Comparison of the adaptation curve of CIE 88:1990 to curves produced by the Excel file "Analysis of tunnel lighting based on visual performance and visual comfort - version January 2019"

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The above-mentioned adaptation curve is shown in figure 1. It shows the road surface luminance as a function of the driving time into the transition zone.

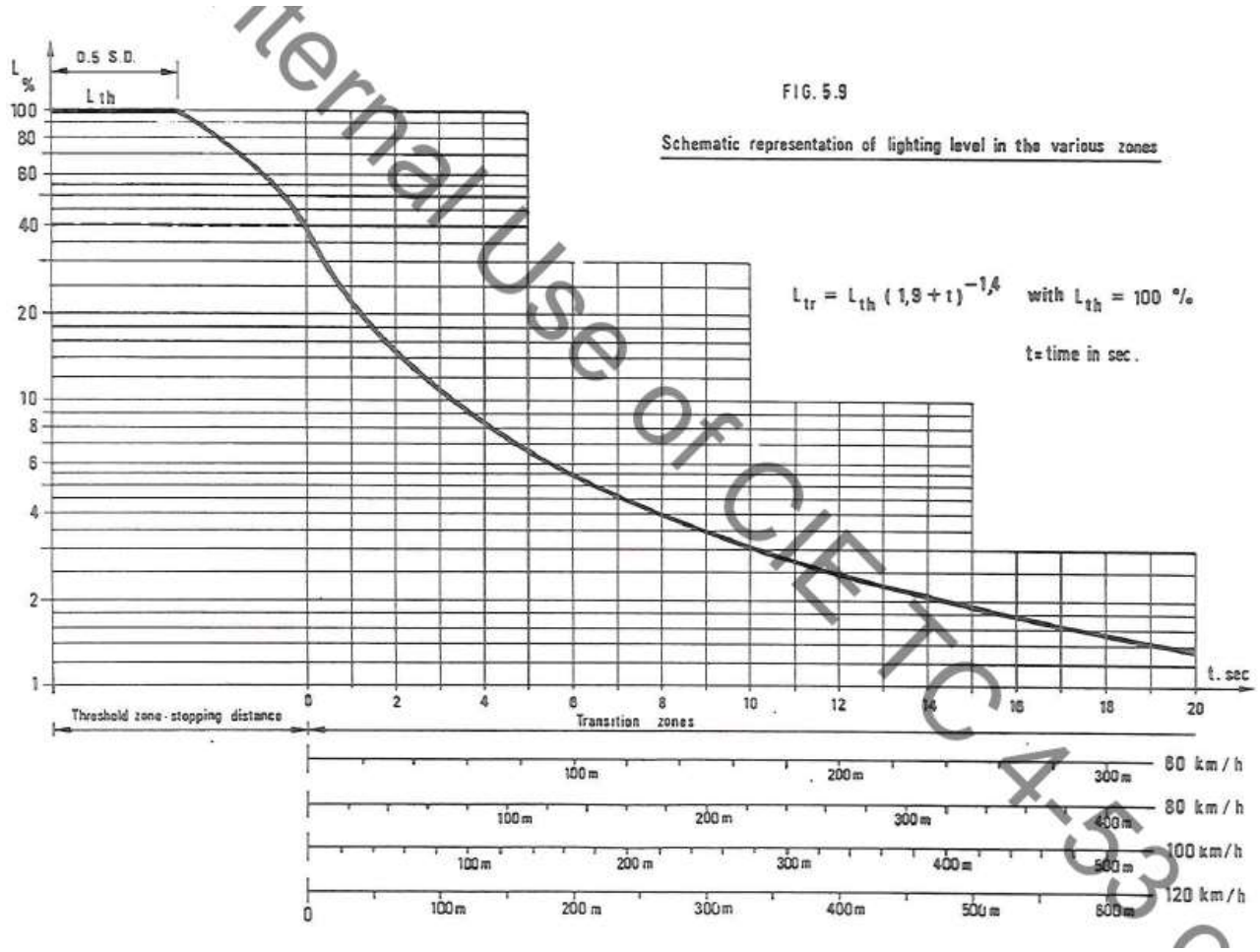

Figure 1: Adaptation curve in CIE 88: 1990.

The excel file offers several options but has been used with the initial settings shown in figure 2.

Driving				Visual task		Disability glare			Criteria			
Design speed V	Driver age	Wind screen trans.	Air transmit-tance	Size of object	Intrinsic Contrast of object	Daylight total Lseq	Lighting installation D	Other sources Lseq	Visibility Level VL	Time per factor 10 t10	Road surf. luminance interior zone Lin	maximum all zones
km/h	23-75 y	%	%	m	%	cd/m2		cd/m2		seconds	cd/m2	
60	60,0	80	100	0,2	-68	200	0,1	0,25	5,00	5		1000

Figure 2: Initial settings used for the excel file.

The CIE 88: 1990 adaptation curve together with curves produced by means of the excel file for driving speeds of 60, 80 and 90 km/h are shown in figure 3.

The curves are in the same scale in the sense that they all apply for a threshold luminance of 100 cd/m^2. The CIE 88:1990 adaptation curve is arranged that way, while the scale of the other curves is obtained by proper settings of the total L_{seq} for daylight (the threshold luminance is an output).

It is seen that the road surface luminance curves, in particular for the two lower driving speeds of 60 and 80 km/h, decrease faster than the CIE 88: 1990 curve.

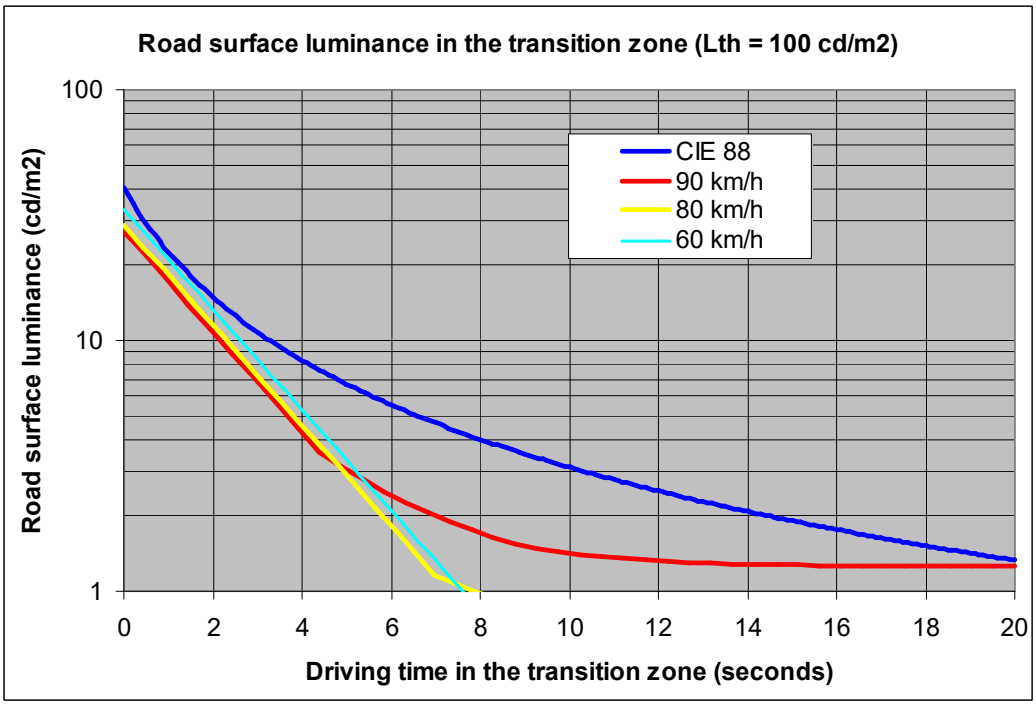

Figure 3: The CIE 88: 1990 adaptation curve together with curves produced by means of the excel file for driving speeds of 60, 80 and 90 km/h.

However, the threshold luminance L_{th} tends to be low for a low driving speed and increase with increasing driving speed (and the associated stopping distance). This is taken into account in figure 4, where to curve for 90 km/h is in the same scale as the adaptation curve of CIE 88: 1990, while the curves for 60 and 80 km/h represent the natural reduction of the threshold luminance (the total L_{seq} for daylight is kept constant).

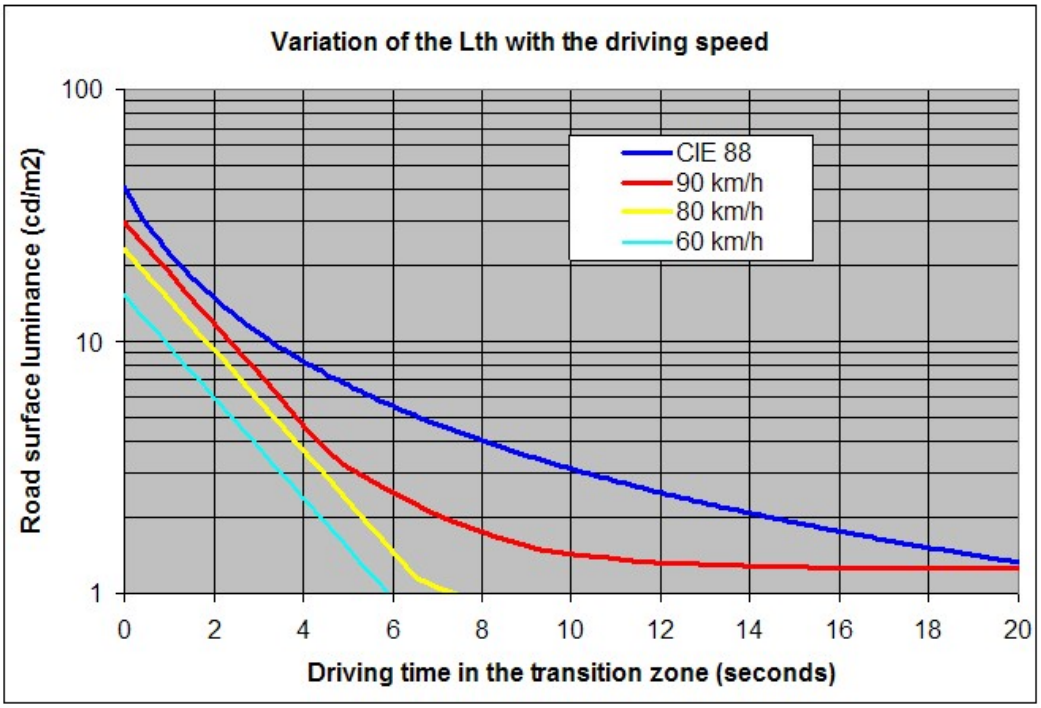

Figure 4: As figure 3, but with variation of the threshold luminance L_{th} with the driving speed.

Figure 5 shows the four curves for the case that the road surface luminance in the inner zone is 1 cd/m^2.

The CIE 88: 1990 adaptation curve is truncated at approximately 10,2 seconds of driving, thereby dropping in one step from 3 to 1 cd/m^2. This is justified by this sentence in CIE 88: 1990:

> In the application of fig. 5.9, the end of the transition is reached when the luminance is equal three times the interior level.
>
> Note: Figure 5.9 shows the adaptation curve in CIE 88: 1990 as also shown in figure 1 of this note.

The curves for the three driving speeds are modified compared to figure 4 by setting the luminance of the inner zone to 1 cd/m^2. These curves also involve a truncation which, however, is small (from 1,2 to 1,0 cd/m^2).

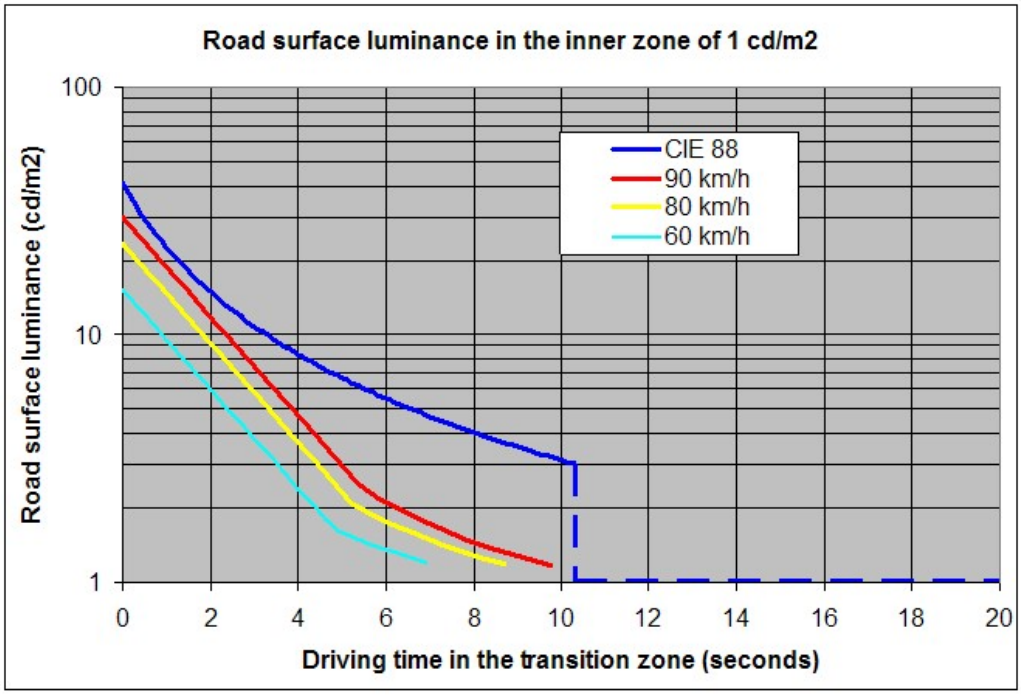

Figure 5: Curves for the case that the road surface luminance in the inner zone is 1 cd/m².

The last figure, figure 6, deviates from figure 5 in the sense only that the luminance in the inner zone is set to 2 cd/m².

In this case, the CIE 88: 1990 adaptation curve is truncated at approximately 5,5 seconds of driving, dropping in one step from 6 to 2 cd/m². This means that the driving time in thew transition zone is very short (approximately 5,5 seconds) and even shorter than the curves for the three driving speeds Approximately 6,2 to 9,2 seconds).

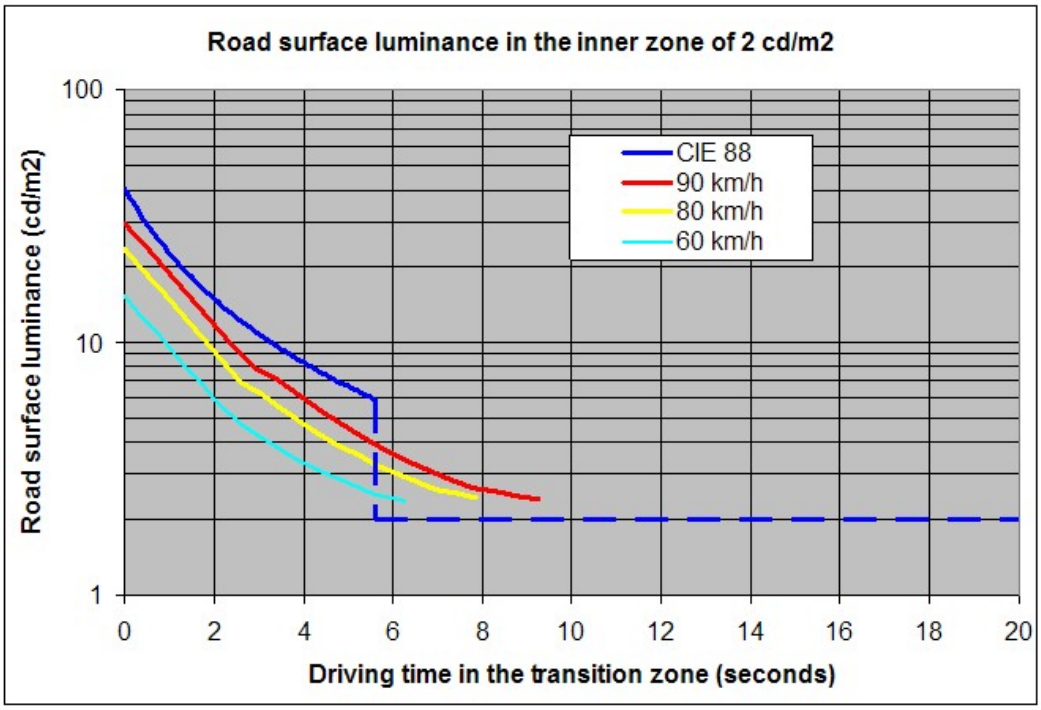

Figure 6: Curves for the case that the road surface luminance in the inner zone is 2 cd/m².