Solar protection glazings and museum lighting

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Purpose

Daylight is widely considered as the most suitable light source for viewing works of art. However, if not properly controlled, it presents potentially harmful effects to their conservation, in particular by the energy of short wavelengths - the ultraviolet radiation. Damage quite as important, can be caused by the infra-red radiation content of daylight which may bring about undesirable rises and variations in temperature of the objects.

The potential damage inside the exhibition space when glazing and protection films are clear is obviously unacceptable. But the situation can be different when suitable solar protection glazing and films are applied to the daylight admitting openings. The present study has started with a colorimetric simulation, and has been followed by validation through real experimentation. The study demonstrates that the proposed installation of solar protection tinted glazing does not inhibit the good viewing of coloured objects.

Study

Colorimetric study

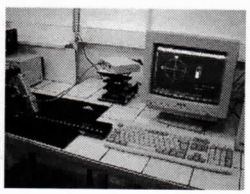
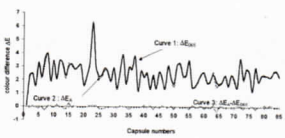


Figure 1: The colorimetric measurement - Colour differences between Farnsworth-Munsell caps and the adjacent ones

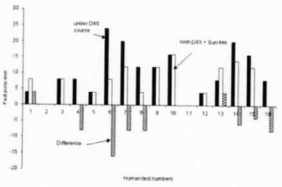


We used the Farnsworth-Munsell 100-Hue test[1] to find if discrimination of two adjacent couloured capsules (caps) is similar under the CIE standard illuminant D65 as under the CIE standard illuminant A. We measured the chromatic co-ordinates L*a*b* of every coloured cap, and then calculated the colour difference[2] ΔE^*_{ab} between one cap and the adjacent one, first with the CIE standard illuminant D65 (Curve 1, Figure 1) and then with the CIE standard illuminant A (Curve 2, Figure 1). Finally we calculated the deviation of the colour differences of the results (Curve 3, Figure 1).

These curves demonstrate that for both illuminants (D65 and A), the chromatic co-ordinates for the same cap are quite different, but the difference ΔE^*_{ab} for the colours remains similar from one cap to another, it is lower than 2 [3].

Psychometric study

Figure 2: Graph of the Farnsworth - Munsell test fault points repartition



The colorimetric study described above can be considered as a modelling of a real case, namely the view of coloured artifacts under daylight filtered by transparent glazing, which obviously transmits the different wavelengths of the visible spectra, as if they were illuminated by the CIE standard illuminant D65. On the other hand a glazing or a film with sun protection may transmit the light as if it is similar to CIE standard illuminant A.

For the present study we chose a film with a tint similar to that used in sunbathing devices. This film has the same visual effect than a temperature conversion filter used in photography to convert the daylight spectrum (5700 K) into artificial light spectrum (3200 K). A "ionized sputter" dark bronze[4] film used for sun protection was chosen.

Sixteen employees of the laboratory participated to this study. After spending a suitable time for adaptation, about 3 minutes, they performed the Fernworht-Munsell 100-hue colour vision test according to the normal protocol that is in a limited duration, under a normalized light D65 from a colorimetric control lightbox[5] . At the end of the test, the points following the number of faults are contend.

About one month later the same persons repeated the same test under light which imitated the sunlight transmitted through a sun protection film. After a few minutes of adaptation (no more than at the first test) the test was done according to the same protocol as the first time.

The results show that the rate of errors is not different than in the basic test (figure 2, table 1).

1. The Farnworth-Munsell 100 hue test is an effective method for determining colour vision abnormalities and testing colour discrimination. The set consists of 4 trays containing a total of 85 colored reference (12 mm diameter) caps. They are chosen from the Munsell atlas, of a lightness (Value) and saturation (Chroma). According to the chromatic order, they should be arranged in a continuous succession of hue.
2. We base our consideration on the formula of colour difference CIEL*a*b* 1976. It is an old formula, adapted to measure colour difference between two objects, but we apply it for finding the deviation between these differences.
3. According to Hunt (see Bibliography, p. 141), a deviation of 2 between two adjacent coloured caps of Chroma, is.
4. Film SBI 25 RS 500 SR Xylar filter (Vecteurs Applications, 37 boulevard Jean Allemane 95100 Argenteuil, France).
5. Light box GAMAIN M 6584 HF (31, rue des Annelets 75019 Paris, France).

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Results

1. Coloured caps from the Farsworth-Munsell 100-Hue have been tested under typical continuous spectra sources: the CIE illuminants D65 and A,. The differences in ΔE*ab between two adjacent caps are similar.
2. The same test, carried out by a psychometric method with human observers has confirmed these results.

This study has reveals that by using solar protection glazing or solar protection films, it is possible to obtain in the museum good colour perception of coloured art works.

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