P07
Space Consideration

E212 - Facilities Planning and Design

SCHOOL OF ENGINEERING

Space Requirement

- Determining the amount of space required in a facility is perhaps the most difficult determination in facilities planning

- Design lifespan for a facility: typically 5 – 10 years

- Uncertainties:
  - Technologies
  - Product mix
  - Demand level
  - Organizational designs

Parkinson’s Law

Things will expand to fill all available capacity sooner than you plan!

Systematic Approach to Space Planning

- Manufacturing and Office environments
  - Determine space for individual workstations
  - Determine space for department, based on the collection of workstations in department
- Storage and Warehousing activities
  - Inventory levels, storage units, storage methods and strategies, equipment requirements, building constraints and personnel requirements need to be considered

Workstation Specification - Equipment

- Obtain the following information from machinery data sheets or physical inventory check:
  - Equipment actual dimensions
  - Machine travel
    - Maximum travel to left and right
    - Maximum travel towards operator and away from operator
    - Maximum vertical travel
  - Machine maintenance requirement and areas
  - Plant services requirement and areas
- Floor area requirement

  = Total width (static width plus maximum travel to the left and right)

  x Total depth (static depth plus maximum travel towards and away from operator)
- Total machinery area = Floor area requirement + Maintenance and plant service area

Workstation Specification - Material

- Receiving and storing materials
- In-process materials
- Storing and shipping materials
  - Requires information on dimension of unit loads, flow of material through machine, whether inventory holding zone is within workstation or department
  - If inventory holding zone not within workstation, minimum requirement for space may be 1 unit load to be worked next, one unit load being worked from, one unit load being worked to, one unit load completed
- Storing and shipping waste and scrap
  - Storage prior to removal from workstation
- Tools, fixtures, jigs, dies and maintenance materials
  - Depends on whether storage is at department or individual workstation level

Workstation Specification - Personnel

- Operator
- Material handling
  - Requires knowledge of method of performing operation
  - Based on motion study and ergonomic study taking into account:
    - Pick up and discharge with walking or making long/awkward reaches
    - Efficient and effective utilization of operator
    - Minimize time spent on material handling
    - Maximize operator safety, comfort and productivity
    - Minimize hazards, fatigue and eye strain
  - Minimal 30-inch aisle to travel pass through 2 stationary objects
  - Minimal 36-inch aisle to travel pass stationary and moving objects
  - Minimal 42-inch aisle to travel pass through 2 moving objects
- Operator ingress and egress

Aisle Arrangement

- Departmental aisle and main aisle allowance

Recommended Aisle Widths for Various Types of Flow

Types 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 in the aisle from one side	6
Personnel with doors opening in the aisle from two sides	8

P07 Sample Solution

Workstation Specifications

- Equipment:
  - 4x Multi-Tasking CNC Machines: 2400 mm X 4121 mm each
  - 4x Workbenches [(L) 1200 mm x (W) 800 mm each],
  - 1x CMM Machine [(L) 2500 mm x (W) 2500 mm],
  - 1x Wire-Brushing Station [(L) 1200 mm x (W) 1200 mm],
  - 2x Metal Storage Racks [(L) 1500 mm x (W) 800 mm each] for equipment maintenance tools,
  - 4x Waste Metal Bins [(L) 1800 mm x (W) 1200 mm each] for collecting waste chips from CNC Machines,
  - 8x Standby Coolant Containers [∅ 500 mm each],
  - Machine travel: assume need to cater for opening of covers and doors.
  - Machine operation area: Area in front of each CNC Machine (with workbench) is available for operation
  - Machine maintenance area: Area at the access doors of machine is available for ease of maintenance
  - Plant service area: Clearance area near to power source for maintenance

Workstation Specifications

- Material:
  - Incoming, outgoing and storage materials:
    - Assume raw materials and finished good are transported in and out of the machining center by the forklift efficiently.
  - In-process materials: nil
  - Waste from scrap
    - Assume dump into the Waste Metal Bins
  - Housekeeping / maintenance materials
    - Assume at department level only

Workstation Specifications

- Personnel:
  - Operator working space: At least a space of 3’ allowance.
  - Material handling: At least a space of 9’ allowance for 1-Ton forklift to move around the machining center.
  - Aisle space for each workstation:
    - Minimal 914 mm (36”) (to travel pass stationary and moving objects)
  - Operator ingress and egress: nil

Recommended Aisle Arrangement

- Based on below guideline:

Types of Flow	Aisle Width (feet)
Tractors	12
3-ton Forklift	11
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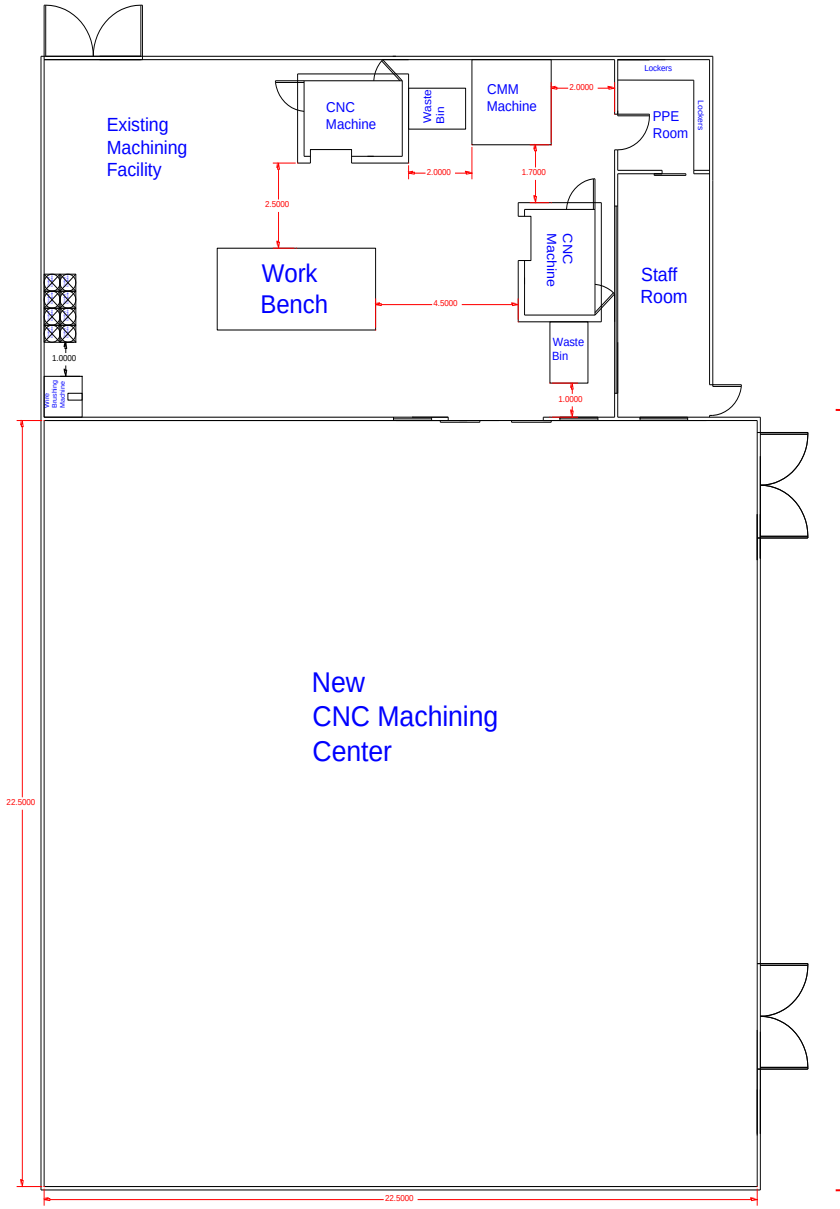
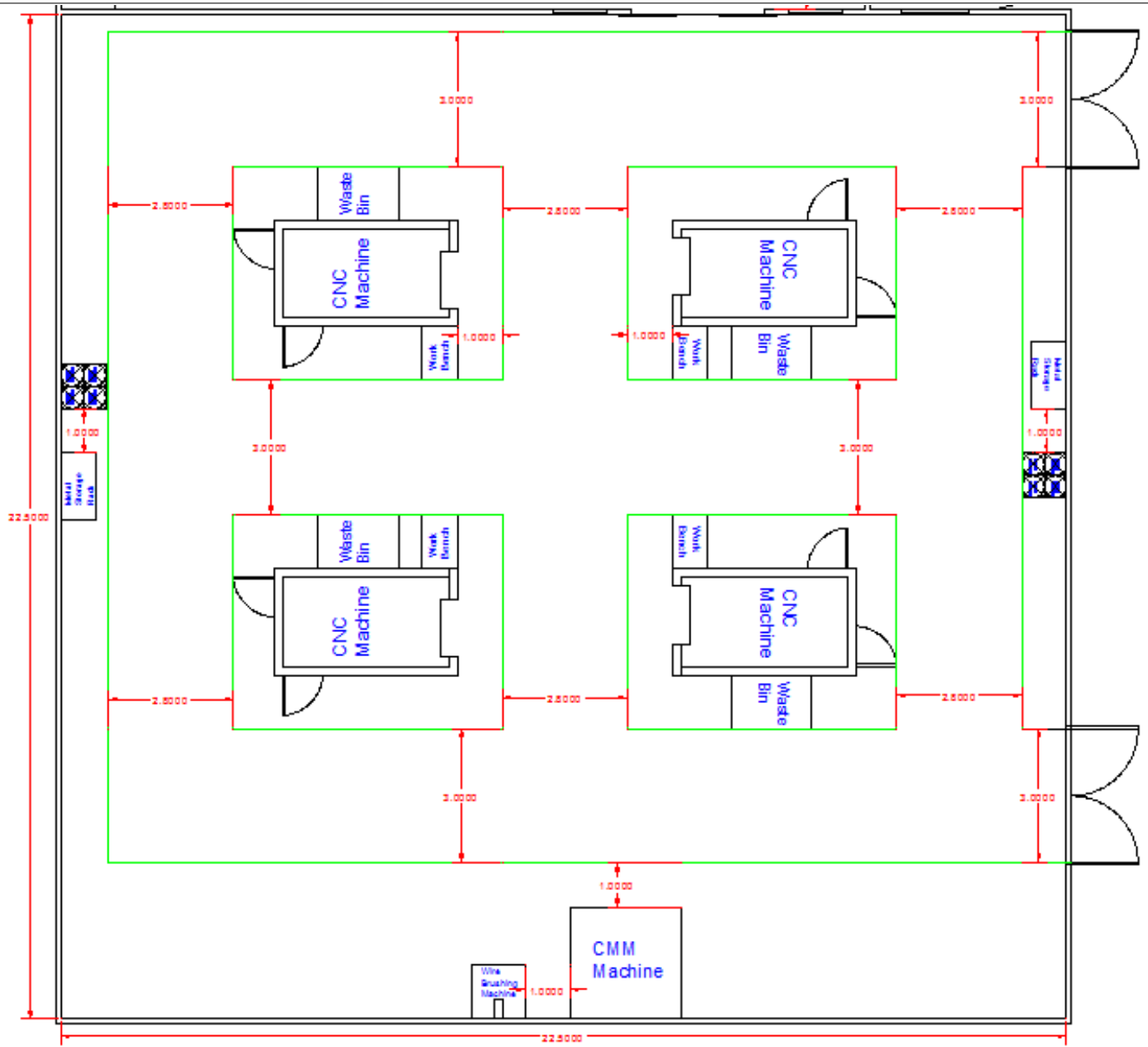
- Recommended aisle dimension for the new CNC Machining Center:
  - Between workstation: By Personnel = 914 mm (3 feet)
  - Main aisle: By 1-Ton Forklift =2743.2 mm (9 feet)

Initial Layout



Focus Area for New CNC Machining Center

Proposed Facility Layout



Learning Objectives

- Plan for sufficient aisle space for the materials handling and human flow in a facility.
- Determine the minimal space requirement of a department based on the number of machine required, machine footprint, minimal aisle space and maintenance requirement
- Define minimal space requirement for the facility based on the department requirement and common aisle requirement.