



## SPACE REQUIREMENT

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## SPACE REQUIREMENTS

- The most difficult determination in facilities planning
- The design year: 5-10 years
- Uncertainty –due to impact of technology, Changing product mix, changing demand levels, changing organization designs for the future
- Needs a systematic approach: "From the ground up"

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## SPACE REQUIREMENTS

- In manufacturing and office environments, space requirements should be determined first for individual workstations; next, departments, etc.
- Modern manufacturing approaches can reduce space requirements.
  - Products are delivered to the points of use in smaller lot and unit load size
  - Decentralised storage areas
  - Less inventories (using a pulled system)
  - Manufacturing cells
  - Companies are downsizing

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## SPACE REQUIREMENTS

- Workstation Specification (space for equipment, materials, and personnel)
- Equipment Space consists of space for
  - the equipment; machine travel; machine maintenance;
  - plant services
- Materials Space consists of space for
  - Receiving and storing materials; In-process materials;
  - Storing and shipping materials; Storing and shipping waste and scrap; Tools, fixtures, jig, dies, and maintenance materials
- Personnel area consists of space for
  - The operator; Material handling; Operator ingress and egress.

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## SPACE REQUIREMENTS

- Department Specification
- Aisle Arrangement
- Visual Management and Space Requirement

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## SPACE REQUIREMENTS

Simple rules of thumb are used to determine the extra space that is required (Heragu, 1997)

- 3 – 4 feet are added to the length and width of each machine or workstation
- The additional space is calculated as a percentage of the actual area occupied by a workstation, typically 200% to 300%
- Calculate the space required for the workstation, auxiliary equipment, operator space, incoming material and work in process space, and other additional space (e.g., load and unload access, material handling carrier clearance) and add the separate quantities to determine the total space required (*the preferred method of determining extra space*)

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## SPACE REQUIREMENTS

Figure 2.16 Production space requirement sheet

Department Name (1)	Work-center Name (2)	Work-center Code (3)	Length (feet) (4)	Width (feet) (5)	Area (square feet) (6)	Auxiliary Area (square feet) (7)	Operator Space (square feet) (8)	Material Space (square feet) (9)	Subtotal (square feet) (10)	Allowance (square feet) (11)	Total Space Per Machine (square feet) (12)	Number of Machines (13)	Total Space for Machine Type (square feet) (14)
General machining	Vertical milling	1202	15	15	225	70	30	50	375	150%	565	2	1130
	Planer	2005L	25	5	125	40	20	40	225	125%	290	1	290
	Punch press	3058	10	10	100	30	20	20	170	140%	240	2	480
	Injection molding	6078	20	10	200	60	50	100	410	150%	615	3	1845
Optoscope cell	NC-machine	9087	20	8	160	50	30	30	270	125%	340	2	680
	Lathe	1212	15	8	120	40	20	30	210	150%	315	1	315
	Auto-checker	2056	5	5	25	10	5	5	45	125%	60	1	60

## WORKSTATION

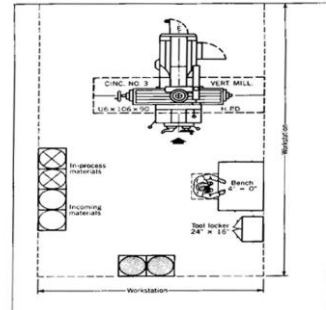


Figure 4.26 Workstation work requirements and minimum total area requirements.

## AISLE ALLOWANCE

Table 4.3 Aisle Allowance Estimates

If the Largest Load Is	Aisle Allowance Percentage Is <sup>a</sup>
Less than 6 ft <sup>2</sup>	5–10
Between 6 and 12 ft <sup>2</sup>	10–20
Between 12 and 18 ft <sup>2</sup>	20–30
Greater than 18 ft <sup>2</sup>	30–40

<sup>a</sup>Expressed as a percentage of the net area required for equipment, material, and personnel.

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## DEPARTMENTAL SERVICE

DEPARTMENTAL SERVICE AND AREA REQUIREMENT SHEET

Company	A.B.C. Inc.	Prepared by	J.A.	Sheet 1 of 1						
Department	Turning	Date								
Service Requirements										
Work Station	Quantity	Power	Compressed Air	Other	Floor Loading	Ceiling Height	Area (square feet)			Total
							Equipment	Material	Personnel	
Turret lathe	5	440 V AC	10 CFM @ 100 psi		150 PSF	4'	240	100	100	440
Screw machine	6	440 V AC	10 CFM @ 100 psi		190 PSF	4'	280	240	120	640
Chucker	2	440 V AC	10 CFM @ 100 psi		150 PSF	5'	60	100	40	200
							Net area required	1200		
							13% aisle allowance	162		
							Total area required	1342		

Figure 4.27 Department service and area requirements sheet.

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## AISLE WIDTHS

Table 4.4 Recommended Aisle Widths for Various Types of Flow

Type of Flow	Aisle Width (feet)
Tractors	12
3-ton Forklift	11
2-ton Forklift	10
1-ton Forklift	9
Narrow aisle truck	6
Manual platform truck	5
Personnel	3
Personnel with doors opening into the aisle from one side	6
Personnel with doors opening into the aisle from two sides	8

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## VISUAL MANAGEMENT

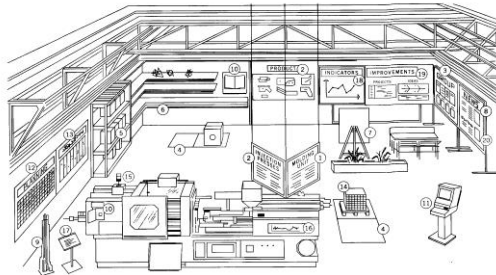


Figure 4.28 Visual factory scenario.

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## VISUAL MANAGEMENT

- Keterangan gambar:
    - A. Identification, housekeeping, and organization
      1. Identification of the department
      2. Identification of activities, resources, and products
      3. Identification of the team
      4. Markings on the floor
      5. Markings of tools, racks, fixtures
      6. Technical area
      7. Communication and rest area
      8. Information and instructions
      9. Housekeeping tools
    - B. Visual documentation
      10. Manufacturing instructions and technical procedures area
    - C. Visual production, maintenance, inventory, and quality control
      11. Computer terminal
      12. Production schedule
      13. Maintenance schedule
      14. Identification of inventories and work-in process
      15. Monitoring signals for machines
      16. Statistical process control
      17. Record of problems
    - D. Performance measurement
      18. Objectives, result, and difference
    - E. Progress status
      19. Improvement activities
      20. Company project and mission statement
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## PERSONEL REQUIREMENT

TATA LETAK FASILITAS (TIN 4124)

## PERSONNEL REQUIREMENTS ANALYSIS

- $n$  number of types of operations
- $O_i$  aggregate number of operation type  $i$  required on all the pseudo (or real) products manufactured per day
- $T_i$  standard time required for an average operation  $O_i$
- $H$  total production time available per day
- $\eta$  assumed production efficiency of the plant

$$N = \sum_{i=1}^n \frac{T_i O_i}{\eta H}$$

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## PERSONNEL REQUIREMENTS

- Philosophies relating to personnel:
  - "Our firm is responsible for our employees from the moment they leave their home until they return. We must provide adequate methods of getting to and from work"
  - "Employees spend one third of their life within our facility, we must help them enjoy working here"

## PERSONNEL REQUIREMENTS

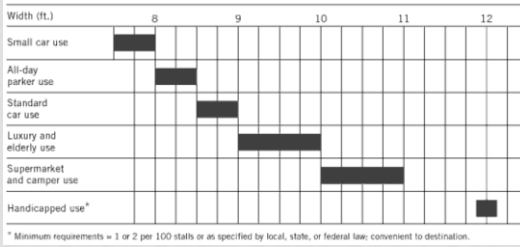
- Facilities planning relating to personnel includes planning for:
  - The Employee-Facility Interface
    - Employee parking
    - Locker rooms
  - Restrooms
  - Food services
  - Health services
  - Barrier-Free Compliance

## PERSONNEL REQUIREMENTS

- The Employee-Facility Interface
  - Employee Parking
    - The procedure of planning employee parking:
      1. Determine the number of automobiles to be parked
      2. Determine the space required for each automobile
      3. Determine the available space for parking
      4. Determine alternative parking layouts for alternative parking patterns
      5. Select the layout that best utilizes space and maximizes employee convenience
    - The factors to be considered in determining the specification for a specific parking lot are:
      1. The percentage of automobiles to be parked that are compact automobiles. As a planning guideline, if more specific data are not available, 33% of all parking is often allocated to compact automobiles
      2. Increasing the area provided for parking decreases the amount of time required to the park and de-park
      3. Angular configurations allow quicker turnover; perpendicular parking yields greater space utilization
      4. As the angle of parking space increases, so does the required space allocated to aisles
    - Parking lot location should not be more than 500 ft from entrances and exists of the facility

## PERSONNEL REQUIREMENTS

- Recommended parking dimensions:



## PERSONNEL REQUIREMENTS

- Parking dimensions for each car group as a function of single and double loaded model:

Group I Small Cars	# ANGLE OF PARK	Width (ft.)							
		45°	60°	75°	90°	105°	120°	135°	150°
1	25'0"	26'0"	27'0"	28'0"	29'0"	30'0"	31'0"	32'0"	33'0"
2	30'0"	31'0"	32'0"	33'0"	34'0"	35'0"	36'0"	37'0"	38'0"
3	35'0"	36'0"	37'0"	38'0"	39'0"	40'0"	41'0"	42'0"	43'0"
4	40'0"	41'0"	42'0"	43'0"	44'0"	45'0"	46'0"	47'0"	48'0"

## PERSONNEL REQUIREMENTS

- Locker rooms

## PERSONNEL REQUIREMENTS

- Restrooms
- Plumbing fixture requirements for number of employees

Water Closets	Employees	Lavatories	Employees
1	1-15	1	1-20
2	16-35	2	21-40
3	36-55	3	41-60
4	56-80	4	61-80
5	81-110	5	81-100
6	111-150	6	101-125
7	151-190	7	126-150
8		8	151-175

One additional water closet for each 40 employees in excess of 190. One additional lavatory for each 30 employees in excess of 175.

Industrial, Foundries, and Storage			
Water Closets	Employees	Lavatories	Employees
1	1-30	1	3-8
2	11-25	2	9-16
3	26-50	3	17-30
4	51-80	4	31-45
5	81-125	5	46-65

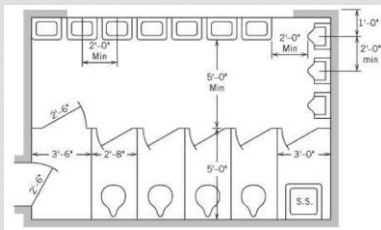
One additional water closet for each 45 employees in excess of 125. One additional lavatory for each 25 employees in excess of 65.

Assembly, Other Than Religious, and Schools					
Water Closets	Occupants	Urinal	Male Occupants	Lavatories	Occupants
1	1-100	1	1-100	1	1-100
2	101-200	2	101-200	2	101-200
3	201-400	3	201-400	3	201-400
4	401-700	4	401-700	4	401-700
5	701-1100	5	701-1100	5	701-1100

One additional water closet for each 600 occupants in excess of 1100. One additional urinal for each 300 occupants in excess of 1100. One additional lavatory for each 1500 occupants in excess of 1100. Such lavatories need not be supplied with hot water.

## PERSONNEL REQUIREMENTS

- Restrooms
- Restroom layout with typical clearances



## PERSONNEL REQUIREMENTS

- Food services
- Alternatives for food services requirements:
  - Dining away from the facility
  - Vending machines and cafeteria
  - Serving line and cafeteria (> 200 employees)
  - Full kitchen and cafeteria (> 400 employees)
- Disadvantages of dining away alternative:
  - Longer meal break
  - Lost supervision
  - A loss of worker interaction
  - A loss of worker concentration on the tasks to be performed

## PERSONNEL REQUIREMENTS

- Food services

Beginning of Lunch Break	Time Sat Down in Chair	End of Lunch Break
11:30 A.M.	11:40 A.M.	12:00 Noon
11:50 A.M.	12:00 Noon	12:20 P.M.
12:10 P.M.	12:20 P.M.	12:40 P.M.
12:30 P.M.	12:40 P.M.	1:00 P.M.

Shifting timing for 30 min lunch break

Classification	Square Footage Allowance per Person
Commercial	16-18
Industrial	12-15
Banquet	10-11

Space requirements for cafeterias

Number of Meals Served	Area Requirements (ft <sup>2</sup> )
100-200	500-1000
200-400	800-1600
400-800	1400-2800
800-1300	2400-3900
1300-2000	3250-5000
2000-3000	4000-6000
3000-5000	5500-9250

Space required for full kitchen

## PERSONNEL REQUIREMENTS

- Health services

- Types of health services that may be provided within a facility include:

1. Pre-employment examination
2. First aid treatment
3. Major medical treatment
4. Dental care
5. Treatment of illnesses

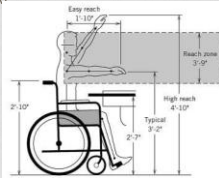
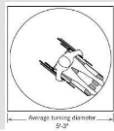
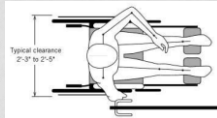
- First aid treatment:

- Without nurse: 100 ft<sup>2</sup> (first aid kit, a bed, 2 two chairs)
- With a nurse: 250 ft<sup>2</sup> (first aid kit, two beds, 2 two chairs), 75 ft<sup>2</sup> waiting room. Every additional nurse = add 250 ft<sup>2</sup> space, and 25 ft<sup>2</sup> waiting room
- Add a physician: add 150 ft<sup>2</sup> for examination room

## PERSONNEL REQUIREMENTS

- Barrier-Free Compliance

- Americans with Disabilities Act (ADA)



## GROUP TECHNOLOGY: MACHINES ASSIGNMENT

TATA LETAK FASILITAS (TIN 4124)

## MACHINE ASSIGNMENT

- Popular Approach:

- Classification and coding
- Production flow analysis
- Clustering techniques
- Heuristic procedures
- Mathematical models (branch and bound method)

- Clustering techniques:

- Five commonly used algorithms:
  - Rank order clustering
  - Bond energy
  - Row and column masking
  - Similarity coefficient
  - Mathematical programming approach

## MACHINE ASSIGNMENT

- TUGAS:

- CARI dan RESUME JURNAL MENGENAI MACHINE ASSIGNMENT
- CARI dan RESUME JURNAL MENGENAI DESAIN FASILITAS

- Balasan:

- Jurnal nasional dan atau internasional
- 5 tahun terakhir
- Kelompok: maksimum 3 orang

## REFERENCES

- Heragu, S. (2008). *Facilities Design* (3rd Ed.). CRC Press.
- Tompkins, White, Bozer and Tanchoco. (2010). *Facilities Planning* (4th Ed.). New York: Wiley.