LIGHTING CALCULATION REPORT

Tutorial 1 - Open plan office

Open plan office

COMPLIANT

12 of 12 assessed criteria met | 0 not met | 0 with a thin margin | 0 not assessed

MAINTAINED ILLUMINANCE	UNIFORMITY UO	WORST-CASE UGR	POWER DENSITY
537 lx	**0.892**	**17.3**	**4.74 W/m2**
task area average	Emin / Eavg	CIE 117	16 luminaires

Client	**Lumina walkthrough**
Designer	**Lumina**
Project reference	**TUT-01**
Space type	**Office - Open plan office, general**
Standard	**EN 12464-1 - Light and lighting: Lighting of work places, Part 1: Indoor work places**
Location	**London**
Revision	**1**
Engine	**Lumina photometric engine 1.0.0**

1. Design inputs

Space

Dimensions	**12.00 x 9.00 x 2.90 m**	length x width x height
Floor area	**108.00 m2**	volume 313.2 m3
Working plane	**0.75 m**	above finished floor
Boundary band excluded	**0.50 m**	task area = room less this band
Reflectances	**80 / 60 / 30 %**	ceiling / walls / floor
Area-weighted mean	**56.8 %**	all six surfaces
Maintenance factor	**0.80**	applied to initial values
Observer eye height	**1.20 m**	for glare and cylindrical illuminance

Calculation grid

Grid	**11 x 9 points**	en12464
Spacing	**1.091 x 1.000 m**	EN 12464-1 maximum 1.136 m

2. Method

Illuminance is computed in two physically separate parts. The direct component is evaluated point by point from each luminaire's measured intensity distribution, combining the inverse square law and the cosine law as E = I(gamma, C) x cos(theta) / r^2 and summing over every luminaire, so overlapping beams add exactly. The interreflected component comes from a radiosity solution of the room enclosure using closed-form configuration factors, which converges on the analytic energy balance rather than relying on a tabulated coefficient of utilisation.

Maintained values are initial values multiplied by the maintenance factor. Standards state their illuminance requirements as maintained values, so compliance is assessed against the maintained figures on the task area only.

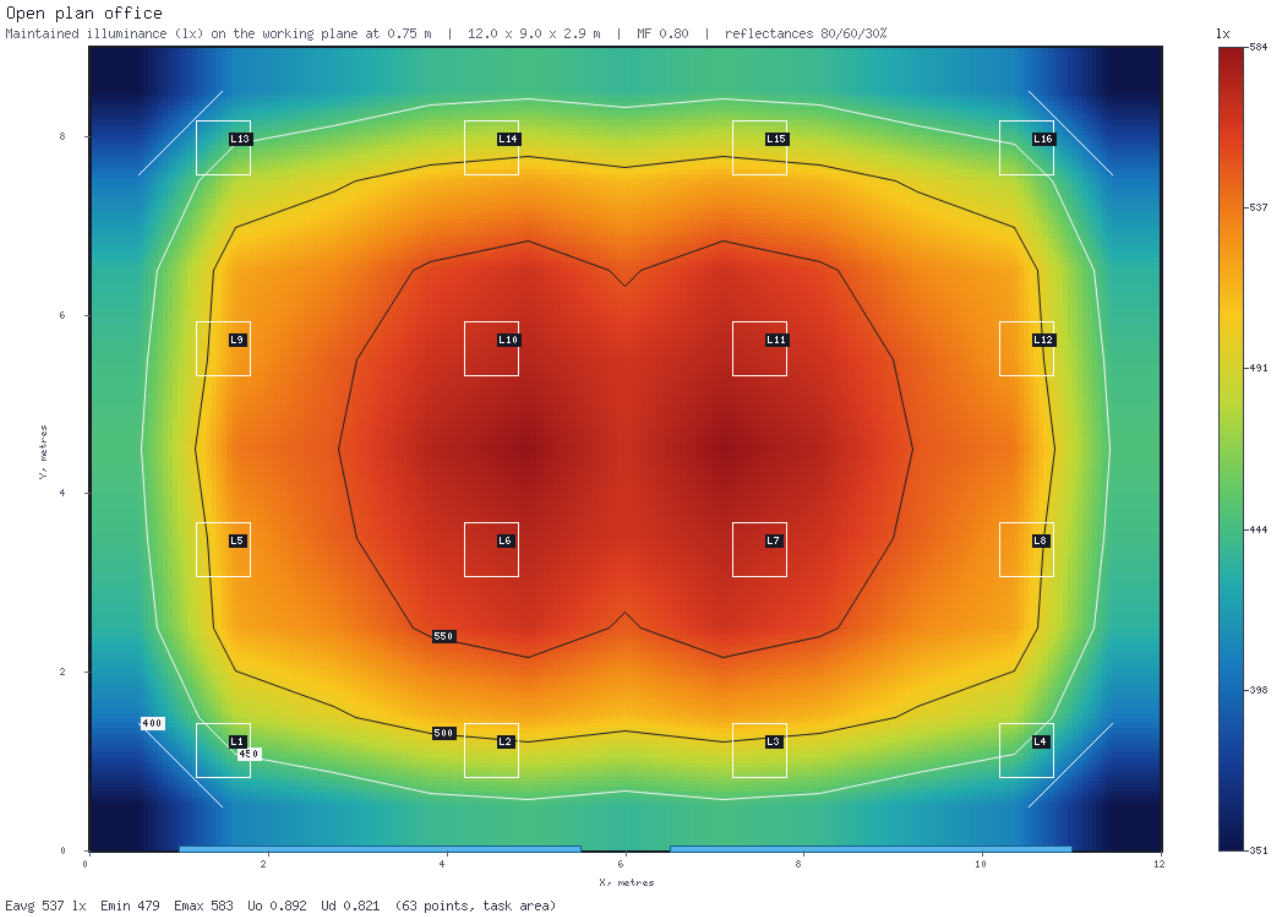
Lumen method cross-check

The lumen method average is derived independently, by integrating each distribution over solid angle and tracing the flux to the surface it lands on. Because it shares no numerical machinery with the point-by-point grid, agreement between the two is a real check on the solution rather than a restatement of it.

Utilance	**1.0391**	direct 0.7515 + interreflected 0.2876
CU vs lamp lumens	**not applicable**	LOR absolute photometry
Room cavity ratio	**2.090**	room index K = 2.392
Effective reflectances	**0.800 ceiling / 0.310 floor cavity**	IES zonal cavity
Lumen method Eavg	**492.7 lx**	grid average 494.8 lx
Agreement	**0.44 %**	between independent routes

Numerical quality: 72 enclosure patches, interreflection converged in 13 iterations to a residual of 5.1e-7. Flux accounting closes to 100.41% on direct incidence and 100.39% on absorption, where 100% is exact energy conservation.

3. Results



Maintained illuminance on the working plane with iso-illuminance contours.

Illuminance summary

Area	Points	Emin lx	Eavg lx	Emax lx	Uo	Ud
Task area (compliance basis)	63	479	**537**	583	0.892	0.821
Whole room	99	351	495	583	0.710	0.602
Direct component only	63	344	407	457	0.845	0.753
Interreflected component only	99	127	136	154	0.928	0.822

Room surfaces

Surface	Area m2	Reflect.	Edir lx	Eind lx	Etotal lx	L cd/m2
Ceiling	108.0	80 %	0	150	150	38.2
Floor	108.0	30 %	315	141	456	43.5
Wall X = 0	26.1	60 %	136	138	274	52.4
Wall X = max	26.1	60 %	136	138	274	52.4
Wall Y = 0	34.8	60 %	148	138	286	54.7
Wall Y = max	34.8	60 %	148	138	286	54.7

Vertical and cylindrical illuminance at 1.20 m

Quantity	Min lx	Mean lx	Max lx	Uo
Cylindrical Ez	225	**270**	313	0.833
Vertical Ev, plane facing +X	167	272	346	0.615
Vertical Ev, plane facing -X	167	272	346	0.615
Vertical Ev, plane facing +Y	174	268	340	0.647
Vertical Ev, plane facing -Y	174	268	340	0.647

Glare

Worst-case UGR	**17.30**	looking +Y
Observer position	**6.00, 1.20, 1.20 m**	x, y, eye height
Background luminance	**45.4 cd/m2**	from the interreflected component
Positions assessed	**30**	positions x four viewing directions

4. Standards compliance

Standard	**EN 12464-1 - Light and lighting: Lighting of work places, Part 1: Indoor work places**	
Space type	**Office - Open plan office, general**	
Required Em	**500 lx**	Uo >= 0.60, UGR <= 19, Ra >= 80

Criterion	Actual	Required	Unit	Margin	Verdict
Maintained illuminance on the task area	537.04	>= 500	lx	37.04	PASS
Overall uniformity Uo (Emin/Eavg) on the task area	0.892	>= 0.6		0.292	PASS
Diversity Ud (Emin/Emax) on the task area	0.821	>= 0.2		0.621	PASS
Unified glare rating UGR (worst observer position)	17.3	<= 19		1.7	PASS
Mean cylindrical illuminance at 1.2 m	269.78	>= 150	lx	119.78	PASS
Immediate surrounding area maintained illuminance	494.81	>= 300	lx	194.81	PASS
Mean maintained illuminance on the walls	280.3	>= 50	lx	230.3	PASS
Mean maintained illuminance on the ceiling	149.98	>= 30	lx	119.98	PASS
Colour rendering index Ra of the specified luminaires	80	>= 80		0	PASS
Calculation grid spacing	1.091	<= 1.136	m	0.045	PASS
Lighting power density	4.741	<= 7.58	W/m2	2.839	PASS
Average daylight factor	3.1	>= 2	%	1.1	PASS

Criteria are reproduced for design guidance. Confirm the governing values against the purchased standard and any local amendments before issuing a design.

6. Daylight

Average daylight factor	**3.10 %**	min 0.61 %, max 16.98 %
Uniformity of DF	**0.197**	
BRE closed-form check	**2.86 %**	independent estimator
Glazing to floor area	**13.3 %**	window to wall 11.8 %

Well daylit: electric lighting can be switched or dimmed for much of the day

Window	Wall	Width m	Sill - head m	Area m2	Glass tau	Net tau	Obstr. deg
Window 1	S (S)	4.50	0.90 - 2.50	7.20	0.70	0.504	0
Window 2	S (S)	4.50	0.90 - 2.50	7.20	0.70	0.504	0

Annual daylight availability

Daylight autonomy	**55.5 %**	at 500 lx, range 6 to 91 %
Spatial daylight autonomy	**62 % of area**	achieving DA >= 50 %
Useful daylight illuminance	**71.6 %**	band 100 to 2 000 lx
Excessive daylight	**17.0 %**	above 2 000 lx: check glare and solar gain
Occupied hours modelled	**2 607**	8:00 to 18:00

Annual figures use 12 representative days x 24 hours, weighted by days per month, with a monthly clearness climate. Switch to the hourly model for a full 8760 step run.

7. Energy, carbon and whole-life cost

Installed load	**512.0 W**	16 luminaires
Power density	**4.741 W/m2**	installed efficacy 125.0 lm/W
Annual energy	**934 kWh**	8.7 kWh/m2
Without controls	**2 088 kWh**	saving 55.3 %
Full-load equivalent	**1 824 h/yr**	mean output level 0.118
Annual cost	**£233.50**	at 0.250 per kWh, flat
Annual carbon	**193 kg CO2e**	at 0.207 kg/kWh

Control zones

Zone	Circuit	Strategy	Target	Min output	Occupancy
Window row daylight dimming	C1	dimming	500 lx	10 %	100 %
Inner rows	C2	dimming+occupancy	500 lx	10 %	85 %

Power density against allowance

Design	**4.741 W/m2**	
Allowance	**7.580 W/m2**	within by 37.5 %

Compared against the lighting power density allowance for the space type. Control credits, where a code permits them, are not applied automatically.

Whole-life cost, 20 year study

Cost element	Present value	Share
Capital and installation	£1,232.00	17.7 %
Energy	£3,424.37	49.3 %
Replacements	£1,890.54	27.2 %
Cleaning	£398.79	5.7 %
Total present value	**£6,945.70**	**100 %**

Discount rate	**5.0 %**	energy escalation 2.0 %
Equivalent annual cost	**£557.34**	annualised over the study period
Burning hours	**8 760 h/yr**	drives replacement timing

All luminaires carry a unit price.

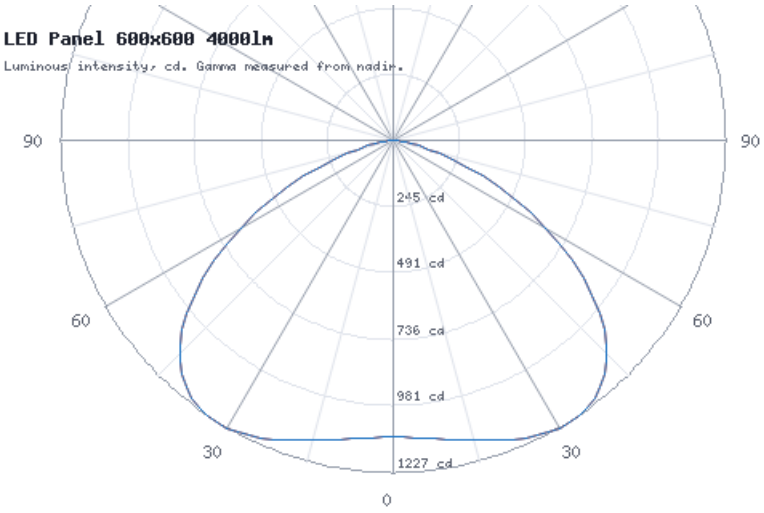
8. Fixture schedule and bill of quantities

Mark	Product	Code	Qty	lm	W	Total W	CCT / Ra	LLF	Cost
T1	Generic LED Panel 600x600 4...	PNL-600-4000	**16**	4 000	32.0	512	4000K / Ra80	0.847	£832
	Total		**16**			**512**			**£832**

T1 **Generic LED Panel 600x600 4000lm** Recessed, LED, 600 x 600 x 30 mm, IP20, circuits C1, C2

9. Photometric distributions

Generic LED Panel 600x600 4000lm



C0 – C180
C90 – C270

4,000 lm | peak 1,227 cd at 33 deg | DFF 100% | direct

Basis of the calculation

Results are a numerical prediction for the geometry, surface properties and photometric data entered. Real installations differ: construction tolerances, furniture and partitions, surface finishes as built, luminaire orientation on site and lamp or LED batch variation all move the measured result. Room surfaces are modelled as diffuse reflectors, and obstructions inside the space are not included unless drawn as geometry.

Note: Grid per EN 12464-1: 11 x 9 points at 1.091 x 1.000 m spacing (maximum permitted 1.136 m).

Standards criteria, tariffs, grid emission factors and any generic fixture photometry shipped with this software are indicative reference data for design work. Confirm governing values against the purchased standard, the client's tariff and the manufacturer's photometric report before issuing a design for construction.