GLAZING

• REAPING THE BENEFITS

• AVOIDING THE PITFALLS

Martin Ratcliffe
Visiting Research Fellow, Centre for Energy Studies at LSBU
Head of Roger Preston Environmental

CIBSE/ASHRAE Meeting  LSBU  May 12th 2004
GLAZING

Objectives

• Show that glazing
  – is important for occupant well being and productivity
  – can reduce energy consumption
  – can lead to thermal & visual discomfort

• Give guidelines on design of glazing
GLAZING

The Balancing Act

PASSIVE SOLAR HEATING AND DAYLIGHT

VIEW OUT / IN

EXCESSIVE COOLING/HEATING

THERMAL DISCOMFORT AND GLARE
GLAZING

Well-Being

• View Out

• Preference for Natural Light
GLAZING

Well-Being

• Feel Valued
• In touch with outside world
• Photophysiological Effects
GLAZING

Well-Being

• Increase in Productivity
Daylight

About 100 Lumens per Watt

– (artificial lighting = 50 Lm/W)
Daylight Factor

Indoor Illuminance
Outdoor Illuminance
GLAZING

Daylight

Daylight Factor for 100% glazing, clear glass

Distance from window

Daylight Factor

0.0 5.0 10.0 15.0 20.0 25.0 30.0

0 5 10 15 20

Martin Ratcliffe LSBU/Roger Preston
Environmental
Daylight and glazing

daylight transmittance

- clear low e
- clear with blinds (closed)
- ipasol 52/29
- strongly heat absorbing
Lighting Energy

potential energy savings with dimming photoelectric control
GLAZING

Overall Energy

![Graph showing energy consumption with different percentages of glazing. The graph illustrates the annual energy in kWh/m² as a function of % glazing, with lines for total energy, cooling, lighting, and heating.]
The Solar Process

GLAZING

DIRECTLY TRANSMITTED

REFLECTED

ABSORBED

RE-EMITTED

SHORTWAVE

LONGWAVE
GLAZING

Total Solar Gain

= directly transmitted (shortwave) + re-emitted (longwave)
GLAZING

Shading Coefficient

SC = SWSC + LWSC

Solar Gain through actual glazing
Solar Gain through clear single glazing
GLAZING

Solar Heat Gain Factor

“g-value”

Total Solar Gain

\[
\frac{\text{Total Solar Gain}}{\text{Incident Solar Intensity}}
\]
GLAZING

Peak Solar Gains - UK

Peak solar gain through east or west facing single clear glass

Martin Ratcliffe LSBU/Roger Preston
Environmental
GLAZING

Peak Solar Gains - UK

Peak solar gain through south facing single clear glass

W/m²

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
GLAZING

Thermal Comfort - Radiant Temperature
GLAZING

SHORTWAVE

depends on
  – transmittance of glass
  – external shading
  – internal shading
  – sun position
GLAZING

Longwave

• Depends on
  – glass/blind surface temp
  – glazing absorptance
  – window area
  – distance from glazing
Maximum Dry Resultant Temperature
100% glazing

includes shortwave solar radiation
Frequency of occurrence of dry resultant temp at 2m from the glazed facade

- Frequency is presented in hours per year for dry resultant temperatures ranging from 25 to 32 degrees Celsius.
- The chart includes data for both 3.5m and 5m BS, with 5m BS specifically indicating direct solar.

The chart highlights the following:
- There is a significant concentration of hours in the temperature range of 25 to 27 degrees Celsius.
- The frequency decreases as the temperature increases, with the highest frequency observed at 25 degrees Celsius.

This data is relevant for understanding the thermal environment near glazed facades and can inform design considerations for energy efficiency and comfort.
Asymmetric radiation
Variation in Asymmetric Radiation with distance from window and Glass Surface Temperature

100% Glazing to one wall, blinds closed, sunny day

- 50°C
- 45°C
- 40°C

Asymmetric Radiation, °C

distance from window, m
GLAZING

flexibility!

Solar gains vary with
  – Weather conditions
  – Time of year
  – Time of day
GLAZING

flexibility

Want a glazing system that can cope with this:

*Variable* solar performance
GLAZING

Possible solutions?

• Ventilated cavity

• Adjustable external shading

• Photochromic
GLAZING

Ventilated cavity

G=0.15
GLAZING

summary

- Opportunity to reduce energy consumption
- Improve occupant well being
- Improve productivity
- Potential for discomfort on sunny days
- Standard calculations not sufficient
- Need an adaptable system of solar control