



## WAREHOUSE FACILITY LAYOUT DESIGN

INTM- 542

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## Executive Content:

### 1.1 Summary:

In Houston, Texas, Nova Vertex Warehousing Company is starting to build a cutting-edge warehouse complex. We are dedicated to building a facility that complies with strict design guidelines, giving safety, operational effectiveness, and prompt product delivery top priority.

With a wide range of products, from televisions and cellphones to water bottles, Nova Vertex has a history of selling more than a million units. Our approach to handling and storing products of various sizes and fragility is emphasized by our dedication to excellence and trust.

We have created a system that can hold a variety of items while maintaining their integrity and safety since we understand the need for adaptable storage solutions. This involves using wired pallets for short-term storage, especially for goods that need to be kept for a month or less. These pallets' design maximizes storage capacity by ensuring that each product has enough room.

Our facility's architecture places a strong emphasis on timely dispatch, smooth operations, and safety. Modern storage system deployment is our top priority in order to improve efficiency and dependability. These design guidelines are intended to give our wide variety of products a safe and regulated environment.

### 1.2 Introduction:

To build a state-of-the-art storage facility in the Houston, Texas, USA area, Nova Vertex Warehousing Company starts a strategic plan. Our wide range of products, which includes anything from water bottles to televisions and cellphones, each with a record-breaking sales volume of more than a million units, is thoroughly examined in this extensive research. Our design requirements prioritize safety, operating effectiveness, and prompt delivery of the items to their destinations while maintaining an unshakeable commitment to excellence and trust.

With the best storage systems and careful engineering, our warehouse guarantees not only the security of our numerous items but also the dependability of our cutting-edge machinery. This dedication includes using wired pallets to hold goods for a month and guaranteeing a smooth shipment in safe containers. From safety regulations to product-specific storage arrangements, every facet of our warehouse design demonstrates our commitment to establishing industry standards and offering unmatched storage and logistics services.

### 1.3 Objectives:

To accommodate 20 different goods with monthly sales of one million units to SOK, the main goal of the warehouse plan was achieved. Some of the main goals that are crucial in creating the warehouse's layout are as follows:

- To reduce handling costs, select efficient racking arrangements for items A, B, and C, such as flow racks, double-deep racking, push-back racking, or powered mobile racking.
- Create a picking strategy that minimizes picking time and ensures order fulfillment on time by being in line with daily inventory targets and safety stock.
- To ensure efficient workflows from reception to dispatch, optimize receiving and dispatch docks to hold one day's worth of incoming items and 1.5 days' worth of outgoing goods.
- Organize a sorting area well for 1-hour product holding, considering pallet assembly, sorting bins, and aisle room to swiftly remove finished pallets.
- Use handling tools and storage techniques that adhere to safety regulations while taking the maximum rack height and warehouse structural limitations into account.
- To ensure optimal space utilization, modify dispatch area criteria for outgoing shipments including mixed products to 70% cubic efficiency.
- Create a thorough floor plan that satisfies operational requirements by following a rectangular framework and integrating specific handling tools, storage techniques, and aisle layouts.



## 2.0 Product Details & Demand:

**2.1 Category A: The demand for each product in this category is 1 million units per month.**

Unit	Product	L	W	H
A1	Smartphone	6	3	1
A2	Water bottle	9	3	3
A3	Food container	7	7	3
A4	Headphones	7	6	3
A5	Printer Paper	8.5	11	2

**2.2 Category B: The demand for each product in this category is 300K units per month.**

Unit	Product	L	W	H
B1	Television	40	24	3
B2	Wearable Device	2	1.5	0.5
B3	Laptops	14	10	1
B4	Water Purifier	12	8	15
B5	Sunglasses	6	2	2

**2.3 Category C: The demand for each product in this category is 50K units per month.**

Unit	Product	L	W	H
C1	Drones	12	12	4
C2	Instant Pot	13	13	12
C3	Coffee Maker	10	8	14
C4	Hand-held Vacuum Cleaner	5	5	5
C5	Speaker	8	8	12
C6	Amazon Echo Dot	3	3	2
C7	Throw Pillow	16	2	16
C8	Wallet	4.5	3.5	1
C9	Printer	17	15	8
C10	Camera	5	3	2

## 3.0 Constraints & Calculations

### 3.1 Fixed Constraints:

- Carton Size: 24" x 18" x 14"
- Pallet size: 48" x 40" x 4.5"
- Cartons per Pallet: 20
- Safety Stock for Category A: 10%
- Safety Stock for Category B 20%
- Safety Stock for Category C :30%

### 3.2 Calculating the daily and monthly pallets for each product:

- No of items that can fit in carton box= Carton box volume/ Volume of each item
- No of pallets required monthly= Items that sell at units per month/ carton per pallet
- Pallets for a single day = No. of pallets required per month / 30.

Unit	Product	Volume (in³)	Units per Carton	Units per Pallet	Monthly Pallets	Daily Pallets	Pallets per Hour
A1	Smartphone	54	213	4686	213	7	0.4375
A2	Water bottle	81	47	1034	967	32	2
A3	Food container	147	26	572	1748	58	3.625
A4	Headphones	126	30	660	1515	51	3.1875
A5	Printer Paper	187	20	440	2273	76	4.75
B1	Television	2,880	1	22	13,636	455	28.4375
B2	Wearable Device	1.5	2,560	56,320	5	1	1
B3	Laptops	140	27	594	505	17	1.0625
B4	Water Purifier	1,440	2	44	6,818	227	14.1875
B5	Sunglasses	24	160	3,520	85	3	0.1875
C1	Drones	576	6	132	379	13	0.8125
C2	Instant Pot	2,028	1	22	2,273	76	4.75
C3	Coffee Maker	1,120	3	66	758	25	1.5625
C4	Hand-held Vacuum Cleaner	125	30	660	76	3	0.1875

C5	Speaker	768	5	110	455	15	0.9375
C6	Amazon Echo Dot	18	213	4,686	11	1	0.0625
C7	Throw Pillow	512	7	154	325	11	0.0685
C8	Wallet	16	243	5,346	9	1	0.0625
C9	Printer	2,040	3	22	2,273	76	4.75
C10	Camera	30	128	2,816	18	1	0.0375

### 3.3 Receiving Area Calculation:

Category	Monthly Demand	Daily Demand	Pallets Required per Day
A	5,000,000	1,66,666.65	224
B	1,500,000	50,000	703
C	500,000	16,666	222

The warehouse's receiving area requires 1149 pallets to accommodate the daily demand of 20 products.

Considering the Safety Stock, we require 1534 pallets per day.

### 3.4 Shipping Area Calculations:

Category	Monthly Demand	Daily Demand	1.5 Days Holding Pallets	Pallets per Day
A	5,000,000	1,66,666.65	250,000	336
B	1,500,000	50,000	75,000	1,054.5
C	500,000	16,666	24,999	1,111.5

The warehouse's shipping area should be able to hold the products for at most 1.5 days. We need to have 2502 pallets in the warehouse to satisfy our needs. Considering the safety stock of each product category, the total number of pallets required in the warehouse is 3084.

### 3.5 Sortation Area:

For the Sortation Area, we need to consider the following

- Number of Shifts= 2
- Duration For each shift= 8hrs
- Total Working hours per day =  $2 \times 8 = 16$

- Total Pallets Daily =  $\frac{\text{Daily Pallets}}{16}$

The Sortation Area is calculated on the number of operation hours each day per employee, which is summed to 72 palettes. For all the products that require less than one pallet, we adjust them to the safety stock requirement as the pallets will change often.

Unit	Product	Pallets per Hour
A1	Smartphone	0.4375
A2	Water bottle	2
A3	Food container	3.625
A4	Headphones	3.1875
A5	Printer Paper	4.75
B1	Television	28.4375
B2	Wearable Device	1
B3	Laptops	1.0625
B4	Water Purifier	14.1875
B5	Sunglasses	0.1875
C1	Drones	0.8125
C2	Instant Pot	4.75
C3	Coffee Maker	1.5625
C4	Hand-held Vacuum Cleaner	0.1875
C5	Speaker	0.9375
C6	Amazon Echo Dot	0.0625
C7	Throw Pillow	0.0685
C8	Wallet	0.0625
C9	Printer	4.75
C10	Camera	0.0375

### 3.6 Bulk Storage Calculation:

Unit	Product	Monthly Pallets
A1	Smartphone	213
A2	Water bottle	967
A3	Food container	1748
A4	Headphones	1515
A5	Printer Paper	2273

B1	Television	13,636
B2	Wearable Device	5
B3	Laptops	505
B4	Water Purifier	6,818
B5	Sunglasses	85
C1	Drones	379
C2	Instant Pot	2,273
C3	Coffee Maker	758
C4	Hand-held Vacuum Cleaner	76
C5	Speaker	455
C6	Amazon Echo Dot	11
C7	Throw Pillow	325
C8	Wallet	9
C9	Printer	2,273
C10	Camera	18

The Bulk Storage area is designed to hold each product for one month, for which we require 35,000 pallets per month, which has a utilization factor of 85% in the warehouse.

## 4.0 Storage Methods and Picking Strategies:

### 4.1 Category A Storage - Pallet Aisle Racking

A items include

- Smartphones, Water bottles, Food containers, Headphones, and Printer paper sets.
- The Storage method we use is the Pallet Aisle Racking System.
- Leveraging Equipment as counter-balanced fork trucks

Specially designed racks that can effectively accommodate these different A items will be part of the Pallet Live (Flow Rack) system. Each rack will have flow lanes created to allow for easy product access and retrieval while preserving optimal organization. Smartphones, water bottles, and food containers can be placed in smaller flow lanes, while Headphones, and Printer paper sets can be placed in bigger lanes.

When collecting these items with counter-balanced fork trucks, the floor layout must take certain aisle constraints into account. Establishing the necessary aisle width to allow fork trucks to travel smoothly is one of these restrictions. Aisle widths will be calculated based on the fork trucks' size and turning radius to guarantee safe and efficient passage through the storage area.

**Footprint for Pallet Live (Flow Racks) Storage:**

The footprint needed to accommodate the Pallet Live (Flow Rack) system and related aisles will depend on inventory goals and racking configuration. To optimize the storage area and provide sufficient space for fork truck movement, a thorough evaluation of space utilization will be conducted.

Pallet Live (Flow Rack) storage for A items requires careful consideration of aisle restrictions, footprint allocation, and racking structure. By adjusting the system to the unique characteristics of each product and utilizing counter-balanced fork trucks to meet inventory goals while maximizing space utilization, a well-organized and effective storage solution may be achieved.

**4.2 Category B Storage - Push-back Racking**

Coming to the B Product items

- Television, Wearable Devices, Laptops, Water purifiers, and Sunglasses
- We use push-back racking as the storage method
- And reach truck for pallet retrieval.

### Method of Storage:

It is advised that B goods be stored in our warehouse using push-back racking. A high-density storage method that maximizes area utilization and permits simple pallet access is push-back racking. It works especially well for products like the ones listed above that have a moderate turnover rate.

### Selection of Equipment:

Pallets are best retrieved from the push-back racking system using a reach truck. Reach trucks can manage the racking height and are made for storing in small aisles, guaranteeing safe and effective pallet retrieval.

- Aisle Width: To provide the reach truck enough room to maneuver comfortably, the aisle width should be between 8 and 10 feet (2.4 and 3 meters).
- Aisle markings: To protect the safety of employees and equipment operators, aisles should be clearly marked with designated travel routes and safety zones.



### 4.3 Category C Storage - Narrow Aisle Racking

#### For C Category Items:

- Products under this category: Drones, Instant Pot, Coffee Maker, Hand-held Vacuum Cleaner, Speaker, Amazon Echo Dot, Throw Pillow, Wallet, Printer, Camera.

- We go to Narrow Aisle Racking to store these products.
- We use the narrow-aisle truck for moving the product.

Both methods save space, but because of its static form, narrow-aisle racking achieves a higher storage density. This makes it ideal for effectively storing a variety of products, including those of different sizes, like the wide range seen in the inventory of C products.

Narrow-aisle racking frequently has cheaper initial investment and maintenance costs than powered mobile racking, which results in more economical warehouse management.

More layout and design flexibility are provided by narrow-aisle racking, making it simpler to reconfigure as inventory requirements evolve.

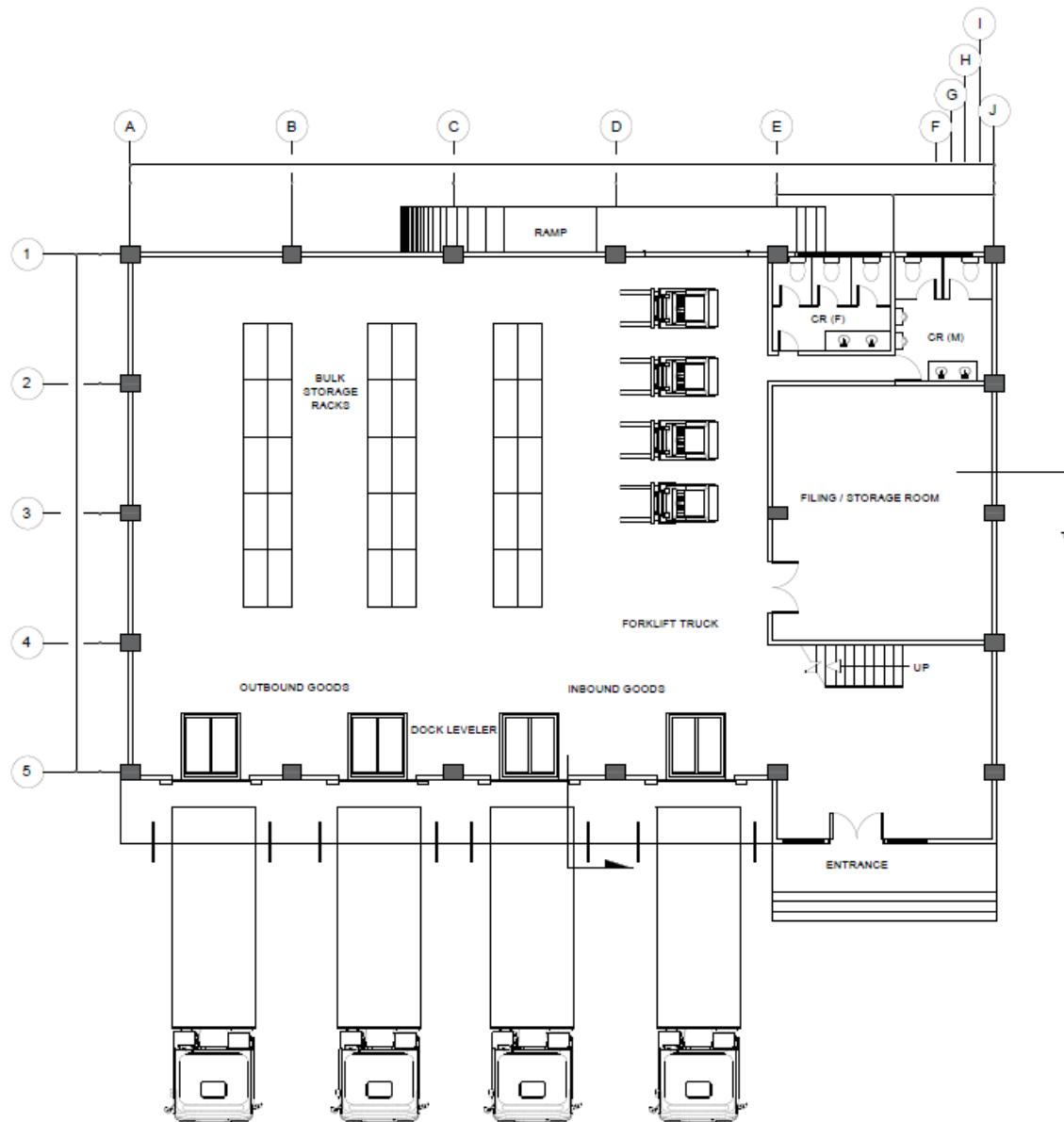
Narrow-aisle trucks offer faster travel and picking speeds than powered mobile racks, contributing to more rapid order fulfillment.

In the end, narrow-aisle racking is a better solution for the storage and handling of the specified C items due to its space efficiency, optimized footprint, improved accessibility, and cost-effectiveness as compared to powered mobile racking systems. The selected approach will allow for effective storage and retrieval of the various objects while using the least floor space.



## 5.0 Layout & Space Planning

### 5.1 Warehouse Layout:



## 5.2 Warehouse Area Calculation:

Area in Warehouse	Area Required (sq. ft.)
Bulk Storage	114,470
Sortation	2,433
Picking	25,576
Shipping	25,700
Receiving	12,783

The calculation for each area is done using the warehouse calculator

<http://www.spartanwarehouse.com/warehouse-space-calculator> Giving the specifics with the amount of utilization required for each area.

## 6.0 Financial Analysis:

### 6.1 Construction Costs

Cost of setting up the warehouse:

Total area required for Warehouse: \$180,953 Sq.Ft

Total Amount required to build the warehouse (if the land is owned):

- Including (Labour Cost, Land Cost, Materials, and labor): \$47 per Sq. Ft
- Construction Cost = \$180,952 Sq. Ft \* \$47 per Sq. Ft = **\$8,504,791**

### 6.2 Utility System Installation

Assuming a cost of \$15 per square foot for utility system installation:

- Utility System Installation Cost = Total Area (in square feet) \* Cost per Square Foot Utility
- Utility System Installation Cost = \$180,952 Sq. Ft \* \$15 per Sq.Ft = **\$2,714,295**

### 6.3 Total Project Cost

The total estimated cost to build and equip the warehouse (including the construction cost and utility system installation) is:

- Total Estimated Cost = Construction Cost+ Utility System Installation Cost
- Total Estimated Cost= **\$8,504,791 + \$2,714,295 = \$11,219,086**

**Conclusion:**

To sum up, Nova Vertex Warehousing Company is ready to build a warehouse in Houston, Texas that will set new standards. Our steadfast devotion to operational excellence, safety, and the safe storage of a wide variety of products demonstrates our commitment to meeting and beyond industry standards. Our facility is more than just a place to store things; it reflects our dedication to excellence and trust, with a careful focus on efficiency and dependability. We are certain that as we move forward, our warehouse will not only satisfy but also exceed the ever-changing needs of the market, establishing new benchmarks for the local logistics and warehousing sector.

Nova Vertex is eager to help ensure that everything from water bottles to state-of-the-art electronics moves smoothly, enhancing our standing as a reliable partner in the storage and distribution industry.