Three reasons why full shielding is indispensable

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Introduction

Let's distinguish three situations when fully shielded luminaires perform much better than the non-complying ones, i.e., those with non-zero (≥ 0.5 cd/klm) horizontal emissions.

1. you are above them
2. far from them
3. concerned with skyglow

I remind that "full cutoff" category differs from a fully shielded one just by adding a very loose limit of 100 cd/klm at 80 degrees and above. "CIE cutoff" category demands 30 cd/klm there. Luminaires, which are both "Fully shielded" and "CIE cutoff" in the same time, promise to be low-disturbing ones.

Further I'll consider just the basic < 0.5 cd/klm limit demanded by many laws for any horizontal or higher-aimed beam (specific luminous intensity: luminous intensity divided by the luminous flux produced by the bulb; an equvalent mcd/lm would be a more SI-complying unit; a bare lengthy light source like a candle flame has up to some 100 mcd/lm).

1 when the luminaire is lower than you are

Looking from a window which is above a fully shielded luminaire, no direct light is visible. This is a tremendous health (for bedrooms) and aesthetic improvement. Life quality of hundreds of millions of people living in cities could be improved this really simple way. There is no excuse for using other than fully shielded luminaires in areas with >2-floor houses or slopes.

2 when it is above you, but far enough

If the distance is over ten times the height difference (you see light at 84 degrees from luminaire nadir), the luminous opening of the luminaire becomes just a line segment (its width is one tenth of the original circle or rectangle). The burner itself is invisible, just its diffuse or specular reflection in the opposite side of the luminaire cavity can be seen.

In principle, there could be still a lot of light with special configurations, say 400 cd/klm without glass (flat glass reduces the amount of light four times at this angle). However, no such luminaires are made, for symmetric lighting: light going over 80 degrees is avoided. Even David Keith's extreme example,

see amper.ped.muni.cz/light/ies2/d_keith/tab/samp0479.txt (missing the 0.5 cd/klm just slightly, having 0.7 at one isolated direction) has "just" 50 cd/klm at 85 degrees.

My guess is that maximum specific luminous intensity is 70 cd/klm at 84 degrees from bi-directional fully shielded luminares.[1] A thin outer shield could be added to such a luminaire, blocking any harmful almost horizontal beam, if needed.

Vast majority of fully shielded luminaires have however less then 10 cd/klm, 3 cd/klm is a typical upper limit. At 3 cd/klm, 30 m from you and with a 100W HPS (roughly 10klm) source, this translates to 0.03 lx vertical illuminance. At 100 m it would be 3 mlx, what can be tolerated in most cases (even if being 30×stronger than the brilliant Venus as Evening star).

Quick reduction of luminous intensity as the beam approaches 90 degrees helps 3D orientation at night tremendously: it's obvious which lights are far from you (say, over a crossing) and which are close. This is not the case with non-FS lights.

3 when you are concerned with the clear sky luminance

Total amount of uplight is relevant just in the case of overcast sky, when the cloud layer returns most of the light back to the ground. Minimising this quantity can help to protect healthy sleep and to protect wildlife. Some luminaires just missing the fully shielded limit may be as good as the best fully shielded ones for this purpose (or even slightly better, on the cost of more glare etc.), if minimizing installation costs is an aim too. If such luminaires with zero or very low upward emissions are used, the key to minimizing uplight is minimizing total emissions, i.e., avoiding any light outside target areas and any intensities over the demanded ones (incl. late night demand; this calls for continuous dimming technology).

For a *cloudless sky*, however, *total amount of uplight is an irrelevant quantity.* Sky luminance is given mostly by that light, which propagates just a bit upwards, and which becomes completely dispersed after some 100 miles of atmospheric path. Steeply going light makes little harm, as it escapes to the space from 90 per cent.

This is the reason why there is MUCH less skyglow over areas with no other lights than fully shielded ones. Apart from observations, it's an easy physics to compute the effect, as Pierantonio Cinzano has done convincingly (use e.g. his Roadpollution software to compute some examples yourselves), and as my ies2tab programme does too. For reducing skyglow over EU or US, 0.5 cd/klm is a vital limit. 1 cd/klm cannot be tolerated, if it would concern most azimuths.

Basic and additional shielding

The above 3 reasons should be enough for introducing a legal obligation to use no other luminares than fully shielded ones for >1klm sources. Of course, this elementary obligation does not ensure that the lighting will be excellent. But it's simple, easy to verify and avoids the worst impacts of outdoor lighting.

An additional obligation should exist: to shield any luminaire, when some its beams are obtrusive for any driver, pedestrian or inhabitant and not needed at that particular place for safety. Such an obligation would become a tool how to make lighting designers to care about the proper downward-going light distribution, to spare future costs to the luminaire owners.

Outer shades (e.g., a rectangular boxe with its long axis along the road) should be added in many cases at the very time of the luminaire installation. The reason is that current too small and poorly-directing fixtures let a lot of direct light from the burner going sideways, e.g. to windows lying behind and below them. A strange daytime view should be no hindrance to achieve a good benefit/harm ratio at night. After all, at least Phillips has some fixtures with a slit for inserting an outer vertical mirror (a coated, non-corroding aluminium sheet) to reflect houseside-going light back to the street. Low-cost and good performing solutions can be always found, if there is a good will. Outdoor lighting can cease to be a curse of our epoch.

[1] To be accurate, for unidirectional streets, ski slopes and sport facilities, fully shielded beamers can be employed, which have over 200 cd/klm at 85 degrees (e.g. by using inclined glass inside the fixture). Such special installations should be subject to some special permit, to avoid light imissions to distant human or wildlife habitats, to another streets etc.