

Daylight and sunlight in housing

Stephanie King

BRE Environment, Building Technology Group

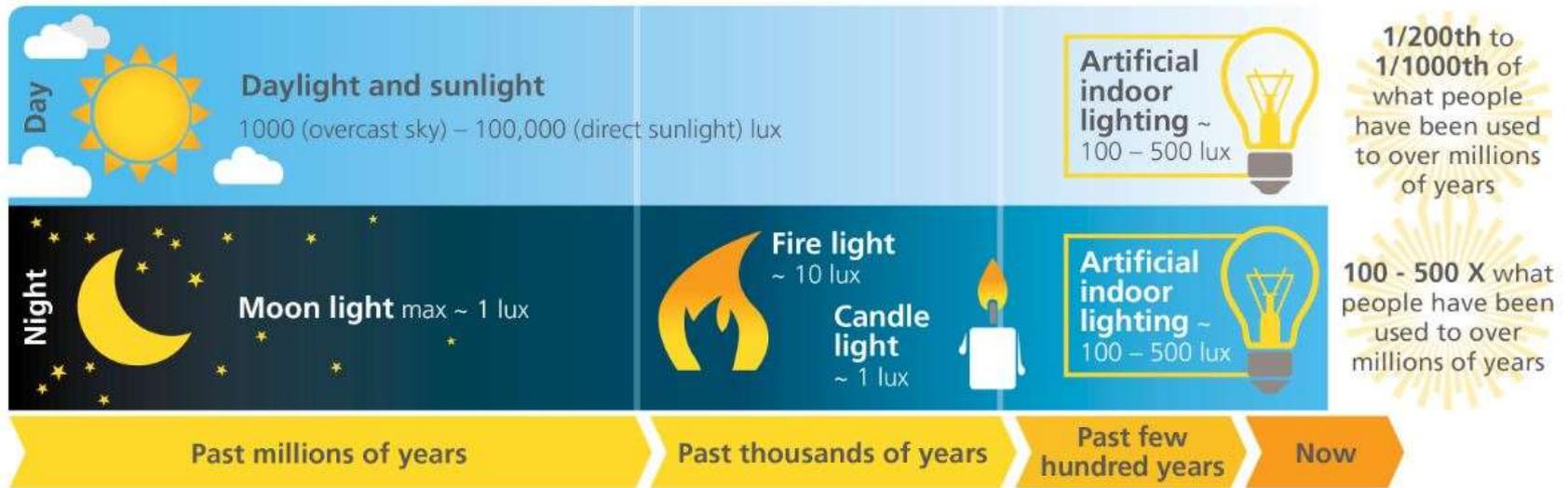
New Homes and our Health Conference

6 July 2017



Light and evolution

Typical illuminance for light sources used in human evolutionary timeline



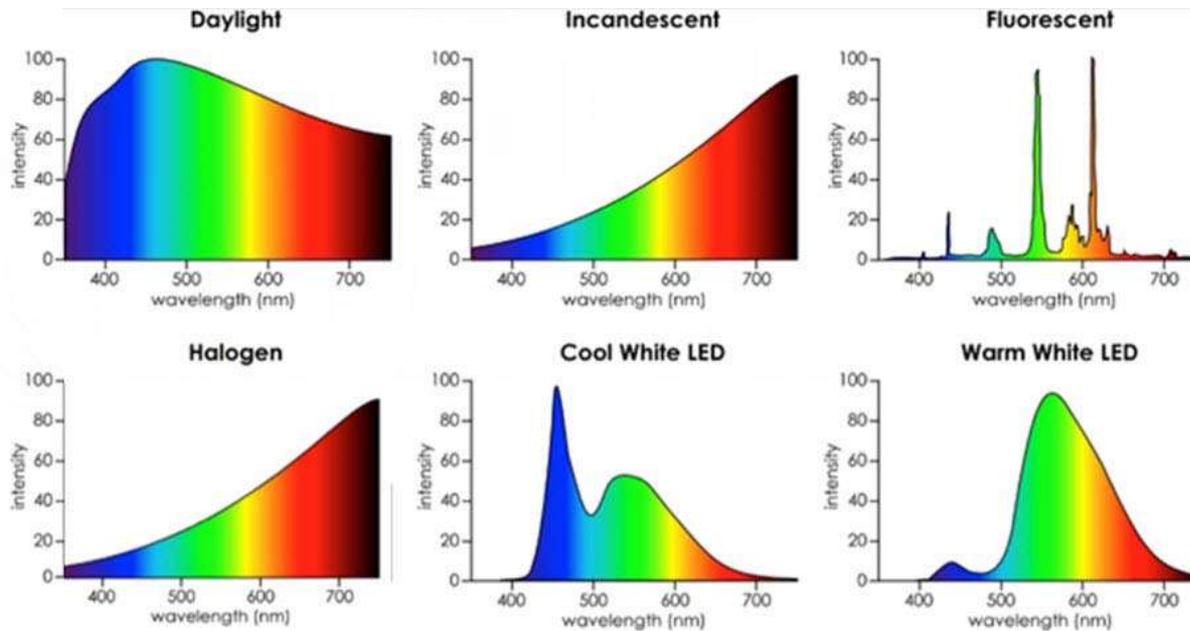
Light from the sky

Condition	Illumination (lux)
Very sunny day	100,000
Typical sunny day	50,000
Well daylight day	20,000
Overcast day	5,000-10,000
Twilight	10
Deep twilight	1
Full moon	0.1
Quarter moon	0.01
Starlight	0.001



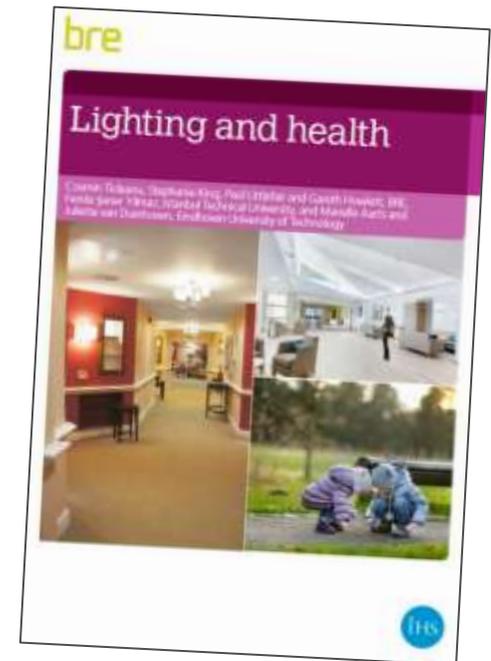
Spectral composition of light

- Varies with light source
- Might not be noticeable to the eye
- Affects how we see colour
- Affects circadian response (460 nm)



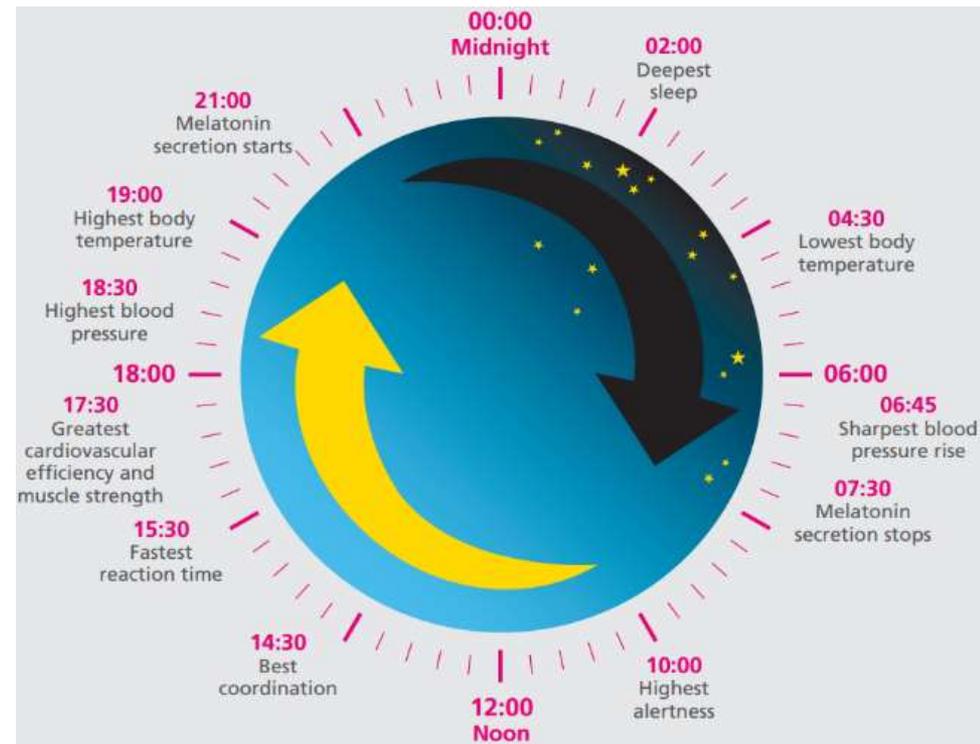
The health benefits of daylight

- Circadian rhythms
- Contact with the outside
- Sunlight
- Other benefits of windows such as ventilation



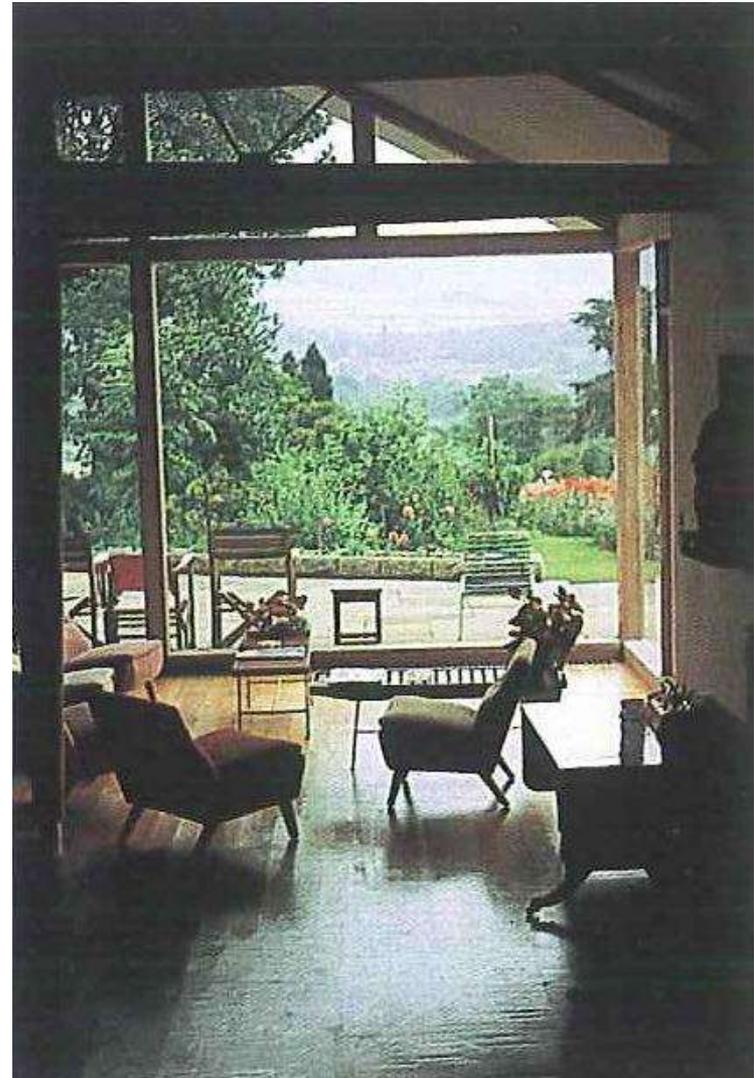
Circadian rhythms

- Powerful entrainment effect of light on circadian rhythms
- Exposure to right light during the day helps regulate daily rhythms of sleep and alertness
- Lack of light during the day can lead to ‘free running’ rhythms, sometimes with wakefulness at night and sleepiness during the day
- Daylight gives high levels of blue enriched light which are ideal for modulating circadian rhythms
- Particular benefits for elderly, visually impaired



Contact with the outside

- View out
- Contact with others
- Information about weather
- Contact with nature
- Variability
- May improve recovery from illness



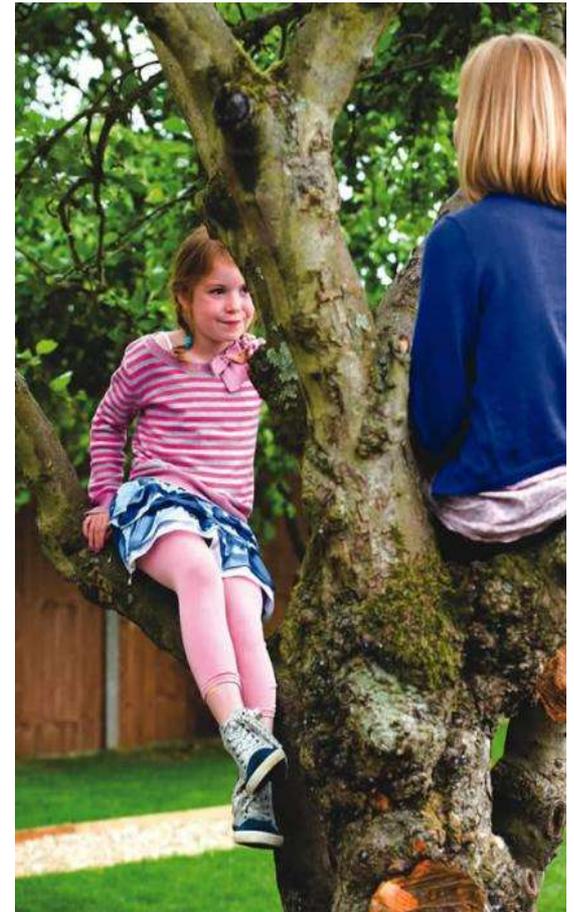
Sunlight

- Extra light. Sunlight can give illuminances of 10000-50000 lux indoors
- Sun adds warmth in heating season
- May enhance mood
- May have germicidal effect



Outdoor light: Vitamin D and myopia

- Outdoors, exposure to sunlight allows synthesis of Vitamin D, essential for healthy bones, and probably beneficial to the cardiovascular system, and mood
- In a US study, Godar et al (2012) surveyed 2000 children. Results suggested many did not get adequate UVB exposure to satisfy year round Vitamin D needs.
- Exposure to high levels of daylight as children grow reduces the risk of developing myopia (Lougheed, 2014)



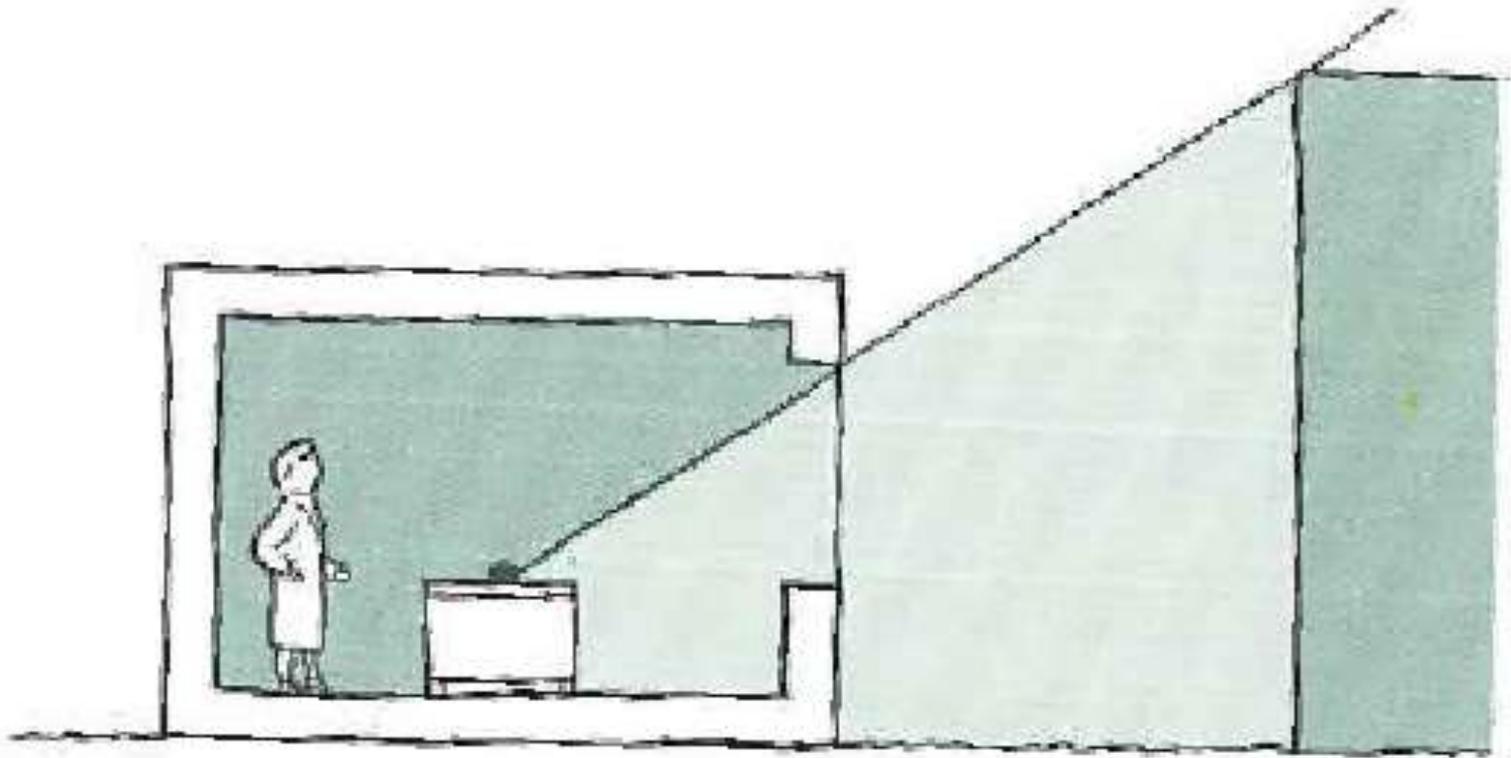
Daylight in the city?



Obstructions affect amount of daylight



Obstructions affect distribution of daylight



Obstructions affect sunlight reaching windows



Obstructions affect sunlight in gardens and open spaces



‘Site layout planning for daylight and sunlight: a guide to good practice’

– New edition 2011

SITE LAYOUT PLANNING FOR DAYLIGHT AND SUNLIGHT

A guide to good practice
SECOND EDITION

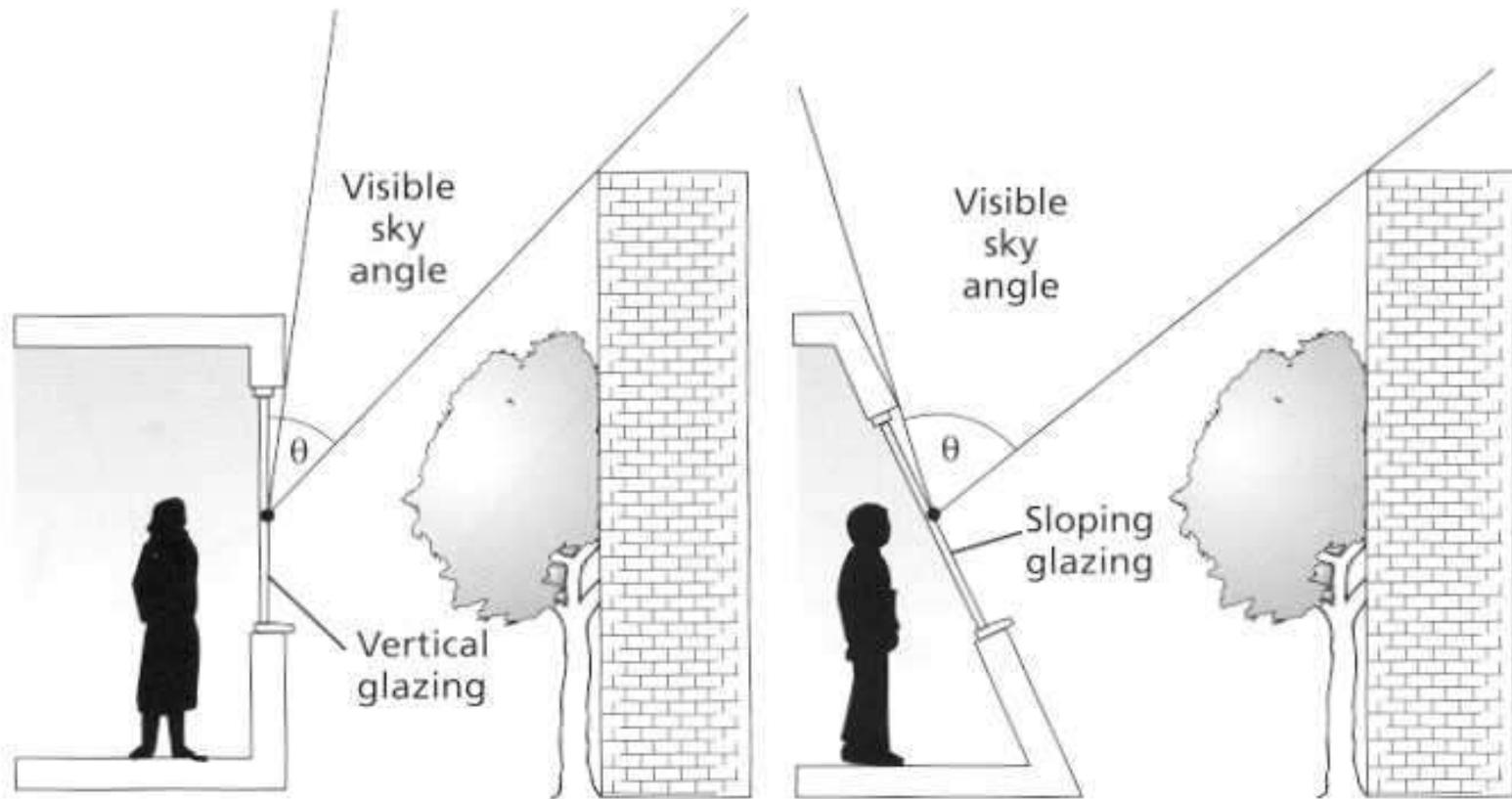
Paul Littlefair



bre press

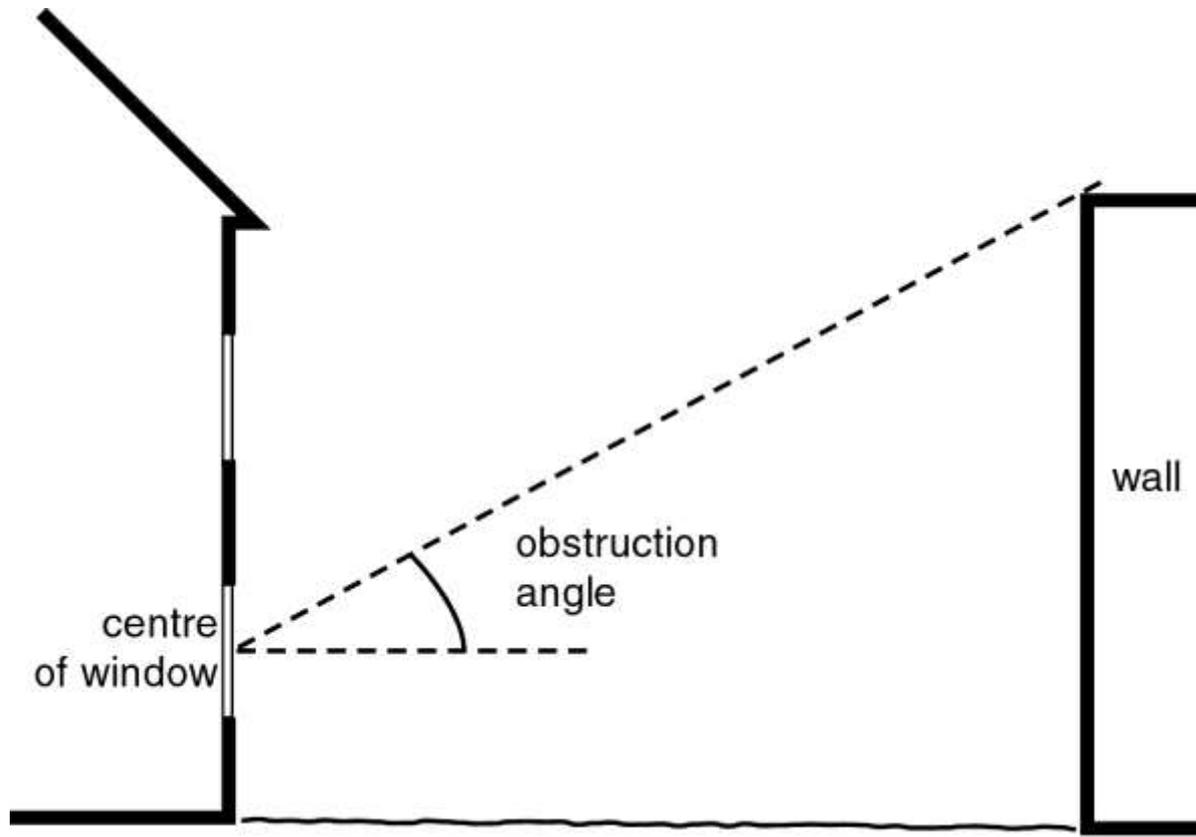
bre trust

Quantifying daylight; visible sky angle



Obstruction angle

- If obstruction angle less than 25 degrees to horizontal, potential for good daylighting inside the building



Vertical sky component

Vertical sky component

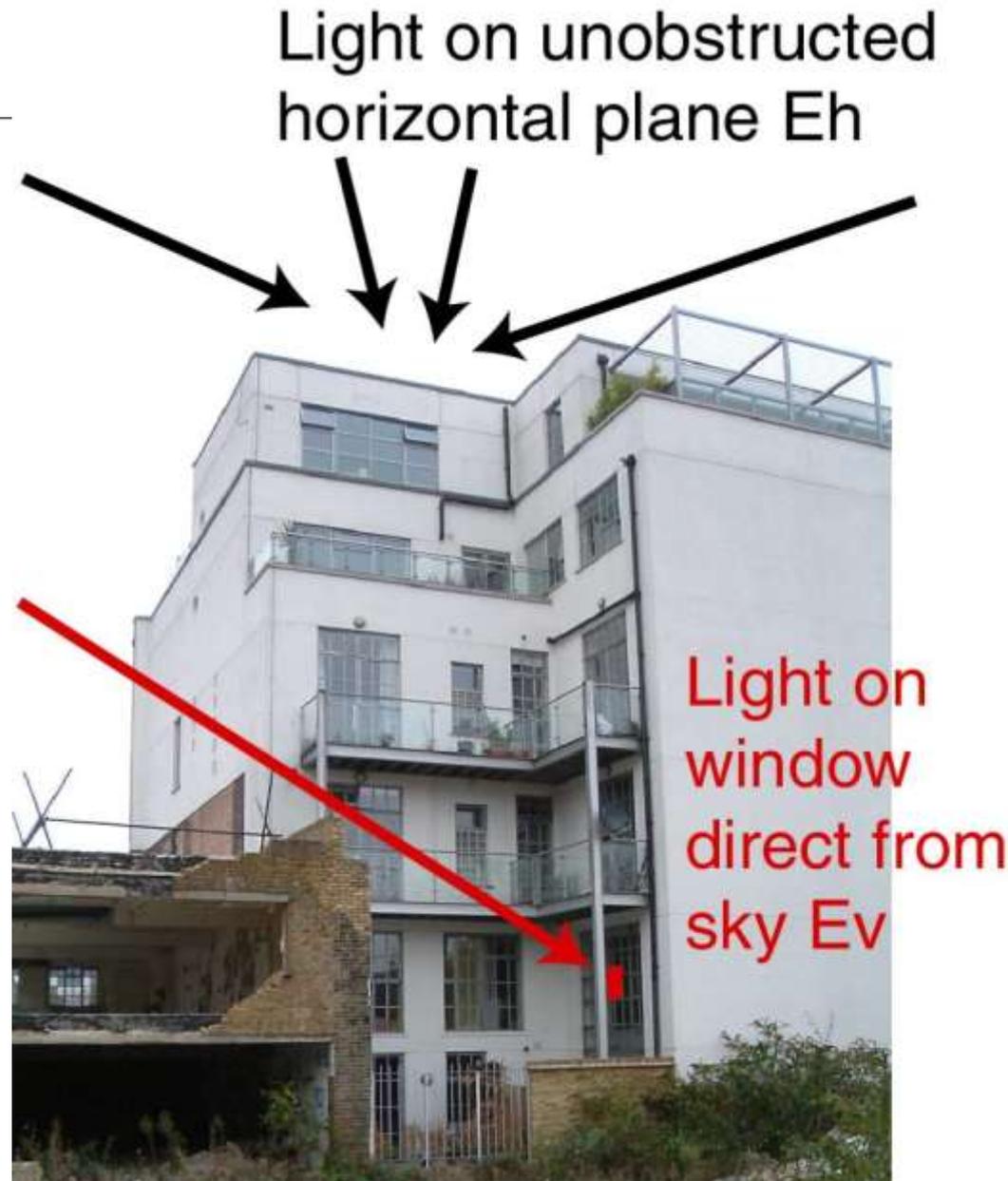
$$\text{VSC} = E_v / E_h \times 100\%$$

where E_v = direct sky light reaching window

E_h = light on unobstructed plane

Maximum value 40%

27% gives good potential for daylighting



Daylight in new dwellings

- Designers can compensate for obstructions by making windows larger, altering room layout



Light from the sky in new buildings

- θ greater than 65° (obstruction angle less than 25° or vertical sky component (VSC) at least 27%) conventional window design will usually give reasonable results
- θ between 45° and 65° (obstruction angle between 25° and 45° , VSC between 15% and 27%) special measures (larger windows, changes to room layout) are usually needed to provide adequate daylight
- θ between 25° and 45° (obstruction angle between 45° and 65° , VSC between 5% and 15%) it is very difficult to provide adequate daylight unless very large windows are used
- θ less than 25° (obstruction angle greater than 65° , VSC less than 5%) it is often impossible to achieve reasonable daylight, even if the whole window wall is glazed.

Daylight in new dwellings; average daylight factor

- The average daylight factor (ADF) is the average illuminance in a space divided by the simultaneous horizontal unobstructed illuminance outside, under standard overcast sky conditions.
- 5% ADF gives a well daylit space
- 2-5% gives good daylighting though supplementary electric lighting may sometimes be needed.
- BS 8206 Part 2 gives minimum values for housing of 2% for kitchens, 1.5% for living rooms, 1% for bedrooms

Home Quality Mark

- Average daylight factor is the basis for the daylighting credit in BRE's new Home Quality Mark
- Home Quality mark also gives credits for a range of other health based issues, including air quality, ventilation, temperature control, noise, space and access, safety, ...



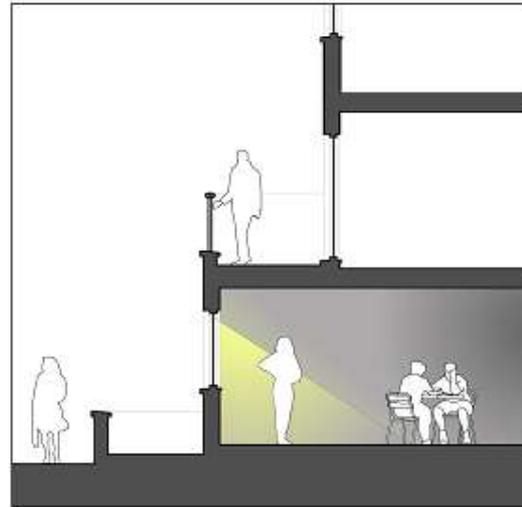
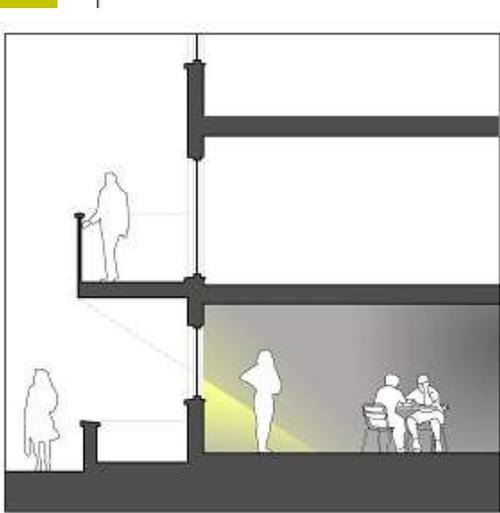
Problem areas- lower floors

- Modern buildings often have same windows on all floors
- Lower floors are more obstructed and need larger windows for same amount of light
- Disabled or special needs units are often situated on lower floors

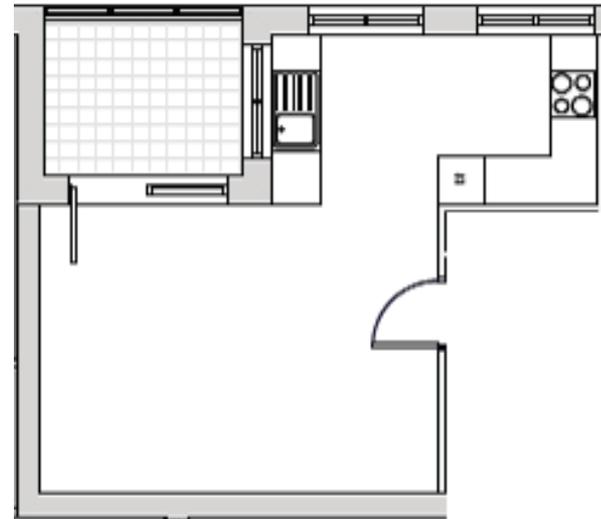


Problem areas: balconies and overhangs above

- Balconies or overhangs above a window will restrict daylight and reduce average daylight factor
- Consider stepping façade, staggering balconies, additional windows



Problem areas: winter gardens



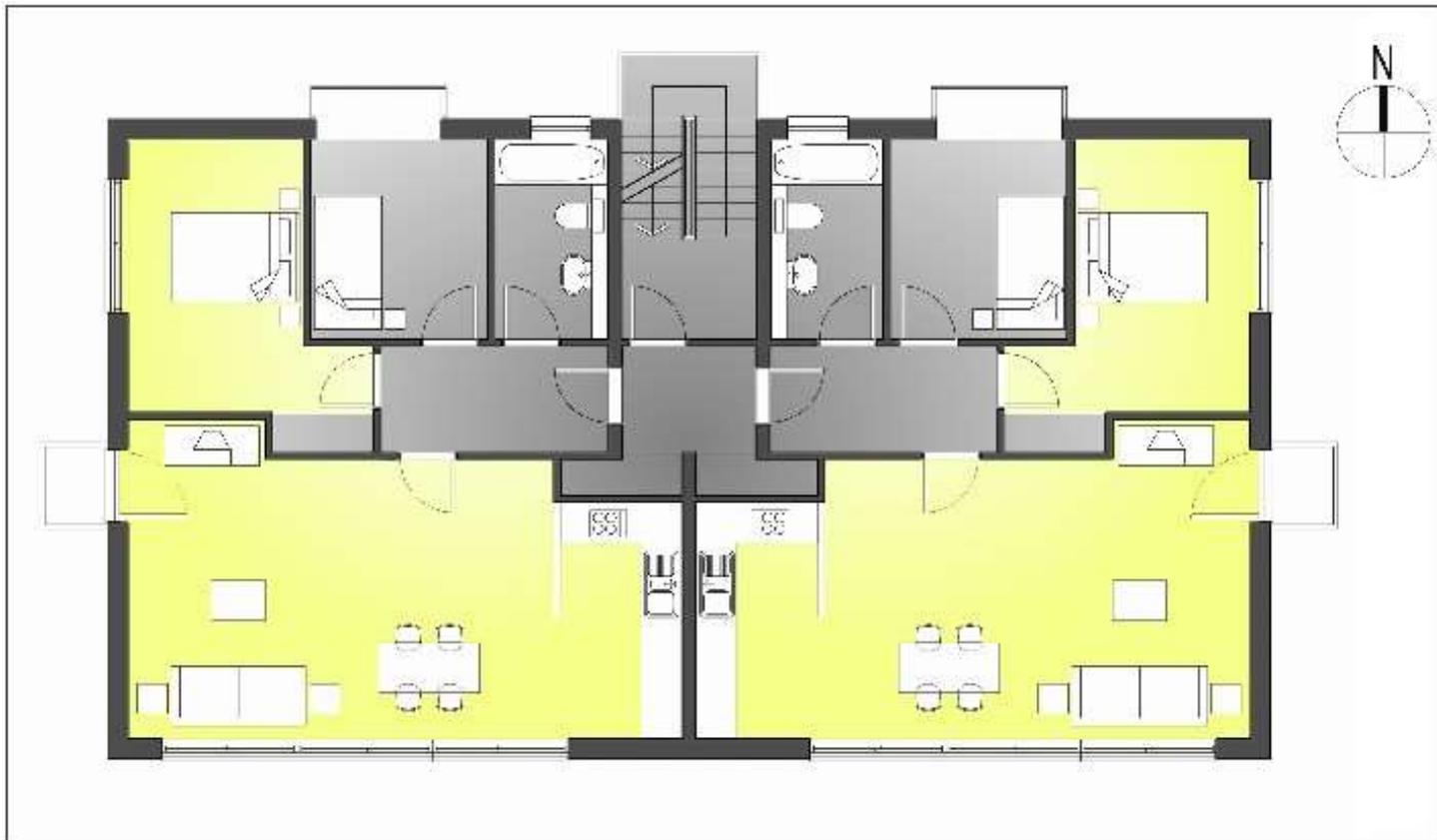
Sunlight: effect of orientation

- % of annual probable sunlight hours reaching an unobstructed vertical window wall, Manchester

South	88
South west	76
South east	75
West	53
East	47
North west	25
North east	24
North	12

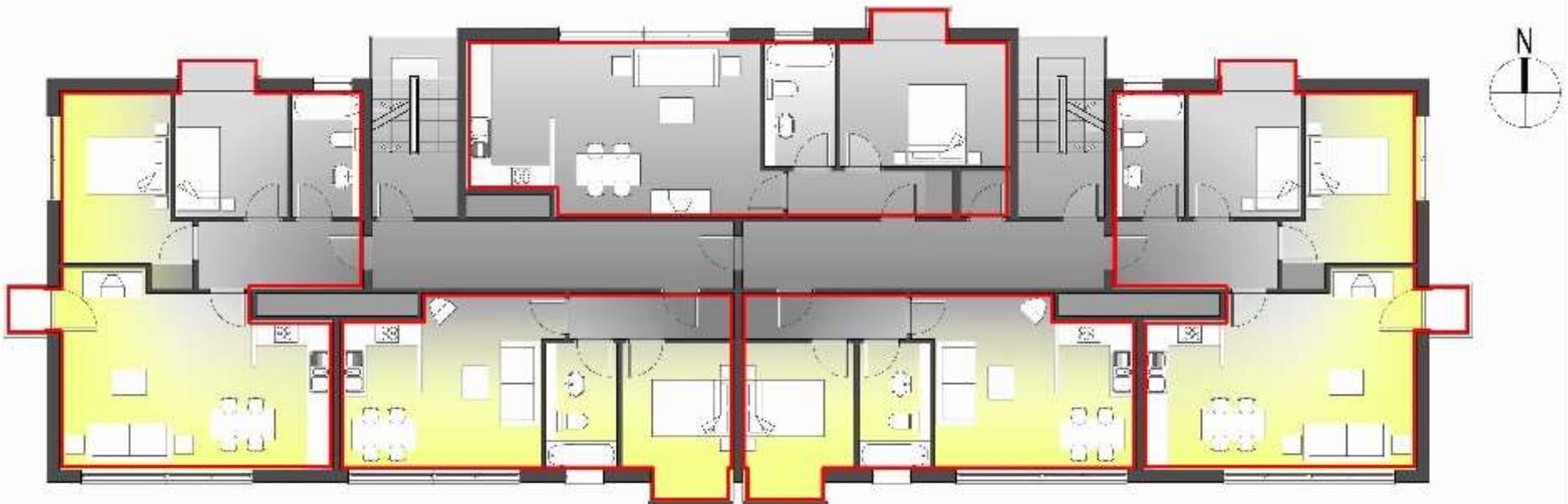
Sunlight in new developments

- Ideally new flats should have living room facing within 90 degrees of due south



Sunlight in new developments

- For a large residential development, maximise dwellings with window to a main living room facing south, east or west.



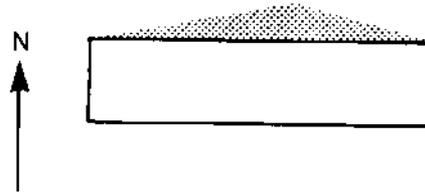
Sunlight: annual probable sunlight hours

- Sunlight can be quantified by calculating annual probable sunlight hours to main living room windows.
- Defined as hours of sunlight falling on centre of window in typical year, as % of unobstructed ground.
- 25% of annual probable sunlight hours year round, 5% in winter (23 Sept-21 March) is enough

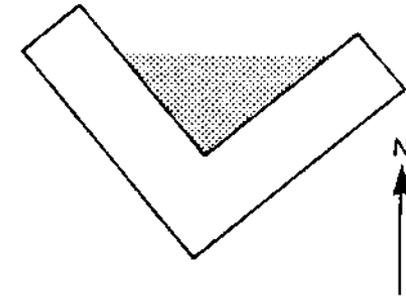
Sun in gardens, open spaces

Some layout types give poor sun on ground. The shaded areas receive no sun on March 21.

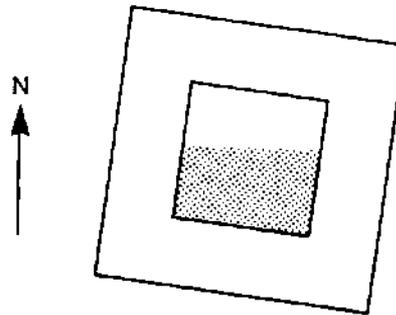
North-facing building



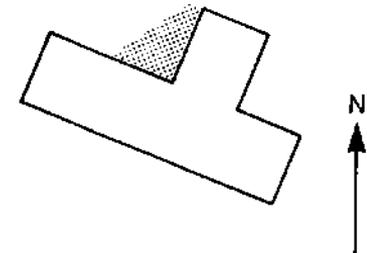
L-shaped block



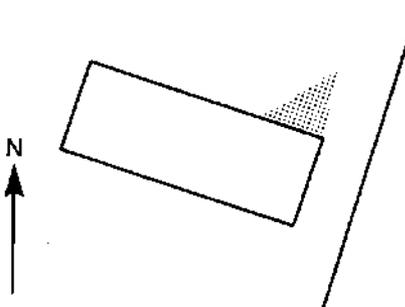
Courtyard



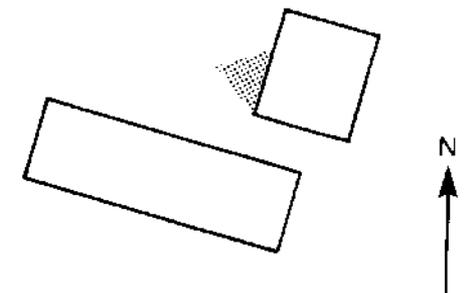
Extension



High wall and building



Buildings at an angle



Conclusions

- Daylight and sunlight have important health benefits
- In urban areas can be restricted by obstructions
- In problem areas, need extra glazing to have enough daylight
- Orient dwellings and arrange open spaces to maximise sunlight
- Guidance in BRE Report ‘Site layout planning for daylight and sunlight: a guide to good practice’



bre

Thank you for your attention

Stephanie.King@bre.co.uk

