

FAKTOR LINGKUNGAN KERJA



BrokenView™

RAILWAY STATION
ZAMORA, SPAIN

PHOTO TAKEN ON
MAY 13, 2002

CONCEPT DESIGN AND PHOTO BY RICARDO MARTÍN

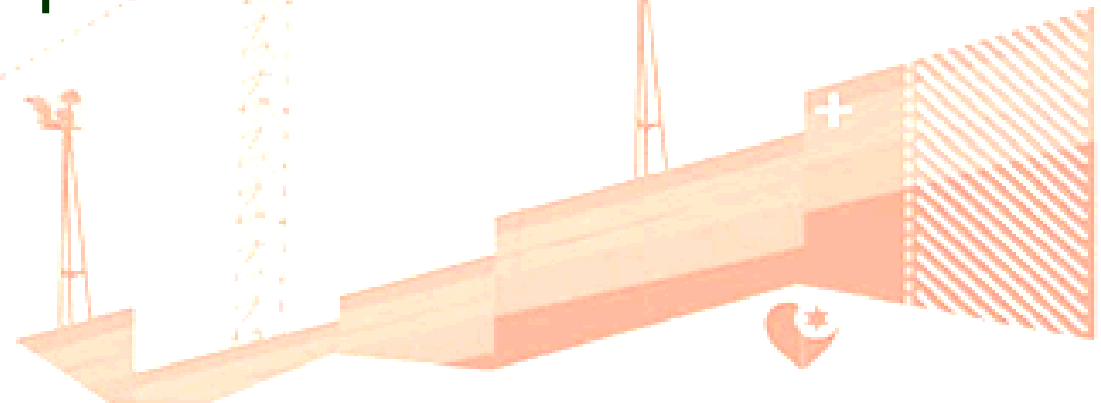
Tujuan

- Memahami kondisi pencahayaan, warna dan tingkat kebisingan yang dapat diterima untuk lingkungan kerja manusia

Pokok Bahasan

- Pencahayaan
- Warna
- Bunyi dan Kebisingan

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PENCAHAYAAAN



Faktor Yang Dipertimbangkan Untuk Penerangan/Pencahayaan Bagi Tempat Kerja :

- **Tingkat iluminansi yang sesuai**
Jumlah cahaya yang jatuh ke permukaan obyek (foot-candles / fc)
- **Tingkat luminansi permukaan obyek**
Cahaya yang dipancarkan oleh permukaan obyek (foot-lambert / fl)
- **Pantulan (reflectance)**
Rasio luminansi dan iluminansi pada permukaan obyek

$$\text{Reflectance} = \frac{\text{luminance} \times \pi}{\text{illuminance}}$$

Reflectance dinyatakan dalam % (pada kisaran 0-100)

Reflectances recommended for room and furniture surfaces in the office (ANSI)



Ceilings: 80 – 90% (matte-white paint)

Business machines: 25 – 50% (matte gray finish)

Walls: 50 – 70% (neutral)

Furniture: 25 – 45% (matte, unpolished wood)

Curtains: 40 – 60% (cloth)

Floor: 20 - 40% (slightly darker color carpet)

Pencahaya an

Color or finish	Percent of reflected light	Color or finish	Percent of reflected light
White	85	Medium blue	35
Light cream	75	Dark gray	30
Light gray	75	Dark red	13
Light yellow	75	Dark brown	10
Light buff	70	Bark blue	8
Light green	65	Dark green	7
Light blue	55	Maple	42
Medium yellow	65	Satinwood	34
Medium buff	63	Walnut	16
Medium gray	55	Magohany	12
Medium green	52		

TABLE 6-2

Recommended Illumination Levels for Use in Interior Lighting Design

Category	Range of Illuminance (fc)	Type of Activity	Reference Area
A	2-3-5	Public areas with dark surroundings.	General lighting throughout room or area.
B	5-7.5-10	Simple orientation for short temporary visits.	
C	10-15-20	Working spaces where visual tasks are performed only occasionally.	
D	20-30-50	Performance of visual tasks of high contrast or large size, e.g., reading printed material, typed originals, handwriting in ink and xerography; rough bench and machine work; ordinary inspection; rough assembly.	Illuminance on task.
E	50-75-100	Performance of visual tasks of medium contrast or small size, e.g., reading medium-pencil handwriting, poorly printed or reproduced material; medium bench and machine work; difficult inspection; medium assembly.	
F	100-150-200	Performance of visual tasks of low contrast or very small size, e.g., reading handwriting in hard pencil on poor-quality paper and very poorly reproduced material; highly difficult inspection.	
G	200-300-500	Performance of visual tasks of low contrast and very small size over a prolonged period, e.g., fine assembly; very difficult inspection; fine bench and machine work; extra fine assembly.	
H	500-750-1000	Performance of very prolonged and exacting visual tasks, e.g., the most difficult inspection; extra fine bench and machine work; extra fine assembly.	Illuminance on task via a combination of general and supplementary local lighting.
I	1000-1500-2000	Performance of very special visual tasks of extremely low contrast and small size, e.g., surgical procedures.	

(Adapted from IESNA, 1995)

TABLE 6-3

Weighting Factors to be Considered in Selecting Specific Illumination Levels Within Each Category of Table 6-2

Task and Worker Characteristics	Weight		
	-1	0	+1
Age	< 40	40-55	> 55
Reflectance of task/surface background	> 70%	30-70%	< 30%
Speed and accuracy (only for categories D - I)	Not important	Important	Critical

(Adapted from IESNA, 1995)

TABLE 6-4
Artificial Light Sources

Type	Efficiency (lm/W)	Color rendering	Comments
Incandescent	17-23	Good	A commonly used light source, but the least efficient. Lamp cost is low. Lamp life is typically less than one year.
Fluorescent	50-80	Fair to good	Efficiency and color rendering vary considerably with type of lamp: cool white, warm white, deluxe cool white. Significant energy cost reductions are possible with new energy-saving lamps and ballasts. Lamp life is typically 5-8 years.
Mercury	50-55	Very poor to fair	A very long lamp life (9-12 years), but efficiency drops off substantially with age.
Metal halide	80-90	Fair to moderate	Color rendering is adequate for many applications. Lamp life is typically 1-3 years.
High-pressure sodium	85-125	Fair	Very efficient light source. Lamp life is 3-6 years at average burning rates, up to 12 hours per day.
Low-pressure sodium	100-180	Poor	The most efficient light source. Lamp life is 4-5 years at average burning rate of 12 hours per day. Mainly used for roadways and warehouse lighting.

The efficiency (column 2), in lumens per watt (lm/W), and color rendering (column 3) of six frequently used light sources (column 1) are indicated. Lamp life and other features are given in column 4. Color rendering is a measure of how colors appear under any of these artificial light sources compared with their color under a standard light source. Higher values for efficiency indicate better energy conservation.

Adapted from Lum-i-neering Associates, 1979; Ross and Baruzzini, Inc. 1975; courtesy Human Factors Section, Eastman Kodak Co.

Faktor Yang Dipertimbangkan Untuk Penerangan/ Pencahayaan Bagi Tempat Kerja

- Visibility
- Sumber Cahaya
- Distribusi Cahaya
- Silau (Glare)
- Warna



Visibility

Kejelasan manusia dalam melihat sesuatu

Ditentukan oleh 2 faktor:

$$\text{Visual angle (arc minutes)} = 3438 \times \frac{H}{D}$$

H= tinggi target/obyek penglihatan

D= jarak target ke mata

arc minutes = $1/60^\circ$

Faktor yang mempengaruhi visibility

- Kontras : Perbedaan luminansi antara target dengan latar belakangnya.

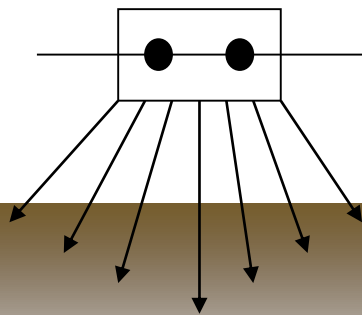
$$\text{Contrast} = (L_{\text{max}} - L_{\text{min}}) / L_{\text{max}}$$

- Waktu/lamanya target diperlihatkan
- Gerakan target
- Usia
- Training
- Lokasi yang sudah diketahui

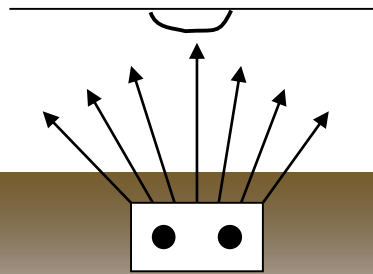
Faktor Yang Dipertimbangkan Untuk Penerangan/ Pencahayaan Bagi Tempat Kerja

- Sumber Cahaya
Parameter yang dipertimbangkan dalam memilih sumber cahaya artifisial :
 - ⚡ Efisiensi (output cahaya/unit energi)
 - ⚡ Pantulan warna (color rendering)

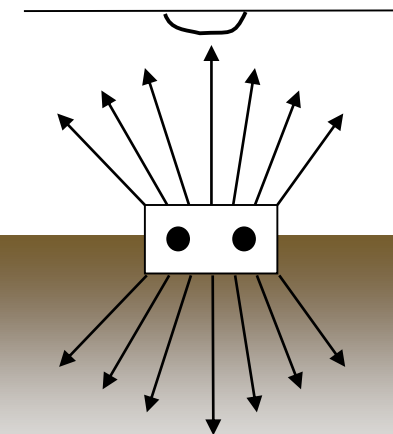
- Distribusi Cahaya
Menentukan cara mendistribusikan cahaya yang paling baik



direct



Indirect



Direct-indirect

Faktor Yang Dipertimbangkan Untuk Penerangan/ Pencahayaan Bagi Tempat Kerja

- Silau (glare)
Penerangan yang berlebihan terhadap penglihatan

Silau dihindari dengan cara memilih kombinasi yang sesuai antara penerangan langsung dan tidak langsung





Warna

Faktor Yang Dipertimbangkan Untuk Penerangan/ Pencahayaan Bagi Tempat Kerja

- Warna
warna dan tekstur obyek diamati

Warna memberikan efek psikologi

Warna tembok ruangan tempat bekerja

Merah : bersifat merangsang

Kuning : kesan luas dan lega

Hijau atau biru : kesan sejuk, aman & menyegarkan

Gelap : kesan sempit

Terang : kesan leluasa

TABLE 6-5

The Emotional and Psychological Significance of the Principal Colors

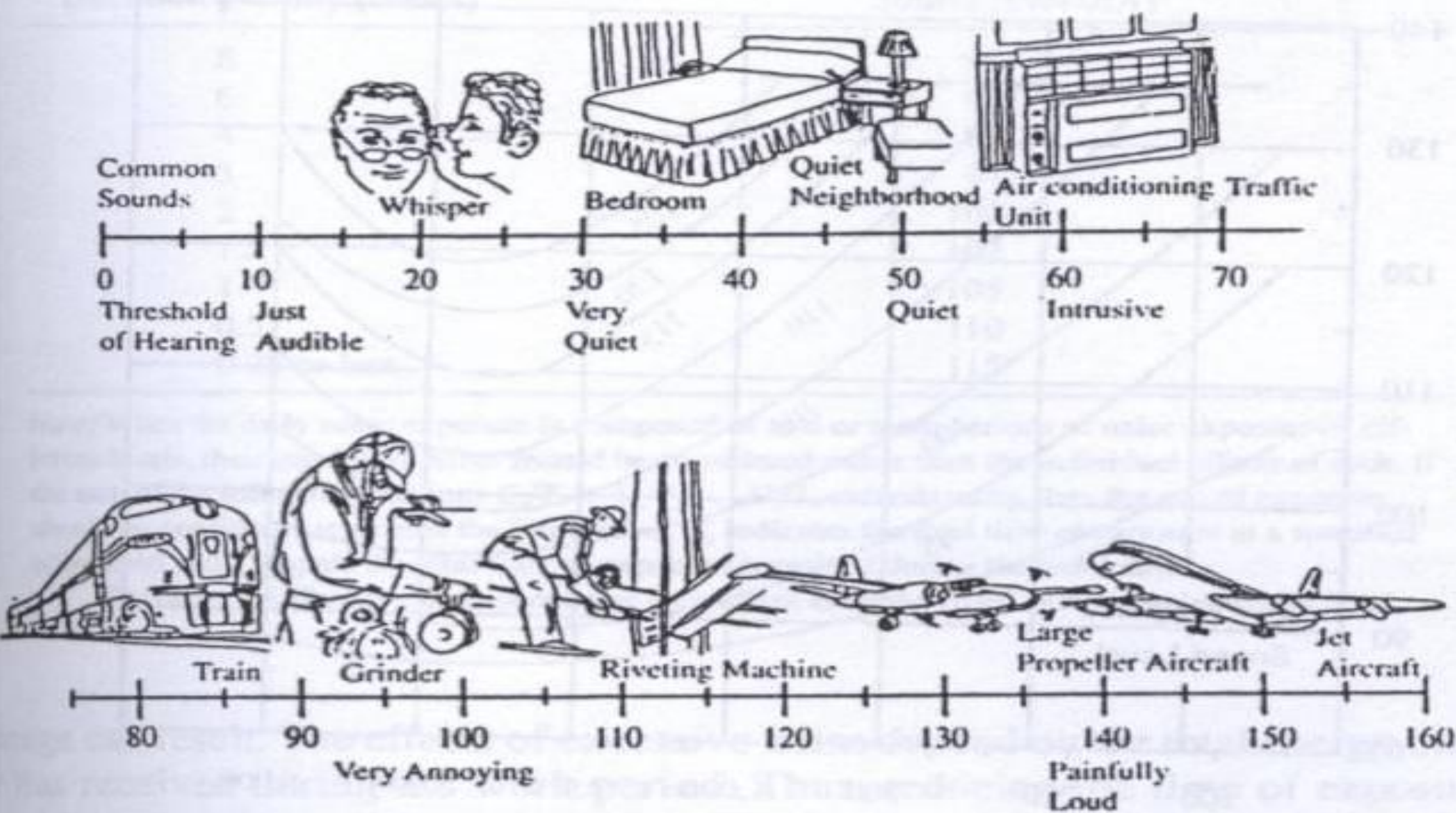
Color	Characteristics
Yellow	Has the highest visibility of any color under practically all lighting conditions. It tends to instill a feeling of freshness and dryness. It can give the sensation of wealth and glory, yet can also suggest cowardice and sickness.
Orange	Tends to combine the high visibility of yellow and the vitality and intensity characteristic of red. It attracts more attention than any other color in the spectrum. It gives a feeling of warmth, and frequently has a stimulating or cheering effect.
Red	A high-visibility color having intensity and vitality. It is the physical color associated with blood. It suggests heat, stimulation, and action.
Blue	A low-visibility color. It tends to lead the mind to thoughtfulness and deliberation. It tends to be a soothing color, although it can promote a depressed mood.
Green	A low-visibility color. It imparts a feeling of restfulness, coolness, and stability.
Purple and violet	Low-visibility colors. They are associated with pain, passion, suffering, heroism, and so on. They tend to bring a feeling of fragility, limpness, and dullness.



Bunyi Dan Kebisingan



Decibel Values of Typical Sounds (dBA)



Tiga Aspek Penentu Kualitas Bunyi Dan Tingkat Gangguan Terhadap Manusia (1)

1. Frekuensi bunyi (f)

- Merupakan jumlah gelombang suara yang sampai ke telinga setiap detik
- Dinyatakan dalam jumlah getaran/detik atau Hertz

$$C = f \cdot \lambda$$

C = kecepatan bunyi merambat di udara
(1000 ft/sec) atau (340 m/det)

f = frekuensi dalam Hertz

λ = panjang gelombang

scREAM taBÚ

www.screamtabu.com Becerril de la Sierra Madrid España Europa Hemisferio Norte

Tiga Aspek Penentu Kualitas Bunyi Dan Tingkat Gangguan Terhadap Manusia (2)

2. Intensitas Bunyi (Decibel/dB)

- Besarnya arus energi per satuan luas
- Alat ukur bunyi adalah sound level meter

$$L = 20 \log_{10} [P_{rms}/P_{ref}]$$

L = Tingkat tekanan/intensitas bunyi (dB)

P_{rms} = Intensitas/tekanan bunyi aktual dalam N/m² (microbars)

P_{ref} = Intensitas bunyi pada ambang batas pendengaran orang muda, yaitu pada 1000Hz (=0,0002 microbars)

- Batas dengar 0-120 db

Tiga Aspek Penentu Kualitas Bunyi Dan Tingkat Gangguan Terhadap Manusia (3)

3. Lama

- Lama/waktu mendengarkan kebisingan
- Menurunkan kemampuan pendengaran
- Konsep Dosis Kebisingan (Noise Dose)
OSHA menentukan dosis waktu yang diijinkan/aman bagi seorang pekerja untuk mendengar bunyi > 80 dB
- Kerusakan pendengaran meningkat ketika frekuensi bunyi mencapai 2400–4800Hz

$$D = 100x(C1/T1 + C2/T2 ++Cn/Tn) \leq 100$$

D = Dosis kebisingan

C = Waktu yang dihabiskan pada level kebisingan tertentu (jam)

T = Waktu yang diijinkan pada tingkat bunyi tertentu (lihat tabel 6-6, Niebel)

TABLE 6-6

Permissible Noise Exposures

Duration per day (hours)	Sound level (dA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Note: When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered rather than the individual effects of each. If the sum of the following fractions $C_1/T_1 + C_2/T_2 + \dots + C_n/T_n$ exceeds unity, then the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure at a specified noise level and T_n equals the total time of exposure permitted during the work day.

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

A modern building with large glass windows and a swimming pool, with the word 'VENTILASI' overlaid in a green banner. The building features a mix of wood and glass siding. The pool is in the foreground, and there are trees and a fence in the background.

VENTILASI

VENTILASI



Tujuan :

- menyediakan udara segar
- mengeluarkan gas-gas dan kontaminan yang berbahaya
- Mengeluarkan panas dari tempat kerja

Kecepatan udara yang direkomendasikan

- $<0,1$ m/det □ perasaan pengap dan sesak
- $>0,2$ m/det □ banyak angin/berangin

- Pada kondisi panas ($>24^{\circ}\text{C}$) kecepatan udara $0,2-0,5 \text{ m/det}$ akan membantu pendinginan tubuh terutama ketika kelembaban tinggi
- Ventilasi biasanya ditempatkan pada ketinggian $8-12 \text{ feet}$ ($2,4-3,6 \text{ m}$)
- Pengganti ventilasi : fan



GETARAN



Getaran

- Parameter getaran : frekuensi, amplitudo, velocity, percepatan
- Amplitudo (s) : simpangan maksimum dari posisi statis (inch)
- **Maximum velocity :**

$$\frac{ds}{dt} = 2\pi(s)(f) \text{ in/sec}$$

f= frekuensi

s= simpangan amplitudo

- **Max acceleration :**

$$\frac{d^2s}{dt^2} = 4\pi^2(s)(f^2) \text{ in/sec}^2$$

Getaran

TETSOO PRODUCTION



- Simpangan amplitudo dan percepaan (acceleration) adalah parameter utama yang digunakan untuk menentukan intensitas getaran
- Getaran dengan amplitudo tinggi dan frekuensi yang rendah mempunyai efek yang tidak diinginkan terhadap organ dan jaringan tubuh

FULL VERSION WITH 3D VIDEO NAVIGATION
ENTER

LIGHT VERSION
ENTER

SYSTEM REQUIREMENTS
EXPLORER 5.0 OR NETSCAPE 6.2 /// FLASH 5 MX PLAYER /// QUICK TIME 5.0.2
1024 X 768 RESOLUTION AT LEAST /// MILLION OF COLORS
FAST CONNECTION
■ DOWNLOAD FLASH PLAYER HERE
■ DOWNLOAD QUICKTIME PLAYER HERE

(TM) HOSTING POWERED BY MEDIATEMPLE

Tiga Klafisikasi Getaran

a. Getaran yang mempengaruhi seluruh permukaan tubuh

Ex : getaran yang diakibatkan intensitas bunyi yang tinggi di udara

b. Getaran yang dialirkan tubuh melalui supporting area

Ex: melalui *buttock* orang yang mengendarai truk

c. Getaran yang hanya dirasakan area tubuh tertentu (terlokalisasi)

Ex: terhadap tangan ketika mengoperasikan alat tertentu

Getaran

Efek getaran :

- Mempengaruhi konsentrasi kerja
- Mempercepat kelelahan
- Menyebabkan timbulnya beberapa penyakit
ex : gangguan mata, syaraf, otot, tulang dsb