The Cleveland Museum of Art: Lighting for the Twenty-First Century

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HISTORIC CONTEXT

The Cleveland Museum of **Art** opened in 1916. The process which resulted in the finished edifice actually began in 1881 when philanthropist Hinman B. Hurlbut decided to leave the bulk of his estate and his art collection for the establishment of an art museum for the Cleveland community. In 1890 Horace Kelley left the majority of his estate "for the purpose of purchasing land and the erection thereof in the city of Cleveland of a suitable fireproof building to be used forever as a gallery of art for the reception and exhibition of fine paintings, drawings and sculpture, either purchased, donated or loaned, and said building also to be used in part as a college for designing, drawing, painting and other fine arts and for the advancement of the same" [1]

The local newspaper, the *Cleveland Leader,* editorialized concerning the proposed Art museum on December 12, 1890:

> The refinements and graces of life cluster and flourish around such a center, and the city will be far more metropolitan, far more independent and enlightened, than ever before. Nothing else in Cleveland will give such distinction to the city which is soon to be the metropolis of Ohio. No other attraction will be so strong to persons of culture and refinement, from within its limits. Within a few years the art museum, so long desired and now assured, will be the chief pride of the community. It will go far toward making art popular and the appreciation of art common, and it will serve to balance somewhat the purely commercial and material development of Cleveland. Such institutions are the noblest of monuments and the finest of memorials. They earn the heartfelt gratitude of every enlightened man and woman, and do only good continually.

Trustees were named to develop the museum. In addition to the usual political and business decisions concerning the location and the obtaining of the necessary land, the trustees began to investigate the type of building they sought. This was prior to the 1892-1893 World's Fair which made classical public buildings popular. They visited the Metropolitan Museum of Art in New York and rejected the idea of this building because of what they termed to be its ugly appearance and the failure to provide its major goal, that is, the necessary light to be able to view the art objects displayed in the spaces. The trustees determined that they had two goals for the new museum. One, it must be beautiful. Two, it must be naturally lighted, and to accomplish that with the best overhead light, the building should not exceed two stories in height. It was accepted that painting artists created their work with overhead natural light.

In 1892 a site was chosen and received as gift in the relatively remote part of the city now known as University Circle. The site was a privately owned and operated park. This site was chosen because it allowed a separation from the pollution of the downtown industrial area and it was adjacent to the college now known as Case Western University. Today that area is the cultural center of Cleveland. Nearby stands Severance Hall, the home of the Cleveland Orchestra, the Museum of Natural Science, the Institute of Art and the Institute of Music, hospitals and several other museums and schools. The *Cleveland Leader* editorialized :

> ... a magnificent temple of art will stand in a beautiful park which is already the most popular outdoor resort in Cleveland ... Colleges will be in immediate proximity ... The visitor can turn from the glories of art to the loveliness of nature ... All the surroundings ... most befit the study and enjoyment of the beautiful ... a feast of the beautiful is better enjoyed when it is a little apart from the associations and surroundings of business life.

The site provided the opportunity to have plenty of access to natural light.

In January 1900 a building committee was appointed to investigate the best method of employing architects and how to best build the museum. The committee chose to educate itself by conducting a survey of art galleries in the United States. They gathered catalogues and reports as well as architectural plans for museums. Their intention was to select not only an architect but the style of building as well.

The Albright Art Gallery opened in Buffalo in 1905 and became a model to the committee. It was decided that the museum would be of classic Greek architecture.

At a special meeting of the Cleveland chapter of the American Institute of Architects held on June 10, 1905 a resolution was adopted to urge that Cleveland architects be employed for important public buildings. The building committee spent considerable time determining who would be the architect. Discussions were conducted with both local firms and firms outside of the Cleveland region. On September 4, 1906 the committee voted to hire Hubbell and Benes, a local Cleveland firm, who had prepared drawings voluntarily of an initial idea for a Palladian style museum. Edmund M. Wheelwright, consulting architect for the Boston Museum of Fine Arts and an east coast architect, was hired as a consultant.

Hubbell and Benes immediately began working on a design that focused on the external appearance and the view that the building was a work of art in itself, seen as a classical object in the park setting. Wheelwright saw the problem as one of fulfilling the functional needs of an art museum with the external appearance a secondary consideration. He submitted a report with the following recommendations and suggestions:

1. Top-lighted galleries increase hanging space and allowed an axial floor plan so as to provide "dignity" to the displayed works.
2. Side-lighted galleries take up valuable wall space and the viewers need to move close to the walls so as to avoid direct glare from the windows. The result is congestion and the loss of axial importance for the displayed works. Also, the walls need to be beveled to allow for all pieces to receive equal amounts of illuminance.
3. Side-lighted galleries create the impression that each work is an individual piece with little connection to the adjacent works. The observer connects with the individual piece more so then in a top-lighted gallery.
4. Until the eighteenth century no paintings had been hung in top-lighted galleries and therefore important older pictures were best served in side-lighted galleries.

The architects developed several ideas on the site plan. Finally, at Wheelwright's insistence a new site plan was developed orienting the building on an east-west axis. That orientation provides a maximum of north light and avoids shadows of higher parts of the building on the skylights and windows. Hubbell and Benes accepted this idea stating that "a southern exposure best displays the beauties of a facade."[2]

In 1911 after several frustrating attempts to develop more grandiose two-story schemes that ran into excessive construction costs, the architects sold the concept of a one story building that achieved a monumental scale appropriate to the importance of the building on the site. Actually, it was and is a two-story scheme with the northern rear level entering at the first level and serving as a service level while the exhibition main level is entered from the south through a series of monumental stairs and terraces. The interior is simple and symmetrical. Arrival is in a central octagonal rotunda from which visitors move and circulate to explore the surrounding galleries.

To the east and west of the central rotunda are two courts oriented on the east-west axis. Each is 46 feet by 85 feet in plan with ceiling heights of 34 feet. Surrounding these courts are the individual exhibition galleries. All galleries have

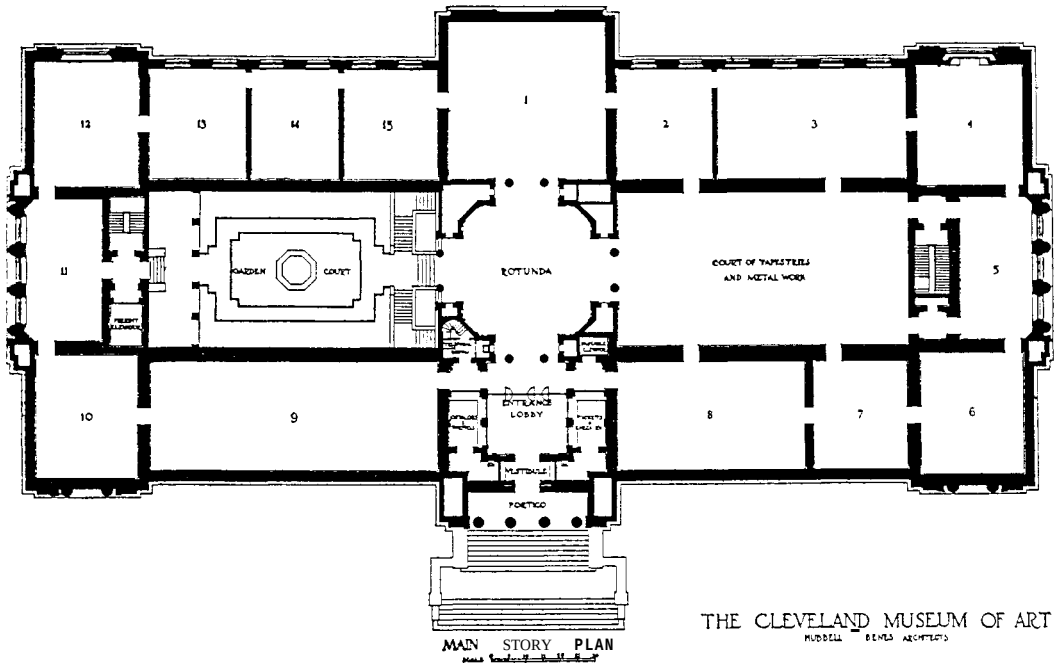

Figure 1. Floor Plan of Original Museum

provision for overhead light and with the exception of the south galleries, have side-lighted sources as well.

The final plans approved on November 17, 1913 included floors of dark oak so as to not compete with the focused brightness of the vertically displayed paintings and sculptures. The walls were natural cream or buff color to serve as a background while retaining a warmness to go with the natural and artificial light.

ORIGINAL SYSTEMS

As none of the building committee nor the design professionals had experience in lighting design, a committee of local lighting experts was formed, headed by Dr. Edward P. Hyde who was researching the production of light and its impact upon humans at General Electric's nearby Nela Park.

Lighting design goals were set to achieve the best possible lighting systems. (1) Daylight was to be the standard for the electric light. (2) Floors and ceiling brightness were to defer to the focused brightness on the wall displays and be designed in balance with that brightness. (3) In this connection, the vertical light was not to be out of proportion with the light directed at the walls. (4) Viewing angles were to be considered when designing the display lighting so as to not create veiling reflections on specular displays.

The greatest attention was devoted to the design of the top-lighting of the galleries. The skylights are designed as gable-roof formed transparent openings in the roof. Below these roof openings are crystal glass horizontal ceiling panels designed to soften and direct the daylight to the wall surfaces. The space between the two transmitting surfaces acts as an attic space in which are placed the physical structure, electric light sources and adjustable metal louvered lighting control devices. These louvers are operated by electric motors and controlled by manual switches located in the galleries. The louvers control or eliminate direct solar radiation and direct the reflected diffuse light to the vertical wall surfaces to the wall surfaces and eliminates excessive vertical light. The system proved to be an effective and inexpensive control system that required considerable effort to design. Louver size, shape and location had to be determined.

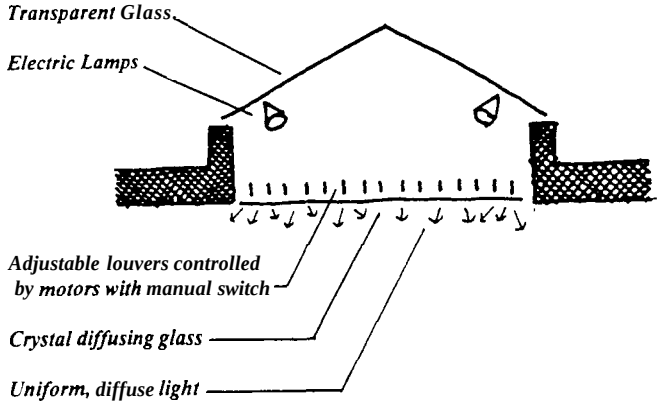

Figure 2. Skylight Section

At the time of the design, electric lamps were a new technology. They were placed in the attic cavity to reinforce and augment the daylight. This approach allowed the design to avoid having the electric light sources located within the galleries as additional objects. The hidden locations were determined to best light the displays and avoid the creation of hot spots on the ceiling.

The Cleveland Museum of Art was the first large museum fully lighted by electric light. It was cutting edge technology that achieved psychological as well as functional goals and set the standards for the future. The technical details took over four years to design. The original systems in this building are part of the character and history of the museum. On June 7, 1916 the museum was opened to the public.

PRESENT CONTEXT

Although three additions, including Marcel Breuer's 1971 new north entry and central arrival lobbies, now provide increased area and facilities for the museum, the original 1916 southern front serves as the heart and soul of the nature and character of a truly significant building.

Today, the Cleveland Museum of Art finds itself in the difficult position of attempting to achieve a technological environment appropriate to the high quality exhibited by its holdings. Although the technical systems were originally designed with these same high standards, change in technology has greatly outpaced the relative change in the art the building displays. This is a prime example of the principle that to maintain a quality environment, the technical systems must be updated, changed and maintained more frequently than the functional and aesthetic systems of the built environment. The rate of change in technology is great.

MUSEUM LIGHTING TODAY

The current concern for the museum community is to discover how the best lighting technology can be incorporated to provide the best viewing. That is, an environment which not only uses the latest lighting systems, but one which provides lighting performance fulfilling the highest and latest standards of the art and science of lighting.

Lighting technology is today defined by the performance capability of electric lighting systems. The control available with respect to direction, color and time allows the definition ofperformance standards which exceed that control achieved through daylighting systems. The results are that contemporary lighting design quality in a museum environment is defined within the framework of the capability of electric lighting systems. Daylighting systems provide expressions of the past context in which much of the art was created and the psychological and physiological benefits of connection to nature and the exterior world. The values of the luminance on the art objects are defined in terms of the electric light. The daylighting luminance is secondary to the electric lighting.

In order to minimize the degradation of the displayed

objects, lighting design in an art museum is characterized by the minimization of light quantities. Conservation and display of art materials requires a balance between visibility and the prevention of material degradation, particularly, the shifting of colors because of the elimination of the most vulnerable color pigments. The least amount of light necessary to provide the visibility of the artifacts will best provide the environment which maintains and prolongs the life of the displayed objects. Colored materials will inevitably fade over time in response to light radiation as well as ultraviolet and atmospheric conditions. As visible light provides the greatest amount of radiant energy in these environments, it is the radiant component which requires the greatest amount of control. The best control to minimize deterioration is to control the cumulative amount of time and amount of radiation to which the items are exposed.

This standard of lighting design is defined in units of visible illuminance and time. In English units this unit is defined to be footcandle-hours (lux-hours in metric units). Noticeable fading occurs in dyed materials after fifty thousand footcandle hours up to one million footcandle hours. In exterior window displays, this quantity of radiation can occur after a few weeks of display. In controlled museum displays, this typically produces life spans of displayed material for public viewing of five to one hundred years. Some standards set 200 years life as a goal.

Based upon this data, the Illuminating Engineering Society (IES) currently recommends that annual exposure of displayed fabrics be limited to 12,000 footcandle-hours. At a rate of 300 days per year, eight hours per day this recommendation provides a lighting level of only five footcandles on the displayed items. Assuming the brightness contrast focus is upon the objects, this means a very low level of ambient lighting throughout the museum.

A 1987 study by K. Cuttle indicated that observers desired illuminance of up to 20 footcandles in order to appreciate oil and watercolor paintings. At this rate, paintings could be displayed from two to three months per year to fulfill the IES recommendations. Another factor revealed by this particular study is that observers preferred warm white light sources at these relatively low illuminance levels. Incandescent lamps, including halogen, are the preferred sources. These lamps provide not only the preferred color rendering but also ease of application, dimmability, interchangeability and a variety of optical types and wattages.

Ultraviolet energy with respect to electric light is of limited significance in this study because the ultraviolet energy produced by current electric lamps is a very small percentage (1-5%) of the total emitted energy and there are available filtering techniques to eliminate this energy from being transmitted to the environment. Ultraviolet energy in daylighting is a significant factor. Typically, 7-14% of this energy is in the fonn of ultraviolet energy. Together with the fact that daylighting levels are generally significantly higher than electric levels, the design of daylighting is a very difficult task within the constraints of the IES recommended 12,000 footcandle-hours per year.

A concern with dealing with the issue of footcandle-hours is that light meters are typically corrected to model the vision sensitivity of the human eye. The radiant energy that is producing the degradation of the displays does not follow that profile and correction must be made or meters that do measure actual radiance must be used in measuring footcandle levels. Photographic flashes produced by cameras within the environment or by copy making machines have little impact by these standards because of the very short period of time involved at the relatively high levels of footcandles.

DESIGN RECOMMENDATIONS

Henderson, McGowan and LaGiusa have investigated these studies, recommendations and data and have arrived at the practical guidelines for "minimizing degradation of highly light-sensitive objects":

Priorities

1. Limit light level exposure to 12,000 footcandle-hours per year (dyed silk, paper, cotton fibers and color photographs). Moderately susceptible materials (dyed wool) may be limited to up to double this level.
2. Reduce the intensity of light and/or duration of exposure to the minimum needed for viewing. Use time controls, viewer-sensing or manual switches or art covers to control exposure duration.
3. Rotate display items to provide 'rest' periods.
4. Block direct sunlight or skylight, both of which are potentially more harmful than most electric lighting.
5. Control daylight with blinds, shutters, draperies, filters or by indirect illumination and UV-absorbing finishes such as zinc oxide or titanium dioxide-based paints.
6. Place the most sensitive items in the lowest ambient light settings within the exhibition area to permit more dramatic contrast at the lowest intensities.

Other

1. Be aware that dimming incandescent and halogen lighting will lower the color temperature producing a 'warmer', more candle-like, color.
2. Minimize UV radiation by means of filters over sources, or over displayed materials, or more 'specifically by means of glass and plastic products with special UV filter media.
3. Use enlarged photos of objects for detailed viewing at higher levels.
4. If electric light sources are used in enclosed displays or at relatively high light levels, reduce the radiant heating by using the more efficient display lighting sources such as halogen lamps and those with 'cool beam' characteristics, or, add heat filters to standard lamps. Vent closed cases.
5. Control humidity to a stabilized value at all times. [3]

ARCHITECTURAL LIGHTING STUDIES

At the present time, the lighting design staff of the Cleveland Museum of **Art,** under the direction of lighting designer Jeffrey Strean, is designing and installing new lighting systems one gallery at a time. The Kent State University School of Architecture environmental technology class is providing assistance by using the individual gallery spaces as lighting design projects. This project was conducted during the Fall, 1995 semester.

The class was divided into four-to-five-person teams with one gallery space per team as the assignment. Twenty-one different galleries were studied, ten of which are in the original building. The remaining eleven galleries are in subsequent additions to the original building.

We have learned a great deal through the process. The project brought together the ideas of a historical building in the urban environment, the scientific/engineering issues related to human seeing and the preservation of valuable objects and the real-world balance needed in the use of technology and resources.

The class was asked to:

1. Visit the museum and analyze the existing lighted environment. Due to the lack of adequate measuring equipment, only horizontal footcandles were measured. A more detailed measurement of the environments remains for a future study.
2. Build a 1/2"= 1'-0" physical model of the gallery to study daylighting. If no daylighting existed in the gallery, the team was asked to propose a daylighting system.
3. Propose an electrical lighting system and modifications or improvements to the daylighting system.

RESULTS OF ARCHITECTURAL STUDIES

Approximately 20% of the galleries in the museum had already been retrofitted with new electric lighting systems and, in a few cases, modifications of the daylighting systems. A review of these particular spaces made it apparent that, in fact, improved lighting was possible. The improvements were evident in the better level of brightness contrast, focus and control of the light on the surfaces. The new electric lighting systems consisted of track lights with PAR-38 halogen lamps. The flexibility of lamp mounting and aiming makes this the system of choice for museums. Where greater control and less light travel distance is required, miniature reflector (MR) lamps are utilized. This was the typical display case lamp.

Observers are able to focus on the art objects and see greater amounts of detail. Glare on non-critical surfaces and from light sources is less. The balance of luminance ratios on all spatial surfaces in relationship to the brightest focus on the art objects provides better visual comfort. Ratios are within the 1:2 to 1:5 range. The pattern and organization of the luminaires on the ceiling is more orderly than the periodically installed track systems of the non-retrofitted galleries. With these improved qualities the movement into, through and exiting from the individual galleries improved.

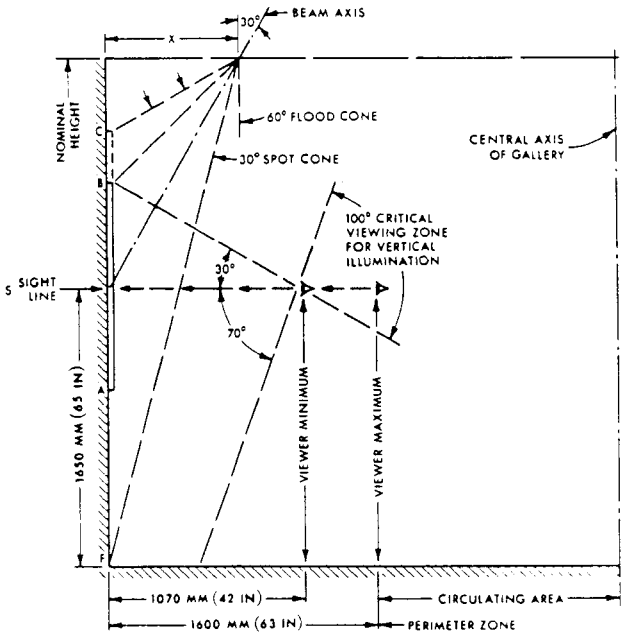

Figure 3. IES Recommendations for Vertical Display Lighting

The strength of the museum is the wide variety of its holdings. Each gallery represents a different style and period. The more classical, traditional exhibits require greater amounts of contrast to provide focus upon individual objects. Dark wall backgrounds and ornate detail characterize these spaces. Lower overall lighting levels predominate. In contrast, the more contemporary, modem galleries require higher brightness of more uniform lighting levels. Uniform white and off-white spatial surfaces serve as the background to the art objects. The transition in lighting levels from adjacent gallery to adjacent gallery often imposes brightness adaptations which require more time than typical human movement allows.

The effort to maintain and use the daylighting systems has been minimal to non-existent. In the majority of cases the daylighting systems have been painted to reduce the transmission of light to minimal levels. The louver control systems are ignored. Vertical windows are, in some cases, covered so as to be ignored in the interior. In other instances, they lack control and provide excess visual glare in the normal field of vision. One space, the "Egypt" gallery, has had the windows treated with a mesh type of interior shading curtain. The windows view out into an exterior courtyard. Together, with a new electric lighting system, the result is the best lighted gallery in the museum.

The model studies indicated that the daylighting systems did have a role to play in the lighting of the galleries. The best solutions prevented the daylighting from flooding the space with top light. but reflected the top light to the highest portions of the vertical enclosing walls. Several of the existing galleries exhibited a weakness in this regard. The highly focused brightness on the vertically mounted art objects at human eye height overpowered the remaining

higher portions of the 15' - 25' high spaces. the ceiling cavities appear dark and gloomy. The reflection of the daylight to these higher surfaces greatly improves the environmental quality while at the same time keeping the high amount of daylight ultraviolet energy from striking the art objects. some student proposals are to achieve this same impact with recessed, indirect fluorescent lamps where daylighting is not easily available.

CONCLUSION

The best electric lighting design of the Cleveland Art Museum is achieved with the use of track lights and PAR and MR halogen lamps. The benefits and value of the original skylighting systems is currently overlooked. The reasons are the cost of maintaining and operating the systems, the recommendations to avoid daylight because of the dangers of deterioration of valuable artifacts and failure to recognize the improved spatial quality achieved with the daylighting. It is our goal to pursue further studies of the existing skylighting systems so as to discover means to operate the systems to the best advantage of the museum of art and demonstrate that valuable benefit.

REFERENCES

[1] *Cleveland Builds an Art Museum,* Walter C. Leedy, Jr., 1991; The Cleveland Museum of Art., p 5.
[2] Ibid ., p.29.
[3] "Light Sources and Dye Fading," Henderson, A.J., LaGiusa, F.K., McGowan, T.K., 1990; GE Nela Park, Cleveland OH 44112