



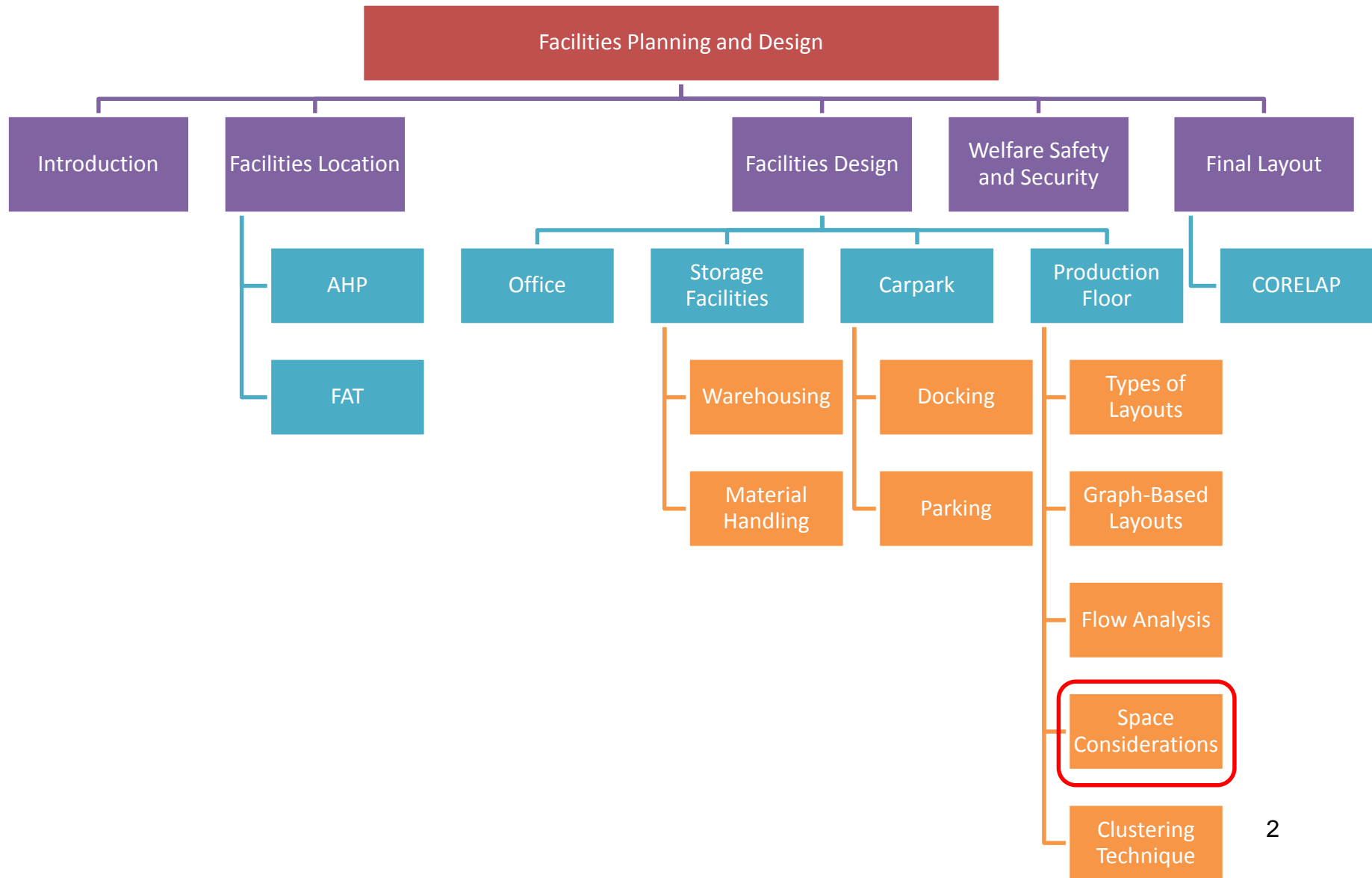
Problem 07

Blank Space

E212 – Facilities Planning and Design

SCHOOL OF
ENGINEERING

E212 Facilities Planning & Design - Topic Tree



Learning Objectives



- Determine and plan for sufficient aisle space for the materials handling and human flow in a facility.
- Calculate the minimal space requirement of a department based on the number of machine required, machine footprint, minimal aisle space and maintenance requirement.
- Calculate minimal space requirement for the facility based on the departmental requirement and common aisle requirement.
- Draft out a facility layout using AutoCAD.

Space Requirements



- 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:
 - Technology evolutions
 - Product mix changes
 - Demand level fluctuations
 - Organizational designs changes

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

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
- Operator ingress and egress

Aisle Arrangement



Departmental aisle

- Aisle space will usually be based on the material handling equipment that take up the largest Aisle space.

Recommended General Aisle Widths for Various Types of Flow (Tompkins et al., 2002)

Types of Flow	Aisle Width (in feet)	Aisle Width (in metre)
Tractors	12	3.66
3-ton Forklift	11	3.35
2-ton Forklift	10	3.05
1-ton Forklift	9	2.74
Narrow aisle truck	6	1.83
Manual platform truck	5	1.52
Personnel	3	0.91
Personnel with doors opening in the aisle from one side	6	1.83
Personnel with doors opening in the aisle from two sides	8	2.44

**1 ton = 1000 kg*

Suggested Solution

A large, solid green curved shape that starts from the bottom left and curves upwards and to the right, filling the right side of the slide. It has a smooth, organic edge.

Workstation Specifications



- Equipment List

(the allowance for machine's operational and maintenance space is included)

Station Description	Equipment Description	Dimension (m)		Number of Equipment Needed
		L	W	
Drilling Station	Drilling Machine	4	1	8
Bending Station	Bending Machine	4	1	6
Plastic Molding Station	Plastic Molding Machine	6	2	6
Spray Painting Station	Spray Painting Machine	6	3	6
Cutting & Welding Station	Cutting & Welding Machine	6	2	8
Motor & Electronics Station	Motor & Electronics Machine	6	3	4
Final Assembly, Inspection, and Packaging Station	Final Assembly Table	4	1	4
Raw Material Area	Raw Material Area	10	5	1
Finished Goods Area	Finished Goods Area	10	10	1

Equipment Minimal Space Requirement

Station Description	Equipment Description	Area (m ²)
Drilling Station	Drilling Machine	32
Bending Station	Bending Machine	24
Plastic Molding Station	Plastic Molding Machine	72
Spray Painting Station	Spray Painting Machine	108
Cutting & Welding Station	Cutting & Welding Machine	96
Motor & Electronics Station	Motor & Electronics Machine	72
Final Assembly, Inspection, and Packaging Station	Final Assembly Table	16
Raw Material Area	Raw Material Area	50
Finished Goods Area	Finished Goods Area	100

Working example:

Drilling Station = (equipment length x equipment width) x number of equipment
= 4 x 1 x 8 = 32 m²

Recommended Aisle Arrangement



Based on below aisle guideline (Tompkins et al., 2002):

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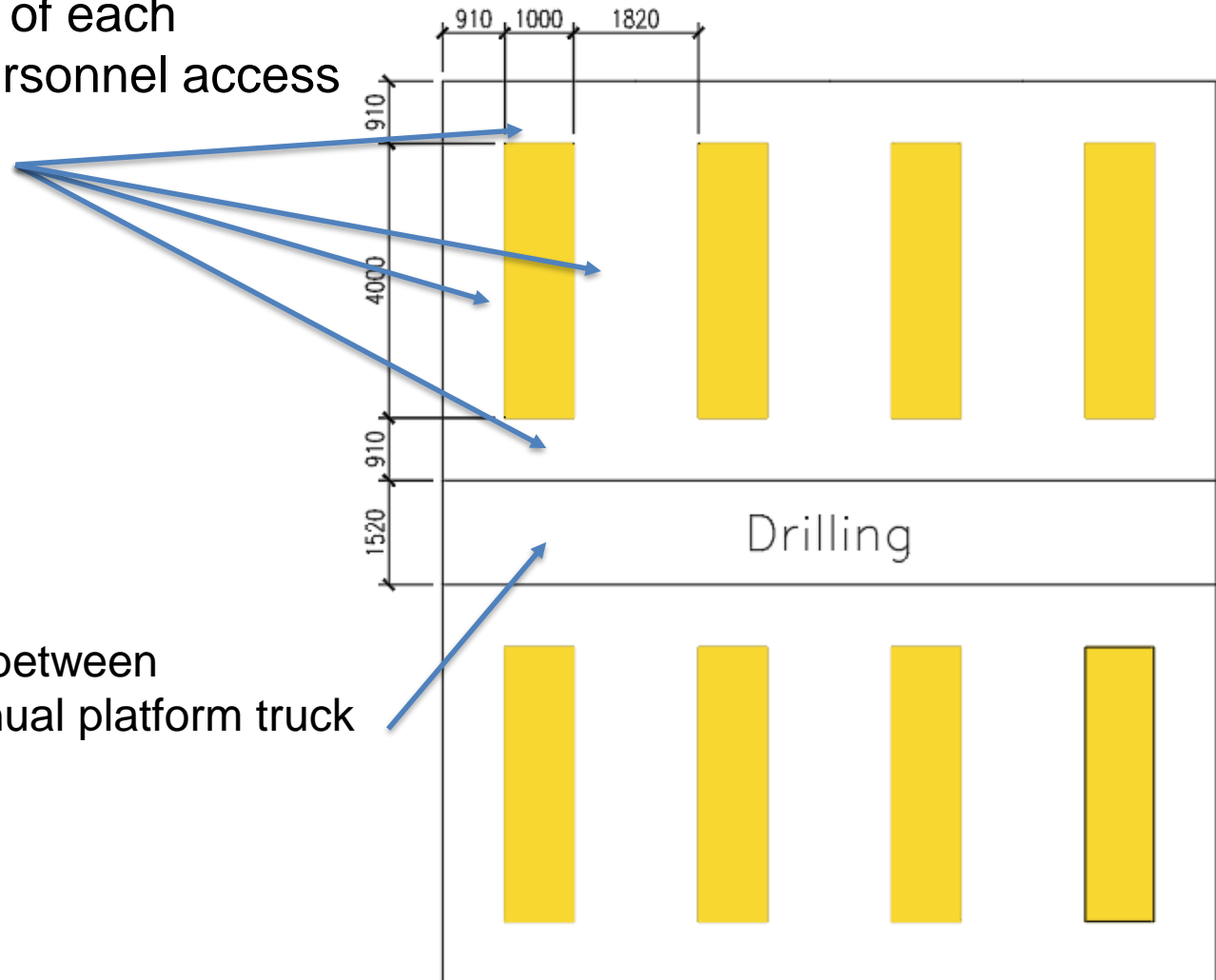
Recommended aisle dimension:

- For all 4 sides of each equipment: personnel access = 0.91 m.
- Aisle within station: manual platform truck = 1.52 m.
- Aisle between stations (including from the raw material area and to the finished goods area): 2-ton forklift = 3.05 m.

Recommended Aisle Arrangement



For all 4 sides of each equipment: personnel access = 0.91 m.

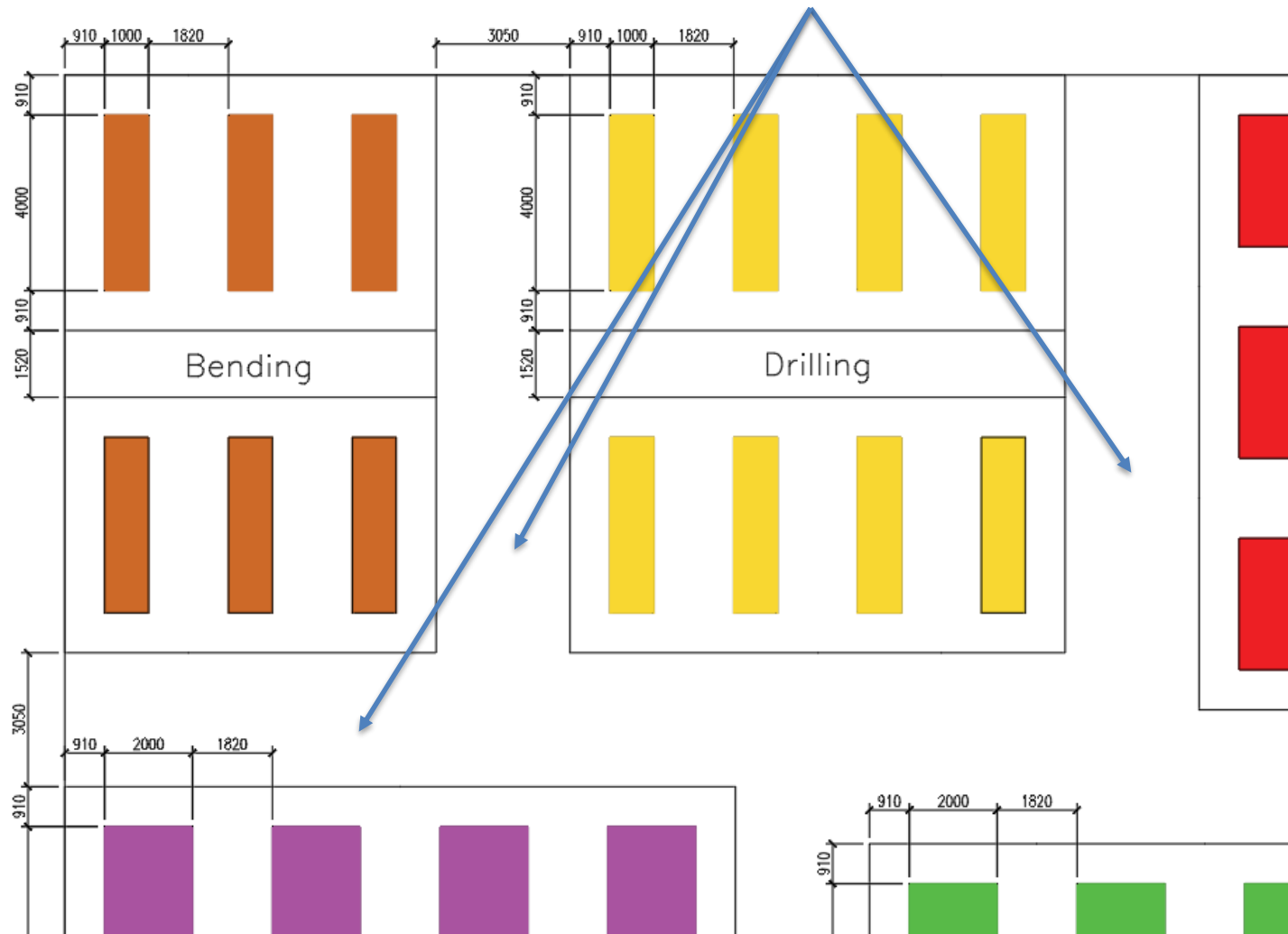


Within stations between equipment: manual platform truck = 1.52 m.

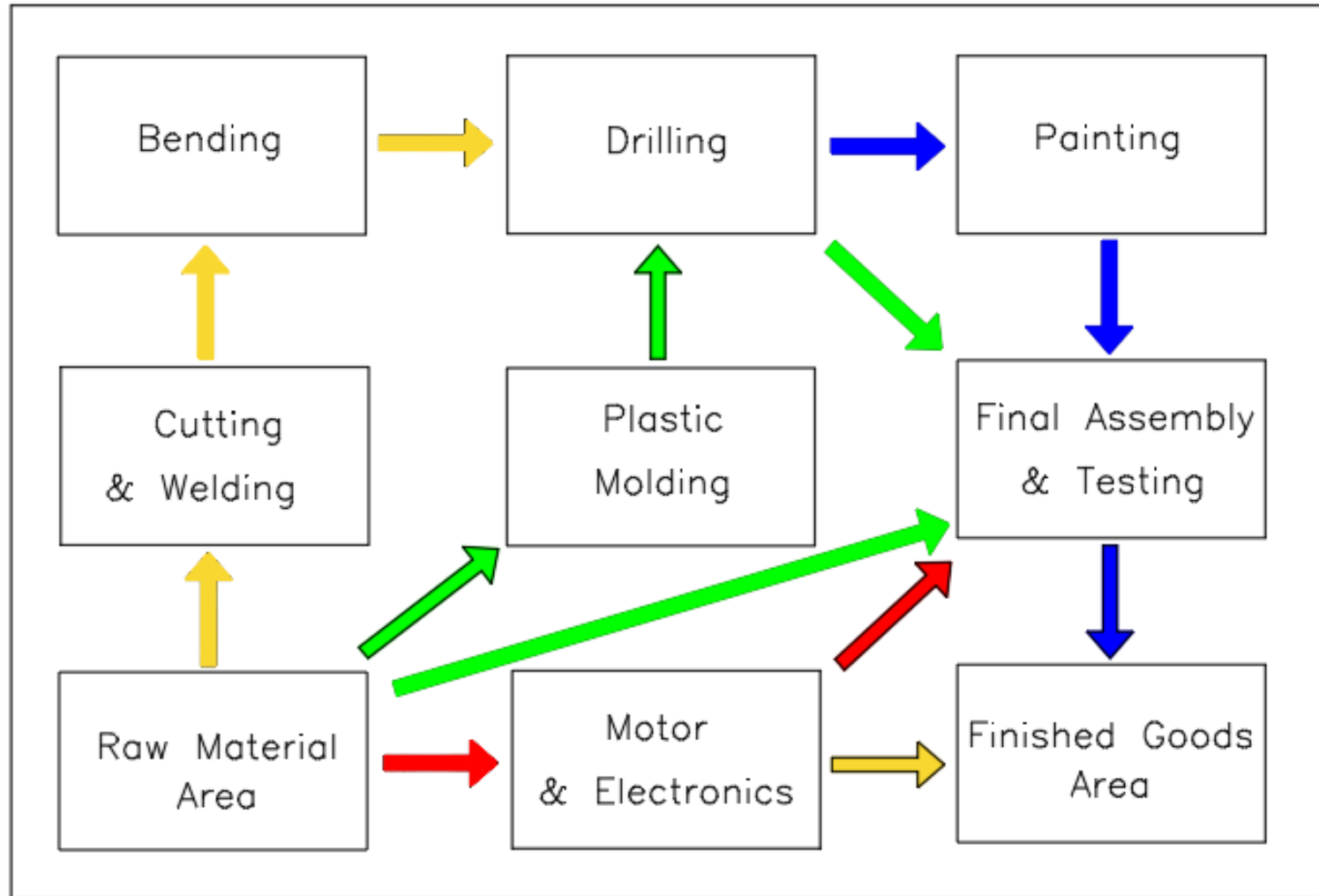
Recommended Aisle Arrangement



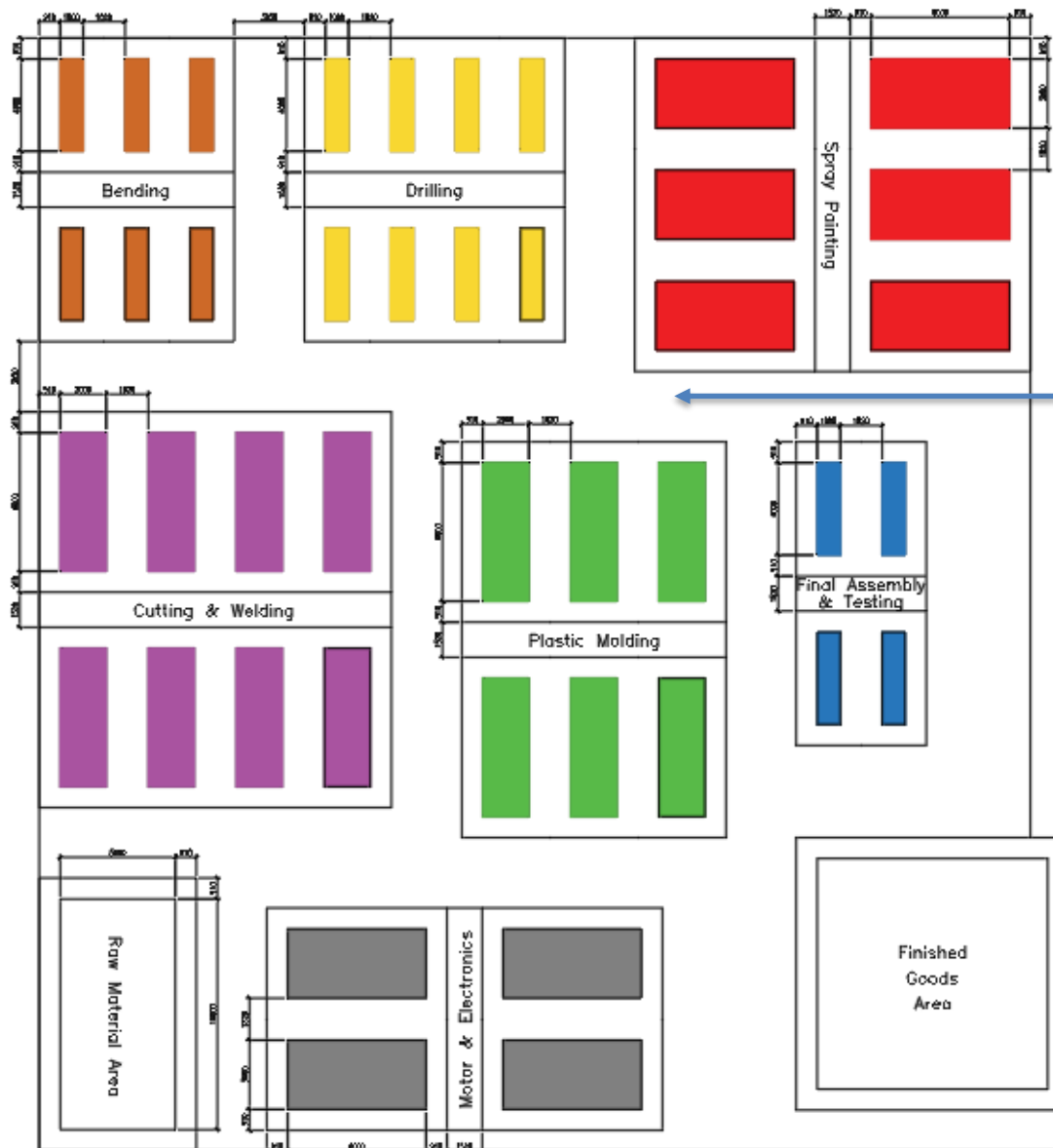
- From the raw material area, between stations, and to the finished goods area: 2-ton forklift = 3.05 m.



Proposed Layout from P06



Proposed Layout with Space Consideration

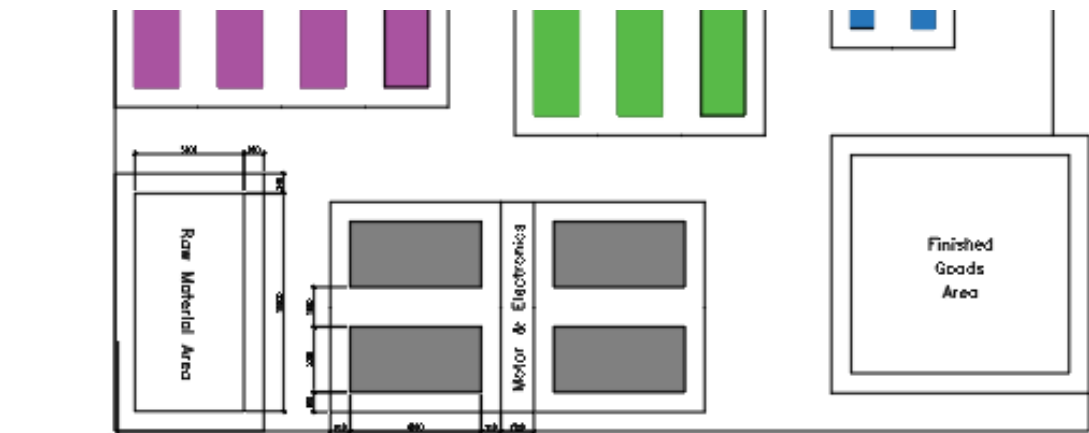
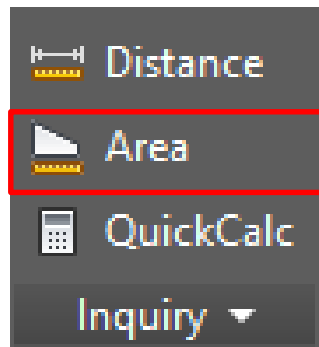


Aisle space for
2-ton forklift:
3.05 m

Total Minimal Space Requirement



- Type AutoCAD command “Area” (or click the “Area” button), then click all the corners of the object (i.e. the whole production floor area), then press enter.



2096846200.0 mm²
= 2096.85 m²



Area = 2096846200.0, Perimeter = 185800.0

- We can also use this command to calculate the area of each station.



New AutoCAD commands we have used today:

- Offset
- Trim
- Hatch
- Line
- Mtext
- Dimension (DIM)
- Area

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Overview of E212 Facilities Planning and Design

