Lux

El **lux** (símbolo: **lx**) es la unidad derivada del Sistema Internacional de Medidas para la iluminancia o nivel de iluminación. Equivale a un lumen /m^2. Se usa en fotometría como medida de la intensidad luminosa, tomando en cuenta las diferentes longitudes de onda según la función de luminosidad, un modelo estándar de la sensibilidad a la luz del ojo humano.

Fotómetro para medir la iluminancia en lugares de trabajo.

Definición

$1 \text{ lx} = 1 \text{ lm/m}^2 = 1 \text{ cd} \cdot \text{sr/m}^2$

Explicación

El lux es una unidad derivada, basada en el lumen, que a su vez es una unidad derivada basada en la candela.

Un lux equivale a un lumen por metro cuadrado, mientras que un lumen equivale a una candela x estereorradián. El flujo luminoso total de una fuente de una candela equivale a 4π lúmenes (puesto que una esfera comprende 4π estereorradianes).

Iluminancia	Abr.	Ejemplo
0,00005 lux	50 µlx	Luz de una estrella (Vista desde la tierra)
0,0001 lux	100 µlx	Cielo nocturno nublado, luna nueva
0,001 lux	1 mlx	Cielo nocturno despejado, luna nueva
0,01 lux	10 mlx	Cielo nocturno despejado, cuarto creciente o menguante
0,25 lux	250 mlx	Luna llena en una noche despejada[1]
1 lux	1 lx	Luna llena a gran altitud en latitudes tropicales[2]
3 lux	3 lx	Límite oscuro del crepúsculo bajo un cielo despejado[3]
50 lux	50 lx	Sala de una vivienda familiar[4]
80 lux	80 lx	Pasillo/cuarto de baño[5]
400 lux	4 hlx	Oficina bien iluminada
400 lux	4 hlx	Salida o puesta de sol en un día despejado.
1000 lux	1 klx	Iluminación habitual en un estudio de televisión
32.000 lux	32 klx	Luz solar en un día medio (mín.)
100.000 lux	100 klx	Luz solar en un día medio (máx.)

Lux y lumen

La diferencia entre el lux y el lumen consiste en que el lux toma en cuenta la superficie sobre la que el flujo luminoso se distribuye. 1000 lúmenes, concentrados sobre un metro cuadrado, iluminan esa superficie con 1000 lux. Los mismos mil lúmenes, distribuidos sobre 10 metros cuadrados, producen una iluminancia de sólo 100 lux. Una iluminancia de 500 lux es posible en una cocina con un simple tubo fluorescente. Pero para iluminar una fábrica al mismo nivel, se pueden requerir decenas de tubos. En otras palabras, iluminar un área mayor al mismo nivel de lux requiere un número mayor de lúmenes.

Relación entre iluminancia e irradiancia

Como todas las unidades fotométricas, el lux tiene una unidad radiométrica correspondiente. La diferencia entre unidades fotométricas y radiométricas consiste en que las segundas se basan en la potencia física, con todas las longitudes de onda medidas por igual, mientras que las unidades fotométricas toman en cuenta el hecho de que el ojo (humano) es más sensible a unas longitudes de onda que a otras, por lo que cada longitud de onda tiene un peso diferente en su cálculo. El factor que determina el peso de cada longitud de onda es la función de luminosidad.

Un lux es un lumen/metro^2, y la unidad radiométrica correspondiente, que mide la irradiancia, es el vatio por metro cuadrado (W/m^2). No hay una fórmula de conversión entre lux y W/m^2; existe un factor de conversión diferente para cada longitud de onda, y no es posible realizar la conversión a menos que se conozca la composición espectral de la luz en cuestión.

El valor máximo de la función de luminosidad se encuentra en los 555 nm (correspondiente al color verde); el ojo es más sensible a la luz de esta longitud de onda que a ninguna otra. En el caso de luz monocromática de esta longitud de onda, la irradiancia necesaria para producir un lux es la mínima: 1,464 mW/m^2. Es decir, en esta longitud de onda se obtienen 683,002 lux por W/m^2 (o lúmenes por vatio). Otras longitudes de onda de luz visible producen menos lúmenes por vatio. La función de luminosidad cae a cero para las longitudes de onda fuera del espectro visible.

Para una fuente de luz con diversas longitudes de onda, el número de lúmenes por vatio se puede calcular usando la función de luminosidad. Para que una luz sea razonablemente blanca, se requiere una mezcla de luz verde con abundancia de luz roja y azul, a las que el ojo es mucho menos sensible. Esto implica que la luz blanca (o blanquecina) produce mucho menos de los 683 lúmenes por vatio que constituyen el máximo teórico. La relación entre el el número real de lúmenes por vatio y el máximo teórico se expresa como un porcentaje que recibe el nombre de eficiencia luminosa. Por ejemplo, una bombilla común suele presentar una eficiencia luminosa de tan sólo el 2%.

En realidad, cada persona presenta una variación propia de función luminosa. No obstante, las unidades fotométricas se definen con gran precisión, basándose en una función de luminosidad estándar obtenida de la medición de muchos sujetos.

Uso en especificaciones de videocámaras

Las especificaciones de videocámaras suelen incluir un nivel mínimo de iluminancia en lux, a partir del cual la cámara puede grabar una imagen satisfactorias. Una videocámara con buenas características de grabación en condiciones de luz escasa tendrá un valor bajo de lux. Las cámaras fotográficas no usan esta especificación, porque en condiciones de poca luz pueden tomar fotografías simplemente usando mayores tiempos de exposición, cosa que las videocámaras no pueden hacer, puesto que el tiempo de exposición viene determinado por las imágenes por segundo que deben registrar.

Unidades de fotometría del SI

Magnitud	Símbolo	Unidad del SI	Abrev.	Notas
Energía luminosa	Q_v	lumen segundo	lm·s	A veces se usa la denominación talbot, ajena al SI
Flujo luminoso	F	lumen (= cd·sr)	lm	Medida de la potencia luminosa percibida
Intensidad luminosa	I_v	candela (= lm/sr)	cd	Una Unidad básica del SI
Luminancia	L_v	candela por metro cuadrado	cd/m^2	A veces se usa la denominación nit, ajena al SI
Iluminancia	E_v	→ lux (= lm/m^2)	→ lx	Usado para medir la incidencia de la luz sobre una superficie
Emisión luminosa	M_v	→ lux (= lm/m^2)	→ lx	Usado para medir la luz emitida por una superficie
Eficiencia luminosa		lumen por vatio	$lm·W^{-1}$	razón entre flujo luminoso y flujo radiante; el máximo posible es 683,002

Referencias

[1] « Sistema de referencia Petzl para el rendimiento luminoso (http://en.petzl.com/petzl/frontoffice/Lampes/static/referentiel/present_referentiel_en.jsp)» (en inglés).

[2] Bunning, Erwin, and Moser, Ilse (Apr. de 1969). «Interference of moonlight with the photoperiodic measurement of time by plants, and their adaptive reaction» (http://www.pnas.org/cgi/reprint/62/4/1018). *Proceedings of the National Academy of Sciences of the United States of America* **62** (4): 1018–1022. DOI: 10.1073/pnas.62.4.1018 (http://dx.doi.org/10.1073/pnas.62.4.1018).

[3] « Electro-Optics Handbook (http://www.burle.com/cgi-bin/byteserver.pl/pdf/Electro_Optics.pdf)» (pdf). *burle.com* págs. p. 63.

[4] Sustainable Solutions Pty Ltd (June, 1998), "Chapter 7: Appliance technologies and scope for emission reduction" (http://www.greenhouse.gov.au/local/strategic/chapter7a.html#lighting), *Strategic Study of Household Energy and Greenhouse Issues (http://www.greenhouse.gov.au/local/strategic/index.html)*, Australian Greenhouse Office, , consultado el 2007-03-13

[5] Australian Greenhouse Office (May, 2005), "Chapter 5: Assessing lighting savings" (http://www.greenhouse.gov.au/lgmodules/wep/lights/training/training9.html), *Working Energy Resource and training kit: Lighting (http://www.greenhouse.gov.au/lgmodules/wep/lights/index.html)*, , consultado el 2007-03-13

Enlaces externos

- FAQ de radiometría y fotometría (http://www.optics.arizona.edu/Palmer/rpfaq/rpfaq.htm) FAQ de la página de Radiometría del Profesor Jim Palmer, (Universidad de Arizona) (en inglés)

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