B. NATURAL ILLUMINATION OR DAYLIGHTING

Although the cost of artificial light has been dropping steadily in recent years, there is no doubt that utilization of all possible natural light will save money in the lighting account. However, it is equally true that the cost of air cooling for buildings located near the equator may give the windowless or "blackout" plant an economic advantage over the generously glazed building. In northern climates, solar radiation may be used to reduce the heating load in the winter. It is therefore unwise to compute the relative costs of various lighting methods without anticipating the corresponding effects on the air-conditioning system.

The design of factory buildings to receive a given level of natural illumination is complicated by a number of variables that are either inevitable or controllable. Winter light is about 50 per cent less than summer light in the northern United States. Dust accumulation on exterior and interior glass surfaces may cut out 50 to 80 per cent of the light available immediately after window washing. Light varies hourly throughout the day. The movement of clouds creates a constantly changing illumination on some days. Weather variations create a range of outdoor daytime illumination from 10,000 down to 100 ft.-c., or lumens per square foot.

The prediction of daylighting intensities and distribution from the architectural design and fenestration of industrial buildings should be left to the illuminating engineer. Buildings can be designed for efficient utilization of natural light. Lighting requirements have exerted a growing influence on architectural design, and earlier standards of daylighting are certain to be revised to conform with current practices.

Special transparent and translucent materials are modifying the distribution characteristics of sun and sky illumination, so that new studies of light intensity variations throughout daylighted workrooms will be necessary. Roof, wall, monitor, and skylight contours have been redesigned for the modern factories to achieve more uniform daylight within. Therefore, daylighting standards based solely on the ratio of window area to floor area (such as 20 to 40 per cent) are quite inadequate for contemporary industrial architecture, and may even be so written into building codes as to hamper the sound development of better design for efficient daylighting.

Those who wish to study the technique of estimating and appraising the natural illumination of buildings of all types and proportions will find an extensive literature containing both mathematical and empirical procedures.[72-75]

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C. ARTIFICIAL ILLUMINATION

Modern artificial illumination is much superior to daylighting from the standpoint of flexibility and precision of control. It makes possible providing strong light that may be adjusted in any direction to enhance contrast and minimize glare; avoidance of variations due to cloudy and stormy weather and seasonal change in the length of day; and elimination of glare and shadows cast by shifting rays of the sun. Photoelectric illumination control may be used to vary the amount of artificial light to offset daylight fluctuation. One of the most interesting developments emphasizing the versatility of artificial lighting is the use of near ultraviolet or "black light" together with penetrating fluorescent oils and powders for industrial inspection work. This combination seems to be especially good for highly polished metal parts where inspection with visible light would be difficult and tiring.[76]

When the quantity and quality of light for a given visual task have been decided in accordance with the principles of efficient and comfortable seeing outlined earlier, the lighting engineer proceeds to select and arrange the fixtures and lamps for the desired light intensity, color, distribution, and direction. He must co-ordinate the general and local lighting systems to acquire the right brightness contrasts in the field of vision. His ingenuity must not be hampered by standards and procedures formulated years ago when the principal method of lighting was the incandescent lamp in a reflector or the diffusing globe spotted at regular intervals throughout the workroom. The environmental engineer must be ready to modify his demands for the luminous environment to correspond with the latest improvements in electric lighting equipment; his job is principally that of studying and specifying illumination objectives and then carefully observing the physical installations developed by the illumination engineer to determine whether his requirements are reasonable and economical.

An appreciation of the technical problems confronting the industrial lighting engineer can be obtained by studying the many reports on requirements in various industries[77-84] and on the methods and equipment for general and supplementary lighting of manufacturing operations.[85-90]

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