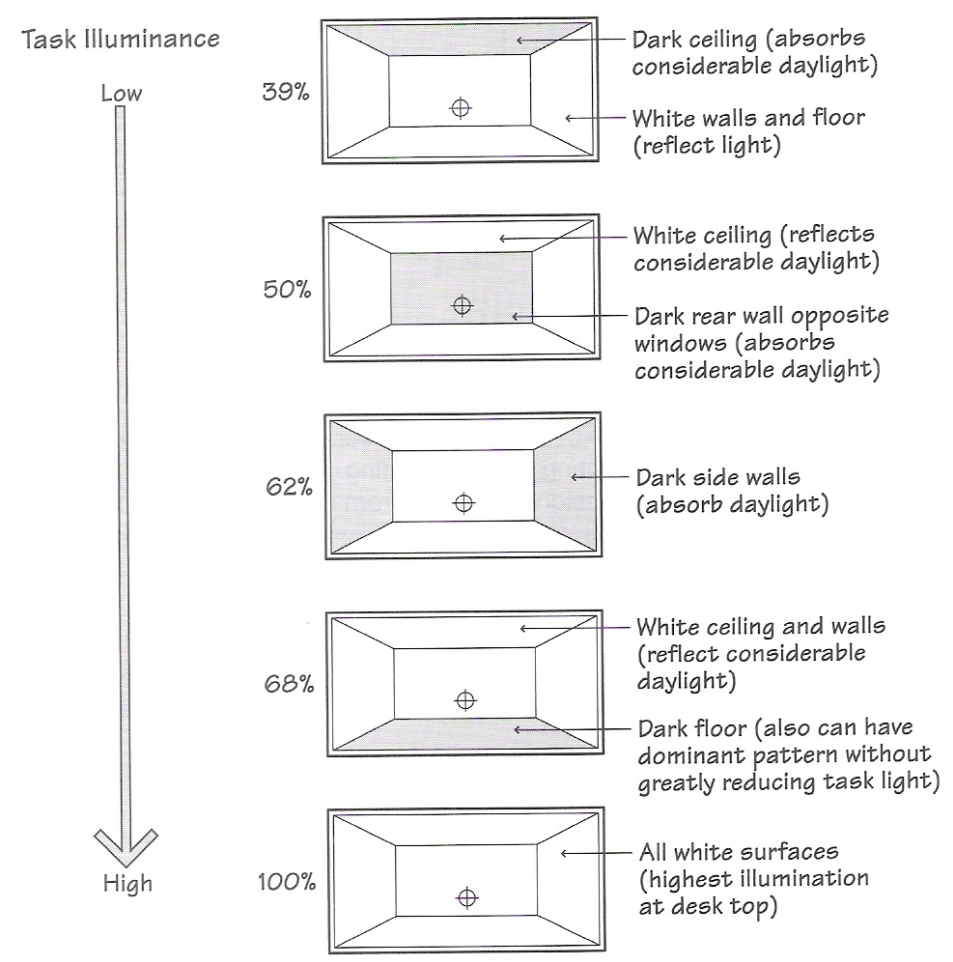
Shading devices



Redirecting devices

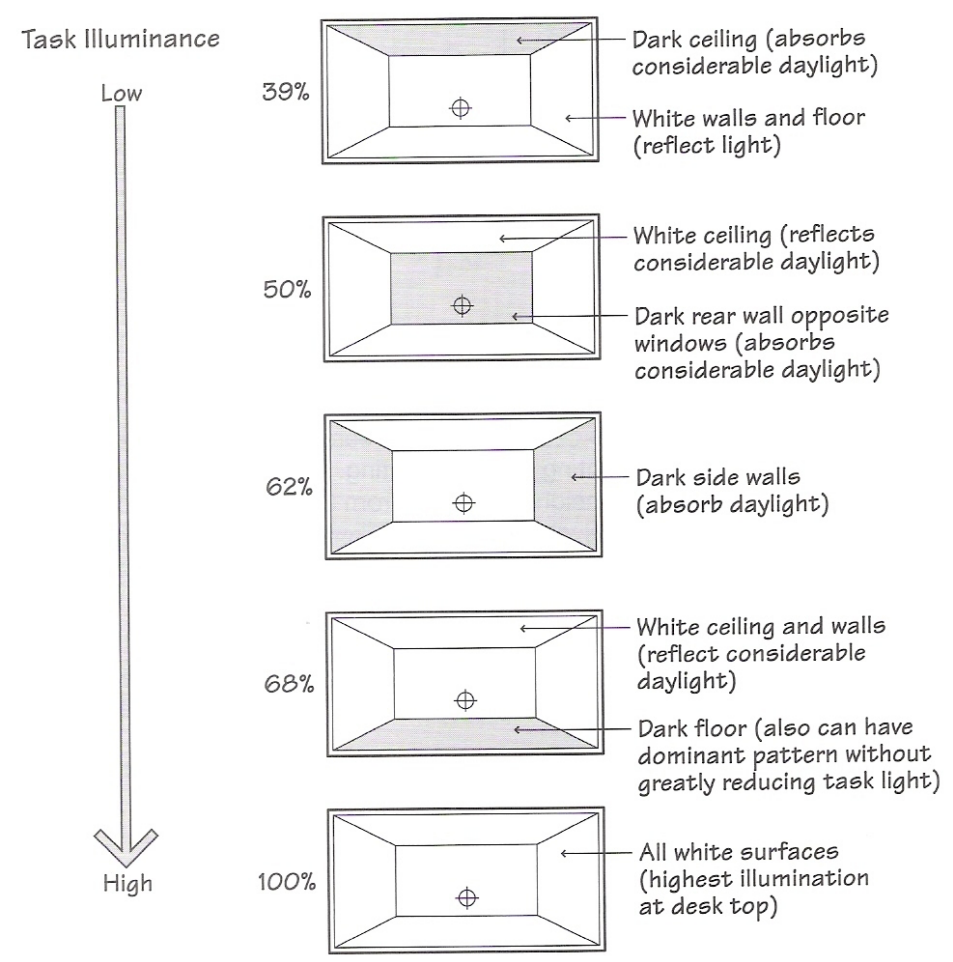


Reflectances



Surface type	Description	Reflectance
Ceilings	White emulsion paint on plain plaster surface	0.8
	White emulsion paint on acoustic tile	0.7
	White emulsion paint on no-fines concrete	0.6
	White emulsion paint on wood-wool slab	0.5
Walls	White emulsion paint on plain plaster surface	0.8
	Tiles: white glazed	0.8
	Brick: white gault	0.7
	Plaster, pink	0.65
	White asbestos cement	0.4
	Brick: concrete, light grey	0.4
	Portland cement, smooth	0.4
	Stainless steel	0.35
	Brick, fletton	0.3
	Concrete: light grey	0.25
	Portland cement, rough (as board marked)	0.25
	Brick, London stock	0.25
	Timber panelling: light oak, mahogany, gaboon	0.25
	Timber panelling: teak, afromosia, medium oak	0.2
	Brick: concrete, dark grey	0.2
	Brick: blue engineering	0.15
	Chalkboard, painted black	0.05
Floors and furniture	Paper, white	0.8
	Cement: screed	0.45
	PVC tiles: cream	0.45
	Carpet: light grey, middle buff	0.45
	Timber: birch, beech, maple	0.35
	Timber: oak	0.25
	PVC tiles: brown and cream marbled	0.25
	Carpet: turquoise, sage green	0.25
	Timber: iroko, kerning, medium oak	0.2
	Tiles: cork, polished	0.2
	Quarry tiles: red, heather, brown	0.1
	Carpet: dark, 'low maintenance'	0.1
	PVC tiles: dark brown	0.1
	Timber: dark oak	0.1

Reflectances



Other	Asphalt	0.07
	Moist earth	0.07
	Salte (dark grey)	0.08
	Gravel	0.13
	Water	0.15
	Grandolite	0.17
	Bluestone, sandstone	0.18
	Macadam	0.18
	Vegetation (average)	0.25
	Cement	0.27
	Dark red glazed brick	0.3
	Green grass	0.33
	Dark buff brick	0.4
	Light buff brick	0.48
	Concrete	0.05–0.5
	Marble (white)	0.45
	Oak	0.15–0.05
	Old white paint	0.55
	New white paint	0.75
	Old snow	0.64
	New snow	0.74
Specular reflectance	Aluminium commercial grade (anodised and polished)	0.7
	Aluminium super-purity (anodised and polished)	0.8
	Surface aluminised glass or plastic	0.94
	Chromium (plate quality)	0.65
	Stainless steel (polished)	0.6
	Steel: white paint glossy (specular only)	0.05

Sources: CIBSE, 1994 *Code for InteriorLighting*, CIBSE, London.; Baker, N, Fanchiotti A and Steemers K; (eds), 1993 *Daylighting in Architecture*, James & James, London.
Cayless M.A and Marsden AM (eds); 1983 *Lamps and Lighting*, Edward Arnold, London.

TABLE III - Lighting recommendations in workplaces

Activity/Space	*Building Type*	*Artificial Lighting:*		*Daylighting:*		
		Illuminance (Lux)	*Glare Index*	*Type of Daylighting**	*Average Daylight Factor (%)*	*Glare Index*
Formal teaching and seminar spaces	Schools Colleges Hospitals, etc	300 to 500 (300 on desks, in hospitals)	16 formal 19 seminar	A B	5 2	21 formal 23 seminar
Laboratories	Educational buildings Hospitals Offices Research establishments Factories	500 to 750 (300 to 500 on bench, in hospitals)	16	A B	5 2	21
Staff rooms Common rooms	Educational buildings Hospitals Offices Factories	150 to 300 (100 average in hospitals)	19	A B	5 2	23
Offices (enclosed)	Offices Educational buildings Factories Hospitals Banks Insurance buildings Post offices Libraries	500 (300 on desks, in hospitals)	19	A B	5 2	23
Computers	Offices Banks Educational buildings Hospitals	500 to 750 Limit illuminance where VDUs are used	19	A B	5 2	23
Drawing offices Design offices	Educational buildings Offices Factories	500 to 750 plus local lighting to 1000 on boards	16	A B	5 1 (in supplemented area)	21

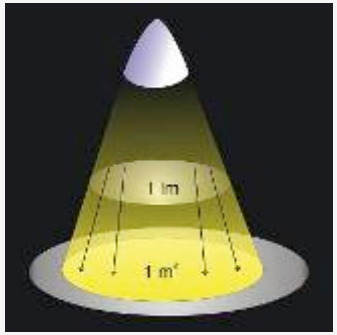
* A - Full daylighting, B - Supplemented daylighting.

Source: *Basic Data for the Design of Buildings: Daylight.* Draft for Development, DD 73: 1982, British Standards Inst.

Illuminance

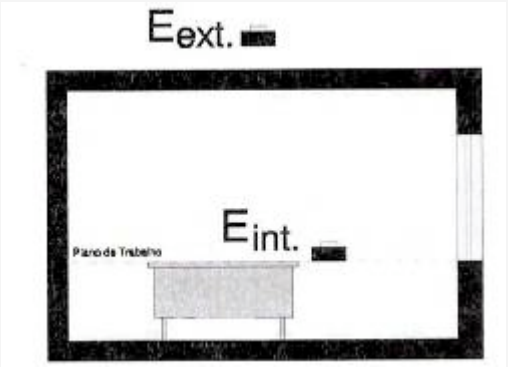
Lux – lx or lm/m2

footcandle -1 fc = 10.764 lx



Daylight Factor

$$DLF = \frac{E_{int.}}{E_{ext.}} \times 100(\%)$$



Visual comfort

Correct illuminance levels

Uniformity of light distributions

Avoidance of glare

Assessment of Daylight through simulations in virtual models

Case Study: Rectory of Universidade Nova de Lisboa

Dissertation for the master degree in
ARCHITECTURE

Mónica Sofia Coutinho

Oriented by: Profª Maria Luísa de Oliveira Gama Caldas

Instituto Superior Técnico

July 2009

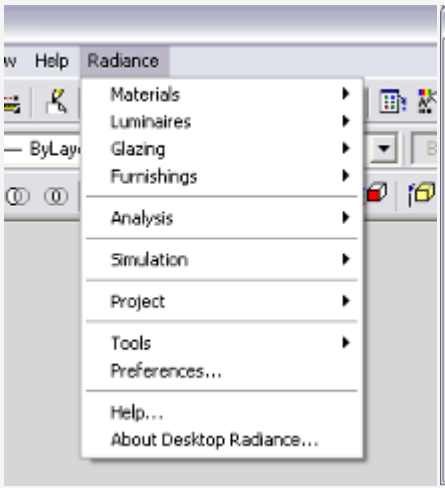
Software

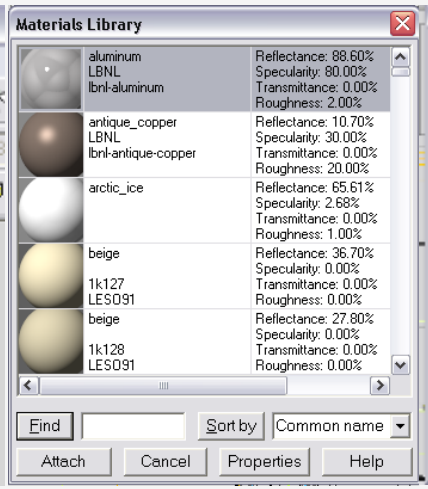
Radiance – Lawrence Berkley Nacional Laboratory

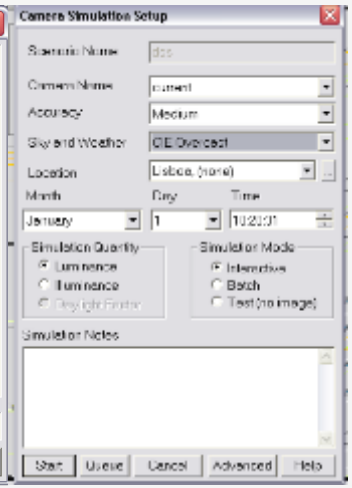
Desktop Radiance – AutoCAD

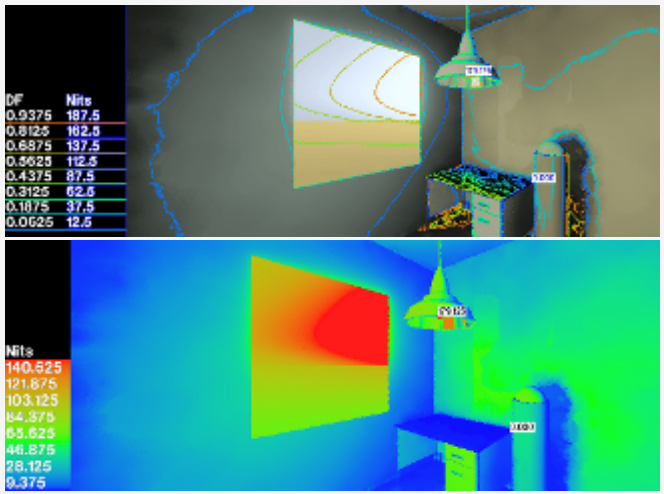
Simulation of natural and artificial light

Library of Material, Glazing, Furniture and Luminaries









Case Study

Simulation

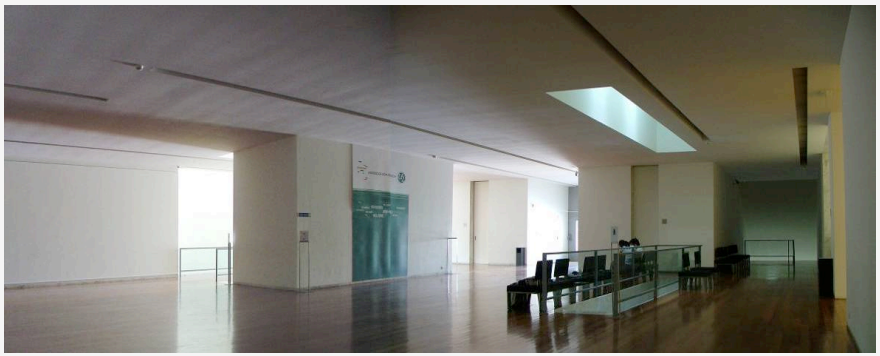
Room 1
Room 2

Atrium

Room 1

Room 2

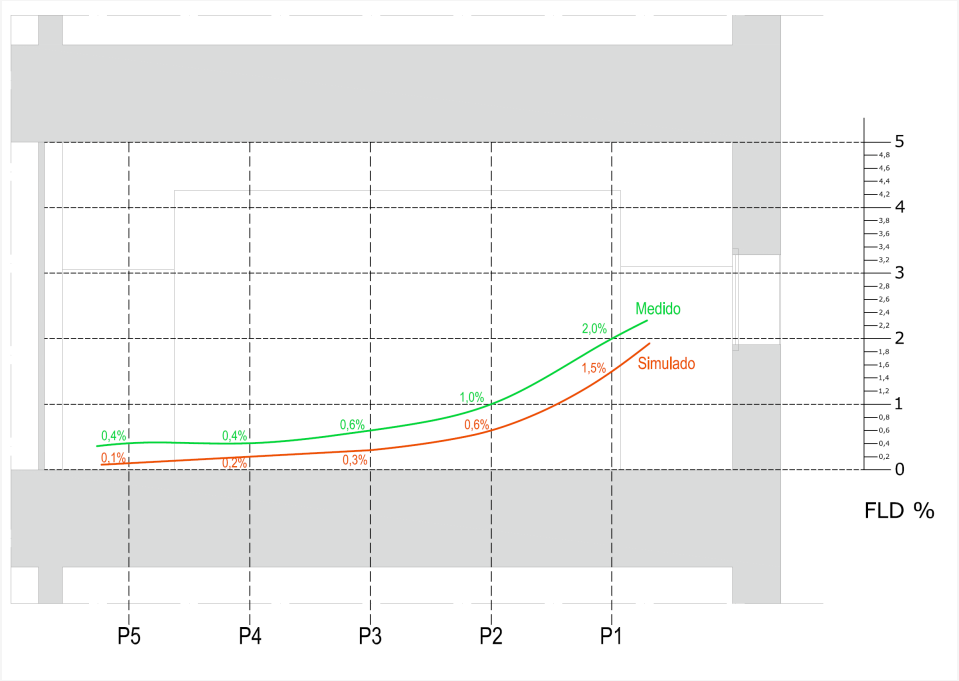
Atrium



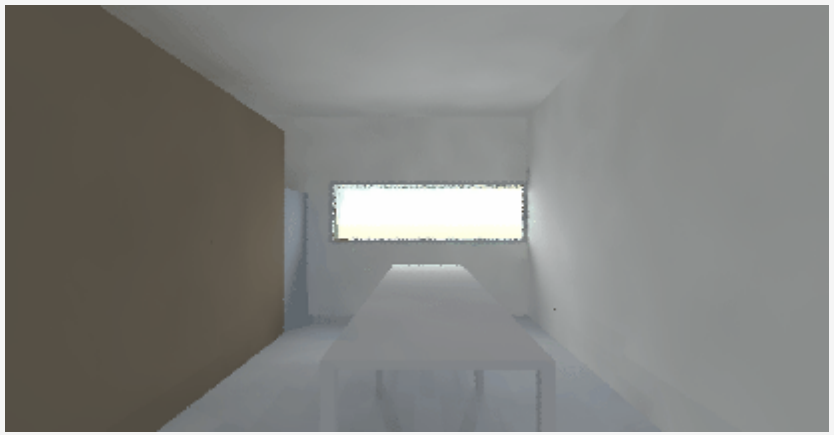
Room 1 | Simulations

Recommended: 500 lux – 2% DLF

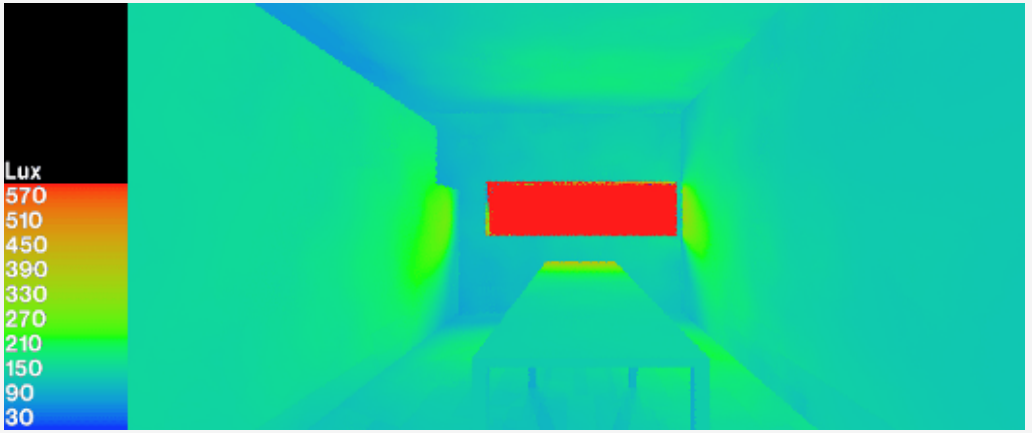
Graphic distribution of Daylight Factor



Synthesized image in Desktop Radiance



analytical image

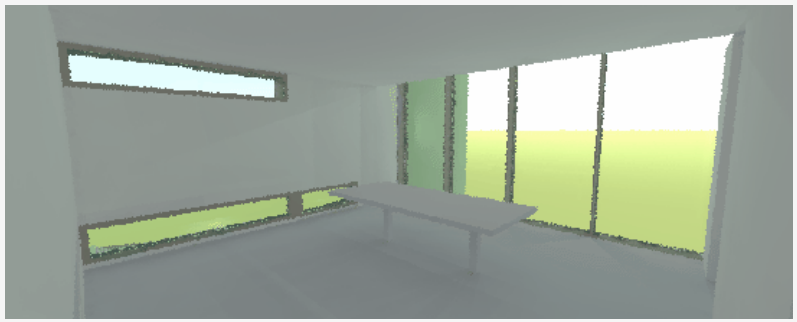


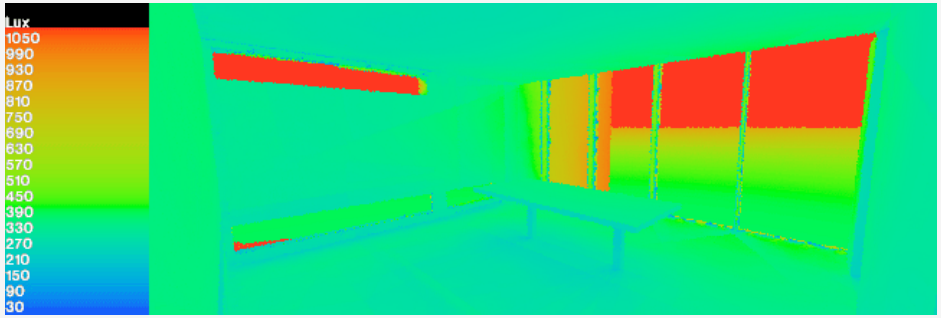
Room 2

Simulation on 21 December

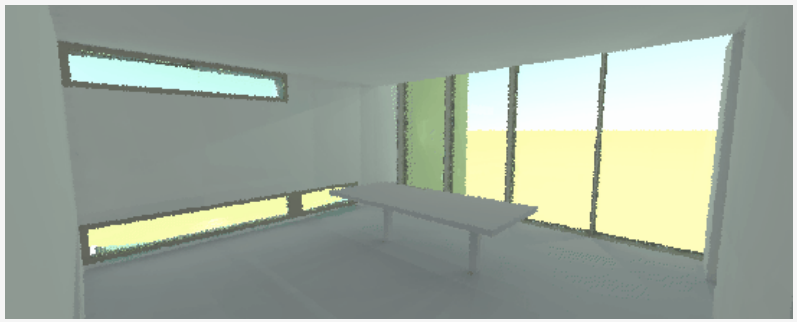
Recommended: 500 lux – 2% DLF

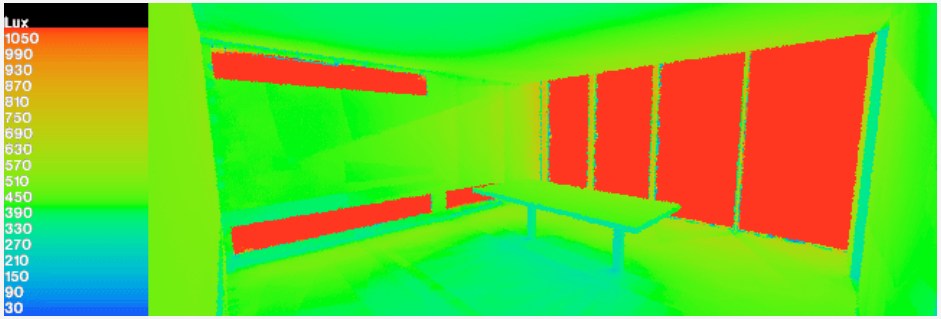
9am



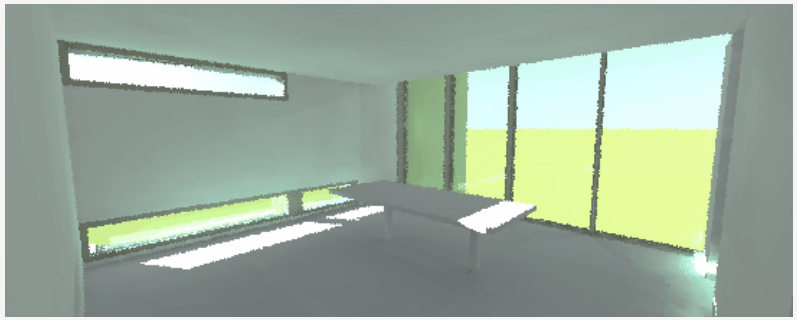


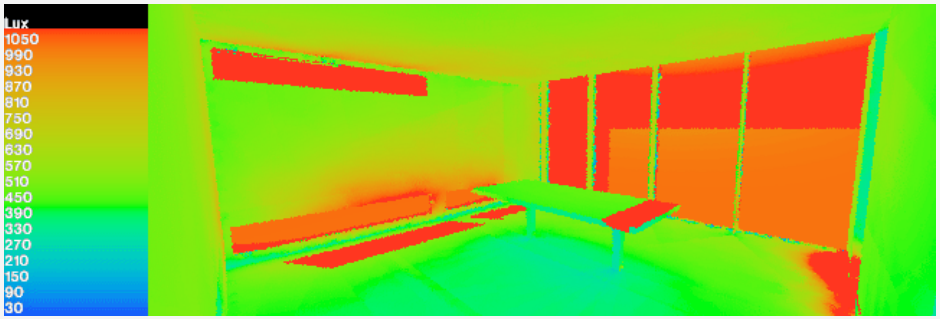
12AM



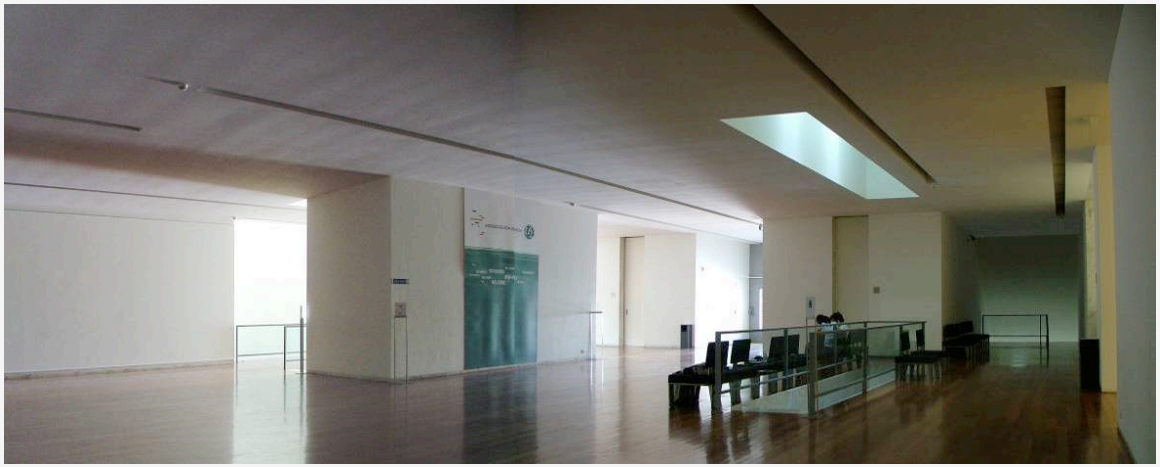


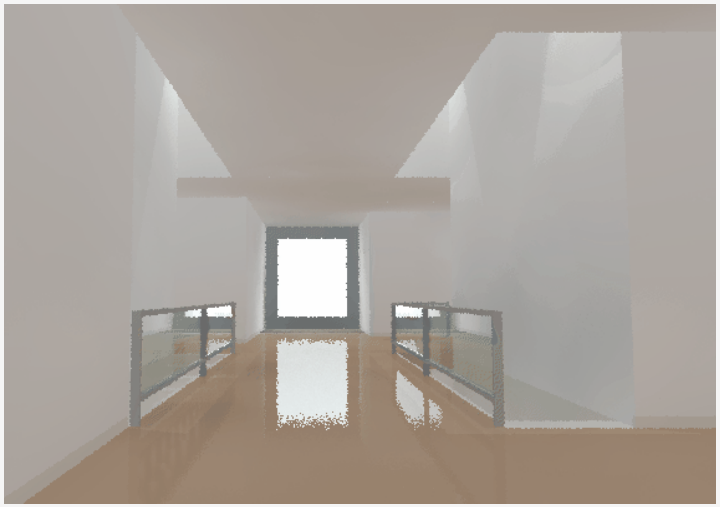
3PM



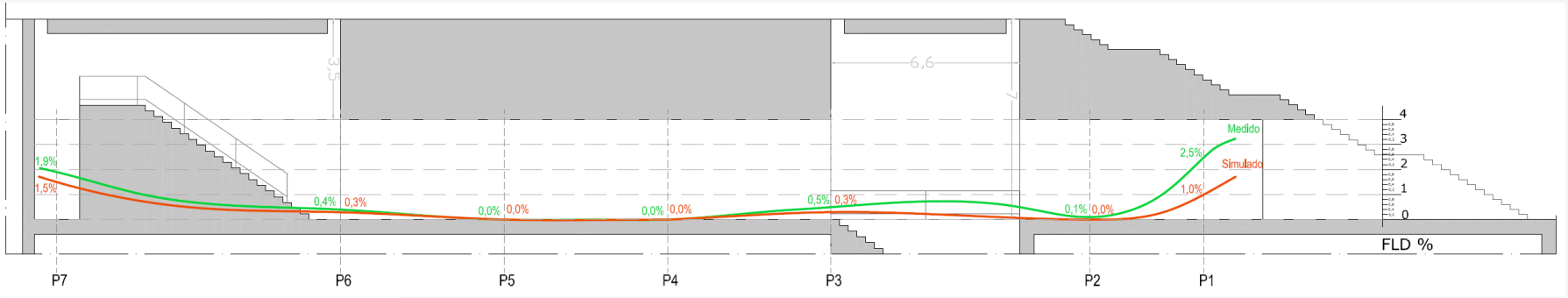


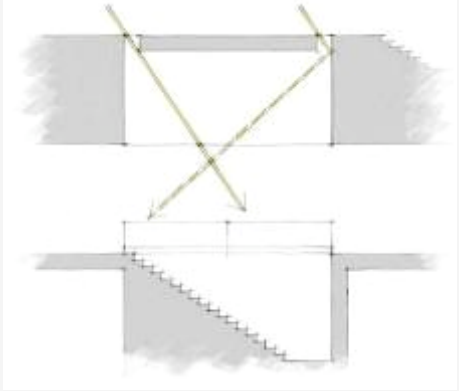
Atrium | Simulations

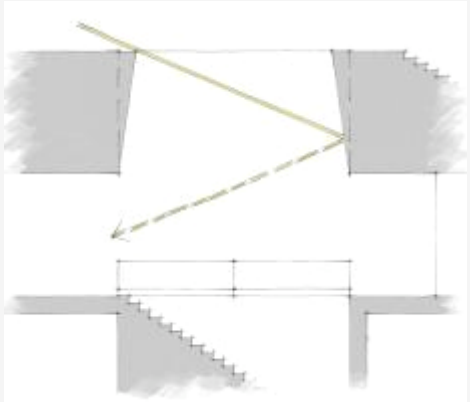




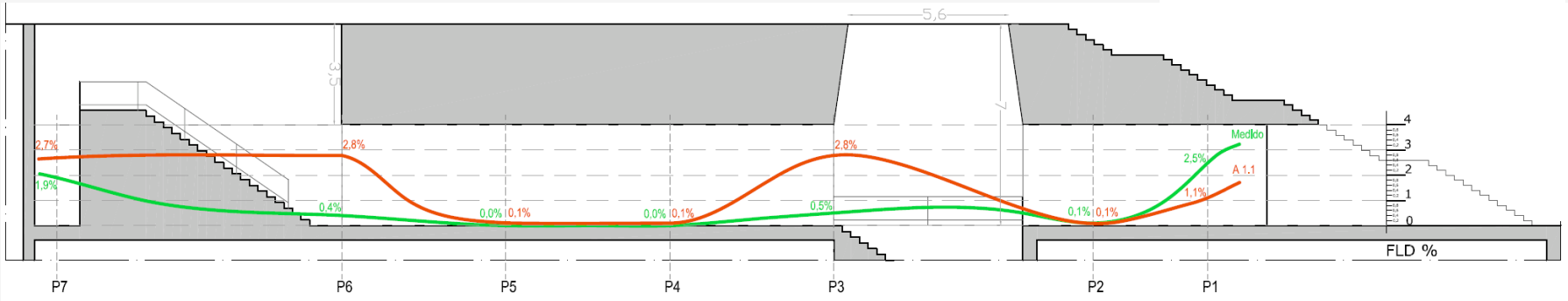
Atrium





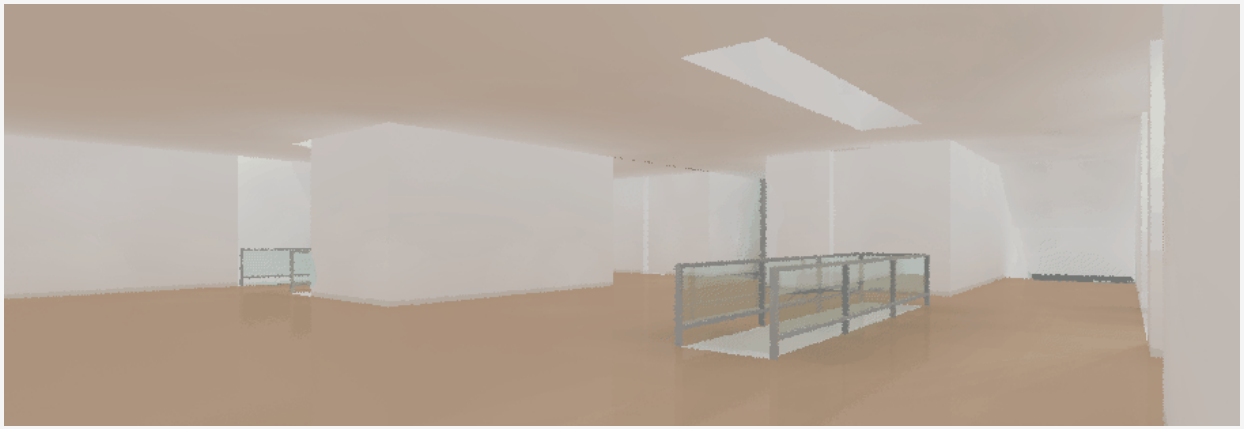


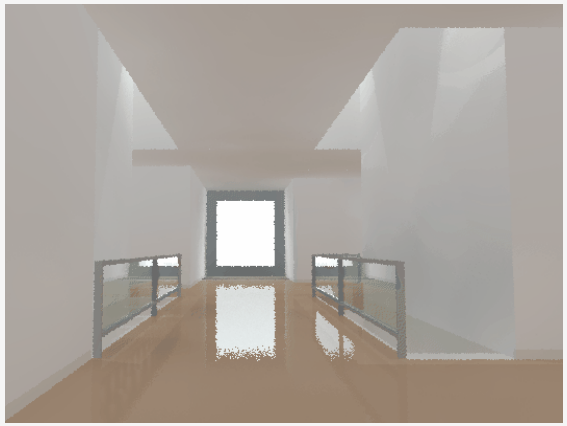
Alternative Solution



Atrium| Simulations

Existent





Alternative Solution