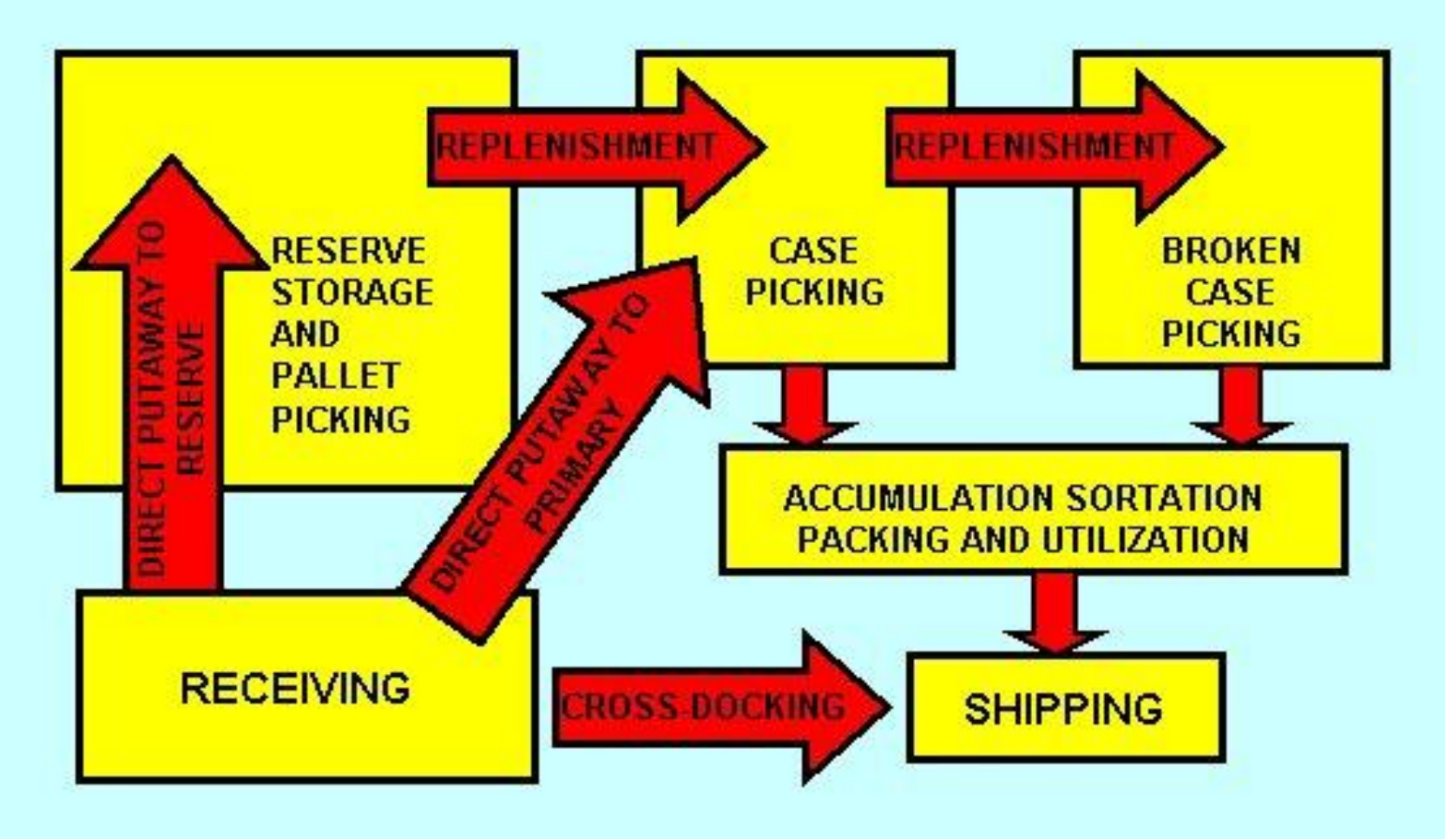
REPUBLIC POLYTECHNIC

Problem 13
Insufficient Docking Capacity

SCHOOL OF ENGINEERING

Warehouse Functions



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

Analysis Chart

Example of an Analysis Chart

Company _____ Date _____ Raw Materials _____ Finished Goods _____
Prepared by _____ Sheet _____ of _____ Plant Supplies _____

1	2	3	4	5	6	7	8	9	10	11
	UNIT LOADS				Size of Shipment (unit loads)	Frequency of Shipment	TRANSPORTATION		MATERIAL HANDLING	
Description	Type	Capacity	Size	Weight			Mode	Specifications	Method	Time

Receiving and Shipping Docks

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)

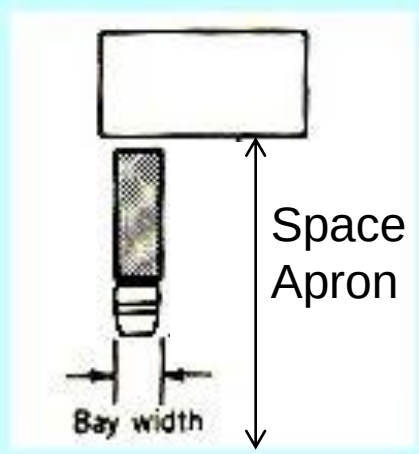
- Dedicated function, e.g. receiving frequent deliveries from light-duty carriers or shipping specific category of goods
- Often used to support Just-in-Time (JIT) manufacturing set-ups
- Usually requires more space than central docking

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.

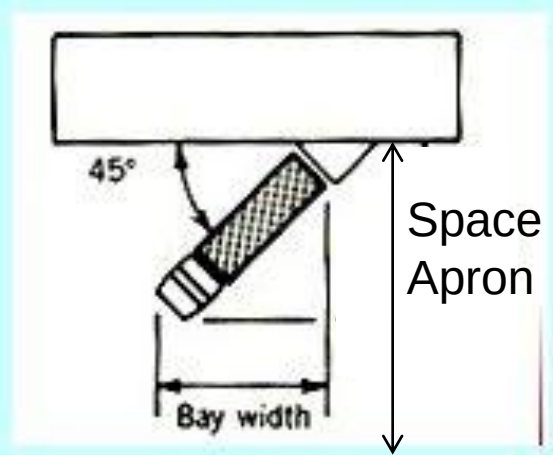
90^{o} Dock



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

Warehouse Dock Configurations

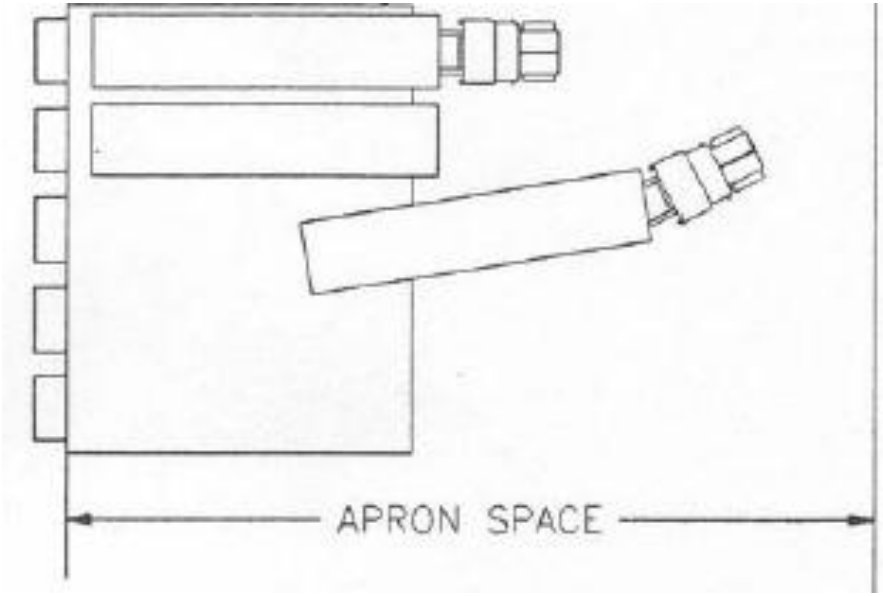
Finger Dock



- Requires lesser apron space but more bay width
- Bigger inside maneuvering area for carriers
- Used when there is insufficient apron space to support 90^{o} dock
- The largest finger dock angle possible should be selected

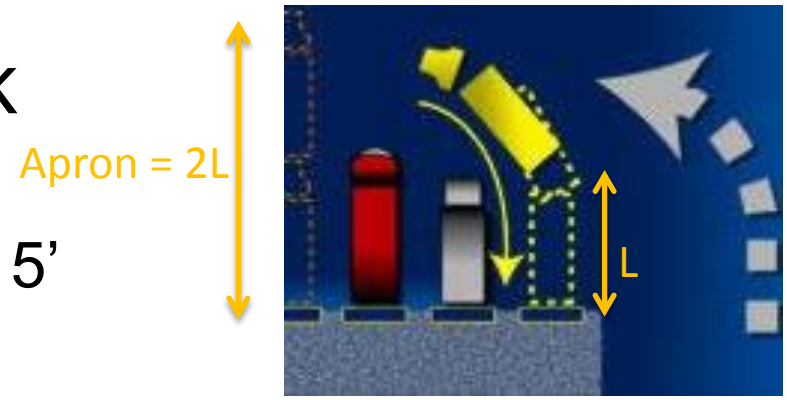
Apron Space

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



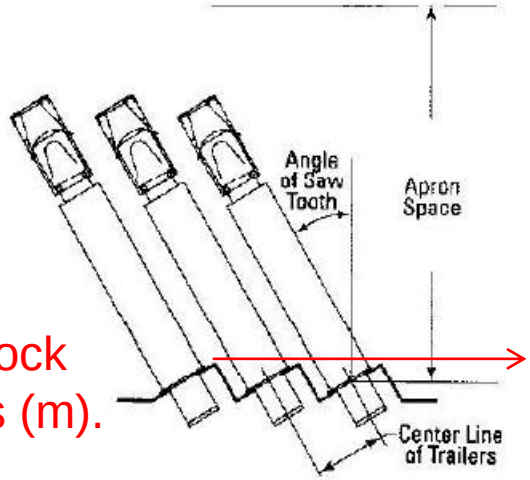
Apron Space Allowance

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



- 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

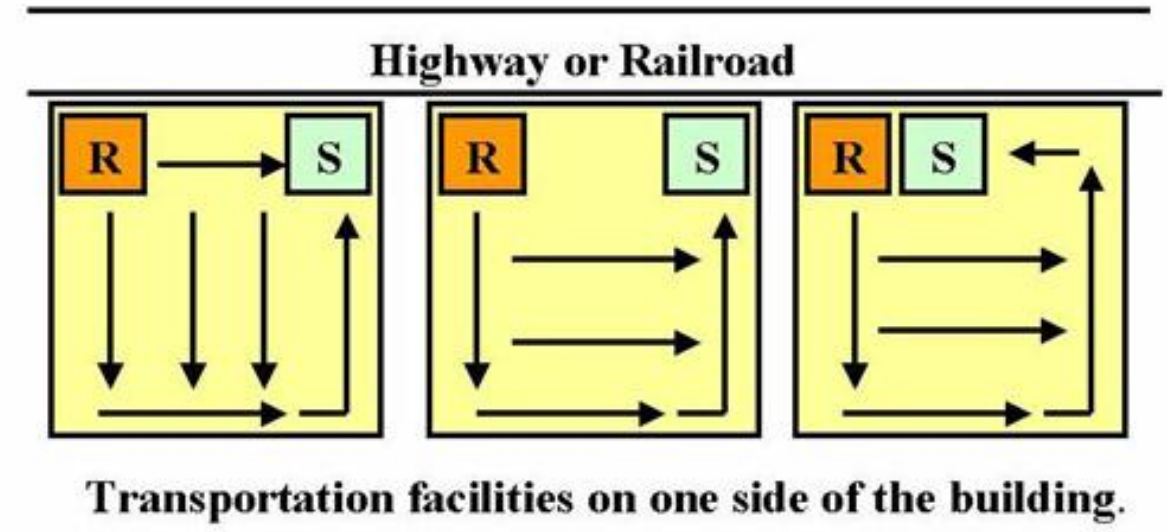
Note: the figures in Finger Dock reference table are in meters (m).

Warehouse Dock Location

Constraint:

- One-side access

R: Receiving
S: Shipping



Transportation facilities on one side of the building.

Dock location	Point-of-use	Point-of-use	Centralized
Space between R and S	Not Used	Not used	Used

P13 Suggested Solution

Present Warehouse Layout

- The facility is a small-sized warehouse with storage area taking up close to half the total land area. There is minimal provision for office spaces.

- Transportation access is located on one side of the warehouse, where receiving and shipping activities take place.

- The facility uses a Centre Dock for both its incoming goods and outgoing shipment. This leads to incident of mixed shipment to customer. There are also congestion in the shipping and receiving area.

- Received feedbacks from truck drivers that maneuvering within the distribution centre a challenge. Looking at the existing design, the present receiving and shipping area does not have sufficient apron space (79 ft.) to support 90^{o} dock configuration for 40 ft. truck, dock space of at least 80ft. = 2x 40ft. (truck length) is needed.

Warehouse Dock re-Layout

- To avoid mixing of goods for shipment, dock to be changed to Point-Of-Use type. The present area should be able to support a maximum of 4 point-of-use docks (2 receiving, 2 shipping) with sufficient internal maneuvering space for trucks.

- Dock width of 12 feet should suffice as dock activity is unlikely to be highly busy. With the distance between two carriers at 3.50m, 45^{o} angle Finger Dock can be designed. The required apron space for such configuration is 23.2m (~76 ft.), where existing apron space is sufficient.

- An important assumption will be that external maneuvering space for trucks (just outside the facility perimeter) is available, e.g. using part of access road.

Calculation on Number of Docks Required

Given 8 hr day = 480 min and 35 trucks per day

Each truck need 30 minutes of loading and unloading time,

- Average number of Trucks in the Distribution Centre at any given 30min block of time = 30*35/480 = 2.1875

Let ‘x’ be the total number of Trucks,

(‘X’ is the event that happen in a specific time interval)

$P(X \leq x)$ = probability of ‘x’ number of truck or less occurring

$1-P(X \leq x)$ = probability of more than ‘x’ number of truck occurring

(also mean = probability of waiting with number of ‘x’ docks)

Cont. Number of Docks Required

Probability of waiting for a truck = 1 – P(X ≤ x)

= 1 – POISSON(x,MEAN,TRUE)

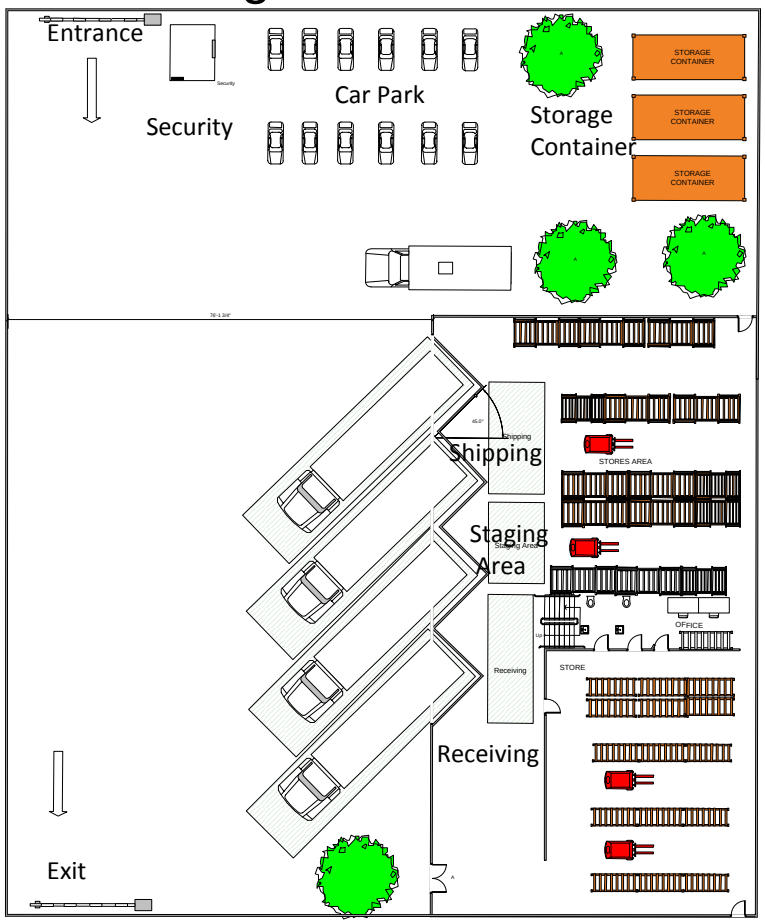
= 1 – POISSON (x,2.1875,TRUE)

Trucks per 8 hour day	Mean Number of Trucks arriving per 30mins interval	Total 'x' Number of Trucks	Probability of waiting (with total 'x' number of trucks)
35	2.1875	2	0.3739
35	2.1875	3	0.1782
35	2.1875	4	0.0712

- From above, the probability of having total more than 4 trucks at any given 30min block of time is 7.12% (less than 10%).
- Thus, 4 docks (one for each truck) is required.

Proposed Warehouse Layout

- Taking into consideration of the space requirement of the 45^{o} dock for 40 feet truck, four trucks can be docked (Point of use)
- Existing warehouse layout need only be altered slightly for the above configuration, from centralized dock to point of use docks.



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Required apron space:
23.2m (~76')

Learning Objectives

- Differentiate different types of dock layout
- Recognize the physical constraints posed by a particular building design/ layout
- Analyze the process flow from/to the receiving and shipping activity
- Propose suitable dock configuration based on operations requirement(s)