



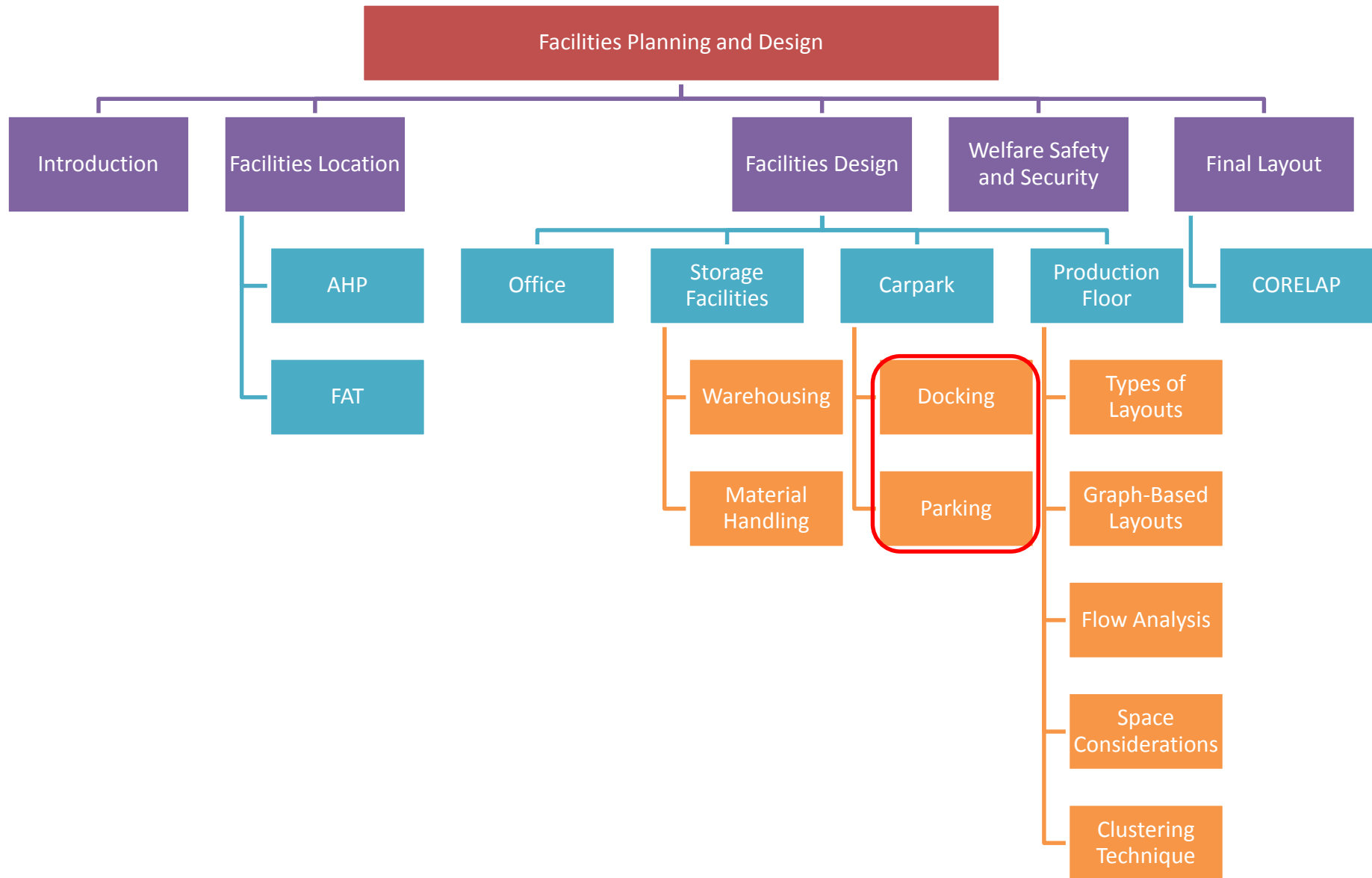
Problem 12

Docking and Parking

E212 – Facilities Planning and Design

SCHOOL OF
ENGINEERING

E212 Facilities Planning & Design - Topic Tree



Learning Objectives



- Describe the space requirement and process flow from/to the receiving and shipping activity
- List the different types of dock layout
- Select suitable dock configuration based on operations requirement(s)
- Perform the layout of a parking facility according to government regulations and guidelines
- Use AutoCAD to design the docking and car park layout

Space Requirement for Receiving and Shipping



To find out total space requirement for warehouse receiving and shipping areas:

- 1) What is to be received and shipped
 - Can use an analysis chart comprising:
 - a) Unit Loads: Type, Capacity, Size, Weight
 - b) Shipment: Size, Frequency
 - c) Transportation: Mode, Specifications
 - d) Material Handling: Method, Time
- 2) Number and type of docks
 - Number of docks: Waiting line analysis, Simulation
 - Type of docks: Flow of carriers, Maneuvering space available
- 3) Internal shipping and receiving areas
 - For office, receiving hold, disposal, pallets, equipment, staging, etc

Warehouse Docking Configuration



Central Dock (single dock for both receiving and shipping)

- Common equipment and personnel
- Better space utilization
- Higher incidence of space congestion
- Greater risk of material loss
- Error in material flow direction, e.g. shipping out a newly-received part by mistake

Point-of-use Dock (multiple docks for receiving or shipping)

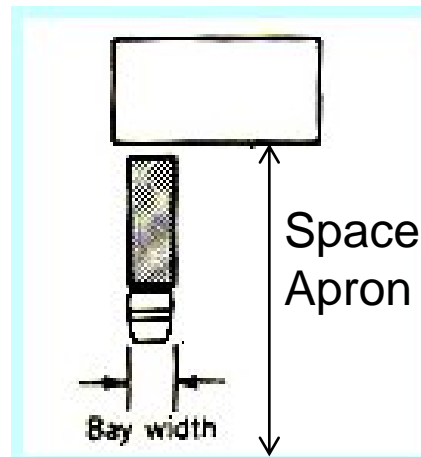
- Dedicated function, e.g. receiving frequent deliveries from light-duty carriers or shipping specific category of goods
- Often used to support Just-in-Time (JIT) manufacturing set-ups
- Usually requires more space than central docking

Warehouse Dock Configurations



- Docks are among the first requirements at a site and are vital for smooth operations. Dock width that is commonly adopted is 12 feet.
- For highly busy docks, width of 14 feet is employed.

90° Dock

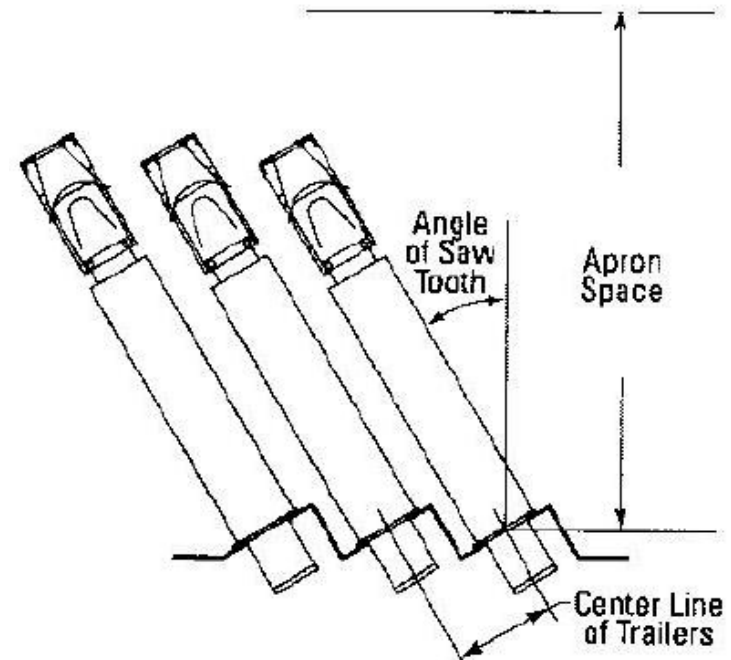
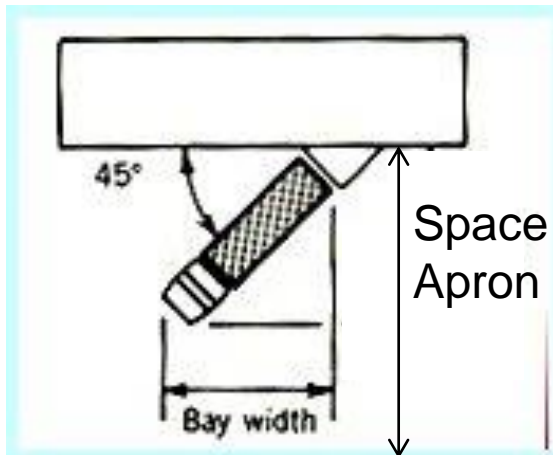


- Requires greater apron space but less bay width
- Larger outside turning area for carriers
- Commonly used when outside space is sufficient

Warehouse Dock Configurations



Finger Dock (or Saw-tooth Dock)



- Requires lesser apron space but more bay width
- Bigger inside maneuvering area for carriers
- Used when there is insufficient apron space to support 90° dock
- The largest finger dock angle (or the smallest saw tooth angle) possible should be selected

* Note the difference between finger dock angle and the saw-tooth angle.

Warehouse Docking Safety



Some equipment requirements for docking operations are as follows:

- 1) Dock Leveler – interface between a dock at a given height and variable height carriers



- 2) Bumper pads – interface between a fixed door and a moveable carrier



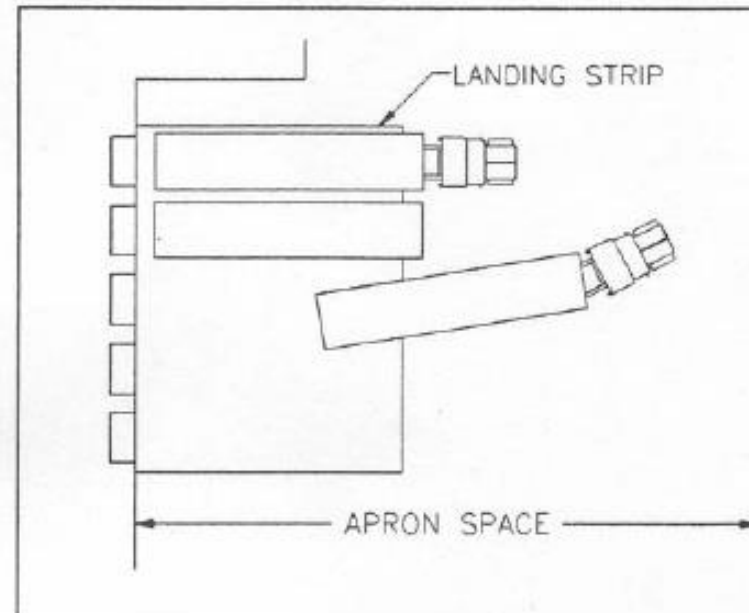
- 3) Dock Shelters – interface between a heated/air-conditioned dock and an unheated/air-conditioned carrier



Apron Space



- Apron Space: configuration of the area required to maneuver and position carrier into place



Landing Strip and Apron Space

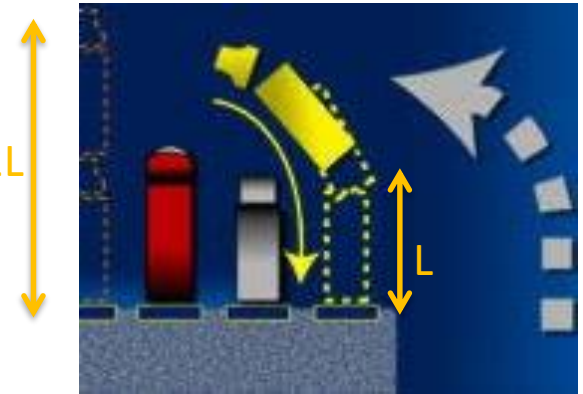
A simple guideline for determining apron space is to take the longest possible truck length and multiply by two. It is also recommended to add a safety factor of about 5' - 10' depending on available room.

Apron Space Allowance

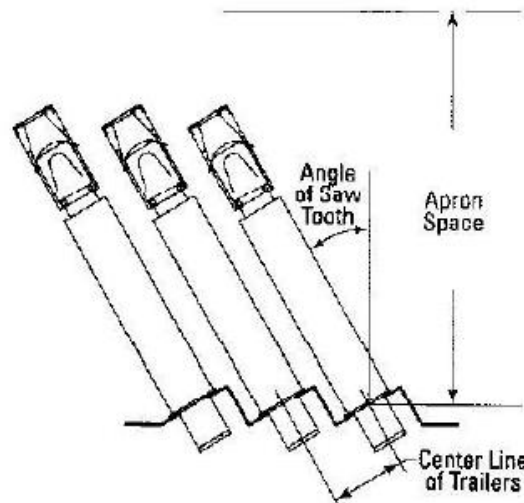


- Apron space for 90° Dock
 - Rule of thumb: 2 x the longest truck length, with an additional 5' to 10' safety factor

Apron = 2L



- Apron space for Finger Dock
(based on 12 feet width, 40 feet carrier)



| Center Dist., m | Saw-tooth angle, degrees | | | |
|-----------------|--------------------------|------|------|------|
| | 15 | 30 | 45 | 60 |
| 3.50 | 33.4 | 28.9 | 23.2 | 16.7 |
| 3.75 | 32.9 | 28.4 | 22.8 | 16.4 |
| 4.00 | 32.4 | 27.9 | 22.4 | 16.1 |
| 4.25 | 31.9 | 27.5 | 22.0 | 15.9 |
| 4.50 | 31.5 | 27.1 | 21.7 | 15.6 |
| 4.75 | 31.0 | 26.7 | 21.3 | 15.4 |
| 5.00 | 30.6 | 26.3 | 21.0 | 15.2 |
| 5.25 | 30.2 | 25.9 | 20.7 | 15.0 |
| 5.50 | 29.8 | 25.6 | 20.5 | 14.8 |
| 5.75 | 29.4 | 25.3 | 20.2 | 14.6 |

Note: the figures in Finger/Sawtooth Dock reference table are all in meters (m).

Vehicle Parking Design



Procedures:

- 1) Determine the number of vehicles to be parked
- 2) Determine the space requirement for each vehicle
- 3) Determine the available space
- 4) Determine alternative parking layouts for different parking configurations
- 5) Modifying alternatives based on any other requirements
- 6) Select the most suitable layout

Vehicle Parking Design in Singapore






- The Land Transport Authority (LTA) provides the rules and guidelines on the requirements for provision of parking places and spaces
- The Parking Places (Provision of Parking Places and Parking Spaces) Rules stipulate the minimum number of parking spaces to be provided for the various land and building uses, the minimum dimensions of such parking spaces, circulation aisle, access ramps and other details on the arrangement of the parking place and spaces – **(From Handbook on vehicle parking provision development proposals, LTA)**

Car Park Design considerations



- Examples of Minimum Parking Provision Standards for factory:

| Use Categories | Minimum Parking Provision Standards | Illustration |
|------------------------------|--|---|
| Flatted Type Factory | 1 car park per 350m ² 1 lorry/loading & unloading space per 3000m ² |  |
| Terrace Type Factory | For 1 st 800 sq. metre, 1 car park per 300m ² After 1 st 800 sq. metre, 1 car park per 350m ² 1 lorry/loading & unloading space per 1500m ² |  |
| Detached Type Factory | 1 car park per 600m ² 1 lorry/loading & unloading space per 1500m ² (up to 13,500m ²) |  |

Car Park Design considerations

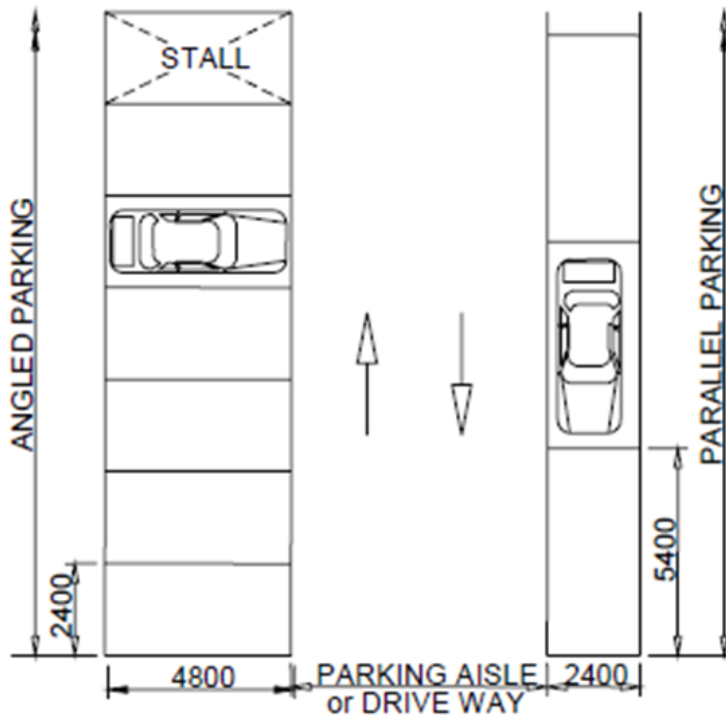


- Examples of Minimum Parking Provision Standards for education facility:

| Use Categories | Minimum Parking Provision Standards | Remarks |
|--|--|--|
| Junior Colleges | 1 car park per 30 day-time staff and student population | |
| Vocational Institutions | 1 car park per 30 day-time staff and student population OR 1 car park per 20 night-time staff and student population | Taking whichever is higher |
| Polytechnics & Universities | 1 car park per 20 staff and student population | Using the higher of the day-time and night time staff and student population |

- Local Zonal Standards (for commercial and entertainment uses)
 - Zone 1 – City Restricted Zone
 - Zone 2 – Within 400m radius from rapid transit system (RTS)
 - Zone 3 – Rest of the Island
- Handicapped Parking

Parking Lot Dimensions



All dimensions in mm

Car Parking Lot

The minimum dimensions required of a car parking lot are as follows:

Lot width: 2400

Lot length: 4800

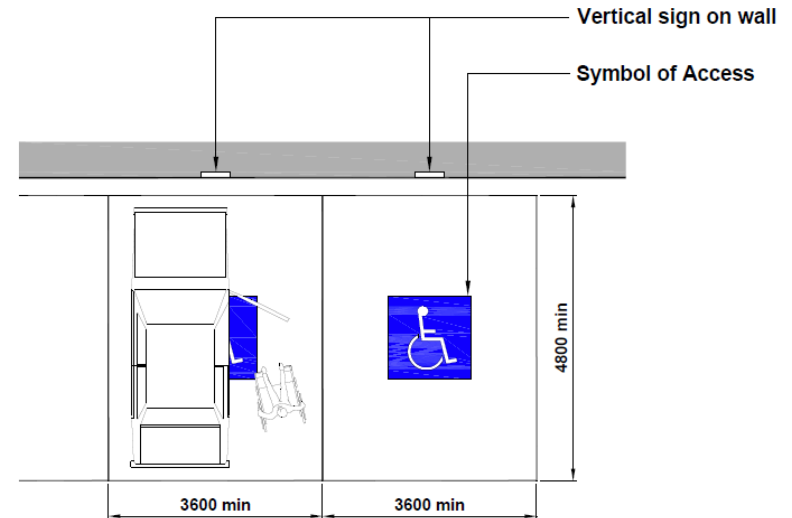
Lot length for parallel parking: 5400

Parking Lot Dimensions



Handicapped Parking Lot

- Dimensions of 4800 mm by 3600 mm
- A firm, level surface without aeration slabs
- Wherever possible, be sheltered



- Where vehicle parks are required to be provided, the table on the right indicates the number of accessible parking lots for vehicles driven by persons with disabilities

Accessible Parking Lots

| Number of vehicle park lots | Number of accessible lots |
|---|---------------------------|
| First 50 lots (1-50) | 1 |
| Next 50 lots (51-100) | 1 |
| Every subsequent 200 lots or any part thereof | 1 |

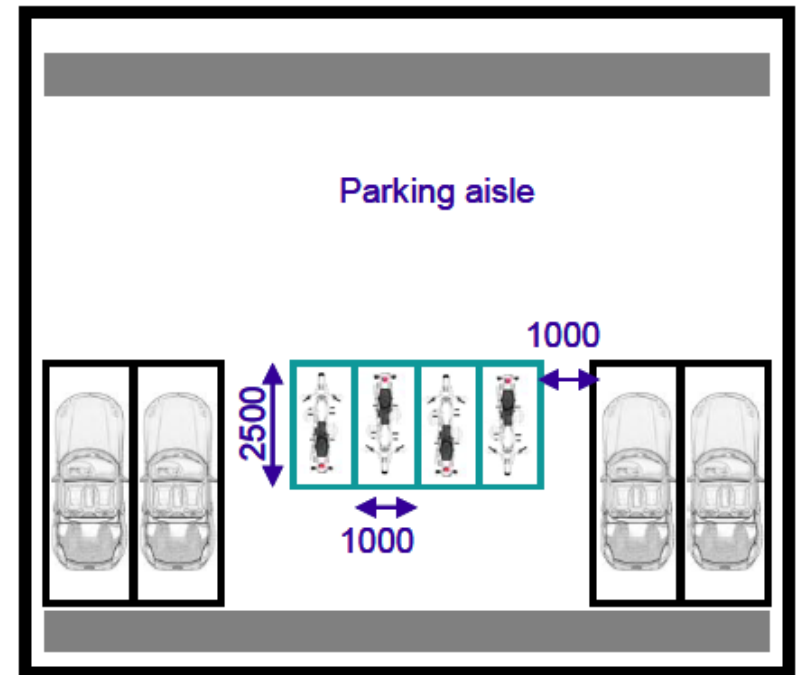
All dimensions in mm

Parking Lot Dimensions



Motor-cycle Parking Lot

- Minimum dimensions of motor-cycle parking lot: 800mm x 2400mm
- Preferred dimensions of motor-cycle parking lot: 1000mm x 2500mm
- Motor-cycle parking lots can be provided at corners or any available space within the parking place. They should not obstruct movement of other vehicles and pedestrians.
- Recommend to provide gap of 500mm to 1000mm between car and motorcycle lots.
- LTA does not have a motor cycle parking provisions, however general rule of thumb is for every 4 car park lot there should be 1 motor-cycle parking lot.

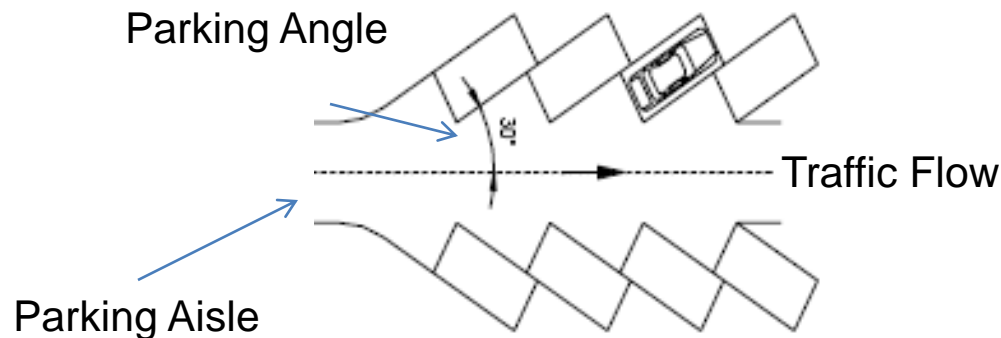


All dimensions in mm

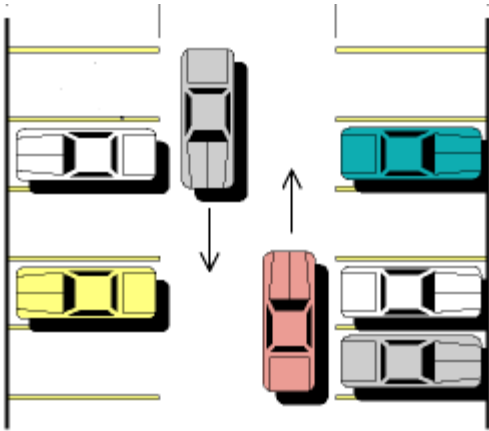
Parking Aisle



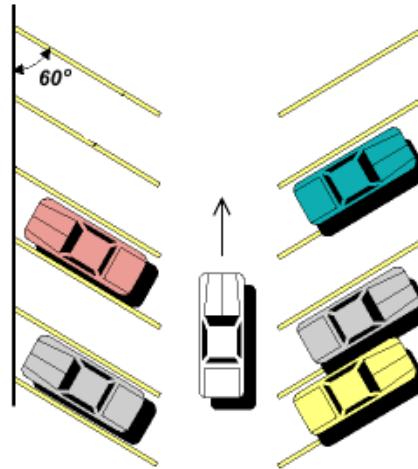
- A parking aisle refers to an access lane or driveway with adjacent parking lots.
- Parking angle is the angle measured between the longer side of the parking lot and the line of traffic flow of the aisle.
- Traffic Flow refers to the direction of vehicle movement.



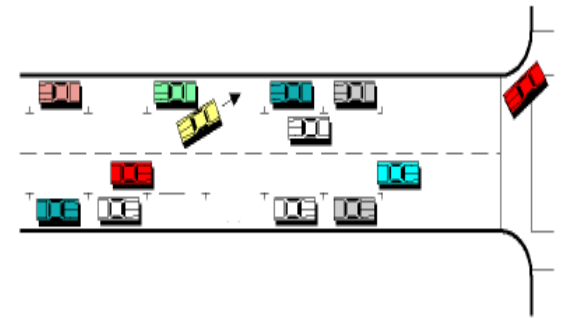
Parking Configurations



90° Parking



Angled Parking



Parallel Parking

Minimum Width of Parking Aisle



For Standard Cars:

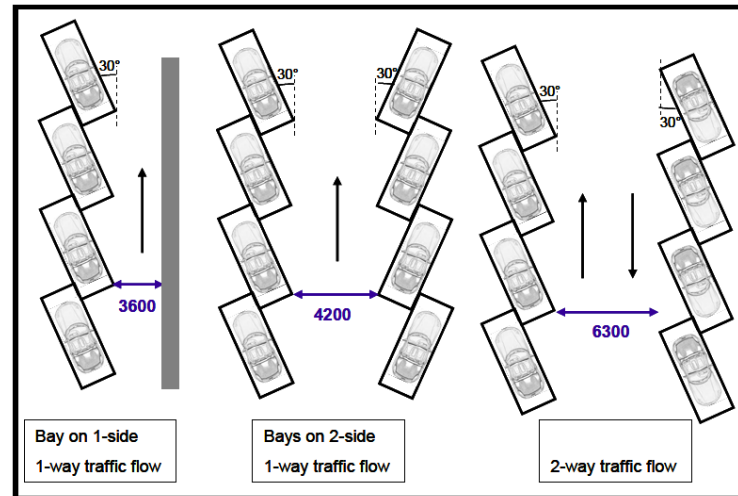
The minimum width of parking aisle shall be as follows:

| Parking Angle | 1-way Traffic Flow | | 2-way Traffic Flow |
|---------------|--------------------|-----------------|----------------------|
| | Bays on 1 side | Bays on 2 sides | Bays on 1 or 2 sides |
| Parallel | 3600mm | 3600mm | 6000mm |
| 30° | 3600mm | 4200mm | 6300mm |
| 45° | 4200mm | 4800mm | 6300mm |
| 60° | 4800mm | 4800mm | 6600mm |
| 90° | 6000mm | 6000mm | 6600mm |

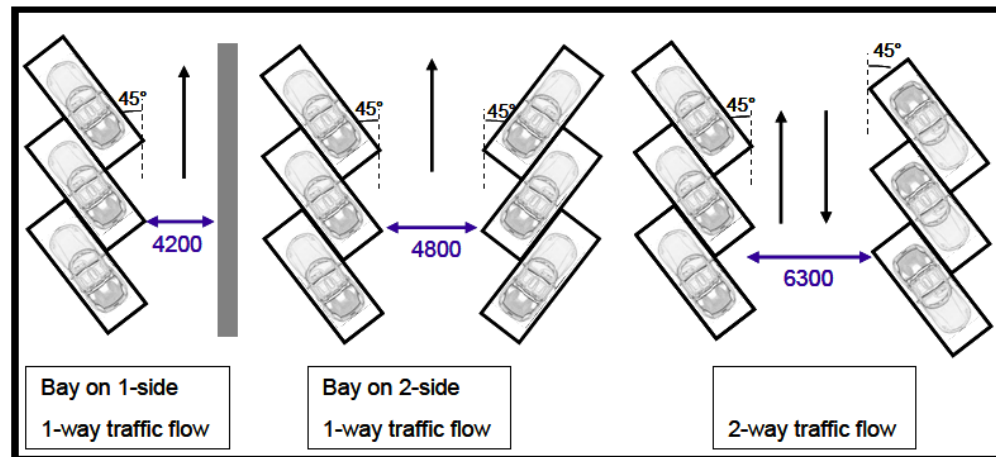
Typical Parking Aisle Dimensions



For Standard Cars:



30° -Angled Parking Aisle



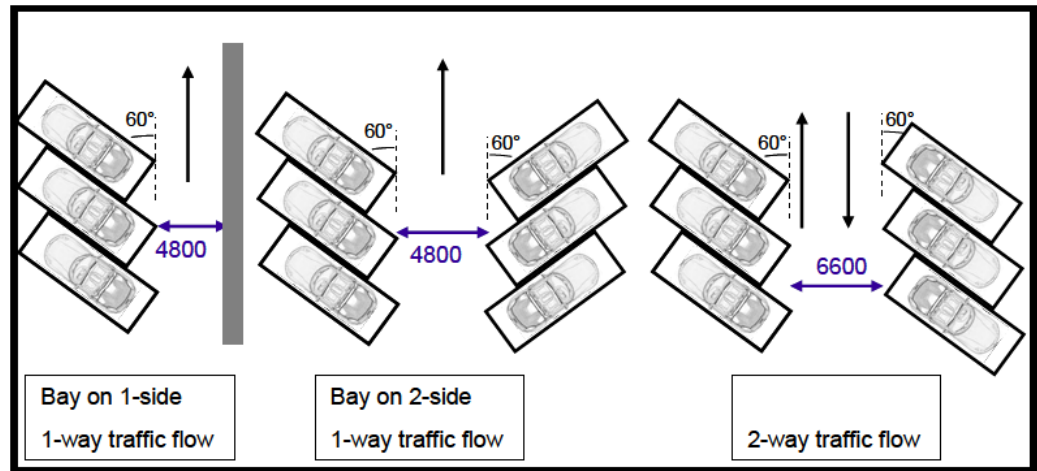
45° -Angled Parking Aisle

All dimensions in mm

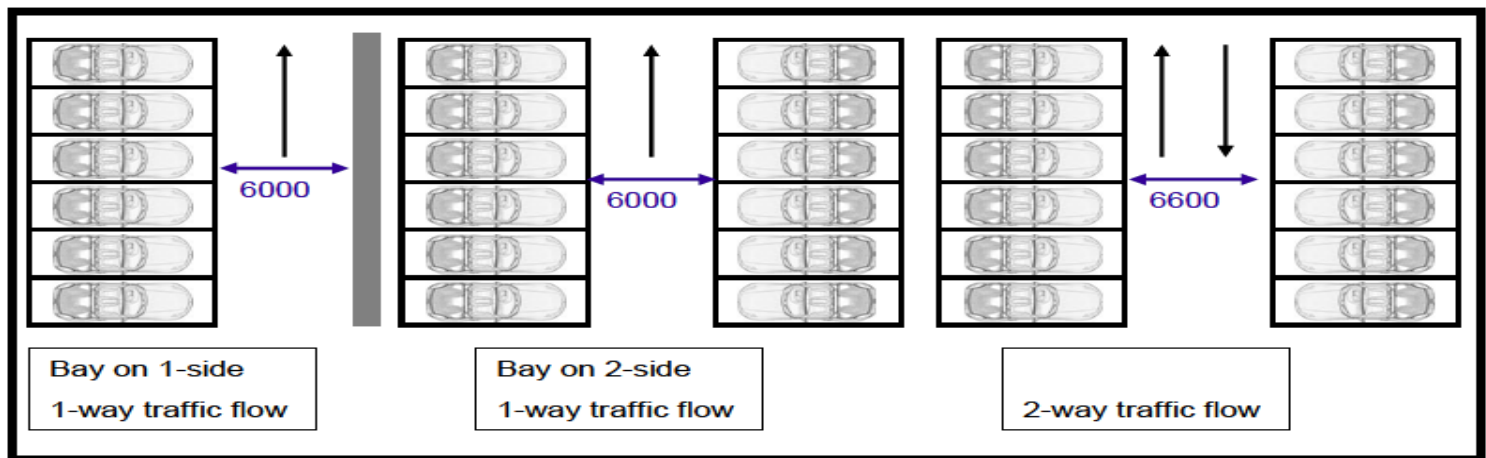
Typical Parking Aisle Dimensions



For Standard Cars:



60° -Angled Parking Aisle



90° -Angled Parking Aisle

All dimensions in mm

Other Considerations



- Increasing the area provided for parking decreases the amount of time required to park
- Angular configurations allow quicker turnover
- Perpendicular parking often yields greater space utilization, although it also requires wider aisles
- As the angle of a parking space increases, so does the required space allocated to aisles

Problem 12

Suggested Solution

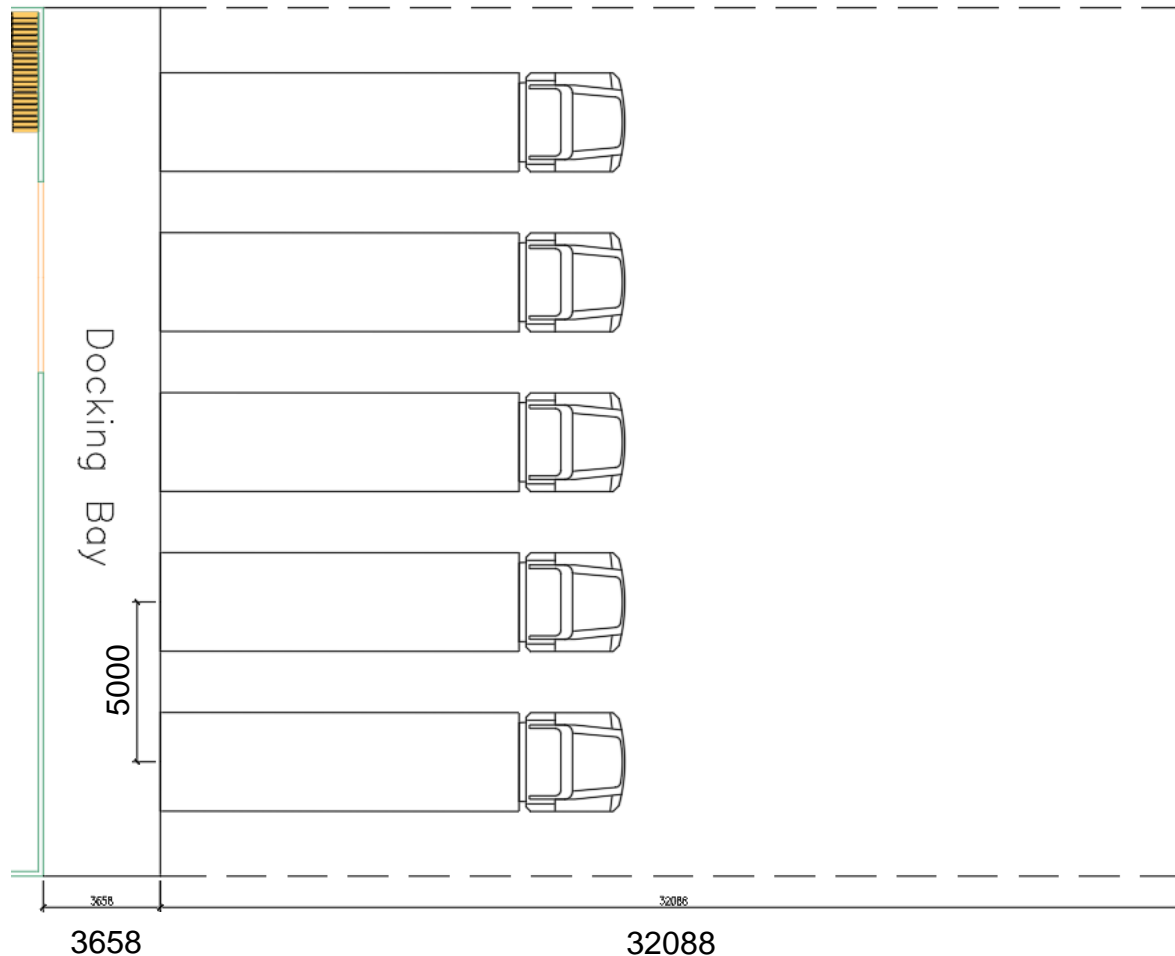
Consideration of Warehouse Dock Layout

- Use of a Centre Dock for both its incoming goods and outgoing shipment can lead to incident of mixed shipment to customer. There will also congestion in the shipping and receiving area.
- Cater for truck drivers to maneuver outside the warehouse, the receiving and shipping area have sufficient apron space (80 ft.) to support 90° dock configuration.

Proposed Dock and Carpark Layout



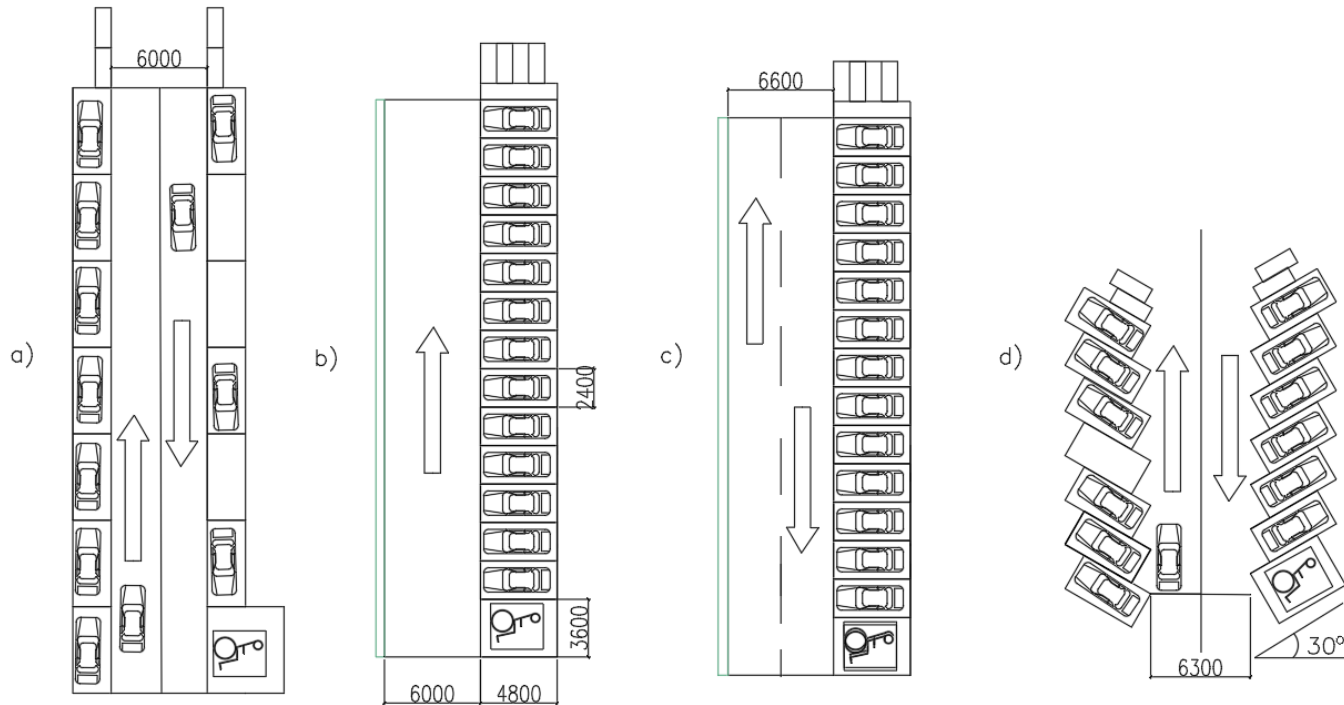
- To support 90° dock configuration the apron space required:
 $(2 \times 14.52\text{m}) + 3.048\text{m} = 32.088\text{m}$.



Proposed Dock and Carpark Layout



- Area of proposed detached factory: 7500m²
- Minimum car lots = $7500/600 = 12.5 \Rightarrow 13$ (round up to whole number)
- Minimum handicapped lots = 1
- Minimum motorcycle lots = based on rule of thumb of 1 per 4, $13/4 = 3.25 \Rightarrow 4$ (round up to whole number)



a) Parallel (two-way traffic)
b) 90° (one-way traffic)

c) 90° (two-way traffic)
d) 30° (two-way traffic)

Learning Objectives



- Describe the space requirement and process flow from/to the receiving and shipping activity
- List the different types of dock layout
- Select suitable dock configuration based on operations requirement(s)
- Perform the layout of a parking facility according to government regulations and guidelines
- Use AutoCAD to design the docking and car park layout

Overview of E212 Facilities Planning and Design

