VISUAL COMFORT ASSESSMENT OF DAYLIT OFFICE

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OBJECTIVE

To evaluate visual comfort/daylighting quality of office space with electrochromic glazing.

SIGNIFICANCE

High performance building fenestration systems that can reduce both solar loads and electric lighting loads have fascinated designers for many years. Electrochromic glazing has great potential in that they can continuously respond to changing solar and climatic forces.

While studies have confirmed that significant energy savings and peak demand reductions are possible, the impact of glazing at variable transmittance on the visual quality of the space have received less attention.

If it were better understood how electrochromic glazing systems impact the interior visual environment, it should be possible to design better control strategies for electrochromic glazing systems that better respond to users' satisfaction and preferences.

TECHNICAL APPROACH

This study proposes to evaluate daylighting quality of office space with electrochromic glazing at its maximum and minimum visible transmittance (T_v = 0.55 and 0.05) based on two performance indicators:

1. Calculated Daylight Glare Index; and
2. IESNA luminance ratio recommendation.

Digital images of the workspace were taken from two locations, from the back of the room – looking at window wall, and from the normal seating orientation – looking at sidewall and VDT task. The workspace images were taken from 9:00 to 17:00 on equinox and solstice solar conditions.

Luminance values were obtained from the luminance map, which was generated with PHOTOLUX image analysis program.

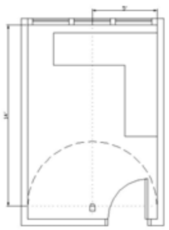
PRELIMINARY RESULTS

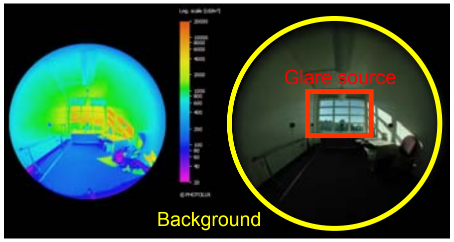
Preliminary results are presented in terms of Daylight Glare Index (DGI), calculated from the back of the room looking south with the assumption that window is the major glare source, and luminance ratio between VDT task and surrounding surfaces.

The results show that electrochromic glazing at its lowest visible transmittance (T_v = 0.05) can deliver a comfortable visual environment when compare with workspace with controlled condition (T_v = 0.55). At T_v = 0.05, Daylight Glare Index (DGI) were kept in the 'just acceptable range' for the whole day under equinox and solstice condition. In addition the luminance ratios were also kept within the IES recommendation.

Further assessment during the summer solstice condition is required before a visual comfort/daylighting quality characteristics of office space with electrochromic can be fully explained.

VIEW 1





Daylight Glare Index (DGI – modification from Chauvel's formula)

$$DGI = 10\log 10.478 \sum [(L_w^{1.6} * \Omega^{0.8})/(L_b + 0.07*\omega*0.5L_w)]$$

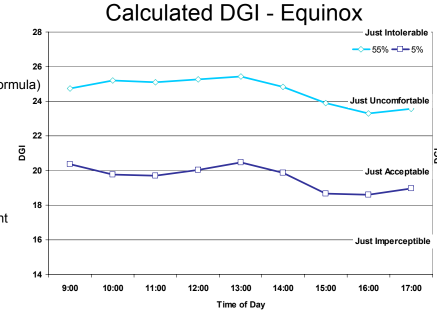
Where L_w = Lwindow (nits)

L_b = Lbackground (nits)

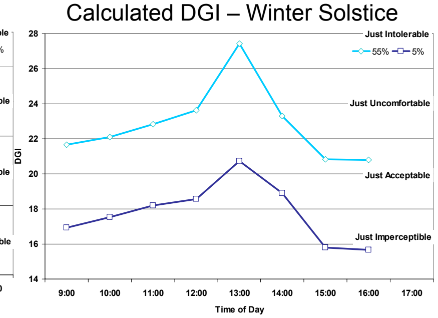
Ω = Solid angle subtended by the window, modified by the position of source (sr)

ω = Solid angle of the source seen from the point of observation (sr)

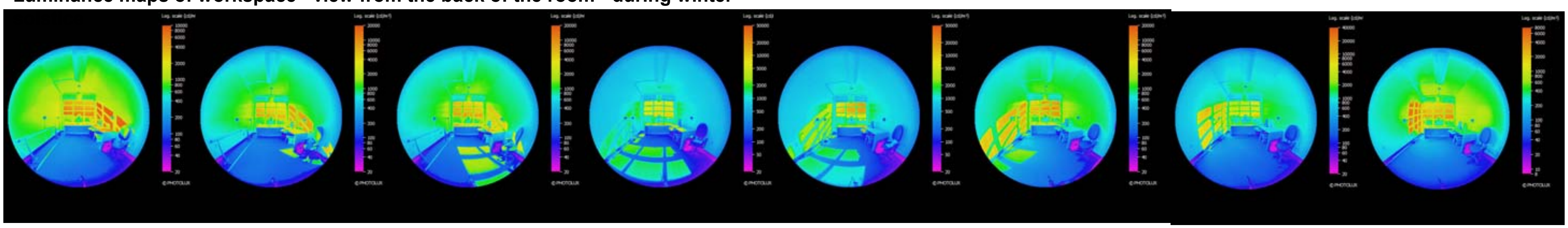
Calculated DGI - Equinox



Calculated DGI – Winter Solstice

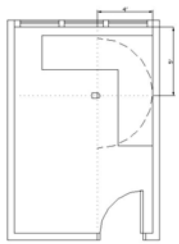


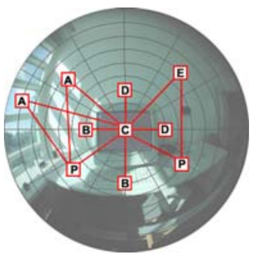
Luminance maps of workspace –view from the back of the room - during winter

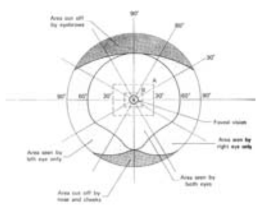


9:00 **10:00** **11:00** **12:00** **13:00** **14:00** **15:00** **16:00**

VIEW 2







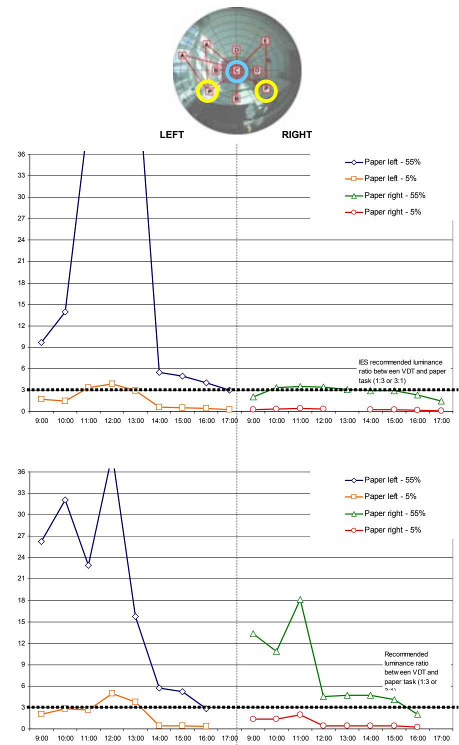
Equinox

Winter Soltice

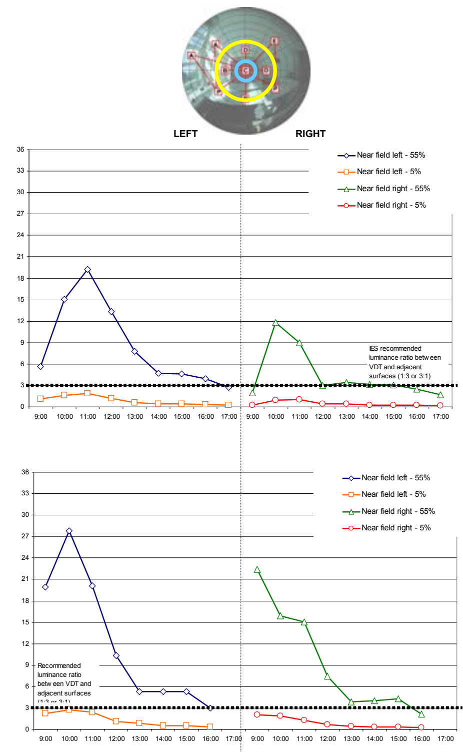
Recommended luminance ratio

Between VDT task and paper task (C:P)	1:3 or 3:1
Between Task and adjacent surface - 30° cone (C:B & C:D)	1:3 or 3:1
Between Task and remote surface - 60° cone (C:A & C:E)	1:10 or 10:1

Luminance ratio between VDT and paper task

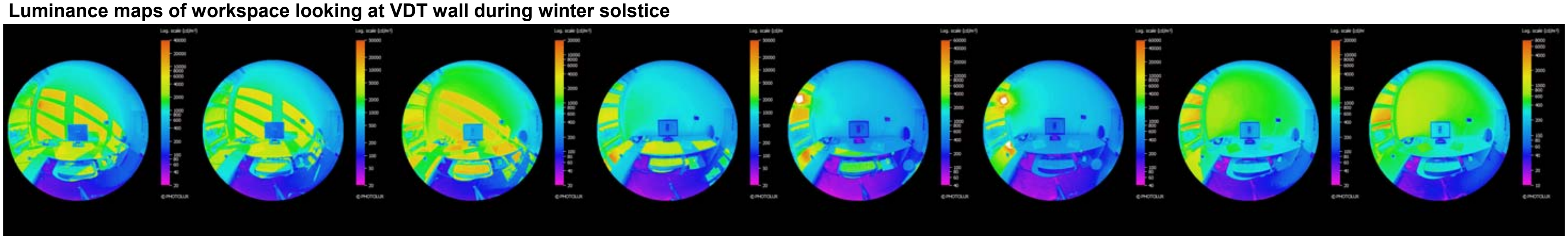


Luminance ratio between VDT and adjacent surfaces



Luminance ratio between VDT and remote surfaces

Luminance maps of workspace looking at VDT wall during winter solstice



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