Lab Notes

Issue 2

The Unified Glare Rating System UGR as a Productivity Tool

Introduction

The Australian Standard AS1680.1 - 1990, “Interior Lighting Part 1, General Principles and Recommendations,” Section 8 provides for two alternative systems for limiting the degree of Discomfort Glare experienced by occupants of interior work places.

These alternatives offer a choice between a luminaire selection system or a glare evaluation system. This latter method is based on a calculated Glare Index (GI) Value.

The table of light technical parameters in each of the AS1680, series 2 Standards includes a column of recommended maximum GI values.

There are now two computer based design programs which can calculate GI values for a given interior, the Optiwin program and LightLab’s GI program. The calculation of this light technical parameter can therefore be done by anyone using an ordinary personal computer.

The past decade has seen many changes, all of which have had very significant effects on lighting methodology. These changes include the introduction of new types of lamps and luminaire technology, the almost universal acceptance of computer aided design programs, radical changes in work practices, and an increasing community awareness in the need for energy conservation and the wise management of resources.

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Similarly, the introduction of the 36W compact fluorescent lamps has brought about another very high source of luminance in the workplace, approximately 25 kcd/m squared.

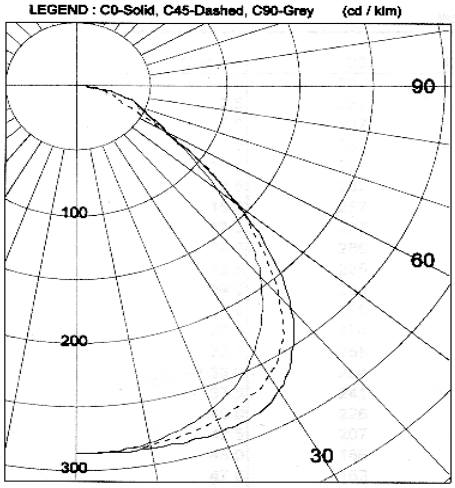

Figure 1. - Typical distribution of a troffer with K12 prismatic panel.

Consequently, in order to maintain the same degree of Discomfort Glare limitation as for the older 38mm tubular fluorescent lamps, much tighter light control is necessary.

The introduction of the "batwing" type of luminaire as a replacement for the prismatic lens panel, has also been a major change as far as interior office lighting is concerned. The prismatic lens panel luminaire generally has a fairly symmetrical Intensity distribution (Refer Fig. 1), whereas the "batwing" type of luminaire tends to produce a disymmetrical distribution (Refer Fig. 2).

As can also be seen in Fig. 2 the C0, Crosswise distribution is considerably different to the C90, Lengthwise distribution, and this generally allows for greater spacings to be used in the C0 plane to obtain the same uniformity of illuminance. (Refer Fig. 3) Consequently fewer luminaires need to be used in an installation, and this of course results in subsequent energy savings.

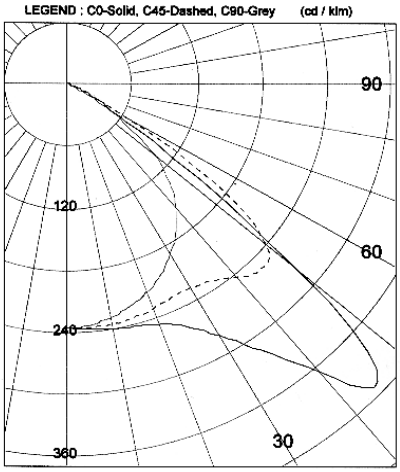

Figure 2. - Typical distribution of a luminaire with a "batwing" louvre.

However as can be seen in Fig. 2, the C45 Intensity distribution tends to be higher than the C0 distribution in the "Glare Zone", which is found in the area between 45 degrees and 90 degrees from the nadir.

Figure 3. - Typical Spacing Diagrams for prismatic (left) and louvred (right) luminaires.

This means that the Luminance distribution of the prismatic lens panel luminaire tends to fit comfortably into the conventional Tabular Method or the Luminance Limiting Graphical Method of calculation, while the “batwing” type of luminaire definitely does not !

As a general rule, lighting installations which consist solely of recessed batwing luminaires tend to be very boring, and produce dull and gloomy interiors. However, if an uplighting installation is added to the design the whole visual environment changes, and offices can become very pleasant workplaces.

Because of the lightened ceiling the Glare Index value will also be reduced, and using a PC and the formula based method, the revised GI value can be calculated. However, it is troubling to note, that neither the Tabular nor the Luminance Limiting Methods can calculate a glare rating for this type of installation. This can only be done by using a Glare Index computer program.

Changes in Work Place Practice

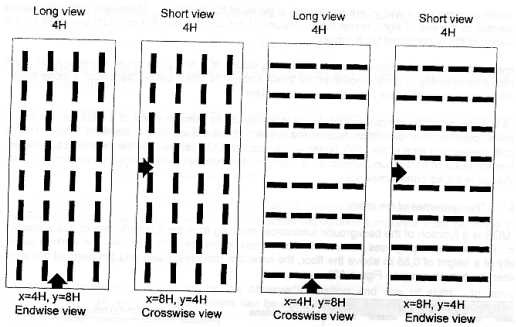

Figure 4. - Conventional lighting systems showing a uniform array of luminaires. Assumed “worst case” observer positions are shown.

Over recent years there have been two major changes in the modern office situation. The introduction of the modern type landscaped office with its random arrangement of office desks and furniture, and the later large scale advent of screen based tasks and workstations in the workplaces.

In the offices of the 1940s the furniture was arranged in a rectalinear array, all facing in the same direction, and all very neat and orderly. In these instances two of the basic assumptions of Discomfort Glare were valid, namely that the C0 and the C90 planes were the predominant viewing directions, and additionally, the “worst case” situations were either in the middle of the back wall or the side wall. (Refer Fig. 4)

However in present day landscaped offices, the whole arrangement is usually irregular and the furniture is often facing to all points of the compass, so that the viewing directions can also be quite varied.

Obviously the introduction of screen based tasks has also led to much ergonomic change in the workplace, and as far as Discomfort Glare is concerned, the major change has been the relative position of the operator’s optical axis, as shown in Fig. 5a. In this diagram a comparison is shown of the optical axis for the reading and writing tasks, as compared with the typing task, and again compared with the tasks of the screen based equipment (SBE) operator. (Refer Fig 5b).

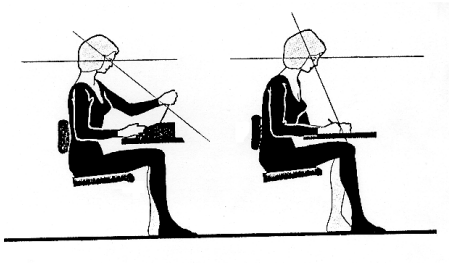

Figure 5a.

The consequence of this higher line of sight for the SBE operator is that more of the ceiling and overhead luminaires comes within the outer peripheral field of view, and because of this, more luminaires fall within the personal "glare zone." It should therefore be obvious that in this way Discomfort Glare has again become a problem in the modern workplace.

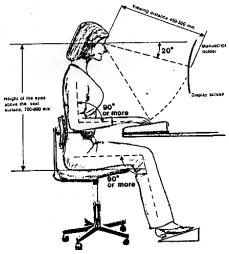

Figure 5b.

The Need For Energy Conservation

Throughout the world, growing community awareness of the need for energy conservation and the wiser use of resources, is being felt in the Lighting Industry. Clients are demanding the use of higher efficiency luminaires and the installation of lighting systems which use fewer luminaires. When conventional luminaire configurations of lens panels or reflector / louvre assemblies are used, more Discomfort Glare is usually experienced.

The pressure is therefore now on for luminaire designers to produce high efficiency luminaires with low glare ratings. This is a very difficult task as it generally means that the unit cost of the individual luminaires will be much greater than that of the conventional luminaires.

And so for the designers, the manufacturers, and the lighting consultants, the dilemma is this - "How can we best produce highly efficient and low glare rating luminaires at a reasonable cost ?"

Glare Index Versus Luminance Limiting

In the past, compliance or otherwise with the Luminance Limiting values simply gave a rough indication that a particular luminaire or installation of luminaires may create a Discomfort Glare situation. The Glare Index system tends to be more sensitive, and can be used to identify troublesome locations and viewing directions within a particular workplace.

In LightLab International's glare calculation program, GLARE INDEX, it is possible to calculate the GI values in several modes, i.e. "Grid", "Find", "Radial". In the "Grid Mode" a simple grid of viewing points is selected and the program calculates the GI values in either the C0 or C90 planes.

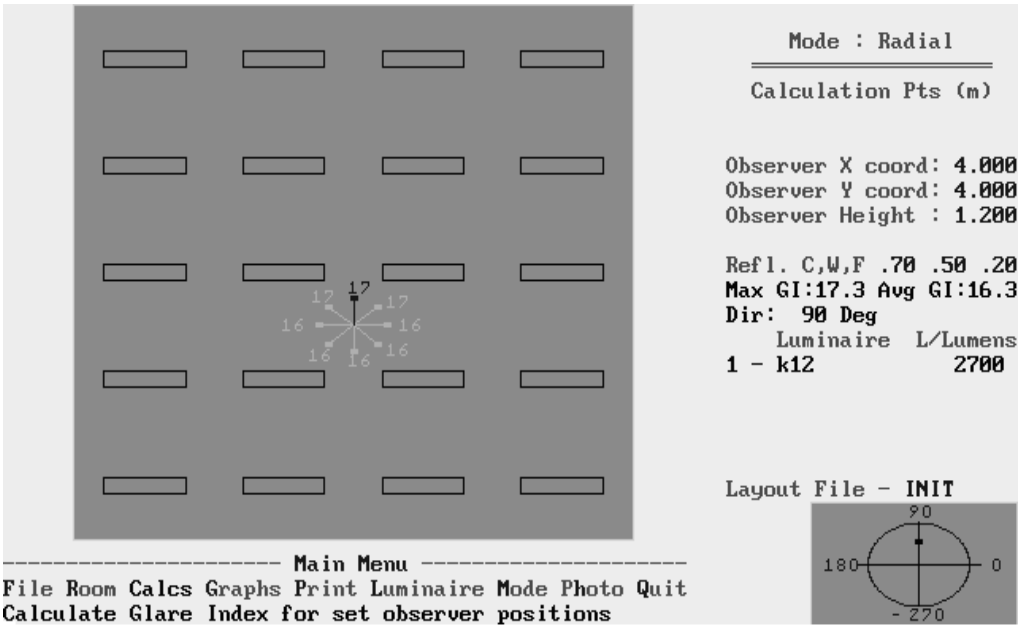

Figure 6. - Glare Index program showing “Radial Mode” calculations.

Fig. 6 shows the process in the “Radial Mode.” It is possible for the computer to calculate at some specified location the GI values at 45 degree intervals around the 360 degree field of view, and also to identify the Maximum value.

Fig. 7 shows the calculation process in the “Find Mode.” In this case the designer must specify a threshold value at or below which the results will not be shown, so leaving the resultant printout less confusing and easier to read. It again shows the location and viewing direction of the Maximum GI value.

Figure 7. - Glare Index program showing “Find Mode” calculations.

How a Glare Index Aids Productivity

The consequences of the presence of Discomfort Glare appear to be an increase in headaches and other physical symptoms, a lowering of a person's level of tolerance, and an increase in social tensions between people in the working environment.

This situation can often be aggravated by other stresses such as excessive noise, uncomfortable thermal conditions, poor ergonomic layout of equipment and even a factor as trifling as an uncomfortable chair ! When considered altogether these factors present a multi stress situation, and this can contribute to low morale and poor productivity in the office situation.

The current striving for greater efficiency and productivity is not meant only for workers on the factory floor, as it is aimed at office and sedentary workers as well.

However, at least one simple fact must be addressed. People cannot work productively if their visual environment is of a poor quality. This fact has been recognized for nearly 40 years, since the CA 30 - 1957 Standard was first published, but there is still a good deal of work to be done before the matter will be completely under control.

As far as the illuminated working environment is concerned, the Glare Index system is a sensitive and easy to use indicator of troublesome locations and viewing directions which are likely to produce high glare index values. These positions are not conducive to high productivity and good visual performance, and should be avoided at all cost.

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