

US Army Corps  
of Engineers  
Seattle District

# GENERAL PURPOSE WAREHOUSE

**THE ORB ORGANIZATION**  
Architects - Planners - Engineers 510 Evergreen Building Renton, Washington 98055

#### General Description

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 design included in this package is for a standardized General Purpose Warehouse. 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 Department of the Army Facilities classes and construction categories for this facility are category codes 44110 and 44220. The classes of supplies to be stored therein, as defined in AR 700-9, are:

- Class 2 - Clothing, individual equipment, tentage, tool sets and tool kits, hand tools, administrative and housekeeping supplies and equipment.
- Class 4 - Construction materials, including installed equipment, and all fortification and barrier materials.
- Class 5 - Ammunition components (nonexplosive).
- Class 9 - Repair parts and components, including kits, assemblies, and subassemblies, repairable and nonrepairable, required for maintenance support of all equipment.

The design's purpose is to provide a standard design for a General Purpose Warehouse under the Department of the Army Facilities Standardization Program. The standard design shall be utilized for installation master planning purposes; early determination of new warehousing requirements and thereby assist in the preparation of DD Form 1391. It will serve as a guide to USACE design agencies and AE firms in applying the definitive design to a specific project. It provides a description of the functional and operational requirements, criteria and the basic technical data necessary to implement the final design process. The brochure conveys to the user the design items and features that are mandatory and those which may be considered optional.

The definitive design package shall be used as a planning tool for general programming and design. The brochure preceding this definitive design package 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. The definitive design package also provides schematic guidance for ultimate final design by design agencies.

The definitive design portrayed herein has been developed for a standard 120,000 square foot General Purpose Warehouse with a clear height of 24 feet selected as the base-line for this facility. The area of the facility may be increased or decreased to suit installation requirements. The height is also capable of adjustment from the basic 24 foot clear height to either 34 feet or 60 feet. Depending upon installation 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 will be determining factors in the final configuration.

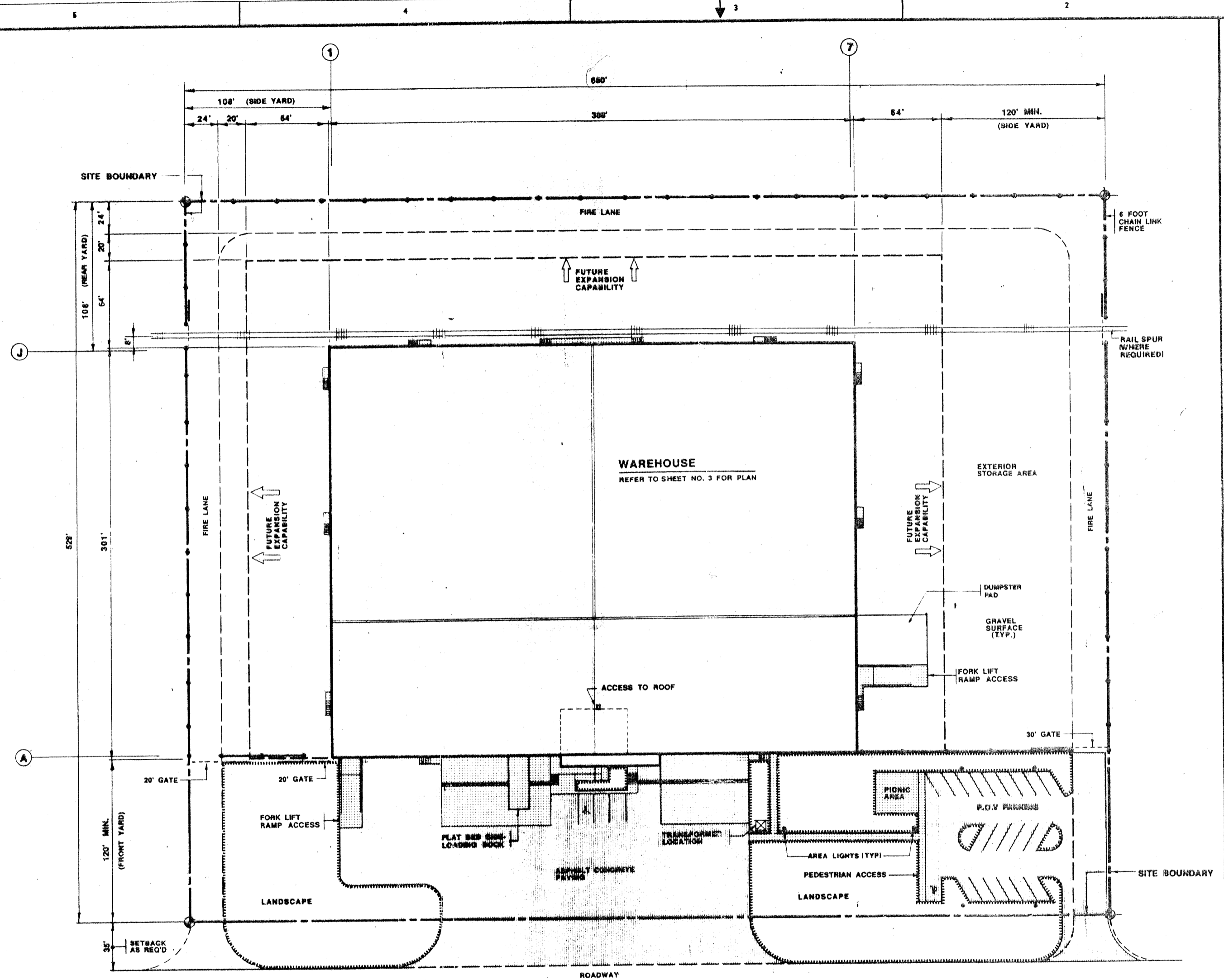
Where no specific programming for the warehouse is attainable, the basic General Purpose Warehouse portrayed by this document should be utilized as the basis for the final design. The definitive design features a centralized shipping and receiving area supported by a two-level logistics/administrative area.

Efforts have been made in this definitive design 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 as depicted on the definitive drawings. Roof-mounted smoke vents shall be provided when required by NFPA. These smoke vents can serve as sky-lights with approved ultra-violet resistant and U-V screening properties.

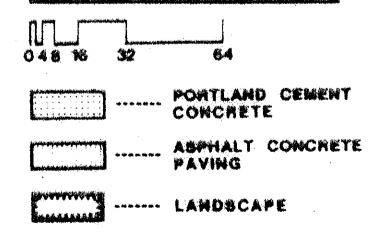
The geographic location will play a major role in the design of this facility. Elements that require conforming to local geographical considerations are: Weather; climate; seismic design; snow and wind loads; construction materials; and local techniques, codes, and designs. These will all have an effect on the exterior design treatment, structural systems, and mechanical and electrical systems.

This design has been developed to allow the installation and the USACE design agency or A-E firm maximum flexibility while maintaining the functional requirements for this building. The warehouse 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 the site specific requirements will dictate not only a significantly different "footprint," but also the required cubage content, and the specific materials handling equipment that will be utilized. This determination may affect the size, height, and conceivably the column grid spacing. Flexibility, together with the optional features presented in this document, will permit a final design that meets installation's specific requirements.

Revisions			
Symbol	Description	Date	Approved
<b>THE ORB ORGANIZATION</b>		U. S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON	
Designed by: LDC	DEPARTMENT OF THE ARMY FACILITIES STANDARDIZATION PROGRAM DEFINITIVE DESIGN		
Drawn by: KNY	GENERAL PURPOSE WAREHOUSE		
Checked by: LDC/DHH	Scale: As shown	Sheet number: 1	Drawing number: 44110-01 44220-01
Submitted by:	Spec. No.	Contract No. DACA 87-88-D-0028	



**SITE PLAN**



**Site Requirements**

The siting of this facility has been developed reflecting the ideal conditions of a level site with no physical constraints. In actual application, site availability may require adjustments for final design depending upon site configuration, topographic conditions, underground utilities, adjacent roadways, rail spurs, and the like. The site requirements that follow provide the basic criteria necessary to support this Standard General Purpose Warehouse.

The Standard General Purpose Warehouse shall be provided with improved access for commercial and military truck and trailer equipment with up to 48-foot trailers; material handling apparatus; and mobile fire apparatus. Truck/trailer parking and maneuvering space shall be provided. It is essential that all apron and approach areas to the shipping and receiving areas be paved. It is highly recommended that all parking areas for assigned staff and privately owned vehicles (POV) be paved and fully improved. Portland Cement Concrete paving shall be included at each loading dock area for trailer landing gears varying from 27 feet to 48 feet or more.

The undeveloped front yard setback areas shall receive a lawn or other suitable landscaping. The balance of the undeveloped site at the side and rear yards of the Warehouse may be surfaced in a suitable low maintenance/low cost gravel surfacing or lawn area if consistent with general installation development.

The source and location of all major utilities, both above and below ground, shall be determined. The facility site should be selected to take advantage of direct access to required utilities while preserving expandability and maintainability of the building and utility system. Utility services normally required at the site will be water, sanitary sewer, electrical, telephone, and natural gas where available. Storm drainage shall be treated per site specific requirements.

Employee parking shall be within walking distance of the facility. Where other existing parking areas are available nearby, they may be utilized to meet the parking requirements if consistent with instruction policy. Avoid double accounting. Parking shall be sized for each facility. Parking shall be provided for privately owned vehicles (POV), organizational vehicles (OV), smaller institution pick-up and delivery vehicles (with call) and for the physically handicapped. Provide pedestrian access to the building from the designated parking areas and from the frontage road where appropriate.

Except for mail call, parking areas shall be separated from the truck docks and other activity areas. Site security should be enforced by controlling access to the side yards, rear yards, and outdoor storage areas. Parking shall be isolated from receiving and shipping functions.

Fencing designed to control general ingress and egress to the site shall be provided at property lines of the site beginning with the front yard setback of building (120 feet). Provide appropriate rolling gates at access points to perimeter access roads from parking areas, frontage streets and at rail spur crossings. This requirement may vary, based upon site specific needs of each installation and its mission.

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 of access to the designated parking and parking area lighting.

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.

Facilities shall be made fully accessible in accordance with the Uniform Federal Accessibility Standards, as developed jointly by GSA, HUD, DOD, and U.S. Postal Service, current edition, unless otherwise required by DD Form 1391.

Each 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 end and on the building. Incorporation of a color coding system is highly recommended if it is consistent with installation guidelines. Building identification shall also be visible at night.

Based upon the building modular bay spacing of 64 feet x 33 feet and a basic building configuration of 388 feet wide x 301 feet deep the required minimum site configuration and acreages for the basic site and two alternatives are as follows:

**Basic Site - Preferred Site (Shown):**  
If modular future expansion in both width and depth of the building are to be anticipated in the future with a rail spur at rear of the building, then minimum site requirements are:  
630' x 529' ----- 359,720 square feet = 8.25 acres

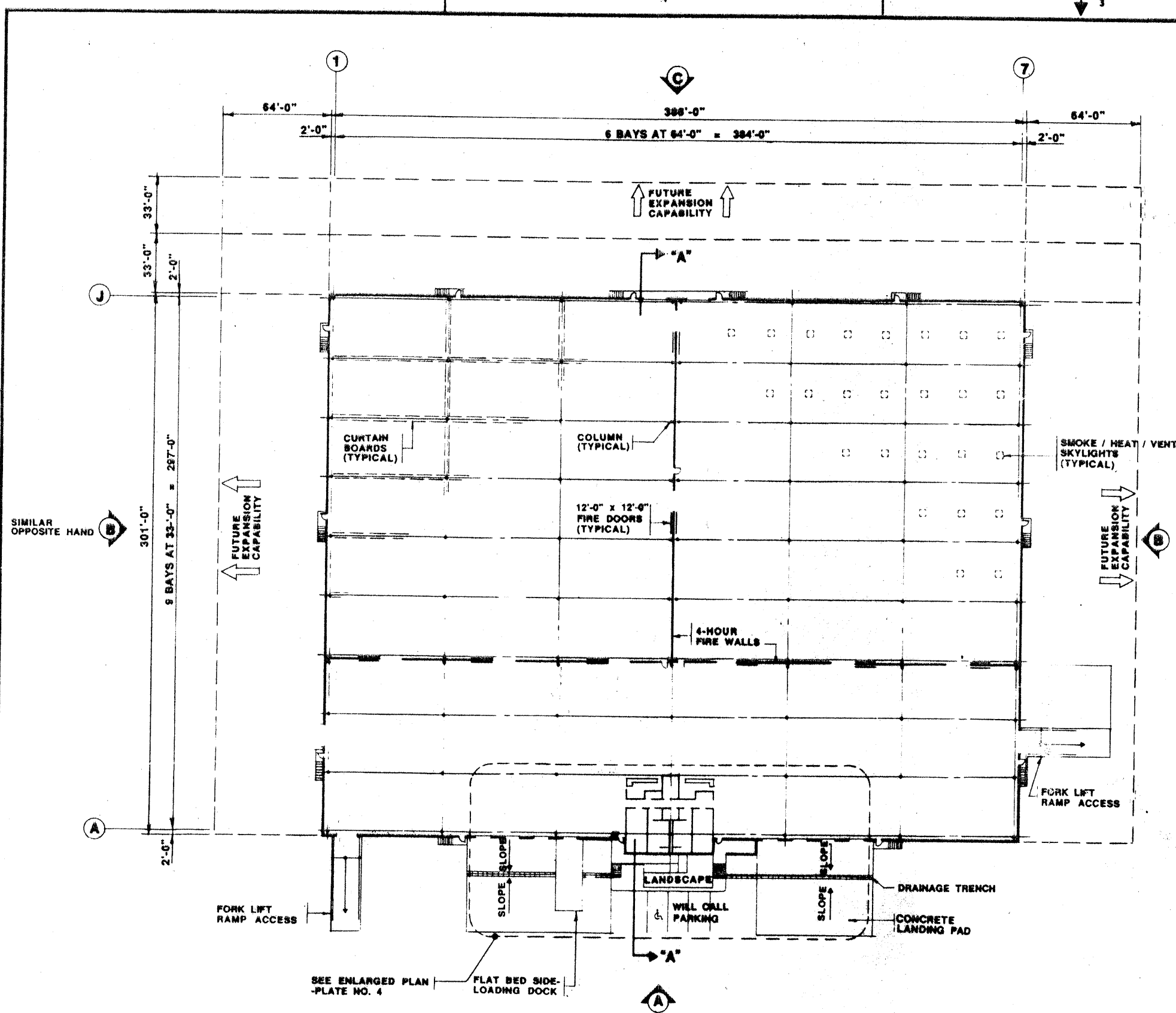
**Alternative "A" - Intermediate Size:**  
If modular future expansion in depth (rear) only is anticipated and no rail spur is provided, then the intermediate site requirements are:  
552' x 529' ----- 292,008 square feet = 6.70 acres.

**Alternative "B" - Minimum Size:**  
If modular future expansion in width or depth of the building is not contemplated and no rail spur is provided, then minimum site requirements are:  
476' x 465' ----- 221,340 square feet = 5.08 acres

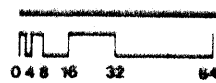
Revisions		Date	Approved

<b>U.S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON</b>			
Designed by: <b>LDC</b>	<b>DEPARTMENT OF THE ARMY FACILITIES STANDARDIZATION PROGRAM DEFINITIVE DESIGN</b>		
Drawn by: <b>KNY</b>			
Checked by: <b>LDC/DHH</b>			
<b>GENERAL PURPOSE WAREHOUSE</b>			
Reviewed by:	Scale: As shown	Sheet number: <b>2</b>	Drawing number: <b>43110-01 44220-01</b>
Submitted by:	Contract No. <b>DACA87-86-D-0033</b>		



**FLOOR PLAN**



**GENERAL NOTES**

- GROSS BUILDING AREA:**  
PRIMARY CONFIGURATION  
  - Logistics/Administration support area:
    - Mezzanine level area = 2,635 S.F.
    - Deck level area = 2,285 S.F.
    - Gross warehouse area = 115,159 S.F.
  - Total gross floor area = 120,075 S.F.
  - Building "footprint" area = 117,445 S.F.
- The column spacing of 64 feet x 33 feet represents a grid pattern that serves numerous storage/aisle/MHE configurations effectively. This grid pattern may be adjusted for final design where site specific warehouse planning indicates a grid that will more effectively serve the precise materials handling equipment and storage racks selected.
- This facility may be programmed in area incremental increases or decreases to provide a building area between 40,000 to 240,000 S.F. Refer to Sheet number 7. Other modular arrangements will work also.
- This facility may be programmed in vertical modules of the basic "clear height" of 24 feet, or two (2) optional heights of 34 feet or 60 foot clear height, or a combination of these heights.
- The Warehouse should be site oriented to take maximum advantage of existing conditions. Plan elements may be reversed or adjusted to satisfy site specific and local requirements.
- "Special use" areas are not contained in a standard General Purpose Warehouse; they may be programmed during final design on a site specific basis.
- Logistics Administration/Support areas, as shown, are to be provided as stipulated by activity requirements.
- All areas of building shall be provided with automatic sprinklers.
- Architectural treatment, materials framing, and construction may vary.
- Positive roof slope and composite roof drainage is required. A minimum roof slope of one-half inch per foot is recommended.
- Warehouse floor live load 25# P.S.F. minimum. The floor load depends upon material handling equipment (M.H.E.) and product being stored. Mezzanine and administrative floor live load: 100 P.S.F. minimum.

**Functional and Operational Requirements:**

The overall functional objective of this definitive design is to provide a building capable of meeting the Department of the Army's General Purpose Warehousing requirements. The basic facility shown herein of 120,000 square feet and 24 foot clear height should serve most installations with little or no change; however, it should be recognized that the building may be scoped downward or upward in both "area" and "cubage" to meet the more defined site specific requirements. The use of more efficient and more sophisticated materials handling equipment may affect the column spacing (grid layout) which could require adjustment accordingly. With these variables in mind, the definitive design was developed to provide the maximum degree of flexibility that would be necessary to satisfy installation and site specific requirements.

The functional relationships were developed to provide the most efficient operational adjacencies for this type of facility. The basic building was conceived essentially as a square configuration as this is acknowledged to be not only the most cost effective for construction costs and energy consumption, but also the most efficient for the facilities' internal material handling use and circulation. The centralized shipping and receiving areas, together with the logistics/administration area, provide the degree of control desired in addition to providing efficient access to all areas of the building. This relationship provides an excellent method of satisfying the "JIT Principle" -- Just In Time -- whereby products brought into receiving that are to flow out promptly without going into storage can be accommodated in this centralized area with a minimum of handling once inside the building. The configurations further serve the "ABC Principle" of warehousing which requires that short term turn-around items be held in storage nearby, while the medium and longer term storage items be located progressively further into the recesses of the building.

The 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; restrooms; lockers; lunch break, training and conference room; warehouse supervisor's office; material information center; and general office. This core area is at deck level with a mezzanine above and is accessible to the physically handicapped, as is the balance of the facility. This core area may be adjusted in size to suit site specific mission requirements. In the case of depot level storage, this core area may not be required; or possibly a one-person prefabricated office module could suffice.

Immediately adjacent to the logistics/administrative core are the main power panels; distribution panels for the electrical service; fire alarm control panel and telephone panels.

Other activities such as the packing and crating shop, special preferable storage, humidity controlled area, or even a refrigerated area, can be readily integrated into the plan where required. Safety for personnel and building contents provided through appropriate alarms; fire protection sprinkler systems; and fire exits and access, 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 as required by the Architectural and Engineering Instructions.

Externally, the major functional areas provide separated shipping and receiving truck docks with ample handstand parking 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 load unloading, a dock-high loading platform has been provided. This platform permits both end and side loading/unloading capabilities. This platform may be positioned on either the shipping or receiving side of facility. Overflow or other temporary storage may be stored within the fenced side yard of the warehouse.

One of the most critical factors in the development of the layout for a Standard General Purpose Warehouse is the relationship between actual equipment dimensions and performance characteristics and the building dimensions. With numerous types of fork lifts, styles and types of racks and shelves available on the open market, few conform to any industry-wide dimensional standards. Different makes and styles of fork lift trucks require different aisle widths and turning radii. Racks and shelves have a variety of internal dimensions, such as column and rail depth, shelf and rail spacing, etc. Many equipment and storage system option dimensions can be normalized so that the handling and storage modulus will fit most of the available classes of equipment; however, since this is not always practical, it is essential that the user, considering application of the proposed layout grids, check locally and define dimensions of the selected equipment and the building(s) under study before commitment of funds to an installation design.

The dimensional limitations and structural design characteristics of the building will be impressed upon the warehousing methods utilized and material handling equipment (MHE) parameters. The relationship between the pallet or tote box, the racks, the fork lift truck or Automated Storage and Retrieval System (AS/RS) devices and the aisles and overhead clearances must first be established for optimum materials handling and storage efficiency and fit the column pattern, bay spacing, storage height (SH), and building envelope. The final structural configuration of the building must be designed to fit the optimum material handling equipment system being considered for the specific project requirements.

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 inventory turnover patterns). These factors are a function of the installation's mission and can change with time and conditions. Thus, the design must be based upon common denominator criteria with built-in fail-safe reliability and flexibility to accommodate all conditions of material mix, movement, mission configuration, and level of activity.

**Architectural Design Objectives:**

The architectural design objective of the definitive design is to delineate a General Purpose Warehouse prototype with related site features that may be adapted to a variety of locations on a worldwide basis. The definitive design has been developed with flexibility in mind to permit its adaptation to the numerous conditions and differing warehousing requirements anticipated for this type of facility. Insofar as this facility is to serve two different category codes, 44110 and 44220 and will be developed around a variety of materials handling systems and operational requirements for anywhere from large depot level installations to the considerably smaller installations, the definitive must be flexible enough to adapt to the many combinations possible.

While warehouses, by the very nature of their highly functional characteristics essentially dictate size and configuration, it is still incumbent upon the design agency in the final design to develop the buildings' external appearance to express a feeling of order, strength and simplicity. The designer of the final product shall pay particular attention to the buildings' exterior treatment and develop an appearance that will harmonize with other contiguous located facilities. This can be accomplished through the selection of materials, colors, decorative banding, or differing treatments for the clerestory portions of the facilities and even signage. Building siting should not only be established based upon optimal conditions pertaining to weather exposure, but also to provide appropriate relationship to the installation's traffic patterns and to other support warehousing and logistics facilities. An effort has been made in this definitive design package to improve the "quality of life" associated with these warehouses. Traditionally, these facilities have been produced to suit function only with little thought devoted to "quality of life," area enhancements or overall facility appearance. This facility, when properly configured and thoughtfully designed, can function efficiently and effectively as a General Purpose Warehouse and enhance the general area in which it is sited.

Internally, the facility is, in essence, three areas, separated by 4-hour fire walls per requirements stipulated in the Architectural and Engineering Instructions. These fire walls may be waived for installations where certain conditions are met. Refer to "Options" descriptions on Sheet Number 7. Fire walls present a formidable barrier to efficient space utilization and material handling methods; however, the judicious use and spacing of approved fire doors can greatly enhance the functional circulation throughout the building. Aisle patterns, once determined will establish the fire door locations.

The Logistics/Administrative core, located in the central portion of the forward 40,000 square foot area, represents the operational and physical 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 the mezzanine level viewing deck present a commanding visual effect that literally says, "This is the Control Center."

In the selection of the interior treatment, the design agency shall work with colors and materials that are light and bright, plus having low maintenance characteristics. Floor patterns should be well marked on the floors and protective bollards placed where potential vehicular impact would cause internal damage. Wall facings shall be of durable, damage resistant materials to a minimum height of 14 feet above floor line.

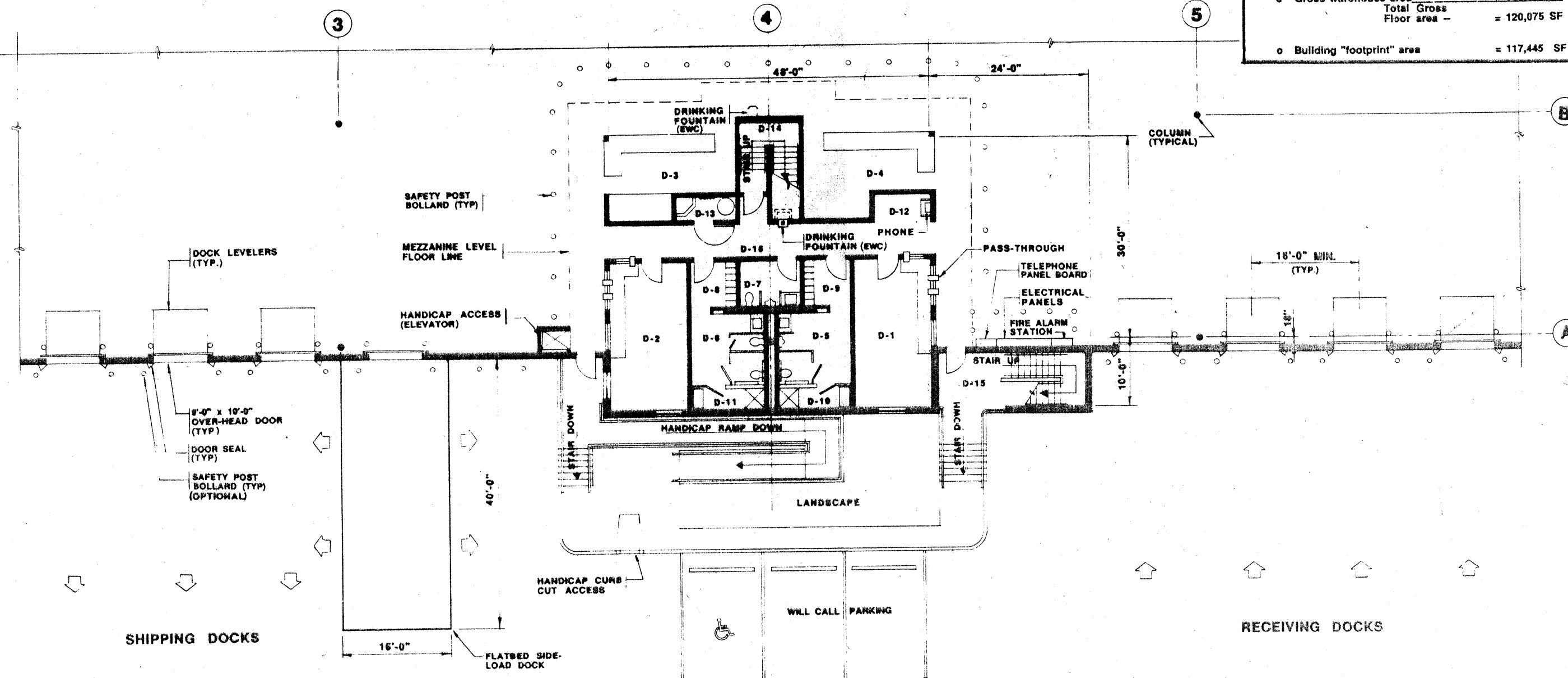
At the using agencies choice, the interior lighting of the facility can be greatly enhanced through the use of ultra-violet resistant and ultra-violet screening insulated translucent panels at the clerestory level. Further, if smoke vents are required, natural light throughout the entire facility can be achieved through use of ultra-violet resistant and ultra-violet screening translucent panels at the smoke vents located in the roof area. This natural lighting will greatly enhance the quality of life for personnel assigned to these facilities and could represent some energy cost savings.

Revisions			
Symbol	Descriptions	Date	Approved

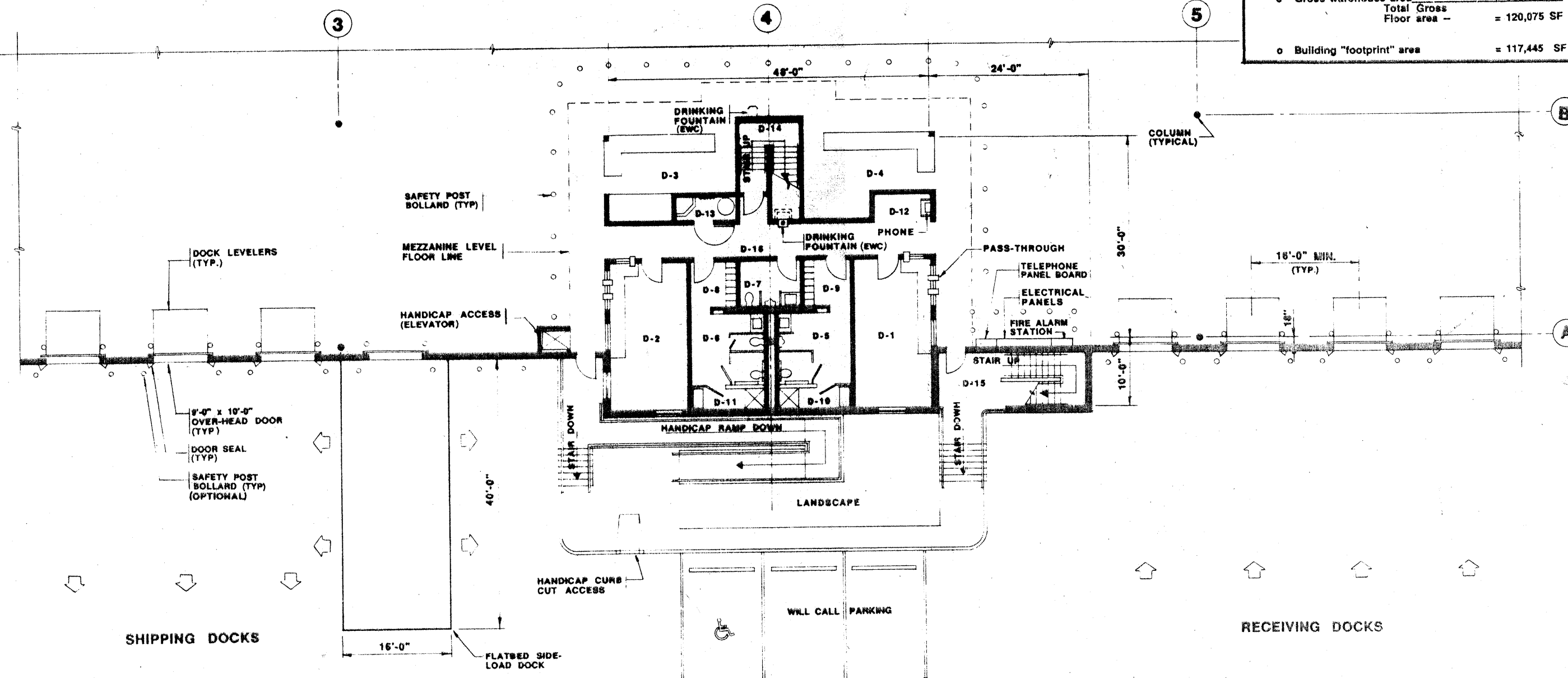
  

		U. S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON	
Designed by:	LDC	DEPARTMENT OF THE ARMY FACILITIES STANDARDIZATION PROGRAM DEFINITIVE DESIGN <b>GENERAL PURPOSE WAREHOUSE</b>	
Drawn by:	KNY		
Checked by:	LDC/DHH		
Reviewed by:		Scale:	As shown
Submitted by:		Sheet number:	<b>3</b>
Contract No. DAC67-88-P-9028		Drawing number: 44110-01 44220-01	

### MEZZANINE LEVEL FLOOR PLAN



### DOCK LEVEL FLOOR PLAN



### ROOM NUMBER AND AREA TABULATION

Room Number:	Room Name:	Area:
<b>I. DOCK LEVEL:</b>		
<b>OFFICES:</b>		
D-1	RECEIVING OFFICE	310 SF
D-2	SHIPPING OFFICE	310 SF
<b>WORKSTATIONS:</b>		
D-3	PARCEL POST SHIPPING ORDER ASSEMBLY	210 SF
D-4	ACCEPTANCE INSPECTION QUALITY CONTROL (QC)	210 SF
<b>RESTROOMS:</b>		
D-5	MEN	135 SF
D-6	WOMEN	135 SF
D-7	TRUCKER	40 SF
<b>LOCKER ROOMS:</b>		
D-8	WOMEN	65 SF
D-9	MEN	65 SF
<b>SHOWER ROOMS:</b>		
D-10	MEN	45 SF
D-11	WOMEN	45 SF
D-12	TRUCKER LOBBY	50 SF
D-13	JANITOR / WATER HEATER CIRCULATION:	50 SF
<b>STAIRS TO MEZZANINE:</b>		
D-14	MAIN STAIR	130 SF
D-15	SECONDARY FIRE EXIT	210 SF
D-16	CORRIDOR	235 SF
<b>II. MEZZANINE:</b>		
<b>OFFICES:</b>		
M-1	WAREHOUSE SUPERVISOR	360 SF
M-2	GENERAL OFFICE	360 SF
M-3	LUNCH / BREAK ROOM	480 SF
M-4	MANAGEMENT INFORMATION CENTER (MIC) CIRCULATION:	460 SF
M-5	CORRIDOR	435 SF
M-6	OBSERVATION	340 SF
<b>III. WAREHOUSE AREA:</b>		
		119,155 SF
<b>Gross Building Area:</b>		120,075 SF
<b>GROSS BUILDING AREA:</b>		
o Logistics / Administration support area = 2,835 SF		
o Mezzanine level area = 2,285 SF		
o Dock level area = 115,155 SF		
o Gross warehouse area = 115,155 SF		
<b>Total Gross Floor area</b>		<b>= 120,075 SF</b>
o Building "footprint" area = 117,445 SF		

### Architectural Design Objectives (Continued)

Development of the roof system will be accomplished during final design and care shall be taken to insure a system compatible with the geographic area of this facility. Use of multiple or split-level roof heights requires that the designer pay particular attention to resolving potential deflection and leakage problems. All roofs shall be provided with positive roof drainage. The roof membrane shall be selected for longevity, low maintenance, and watertight qualities. External roof drainage has been developed for this building, however, internal roof drains may be substituted where local conditions are favorable. Collection and retention systems may also be a requirement for rain water run-off. Minimum roof slope recommended is 1/2" per foot.

Safety provisions are considered a high priority in warehouses. The Occupational Safety and Health Act (OSHA) requirements shall be followed throughout the design process, as well as the Life Safety Code.

Access by physically handicapped persons shall be provided in accordance with the Uniform Federal Accessibility Standards. Provisions shall include a suitable elevator to the mezzanine level as well as access from exterior to main dock level.

The building shall be fully sprinklered for fire protection and appropriate detection and alarm systems provided. Normally, the sprinkler system will be a "wet-pipe system," however, there will be instances where a "dry-pipe system" will be appropriate. These decisions shall be made at final design based upon the functions of the Warehouse or other site specific requirements. In all cases, fire protection shall fully comply with provisions of NFPA and local codes/regulations if more restrictive.

### Structural Design Objectives

The primary design objective for this facility has been to develop a structural system that is both economically feasible and compatible with current and foreseeable warehousing material handling techniques. There are a number of structural system types available worldwide; therefore, the final selection is left to the USACE design agency or the A-E firm that will design the final product. However, the basic structural steel framing system utilized as the basis for this study is considered to be the most 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. The building structure shall be designed to resist loading conditions described in TM 5-809-1 and TM 5-809-10 (in seismic regions). Slab on grade design shall comply with either TM 5-809-2 or TM 5-809-12, depending upon size and weight of imposed loads.

Selection of a foundation system will depend on the geological conditions at the site. The site selection process should avoid areas requiring special designs for foundations and slabs-on-grade.

The thickness of slab-on-grade will depend on the size and weight of material handling equipment to be utilized, the magnitude and distribution of storage loads, the aisle widths, slab joint layout, quality of the subgrade support and the strength of the concrete. The flatness of the slab is critical to the proper performance of the materials handling equipment and storage structure, especially in the high-rise types of warehouse. Quality control during construction is critical.

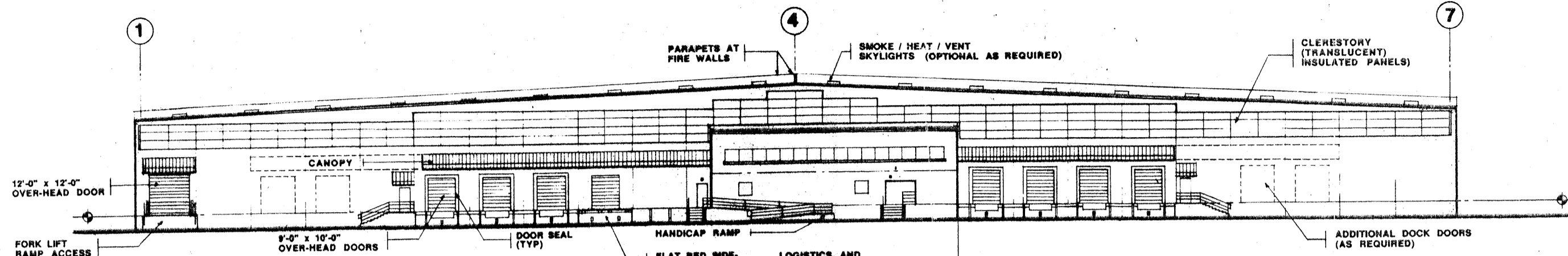
The basis for the structural system selected was dependent upon several factors, with functional layout requirements and related costs being the primary factors. The intent was to provide a structural bay column spacing that would accommodate the maximum varieties of layouts possible as determined by the types of materials handling equipment to be employed, and to provide a sound basis for increasing or decreasing the size of the basic 120,000 sq. ft. warehouse in some logical manner that would retain the integrity of a rectangular building. Numerous column locations were evaluated to determine the range of bay configurations that should be considered. These studies were developed around a range of bay configurations from 25' x 40' to 64' x 64' as it was felt that this range afforded the greatest flexibility of building configurations and for upsizing or downsizing in nominal modular increments.

The relative costs of the various column spacing and bay configurations were studied based upon a structural system of steel columns, truss girders, and long-span bar joists. Review was also made of a recent U.S. Navy study in which a conclusion was drawn that a 64' x 33' grid would accommodate the widest range of commonly utilized warehousing materials handling equipment and aisle spacings.

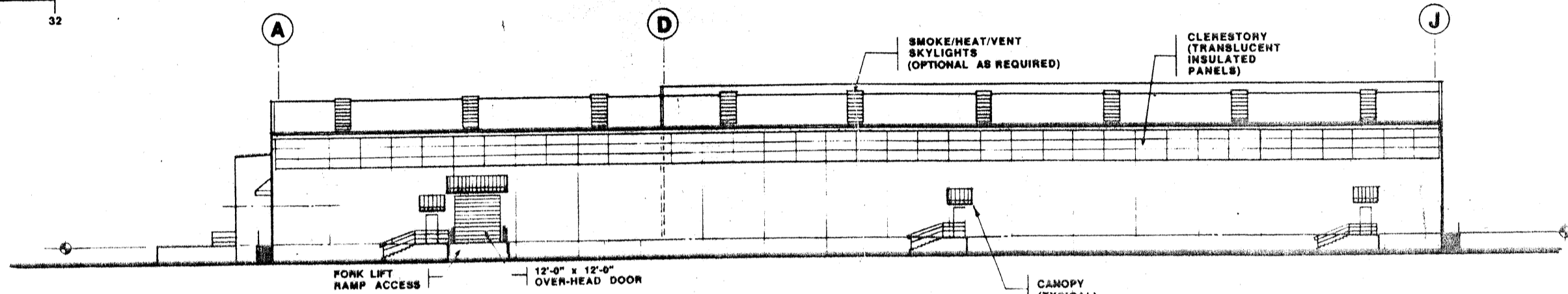
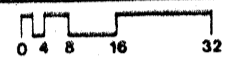
The building, as provided by this definitive design, would not prove suitable as a fallout protection facility due to its interior openness and the extent of wall and roof penetrations.

The structural system shown is most efficient in resisting lateral loads when the building configuration is relatively square, thus allowing the roof deck to function as a diaphragm. As the building configuration narrows, the roof deck diaphragm will be replaced by a horizontal bracing system. As the ratio of length to width approaches 3 to 1 the rigid frame structure may become the more viable solution for resisting lateral loads in the narrow direction. The effect of temperature on the building structure becomes more critical as the building size increases beyond the relatively square 120,000 sq. ft. configuration and should be considered during final design.

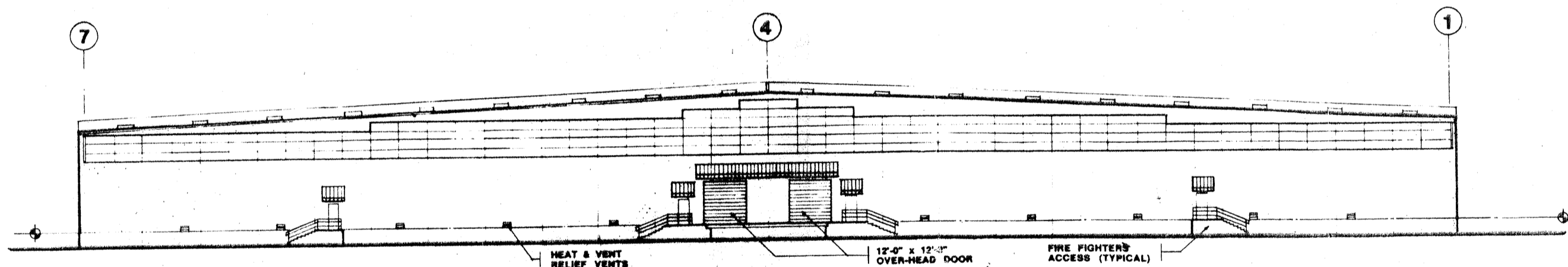
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Submitted by:		Spec. No.:	Drawing Number:
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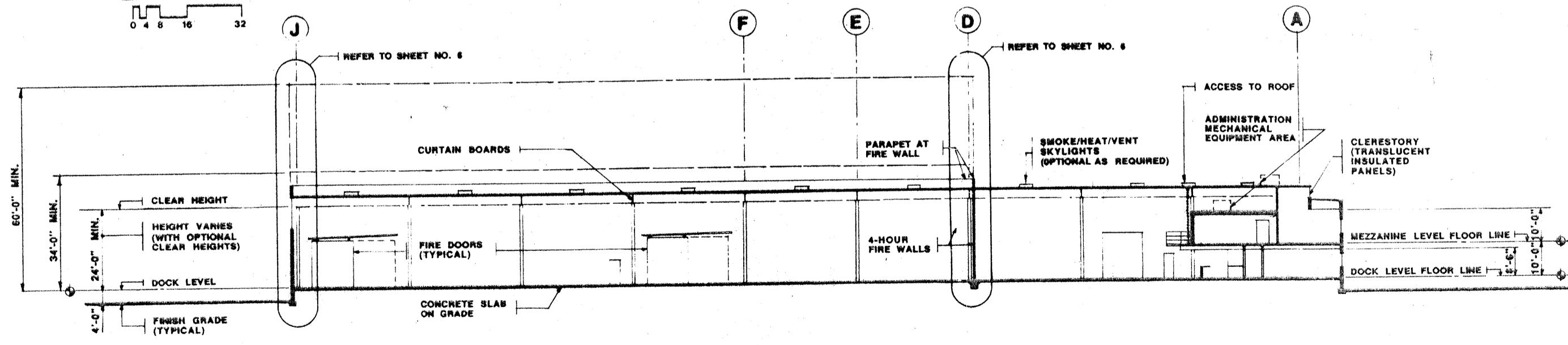
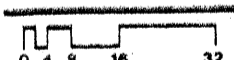
**FRONT ELEVATION -- "A"**



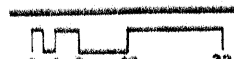
**SIDE ELEVATION -- "B"**



**SIDE ELEVATION -- "C"**



**BUILDING SECTION -- "A-A"**



**Mechanical Design Objectives:**

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. The design agency shall investigate various heating, ventilating and air-conditioning systems for appropriate application in the geographical area in which the project occurs.

Air-conditioning of the administrative areas shall be permitted only where authorized under the Architectural and Engineering Instructions criteria. The HVAC system selected shall take into account the available sources of energy, the economics of the system, fuel type used, energy conservation, and local governing conditions.

While there are several heating and ventilation system types available, the type recommended for the Warehouse area is a direct fired, space heating unit. A building pressurization system with minimal ductwork shall be utilized. The system shall provide barometric relief air dampers strategically located at the perimeter of the building to exhaust air evenly. Features of this type of equipment, which are particularly useful for warehouse area heating and ventilating, are as follows:

First, the equipment utilizes building pressurization along with a very low (less than 90 degrees F.) discharge air temperature. These two factors combine to eliminate cold drafts and stratification. The system uses building pressurization; therefore, minimal ductwork is required to vector the air in a horizontal direction after leaving the unit. If commodities are allowed to be stored high enough to obstruct the air flow, the unit should be aligned so air can be blown down the aisles. Building pressurization allows considerable flexibility in locating units. They can be mounted where a structural support system can most easily be developed. Typically, the heating and ventilating units are relatively light with about an 85 pound per square foot "footprint" when in a horizontal configuration.

Second, the unit is entirely self-contained, factory built, and designed to be located indoors, suspended from the roof or mounted vertically against an outside wall, or located outdoors on the roof or vertically against a wall. It has a built-in diagnostic trouble shooting control system to aid maintenance personnel in identifying operational problems. The components of the system are standard U.S. manufactured and readily available.

Thirdly, the unit conforms to ANSI Z83.18 "Direct Fired Industrial Air Heater," and has evolved over the years to become one of the most energy efficient types of systems for heating large warehouses. This is because of several factors: 100% efficient direct gas fired; a recirculation feature which allows up to 80% of the air to be recirculated after the burner; and a high (25 to 1 turndown ratio) combustion system which allows burner output to match the building heat requirements.

Interior and exterior design temperatures shall be based upon the Architectural and Engineering Instructions and ASHRAE Standard 55-75. Examples of heating loads for various conditions are indicated elsewhere on these drawings. Whereas the Warehouse area will generally be designed for an interior design temperature of 55 degrees F., a Warehouse that is to be unstaffed may be designed for 40 degrees F. Ventilation requirements are stipulated at a minimum of two air changes per hour; however, the designer shall review final design conditions/requirements and provide required ventilation for fuel powered lift trucks and electrical charging areas.

The basic fuel is assumed to be natural gas, however, "current criteria" for fuel selection shall be part of the designer's final design fuel selection responsibilities. A life cycle cost analysis should be performed to verify its economic viability. This fuel was selected at the time because of its wide availability; its current cost relative to other fuels; and its efficiency of combustion. Other fuels may be considered such as electricity and propane (LPG). Oil may be used for "indirect fired" equipment only. The type of fuel selected may affect the type of heating equipment selected, but not the design approach. The warehouse heating units described hereinbefore have, as a rule, adequate facility for housing the heat exchange equipment and controls necessary to adapt to other fuels if it becomes necessary to change to a different fuel source after installation. It is the responsibility of the designer to make sure all equipment specified will meet this criteria. Dual fuel capability is not required.

Plumbing fixtures of barrier-free design shall be provided. The quantity of fixtures shall be determined by National Plumbing Code, based on the male/female populations. Army Tech Manual TM5-810-3 "Plumbing" shall be used to provide specific design guidance.

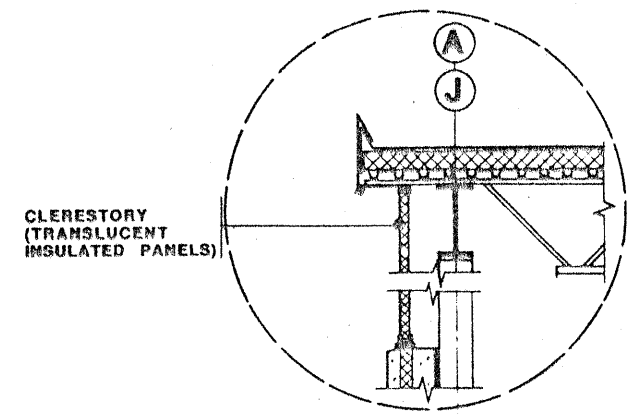
Floor drains are to be included in the restroom areas, with trap primers.

Passive solar design for the warehouses is best implemented by properly orienting the clerestory translucent panels where practicable. When it appears that appropriate conditions may exist, a life cycle cost analysis should be developed to determine the cost benefit of active solar design.

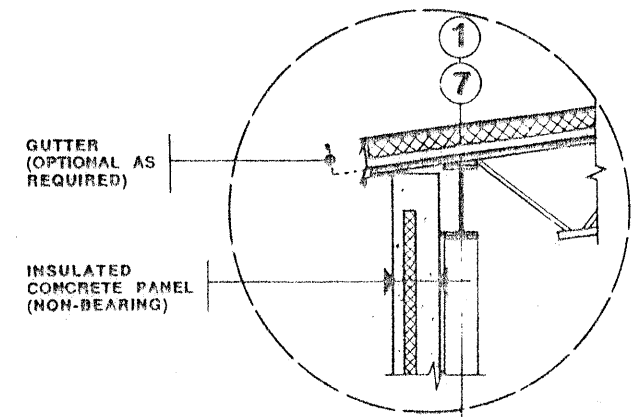
Revisions			
Symbol	Description	Date	Approved

	U. S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON		
	DEPARTMENT OF THE ARMY FACILITIES STANDARDIZATION PROGRAM DEFINITIVE DESIGN		
Designed by: LDC	GENERAL PURPOSE WAREHOUSE		
Drawn by: KNY			
Checked by: LDC/DHH			
Reviewed by:	Scale: As shown	Sheet number: 5	Drawing number: 44110-01 44220-01
Submitted by:	Contract No. OACA 87-88-D-0028		

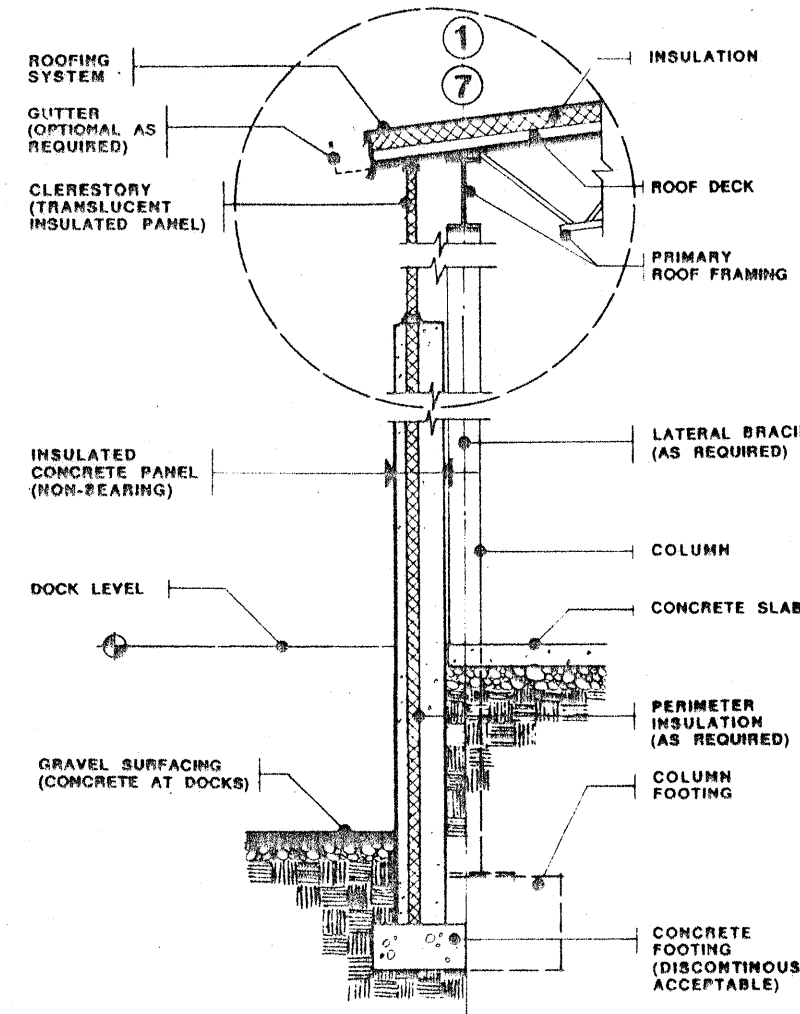


CLERESTORY (TRANSLUCENT INSULATED PANELS)

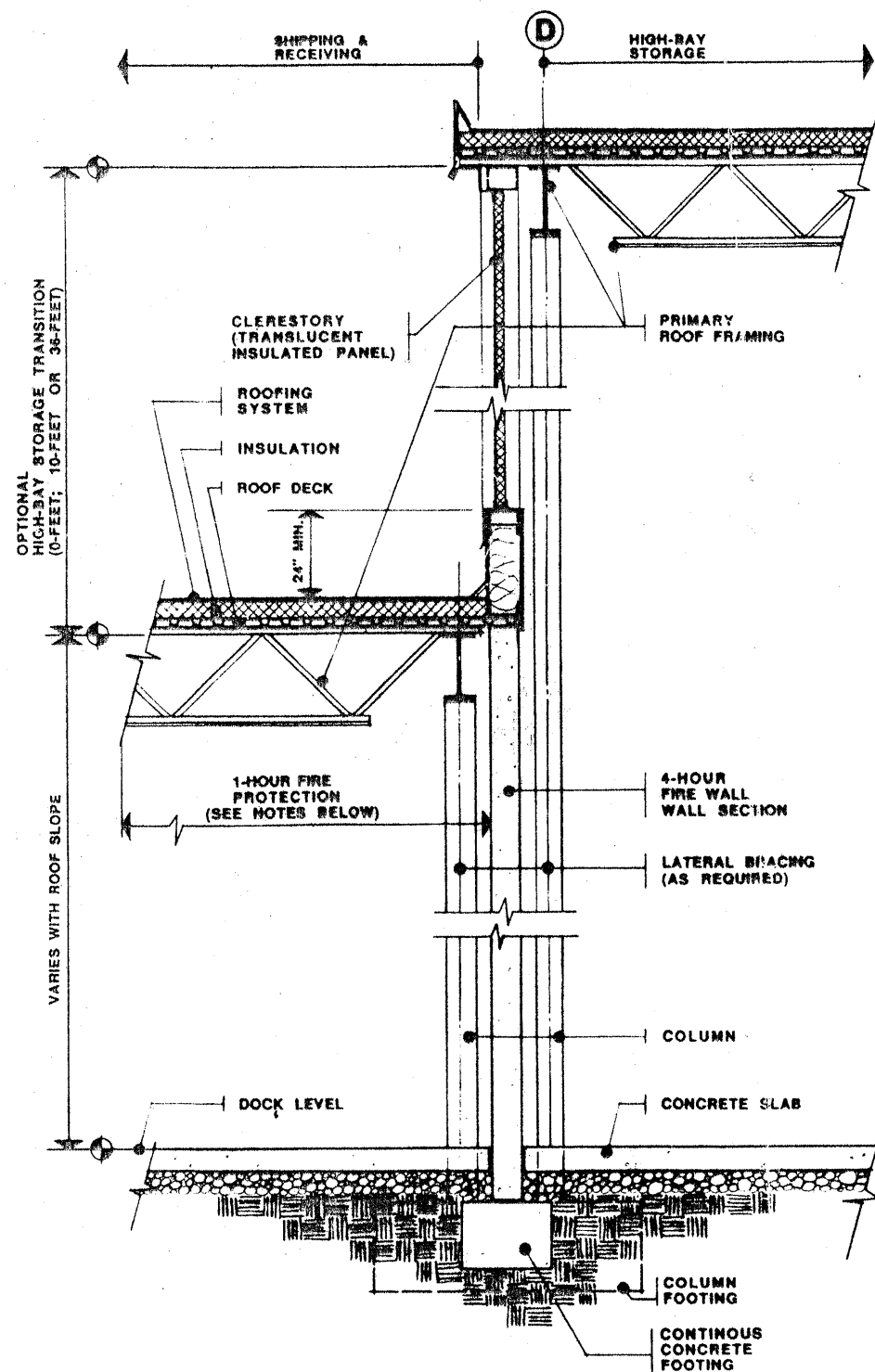
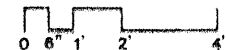


GUTTER (OPTIONAL AS REQUIRED)

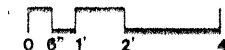
INSULATED CONCRETE PANEL (NON-BEARING)



WALL SECTION



WALL SECTION



NOTE:  
ONE (1) HOUR FIRE PROTECTION REQUIRED AS FOLLOWS:  
- 10 FT. MIN. IF PRIMARY ROOF FRAMING IS PARALLEL TO FIRE WALL.  
- FULL SPAN OF PRIMARY ROOF FRAMING IF FRAMING IS PERPENDICULAR TO FIRE WALL.

**ELECTRICAL REQUIREMENTS**

	Connected Load	Estimated Demand Load
<b>A. 24-Ft. High Warehouse:</b>		
Lighting	72.0 KW	72.0 KW
Receptacles	27.0 KW	13.5 KW
HVAC	62.4 KW	37.5 KW
Misc. Power *	33.0 KW	19.8 KW
<b>Total</b>	<b>194.4 KW</b>	<b>142.8 KW</b>
<b>B. 34-Ft. High Warehouse:</b>		
Lighting	85.0 KW	85.0 KW
Receptacles	27.0 KW	13.5 KW
HVAC	77.3 KW	46.4 KW
Misc. Power *	33.0 KW	19.8 KW
<b>Total</b>	<b>222.3 KW</b>	<b>164.7 KW</b>
<b>C. 60-Ft. High Warehouse:</b>		
Lighting	100.0 KW	100.0 KW
Receptacles	27.0 KW	13.5 KW
HVAC	139.6 KW	83.8 KW
Misc. Power *	33.0 KW	19.8 KW
<b>Total</b>	<b>299.6 KW</b>	<b>217.1 KW</b>

\* OH doors, dock levels, etc. Power for materials handling equipment will be determined to supply the MHE installed.

**Electrical Design Objectives**

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. In general, the medium voltage distribution shall meet the characteristics of the available utility source. Low voltage distribution shall be of the highest order consistent with the load served. Where practical, the low voltage distribution shall be 3 phase, 4 wire 277/480 volt wye, with 3 phase, 4 wire 120/208 volt dry type transformer being provided to serve the small motor loads, receptacles and lighting. Lighting and power connected and demand loads are shown elsewhere on this drawing.

The interior lighting levels as established by the Architectural and Engineering instructions are:

Inactive warehousing	5 FC
Active warehousing	10 FC
Main aisles	15 FC
Office areas	50 FC
Restroom Facilities	20 FC
Lunch/Break Room	25 FC
Shipping and Receiving	20 FC
Management Information Center	50 FC

Special illumination levels may also be required for certain types of materials handling systems, conveyors, control centers, truck interiors, etc. This should be determined at time of final design.

All of the warehousing lighting levels shall be measured 48 inches from the floor. The lighting shall be installed with energy-saving lamps and ballasts. All administrative/logistics areas shall be provided with individual room switches. The warehouse area shall be provided with switches for individual aisle groups, the exact switching configuration to be determined to meet the specific requirements.

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 with the wattages being chosen to provide the most economical installation.

High pressure sodium is recommended where color resolution is not critical, as it is most energy efficient. Metal halide should be used where color resolution is a factor. Lamp efficiencies (lumens/watt) are as follows:

Mercury Vapor	63
Metal Halide	125
High Pressure Sodium	140

In general, 400 watts shall be used for the 24 and 34 ft. clear height Warehouse areas; 1,000 watts shall be used in the 60 ft. clear height Warehouse areas. When high-intensity discharge lighting is used, emergency supplementary incandescent, fluorescent or integral part quartz lighting of 1FC shall be provided along all aisles and walkways. This lighting shall be in addition to the regular lighting systems. The lighting shall be energized at any time building power is on but the HID fixture is not capable of producing sufficient illumination.

Supplementary lighting is not a substitution of regular emergency lighting as required per APWA 101, Life Safety Code.

Each loading dock shall be provided with dock lights specifically designed for truck loading and unloading; exact location and fixture type shall be determined by specific loading requirements.

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 to 5 FC 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 to 0.5 FC using pole mounted, cutoff type lighting fixtures. The most cost effective pole height and wattage illuminance shall be used. Concrete pole bases, a minimum of 30 inches high, shall be provided for lighting pole protection.

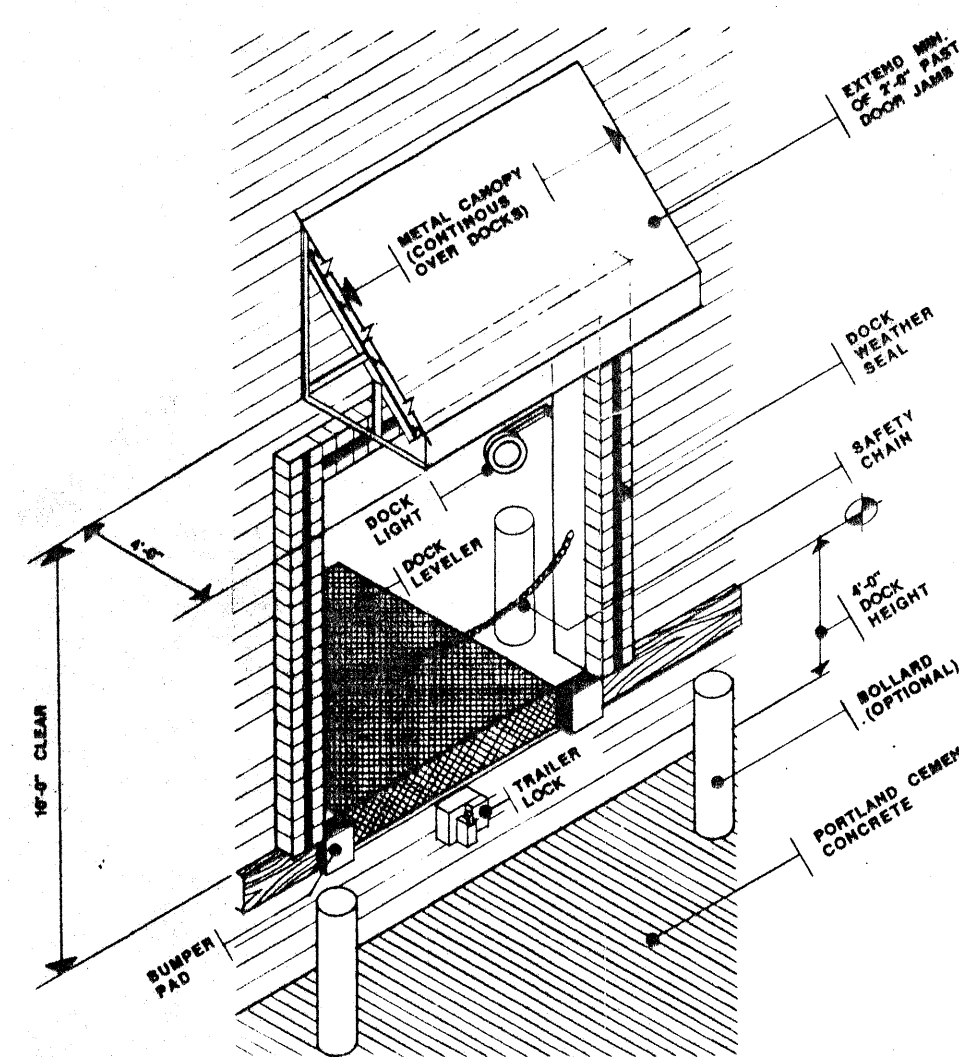
Exit and pathway lighting shall be provided battery powered backup systems delivering a level of 1 FC for a period of 1-1/2 hours after normal lighting failure.

A fire detection and alarm system shall be provided to meet the requirements of the local fire marshal. The means of transmission of fire alarm signals shall be coordinated with the installation fire authority.

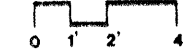
A telephone system shall be provided to all office areas and shipping/receiving. The telephone switching requirements shall be coordinated with the communication authority. An intercom system shall be provided for voice communication between offices, shipping/receiving and all areas of the warehouse. Provide one speaker for each 2,000 sq. ft. of warehouse.

Receptacles shall be installed in all offices, management information center room, lunch/break room, and shipping/receiving areas to meet requirements. Receptacles shall be mounted at 4-48 inches in the warehouse and shall be installed at alternate columns of this structural grid.

Battery-charging receptacles shall be provided for fork-lift equipment. NEMA 3R, GFI protected receptacles shall be provided on the building exterior.



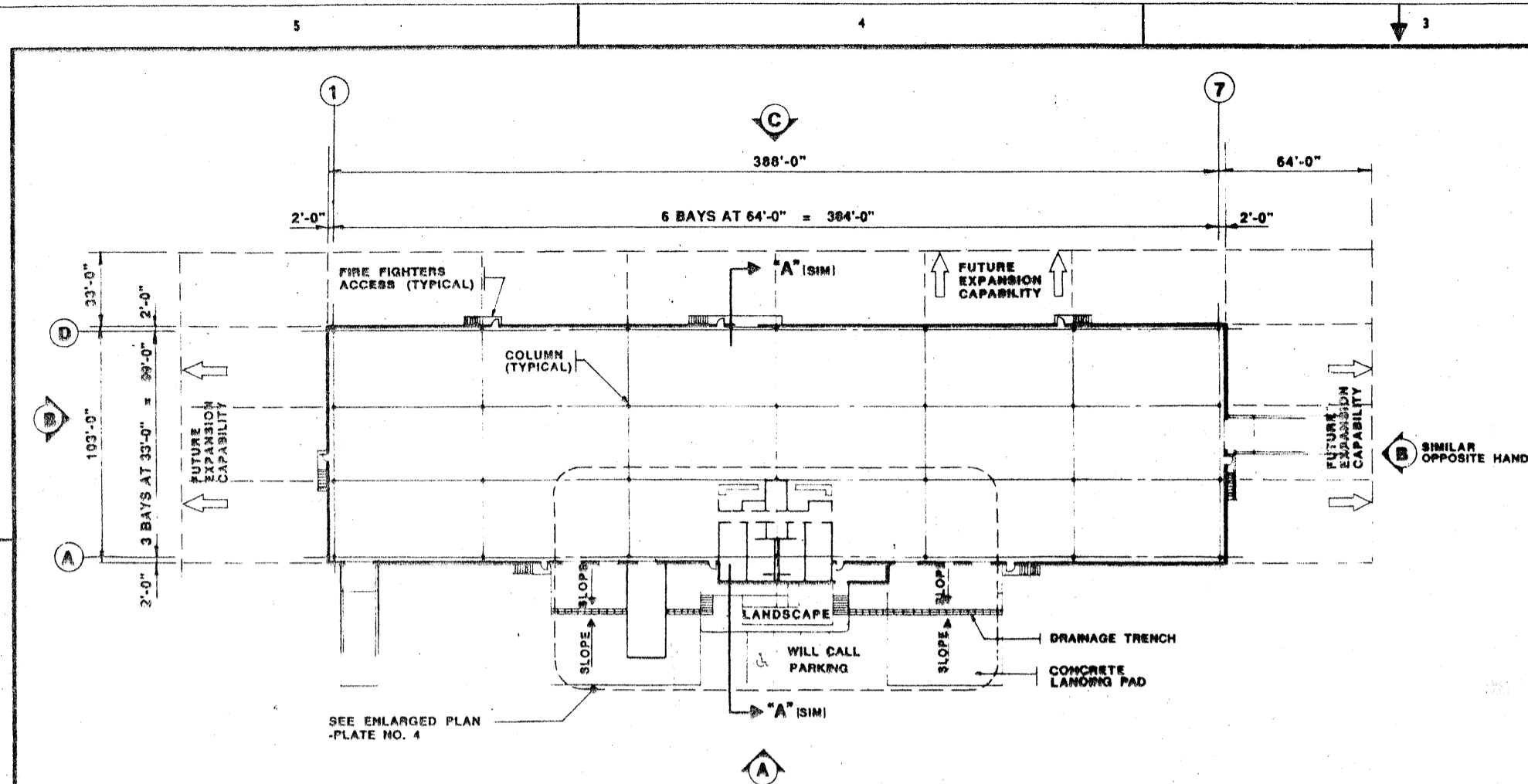
TRUCK DOCK EXAMPLE



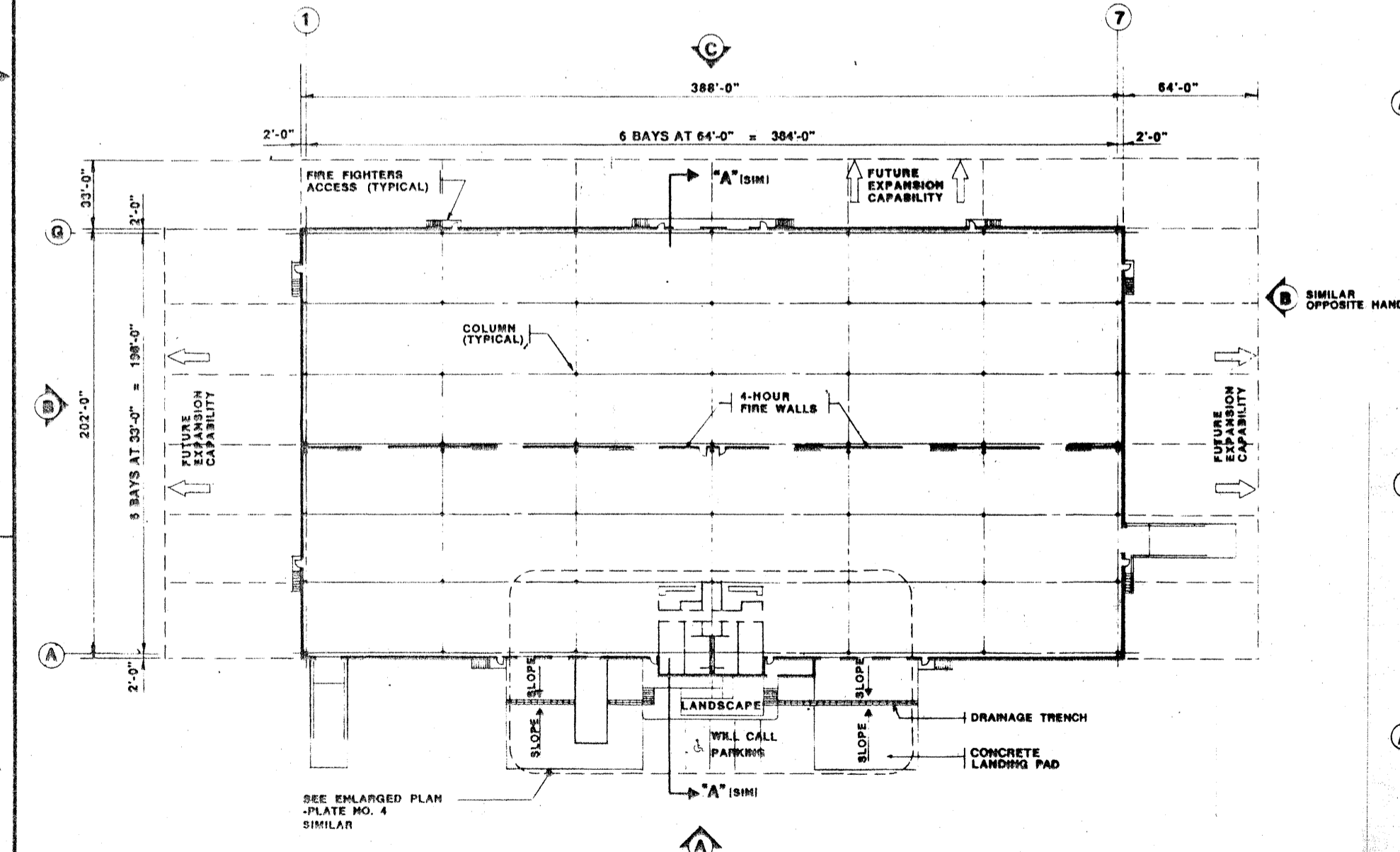
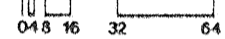
Revisions			
Symbol	Descriptions	Date	Approved

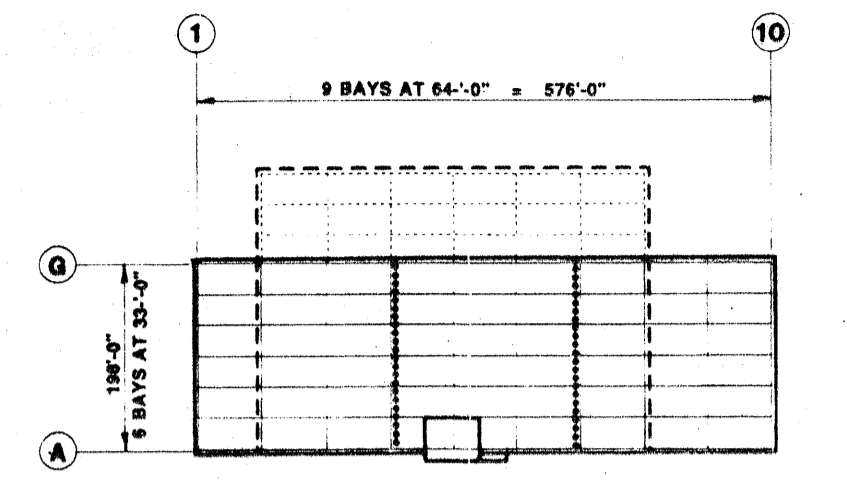
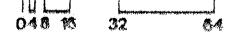
		U. S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON	
Designed by: LDC	DEPARTMENT OF THE ARMY FACILITIES STANDARDIZATION PROGRAM DEFINITIVE DESIGN		
Drawn by: KNY	GENERAL PURPOSE WAREHOUSE		
Checked by: LDC/DHH	Scale: As shown	Sheet number: <b>6</b>	Drawing number: 44110-01 44220-01
Reviewed by:	Spec. No.	Contract No. DACA87-86-D-0029	Drawing number:
Submitted by:	Contract No.	Drawing number:	Drawing number:



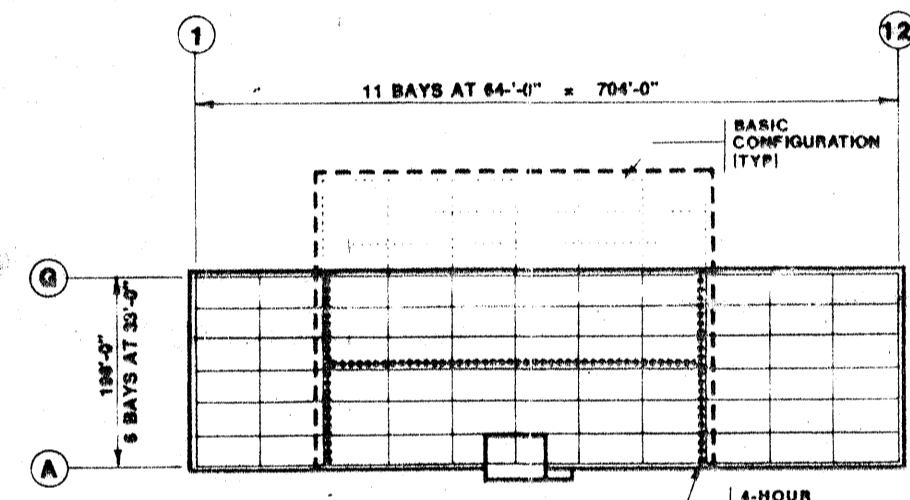
40,000 SF -- PLAN CONFIGURATION



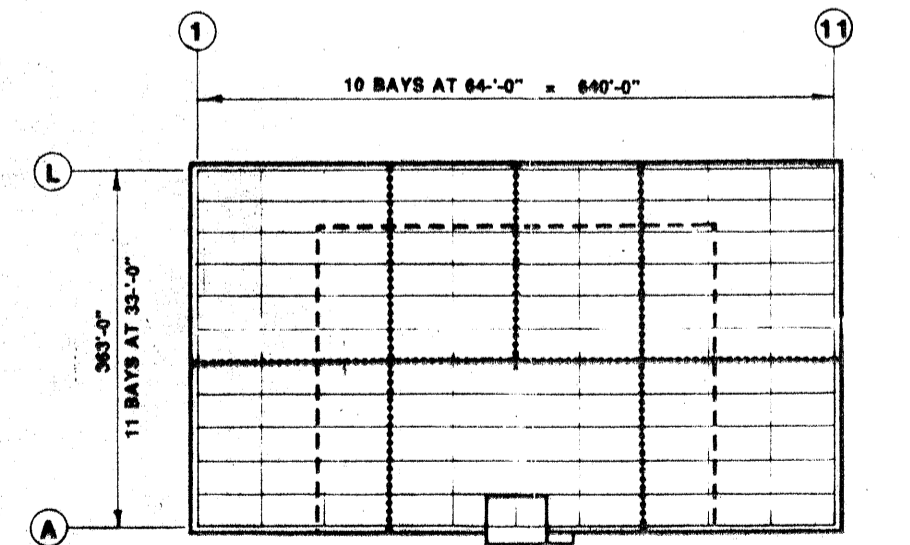
80,000 SF -- PLAN CONFIGURATION



120,000 SF -- PLAN CONFIGURATION



145,000 SF -- PLAN CONFIGURATION



240,000 SF -- PLAN CONFIGURATION

**Optional Design Features**  
 This Standard General Purpose Warehouse supports two separate category codes, 44110 and 44220 and may have substantially differing design and operational requirements in order to meet the Army's needs on a worldwide basis. Facilities which will serve the largest depot level to the smallest base installations, may range in size from several hundred thousand square feet to as few as forty thousand square feet. The material handling systems will also vary from very basic to the highly automated. To be a viable prototype for the unlimited range of facilities that are possible, it has been necessary to retain the highest degree of flexibility.  
 While the basic 120,000 square foot prototype, shown and described herein, may serve many installations with little or no modifications, it is necessary that certain options be left open to the user and the design agency. These options must be fully identified with justification in the DD Form 1391 and approved by the Installation MACOM prior to implementing the planning, design and construction processes for this facility.

- Optional features that are deemed appropriate are:
- INCREASE/DECREASE SIZE:** Many combinations exist with the 64' x 33' grid to adjust configuration and size. Examples of some possibilities are indicated herein.
  - INCREASE HEIGHT:** Depending upon products to be handled, stored and the selection of specific materials handling equipment, selection of a 34' or 60' clear height may be warranted. A multiple height building may prove to be the most cost effective.
  - GRID ADJUSTMENT:** The column grid of 64' x 33' was determined to be a universal grid that would meet the widest variation in material handling layouts. Where specific selection of the materials handling equipment is determined during early-on programming, and the related analysis of the system(s) indicates a different grid layout would be more efficient and cost effective, the grid pattern may be altered.
  - GRADE LEVEL MAIN FLOOR:** Some installations, generally depot level, may determine that having the main floor at grade in lieu of dock level will be more effective operationally; this is an acceptable option.
  - RAIL SPUR DOCK:** It has been generally acknowledged that rail service to Army warehousing has declined substantially and that most are serviced by truck. There will be instances where the rail spur is accessible and required, and the optional rail dock added as an acceptable option.
  - NUMBER OF DOCKING DOORS:** The docking doors indicated on the prototype will satisfy most conditions. However, the number of doors may be increased (or decreased) where the user has sufficiently justified the quantity of doors required.
  - LOGISTICS/ADMINISTRATIVE CORE:** This operations support core represents a workable size and arrangement for a 120,000 square foot General Purpose Warehouse. Factors at specific locations may require a greater number of personnel and space, while there will be applications where no Logistics/Administrative Core would be required. This option allows the user to adjust this core area to his specific requirements in those instances where the function and the staffing of the warehouse is well documented, and where there is no foreseeable future change of the warehouse mission.
  - MATERIALS AND TYPES OF CONSTRUCTION:** The type of construction together with the materials shown represents a widely recognized and accepted method for warehouse facilities. The application to worldwide use mandates that certain geographic locations will have varying construction techniques, materials, customs, codes and regulations which must be complied with.
  - SPECIAL PURPOSE MODULES:** Some installations may require special storage capability such as secured storage, humidity control, refrigeration, etc. These optional items may be added to the basic design, or brought in in modular form at some future date.
  - POV PARKING:** The POV parking may be increased, decreased or eliminated as site specific staffing criteria warrants. The user should determine from the function and operation of the warehouse what the staffing requirements are, and whether on-site parking will be a requirement.
  - FIREWALLS:** 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.

Revisions			
Symbol	Descriptions	Date	Approved

	U. S. ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON
	DEPARTMENT OF THE ARMY FACILITIES STANDARDIZATION PROGRAM DEFINITIVE DESIGN <b>GENERAL PURPOSE WAREHOUSE</b>
Designed by: LDC	Scale: As shown Sheet number: <b>7</b> Drawing number: 44110-01 44220-01
Drawn by: KNY	
Checked by: LDC/DHH	
Reviewed by:	
Submitted by:	Contract No. DACA 87-85-D-0029