LIGHTING DESIGN – GENERAL INDUSTRIAL APPLICATIONS

The purpose of industrial lighting is to provide energy efficient illumination in quality and quantity sufficient for safety and to enhance visibility and productivity within a pleasant environment.

Industry encompasses seeing tasks, operating conditions and economic considerations for a wide range. Visual tasks may be extremely small or very large; dark or light; opaque, transparent or translucent; on specular or diffuse surfaces and may involve flat or contoured shapes. With each of the various task conditions, lighting must be suitable for adequate visibility and productivity in developing raw materials into finished products. Physical hazards exist in manufacturing processes and, therefore, lighting must contribute to the utmost as a safety factor in preventing accidents. The speed of operations may be such as to allow only minimum time for visual perception and, therefore, lighting must be a compensating factor to increase the speed of vision.

Lighting must serve not only as a production tool and as a safety factor, but should also contribute to the overall environmental conditions of the work space. The lighting system should be part of an overall planned environment.

The design of a lighting system and selection of equipment may be influenced by many economic and energy related factors. Economic decisions in regard to the lighting system should not only be based on the initial and operating costs of the lighting, but also on the relationship of lighting costs to other plant producing facilities and costs of labor.

GENERAL CONSIDERATIONS OF DESIGN FOR LIGHTING INDUSTRIAL AREAS

The designer of an industrial lighting system should consider the following factors as the first and all-important requirements of good planning.

1. Determine the quantity and quality of illumination desirable for safety of personnel (see page 136), the manufacturing processes and the environment.
2. Select lighting equipment that will provide the quantity and quality requirements by examining photometric characteristics, and mechanical performance that will meet installation, operating and actual maintenance conditions.
3. Select and arrange equipment so that it will be easy and practical to maintain.
4. Balance all of the energy management considerations discussed in Section 4 and economic factors including initial, operating and maintenance costs, versus the quantity and quality requirements for optimum visual performance. The choice of the electric distribution system may affect overall economics.

Although not specifically mentioned in the discussions of the lighting for each industry that follow, the use of daylighting should be considered for area lighting in all industries.

FACTORS OF SPECIAL CONSIDERATION

Lighting and Space Conditioning. With the use of higher illuminances, it is often practical to combine the lighting, heating, cooling and atmospheric control requirements in an integrated system. The lighting system can often provide most of the energy during the heating period. When cooling is required much of the lighting heat can be removed by the air exhaust system. See Section 2 for further details.

High Humidity or Corrosive Atmosphere and Classified Location Lighting. Enclosed gasketed luminaires are used in non-classified areas where atmospheres contain nonflammable dusts and vapors, or excessive dust. Enclosures protect the interior of the luminaire from conditions prevailing in the area. Steam processing plating areas, wash and shower rooms, and other areas of unusually high humidity are typical areas that require enclosed luminaries. Severe corrosive conditions necessitate knowledge of the atmospheric content to permit selection of proper material for the luminaire.

Classified locations are areas where atmospheres contain inflammable dusts, vapors or gases in explosive concentrations. They are grouped by the *National Electrical Code* on the basis of their hazardous characteristics, and all electrical equipment must be approved for use in specific classes and groups. Luminaries are available specifically designed to operate in these areas, which are noted in Article 500 of the *National Electrical Code* as Class I, Class II and Class III locations.

Abnormal Temperature Conditions. Low ambient temperatures must be recognized as existing in such areas as unheated heavy industrial plants, frozen food plants and cold storage warehouses. Equipment should be selected to operate under such conditions and particular attention should be given to lamp starting and light output characteristics, if fluorescent equipment is considered. With high intensity discharge equipment, temperature variation has practically no effect on light output, but the proper starting characteristics must be provided. With incandescent filament lamp equipment neither the starting nor the operation is a problem at low temperature.

Abnormally high temperatures may be common in truss heights in foundries, steel mills, forge shops, etc. Caution should be observed in selecting lighting equipment for mounting in such locations, it is particularly important to consider the temperature limitations of fluorescent and high intensity discharge ballasts under such conditions. Often ballasts should be remotely located at a lower and cooler level or special high temperature equipment should be used. The reduction in fluorescent lamp output at high operating temperatures should be recognized.

Maintenance. Regular cleaning and prompt replacement of lamp outtages is essential in any well-operated industrial lighting system. It is important for the lighting designer to analyze luminaire construction and reflector finish and also to make provisions for maintenance access so the system can be properly serviced. Another point that should be considered is that it may often be necessary to do the servicing during the plant operating hours.

SUPPLEMENTARY LIGHTING IN INDUSTRY

Difficult seeing tasks often require a specific, amount or quality of lighting which cannot readily be obtained by general lighting methods. To solve such problems supplementary luminaires often are used to provide higher illuminances for small or restricted areas. Also, they are used to furnish a certain luminance, or color, or to permit special aiming or positioning of light sources to produce or avoid highlights or shadows to best portray the details of the task.

Because supplementary lighting can be specified, it is necessary to recognize the exact nature of the visual task and to understand its light reflecting or transmitting characteristics. An improvement in the visibility of the task will depend upon one or more of the four fundamental visibility factors — luminance, contrast, size and time. Thus, in analyzing the problem, the designer of the lighting may find that seeing difficulty is caused by insufficient luminance, poor contrast (veiling reflections), small size, or that task motion is too fast for existing seeing conditions.

The planning of supplementary lighting also entails consideration of the visual comfort of both those workers who benefit directly and those who are in the immediate area. Supplementary equipment must be carefully shielded to prevent glare for the user and his associates. Luminance ratios should be carefully controlled. Ratios between task and immediate surroundings should be limited. To attain these limits it is necessary to coordinate the design of supplementary and general lighting.

Guth Lighting will be pleased to provide you with specific solutions to any of your application needs.