

Let there be light

By Ernest Wotton

The word “museum” or “art gallery” instantly evokes a building: bold, imposing, worthy of civic and even national pride. The very nature of traditional museum architecture supports this view: think of the National Gallery in London, the Metropolitan Museum of Art in New York or the Museum of Natural History in Ottawa.

This emphasis on the building continues worldwide. There is the dramatic architecture of Frank Gehry’s Guggenheim Museum in Bilbao, soon to be joined by his recently-unveiled design for the Art Gallery of Ontario was unveiled recently. Daniel Libeskind will be represented in Toronto by the new Royal Ontario Museum, although his original spectacular use of glass has been replaced by stainless steel since. As *The Globe and Mail* reported, “ROM officials feared that too much light and humidity in parts of the building would damage fragile artifacts.”

The people who operate our museums and galleries are under pressure. Their performances are increasingly monitored in terms of attendance figures. There is no denying that the Bilbao Guggenheim draws tourists who would otherwise not go to the industrialized Basque city at all. Gehry’s architecture is the attraction. Yet in these buildings, it’s easy for the public to forget that a collection also has to be presented.

Display techniques, and what is to be displayed, are continually changing. Museum buildings must permit these changes. Flexibility is required, not only to give a new look, but also to make it possible to accommodate the exhibits which come crowding into any museum. Without flexibility there is sterility, and the museum becomes just another monument.

People go to a museum to look at things that give them emotional or intellectual stimulation. But with too much stimulation, the palate becomes jaded. The museum must therefore be designed so that the visitor can proceed through the exhibits at his own pace, a pace governed only by his curiosity to see what comes next, and with the opportunity of frequent relief from the exhibits.

Light is a key factor in producing this ambience. Accordingly, it must not be dealt with later; it must be considered right at the start as something without which the displays will not come off.

Good lighting recognizes the requirements of conservation, displays the artefacts in an appropriate manner, is appropriate to the ambience, is inconspicuous, and helps tell the story.

The first requirement is conservation. The museum curator, believing that for fragile artefacts the best light is no light at all, has the responsibility of ensuring that his exhibits are not damaged by too much light; by too high a temperature or by heating that is too rapid; by a wide variation in humidity, and so on. These requirements will include how much light the exhibits may receive and for how long; the limit to the heating from the lighting system, and eliminating the UV and restricting the deep blue components of the light - they are both dangerously photochemically active.

The need to meet the demands of conservation has had enormous influence on the design of museums and galleries. It brought about the change in the design of the ROM that has already been mentioned. And, for example, the Bibliotheque nationale de France, which opened in Paris in 1997, was originally conceived, to quote *The New York Times*, as “a complex of ethereal glass buildings filled with light”. Only then was the damaging effect of so much light on the books taken into account and interior shutters fitted to cut it down. The result, some critics say, is “an unremarkable collection of opaque towers”.

Gehry described his AGO in a stellar presentation to an audience of 1,300 that occupied every seat in the Toronto Convention Centre. He said little about the use of light. But the brochure *Transformation AGO* notes that “in ways sensitive to art conservation, natural light flows in through atrium walkways, open stairways, glass walls to the north and south, and new skylights”. These deep skylights appear to be similar to those at the Tate Modern. There they are lined with fluorescent lamps; the mix of colour of the light from these lamps can be changed to match the colour of the changing daylight.

Thomson's work at the National Gallery, London, led to recommendations calling for an illuminance (light level) of five foot candles (equivalent to 50 lux) on objects specially sensitive to light - textiles, water-colours, for example - and for 15 foot candles on more light stable objects such as wood, ivory, and oil paintings.

The current recommendations of the Illuminating Engineering Society of North America not only call for a maximum illuminance to which an artefact should be exposed but also the total exposure limits in terms of lux-hours per year. Thus for water-colours, the limits are 50 lux and 50,000 lux-hours annually - an exposure to an illuminance of 50 lux for 1,000 hours a year. An example of conservation in accord with this principle is the Menil Collection at Houston, Texas. The illuminance is monitored and objects which are approaching their recommended annual exposure are removed and placed in the dark.

No firm recommendations have been published for lighting digital prints. This is not surprising since they fade unpredictably, even in the dark. Carrina Parraman wrote typically that "we are guaranteed by ink manufacturers that some inks have, according to accelerated light tests, a life expectancy of 99 years. However, a growing area of concern among artists and conservators and collectors is whether these claims are true".

The lowest illuminance required for conservation is about the limit at which a young, healthy eye can see fine detail; but elderly people cannot. The population of people 60 years or more old is growing; they need more light than the young but, at the same time, they are more prone to glare. Moreover, pathological changes in the eye may distort colour vision. (2) The needs of older visitors to our museums must be accommodated although this may involve temporary, rather than permanent, changes to the lighting under the control of a time switch.

Today conservation invariably results in a low illuminance. Those of us fortunate enough to visit the Turner exhibit at the Art Gallery of Ontario will recall the explanatory note on that illuminance.(3) If one enters a space lit to this low level from the bright outdoors, then the space will, at first, appear dark and gloomy because the eye will have been adapted to the outdoor brightness. After a while, as the eye becomes adapted to the low illuminance in the museum, the space no longer appears gloomy.

Thus it is necessary to provide a transition zone between the outdoors and the exhibits in which the lighting is increasingly reduced as it approaches the exhibits. By passing through this zone, the eye becomes adapted to the low illuminance on the exhibits.

There is evidence that the artists's intention may not be realised with the low illuminance. A study by Crawford concluded that, even with normal sight, colour vision is not significantly impaired with an illuminance of 50 lux. However, the subjective sensation experienced by the viewer may not be what the artist intended until the illuminance is of the order of 300 lux.

Then the lighting must help the exhibit to be intriguing, in the sense that it helps to make the visitor wonder what is over here or around the corner. This does not call for bright luminaires in the ceiling - I have seen them - because our eyes are attracted automatically to the brightest part of our field of view when what we want to be drawn to are the exhibits.

Finally, the lighting must be appropriate. But although appropriate, one should not be able to notice how it is done, or even that it is being done. To quote Peter Stone, the eminent art critic, "Surely lighting that says 'Look how clever I am' is, by the very loudness of its statement, detracting from what it is supposed to light, however well it lights it."

There is an exception to this; it occurs in the use of period lighting devices in the display of historic interiors. These devices are visible - they are part of the history - but they cannot be relied on to provide adequate lighting in period rooms. Supplementary lighting from carefully concealed luminaires is required although this brings with it the problem of concealing both the luminaires and the wiring to them.

Then what sort of lighting?

Day lighting

Gropius, when talking about museum and gallery lighting said “the fleeting occurrence caused by the change in light is just what we need, for every occurrence seen in the contrast of changing daylight gives a different impression each time”. And English Heritage over 50 years later called for “natural light (to) be exploited as much as possible within the conservation limits set by the curator. Changes in colour and brilliance resulting from the weather, time of day and seasons, will be valued”. But the powerful effects of direct sunlight must be completely removed in most lighting applications, while diffuse skylight from the vault of the heavens must be reduced to, possibly, not more than 2% of that outdoors. This point has been made by Jack Harris who was responsible for lighting a number of UK galleries; he said “what usually happens in practice is that the architect designs for daylight (to suit his client’s requirements) at great expense and additionally provides, at even greater cost, systems for virtually eliminating it”.

Daylight is frequently controlled by a louvre system, the louvres being opened or closed to let in more or less diffuse daylight in response to signals from a meter in the gallery itself.⁽⁴⁾ At the National Gallery of Canada, in Ottawa, daylight collected by a large light shaft passes through such a system to flood the principal galleries with light and, at the same time, to provide an illuminance of 100 +/- 50 lux on the paintings. A delay is built into the system controlling the louvres so that a large variation of short duration in the daylight - as, for example, when a cloud passes overhead - does not result in a large change in the Gallery lighting. If one is a casual observer, a gentle change in the day lighting will not be noticed until a change of something like 40% has occurred. A permanent exhibition of aboriginal art is being mounted in part of the National Gallery. Some of the exhibits are particularly sensitive to light; consequently, Christine Fagan, the Gallery lighting designer, has the job of re-calibrating the louvre control system to provide a target illuminance of only 50 lux from daylight.

Jonathan David, a keen observer of the London lighting scene has reported that, in the North Extension of the National Gallery the “rooms have 100% daylight which feels like artificial lighting because it is so constant”. He made a similar report on the Clore Gallery at the Tate. In order to meet the requirements of conservation the “alive and dynamic” aspect of day lighting, commented on so favourably by Gropius, is lost. And Kit Cuttle, now teaching in a school of architecture in New Zealand, reported a survey showed that spaces with a high general illuminance from daylight – 1,000 lux or more - were most attractive. Where conservation recommendations had been maintained with a low level of daylight, the effect was generally disappointing; a “rather dull appearance” resulted.

Now a word about side windows. I taught in the Master of Museology program mounted jointly by the ROM and the University of Toronto. I got my students to survey the lighting in the museum. Without exception they reported that reflections of the bright windows in the display cases made it difficult to see the exhibits. The windows were subsequently blacked out.

Electric lighting

Using incandescent reflector lamps

Incandescent reflector lamps come in a variety of wattage and beam patterns and are widely used in museum and gallery lighting. However, the light from the lamp may be too “warm” for use where good colour discrimination is needed. Ruhemann, an experienced restorer, wrote of the lighting then at the Metropolitan Museum of Art in New York City that “spotlights of a warm sunset hue illuminated the pictures. They killed the delicate blues and greens so characteristic of Cézanne and thereby robbed the paintings of their distinction. After a brief and friendly argument, the director in charge agreed with my criticism of the lighting”. This report did not state if the lamps were dimmed to provide a specified illuminance. Incandescent lamps inherently emit a lot of their light in the red part of the spectrum so that blues and greens are dulled. This effect is even more pronounced when a lamp is dimmed; the light then becomes “warmer” as the proportion of red light is increased. For this reason the National Gallery in Ottawa has a policy of not dimming incandescent lamps.

Reflector lamps can be used with a “daylight” filter which reduces the red component of the light. At the same time it absorbs most of the UV radiation from the lamp reducing it from about 70 to 10 uW/lumen.

The lamps may also be used with a lens to achieve a particular distribution of light. The lens should be of iron-free glass; otherwise it will act like a green filter between the light and the object being illuminated.

Using fluorescent lamps

Fluorescent tubular lamps have long been used in museum lighting. The designer is no longer restricted to lamps 1 1/2" diameter; slimmer lamps are now available down to those only 1 1/4" diameter. The use of the slimmer lamps has meant a reduction in the size of the optical device - frequently a reflector - controlling the light from the lamp; the device can be fitted unobtrusively into a display case.

An indication of the way the light from a lamp - any lamp, not only a fluorescent lamp - affects the appearance of coloured objects is given by its colour rendering index (CRI). For museum work where good colour is required a minimum CRI of 85 is usually specified, but it is always necessary to inspect the artefact to make sure that it responds well to the light from the lamp.

Fluorescent lamps emit UV radiation on average about 140 uW/lumen; thus a typical 48" 32W fluorescent lamp will emit about 1/2W of that radiation. Consequently, fluorescent lamps are usually used in conjunction with a UV filter; it can be built into the luminaire or, in the form of a tube, slipped over the lamp.

A ballast is required to operate a fluorescent lamp. Until recent years, this was a magnetic transformer device; it gave off an audible hum - quite loud when used with a high wattage lamp. Nowadays, an electronic ballast is used; it operates the lamp at high frequency and may enable the lamp to be dimmed easily. But although that frequency is beyond the range of the human ear, an electronic ballast is not quite silent; it contains a small magnetic component which emits noise, although the noise is much less than that from the earlier ballasts.

Using a fibre optics system

In this system, light from a lamp is projected into one end of a bundle of very thin cylindrical plastic or glass fibres - called a tail - and travels to the other end by the process of total internal reflection. The emerging light is controlled by a simple lens or reflector and contains none of the IR and almost none of the UV generated by the lamp. If the tails are long there may be a shift in the colour of the light from the lamp towards the green end of the visible spectrum although the extent of the shift depends on the material of the fibres.

Metal halide and tungsten halogen lamps are commonly used as the light sources. The lamp assembly, which may include colour filters, is housed in a box called the illuminator, which is connected to the power supply. Thus, the electrical connection is remote from what is being illuminated.

When a tungsten lamp is used as the light source, the illuminator is almost always fitted with a cooling fan. The noise of the fan may be intrusive.

Using light emitting diodes (LEDs)

The little light that shows your computer has been switched on is an LED. Today the major lamp companies have formed partnerships with semi-conductor manufacturers to develop LEDs for conventional lighting applications. LEDs particularly lend themselves to display case lighting; they are small; their light is emitted forward in a variety of beam patterns; and that light contains no harmful UV and IR radiation.

Good white light from a LED has been difficult to obtain. In some applications it has been produced by combining the light from red, blue and green LEDs in the same device. However, some individuals with colour deficiencies in their sight may not see that light as white.

But LEDs emitting white light from 4,500-8,000K and with a Colour Rendering Index greater than 80 are available; with these high colour temperatures the light is "cool". Recently, a 3,200K LED with the very desirable CRI of 90 has been announced.

Helping to make the museum user friendly

Labels describing exhibits should be designed primarily to be easily read, not for elegance. This calls for a large type face in contrast with its background - say, black on white. If the label is glazed, the glazing must not carry bright reflections of the lighting system; they obscure the legend.

Footnotes: Each footnote to be placed at the foot of the appropriate page - not lumped all together.

(1) "To house Mr. Tate's bad pictures" to quote Sickert, who was a friend of Whistler.

(2) Many people develop cataracts, which blur vision and distort colours, usually by making blues less bright. In his early paintings, Monet's white and blues were unalloyed. Then the whites and greens became yellowed and the blues purple. In 1928, Monet had a cataract operation that partially restored his sight. He then "started enthusiastically retouching his paintings until his friends and relatives persuaded him to stop".

(3) In 1900 the collector, Henry Vaughan, bequeathed 38 of Turner's paintings to the National Gallery of Scotland with the stipulation that they be shown annually - but only in January when they were least at risk from sunlight.

(4) Shades "were to be down when the sun shone on them but when visitors are expected there is to be some servant who is to pull up all these shades before the visitors come so that the shades will not be visible."

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