

16—Industrial Buildings and Plant Layout

portable and possibly hazardous. Moderate deficiencies are not readily detected, although the cumulative effect of even slightly glaring conditions can result in material loss of seeing efficiency and in fatigue.

Glare

Glare may be defined as any brightness within the field of vision of such character as to cause discomfort, annoyance, interference with vision, or eye fatigue. Glare may be direct or reflected.

When glare is caused by the source of lighting within the field of view (whether it be daylight or electric), it is described as direct glare.

When glare is caused by high-brightness images or brightness differences reflected from shiny ceilings, walls, desk tops, materials, and machines or surfaces within the visual field, it is described as reflected glare.

Reflected glare is frequently more annoying than direct glare because it is so close to the line of vision that the eye cannot avoid it. Furthermore, reductions in contrast often occur which can drastically reduce the task contrast and hence the ability to discern detail. Reduced brightness of light sources will reduce both direct and reflected glare.

Glare reduces the efficiency of the eye and may cause discomfort and fatigue. It may reduce the detail of the visual task to such an extent as to seriously impair vision, thus increasing accident hazards. See page 1456.

Direct glare may be reduced by (a) decreasing the brightness of the light source, (b) positioning the light source so that it no longer falls within the normal field of vision, (c) increasing the brightness of the area surrounding the glare source and against which it is seen.

Reflected glare may be reduced by (a) decreasing the brightness of the light source, (b) positioning the light source or the visual task so that the reflected image will be directed away from the eye of the observer, (c) increasing the level of illumination by increasing the number of sources in order to reduce the relative brightness of the glare, or (d) in special cases, changing the character of the offending surface to eliminate the specular reflection and the resultant reflected glare.

Soft shadows from general illumination can accent the depth and form of various objects. Avoid harsh shadows, however, since they may obscure hazardous conditions or interfere with visibility at the work area because of undesirable brightness contrasts.

Safety

Because safe working conditions are essential in any industrial plant, the effect of light on safety must be considered. The environment of a plant should be designed to compensate for the limitations of human capability. Any factor that aids seeing increases the probability that a workman will detect the potential cause of an accident and act to avert it.

In most cases where accidents are attributed to poor illumination, the cause is marked down as "very noticeable poor quality of illumination" or "practically no illumination at all." Many less tangible factors associated with poor illumination are, however, important contributing causes of industrial accidents. Some of these are direct glare, reflected glare from the work, dark shadows—all of which hamper seeing and together cause after-images—and excessive visual fatigue, which alone may lead to accidents.

Accidents may also be caused by delayed eye adaption when coming from bright surroundings into dark ones. Some accidents which are attributed to "individual carelessness" can be traced to difficulty in seeing, from one or more of these causes.

Seeing tasks tend to become more difficult and vital to profitable operation. Close observations of equipment and instruments, and quick physical response to the minute changes indicated will call for more and better lighting to protect major investments in machines and highly trained personnel.

For extensive lighting installations, a qualified illuminating engineer should always be consulted. The safety director, however, should be familiar generally with the lamps and reflectors, and lighting requirements for industrial environments.

For a more extensive treatment of industrial lighting see pages 1449 and 1456 in Chapter 46, and the following references:

1 ANSI A11.1, *Standard Practice for Indus-*