

# ICA 17: Warehouse Space Requirements

ISE 453: Design of PLS Systems

Spring 2020

1. What is the 2-D cube utilization associated with three-deep, four-high dedicated block stacking of  $48 \times 42 \times 36$  in. ( $y \times x \times z$ ) pallet loads of products A, B, and C along a 10-foot-wide down aisle assuming that the maximum inventory levels of the products are 10, 18, and 32, respectively? All of the products are stored on one side of the aisle, and the opposite side of the aisle is used to store other products.

Lane/unit-load width	$x$	3.5			
Unit-load depth	$y$	4			
Unit-load height	$z$	3			
No. different items	$N$	3			
Down aisle width	$A$	10			
No. levels for stacking	$H$	4			
No. of rows (lane depth)	$D$	3			
	<b>SKU</b>	<b>Total</b>	<b>A</b>	<b>B</b>	<b>C</b>
Max no. units of SKU $i$	$M_i$	60	10	18	32
Number of lanes	$L$	6	1	2	3
Total area (2-D)	$TA$	357			
Number of stacks		16	3	5	8
Item area (2-D)		224			
Cube utilization (2-D)		62.75%			

2. A warehouse is being designed that will have a rectangular shape with a single I/O point located along its perimeter. Randomized block stacking will be used to store 5,000 different SKUs along 8-ft-wide down aisles, and the area used for cross aisles, etc., will equal 15% of the storage area. A maximum of 500,000 total units of product are to be stacked six-high on identical  $36 \times 40 \times 48$  in. two-way pallets. (a) What is the minimum total area needed for the warehouse? (b) What is the 2-D cube utilization of the warehouse?

Lane/unit-load width	$x$	3.3333333 ft	
Unit-load depth	$y$	3 ft	
Unit-load height	$z$	4 ft	
No. different items	$N$	5,000	
Down aisle width	$A$	8 ft	
No. levels for stacking	$H$	6	
Est. max no. total units	$M$	500,000	
Optimal lane depth	$D^*$	7	
Number of lanes	$L$	14,346	
Total area (2-D)	$TA$	1,195,500 ft <sup>2</sup>	
Cross aisle percentage		15%	
Total WH area (2-D)	$TA'$	1,374,825 ft <sup>2</sup>	(a)
Item area (2-D)		833,340 ft <sup>2</sup>	
Cube utilization (2-D)	w.r.t. $TA$	70%	(b)
Cube utilization (2-D)	w.r.t. $TA'$	61%	(b)