AI Warehouse Analysis

ABC Company

Sample Optimization Analysis (20,000 Items)

Warehouse Overview

The purpose of this analysis was to optimize the performance of the warehouse using the structure(s) shown in the table below. The sections that follow list a variety of metrics, activity and cost summaries for the optimized warehouse overall, as well as optimal specifications and operating statistics unique to the structure(s) themselves.

Structure Name	Layout Area (sq ft)	Daily Operating Cost	Daily Operating Hours
Racking	97,760.0	$4,052.53	270.3
Pick Stations	800.0	$72.36	4.8

Warehouse Management Summary

The information that follows list a variety of estimates for warehouse performance, fulfillment and cost for the optimized warehouse as detailed in the 'Warehouse Specifications Summary' section of this report.

Cost & Performance Metrics

Total warehouse operating cost per day	$4,124.90
Total warehouse operating hours per day	275.1
Avg warehouse cost per hour	$14.99
Total units fulfilled per day	28,432.9
Avg warehouse cost per unit	$0.15
Total units fulfilled per operating hour	103.36

Order & Unit Fulfillment Metrics

Total customer orders fulfilled per day	50,000.0
Total product orders fulfilled per day	22,746.4
Total units fulfilled per day	28,432.9
Avg products per customer order	0.45
Avg units per customer order	0.57

Operating Cost Ratios

Avg warehouse cost per hour	$14.99

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Avg warehouse cost per customer order	$0.08
Avg warehouse cost per product order	$0.18
Avg warehouse cost per unit	$0.15

Operating Hours and Workload Planning

Total required hours per customer order	0.00550
Total required hours per product order	0.012
Total required hours per unit	0.00967
Customer orders processed per hour	181.76
Product orders processed per hour	82.69
Units processed per hour	160.18

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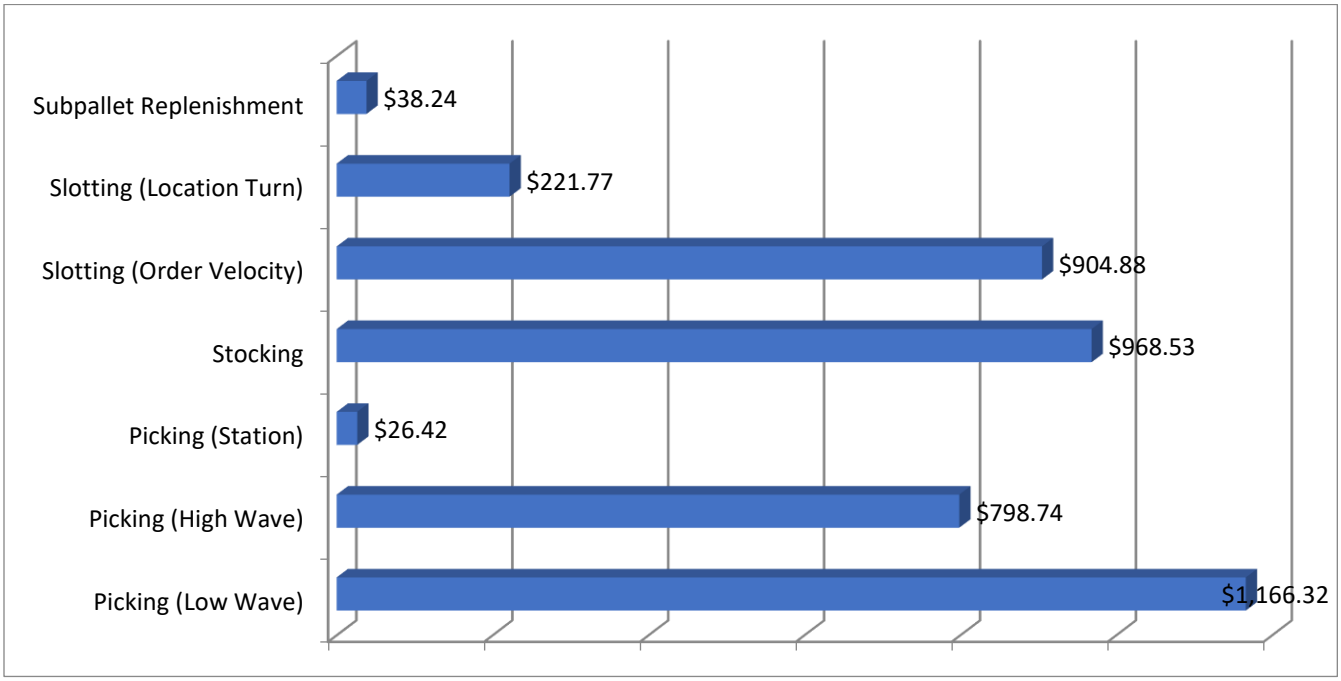
Warehouse Activity and Cost Summary

The following section displays estimates for warehouse activity totals, costs, workloads and productivities for the optimized warehouse as detailed in the 'Warehouse Optimization Summary' section of this report.



Cost and Workload Summary

Department	Activity	Daily Cost	Daily Hours
Picking	Picking (Low Wave)	$1,166.32	77.8
Picking	Picking (High Wave)	$798.74	53.2
Picking	Picking (Station)	$26.42	1.8
Materials	Restocking	$968.53	64.6
Inventory	Reslotting (Order Velocity)	$904.88	60.3
Inventory	Reslotting (Location Turn)	$221.77	14.8
Materials	Subpallet replenishment	$38.24	2.6

Productivity Summary

Department	Productivity Measure	Average
Picking	Picks per hour (Low Wave)	184.14
Picking	Product orders picked per hour (Low Wave)	128.15
Picking	Units picked per hour (Low Wave)	160.18
Picking	Picks per hour (High Wave)	197.42
Picking	Product orders picked per hour (High Wave)	187.12

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Picking	Units picked per hour (High Wave)	233.90
Picking	Product orders picked per hour (Station)	1,600.00
Picking	Units picked per hour (Station)	2,000.00
Materials	Restocks per hour	14.19
Inventory	Reslots per hour (Order Velocity)	3.03
Inventory	Reslots per hour (Location Turn)	12.50
Materials	Subpallet replenishments per hour	223.38

Activity Summary

Department	Activity	Daily Totals
Picking	Picks (Low Wave)	14,317.83
Picking	Picks (High Wave)	10,512.61
Picking	Picks (Station)	323.00
Materials	Restocking	915.96
Inventory	Reslots (Order Velocity)	182.80
Inventory	Reslots (Location Turn)	184.81
Materials	Subpallet replenishments (Fixed)	94.85
Materials	Subpallet replenishments	590.74
Materials	Pallet replenishments	1.90

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Warehouse Structure Summary

The 'Warehouse Structure Summary' describes the optimal specifications for the various structures within the warehouse (racking, stations, etc.) as well as the various activity costs, times and details associated with the structure (picking, restocking, replenishment, etc.)

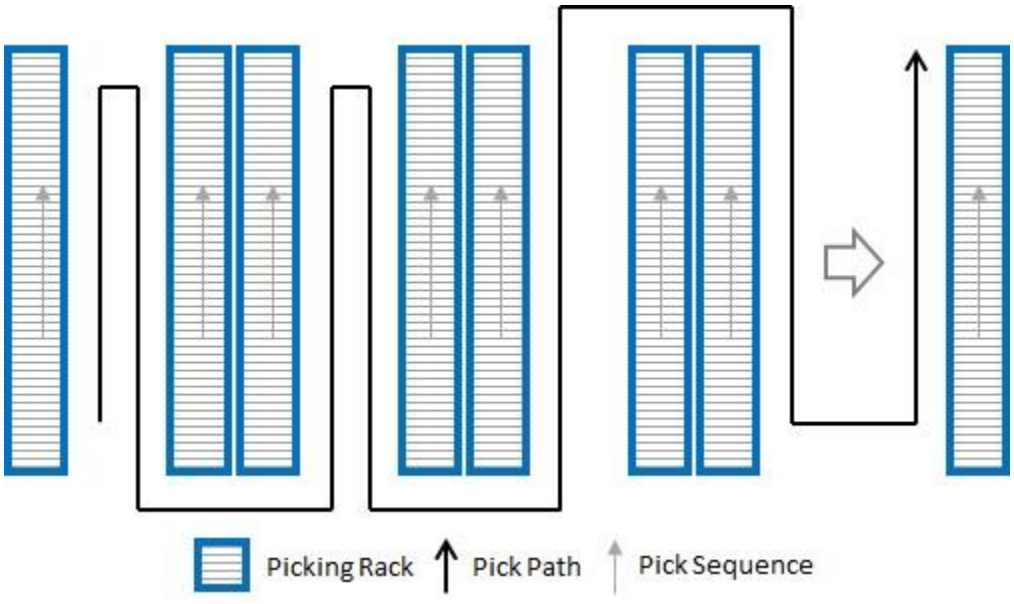
Racking (Optimal Specifications)

The following sections detail the optimal specifications for the above warehouse structure in the areas of:

- Layout
- Dimensions
- Travel Patterns
- Slotting Strategy
- Space Utilization & Location Sizes

Layout

The following image shows the overall layout of the warehouse racking; specifically, how the racking is grouped, how the picks are sequenced, as well as general patterns of travel. It may not show the full detail of the final layout; including the total number of racks, aisles and cross aisles, etc.



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Dimensions

Structure Width

Total rows of pick racking: 26
Pick rack depth: 3.00 ft
Pick aisle width: 10.00 ft
Total aisles: 13
Total structure width: 208.00 ft

Structure Length

Section length: 5.00 ft
Linear feet of racking per aisle: 400.00 ft
Total cross-aisles: 7
Cross-aisle width: 10.00 ft
Total structure length: 470.00 ft

Structure Height

Maximum picking height: 10.00 ft
Minimum picking height: 0.00 ft
Total structure height: 30.00 ft

Structure Area & Volume

Total area: 97,760.00 sq ft
Total volume available for pick locations: 311,999.92 cu ft

Travel Patterns

Total pick paths: 26
Pick facing: Double (picks are on both sides of each picking aisle)
Pick path sequencing: The pick paths within each picking aisle are traveled in a serpentine pattern, regardless of how they are actually sequenced.

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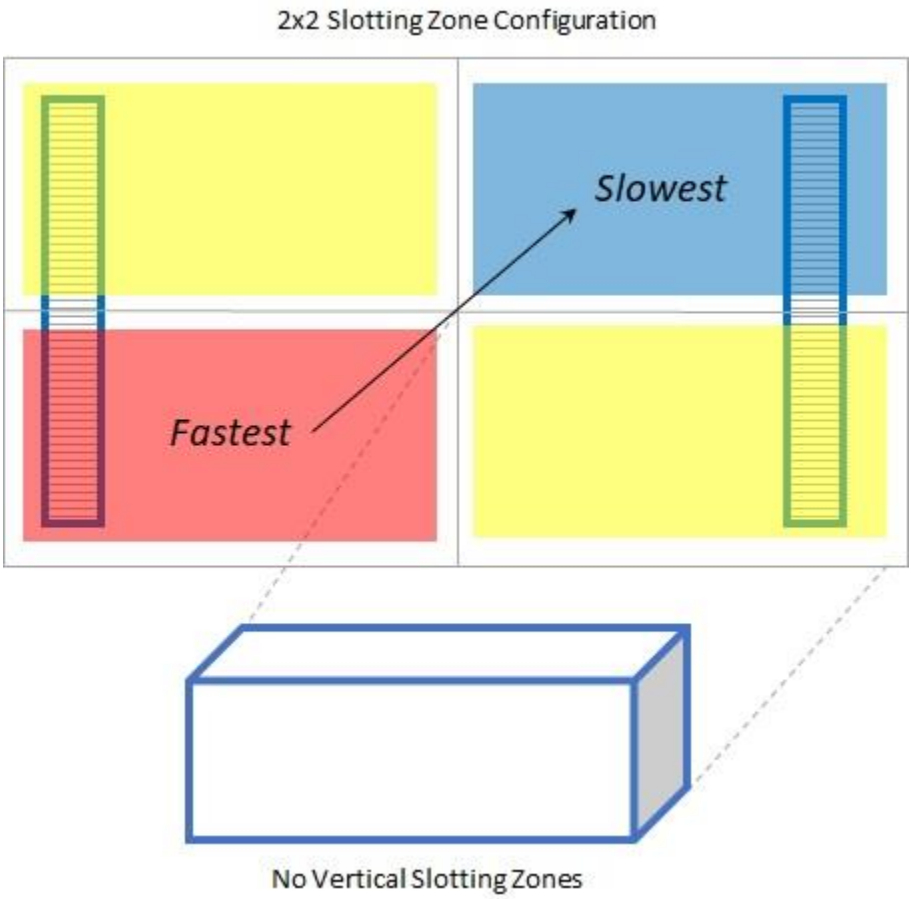
Slotting Strategy (Order Velocity)

Based on the variation of product velocities, wave and overall warehouse characteristics, the recommended strategy is to utilize 'Dynamic Slotting' whereby products are moved into faster/slower zones depending on their current order volume. Travel distance will be minimized by creating a total of 4 slotting zones. The warehouse is divided into 4 sections according to the diagram below, with no vertical slotting levels required within each section.



Slotting Rules (Order Velocity)

The slotting rules to manage the recommended strategy are shown in the table below. Each slotting zone has a minimum and maximum assignment value based on the average orders per day.

Slotting Section	Slotting Level	Avg Orders/Day (Max)	Avg Orders/Day (Min)
Fastest Zone (1)	N/A	Max (14.87)	11.16
Zone (2)	N/A	11.16	3.73
Slowest Zone (3)	N/A	3.73	Min (0.01)

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Location Sizes & Assignment Rules

The location sizes (volume) as well as the number of items assigned to each size is shown in the table below. The recommended location integrity, which is the percentage of products that are assigned to their correct location size at any given time, is 100%. The assignment ranges to maintain the recommended integrity percentage are shown in the 'Min' and 'Max' columns and are a measure of 'Demand-Volume (DV)' which is calculated by multiplying the item's average daily demand by its volume.

Location Volume (cu ft)	Items	Avg DV/Day (Max)	Avg DV/Day (Min)
6.10	5,946	0.19	0.00
13.79	6,629	0.61	0.19
21.96	4,665	1.47	0.61
33.59	2,437	3.71	1.48

Structure Utilization

Total items assigned to this structure: 19,677
Percentage of all items assigned to this structure: 98.4%
Total product orders picked from this structure per day: 19,928.1
Total units picked from this structure per day: 24,910.1
Items are assigned to this structure based on 'Order Volume'
The assignment range for this structure is between 0.0 and 3.0 average orders per day.

Racking (Operational Requirements & Statistics)

Picking (Low Wave)

Average percentage of time structure contains low wave picks: 100.00%
Average number of waves per day: 7,861.36
Total picks per day: 14,317.83
Average picks per wave: 1.82

Total product orders picked per day: 9,964.0
Total units picked per day: 12,455.0
Average product orders per pick: 0.70
Average units per pick: 0.87

Hourly cost: $15.00 / hour
Total time required per wave: 0.01 hours
Total cost per wave: $0.15
Total time required for picking per day (daily average): 77.75 hours
Total cost of picking per day (daily average): $1,166.32

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Picks per hour: 184.14
Product orders picked per hour: 128.15
Units picked per hour: 160.18

Floor Travel (Low Wave)

Total pick paths: 26
Average pick paths required (per wave): 1.79
Average picks per pick path: 1.02

Hourly cost: $15.00 / hour
Average travel speed: 21,000.00 ft / hour
Total travel distance required for all picks (per wave): 169.88 ft
Total time needed to travel required distance (per wave): 0.01 hours
Total cost of travel (per wave): $0.12

Total travel distance required per day (daily average): 1,335,499.75 ft
Total travel time required per day (daily average): 63.60 hours
Total travel cost per day (daily average): $953.93

Vertical Travel (Low Wave)

Total sections: 2,080.00
Average picks per section: 1.00
Total sections that contain picks (per wave): 1.82

Starting pick height: 0.00 ft
Average distance between starting height and highest pick (per section): 1.25 ft
Average distance between starting height and lowest pick (per section): 0.00 ft

Hourly cost: $15.00 / hour
Average vertical speed: 21,000.00 ft / hour
Total vertical distance required for all picks (per wave): 4.55 ft
Total time needed to travel required vertical distance (per wave): 0.00 hours
Total cost of vertical travel (per wave): $0.00

Total vertical distance required per day (daily average): 35,787.51 ft
Total vertical travel time required per day (daily average): 1.70 hours
Total vertical travel cost per day (daily average): $25.56

Reach (Low Wave)

Starting pick height: 0.00 ft

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Average upper reach distance when picking product above starting height: 0.00 ft
Average lower reach distance when picking product below starting height: 0.00 ft
Total units (per wave): 1.58
Average units per reach: 2.00
Total reaches (per wave): 0.79

Hourly cost: $15.00 / hour
Total time spent reaching for all picks (per wave): 0.00 hours
Total cost of reaching for all picks (per wave): $0.02

Total time spent reaching for all picks per day (daily average): 12.46 hours
Total cost of reaching for all picks per day (daily average): $186.83

Picking (High Wave)

Average percentage of time structure contains high wave picks: 100.00%
Average number of waves per day: 3,638.65

Average picks per wave: 2.89
Total picks per day: 10,512.61
Total product orders picked per day: 9,964.03
Total units picked per day: 12,455.04
Average product orders per pick: 0.95
Average units per pick: 1.18

Hourly cost: $15.00 / hour
Total time required per wave: 0.01 hours
Total cost per wave: $0.22
Total time required for picking per day (daily average): 53.25 hours
Total cost of picking per day (daily average): $798.74

Picks per hour: 197.42
Product orders picked per hour: 187.12
Units picked per hour: 233.90

Floor Travel (High Wave)

Total pick paths: 26
Average pick paths required (per wave): 2.79
Average picks per pick path: 1.04

Hourly cost: $15.00 / hour
Average travel speed: 21,000.00 ft / hour
Total travel distance required for all picks (per wave): 228.22 ft

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Total time needed to travel required distance (per wave): 0.01 hours
Total cost of travel (per wave): $0.16

Total travel distance required per day (daily average): 830,413.90 ft
Total travel time required per day (daily average): 39.54 hours
Total travel cost per day (daily average): $593.15

Vertical Travel (High Wave)

Total sections: 2,080.00
Average picks per section: 1.00
Total sections that contain picks (per wave): 2.89

Starting pick height: 0.00 ft
Average distance between starting height and highest pick (per section): 8.76 ft
Average distance between starting height and lowest pick (per section): 0.00 ft

Hourly cost: $15.00 / hour
Average vertical speed: 21,000.00 ft / hour
Total vertical distance required for all picks (per wave): 7.22 ft
Total time needed to travel required vertical distance (per wave): 0.00 hours
Total cost of vertical travel (per wave): $0.01

Total vertical distance required per day (daily average): 26,269.58 ft
Total vertical travel time required per day (daily average): 1.25 hours
Total vertical travel cost per day (daily average): $18.76

Reach (High Wave)

Starting pick height: 0.00 ft
Average upper reach distance when picking product above starting height: 0.00 ft
Average lower reach distance when picking product below starting height: 0.00 ft
Total units (per wave): 3.42
Average units per reach: 2.00
Total reaches (per wave): 1.71

Hourly cost: $15.00 / hour
Total time spent reaching for all picks (per wave): 0.00 hours
Total cost of reaching for all picks (per wave): $0.05

Total time spent reaching for all picks per day (daily average): 12.46 hours
Total cost of reaching for all picks per day (daily average): $186.83

Location Restocking

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Restocking

Average restocks per day: 770.82
Average restocking units per location: 31.97
Cost per hour: $15.00
Time to complete a location restock: 0.08 hours
Restocks per hour: 12.50

Total time spent restocking picking locations per day (daily average): 61.67 hours
Total cost of restocking picking locations per day (daily average): $924.99

Restocking (Pallets)

None - there are no location sizes large enough to require pallet quantity restocking levels.

Reslotting (Order Velocity)

Average reslots per day: 182.80
Average days item stays in slotting zone: 107.64 days

Cost per hour: $15.00
Total time spent reslotting products per day (daily average): 60.33
Total cost of reslotting products per day (daily average): $904.88

Reslotting (Location Turn)

Average location reslots per day: 182.80
Average days item stays in location: 107.64 days

Cost per hour: $15.00
Total time spent reslotting products to other location sizes per day (daily average): 14.62
Total cost of reslotting products to other location sizes per day (daily average): $219.37

Subpallet Replenishment (from Reserve)

Average percentage of time structure requires subpallet replenishments: 100.0%
Average replenishments per day: 591.16
Average replenishment waves per day: 1.00
Average replenishment items per wave: 591.16
Average units per replenishment item: 42.14

Hourly cost: $15.00 / hour

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Total time required to complete a replenishment wave: 2.64 hours
Total cost per replenishment wave: $38.24

Total time required for replenishments per day (daily average): 2.64 hours
Total cost of replenishments per day (daily average): $38.24
Replenishments per hour: 223.54

Floor Travel (Subpallet Replenishment - Reserve)

Average replenishment items per pick path (per replenishment wave): 30.56
Average number of pick paths required per replenishment wave: 19.35

Hourly cost: $15.00 / hour
Average travel speed: 52,800.00 ft / hour
Total travel distance required per replenishment wave: 5,397.01 ft
Total time needed to travel required distance (per replenishment wave): 0.10 hours
Total cost of travel (per replenishment wave): $1.53

Total travel distance required per day (daily average): 5,397.01 ft
Total travel time required per day (daily average): 0.10 hours
Total travel cost per day (daily average): $1.53

Vertical Travel (Subpallet Replenishment - Reserve)

Average replenishment picks per section: 1.41
Total sections containing replenishment picks (per replenishment wave): 418.08

Starting pick height: 0.00 ft
Average distance between starting height and highest replenishment (per section): 11.71 ft
Average distance between starting height and lowest replenishment (per section): 0.00 ft

Hourly cost: $15.00 / hour
Average vertical speed: 52,800.00 ft / hour
Total vertical distance required per replenishment wave: 9,795.73 ft
Total time needed to travel required vertical distance (per replenishment wave): 0.47 hours
Total cost of vertical travel (per replenishment wave): $5.57

Total vertical travel distance required per day (daily average): 9,795.73 ft
Total vertical travel time required per day (daily average): 0.47 hours
Total vertical travel cost per day (daily average): $5.57

Reach (Subpallet Replenishment - Reserve)

Starting pick height: 0.00 ft

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Average upper reach distance when picking product above starting height: 0.00 ft
Average lower reach distance when picking product below starting height: 0.00 ft
Total units (per replenishment wave): 24,910.08
Average units per replenishment reach: 24.00
Total reaches (per replenishment wave): 1,037.92

Hourly cost: $15.00 / hour
Total time spent reaching for product (per replenishment wave): 2.08 hours
Total cost of reaching for product (per replenishment wave): $31.14

Total time spent reaching for product per day (daily average): 2.08 hours
Total cost of reaching for product per day (daily average): $31.14

Racking (Cost Component Summary)

Structure Cost Component	Cost (Daily Average)
Picking travel (Low Wave)	$953.93
Picking vertical (Low Wave)	$25.56
Picking reach (Low Wave)	$186.83
Picking travel (High Wave)	$593.15
Picking vertical (High Wave)	$18.76
Picking reach (High Wave)	$186.83
Restocking	$924.99
Reslotting (Zones)	$904.88
Reslotting (Location Zones)	$219.37
Subpallet replenishment travel (Reserve)	$1.53
Subpallet replenishment vertical (Reserve)	$5.57
Subpallet replenishment reach (Reserve)	$31.14

Total cost (Daily Average): $4,052.53
Unit cost (Daily Average): $0.16

Pick Stations (Optimal Specifications)

The following sections detail the optimal specifications for the above warehouse structure in the areas of:

- Dimensions
- Space Utilization & Location Sizes

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Dimensions

Fixed area (per station): 20.00 ft
Total storage length (per station): 20.00 ft
Total storage width (per station): 3.00 ft
Total storage height (per station): 6.00 ft

Stations: 10.00
Total area: 800.00 sq ft
Total volume available for pick locations: 3,600 cu ft

Location Sizes & Assignment Rules

The location sizes (volume) as well as the number of items assigned to each size is shown in the table below. The recommended location integrity, which is the percentage of products that are assigned to their correct location size at any given time, is 100%. The assignment ranges to maintain the recommended integrity percentage are shown in the 'Min' and 'Max' columns and are a measure of 'Demand-Volume (DV)' which is calculated by multiplying the item's average daily demand by its volume.

Location Volume (cu ft)	Items	Avg DV/Day (Max)	Avg DV/Day (Min)
5.42	98	2.51	0.04
11.12	131	7.66	2.75
17.15	94	17.92	7.81

Structure Utilization

Total items assigned to this structure: 323
Percentage of all items assigned to this structure: 1.6%
Total product orders picked from this structure per day: 2,818.3
Total units picked from this structure per day: 3,522.9
Items are assigned to this structure based on 'Order Volume'
The assignment range for this structure is between 3.0 and 14.9 average orders per day.

Pick Stations (Operational Requirements & Statistics)

Picking

Average percentage of time structure contains station picks: 100.00%
Total product orders picked per day: 2,818.30
Total units picked per day: 3,522.87

Hourly cost: $15.00
Total time required for picking per day (daily average): 1.76 hours

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Total cost of picking per day (daily average): $26.42

Product orders picked per hour (per station): 1,600.00
Units picked per hour (per station): 2,000.00

Location Restocking

Restocking

Average restocks per day: 145.14
Average restocking units per location: 26.49
Cost per hour: $15.00
Time to complete a location restock: 0.02 hours
Restocks per hour: 50.00

Total time spent restocking picking locations per day (daily average): 2.90 hours
Total cost of restocking picking locations per day (daily average): $43.54

Restocking (Pallets)

None - there are no location sizes large enough to require pallet quantity restocking levels.

Replenishment (Fixed Cost)

Subpallet Replenishment

Average subpallet replenishments per day: 94.85
Cost per subpallet replenishment: $0.00
Time to complete a subpallet replenishment: 0.00 hours
Subpallet replenishments per hour: 0.00

Total time spent performing subpallet replenishments per day (daily average): 0.00 hours
Total cost of performing subpallet replenishments per day (daily average): 0.00 hours

Pallet Replenishment

Average pallet replenishments per day: 0.00
Cost per pallet replenishment: $0.00
Time to complete a pallet replenishment: 0.00 hours
Pallet replenishments per hour: 0.00

Total time spent performing pallet replenishments per day (daily average): $0.00
Total cost of performing pallet replenishments per day (daily average): $0.00

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Pick Stations (Cost Component Summary)

Structure Cost Component	Cost (Daily Average)
Picking (Station)	$26.42
Restocking	$43.54
Reslotting (Location Zones)	$2.40

Total cost (Daily Average): $72.36
Unit cost (Daily Average): $0.02