

Facilities Standardization Program GENERAL PURPOSE WAREHOUSE



THE ORB ORGANIZATION INC.

Department of the Army



US Army Corps of Engineers

Introduction

Overview

The definitive design package has been developed and reviewed under the auspices of the U.S. Army Facilities Standardization Committee and General Purpose Warehouse Standardization Subcommittee.

The purpose of this brochure is to present a standard design for a General Purpose Warehouse under the Department of the Army Facilities Standardization Program. The brochure is intended as an information document for users and prospective designers of this facility type. The Standard Design shall be utilized as the basis of design for General Purpose Warehouses constructed within the continental United States (CONUS), Alaska, Hawaii, the Far East and Europe (USAREUR). The brochure provides an overview of the design program and can be used by commanders to identify the options available to them in their planning of this facility. It provides a description of the functional and operational requirements and the basic technical data for a General Purpose Warehouse for worldwide application. The brochure conveys to the user the design items and features that are mandatory and those which may be considered as optional.

The facility portrayed herein as the base-line standard is a 120,000 square foot General Purpose Warehouse with a clear height of 24 feet. The area of the facility may be increased or decreased to suit site specific requirements and conditions. The height is capable of adjustment from the basic 24 foot clear height to either 34 feet or 60 feet. Depending upon user requirements and selection of materials handling equipment, the facility could be constructed with a partial low bay of 24 feet with the balance being either 34 feet or 60 feet. The type of products stored and the materials handling systems selected will be determining factors in the final configuration.

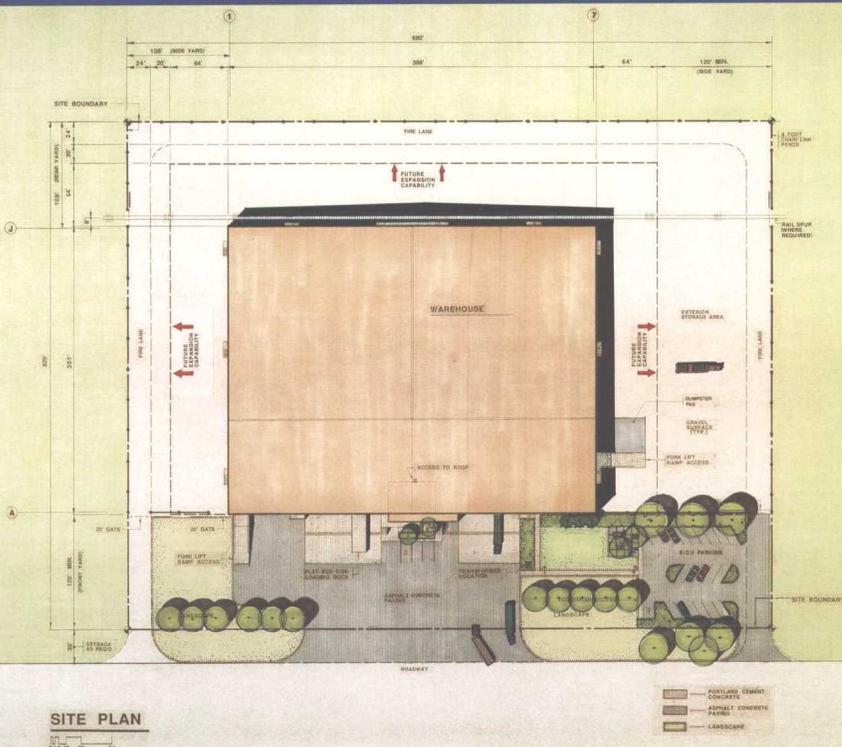
The Warehouse Definitive has been developed to function as a "Universal" Standard General Purpose Warehouse for application throughout the world and can be modified to meet local building codes and regulations overseas. There will be instances where site specific requirements may dictate a significantly different "footprint," required cubage content, and the specific materials handling equipment to be utilized. This determination may affect the size, height, and conceivably the column grid spacing. Flexibility, together with the optional features described in this document, will provide a facility that meets the installation's specific requirements.

Efforts have been made in developing this facility to enhance the "quality of life" by providing a more satisfactory environment in which to work. Colors should be selected for both the interior and exterior that provide a more pleasing appearance. Clerestory lighting is recommended for providing internal natural lighting. The roof mounted smoke vents may also serve as sky-lights when constructed with approved ultra-violet (U.V.) resistant and screening properties.

The design, while prepared for worldwide application, will require adaptation to the particular geographical location in which the facility is to be built. Not only will the elements of weather and site impact the design, but also the local governing codes, available materials and building techniques. Some of the design issues that should be given consideration before final design is commenced are:

- o Site influences
- o Actual products to be warehoused
- o Type of material handling equipment (MHE) being considered
- o Type of storage equipment being considered
- o Operational tactics
- o Projected staffing levels

Site Plan



SITE SIZE REQUIREMENTS:

- o **Basic Site**
 - 8.25 acres
 - Site dimensions - 680' x 529'
 - Basis of definitive design
 - Preferred configuration
 - As shown on definitive drawings
 - Expansion at three sides
- o **Alternative "A"**
 - 6.70 acres
 - Site dimensions - 552' x 529'
 - Intermediate size site
 - No rail spur
 - Expansion at rear side only
- o **Alternative "B"**
 - 5.08 acres
 - Site dimensions - 476' x 465'
 - Minimal site
 - No rail spur
 - No expansion
 - No exterior storage

GROSS BUILDING AREA:

Primary Configuration

- o Logistics/Administration support area:
 - Mezzanine level area = 2,635 S.F.
 - Dock level area = 2,285 S.F.
- o Gross warehouse area = 115,155 S.F.
- o Total Gross Floor Area = 120,075 S.F.
- o Building "footprint" area = 117,445 S.F.

Site Requirements

The siting of this Standard General Purpose Warehouse facility has been developed reflecting the ideal conditions of a level site with no physical constraints.

The Warehouse site shall be provided with improved access for commercial and military truck/trailer road equipment; material handling apparatus; and mobile fire apparatus. Rail spur can be accommodated. Truck/trailer parking and maneuvering space shall be provided. Long, large and unwieldy items may be handled directly at the side yard access ramp or at the elevated dock adjacent to the shipping docks.

The undeveloped front yard setback areas shall receive a lawn or other suitable landscaping. This landscaped area and the outdoor break and lunch area have been provided to enhance quality of life for employees at this facility. The balance of the undeveloped site at the sides and rear of the Warehouse may be surfaced in a suitable low maintenance/low cost gravel surfacing or lawn areas if consistent with installation development.

Utility services normally required at the site will be water, sanitary sewer, electrical, telephone, and natural gas where available. Storm drainage shall be accommodated based upon site specific requirements.

Parking shall be sized for each facility. Parking shall be provided for privately owned vehicles (POV), organizational vehicles (OV), smaller user pick-up and delivery vehicles (will call) and for the physically handicapped where required. Provide pedestrian access to the building from the designated parking areas.

Except for will call, parking areas shall be separated from the truck docks and other activity areas. Site security will be enforced by controlling access to the outdoor storage area.

Fencing designed to control general ingress and egress to the rear and side yards of site shall be provided at all facility site boundaries as shown on the Site Plan.

Exterior lighting shall be used for general security, safety and convenience purposes. All facilities shall have some form of exterior lighting at access points to the building as well as appropriate lighting from the building to the designated parking area.

When adapting this definitive design to a specific location, it is required that the process outlined in Security Engineering Manual of the Omaha District Protective Design Mandatory Center of Expertise (PD-MCX) be used to determine all protective measures required to defeat a threat. The Security Engineering Manual may be obtained by contacting Omaha District Corps of Engineers, Attention: CEMRO-ED-ST.

The Standard General Purpose Warehouse shall be provided with a system of clearly visible and easily identifiable signage and building graphics enabling rapid identification. This signage shall be readily visible at the frontage street and on the building. Incorporation of a color coding system is highly recommended if it is consistent with installation guidelines. Building identification shall be visible at night.

Based upon a modular bay spacing of 64 feet x 33 feet and a base building configuration of 388 feet wide x 301 feet deep the required site size requirements, configuration and acreages are as listed on the site plan.

Functional/Operational Requirements

The basic functional and operational objectives of this design are to provide a building capable of meeting the Department of the Army's General Purpose Warehousing requirements both efficiently and with maximum flexibility. The basic facility of 120,000 square feet and 24 foot clear height should serve many installations with little or no change; however, the building may be scoped downward or upward in both "area" and "cubage" to meet defined installation site specific requirements with modular floor area increases or decreases and optional height increases to 34 feet or 60 feet. The use of more efficient and more sophisticated materials handling equipment may affect the column spacing (grid layout) which could require adjustment accordingly. The warehouse basic configuration is essentially a square for efficiency of operation, lower construction cost, and energy savings. Unlimited other configurations are possible where site specific requirements exist.

Category codes for this facility are:
44110 and 44220.

The classes of supplies to be stored therein are:

- Class 2 - Clothing;
- Class 4 - Construction materials;
- Class 5 - Ammunition components
(nonexplosive);

and

Class 9 - Repair parts and components.

The functional relationships were developed to provide efficient operational adjacencies. The centralized shipping, receiving, and logistics/administration areas provide the degree of control desired and efficient access to all areas of the building. While this building is one entity, for consolidated operations, it may be subdivided where user requirements dictate separate accountability.

The two-level logistics/administrative core physically separates the shipping and receiving areas and provides the support required for the operation of the facility. The core provides shipping and receiving offices; acceptance and

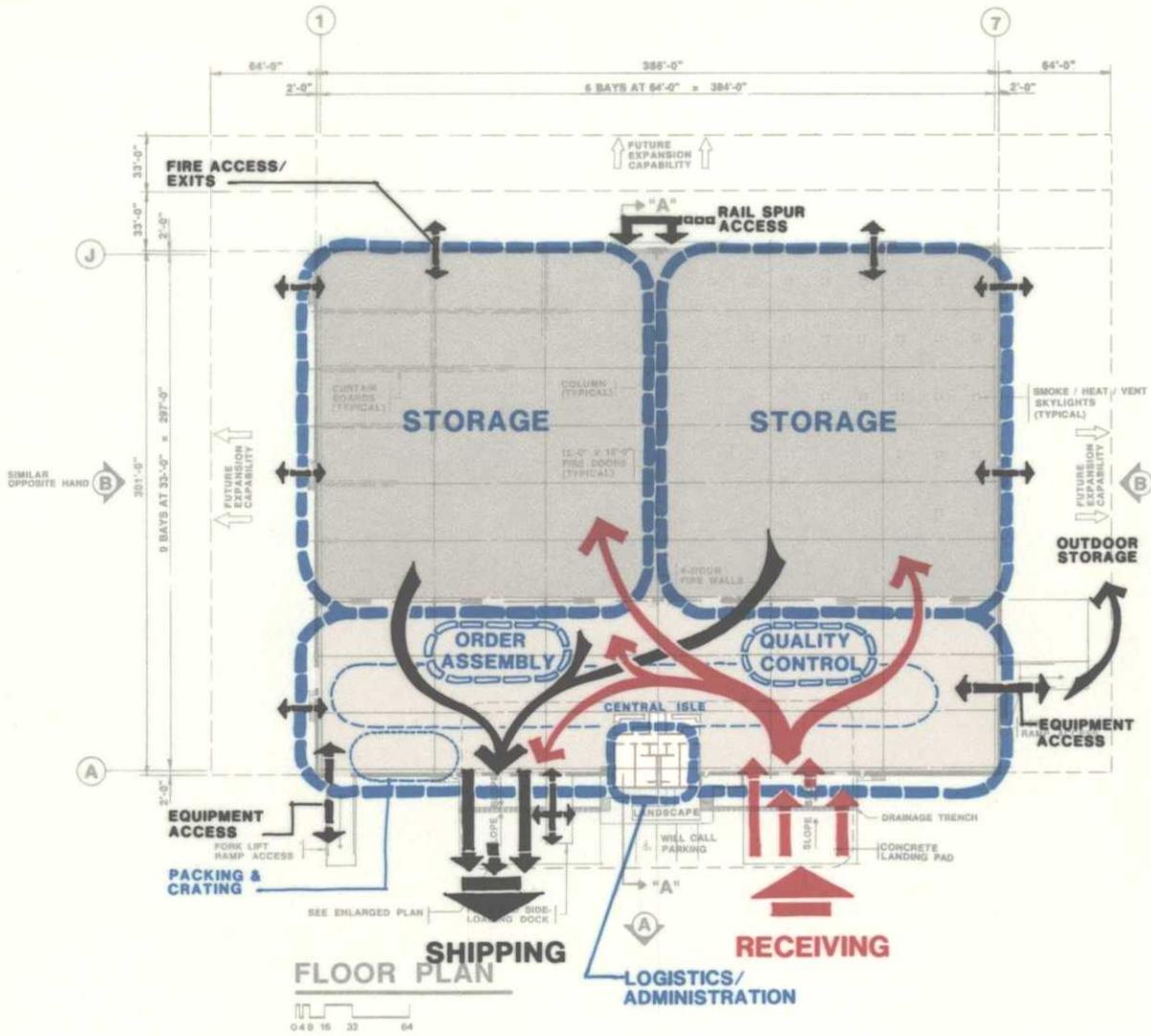
quality control; order assembly; parcel post area; toilets; lockers; lunch, break, training and conference room; warehouse supervisor's office; management information center; and general offices.

Other activities such as the packing and crating shop, pilferable storage, humidity controlled area, or even a refrigerated area, can be readily integrated into the plan where required. Safety for both personnel and building contents are provided through appropriate alarms; fire protection sprinkler systems; and fire exits, all conforming to NFPA. The building has been separated by 4-hour fire walls with each area containing a maximum of 40,000 square feet.

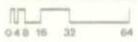
External major functional areas provide separated shipping and receiving truck docks with ample hardstand paving and vehicle maneuvering area. Access ramps at the front and side provide for vehicular and/or fork lift access from ground level to dock level. The side ramp may prove particularly useful in handling long, unwieldy items. To further enhance materials handling of bulky materials and flat bed unloading, a dock-high loading platform has been provided. Overflow or other temporary storage is available within the fenced side yard.

In summary, the functional and operational requirements of the Standard General Purpose Warehouse require that the final design be based on the characteristics of the material being handled and stored (shape, environment, stackability, etc.); the volume and flow pattern through the facility (transaction and cube movement rate); and the inventory pattern (item count, item cube, quantity mix, and turnover patterns). These factors are a function of the Installation's mission and can change with time and conditions. Thus, the design is based upon common denominator criteria with built-in fail-safe reliability and flexibility to accommodate conditions of material mix, movement, mission, configuration, and level of activity.

Floor Plans



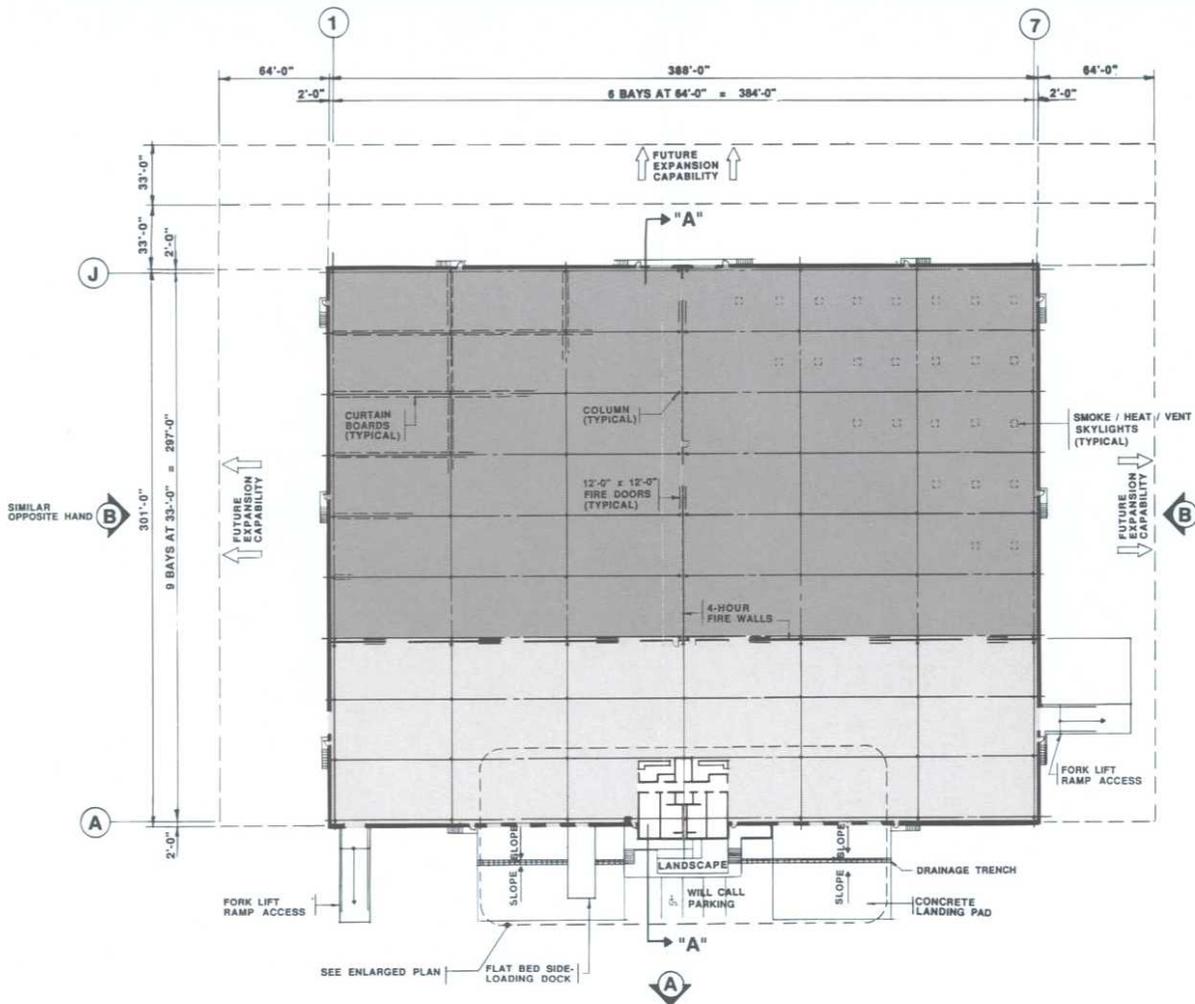
FLOOR PLAN



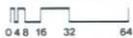
ROOM NUMBER AND AREA TABULATION

Room Number:	Room Name:	Area:	Room Number:	Room Name:	Area:
I. DOCK LEVEL:					
OFFICES:					
D-1	RECEIVING OFFICE	310 SF	D-12	TRUCKER LOBBY	50 SF
D-2	SHIPPING OFFICE	310 SF	D-13	JANITOR/WATER HEATER	50 SF
WORKSTATIONS:					
D-3	PARCEL POST SHIPPING		CIRCULATION - STAIRS TO MEZZANINE:		
D-4	ORDER ASSEMBLY	210 SF	D-14	MAIN STAIR	130 SF
D-4	ACCEPTANCE INSPECTION QUALITY CONTROL (QC)	210 SF	D-15	SECONDARY FIRE EXIT	210 SF
D-4			D-16	CORRIDOR	235 SF
RESTROOMS:					
D-5	MEN	135 SF	II. MEZZANINE OFFICES		
D-6	WOMEN	135 SF	M-1	WAREHOUSE SUPERVISOR	360 SF
D-7	TRUCKER	80 SF	M-2	GENERAL OFFICE	380 SF
LOCKER ROOMS:					
D-8	WOMEN	65 SF	M-3	LUNCH/BREAK ROOM	460 SF
D-9	MEN	65 SF	M-4	MANAGEMENT INFORMATION CENTER (MIC)	460 SF
SHOWER ROOMS:					
D-10	MEN	45 SF	CIRCULATION:		
D-11	WOMEN	45 SF	M-5	CORRIDOR	435 SF
			M-6	OBSERVATION	540 SF
			III. WAREHOUSE AREA:		
					115,155 SF

Gross Building Area 120,075 SF



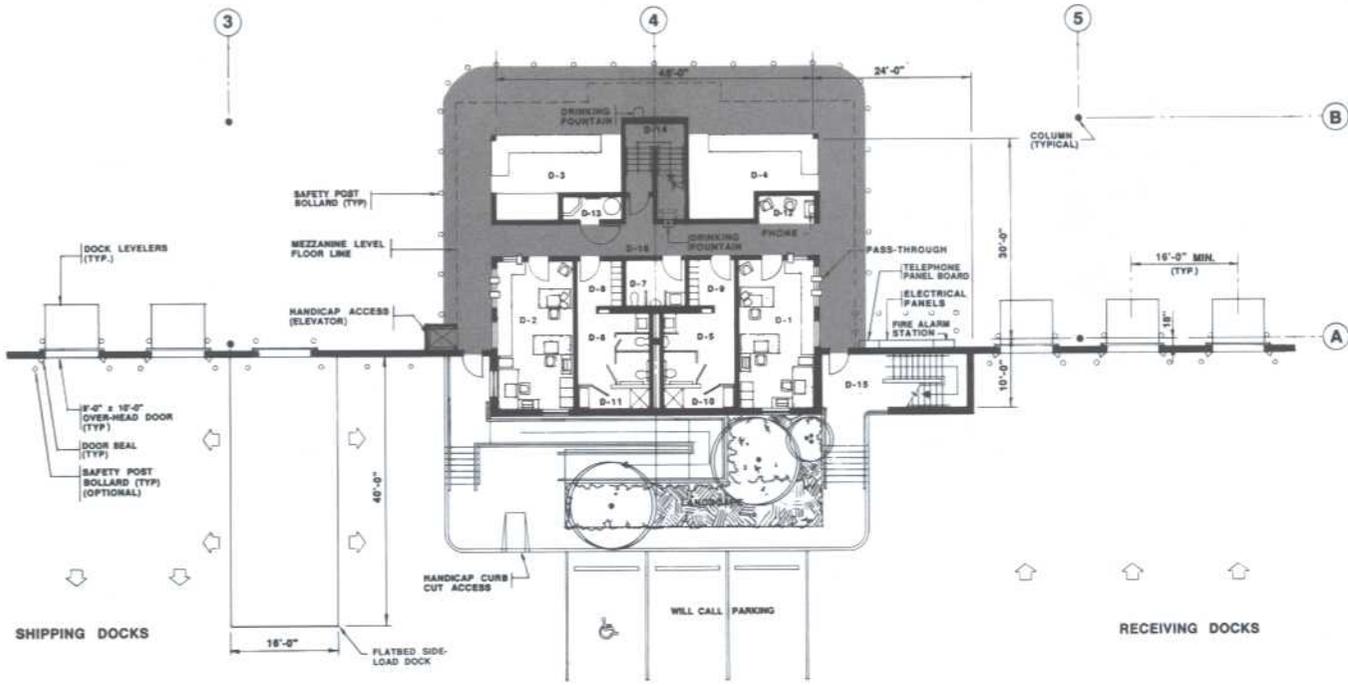
FLOOR PLAN



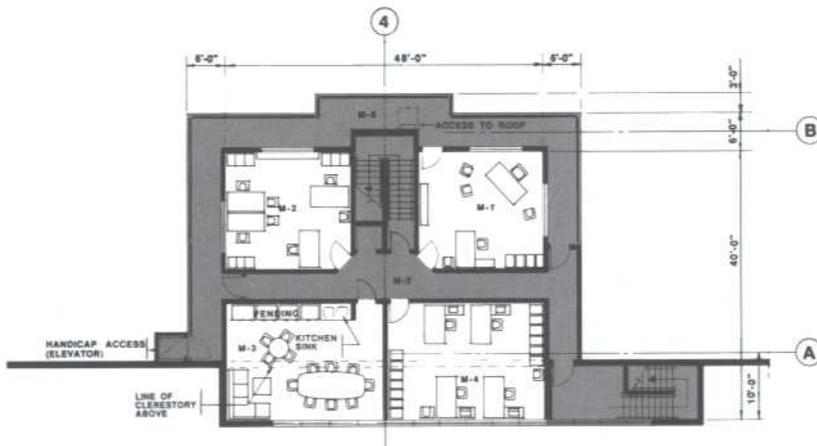
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WORKSTATIONS:					
D-3	o PARCEL POST SHIPPING ORDER ASSEMBLY	210 SF	CIRCULATION - STAIRS TO MEZZANINE:		
D-4	o ACCEPTANCE INSPECTION QUALITY CONTROL (QC)	210 SF	D-14	o MAIN STAIR	130 SF
RESTROOMS:					
D-5	o MEN	135 SF	D-15	o SECONDARY FIRE EXIT	210 SF
D-6	o WOMEN	135 SF	D-16	o CORRIDOR	235 SF
D-7	o TRUCKER	80 SF	II. MEZZANINE		
LOCKER ROOMS:					
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D-9	o MEN	65 SF	M-1	o WAREHOUSE SUPERVISOR	360 SF
SHOWER ROOMS:					
D-10	o MEN	45 SF	M-2	o GENERAL OFFICE	380 SF
D-11	o WOMEN	45 SF	M-3	o LUNCH/BREAK ROOM	460 SF
			M-4	o MANAGEMENT INFORMATION CENTER (MIC)	460 SF
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			M-5	o CORRIDOR	435 SF
			M-6	o OBSERVATION	540 SF
			III. WAREHOUSE AREA:		
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Gross Building Area 120,075 SF



DOCK LEVEL FLOOR PLAN



MEZZANINE LEVEL FLOOR PLAN



Design Objectives

Architectural

The General Purpose Warehouse Definitive Design has been developed with flexibility in mind and to permit its adaptation to numerous site conditions and different code and regulatory requirements that can be anticipated for this type of facility.

An effort has been made in this definitive design package to improve the "quality of life" associated with warehousing. Traditionally, warehouses have been produced to suit functional requirements only with little or no thought devoted to "quality of life," area enhancements, or overall facility appearance. This facility, when properly developed, can function efficiently and effectively as a General Purpose Warehouse and enhance the general area.

The highly functional characteristics of warehousing essentially dictate the building size and configuration. The final design should develop the buildings' appearance to express a feeling of order, strength and simplicity. Particular attention should be paid to the building's exterior treatment and develop an appearance that will tie in with other contiguously located installation facilities. This may be accomplished through selection of materials, colors, decorative banding, or differing treatments for the clerestory portions of the facilities and signage.

Interior treatment, colors and materials that are light, bright, and have low maintenance characteristics should be selected. Wall facings shall be of durable, damage resistant materials up to a height of 14 feet above floor line as a minimum.

The interior natural lighting of the facility can be greatly enhanced through the use of insulated translucent panels at the clerestory level. Additional natural light can be achieved through use of translucent panels in the roof mounted smoke vents, if smoke vents are required. The translucent panels, if utilized, shall be ultra-violet resistant and provide U-V screening.

The type of construction utilized for this warehouse definitive is steel frame with precast, insulated concrete wall panels, other materials and methods may be considered. Exterior doors and windows shall be insulated, with canopies provided at dock, ramp, exit and access doors. Dock levellers and dock seals are provided at dock doors.

The Logistics/Administrative core is the focal point for this facility. Its location, with respect to shipping and receiving, permits close control over all major activities. Its two-story construction and mezzanine level viewing deck present a commanding visual effect that literally says, "This is the Control Center." Development of the roof system will be accomplished during final design and care shall be taken to insure a system compatible with the geographic influences on this facility.

Use of multiple or split-level roof heights requires that the designer pay particular attention to resolving potential deflection and leakage problems.

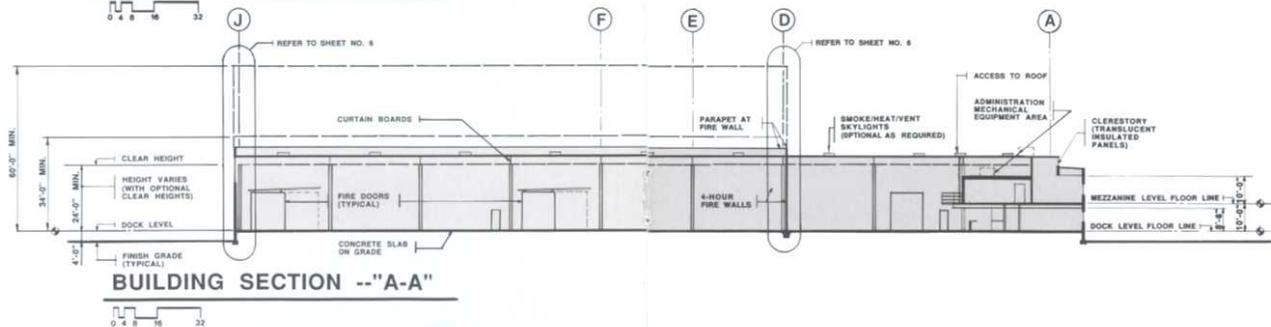
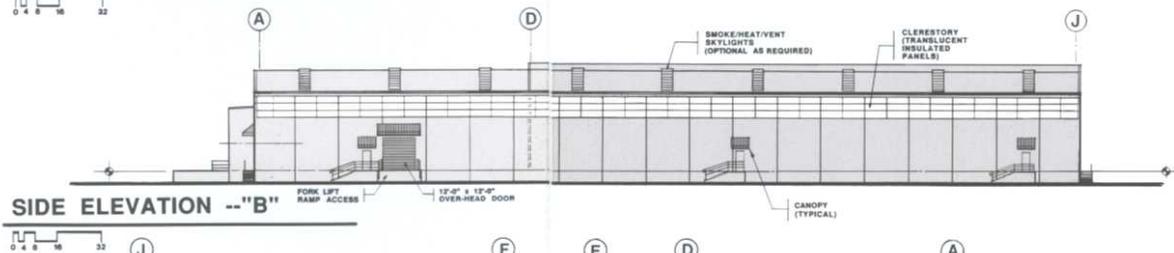
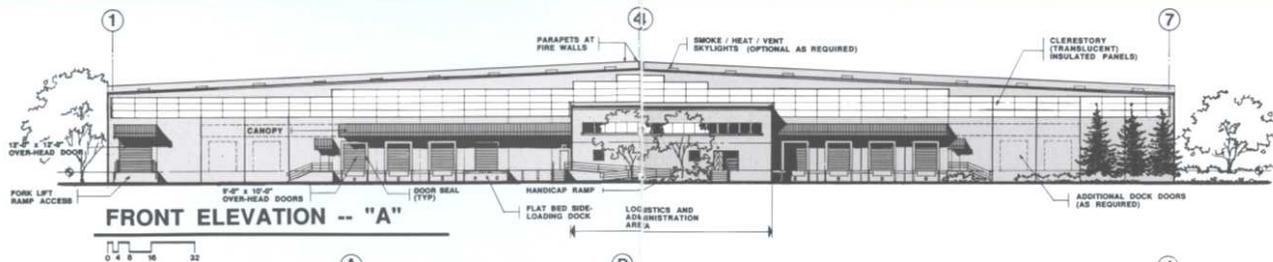
The roof membrane shall be selected for longevity, low maintenance, and watertight qualities. External roof drainage is anticipated for this building; however, internal roof drains may be substituted where local conditions are favorable. Collection and retention of roof drainage and rain water run-off shall be addressed during final design.

Safety provisions are a high priority. The Occupational Safety and Health ACT (OSHA) requirements shall be followed throughout the design process, as well as the Life Safety Code. Emergency fire egress and access doors are provided per code.

Access by physically handicapped persons shall be provided in accordance with the Uniform Federal Accessibility Standards. Where access is not required, it shall be stipulated in DD Form 1391.

The building will be fully sprinklered for fire protection and appropriate detection and alarm systems provided. Fire protection shall comply with provisions of NFPA, and other applicable criteria.





Options

This Standard General Purpose Warehouse supports separate category codes, 44110 and 44220 and will have substantially differing design, construction, and operational requirements in order to meet the Army's needs on a worldwide basis. This facility will serve the largest depot level to the smaller installations, and may range in size from several hundred thousand square feet to as few as forty thousand square feet, or smaller if required. The material handling systems will also vary from very basic to highly automated. To be a viable prototype for the unlimited range of facilities that are possible, it is necessary that the highest degree of flexibility be provided.

The basic 120,000 square foot prototype shown and described in this brochure may serve many installations with little or no modifications; however, there are certain options that must be left open to the user and the design agency. These options must be fully identified with justifications in the DD Form 1391 and approved by the installation's MACOM prior to implementing the planning, design and construction processes for this facility.

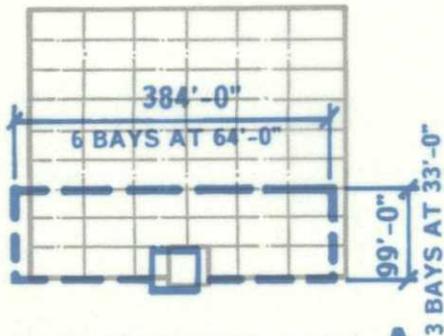
Optional features that are deemed appropriate are:

- o **INCREASE/DECREASE SIZE:**
Building may be increased or decreased in size. Examples of some possibilities are indicated herein.
- o **INCREASE HEIGHT:**
Building clear height may be increased from basic 24' to 34' or 60'.

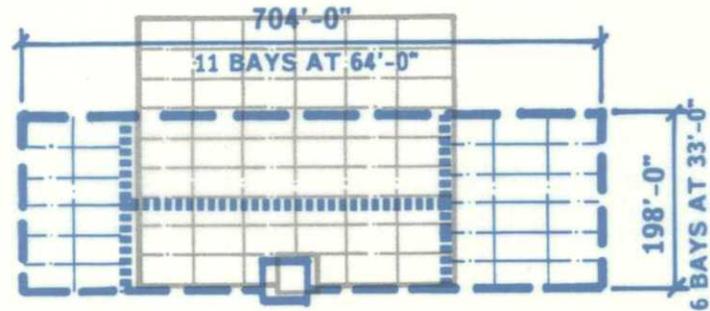
Cost Index Adjustment:
24' Clear Height = 1.0
34' Clear Height = 1.1
60' Clear Height = 1.4
- o **GRID ADJUSTMENT:**
The column grid pattern of 64' x 33' may be altered to suit specific material handling equipment (MHE) requirements.

- o **GRADE LEVEL MAIN FLOOR:**
Main floor may be placed at grade.
- o **RAIL SPUR DOCK:**
An optional rail dock may be added.
- o **DOCKING DOORS:**
The number provided may be increased or decreased.
- o **LOGISTICS/ADMINISTRATIVE CORE:**
May be increased, decreased, or eliminated.
- o **MATERIALS AND TYPES OF CONSTRUCTION:**
May be altered to suit site specific conditions.
- o **SPECIAL PURPOSE MODULES:**
Secured, humidity controlled, and refrigeration type storage, etc. may be added to the basic design, or brought in as modules.
- o **POV PARKING:**
POV parking may be increased, decreased or eliminated.
- o **FIREWALL:**
The firewalls may be eliminated up to 120,000 square feet if approved by the fire protection authority of the MACOM and the following conditions are met and addressed in the DD Form 1391, paragraphs D1 or D5:
 - The increased size of the fire area is required for efficient operation.
 - Possible additional loss due to fire is recognized and acceptable.
 - Automatic sprinkler and alarm systems are included as described in the Army Standard Design.For fire areas greater than 120,000 square feet, a waiver is required from HQUSACE.

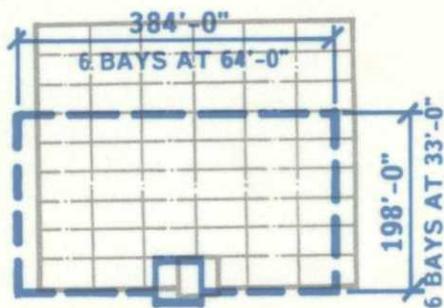
Optional Configurations



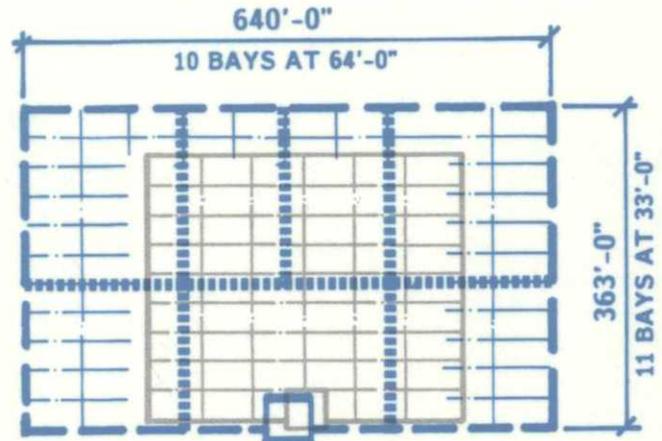
PLAN CONFIGURATION - **A**
40,000 S.F.



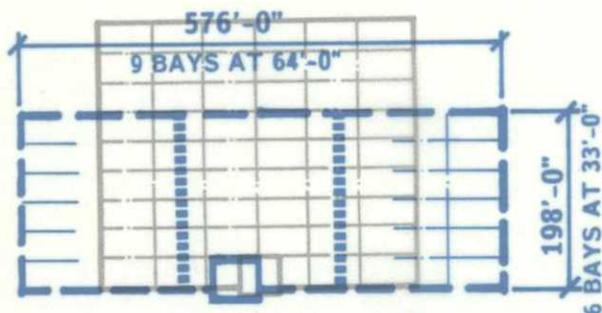
PLAN CONFIGURATION - **D**
145,000 S.F.



PLAN CONFIGURATION - **B**
80,000 S.F.



PLAN CONFIGURATION - **E**
240,000 S.F.

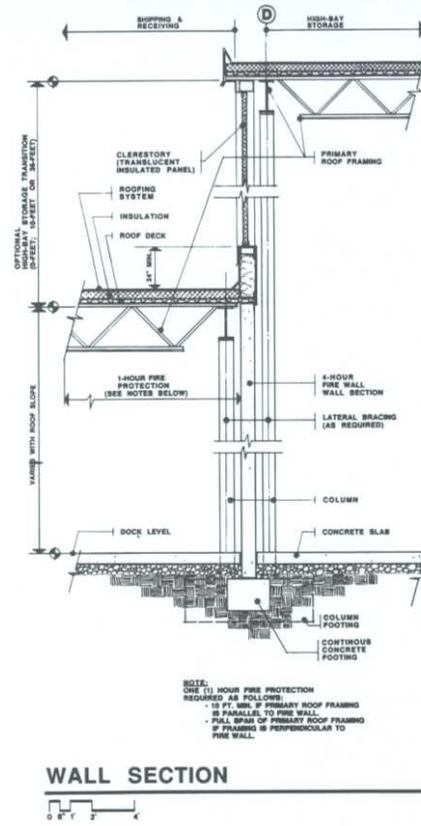
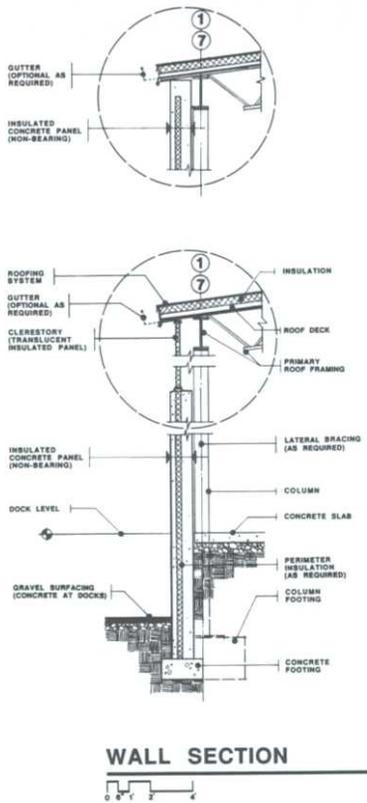


PLAN CONFIGURATION - **C**
120,000 S.F.

4- HOUR FIRE WALL (.....)



Design Objectives



Structural

The primary structural design objective for this facility has been to develop a system that is both economically feasible and compatible with current and foreseeable warehousing material handling techniques. Insofar as there are a number of structural system types available worldwide, the final selection is left to the design agency that will design the final product. The basic structural steel framing system utilized as the basis for this study is universally acceptable and appropriate for this project.

The snow, ice, wind and earthquake design loads for the superstructure will depend on the geographical location of the facility. The design floor loads will be governed by the vehicle and/or storage loads anticipated. Selection of a foundation system will depend on the geological conditions at the site and type of structure selected.

The flatness of the slab is critical to the proper performance of the materials handling equipment and storage structure, especially in the high-rise type of warehouse where "super flat" floors may become a requirement to assure both safety and proper operation.

The structural system selected was dependent upon several factors, with functional layout requirements and related costs being the primary issues. The intent of the structural bay column spacing is to accommodate a maximum variety of layouts, as determined by the types of materials handling equipment to be employed, to provide a sound basis for increasing or decreasing the size of the basic 120,000 sq. ft. warehouse in some logical manner and retain the integrity of a rectangular building. The 64' x 33' grid was selected for the prototype standard as it best satisfies the requirements for universal application.

Mechanical

The mechanical systems for the General Purpose Warehouse shall include warehouse area heating *and ventilating systems, administrative area heating, ventilating and (where appropriate) air conditioning systems, plumbing systems, and fire sprinkler systems.* Air-conditioning of the administrative areas shall be permitted only where authorized.

The heating and ventilation system recommended is a direct fired, space heating unit. A building pressurization system with minimal ductwork shall be utilized.

Interior and exterior design temperatures shall be based upon the CE Architectural and Engineering Instructions and ASHRAE Standard 90-75. The Warehouse area will be designed for an interior design temperature of 55 degrees F.; however, an unstaffed warehouse may be designed for 40 degrees F. Ventilation requirements are a minimum of two air changes per hour. The basic fuel is assumed to be natural gas, however, a life cycle cost analysis should be performed to verify its economic viability. Dual fuel capability is not required.

Plumbing fixtures of barrier-free design shall be provided. Water cooler shall be provided in logistics/ administration area and floor drains are to be included in the restrooms. Army Tech Manual TM5-810-5 "Plumbing" shall be used to provide specific design guidance.

Passive solar design for warehouses is best implemented when it appears appropriate conditions exist; then a life cycle cost analysis should be developed to determine the cost benefit of active solar design.

Electrical

The majority of the Warehouse electrical system load is comprised of lighting, power receptacles, and small motors. The electrical characteristics shall be chosen to supply the electrical requirements in the most economical manner. The interior lighting levels are established by the CE Architectural and Engineering Instructions.

Special illumination levels may be required for certain types of materials handling systems, conveyors, control centers, truck interiors, etc. The warehouse lighting shall be installed with energy-saving lamps and ballasts. All interior areas, other than the Warehouse, shall be illuminated using fluorescent lighting fixtures. The Warehouse shall be illuminated with HID (high intensity discharge) lighting fixtures. Emergency supplementary incandescent or fluorescent lighting of 1FC shall be provided along all aisles and walkways.

Each loading dock shall be provided with dock lights specifically designed for truck loading and unloading. The exterior of the building shall be illuminated for security and shall be designed to provide the most energy-efficient lighting practicable. The truck dock area shall be illuminated with building-mounted lighting fixtures. All exterior lighting shall be controlled using a combination of photocell and time clocks, with photocell on - time clock off. The parking area shall be illuminated and exit and pathway lighting shall be provided. An emergency power shut-off device shall be provided at a primary personnel exit.

A fire alarm detection and alarm system shall be provided. A telephone system shall be provided to all office areas and shipping/receiving. An intercom system shall be provided for voice communication between offices, shipping/receiving and all areas of the warehouse. One speaker for each 2,000 sq. ft. of warehouse shall be provided.



Logistics/Administration Area



CONTACT SEATTLE DISTRICT
CORPS OF ENGINEERS
FOR ADDITIONAL INFORMATION