Lab Notes

Issue 12

How to Select the Best Luminaire For Interior Lighting

1.00 Introduction :

Lab Note Issue 3 “How to Read a Photometric Report,” Section 4.3 discusses the various Light Technical Parameters (LTP) which relate to an interior lighting luminaire, and it is suggested that this Lab Note would be helpful reading before proceeding with this document.

It is a widely held view by many people in the Lighting Industry including Manufacturers, that the Light Output Ratio (LOR) is the most important parameter in a Photometric Report on a luminaire.

Indeed many people including Lighting professionals, consider that if one luminaire has an LOR of say 65%, and another has only an LOR of 64%, then the former must be the superior luminaire.

In the 1990s however, the reality is that this is not necessarily the case.

Certainly in the 1950s and 1960s the LOR was probably the most dominant factor to consider, because by and large all luminaires of that time had similar Intensity distributions.

However at this point in time, two low brightness luminaires even from the same Manufacturer can have different LOR values, yet widely different Intensity distributions shown on the Photometric Reports as Polar Curves.

The question therefore arises, **“If the LOR is not the most important factor in determining which is the best luminaire to choose for a design, what factor is ?”**

LightLab International Pty Ltd
Unit 1 56 Smith Road
Springvale, VIC, 3171
Tel: (03) 9546 2188
Fax: (03) 9562 3717
Email: lightlab@lsa.com.au
Web Page: www.lsa.com.au

2.00 What Makes a Superior Luminaire ? :

The thing that makes Lighting such a fascinating discipline is that there is never just one simple answer to the following questions :

"Why is one luminaire better than another ?"
and
"What makes one Lighting installation superior to another ?"

In fact there are a number of answers which can be given to these seemingly simple questions.

For example one might say :

Luminaire A completely conforms to the requirements of the AS1680 recommendations, whereas Luminaire B does not.
or
For a given lighting installation Luminaire A has a lower overall energy usage than Luminaire B.

These statements could be further discussed in the following terms.

In these days of a growing awareness to global warming and the alarming increase of greenhouse gas emissions, the matter of lower energy usage must be quite critical.

On the other hand, in these same times of severe economic restraint when capital availability for new or retro fitted luminaires is very limited, the minimisation of the total number of luminaires to be installed in a lighting installation must also be of great importance.

After all the fewer luminaires to be used, the lower will be the number of wiring points required, and this fact will make savings in the total cost of the electrical installation.

3.00 What About the Utilisation Factor ? :

Other people might argue that the fundamental parameter to be used in the choice of the best luminaire is the Utilisation Factor (UF). They would argue that clearly the higher this number is, the better would be the installation. Their argument would continue something like this :

The Utilisation Factor takes into account the following criteria :

- the LOR of the luminaire, and the higher this number is, the better
- the reflectance of the room surfaces, and the higher this is, the better
- the cleaning and relamping procedures, the more careful, the better

While these arguments may well have been valid in the 1950s and 1960s for the luminaires of those times with their opal or prismatic panels and symmetrical Intensity distributions, it is not necessarily the case for today's type bi-symmetrical luminaires with batwing Intensity distributions.

4.00 How Can We Compare Different Luminaires ? :

The fundamental requirements for a "good" lighting installation can be summarised as follows :

4.1 The installation conforms with the Recommendations of AS1680

- The installation provides an acceptable illuminance distribution throughout the space
- The quality of the visual environment within the space is in accordance with present Standards

4.2 The installation is energy efficient

- The installation produces the lowest possible power density ie. the lowest possible Watts per square metre

4.3 The installation minimises the overall cost of the electrical installation

- The installation uses the lowest possible number of luminaires
- The number of required wiring points is minimised

5.00 Discussion of the Fundamental Requirements :

5.1 The installation conforms with the Recommendations of AS1680

Obviously before any lighting system can be acceptable, it must conform to the applicable current Lighting Standards. Here in Australia at the present time, the AS1680 series of Standards contain the accepted recommendations for both the quality and quantity of the interior lighting.

Although it is customary to install a regular array of ceiling mounted luminaires to meet the AS1680 recommendations, the same compliance can be achieved with a Task Ambient Lighting (TAL) system.

Depending on the type of area to be lit, an ambient level of light of 160 lux maintained illuminance throughout the space may be applicable. Extra task lighting may then be provided if required by the Standard, or if the difficulty of the particular task demands a higher level of light to maintain visual efficiency.

5.2 The installation is energy efficient

Several countries including the United States of America, and Singapore have Government regulated power density requirements for many types of buildings, both old and new.

5.2.1 Power Density Units (PDUs)

This value is the maximum allowable watts per square metre in either the whole building, or in some cases, in parts of a building. It can certainly be argued that this is very simplistic methodology, and it can also create a bureaucratic nightmare as the assessment of the actual watts per square metre can be very difficult in some cases.

For example in some given instances when quoting for a whole building, the same watts per square metre or PDU is given for a general office, a drawing office and a toilet !

Obviously in each of these spaces the illuminance values will be different, and therefore the watts per square metre must also be different.

However, if the limiting unit is taken as being :

"Watts per square metre, per 100 lux"

then a simple and straight comparison can be made between different spaces.

5.3 The installation minimises the overall cost of the electrical installation

As explained above in 4.3, the overall cost can be minimised if the installation uses the fewest number of luminaires and wiring points.

6.00 The Primary Factors in Luminaire Selection :

The two primary factors which should be seriously considered when selecting a suitable luminaire are :

the Light Output Ratio (LOR)
and
the Spacing to Mounting Height Ratio (SHR)

However there are also several other derived units which are worthy of consideration, especially the Luminance Distribution Table.

6.1 Luminance Distribution Table

These cd/sq.m.values will give the discerning designer an indication as to whether the luminaire under scrutiny may produce excessive Discomfort Glare, or whether the reflected images in VDU screens will or will not be acceptable. These matters have been discussed in other issues of our Lab Notes dealing with the phenomona of Glare.

6.2 The Influence of the Spacing to Mounting Height Ratio

To assist us in understanding the influence of the SHR let us consider three different luminaires in a particular room. Each luminaire has the same LOR, but a different SHR value.

Consider a room of the following parameters : length 30m, width 15m, floor to ceiling height 2.7m and a working plane height of 750mm.

The mounting height (Hm) will therefore be 2700 - 750 = 1950mm (1.95m)

The three luminaires have the following parameters :

Luminaire	LOR	SHR
A	60%	1.23 : 1
B	60%	1.54 : 1
C	60%	1.85 : 1

These luminaires could be briefly described in the following manner :
Luminaire A : a recessed troffer with a K12 prismatic panel
Luminaire B : a low brightness troffer with specular finish aluminium reflectors and louvres
Luminaire C : a low brightness troffer similar to B but with satin reflectors and louvres, and with a much broader batwing Intensity distribution

If we now calculate the number of A,B, and C luminaires required for our 30 x 15 x 2.7m room, and the electrical loadings in kWs for each installation the results would be as follows :

Luminaire A

Spacing : Hm x SHR = 1.95 x 1.23 = **2.4m**
Number of rows across the width : 15 / 2.4 = **6**
Distance from side walls : 1.5m
Number of luminaires per row : 30 / 2.4 = **12**
Total number of luminaires : 6 x 12 **= 72**
Assuming 80watts per luminaire
Total load (kW)= 72 x 80 = **5.76 kW**

Luminaire B

Spacing : Hm x SHR = 1.95 x 1.54 = **3.00m**
Number of rows across the width : 15 / 3 = **5**
Distance from side walls : **1.5m**

If we assume that the standard 1200 x 600 ceiling tile is used, then the tile pattern will restrict the spacing along the length of the room to multiples of 1.2 metres, which will be either 2.4 or 3.6 metres. As the latter is outside the allowed 3 metres, the permissible spacing along the room will be 2.4 metres.

Number of luminaires per row : 30 / 2.4 = **12**
Total number of luminaires : 5 x 12 **= 60**
Assuming 80watts per luminaire
Total load (kW)= 60 x 80 = **4.80 kW**

Luminaire C

Spacing : Hm x SHR = 1.95 x 1.85 = **3.60m**
Number of rows across the width : 15 / 3.6 = **4**
Distance from side walls : **2.1m**
Number of luminaires per row : 30 / 3.6 = **8**
This fits the ceiling tile spacing.
Total number of luminaires : 8 x 4 **= 32**
Assuming 80watts per luminaire
Total load (kW)= 32 x 80 = **2.56 kW**

If Luminaire A is taken as the standard, ie.100%,

an installation of Luminaire B uses 12% less energy
and
an installation of Luminaire C uses 56% less energy

Clearly there are far greater energy savings to be made by improving the spacing to mounting height ratio, than there is in trying to improve the LOR by a few per cent.

While Luminaire C might appear to be an extreme case - Do you remember the "Visionaire" luminaire of the 1980s ? In that case the 1 x 36watt luminaire had an LOR of 77%, but its SHR was 2.1 : 1.

Similarly there are luminaires like Luminaire B with its SHR of 1.5 : 1, which are by no means uncommon.

7.00 Conclusion :

When assessing the performance of a luminaire, or comparing two or more luminaires, it is very simplistic to just evaluate the LOR of the units.

It is very important that the spacing to mounting height ratio be also carefully considered.

For this reason the older style Lumen Method must be remembered to be one of only - "approximation."

A proper computer aided design program which allows the designer to space the luminaires at their recommended spacing distances is a far more reliable evaluation method for use. Such a program is especially useful when it is important to minimise the electrical loadings of the lighting installation to meet prescribed Power Density Unit targets.

Any enquiries should be directed to :

LightLab International Pty Ltd
Unit 1 56 Smith Road
Springvale, VIC, 3171
Tel: (03) 9546 2188
Fax: (03) 9562 3717
Email: lightlab@lsa.com.au
Web Page: www.lsa.com.au