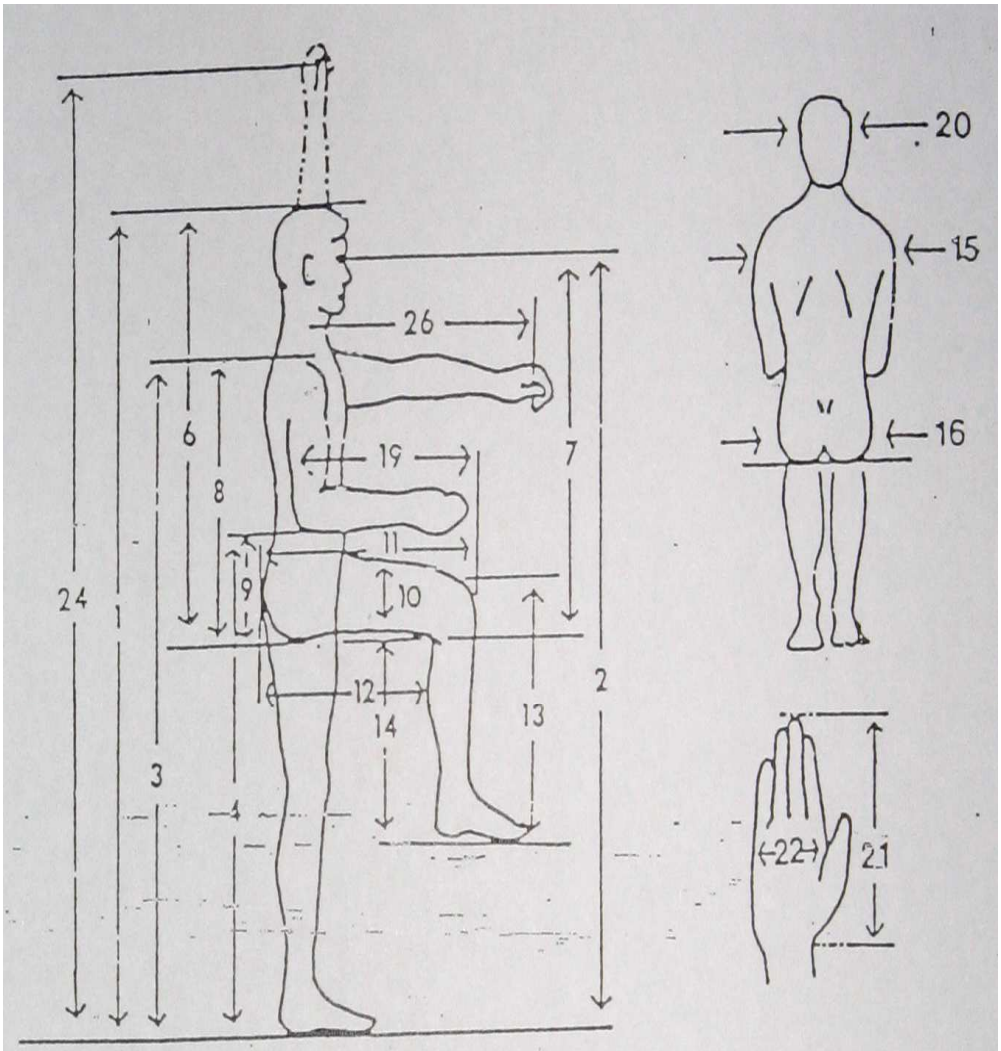
DAFTAR LAMPIRAN

Tabel 5.3

Antropometri masyarakat Indonesia yang didapat dari interpolasi masyarakat British dan Hongkong (Pheasant, 1986) terhadap masyarakat Indonesia (Suma'mur, 1989) serta istilah dimensionalnya dari (Nurmianto, 1991a ;Nurmianto, 1991b).

Dimana : G_x = nilai rata-rata (mean), T = nilai standar deviasi (SD), 5% = nilai 5 persentil, 95% = nilai 95 persentil

DIMENSI TUBUH	PRIA				WANITA			
	5%	X	95%	S.D	5%	X	95%	S.D
1. Tinggi Tubuh Posisi berdiri Tegak	1.532	1.632	1.732	61	1.464	1.563	1.662	60
2. Tinggi Mata	1.425	1.520	1.615	58	1.350	1.446	1.542	58
3. Tinggi Bahu	1.247	1.338	1.429	55	1.184	1.272	1.361	54
4. Tinggi Siku	932	1.003	1.074	43	886	957	1.028	43
5. Tinggi Genggaman Tangan *(Knuckle)* pada Posisi Relaks kebawah	655	718	782	39	646	708	771	38
6. Tinggi Badan pada Posisi Duduk	809	864	919	33	775	834	893	36
7. Tinggi Mata pada Posisi Duduk	694	749	804	33	666	721	776	33
8. Tinggi Bahu pada Posisi Duduk	523	572	621	30	501	550	599	30
9. Tinggi siku pada Posisi Duduk	181	231	282	31	175	229	283	33
10. Tebal Paha	117	140	163	14	115	140	165	15
11. Jarak dari Pantat ke Lutut	500	545	590	27	488	537	586	30
12. Jarak dari Lipat Lutut *(popliteal)* ke Pantat	405	450	495	27	488	537	586	30
13. Tinggi Lutut	448	496	544	29	428	472	516	27
14. Tinggi Lipat Lutut *(popliteal)*	361	403	445	26	337	382	428	28
15. Lebar Bahu *(bideltoid)*	382	424	466	26	342	385	428	26
16. Lebar Panggul	291	331	371	24	298	345	392	29
17. Tebal Dada	174	212	250	23	178	228	278	30
18. Tebal Perut *(abdominal)*	174	228	282	33	175	231	287	34
19. Jarak dari Siku ke Ujung Jari	405	439	473	21	374	409	287	34
20. Lebar Kepala	140	150	160	6	135	146	157	7
21. Panjang Tangan	161	176	191	9	153	168	183	9
22. Lebar Tangan	71	79	87	5	64	71	78	4
23. Jarak Bentang dari Ujung Jari Tangan Kiri ke Kanan	1.520	1.663	1.806	87	1.400	1.523	1.646	75
24. Tinggi Pegangan Tangan *(grip)* pada Posisi Tangan Vertikal ke Atas & Berdiri Tegak	1.795	1.923	2.051	78	1.713	1.841	1.969	79
25. Tinggi Pegangan Tangan *(grip)* pada Posisi Tangan Vertikal ke Atas & Duduk	1.065	1.169	1.273	63	945	1.030	1.115	52
26. Jarak Genggaman Tangan *(grip)* ke Punggung pada Posisi Tangan ke Depan (horisontal)	649	708	767	37	610	661	712	31



Gambar 5.2a.

Anthropometri tubuh manusia yang diukur dimensinya.

Sumber data: Stevenson, 1989 ; Nurmianto, 1991)

Table WRKSTN-D5: Recommended Illumination Levels for Interior Lighting[2]

Activity type	Illumination level (lx)
Rough orientation	75
Occasional rough visual tasks	150
Rough assembly	320
Rough toolmaking	550
Office work—simple	750
Bookkeeping—small character size	1,500
Difficult inspection	1,500
Technical drawing	2,200
Precise assembly work	5,000
Prolonged difficult visual task	7,500
Precise and delicate visual work	11,000
Very special visual tasks—extremely low contrast and small object size	15,000

Table WRKSTN-D6: General Illumination Levels and Types of Illumination for Different Task Conditions[3]

Task condition	Type of task or area	Illuminance level (Ft.-c)	Type of illumination
Small detail, low contrast, prolonged periods, high speed, extreme accuracy.	Sewing, inspecting dark materials, etc.	100	General plus supplementary, e.g., desk lamp.
Small detail, fair contrast, speed not essential.	Machining, detail drafting, watch repairing, inspecting medium materials, etc.	50–100	General plus supplementary.
Normal detail, prolonged periods.	Reading, parts assembly; general office and laboratory work	20–50	General, e.g., overhead ceiling fixture.
Normal detail, no prolonged periods.	Washrooms, power plants, waiting rooms, kitchens	10–20	General, e.g., random natural or artificial light
Good contrast, fairly large objects.	Recreational facilities	5–10	General.
Large objects	Restaurants, stairways, bulk-supply warehouses.	2–5	General.

Table WRKSTN-D7: Reflectance Factors for Surface Color[3]

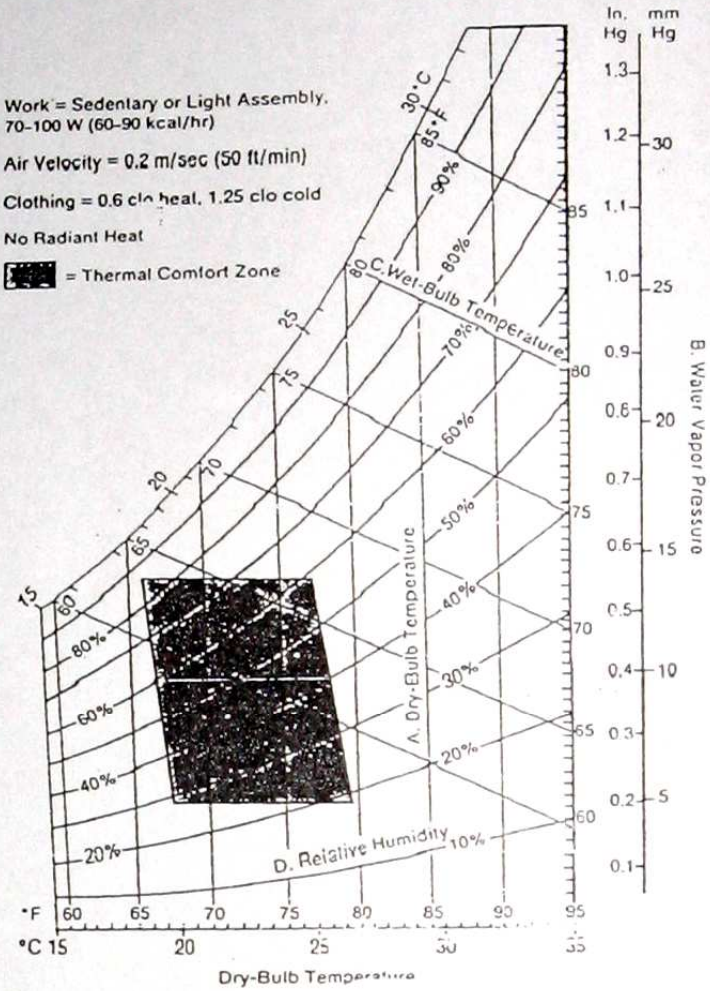
Color	Reflectance	Color	Reflectance
White	85		
Light:		Dark:	
Cream	75	Gray	30
Gray	75	Red	13
Yellow	75	Brown	10
Buff	70	Blue	8
Green	65	Green	7
Blue	55		
Medium:		Wood Finish:	
Yellow	65	Maple	42
Buff	63	Satinwood	34
Gray	55	English Oak	17
Green	52	Walnut	18
Blue	33	Mahogany	12

Table WRKSTN-D8: Techniques for Controlling Glare[4]

To Control Direct Glare	To Control Indirect Glare (Veiling Reflections and Reflected Glare)
Position luminaires, the lighting units, as far from the operator's line of sight as is practical	Avoid placing luminaires in the indirect-glare offending zone (see Figure VC–2)
Use several low-intensity luminaires instead of one bright one	Use luminaires with diffusing or polarizing lenses
Use luminaires that produce a batwing light distribution*, and position workers so that the highest light level comes from the sides, not front and back	Use surfaces that diffuse light, such as flat paint, non-gloss paper, and textured finishes
Use luminaires with louvers or prismatic lenses	Change the orientation of a workplace, task, viewing angle, or viewing direction until maximum visibility is achieved
Use indirect lighting	
Use light shields, hoods, and visors at the workplace if other methods are impractical	

* The effectiveness of the batwing distribution varies with the orientation of the workplace and worker. It can also be used to control indirect glare, because maximum output is in the arc between approximately 35° to 45° angles.

Examples of ways to control direct glare (column 1) and indirect glare (column 2) at the workplace are given. These methods include design approaches that can be used when installing the lighting, as well as interventions that can be made after glare has been identified in a workplace.



The dry bulb temperature and humidity combinations that are comfortable for most people during sedentary or light work are shown as the shaded area on th psychometric chart. The dry bulb temperature range is from 19° to 26°C (66° 79°F), and relative humidities (shown as parallel curves) range from 20 to 85 pe cent, with 35 to 65 percent being the most common values in the comfort zone. C this chart ambient dry bulb temperature (A) is plotted on the horizontal axis ar indicated as parallel vertical lines; water vapor pressure (B) is on the vertical axi Wet bulb temperatures (C) are shown as parallel lines with a negative slope; th intersect the dry bulb temperature lines and relative humidity curves (D) on tl chart. In the definition of the thermal comfort zone, assumptions were made abo the work load, air velocity, radiant heat, and clothing insulation levels. The assumptions are given in the top left corner of the chart.

Figure WRKSTN-E3: Thermal Comfort Zone[1]

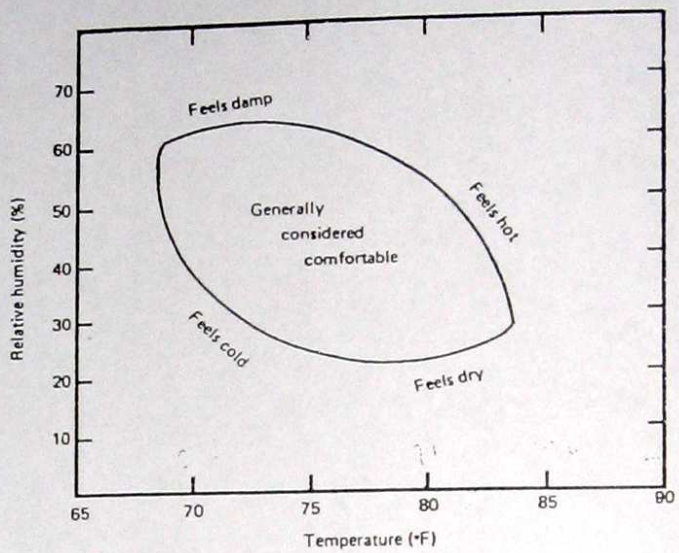


Figure WRKSTN-E4: Comfort Zone as a Function of Relative Humidity Versus Temperature[2]

Table WRKSTN-E3: Maximum Recommended Work Loads, Heat Discomfort Zone[1]

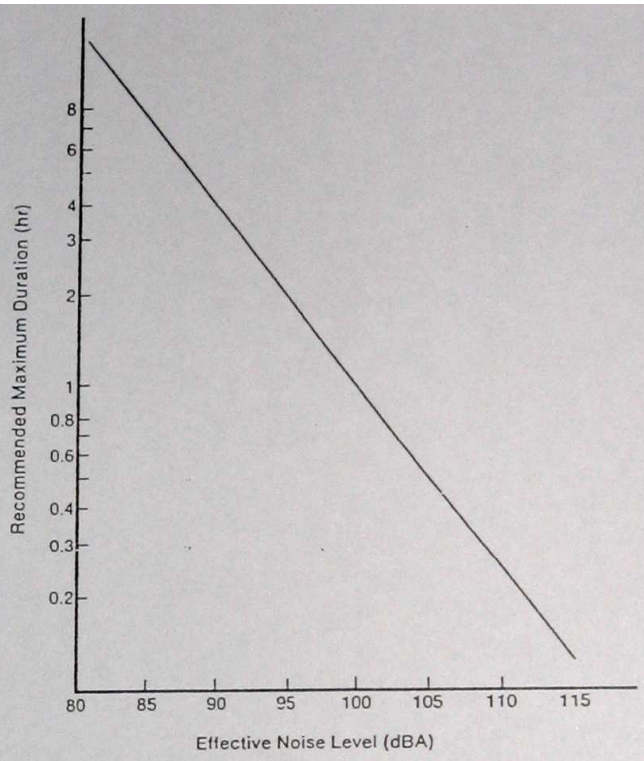
Maximum Recommended Work Load					
Ambient Temperature		Relative Humidity			
°C	°F	20%	40%	60%	80%
27	80	VH	VH	VH	H
32	90	VH	H	M	L
38	100	H	M	L	NR
43	110	M	L	NR	NR
49	120	L	NR	NR	NR

Note: Assumptions include 2-hour continuous exposure, 0.6 clo insulation, air velocity less than 0.5 m/sec (100 ft/min). Higher work loads may be sustained for shorter work periods. See Figure VD–3 for further information. Definitions of work load abbreviations: VH = very heavy, 350–420 W (300–360 kcal/hr); H = heavy, 280–350 W (240–300 kcal/hr); M = moderate, 140–280 W (120–240 kcal/hr); L = light, less than 140 W (120 kcal/hr). NR = not recommended for 2 hours of continuous exposure.

EXPOSURE TO NOISE

Table WRKSTN-E9: Intensity and Effects of Common Noises [2]

Common Sounds	Noise Level (dB)	Effect
Carrier deck jet operation Air raid siren	140	Painfully loud (blurring vision, nausea, dizziness)
Jet takeoff (200 feet) Thunderclap Loud Disco Auto horn (3 feet)	130 120	Begin to "feel" the sound Hearing becomes uncomfortable
Pile drivers	110	Cannot speak over the sound
Garbage truck	100	
Heavy truck (50 feet) City traffic	90	Very annoying
Alarm clock (2 feet) Hair dryer	80	Annoying
Noisy restaurant Freeway traffic Man's voice (3 feet)	70	Telephone use difficult
Air conditioning unit (20 feet)	60	Intrusive
Light auto traffic (100 feet)	50	Quiet
Living room Bedroom Quiet office	40	
Library Soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	
	10	Just audible
	0	Hearing begins



The recommended maximum duration of exposure (in hours, hr, on the vertical axis) to noise of different intensities (in decibels, dBA, on the horizontal axis) is given. The higher the noise level, the less time a person should be exposed to it in order to reduce the risk of hearing damage. Noise levels above 115 dBA should be avoided; levels below 80 dBA are not known to contribute to hearing loss over extended exposure times.

Figure WRKSTN-E7: Guidelines for Noise Exposure to Protect Hearing; Recommended Maximum Duration Versus Noise Level[1]

TABLE 20.2 Coefficients of Utilization for Typical Luminaires with Suggested Maximum Spacing Ratios

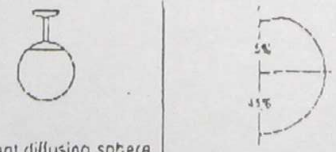
To obtain a coefficient of utilization:

1. Determine cavity ratios for the room, ceiling, and floor.
2. Determine the effective ceiling and floor cavity reflectances from Table 20.3. Use initial ceiling, floor, and wall reflectances.
3. Obtain coefficient of utilization (CU) for 20% effective floor cavity reflectance from appropriate table below for luminaire type to be used. Interpolate, when necessary, to obtain CU for exact room cavity ratio for nearest effective ceiling cavity reflectances above and below reflectance obtained in step 2; interpolate between these CUs to obtain CU for step 2 ceiling cavity reflectance.
4. If effective floor cavity reflectance differs significantly from 20%, obtain multiplier from Table 20.4 and apply this to the CU obtained in step 3.
5. To obtain CU for a ceiling cavity reflectance (ρ_{cc}) of 20 or 10%, multiply the figure for ρ_{cc} = 30% by 0.85 and 0.70, respectively. This is an approximation. For exact figures see *IES Handbook* (1981).
6. Use the figure in the last column (ρ_{cc} = 0; ρ_w = 0) for outdoor lighting, i.e., no walls or ceiling.
7. Legend:

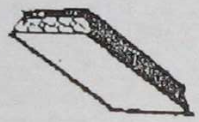
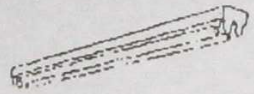
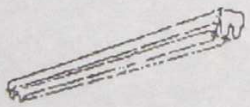
ρ_{cc} = percent effective ceiling cavity reflectance
ρ_w = percent wall reflectance
RCR = room cavity ratio
Maximum *SIMH* guide = ratio of maximum luminaire spacing to mounting above work plane.

NOTE: In some cases, luminaire data in this table are based on an actual typical luminaire; in other cases, the data represent a composite of generic luminaire types. Therefore, whenever possible, specific luminaire data should be used in preference to this table of typical luminaires.

The polar intensity sketch (candlepower distribution curve) and the corresponding spacing-to-mounting height guide are representative of many luminaires of each type shown.

Typical Luminaire	Typical Distribution and Percent Lamp Lumens	Maintenance Category	Maximum SIMH Guide	RCR	ρ_{cc} → 80			70			50			0
					ρ_w → 50	30	10	50	30	10	50	30	10	0
					Coefficients of Utilization for 20% Effective Floor Cavity Reflectance (ρ_{fc} = 20)									
1		V	1.5	0	.87	.87	.87	.81	.81	.81	.69	.69	.69	.44
				1	.71	.67	.63	.66	.62	.59	.56	.53	.50	.31
				2	.61	.54	.49	.56	.50	.46	.47	.43	.39	.23
				3	.52	.45	.39	.48	.42	.37	.41	.36	.31	.18
				4	.46	.38	.33	.42	.36	.30	.36	.30	.26	.15
				5	.40	.33	.27	.37	.30	.25	.32	.26	.22	.12
				6	.36	.28	.23	.33	.26	.21	.28	.23	.19	.10
				7	.32	.25	.20	.29	.23	.18	.25	.20	.16	.09
Pendant diffusing sphere with incandescent lamp				8	.29	.22	.17	.27	.20	.16	.23	.17	.14	.07
				9	.26	.19	.15	.24	.18	.14	.20	.15	.12	.06
				10	.23	.17	.13	.22	.16	.12	.19	.14	.10	.05

(continued)

47  Radial batwing distribution—four lamp, 610 mm (2') wide fluorescent unit with flat prismatic lens	V	1.7	0	.71	.71	.71	.69	.69	.69	.66	.66	.66	.60
			1	.62	.60	.58	.61	.59	.57	.59	.57	.55	.51
			2	.55	.51	.47	.53	.50	.47	.51	.48	.46	.42
			3	.48	.43	.39	.47	.43	.39	.45	.41	.38	.36
			4	.42	.37	.33	.41	.37	.33	.40	.36	.32	.30
			5	.37	.32	.27	.36	.31	.27	.35	.30	.27	.25
			6	.33	.27	.23	.32	.27	.23	.31	.26	.23	.21
			7	.29	.24	.20	.29	.24	.20	.28	.23	.20	.18
			8	.26	.21	.17	.25	.20	.17	.25	.20	.17	.15
			9	.23	.18	.14	.23	.18	.14	.22	.17	.14	.13
			10	.21	.16	.12	.20	.16	.12	.20	.15	.12	.11
48  Two-lamp fluorescent strip unit	I	1.6/1.2	0	1.01	1.01	1.01	.96	.96	.96	.87	.87	.87	.68
			1	.85	.81	.77	.81	.77	.73	.73	.70	.67	.53
			2	.73	.68	.61	.69	.63	.58	.63	.58	.54	.42
			3	.63	.56	.50	.60	.53	.48	.55	.49	.44	.35
			4	.56	.47	.41	.53	.46	.40	.48	.42	.37	.29
			5	.49	.40	.34	.46	.39	.33	.42	.36	.31	.24
			6	.43	.35	.29	.41	.34	.28	.38	.31	.26	.20
			7	.39	.31	.25	.37	.29	.24	.34	.27	.23	.17
			8	.34	.27	.21	.33	.26	.21	.30	.24	.19	.15
			9	.31	.23	.18	.30	.23	.18	.27	.21	.17	.12
			10	.28	.21	.16	.27	.20	.16	.25	.19	.15	.11
49  Two-lamp fluorescent strip unit with 235° reflector fluorescent lamps	I	1.4/1.2	0	1.13	1.13	1.13	1.09	1.09	1.09	1.01	1.01	1.01	.85
			1	.96	.92	.86	.93	.89	.85	.87	.83	.80	.68
			2	.83	.76	.70	.80	.74	.68	.75	.69	.65	.56
			3	.73	.65	.58	.70	.63	.57	.66	.59	.54	.46
			4	.64	.55	.49	.62	.54	.48	.58	.51	.46	.39
			5	.56	.47	.41	.55	.46	.40	.51	.44	.38	.33
			6	.50	.41	.35	.49	.40	.34	.46	.38	.33	.28
			7	.45	.36	.30	.44	.35	.30	.41	.34	.28	.24
			8	.40	.32	.26	.39	.31	.25	.37	.30	.25	.21
			9	.36	.28	.22	.35	.27	.22	.33	.26	.21	.18
			10	.33	.25	.20	.32	.24	.19	.30	.23	.19	.15

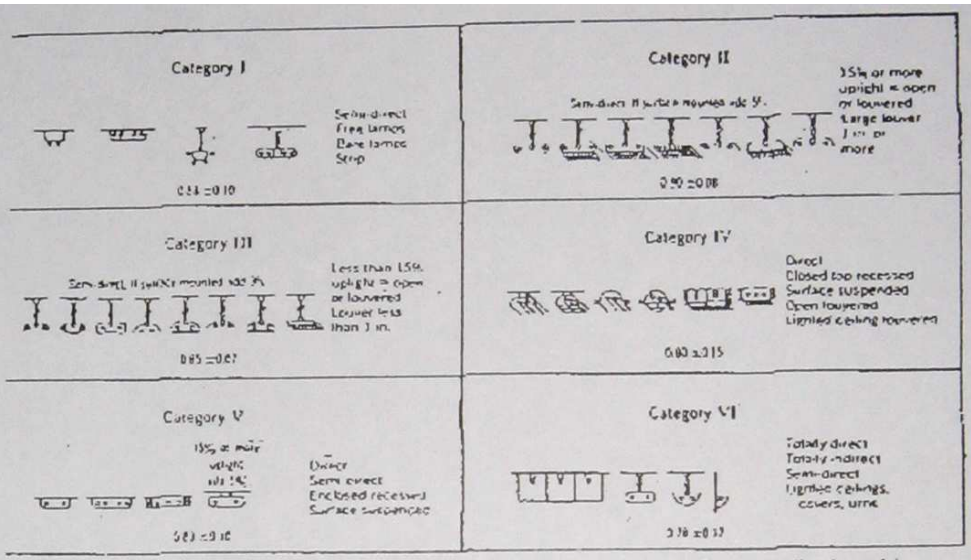


Fig. 20.36 The LDD factor is determined from the category of luminaire, which is an indication of its proneness to dirt accumulation, plus a knowledge of room ambient conditions.

ditions of dirt and maintenance. The categories correspond to those of the IES.

Total LLF is the product of all the depreciation factors above, that is,

$$\text{LLF} = a \times b \times c \times d \times e \times f \times g \times h$$

For example, a fluorescent air-troffer in a regularly maintained group-lamp-replacement, air-conditioned office might typically have an LLF of

$$\text{LLF} = 1.1 \times 1 \times 0.92 \times 1 \times 0.95 \times 0.9 \times 1.0 \times 0.93 = 0.80$$

The same fixture in the same office, but with walls and fixture cleaned only when replacing burned-out lamps would typically have an LLF of

$$\text{LLF} = 1.1 \times 1 \times 0.92 \times 1 \times 0.87 \times 0.85 \times 0.95 \times 0.75 = 0.55$$

Thus, if in the first case the maintained illumination is E fc, in the second case it is $0.55/0.80$ or $0.69E$fc, that is, a reduction of 31% as a result of poor maintenance. When a detailed determination of light loss factor is not possible, use the factors given in Section 20.33. They are somewhat more conservative than those given in Section 20.5c.

20.31 Determination of Coefficient of Utilization (CU) by the Zonal Cavity Method

The coefficient of utilization connects a particular fixture to a particular space, by relating the luminaire's light distribution characteristic to the room size and its surface reflectances. To account for the luminaire's mounting height and its relationship to the working plane, the space is divided into three cavities: the ceiling cavity above the fixture, the floor cavity below the working plane, and the room cavity between the two (see Fig. 20.37). Given the surface reflectances, the effective reflectances of the floor and ceiling cavities can be obtained. With these, the CU can be selected from the tables (either Table 20.2 or manufacturer's data) and the lumen formula (equation 20.3 above) applied to arrive at average illuminance. A step-by-step explanation of the method plus illustrative examples will demonstrate the procedure. The reader should follow the steps with the flow chart in Fig. 20.38 and the calculation form in Fig. 20.39.

STEP 1. First, dimensional data are recorded. In offices, schools, and many other occupancies

Lamp Abbreviation	Lamp Data: Lamp (W)	Lamp Data: Diameter (in)	Lamp Data: Length (in)	Lamp Current (mA)	Ballast (W)[b,c]	Total Watts[c]	Lamp Life (h)[d]	Initial Output (lm)[e]	Lumens at 40% Life	Initial Actual Efficacy (lm/W)[f]	Remarks
Preheat lamps[a]											
F-15 T-8 CW	15	1	18	430	8	23	7,500	670	765	38	Cool white
F-20 T-12 WW	20	1½	24	430	10	30	9,000	1,300	1,155	43	Warm white
Rapid-start—preheat lamps[a]											
F40 T-12 CW	40	1½	48	430	7.5	46	20,000 +	3,150	2,770	68	
F40 T-12 WW	40	1½	48	430	7.5	46	20,000 +	3,200	2,815	70	Warm white
F40 T-12 CWX	40	1½	48	430	7.5	46	20,000 +	2,250	1,855	49	Cool white deluxe
F40 T-12 D	40	1½	48	430	7.5	46	20,000 +	2,600	2,290	57	Daylight
F40 T-12/C50	40	1½	48	430	7.5	46	20,000 +	2,200	1,890	48	5000 K color
F40 T-12/C75	40	1½	48	430	7.5	46	20,000 +	2,000	1,720	44	7500 K color
F40 T-12/U	40	1½	—	430	7.5	46	12,000	2,900	2,525	55	"U" shape[g]
Rapid start—high output											
F48 T-12 CW/HO	60	1½	48	800	12.5	72.5	12,000	4,300	3,740	55	
F60 T-12 CW/HO	75	1½	60	800	15	90	12,000	5,400	4,700	60	
F72 T-12 CW/HO	85	1½	72	800	22.5	107.5	12,000	6,550	5,785	62	
F96 T-12 CW/HO	110	1½	96	800	18.5	128.5	12,000	9,200	8,005	72	
Rapid-start—very high output											
F48 PG-17 CW	110	1½	48	1500	5	125	12,000	6,900	5,100	55	G.E. Power Groove[h]
F72 PG-17 CW	165	1½	72	1500	10	175	12,000	11,500	8,510	66	G.E. Power Groove[h]
F96 PG-17 CW	215	1½	96	1500	10	225	12,000	16,000	12,160	71	G.E. Power Groove[h]
Instant-start (Slimline) lamps											
F42 T-6 CW	25	⅝	42	200	10.5	35.5	7,500	1,750	1,490	49	
F64 T-6 CW	40	⅝	64	200	9	49	7,500	2,800	2,350	57	
F24 T-12 CW	20	1½	24	430	14	34	7,500	1,150	1,035	34	
F36 T-12 CW	30	1½	36	430	13	43	7,500	2,000	1,800	47	Warm white
F48 T-12 CW	40	1½	48	430	12	52	9,000	3,000	2,760	58	
F72 T-12 CW	55	1½	72	430	11	66	12,000	4,550	4,275	69	
F96 T-12 CW	75	1½	96	430	13	85	12,000	6,300	5,800	74	

[a] Data given for a preheat circuit.

[b] Figures are for a two-lamp circuit.

[c] ANSI figures.

[d] Life figures are for 3-h burning per start.

[e] After 100-h burning.

[f] Includes ballast loss.

[g] Data given for lamps in a rapid-start circuit.

[h] U-shaped lamps available with 3½- or 6-in leg spacing; all other characteristics equal.